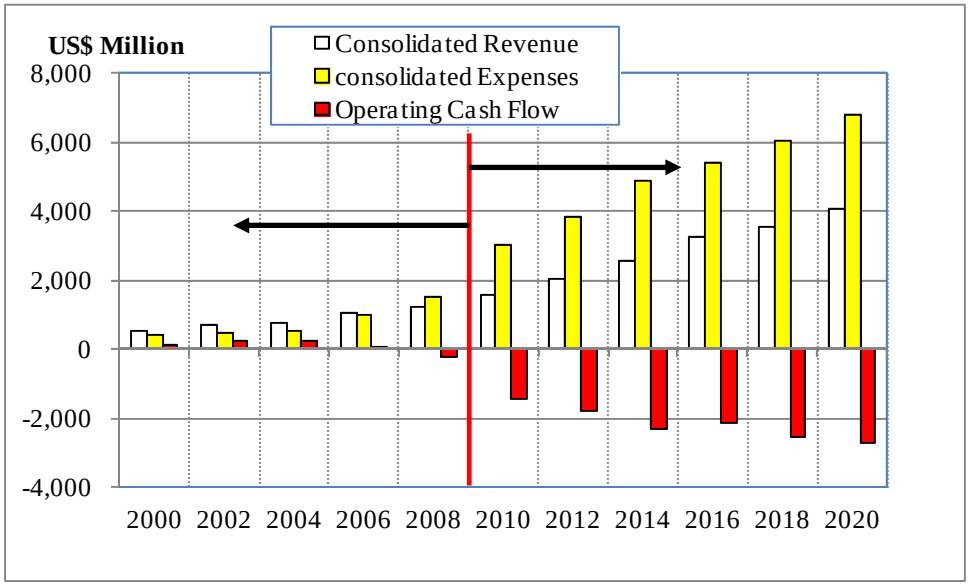
Chapter 6 Tariff System

6.1 Financial Performance of PEEGT and PEDEEE

Figure 6.1-1 shows consolidated past and future financial performance of PEEGT and PEDEEE. Until 2007, consolidated financial performance on the cash flow base was good. However, after 2007 it deteriorated because of fuel price hike. Time lag of tariff hike to fuel price increase is the cause of this deficit.



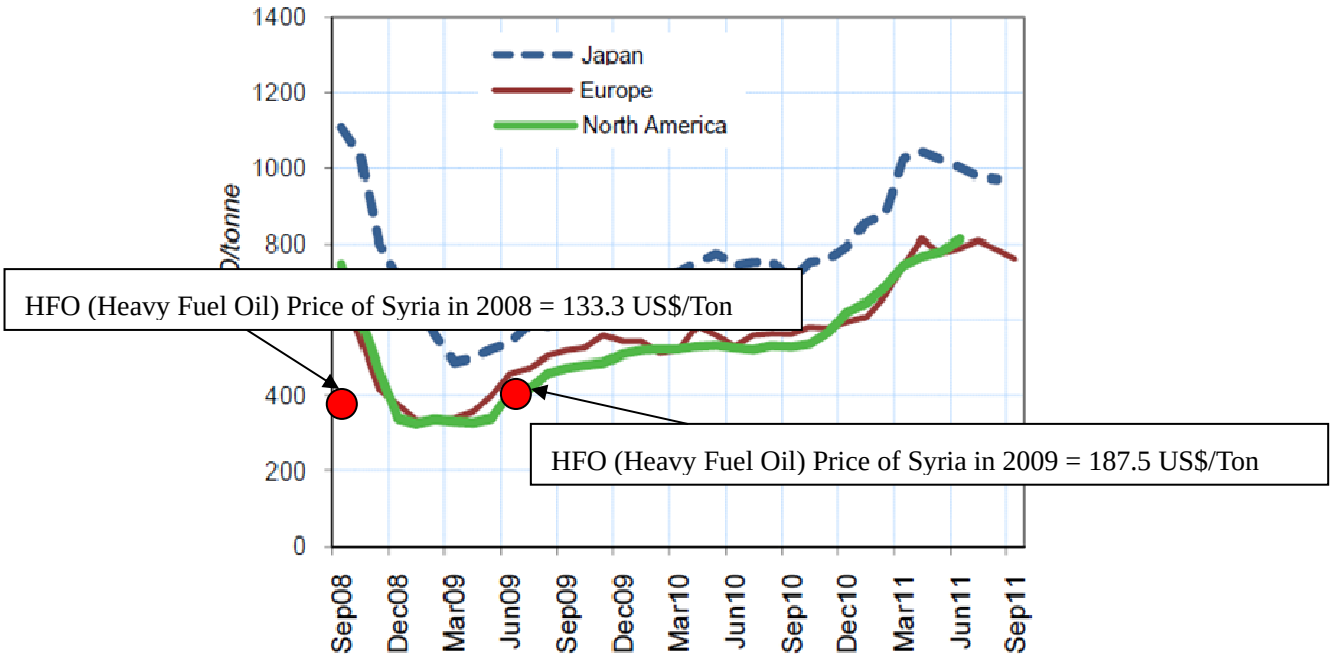
Source: “Electric Sector Strategy Note” by World Bank (MNSSD and MNA)

Figure 6.1-1 Past and Future Financial Performance of PEEGT and PEDEEE

6.2 International Fuel Price Comparison for Power Generation

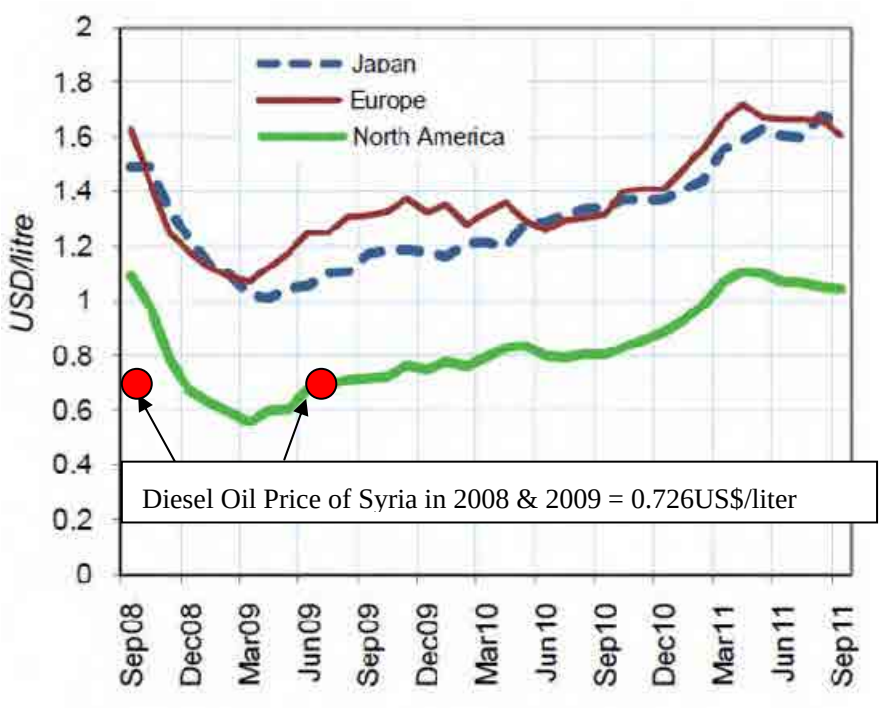
Fuels for power generation in Syria are heavy fuel oil, gas and diesel. The followings paragraphs show an international comparison of Syrian fuel price. Figure 6.2-1 shows the comparison of heavy fuel oil price. Average heavy fuel oil price of Syria in 2008 and 2009 is considerably low, compared to Europe, Japan and North America. And Figure 6.2-2 shows the comparison of diesel oil price. Average diesel oil price of Syria in 2008 and 2009 is low compared to Europe and Japan and on the same level with North America. On the other hand, gas prices of Syria were US$21/kCM (kilo cubic meter) in 2007, US$104/kCM and hiked to 387US$/kCM in 2009 as shown in Figure 6.2-3. Ongoing and future development of gas pipe line network connected with neighboring countries will influence the Syrian gas price to follow international trend. (Figure 6.2-4)

Syrian gas pricing policy for electricity generation will tremendously influence to the profit/ loss and future investment capability of PEEGT and PEDEEE.



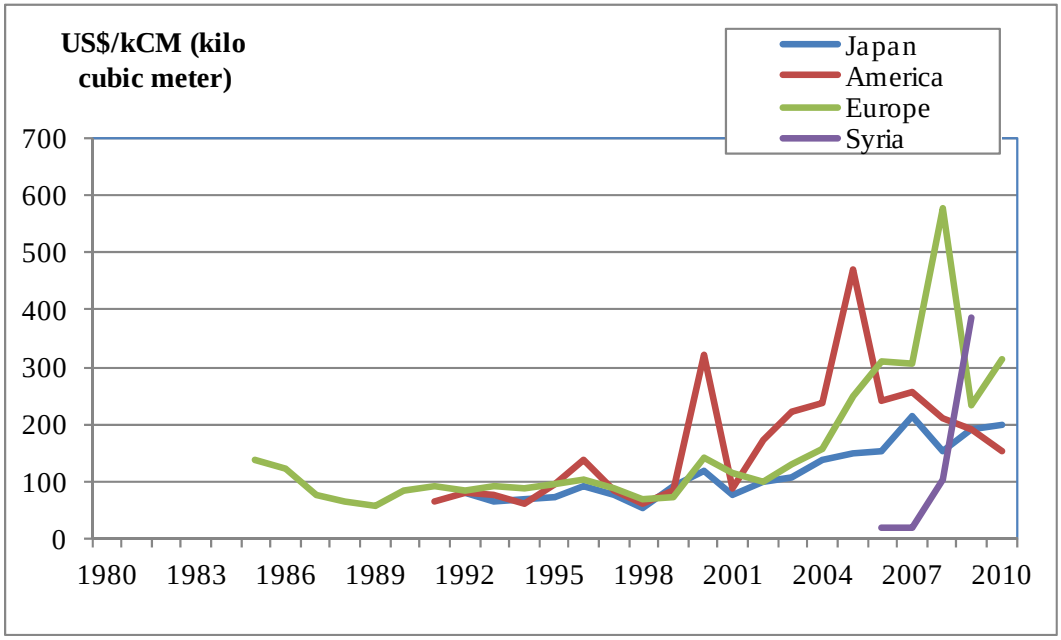
Source: PEEGT, "Electric Sector Strategy Note" by World Bank (MNSSD and MNA) and "End-use petroleum products prices and average crude oil import costs September 2011" by IEA

Figure 6.2-1 International Comparison of Fuel Oil Price Trend



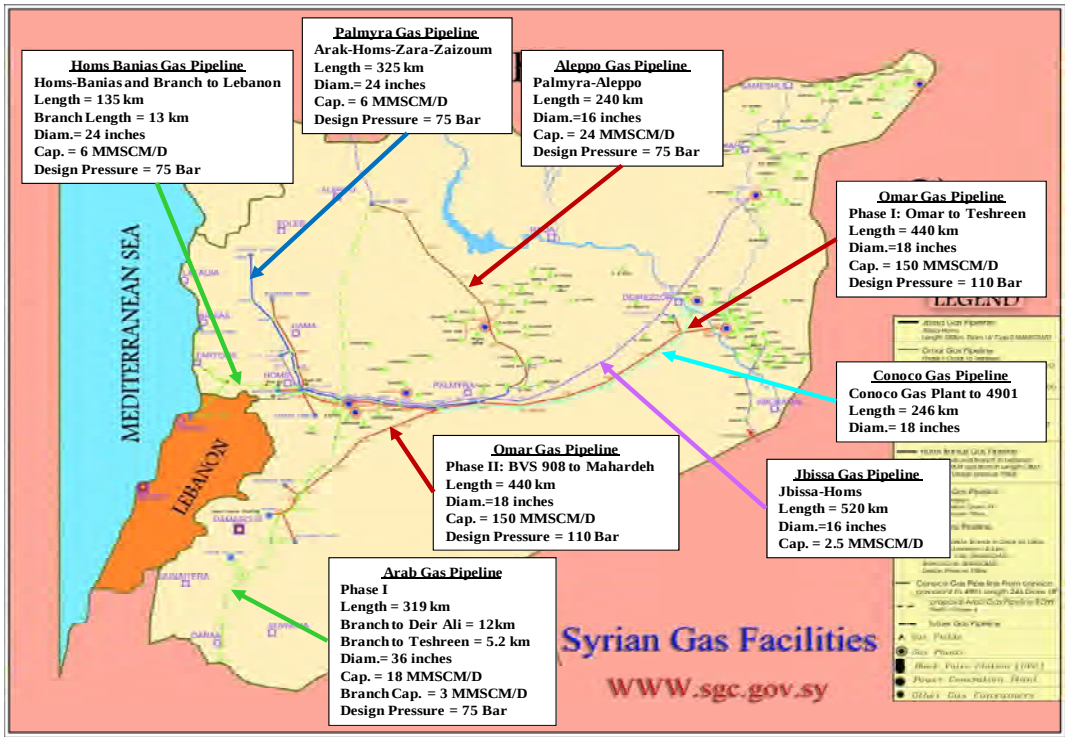
Conversion Factor: Diesel specific gravity = 0.86: 625US$/Ton = 625/0.86= 726US$/kL
Source: PEEGT, "Electric Sector Strategy Note" by World Bank (MNSSD and MNA) and "End-use petroleum products prices and average crude oil import costs September 2011" by IEA

Figure 6.2-2 International Comparison of Diesel Oil Price Trend



Source: PEEGT, "Electric Sector Strategy Note" by World Bank (MNSSD and MNA) and "Primary Commodity Price by IMF

Figure 6.2-3 International Comparison of Gas Price



Source: Syrian Gas Company

Figure 6.2-4 Existing and Future Gas Line Network

6.3 Current Tariff System

Table 6.3-1 shows current tariff system of Syria. Syrian tariff system is composed of only demand charge (consumption charge: variable portion) and there is no basic charge (capacity charge: fixed portion). In the table, tariff is expressed in Syrian Penny (Center column) and US Cent (Right column). Currency exchange rate as of October 1st 2011 is applied.

1 Syrian Pound (SYP = 100Penny) = 0.0202 US$

Source: Bloomberg.co.jp

The tariffs of 2009 and 2010 are shown in the upper and lower lines. The difference between 2009 and 2010 is the tariff raise hike residential sector over 2001kWh monthly consumption.

Table 6.3-1 Current Tariff by Sector (/kWh)

Category of Consumers		Syrian Penny				US Cent			
		Peak	Day	Night	Average	Peak	Day	Night	Average
Industrial and Agriculture	230 kv	300	200	150	200	6.1	4.0	3.0	4.0
	66 kv	376	250	180	250	7.6	5.1	3.6	5.1
	20 kv	450	280	185	280	9.1	5.7	3.7	5.7
	20/0.4 kv	254	180	140	180	5.1	3.6	2.8	3.6
Industrial and Commercial	20/0.4 kv	500	336	245	336	10.1	6.8	4.9	6.8
Residential (0.4 kv)	1-100 kw				25				0.5
	101-200				35				0.7
	201-400				50				1.0
	401-600				75				1.5
	601-800				200				4.0
	801-1000				300				6.1
	1001-2000				350				7.1
	2001-above				400				8.1
Industrial and Agriculture	230 kv	300	200	150	200	6.1	4.0	3.0	4.0
	66 kv	376	250	180	250	7.6	5.1	3.6	5.1
	20 kv	450	280	185	280	9.1	5.7	3.7	5.7
	20/0.4 kv	254	180	140	180	5.1	3.6	2.8	3.6
Industrial and Commercial	20/0.4 kv	500	336	245	336	10.1	6.8	4.9	6.8
Residential (0.4 kv)	1-100 kw				25				0.5
	101-200				35				0.7
	201-400				50				1.0
	401-600				75				1.5
	601-800				200				4.0
	801-1000				300				6.1
	1001-2000				350				7.1
	2001-above				700				14.1

Source: PEEGT

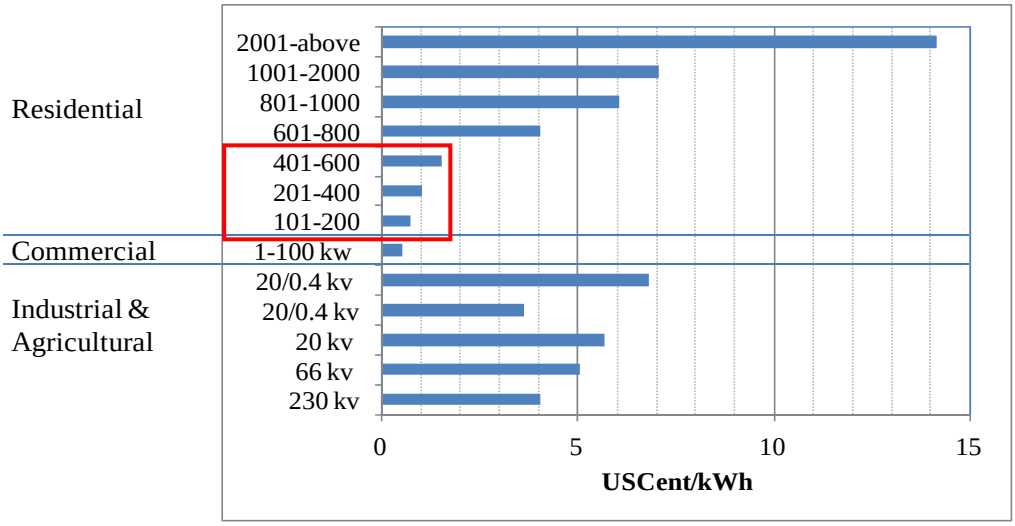
6.3.1 Time Zone Tariff System (TOU: Time of Use)

Time zone tariff system (TOU: Time of Use) is applied to the industrial, agricultural and commercial sectors. And TOU tariff is not applied to residential sector.

Peak time zone starts from sunset for 4 hours. Night time zone starts after the end of peak time for 8 hours. Remaining time zone is day time. As the time of sunset changes, TOU time zone changes every day. It is quite unique to set peak starting time at sunset as Islamic nation and reasonable. “Put on light after sunset”.

6.3.2 Tariff System by Sector and Group

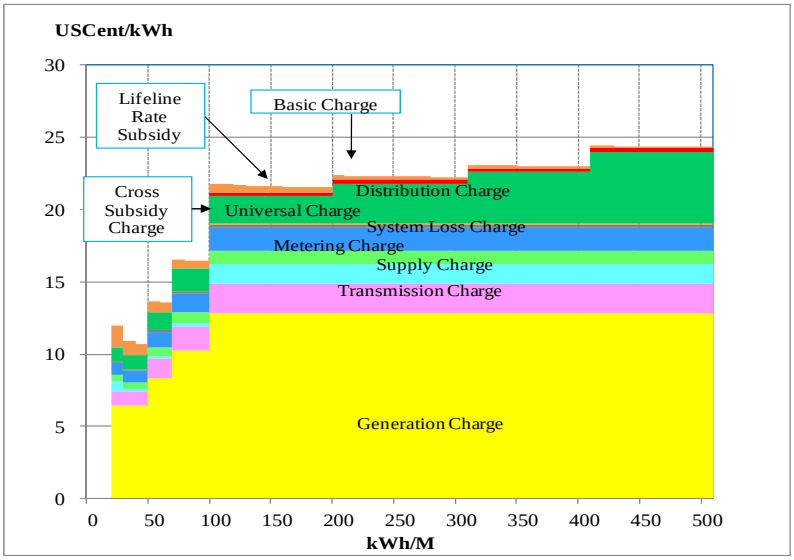
Figure 6.3-1 shows sector and group wise tariff. It is notable that the tariffs for the residential group of monthly consumption below 600 KWh is quite low. It seems that this is the lifeline discount system for low-income classes. However, the monthly consumption of 600kWh is considerably high, compared to other countries. It seems there is a special preferential tariff for residential sector.



Source: PEEGT

Figure 6.3-1 Tariff Comparison by Sector (2010)

For comparison, Figure 6.3-2 shows residential tariff of Philippines. In Philippines, the tariff of residential group under monthly consumption of 20kWh is free. But the tariff over 20kWh consumption is quite high for the promotion of electricity conservation.

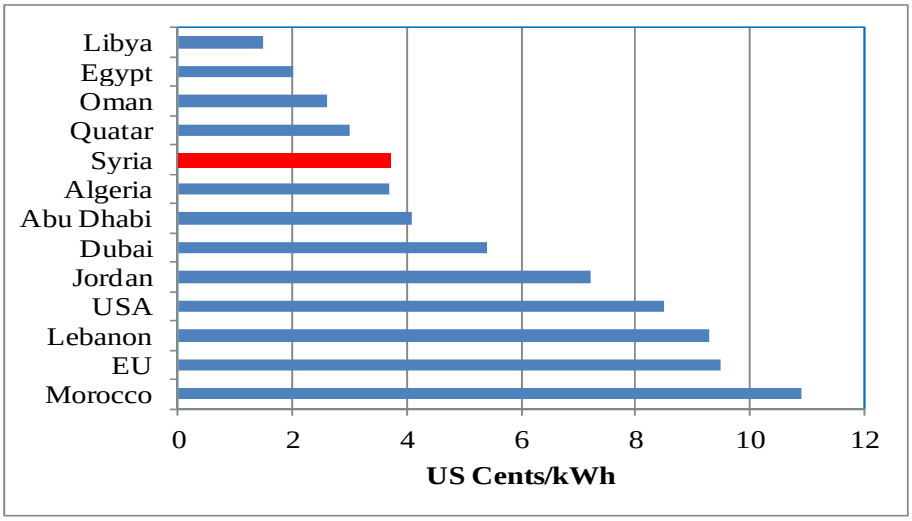


Source: Calculated based on MERALCO Data (July 2010)

Figure 6.3-2 Residential Tariff of Philippines

6.3.3 International Comparison of Syrian Electricity Tariff

Figure 6.3-3 shows electricity tariff comparison of Syria with neighboring countries. Syrian tariff is comparatively cheap in common with oil and gas producing countries like Algeria, Abu Dhabi and Qatar. Tariff of Jordan, Lebanon and Morocco, and non-oil rich countries are high.



Source: Electricity Sector Strategy Note (World Bank)

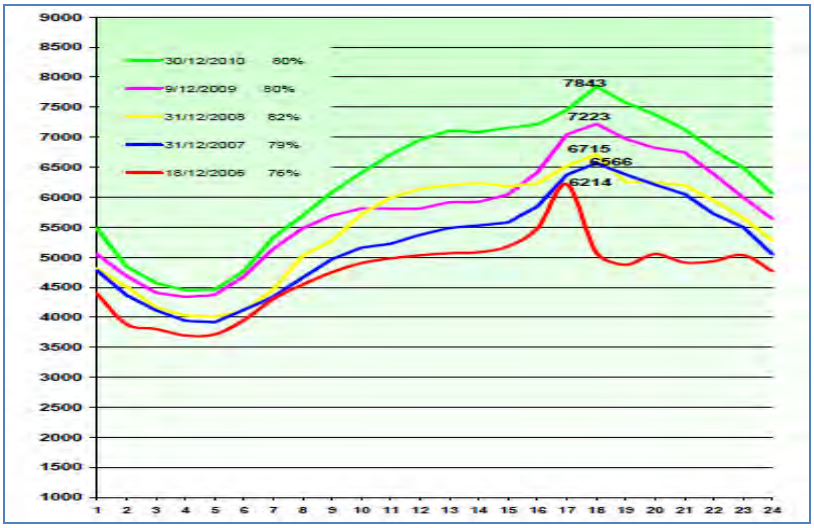
Figure 6.3-3 Electricity Tariffs in Syria Compared to Regional Tariff

6.4 Recommendation of Tariff System Improvement

6.4.1 Time Zone Tariff System TOU (Time of Use)

As explained in 6.3, Syria adopts the TOU tariff system in industrial, agricultural and commercial sectors.

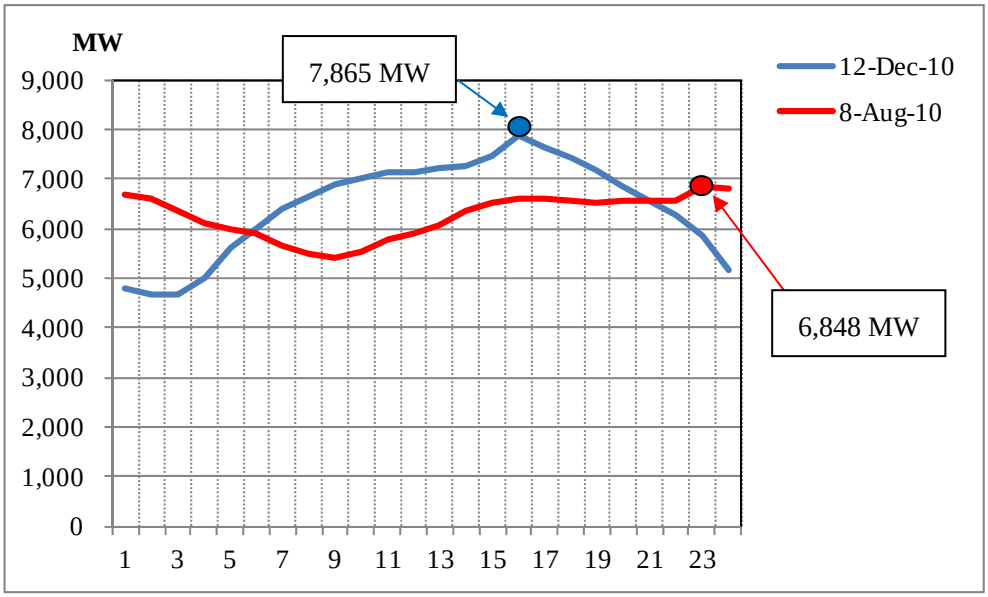
Figure 6.4-1 shows the trend of daily load curve of December from 2006 to 2010. Peak emerges in the evening, which is common in developing countries.



Source: Syrian Statistics 2010 Syrian Power Generation

Figure 6.4-1 Trend of Daily Load Curve of December from 2006 to 2010

On the other hand, Figure 6.4-2 shows daily load curve of August and December. It shows that the shape of summer and winter is quite different each other. It seems difficult to apply same time zone TOU tariff around the year.



Source: PEEGT

Figure 6.4-2 Daily Load Curve of Syria

Figure 6.4-3 shows the merit structure of TOU system. Major merits of peak shift or peak cut are profit from the cost difference of marginal power plants, reduction of transmission and distribution loss and postponement of power plant construction.

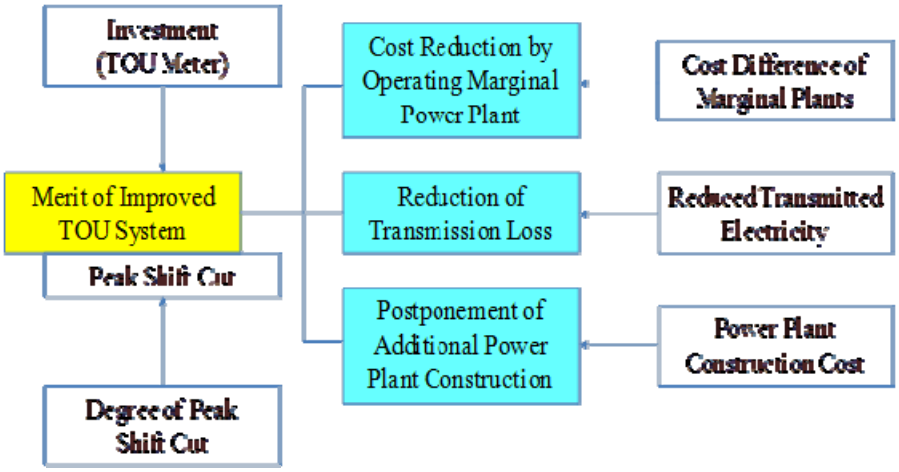


Figure 6.4-3 Merit Structure of Peak Shift and Peak Cut

Table 6.4-1 and Figure 6.4-4 shows the comparison of Syrian TOU time zones with Asian countries. Setting of TOU zones should take into account the daily load curve, seasonal change and economics.

Table 6.4-1 International Comparison of TOU Tariff Time Zone with Asian Country

	Sectors	Contracted Capacity	Peak	Off-Peak	Day
Syria	Industry & Agriculture	230 ~ 20 kV 20 ~ 0.4 kV(Agriculture)	From sunset for 4 hours	From the end of Peak for 8 hours	Remaining hours
	Industry & Commercial	20 ~ 0.4 kV			
Malaysia	Commercial Industrial	Medium (6.6~66kV) & High Voltage (>66kV)	800 – 2200	2200 – 800	-
Philippines	Commercial Industrial	12-month Average peak demand of at least 750kW	800 – 2100	2100 – 800	-
Sri Lanka	Industrial	230/400V, 11/33/132kV	1830 – 2130	2130 – 1830	-
			1830 – 2230	2230 – 430	430 – 1830
Indonesia	Commercial	>200kVA	1800 - 2200	2200 – 1800	-
	Industrial	14 – 200kVA, >200kVA			
Thailand	Residential Commercial Industrial	All	900 – 2200	2200 – 900	-
Vietnam	Commercial Industrial	All	1800 – 2200	2200 – 400	400 – 1800

Source: Tariff System of each country

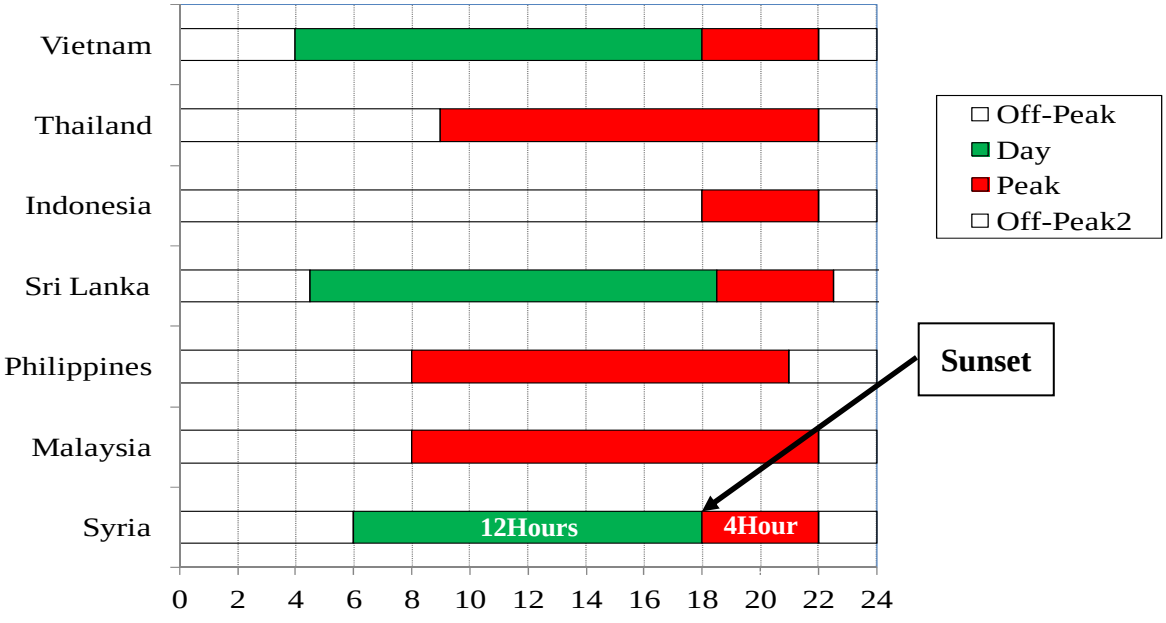


Figure 6.4-4 Comparison of TOU Time Zone with Asian Countries

Figure 6.4-5 shows day-time tariff versus peak-time tariff and off peak-time tariff versus peak-time tariff of Syria and Asian countries. Power companies could receive direct merit from TOU tariff system. Accordingly, incentives to consumers are necessary to promote TOU system dissemination. As an incentive of TOU, lowering these ratios should be studied.

Syria: Day/Peak = 0.5, Off-Peak/Peak = 0.6

Vietnam: Day/Peak = 0.3, Off-Peak/Peak = 0.5

Sri Lank: Day/Peak = 0.3, Off-Peak/Peak = 0.4

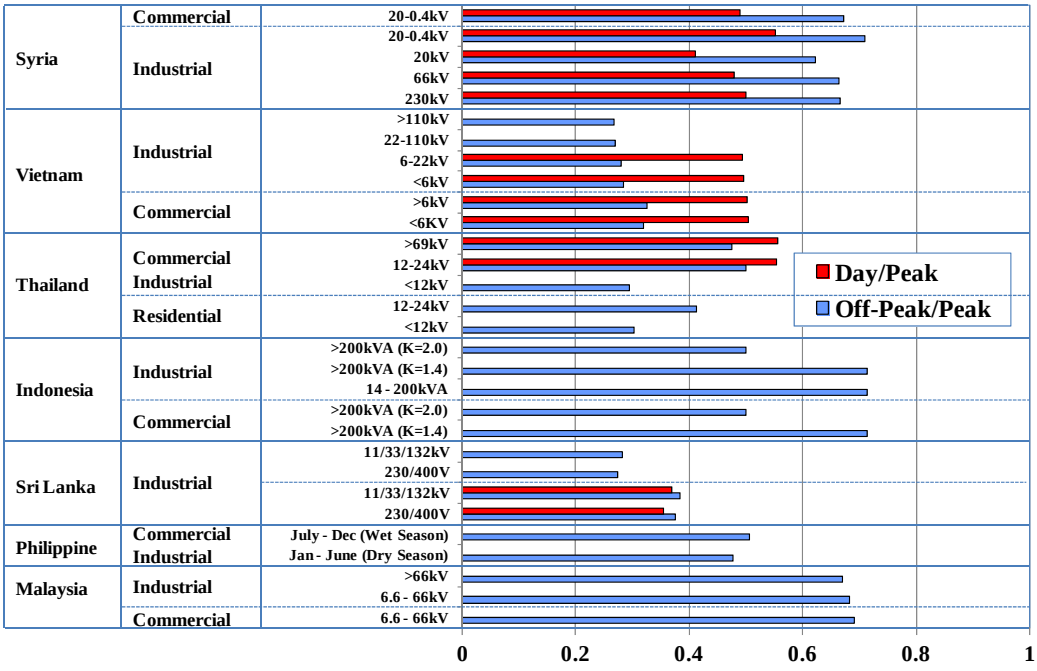


Figure 6.4-5 Comparison of Day and Off Peak Ratio to Peak

6.4.2 Power Factor Clause

In the PEEGT tariff system, penalty is imposed on customers with power factor of under 0.9. And bonus is given to customers with over 0.93.

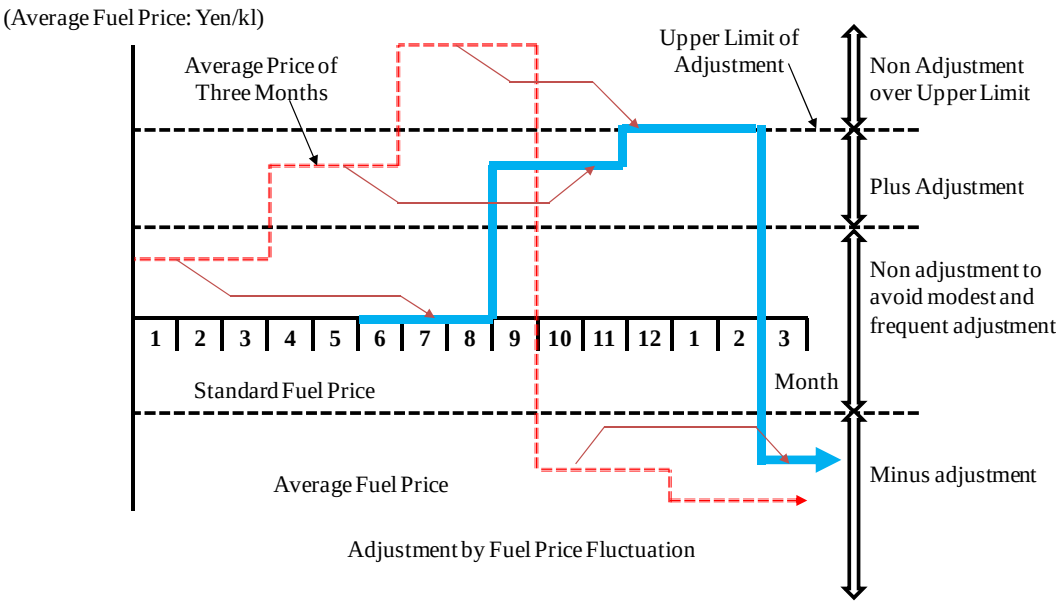
6.4.3 Tariff Adjusting System for Fuel Price Fluctuation

Consumers are afraid of the influence on family and business finance by rapid fluctuation of fuel prices. In the Japanese current adjustment system for fuel price fluctuation, following measures are taken to avoid such rapid fluctuation;

Maximum adjustment price (Capping)

Time lag setting (The price of January to March price applies to the tariff of June to August)

Tariff equalization by adopting 3 month average



Source: TEPCO Illustrated 2010

Figure 6.4-6 Tariff Adjusting System for Fuel Price Fluctuation

Chapter 7 Primary Energy

7.1 Procurement of Gas and Petroleum for Power Generation and their Values

7.1.1 Overview

Syria produces crude oil and natural gas in minor quantities. As of 2009, the crude oil production volume amounts to 385,000 barrels per day. Of this figure, 100,000 barrels per day are exported through the petroleum market. The crude oil is mainly exported to European countries through the petroleum market. However, Syrian Petroleum Refineries fall short of demand, and the country imports a considerable number of the secondary products of petroleum such as Gasoline and Diesel. In 2010, a total of 36,000,000 barrels were imported from other countries.

The crude oil production exhibits a yearly decrease due to the depletion of the oil fields.

Natural Gas Production volume registers 28MM M^3 per day (989MMcf/day), of which 85 percent is used by electric generation of the Ministry of Electricity (MOE) and Public Establishment of Electricity for Generation and Transmission (PEEGT). The remaining 15 percentage is consumed in the domestic market. However, natural gas production is increasing due to the discovery of new gas fields.

Since 2008, the Arab Gas Pipeline (AGP) was connected from Egypt to Jordan, Lebanon and Syria. Syria imported 2.5MM M^3 per day (88MMcf/day) of natural gas from Egypt during July 2008. Syria needs to increase the import of natural gas from Egypt up to 6.0MM M^3 per day (212MMcf/day) in future. Syria exports a small amount of natural gas to Lebanon.

Syria has witnessed an annual reduction in the amount of crude oil production. To make up for this reduction, the country has switched the power generation fuel from crude oil over to natural gas. The country is planning to convert oil-fired power plants into gas-fired plants before 2014. In Syria, there has been a growth in the population and modernization of the daily life. When viewed on a medium- to long-term perspective the production of crude oil and natural gas will fall short of demand. Since Syria does not satisfy the growing demand, it is scheduled to import crude oil and natural gas from neighboring countries via pipeline.

7.1.2 Organization

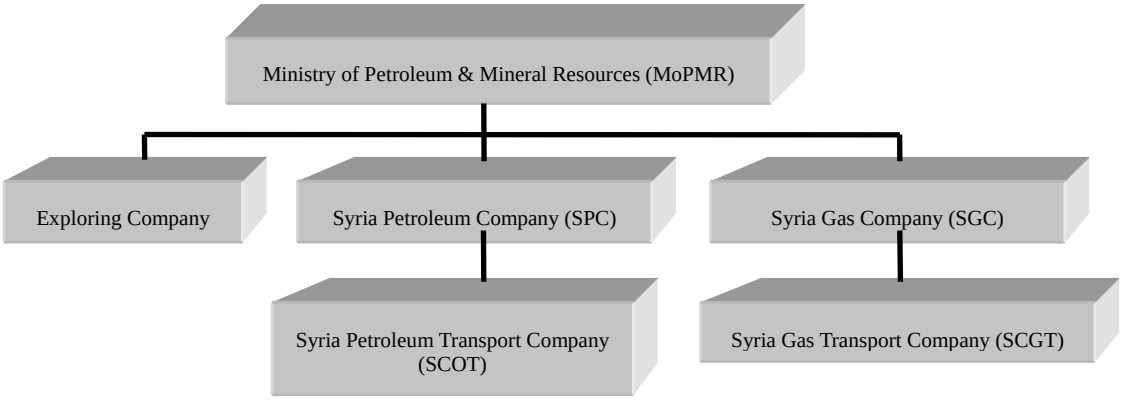
In Syria, the Ministry of Petroleum & Mineral Resources has provided collective administration and supervision of the petroleum and gas related businesses, as well as businesses related to mines and resources such as marble and phosphate rock. The Ministry of Petroleum, Mineral and Energy has subordinate entities such as Syria Petroleum Company and Syria Gas Company.

The Exploring Company plays an important role and provides an overall management of the recovery of petroleum production which is currently deteriorating, in addition, it provides an overall

management of the development of new oil fields and gas fields, and is now cooperating with foreign petroleum enterprises to develop new oil and gas fields. Further, this company has about fifty percent (50 percent) of the investment in oil and gas fields of the country. The foreign enterprises taking part in the development of the oil and gas fields include Al Furat, Petroleum Company as a joint venture, Shell and Asian National Petroleum Company of China.

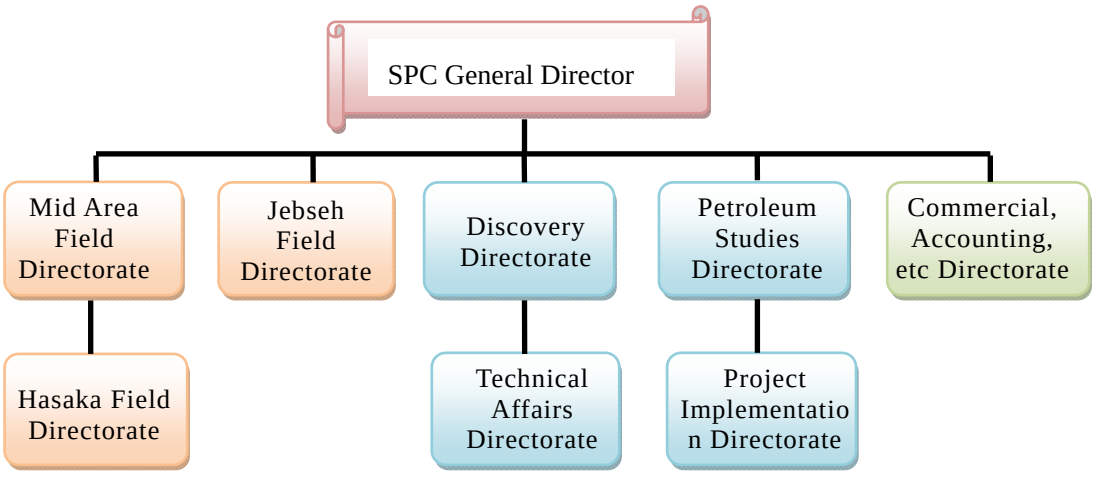
In the meantime, Syria Petroleum Company and Syria Gas Company have provided an overall management of crude oil and natural gas. It main responsibilities are collection, refinery, and transportation oil, compression of natural gas, supply to the power plants and domestic consumers.

The executive organization of the natural gas and oil of Syria is shown in Fig. 7.1-1, and the organizational chart of the Syria oil company is shown in Fig. 7.1-2.



Source: MoPMR

Fig. 7.1-1 Natural gas/petroleum executive organization in Syria



Source: SPC

Fig.7.1-2 SPC Organization

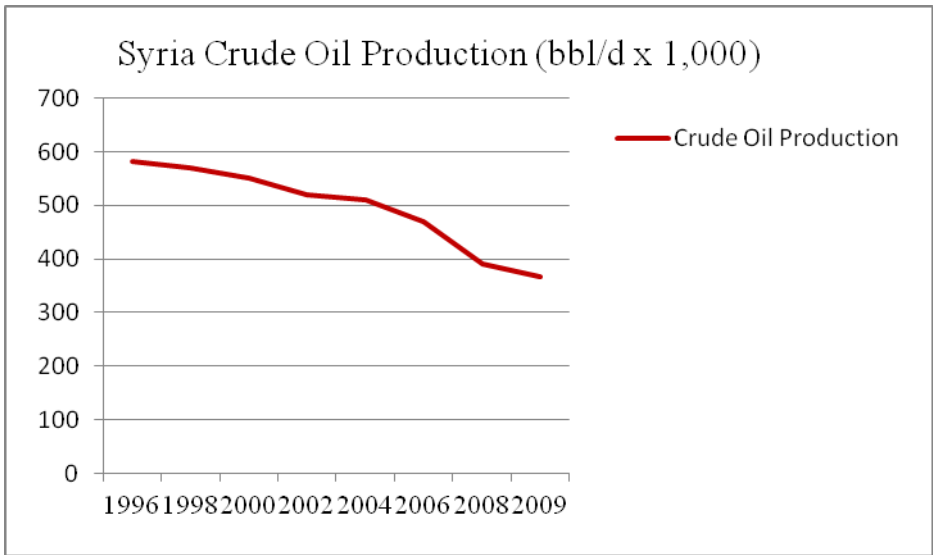
7.1.3 Crude oil

The crude oil production volume in Syria has been declining since mid-1990s. In early 2010, total number of 250 million barrels of crude oil reserves was verified. Oil fields are situated on the national border with Iraq and along the Euphrates, and small oil fields are scattered in the central region.

The volume of crude oil production registered a maximum daily figure of 583,000 barrels in 1996.

This is followed by annual decreases in the production volume, until the daily production dropped to 385,000 barrels in 2009. The daily crude oil consumption within Syria was 285,000 barrels in 2009.

The quantity of production of the crude oil from 1996 to 2009 is shown in Fig. 7.1-3.



Sources : EIA

Fig. 7.1-3 Syria Crude oil production

The large-sized oil fields including Omar oil field of Al Furat Petroleum Company, provide daily production of 100,000 barrels. Further, in the Jbesagas oil field of Syria Petroleum Company, the production volume registers 200,000 barrels per day. Other smaller oil fields are being renovated by Chinese and Russian companies and efforts are made to recover the production. However, the overall reduction in the production volume remains unchanged.

In 2007, oil field prospecting was conducted in the Mediterranean Sea without success. The country has already signed an agreement on petroleum exploration projects with eleven (11) foreign enterprises. At present, seven companies (Shell, Gazprom, Gulf Sand, Tanafuto, Petro Canada, IPR, Lawn Energy) including JV are working on these projects. Furthermore, tenders were requested for new oil field prospecting in eight blocks on the north and east of the country in April 2010, and the work is undergoing.

Syrian petroleum is exported to the OECD countries in Europe through the petroleum market. The petroleum mainly goes to Germany, Italy and France. Syria has three petroleum export/import ports

at Banias, Tartus and Latakia. The Banias Port has seven berths for cargo loading and unloading, and the Tartus Port has two berths. The Latakia Port is used to load and unload smaller cargos. These petroleum loading and unloading ports are connected with the petroleum refinery through the domestic petroleum pipeline network. The petroleum transport system in Syria is already developed and is placed under the operation management of Syria Petroleum Transport Company (SCOT).

The Syrian Petroleum Refineries are located at two sites in Banias and Homs. They have approximately a total of 240,000 barrels per day as of January 2010. The Banias refinery was built in 1975. It encompassed 130,000 barrels per day. Nineteen (19) petroleum storage tanks with a storage capacity of 437,000 tons are installed in the Banias refinery. The Homs refinery was built in 1959, and encompassed a total 100,000 barrels per day. However, these petroleum refineries are declining in the recent years due to excessive demand. To solve this problem, a petroleum refinery program for improvement and new construction plan will be performed in order to enhance the refining capacities of the Banias and Homs petroleum refineries. The crude-oil facilities of Syria are shown in Fig. 7.1.3-2, the development area of an oil field and a gas field is shown in Fig. 7.1.3-3 and the main export destinations of Syria crude oil are shown in Fig. 7.1-4.

Source: JICA Study Team

Fig. 7.1-4 Crude oil facilities in Syria

1: Omar oil field (crude oil production volume: 100,000 barrels/day)

2: Jbesa gas oil field (crude oil production volume: 200,000 barrels/day)

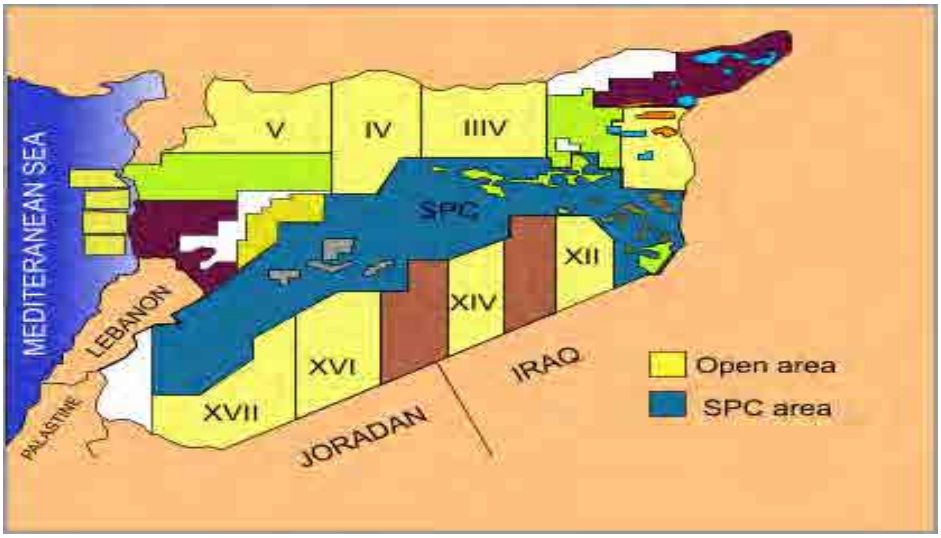
3: Banias crude oil unloading port (seven (7) unloading berths)

4: Tartus crude oil unloading port (two (2) unloading berths)

5: Latakia crude oil unloading port (small cargo unloading)

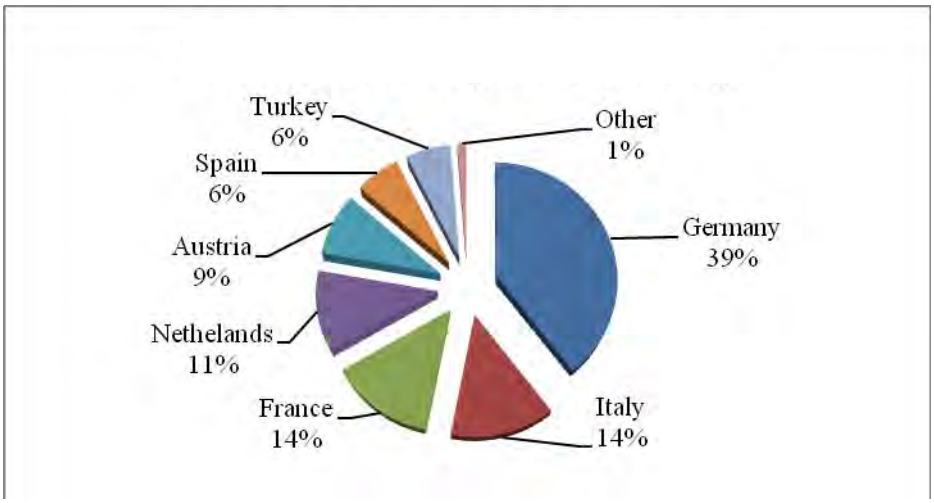
6: Banias Petroleum Refinery (throughput: 130,000 barrels/day)

7: Homs Petroleum Refinery (throughput: 100,000 barrels/day)



Source: SPC

Fig. 7.1-5 Oil and Gas field development area



Source: EIA

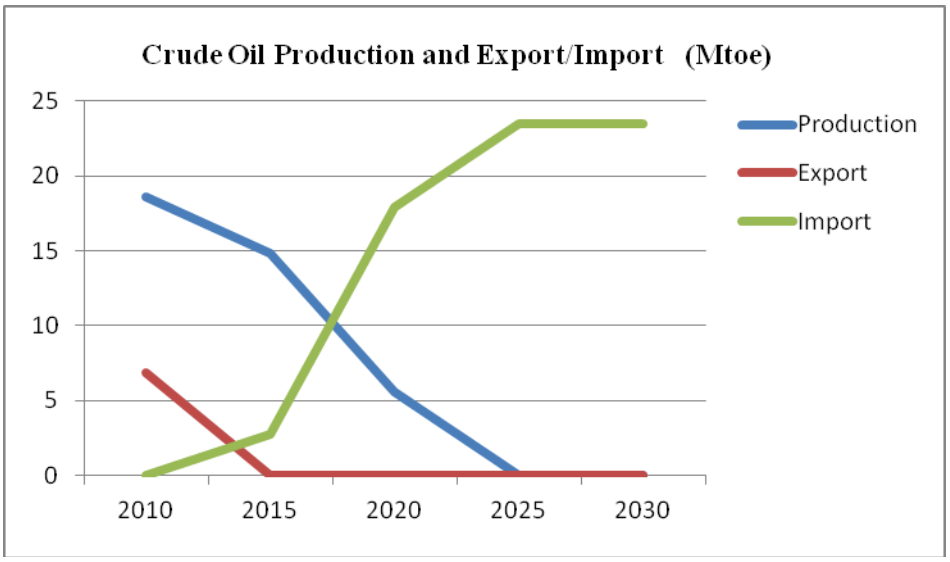
Fig.7.1-6 Syrian crude oil export countries (as of 2010)

7.1.4 Crude oil transaction

As of 2009, the crude oil production volume in Syria is 385,000 barrels per day. Of this figure, 100,000 barrels per day are exported to Europe through the petroleum market. However, there is a yearly decrease in the crude oil production volume. Furthermore, the crude oil refinery fails to meet the domestic demand. Thus, Syria has to depend on import for a greater proportion of petroleum products such as gasoline and diesel.

Although there are programs for increasing the production of petroleum products through the modernization of the existing petroleum refineries and construction of new petroleum refineries, there is a remarkable increase in the Government's subsidy expenditures in recent years due to a greater percentage of the Government's fuel-related subsidy for petroleum products such as gasoline and

diesel. This is a heavy burden on the financial standing of the Government. The fuel subsidy only is estimated to account for 15 percent of the GDP. To solve this problem, the Government is currently engaged in the economic reformation, and has determined to undertake a fundamental reappraisal of the Government subsidy program which has been responsible for the electric power, fuel and household items. In 2008, the Government announced a program of gradually reducing the fuel subsidy for gasoline and diesel to zero in the subsequent five years, and adopting the tax-based fee system. The crude oil production and export/import are shown in Fig. 7.1-7.



Source: EIA

Fig. 7.1-7 Crude Oil Production and Export/Import

7.1.5 Natural gas

Syrian Natural Gas reserves are estimated to register approximately 280,000 MM M^3 (9,888,120 MMcf). Eighty Five (85 percent) percent of the produced natural gas is used as a fuel in power generation plants and the remaining gas is consumed domestic in Syria. Syrian Natural Gas production volume has declined during the period from 2004 to 2008. However, the development of new gas fields up to 2010 was accompanied by massive increase in the production volume. As compared with the 2008 production volume of 6,240 MM M^3 per year (220,364 MMcf/year), the production volume for 2010 was 10,830 MM M^3 per year (382,458 MMcf/year), registering an approximately a twofold increase. A further estimated increase in the production volume will occur.

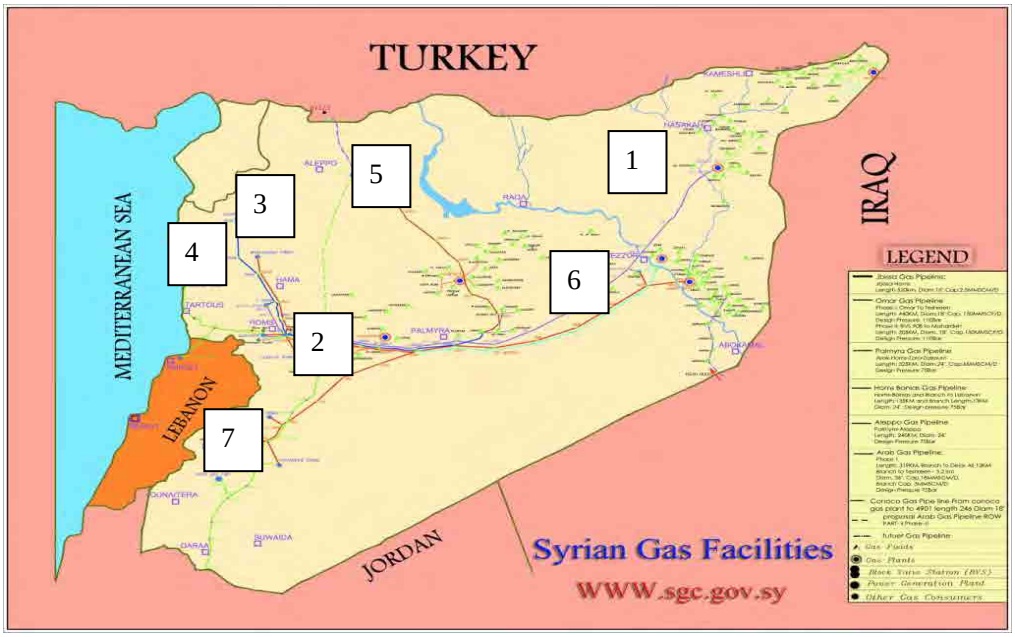
For the production volume in the existing major gas fields, the current production volume of 1.8 MM M^3 per day (64 MMcf/day) in the Hasaka gas field is assumed to be maintained up to 2025. However, the production volume after 2026 is equivalent to zero. In the Jbesa gas field, the current production volume of 2.1 MM M^3 per day (74 MMcf/day) will decline gradually to reach 1.125 MM M^3 per day (39.8 MMcf/day) in 2030. In the gas field of the central region, the current production volume of 1.2 MM M^3 per day (42.4 MMcf/day) will decline to 0.1 MM M^3 per day (3.5 MMcf/day)

in 2030. In the Der Alzorgas field, the current production volume of 4.8 MM M^3 per day (170 MMcf/day) will fall to 0.5 MM M^3 per day (17.7 MMcf/day) in 2030. In the gas field of southern region, the current 6.0 MM M^3 per day (212 MMcf/day) is estimated to be maintained up to 2030.

The production volume of the newly developed gas field in the northern region is estimated at 3.0 MM M^3 per day (106 MMcf/day) during the period from 2012 till 2030. Petro Canada estimates the production volume at 2.5 MM M^3 per day (88.3 MMcf/day) from 2012 through 2030. Haian Company estimates the production at 3.7 MM M^3 per day (131 MMcf/day) from 2012 till 2030.

The produced natural gas is subjected to such a treatment as desulfurization of ethanol amine at six gas treatment sites in Syria, and is conveyed for domestic purposes within the country after the quality has been made specific. In Syria, the natural gas pipeline network is completely provided. The major natural gas pipeline networks are: Jbissa gas pipeline, Omar gas pipeline, Palmyro gas pipeline, Homs/Banias gas pipeline, Aleppo gas pipeline and Conoco gas pipeline. Further, there is an Arab Gas Pipeline (AGP) connecting among Egypt, Jordan, Lebanon and Syria, and construction of this pipe line was completed in 2008. These natural gas pipelines are strategically underground.

Fig. 7.1-8 is shown Syria Domestic Natural Gas Pipeline Network.



出典: Syrian Gas Company

Fig. 7.1-8 Syria Natural Gas Pipeline Network

1: Jbissa gas pipeline
Between Jbissa and Homs
Pipeline length: 520 km
Pipeline diameter: 16 inches
Design pressure: 110 bars

2: Omar gas pipeline
Between Omar and Mahardeh
Pipeline length: 645 km
Pipeline diameter: 18 inches
Design pressure: 75 bars

3: Palmyro gas pipeline
Arak-Zaizoum
Pipeline length: 325 km
Pipeline diameter: 24 inches

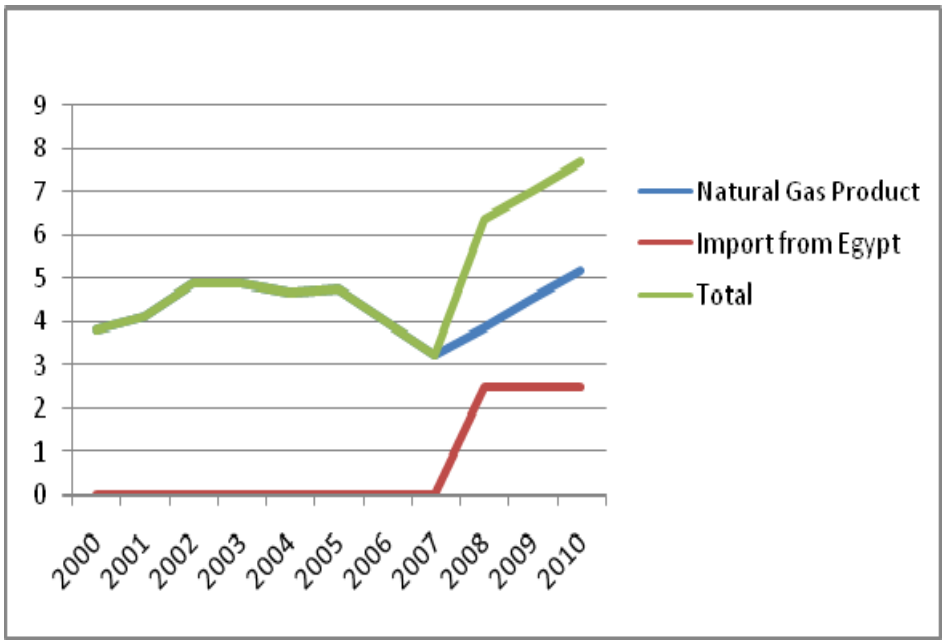
4: Homs/Banias gas pipeline
Between Homs and Banias
Pipeline length: 135 km
Pipeline diameter: 24 inches
Design pressure: 75 bars

5: Aleppo gas pipeline
Between Palmyra and Aleppo
Pipeline length: 240 km
Pipeline diameter: 24 inches
Design pressure: 75 bars

6: Conoco gas pipeline
Pipeline length: 246 km
Pipeline diameter: 18 inches
Pipeline diameter: 24 inches
Design pressure: 75 bars

7: Arab gas pipeline
Arish in Egypt-Homs in Syria
Pipeline length: 1015 km
Pipeline diameter: 36 inches
Design pressure: 75 bars

Syria Gas Company (SGC) takes responsibility for the overall management of these natural gas pipeline networks, management of control section (measurement of transacted gas and pressure rise) and management of natural gas transportation. Fig.7.1-9 shows the production of natural gas from 2000 to2010a year.



Source: IEA data and made by JICA study team

Fig. 7.1-9 Natural gas Production in Syria

7.1.6 Partnership with neighboring countries regarding the crude oil and natural gas pipelines

(1) Arab Gas Pipeline (AGP)

The AGP has been installed in order to supply Jordan, Lebanon and Syria with Egypt-produced natural gas for thirty years. The construction of the AGP covering the four countries of Egypt, Jordan, Lebanon and Syria was completed in July 2008. Completion of the construction of this pipeline made it possible for Syria to start the import of 150 MM M^3 per year (5,297 MMcf/year) of natural gas from Egypt through Jordan.

Further, an agreement was signed between Syria and Turkey in 2009. During the period of five years starting from 2011, a total of 525 MM M^3 through 1,050 MM M^3 (18,540 MMcf through 37,080 MMcf) of natural gas is planned to be imported from Turkey. Extension of the natural gas pipeline is currently underway between Syria and Turkey. According to our survey by an interview with the Ministry of Petroleum & Mineral Resources, the gas pipeline construction work from Aleppo of Syria through Kilis on the border with Turkey will be completed in several months, but another year through 1.5 years will be required to complete the gas pipeline construction work from the border of Syria through Turkey, according to the interview.

Actually, import of natural gas from Turkey is likely to start at the end of 2012 or the beginning of 2013. If the construction of this natural gas pipeline has been completed, the import of natural gas from Azerbaijan and Iran will reach the level of a maximum 3000 MM M^3 per year (105,944 MMcf/year).

In the meantime, Syria is studying the feasibility of implementing the Swap method where, if the

export of natural gas from Egypt to Turkey has been determined, the gas exported from Egypt to Turkey will be consumed in the southern region of Syria, and the equivalent amount of Syria-produced gas will be exported to Turkey from the northern region of Syria close to the border of Turkey.

At present, the AGP is connected to Lebanon and Syria from Egypt through Jordan, and the pipeline connection work is currently under way in Turkey. In future, plans for extending the pipeline to Africa, Asia (Qatar, UAE) and Europe are taking place. The following illustrates the 4 work progress in the construction of the AGP:

- First construction work

A gas pipeline was constructed from Arish of Egypt through Aqaba of Jordan in July 2003. This pipeline has a total length of 265 km, a pipe diameter of 36 inches and a transport capacity of 10,000 MM M^3 per year (353,147 MMcf/year). Bypassing the territory of Israeli, a pipeline covering a length of 15 km was laid at the sea bottom with a depth of 850 m in the Bay of Aqaba.

- Second construction work

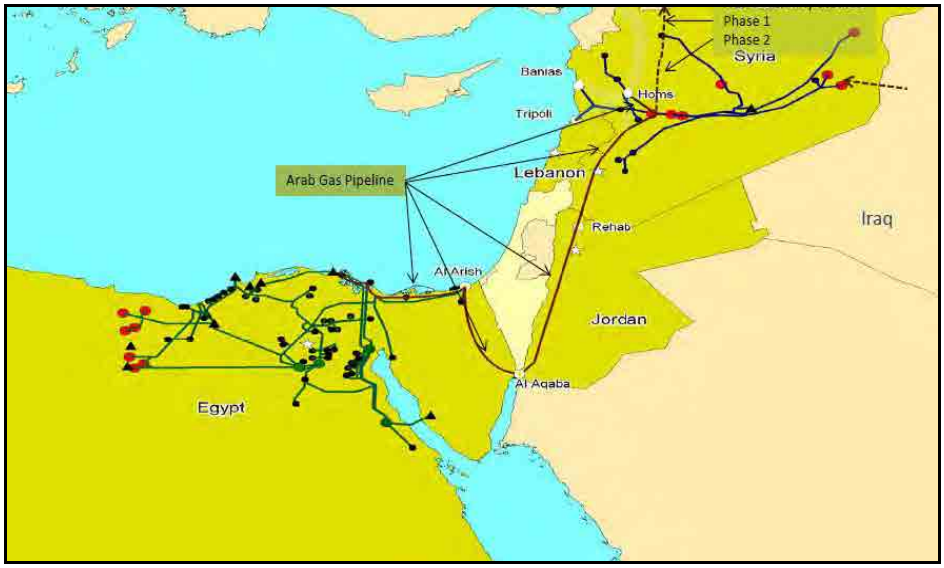
In February 2006, a gas pipeline having a total length of 390 km was installed along the route from Aqaba of Jordan through EL Rehab of Jordan (30 km from the national boundary of Syria). The pipe has a diameter of 36 inches.

- Third construction work

In July 2008, a gas pipeline having a length of 30 km was laid along the route from EL Rehab of Jordan through the boundary of Syria.

- Fourth construction work

In 2008, a gas pipeline having a total length of 330 km was constructed along a route from the boundary between Jordan and Syria through Homs of Syria. Syria started import of gas from Egypt. A gas pipeline installation work is currently under way along the route from Homs of Syria through the boundary of Turkey in order to connect the AGP with the gas pipeline network of Turkey. The map of AGP is shown in Fig. 7.1-10.



Source: JICA Study Team

Fig. 7.1-10 Arab Gas Pipeline (AGP)

(2) Gas pipeline between Syria and Turkey

In 2009, an agreement was signed between Syria and Turkey to install a gas pipeline with a total length of 63 km between Aleppo of Syria and Kilis of Turkey. The installation work is currently underway. According to the agreement, Syria is planning to import 525 MM M^3 through 1,050 MM M^3 (18,540 MMcf through 37,080 MMcf) of natural gas from Turkey for a period of five years starting in 2011. The pipe installation work on the Syrian side will be completed in several months, but the pipe installation work on the side of Turkey is subject to delay.

(3) Gas pipeline between Syria and Iraq

The crude oil pipeline (with an overall length of 800 km) connecting Banias of Syria and Kirkuk on the north of Iraq was closed in 2003 when the Iraq War broke out. In 2009, an initial discussion was held to reopen the crude oil pipeline for the purpose of importing crude oil from Iraq to Syria. A formal agreement has not yet been signed. If this crude oil pipeline is constructed, a total of 100,000 barrels can be imported every day. Further, according to the Iraqi's long-term project, two new crude oil pipelines will be laid between Iraq and Syria in 2017, and a total of 10,000,000 barrels will be exported to Syria every day.

Further, a meeting is also held to discuss the installation of a new gas pipeline between Iraq and Syria, Natural gas will supply the Akkas gas field (48 km from the border of Syria) in the western region of Iraq. According to the plan, the newly installed gas pipeline will be placed through Basra of Iraq. It has a diameter of 56 inches with a transportation capacity of 1.5 MM M^3 per day (53 MMcf/day). The installation cost is estimated at approximately ten billion USD.

(4) Gas pipeline between Syria and Iran

Since three years ago, a discussion has been held on the installation of natural gas pipeline among Syria, Iran and Iraq with a diameter of 56 inches running from Iran through Iraq (completed schedule in 2013 or 2014) for the purpose of importing natural gas from Iran to Syria. This pipeline crosses Iraq from south to north over the distance of approximately 500 km. It will cross Syria over a distance of 500 through 700 km, and will be connected to Lebanon. If this natural gas pipeline is completed, Syria can import 110 MM M^3 per day (3,700 MMcf/year) of natural gas from Iran. This volume is capable of meeting the ever-growing demands for natural gas in Syria. The required cost is estimated at approximately 30 billion USD.

In 2009, a gas pipeline installation agreement was signed between the two countries. However, the agreement is not yet finalized due to safety problems and so on.

(5) Gas pipeline between Syria and Azerbaijan

After the gas pipeline between Syria and Turkey has been installed, Syria is planning to import natural gas from Azerbaijan through Turkey. Syria and Azerbaijan have already signed major agreements. The import of 1,300 MM M^3 per year (45,900 MMcf/year) of natural gas will start in 2012 at the earliest.

7.1.7 Natural gas demand/supply prediction

Since production of crude oil is on the decrease every year, the fuel for power generation plants is converted from crude oil to natural gas. In the meantime, the production of natural gas is anticipated to increase due to development of new gas fields. However, a significant production increase will not be expected. To meet the subsequent demand, Syria has to depend on import from neighboring countries. In 2008, Syria started import of 2.5 MM M^3 per day (88.3 MMcf/day) of natural gas from Egypt using the AGP.

To meet the growing demand of natural gas as there is an increase of electric power resulting from increase in population and the modernization of people's lives, Syria is planning to establish natural gas pipelines in order to import natural gas from neighboring countries such as Egypt, Turkey, Iran, Iraq and Azerbaijan. If natural gas will be successfully imported from the neighboring countries, a stable supply of natural gas will be expected by diversification of suppliers.

However, in order to have safe reservation and mitigate the economic liability, implementation of the following measures at an early stage is desired from fueling reservation at its own country:

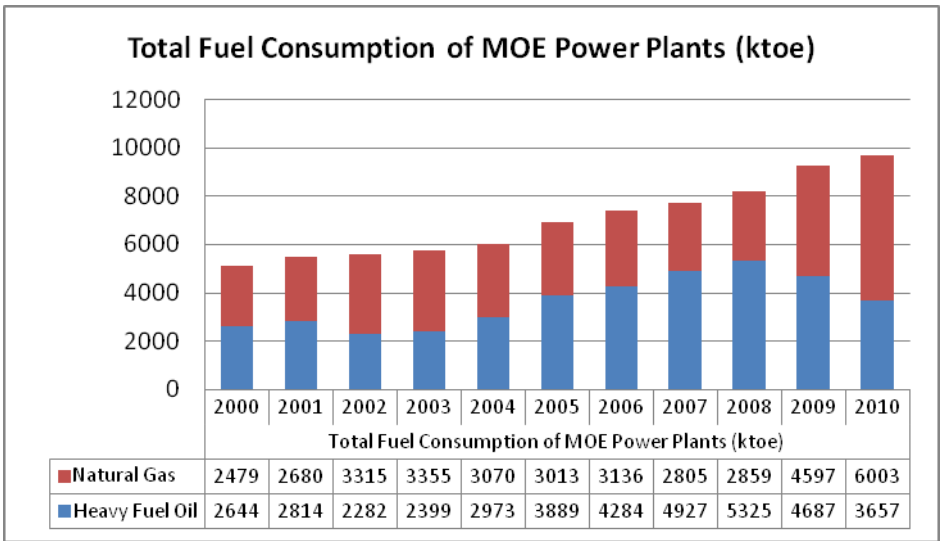
(1)Expedite the date of implementing the project of increasing the use of renewable energy (wind power generation and solar photovoltaic generation) to cover 20 percent of the demand before 2030, and take positive means to ensure complete implementation of this project.

(2)Take energy conservation measures for improving the energy efficiency and using the

energy-saving electric appliances.

(3)Since reserves of shale gas have been verified, Syria makes efforts to achieve earlier development of the shale gas, and encourage its use.

The conversion situation from the oil used in a thermal power plant to natural gas is shown in Fig. 7.1-11.

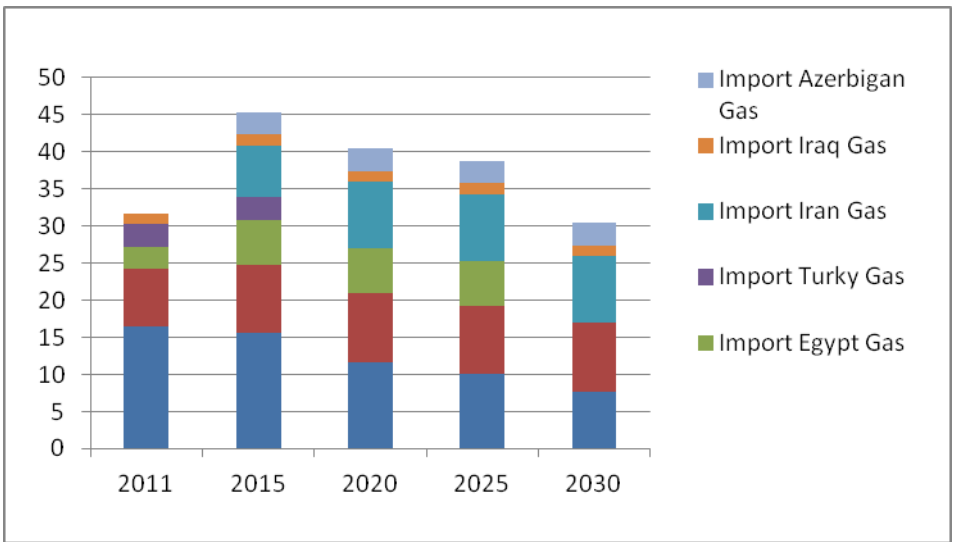


	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Total Fuel Consumption of MOE Power Plants (ktoe)										
Natural Gas	2479	2680	3315	3355	3070	3013	3136	2805	2859	4597	6003
Heavy Fuel Oil	2644	2814	2282	2399	2973	3889	4284	4927	5325	4687	3657

Source: PEEGT

Fig. 7.1-11 Natural gas and heavy fuel oil consumption in thermal power plants

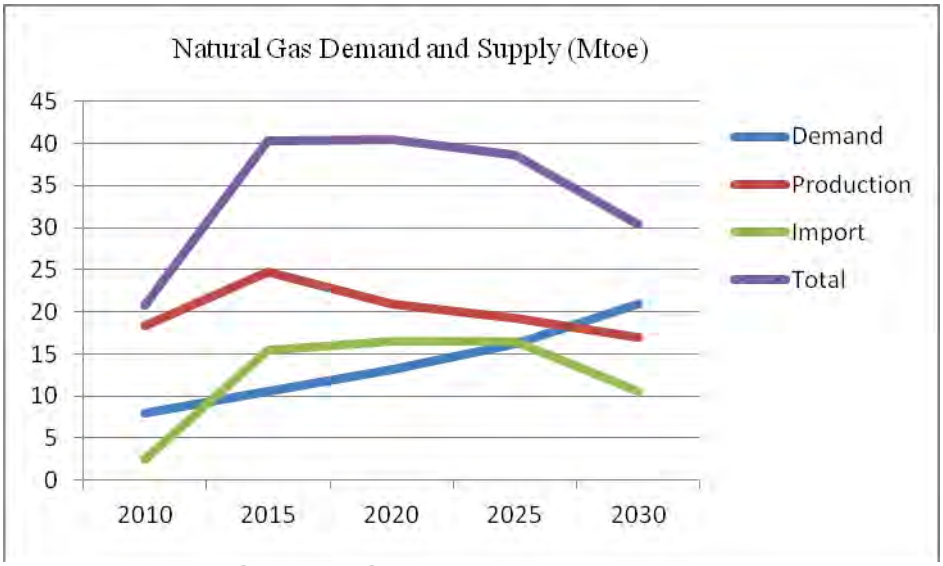
The natural gas supply plan from 2011 to 2030 is shown in Fig. 7.1-12. The natural gas production in Syria (included future production) and imports from the neighboring countries of Egypt, Iran, Iraq, Turkey, and Azerbaijan are planned.



Source: PEEGT

Fig.7.1-12 Natural Gas Supply plan

The supply balance of the natural gas from 2010 to 2030 is shown in Fig. 7.1.7-3. Natural gas demand used the Ref-case which the JICA Study Team predicted, and it was referred to as 6.7 (Mtoe) in 2010, as 9.3 (Mtoe)in 2015, as10.9 (Mtoe)in 2020, as 11.9(Mtoe) in 2025 and as 15.0 (Mtoe) as in 2030. Moreover, the production of the natural gas in the Syria included the natural gas from which development is expected from now on, as 18.3 (Mtoe) in 2010, as 24.8 (Mtoe) in 2015, as 20.9 (Mtoe) in 2020, as 19.2 (Mtoe) in 2025 and as 16.9 (Mtoe) in 2030. It is predicted that Syria is planning to import all quantities of the natural gas from neighboring countries such as Egypt, Iran, Iraq, Turkey and Azerbaijan, with the whole quantity of imports as 2.5 (Mtoe) in 2010, as 18.5 (Mtoe) in 2015, as 19.5 (Mtoe) in 2020, as 19.5 (Mtoe) in 2025 and as 13.5 (Mtoe).



Source: PEEGT and JICA Study Team

Fig.7.1-13 Natural gas demand and supply

7.1.8 Natural gas transaction

Eighty Five (85) percent of the natural gas produced in Syria and natural gas imported from Egypt is consumed by PEEGT (Public establishment of Electricity for Generation and Transmission) as an electric generation of Syria, and the remaining 15 percent is used in the domestic market.

The Syrian Gas Company (SGC) as a supplier of natural gas sets the value of the natural gas supplied to PEEGT at a level slightly lower than the international level. Actually, however, the SGC and PEEGT are state-run companies, and PEEGT does not make specific payment for natural gas consumption. Namely, the payment is handled within the Government in terms of a credit to SGC and a debit to PEEGT, for example. This does not contribute to the revenue for the Government. This is one of the factors resulting in a financial burden.

Further, the natural gas imported from the neighboring countries through the AGP is not based on the international value. The price is determined by negotiations between two countries, with political factors taken into account.

7.1.9 Hydraulic power

Syria has two large rivers, the Euphrates and Tigris originating in the north of Turkey, and hydraulic power plants are installed along these rivers. Large-sized hydraulic power plants include the Al Thawra Dam (880 MW), Tishreen Dam (630 MW) and Al Baath Dam (75 MW). When small-sized dams are taken into account, hydraulic power plants having a total generation capacity of 1,620 MW are installed. The rated output of these installed hydraulic power plants accounts for 9 percent of the Syrian domestic power production volume. However, the Euphrates runs across Turkey, Syria and Iraq. Turkey, located upstream, has control over 88 percent of the water volume, while Syria located at the center has control over a mere 9 percent. Iraq situated on the extreme downstream portion receives a 3 percent supply of water. This has such a serious impact on development that Syria is incapable of development of a large-scale hydraulic power plants project. Further, the generation capacity of a hydraulic power plant greatly depends on precipitation. In winter, as the season of rainfall and snowfall, approximately 70 percent of the rated power output can be generated, and in the dry summer where a peak demand is reached, only about 20 percent of the rated power output can be generated. Unless political and strategic problems with Turkey are solved, development of Syrian domestic hydraulic power plants cannot be implemented. The output condition of a hydroelectric power station is shown in Table 7.1-1

Table 7.1-1 Hydropower output in Summer/Winter

	Rated Output	Winter Season	Summer Season
Al Thawra Dam	880MW	650MW	200MW
Techreen Dam	630MW	450MW	200MW
Al baath Dam	75MW	51MW	51MW

Source: JICA Study Team

7.1.10 Mineral resources

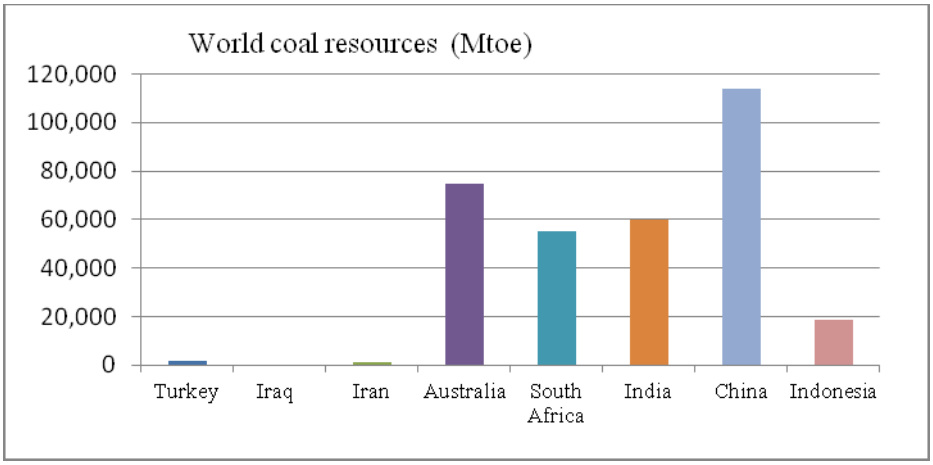
Syria does not produce coal due to lack of coal mines. A small amount of such mineral resources as phosphorus, chromium and manganese can be mined as natural resources. Phosphorus is exported to overseas countries.

In order to correspond to the increasing power consumption in the future, construction of coal fire power is planned, but coal will be imported from foreign countries.

On the occasion of import of coal and construction of coal fired thermal power plant, sufficient examination is required as per the following:

- Identifying reliable coal sources for a long period.
- Coal transportation system (maritime or inland)
- Identifying coal logistics for coal terminal and coal handling
- Identifying environmental impacts

World coal resources are shown in Fig. 7.1-14.



Source: World coal council

Fig.7.1-14 World coal resources

7.1.11 Geothermal

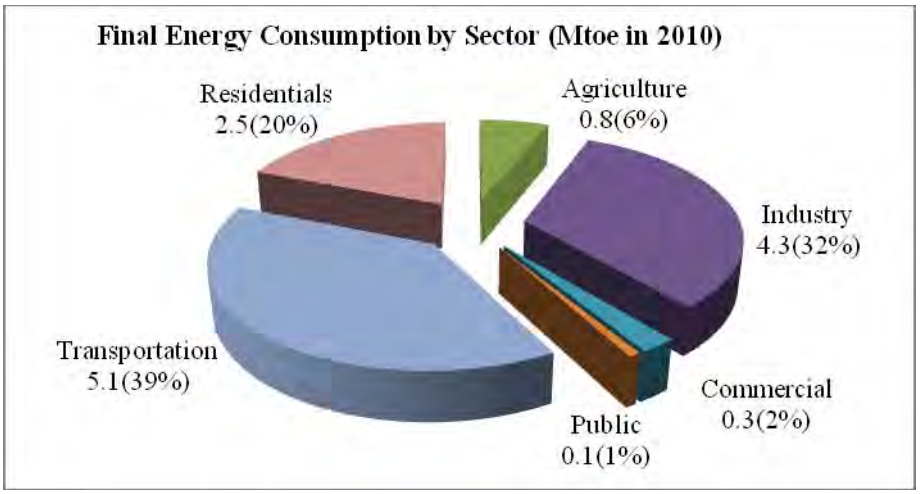
Since Syria does not have hot springs, there is no geothermal availability.

7.1.12 Renewable energy

To promote the use of renewable energy, the Government of Syria has already promulgated laws and regulations required on the policy level. Further, Syria established the National Energy Research Center (NERC) in 2003 to survey and determine the sites and sizes of projected plants for wind power, solar heat and other renewable energy resources. A feasibility study has been started based on the renewable energy master plan, and a pilot project for wind power generation and a solar hot-water supply system have already been planned. According to the renewable energy master plan, 25 percent of the primary energy will be supplied by 2030. Implementation of the project requires huge amounts of funds, and this has caused a delay of the project. The details of the renewable energy are described in Chapter 8.

7.2 Final Energy Consumption by sector

When final energy consumption is studied by sector according to Ref-case, 6 percent of final energy is consumed for agricultural use, 32 percent for industrial use, 2 percent for commercial use, 1 percent for use in government and municipal offices, 39 percent for traffic use and 20 percent for household use in 2010. Fig. 7.2-1 shows final energy consumption by the sector in 2010.

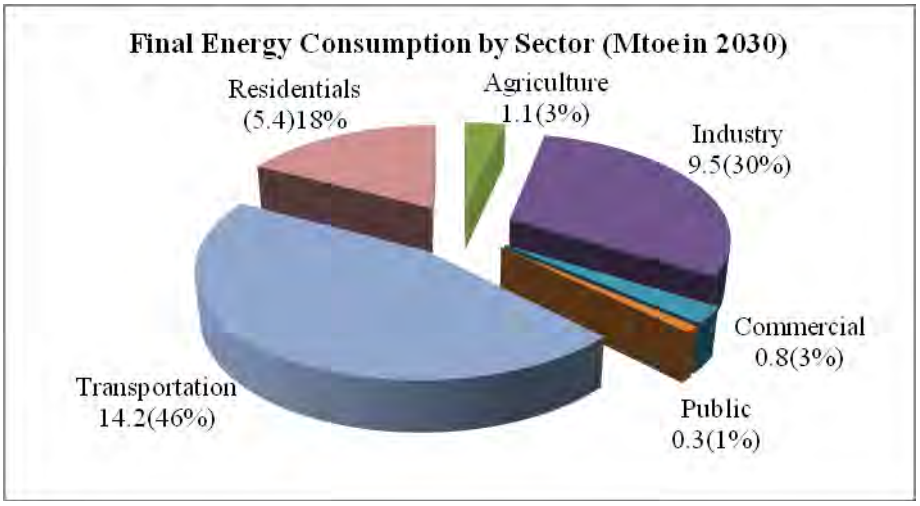


Source: JICA Study Team

Fig. 7.2-1 Final energy consumption by sector (Mtoe in 2010)

To estimate the final energy consumption by sector for 2030 according to Ref-case, the consumption in the agricultural field will remain almost flat at 3 percent, and the consumption in the industrial field will increase 120 percent from the fiscal 2010 level of 4.2 (Mtoe) to 9.2 (Mtoe). The consumption in the commercial field will increase 280 percent from the 2010 level of 0.3 (Mtoe) to 0.82 (Mtoe). The consumption in the government and municipal offices will remain almost flat and the use in the transportation field will increase 280 percent from the 2010 level of 5.1 (Mtoe) to 14.2 (Mtoe). This signifies that human exchange and business transaction with neighboring countries have been activated by economic developments, and development of commercial/industrial systems and transportation systems will be encouraged.

The consumption for household use is estimated to increase by approximately 220percent with the increase of population. Fig. 7.2-2 is shown final energy consumption by the sector in 2030.



Source: JICA Study Team

Fig. 7.2-2 Final energy consumption by sector (Mtoe in 2030)

7.3 Demand/Supply balance in primary energy

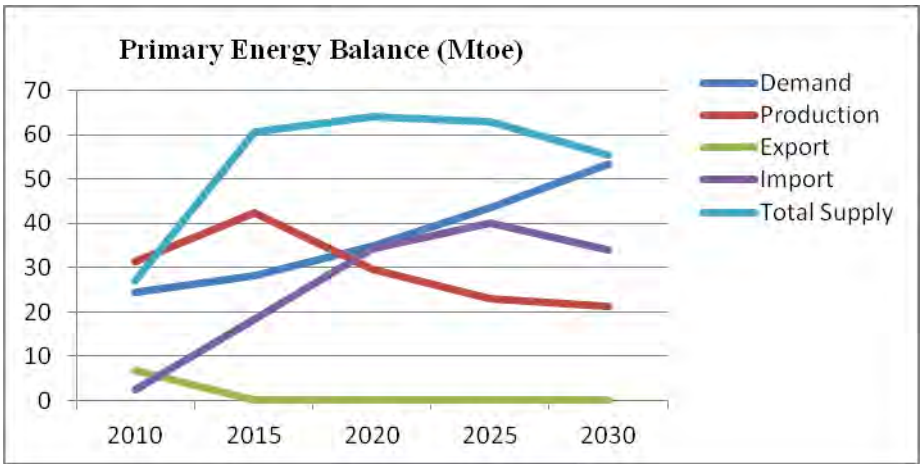
The demand and supply balance of primary energy from 2010 to 2030 is shown in Fig. 7.3-1. The demand of the primary energy predictions based on Ref-case is: as 24.6 (Mtoe) in 2010, 28.2(Mtoe) in 2015, 35 (Mtoe) in 2020, 43.5 (Mtoe) in 2025 and 53.5 (Mtoe) in 2030. The fiscal 2010, primary energy demand was 25 (Mtoe). Primary energy supply was estimated to be covered by a total of 34 (Mtoe), consisting of 11.7 (Mtoe) of crude oil supply calculated by subtraction of the foreign-exported volume from the Syrian domestic production volume 18.3 (Mtoe) of natural gas domestically produced plus 2.5 (Mtoe) imported from Egypt, 0.75 (Mtoe) generated by hydraulic power plants, and 0.7 (Mtoe) of renewable energy.

The production of the natural gas planned to be newly developed during the 2015-2030 period is estimated as 9.2 (Mtoe). The amount of natural gas will import from Egypt is estimated to be increased from 2.5 (Mtoe) to 6 (Mtoe). The amount of natural gas import from Iran is estimated as 5 (Mtoe) to 9 (Mtoe), the amount of natural gas will import from Iraq is estimated 1.5 (Mtoe), and the amount of natural gas that will be imported from Azerbaijan is estimated as 3 (Mtoe).

The crude oil production volume is estimated at 14.8 (Mtoe) for 2015, and 5.6 (Mtoe) for 2020. Syrian domestic oil field is estimated at zero (Mtoe) since it will be exhausted in 2030. Further, the import of crude oil from overseas countries is estimated as 23.5 (Mtoe) which would be imported from Iraq and Iran. During the 2015-2025 period, there will be a comfortable margin of supply to meet the demand. However domestic production of natural gas will drop after 2025, and since an agreement with Egypt for the supply of natural gas will expire accordingly, natural gas imports from Egypt will be reduced to "zero" after 2028, and the amount of natural gas supply is anticipated to decrease.

For the energy supply as of 2030, in addition to the domestic production, natural gas will be imported from Egypt, Iran, Iraq and Azerbaijan, and total amount of natural gas will account for 52 percent of

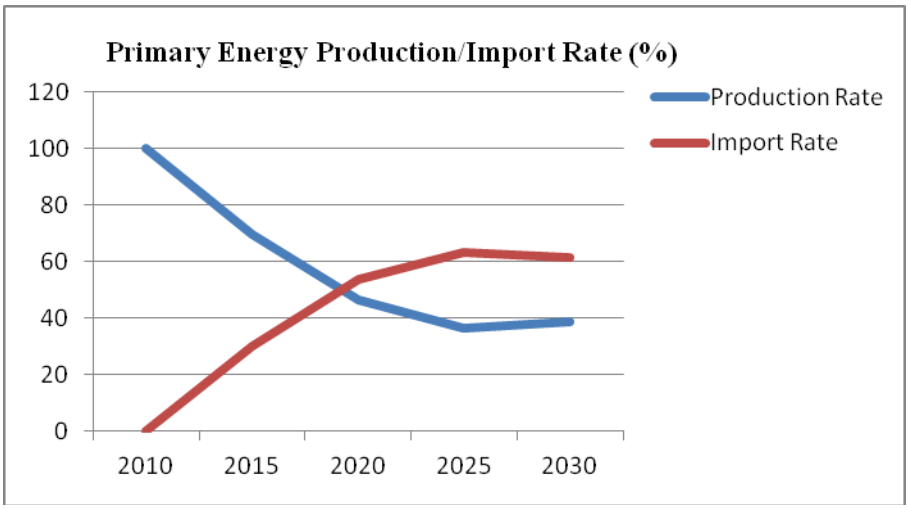
the energy supply. Further, for crude oil, Syria has to completely depend on imports from Iraq and other countries. It is estimated that crude oil will account for 40 percent of the energy supply, renewable energy will account for 7 percent, and hydraulic power will account for approximately 1 percent. This estimate is based on the assumption that all the negotiations with the neighboring countries are currently undergoing and in the future will proceed perfectly as planned. However in actual practice, these neighboring countries also have to meet the increasing demands for domestic consumption resulting from economic growth. There is concern about whether or not all the imports can be provided as Syria is planning.



Source: JICA Study Team estimated from PEEG Data

Fig. 7.3-1 Primary energy demand/supply balance (Mtoe)

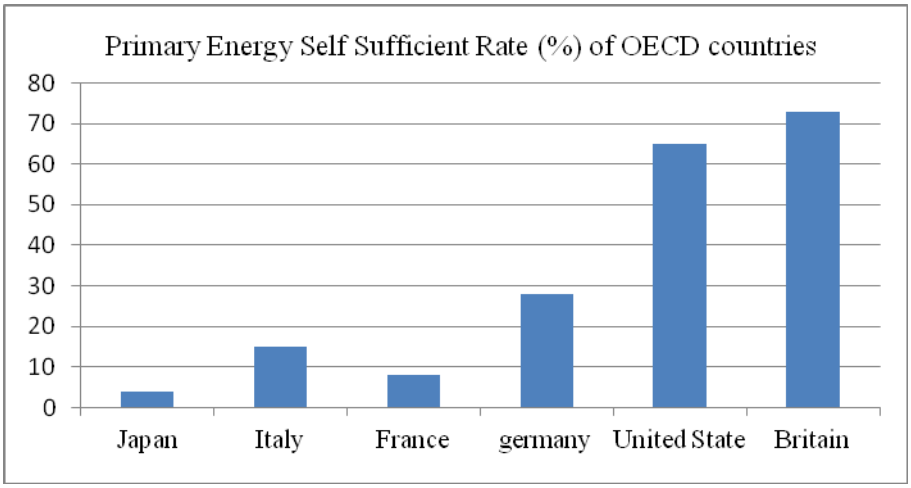
Figure 7.3-2 shows plans for the Syrian Primary Energy Supply at present. Domestic production and the import percentage are also indicated. The primary energy is as of 2010, the whole quantity is being served by domestic production mostly, but imports from neighboring countries exceed production as of 2020. The production percentage of the primary energy in Syria is about 40 percent after 2025, and imports from neighboring countries will be about 60 percent.



Source: PEEG Data

Fig. 7.3-2 Primary Energy Production/Import Rate (percent)

The primary energy self sufficient rate (percent) of the of OECD countries is shown in Fig. 7.3-3.



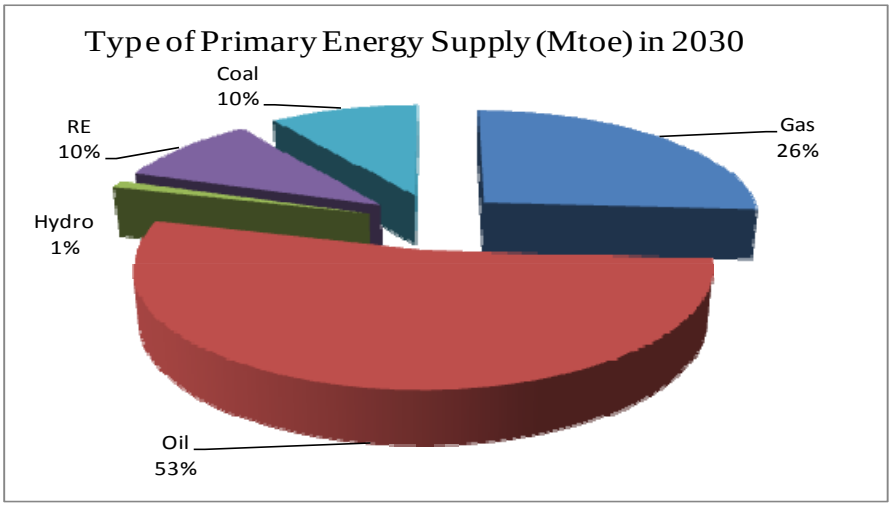
Source: Energy Balance of OECD countries

Fig. 7.3-3 Primary energy self sufficient Rate (percent) of OECD countries

The types of primary energy in Syria in 2030 are shown in Fig. 7.3-4.

Natural gas will consume about 26 percent of all primary energy, and is predicted to mainly be consumed in a gas combined thermal power plant. Although it is predicted in 2025 that the oil fields in Syria will be depleted, there will be still demand for traffic and domestic houses. The crude oil will consume about 53 percent of the whole primary energy as in 2030 and the whole quantity of crude oil will import from neighboring countries, such as Iraq and Iran, as is planned. As for hydraulic power, the amount of water of the Euphrates River is restricted by upstream Turkey, and since development cannot be expected, it is the almost same 1 percent as in 2010. Although renewable energy is

scheduled to provide 25 percent of primary energy under the master plan in 2030, development is delayed from the viewpoint of finance and economical efficiency, and it is predicted it to be 10 percent from then. Since construction of a coal-fired power plant of 2000 MW of total output is planned from 2017 to 2020 according to the Electric Power Development Plan, it is predicted in 2030 that coal will consume about 11 percent of primary energy.



Source: JICA Study Team

Fig. 7.3-4 Type of Primary energy supply (Mtoe) (in 2030)

7.4 Energy policy

The Syrian energy policy is intended to ensure crude oil production, and to increase natural gas production and power generation capabilities, and it includes the following specific policy items. Twenty-five percent of primary energy is estimated to be saved by strict implementation of these policy items in the future.

- Reduction in loss of electric energy in both technological and non-technological terms
- Promotion of energy saving and efficiency improvement campaigns
- Promotion of renewable energy usage
- Adoption and implementation of adequate pricing policy
- Reduction in crude oil consumption (conversion to natural gas)
- Promotion of investment in the sectors of crude oil, natural gas and electric power

7.5 Energy Security

Although Syria is not equipped with energy conservation facilities, the country is making efforts to achieve the best mixture of energy (crude oil, natural gas, hydraulic power and renewable energy), and is planning to diversify the energy suppliers (Egypt, Iran, Iraq and Azerbaijan). Thus, energy security should be guaranteed.

World Petroleum-Reserves system joined the IEA. There are 26 IEA main petroleum consuming countries with petroleum reserves of more than 90 days of the amount of oil import. The petroleum-reserves days of each country which IEA has released are shown table 7.5-1.

Table 7.5-1 The petroleum-reserves days of IEA major countries

Japan	US	Germany	France	Spain	Italy	Britain
165 days	82days	93days	87days	81days	72days	65days

Sources: IEA Statistics

Further, Syria is located at the center of the region from the Gulf States to Europe. In the future, Syria will be connected between the producer Gulf States and consumer Europe, and will play a crucial role in the phase of transportation controlled by pipeline.

On the one hand, Syria is facing an energy and electricity supply shortage. Thus, Syria is required to start earlier implementation of renewable energy projects and to promote the use of the shale gas deposits that have been confirmed.

On the other hand, in the near future, the Government will face tight financial conditions due to a reduction in the crude oil production volume. To solve this problem, the Syrian Government will have to review the current subsidy system for energy and electricity, and to implement an economic reform including promotion of investment by private sectors.

Chapter 8 Energy/Electricity Conservation and Renewable Energy

8.1 Current Situation of Syria's Energy and Electricity Conservation

Judging from current efficiency and government aggressiveness, Syria has great possibility to improve energy and electricity efficiency. Table8.1-1 shows current Syrian activities of energy and electricity conservation. As energy conservation law was issued in 2009, the planning of energy conservation strategy and implementation of various enforcement have become the highest priority issues.

Table 8.1-1 Current Syrian Activities of Energy and Electricity Conservation

Law Establishment	➢ Thermal insulation code for buildings was issued in 2007. Arrangements for its implementation are underway. UNDP is preparing project assistance. ➢ Energy efficiency labels and standards for home appliances law was issued in October 2008. ➢ Energy conservation law was issued in February 2009. NERC is entrusted with coordinating the implementation of measures.
Entities subject to energy conservation law	➢ All energy producers, distributers and consumers of energy ➢ All importers and local manufacturers of equipment for energy generation/use ➢ Associations, institutions and engineering offices operating energy using activities ➢ Public and private educational institutions, scientific research centers, civil associations and religious bodies
EC conservation organization	➢ Central unit (Ministries and other important public organization) ➢ Sub units in facilities and sites designated by central unit
Units responsibilities	➢ Establish data base regarding all energy use ➢ Prepare monthly and annual reports on energy use according to models ➢ Identify opportunities for improved efficiency through energy audits ➢ Implement all actions required by NERC
Building permit for construction	➢ Use of renewable energy (New building: solar water heating) ➢ Thermal insulation of buildings to prescribed standards ➢ Adoption of energy saving lighting system and natural lighting ➢ Optimal design of buildings to improve thermal efficiency
Transportation sector	➢ Development of mass transport means within and outside cities ➢ Improving the energy use efficiency in vehicles ➢ Improving efficiency of bus engines

Role of NERC	➢ Prepare regulations, codes and guidelines ➢ Prepare regulations and codes for public and private buildings ➢ Submit to Council of Ministers

Source: "Master Plan for Energy Efficiency and Renewable Energies Draft Final Report" May 2010 GTZ

8.2 JICA Activities in Energy and Electricity Conservation

According to JICA report November 2006 "Case Example Analysis of Capacity Development in Energy Conservation" energy and electricity conservation activities are follows;

There are two kinds of JICA assistance in energy conservation area: Technical cooperation and group training methods. Technical cooperation aims to establish energy conservation center which conducts training, audit and advertisement until accomplishing self-reliant management. And group training is to invite concerned parties related to energy conservation of each country who study actual energy conservation implementation of Japanese laws and factories.

Table 8.2-1 shows major energy conservation projects by JICA. Similar project was conducted in Saudi Arabia. Projects are under implementation in Indonesia, Vietnam, Sri Land and Philippines.

As explained above, JICA has been implementing law establishment, education of energy managers, improvement of audit technology, provision of information to industrial sector and awareness of consciousness in developing countries. Establishment of energy conservation system, implementation of public services and strategic development of activating energy conservation markets will be targets in next stages.

As Syria is quite aggressive in the energy conservation area, it is worth studying to collaborate with JICA.

Table 8.2-1 Major Energy Conservation Projects

Country	Outline of Project		Project Content	
	Title	Cooperation Period	Project Purpose	Accomplishment
Turkey	Energy Conservation Project	2000/8－2005/7	Capacity development of training, audit, strategy establishment, advertisement	Managing structure establishment of EC activities Managing training equipment and instruments Training of energy managers Energy audit of various industrial factories Information provision, awareness and policy making
Thailand	Training center of energy conservation	2002/4－2005/4	Establishment of education system	Opening of center and establishing implementing structure Establishing national examination system Establishing EC technology course Establishing implementing organization Proposing assisting system
Bulgaria	Energy conservation Center	1995/11－2000/10	Strengthening center function Proposing EC policy Technical guidance of industry	Education of audit expert Consulting of EC audit and factory improvement Study of EC policy structure Advertisement of EC activities
Argentine	EC in industrial sector	1995/7－2000/6	Improvement of CP function EC Training and promotion of industrial sector	CP education to promote EC Education of energy manager in industrial sector EC awareness and dissemination in industrial sector
Poland	EC technology center	2004/7－2008/7	Assisting EC promotion center	Establishment of managing structure Training course of factory Dispatching auditors of EC Assisting efficiency improvement of factory EC information provision to factory
Iran	Energy conservation promoting project	2003/2－2007/3	Industry training by energy conservation center	Establishment of government organization Operation and maintenance of equipment Training of theory and actual work

Source: Reports of each project

8.3 Renewable Energy

8.3.1 Renewable Energy Utilization in Syria

Syria's electricity generation depends on oil and gas more than 90 percent. It is quite aggressive to promote renewable energy utilization. Followings are projects under consideration and implementation of renewable energy.

- Installing a 6MW wind farm as a pilot project, financed by the Spanish government
- Installing a 12.5MW wind farm as an experimental project, financed by investors
- Preparing terms of reference for a 100MW wind farm
- Establishing a National Fund of US$500 million for domestic solar water heating systems. Half of the cost of these systems will be subsidized from government-financed fund
- Negotiation with investors are in progress to implement a 500MW wind farm by 2010
- Preparation of a feasibility study to establish a solar trough and electro cell manufacturing facility with a capacity of 11MW/year. Ukrainian-Syrian joint venture. Start in 2009
- Agreement with a German company to install a 10MW PV power plant
- Cooperation with GTZ on the SOLARTERM project (launched end-2006). Aims to transfer technical expertise in the use of solar energy and to develop strategies and policies to generalize its application
- Implementation of 19 small rural biomass projects and preparation of a large farm waste bio-digester to generate electricity

Table 8.3-1 shows renewable energy utilization plan until 2030.

Table 8.3-1 Renewable Energy Utilization Plan

	Unit	2010	2015	2020	2025	2030
Solar Hot Water System	1,000 unit	480	1,500	3,000	3,500	4,000
Solar Thermal Industrial Process Heat	1,000 unit	75	325	550	800	1,000
Photo Voltaic (Installed Capacity)	MWh	6	70	140	220	300
Wind Power (Installed Capacity)	MW	500	1,000	1,500	2,000	2,500

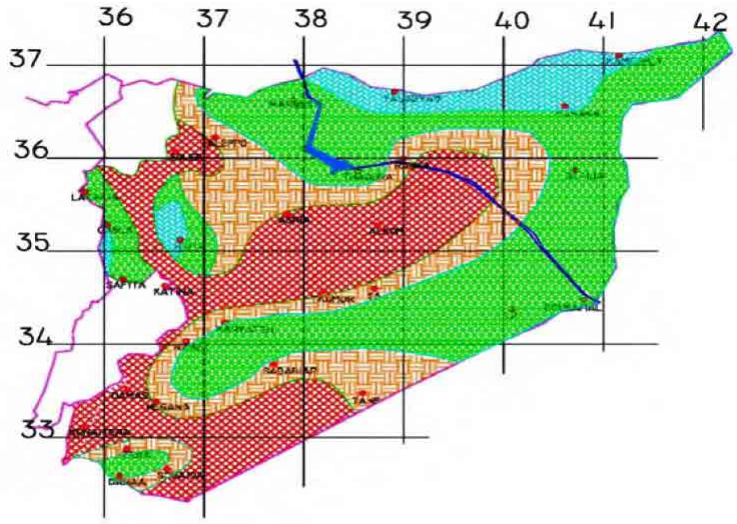
Source: Renewable Energy and Energy Efficiency, Presentation, NERC

And Syria participates in the "Solar Plan for the Mediterranean" subsidized by EU with the plans of two CSP plants (total capacity: 220MW) and PV plant (20MW).

Source: "Identification Mission for the Mediterranean Solar Plan" Final Report, January 2010, European Union

Accordingly, Syria focuses on solar and wind energy utilization among various renewable energies. Figure 8.3-1 shows Syrian wind map. Western and central region has high wind velocity so that wind

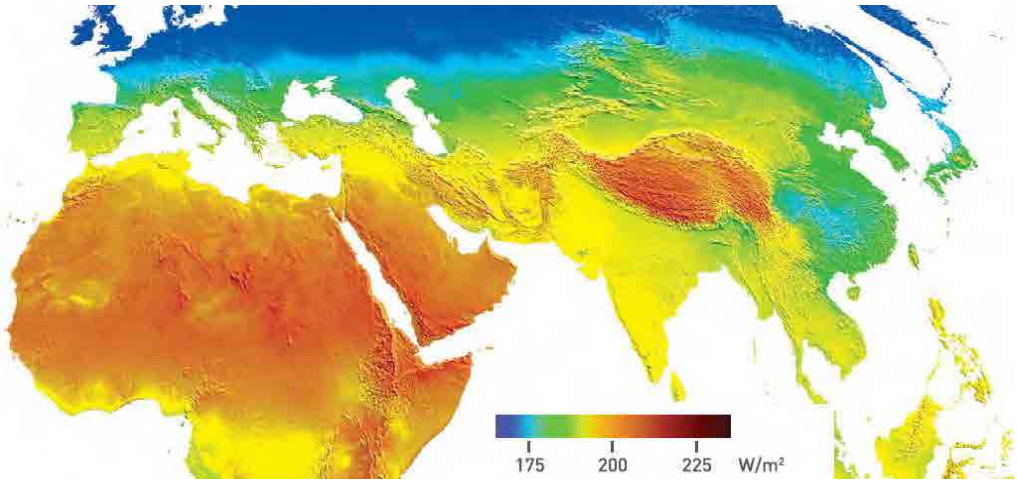
power generation is greatly expected. And as shown in Figure 8.3-2, yearly mean irradiance of Syria is much higher than Japan and European countries so it is a good location for solar energy utilization. About 1.5 times of Japan.



	Unopened Area (City, Forest)	Open Area (Low Trees)	Sea Shore (Low Glass)	Sea Surface (10km in the sea)	Hills	Area
	m/sec					m^2
	5-6	6.5-7.5	7-8.5	8-9	10-11.5	54,000
	4.5-5	5.5-6.5	6-7	7-8	6.5-10	45,000
	3.5-4.5	4.5-5.5	5-6	5.5-7	7-8.5	75,000
	3.5<	4.5<	5<	5.5<	7<	13,000

Source: Syria's Master Plan for Renewable Energy

Figure 8.3-1 Syrian Wind Map



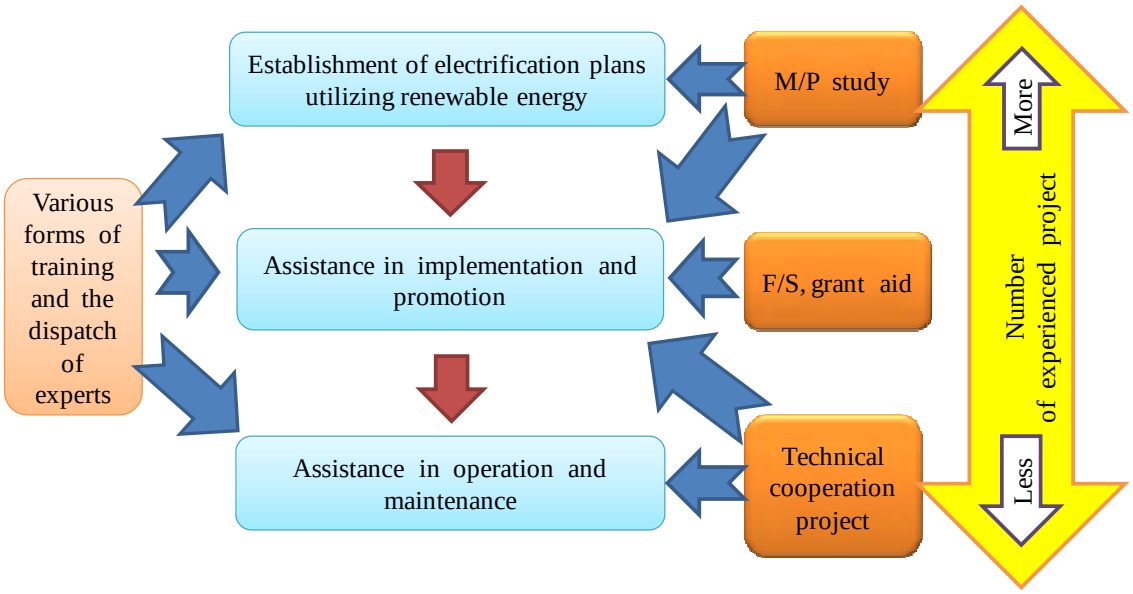
Source: http://www.3tier.com/static/ttcms/us/images/support/maps/3tier_solar_irradiance.pdf

Figure 8.3-2 Yearly Mean Irradiance of Asian, Middle East, Europe and Africa

8.3.2 JICA's Approach to Renewable Energy Utilization

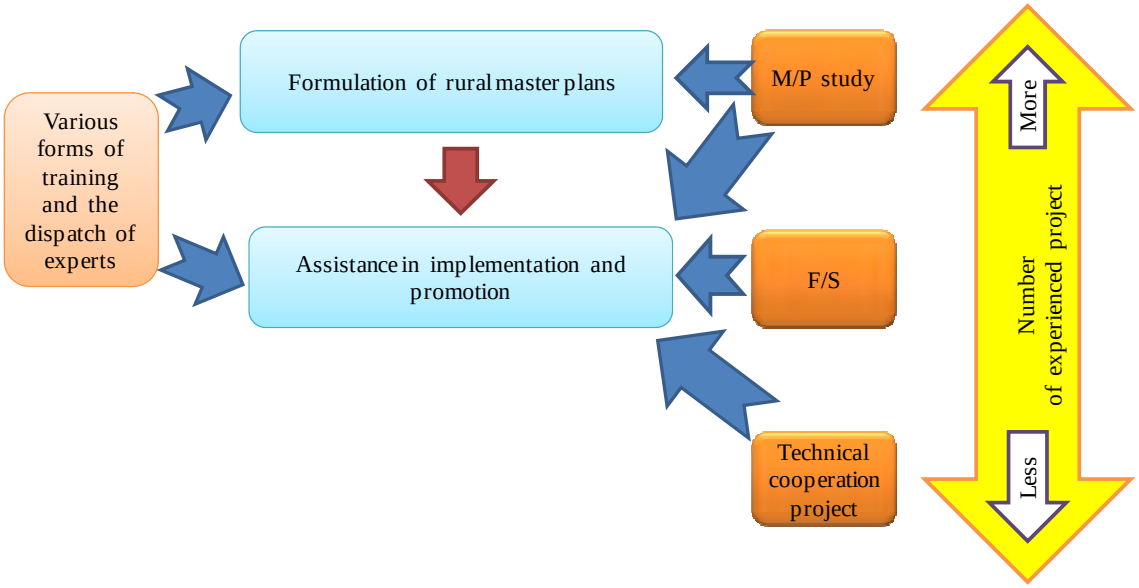
(1) JICA's Development Objectives of Renewable Energy

There are two development objectives for renewable energy utilization in JICA approach. Rural electrification and CDM promotion objectives are shown in Figure 8.3-3 and Figure 8.3-4.



Source: JICA Thematic Guidelines on Renewable Energy, February 2006

Figure 8.3-3 Achievement of rural electrification and promotion of regional development



Source: JICA Thematic Guidelines on Renewable Energy, February 2006

Figure 8.3-4 Reduction of energy risk and promotion of environmental conservation

(2) Photovoltaic

The followings are important issues for PV developments.

- Compatibility with the electrification plan of the target countries
- Examination of the amount of sun eradiation and analysis of location
- Collaboration with Japan Overseas Volunteers, NGOs and NPOs
- Billing system to ensure the sustainability of system
- Human resource development
- Appropriate selection from two methods

  Centralized installation with connection to national grid or mini-grid

  Individual installation such as solar home system (SHS) or battery charging system (BCS)

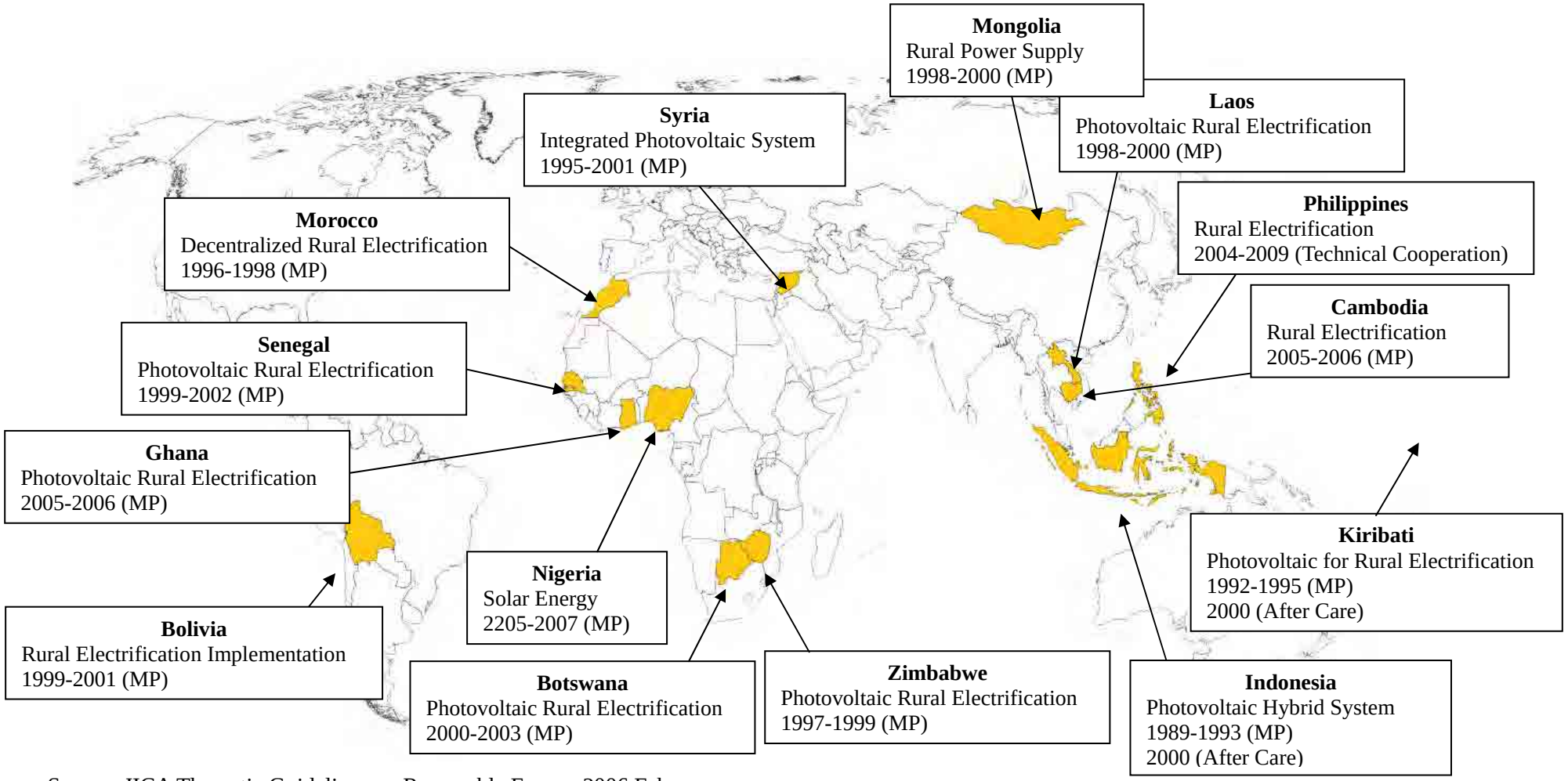
(3) Wind Power Generation

The followings are major steps for wind power generation developments.

- Desk plan: Check for wind conditions and land forms, rough survey of social conditions
- Field surveys: Survey of the geographical conditions and assumption of generator scale
- Detailed check of wind condition
- Basic design: Determination of site and scale, evaluation of the impact on environment and economic efficiency
- Execution design: Precise surveys, geological surveys, equipment design, work design and work management
- Procedures for the related organizations: Law and standards, negotiation on systems with the electric power companies
- Construction work
- Operation and maintenance

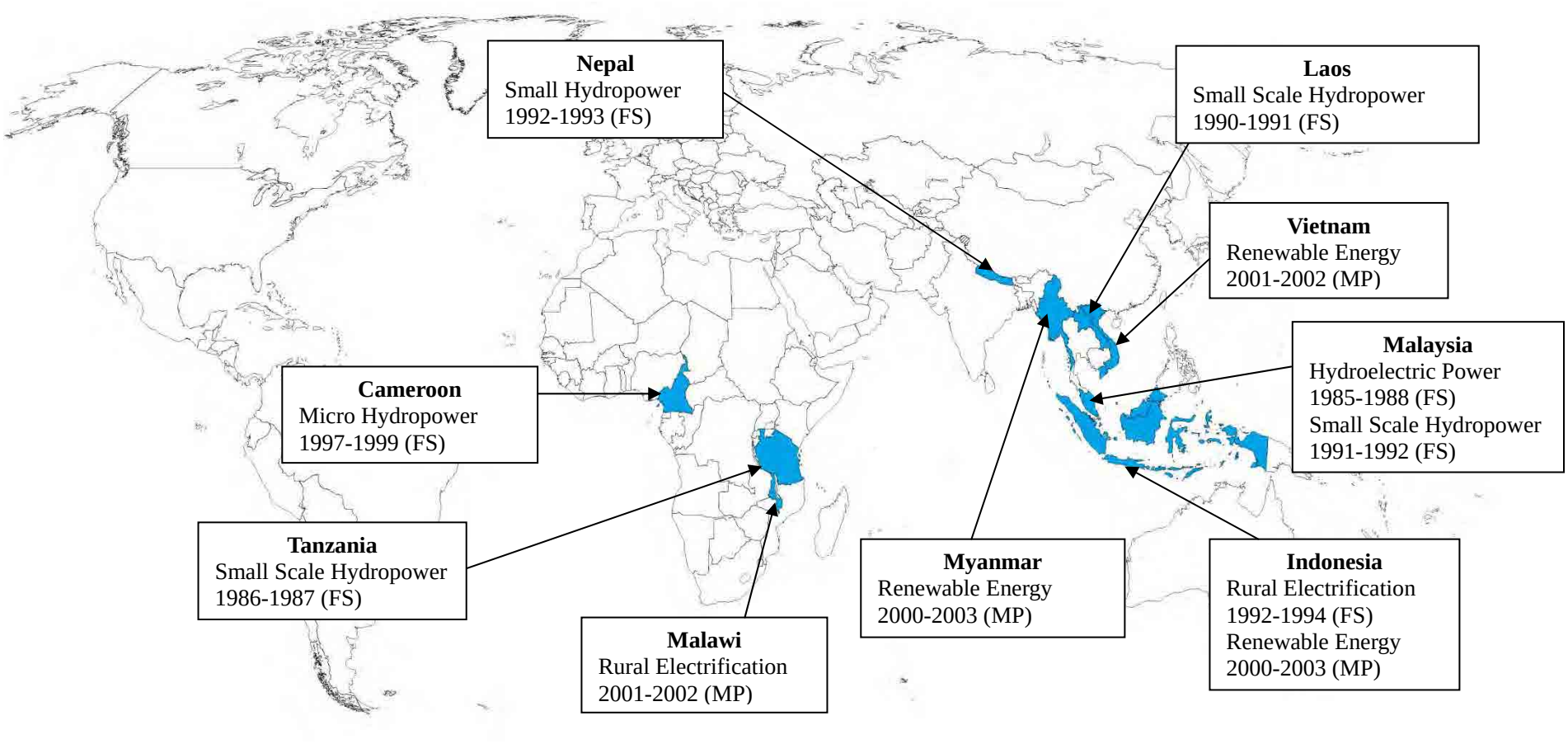
(4) International Collaboration Results in the Area of Renewable Energy by JICA/JBIC

As the reference to proceed collaboration projects with Syria, Figure 8.3-5, Figure 8.3-6 and Figure 8.3-7 shows JICA international accomplishment of PV, micro-hydro and geothermal projects. And Table 8.2-2 shows training projects list regarding to renewable energy.



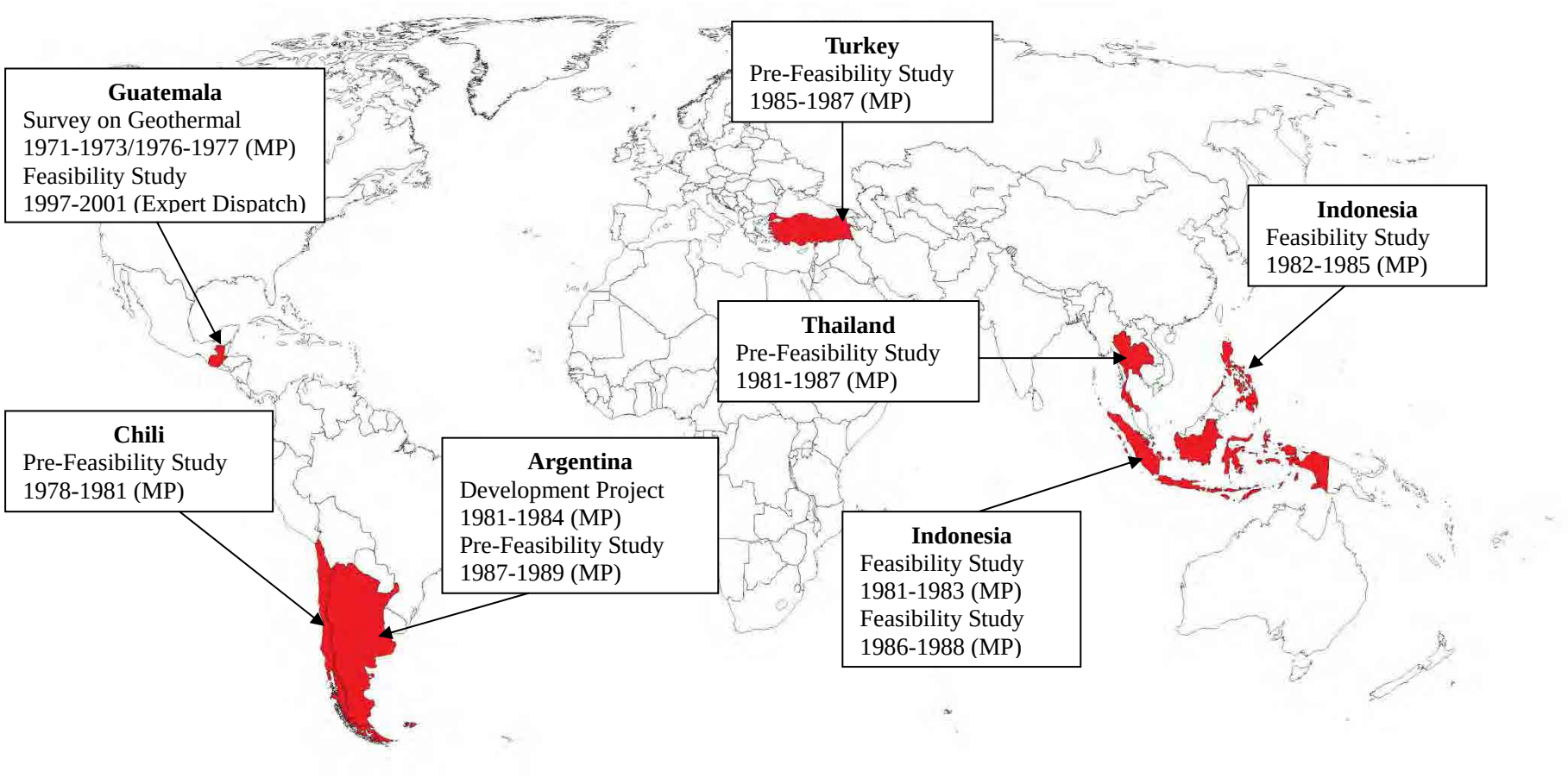
Source: JICA Thematic Guidelines on Renewable Energy 2006 February

Figure 8.3-5 Solar Power Projects by JICA



Source: JICA Thematic Guidelines on Renewable Energy 2006 February

Figure 8.3-6 Hydropower Projects by JICA



Source: JICA Thematic Guidelines on Renewable Energy 2006 February

Figure 8.3-7 Geothermal Projects by JICA

Table 8.3-2 Training Project by JICA

No	Country	Project	Period	Outline
1	Special Offer	Solar Power Generation & ITS Application System (Oceania)	1996-2000	Generalized knowledge on the principles and practice of photovoltaic power generation. Techniques of storing and generating electric power and converting it to motive energy Training required to study and determines the feasibility and adequacy of the introduction of photovoltaic power generation.
2	Special Offer	Small Scale Hydropower Engineering	1999-2003	Accomplishment of planning methods related to the construction of a micro-hydropower plant, and methods for developing participatory operation and maintenance systems and organization of the residents
3	Focusing Country	Solar Power Generation and Application Technology (Oceania)	2001-2005	To offer basic knowledge on photovoltaic power generation that is essential for the development of electric power resources aimed at the effective utilization of solar power, and provide opportunities for generalized training in practical technologies for engineers in developing countries.
4	Group	Small-Scale Hydro Power and Clean Energy Power Engineering	2004-2008	To gain a better comprehension of clean energy with the operation and maintenance of micro-hydropower plants and reductions in CO2 emissions, in which Japan excels; and to improve the technical level
5	Group	Tropical Biomass Utilization	2005-2009	To introduce multistage utilization technology, such as the utilization of renewable biomass and the utilization of other forms of energy, to working-level people who carry out technical research on agriculture and forestry in tropical and subtropical regions, and develop human resources to form the core of the creation of an environment-friendly society

Source: JICA Thematic Guidelines on Renewable Energy 2006 February

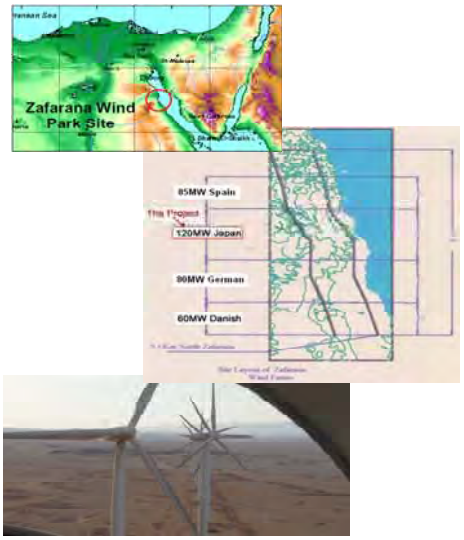
Wind and solar projects in the same region by JICA and JBIC are shown in the followings for reference.

- Egypt: Zafarana Wind Power Project

The outline of project is shown in Table 8.3-6. It consists of construction of 120MW wind power station and additional transformer for system linkage.

Table 8.3- 3 Outline of Zafarana Wind Power Station

Project Name		Wind Power Station
Countries		Egypt
Location		Zafarana (220km Southeast of Cairo)
Schedule		2003/12～2007/2
Project Expense (Million Yen)	Total	18,466 M. Yen
	Yen Loan	13,497 M. Yen
Target	Operating Rate	97%
	Maximum Output	120MW
	Electricity Supply at Transmitting End	415GWh/Year
	CO_2 Reduction	270,000tCO_2/Year
Economics	EIRR	16.90%
	FIRR	1.22%
Project Life		20 Years



Source: JICA/JBIC website

➢ Egypt: Kuraymat Solar Thermal Power Plant

Total power is 150MW including 80MW gas turbine and 70MW steam turbine. This 70MW is consisting of 40MW waste heat recovery from gas turbine and 30MW solar energy recovery. JBIC subsidizes power generation facilities of gas turbine, steam turbine, solar energy recovery and waste heat recovery boiler.

Table 8.3-4 Outline of Kuraymat Solar Thermal Power Plant

Project Name		Solar/Gas Power Station
Countries		Egypt
Location		Kuraymat (110km South of Cairo)
Schedule		2005/9～2011/6
Project Expense (Million Yen)	Total	21,383 M. Yen
	Yen Loan	10,665 M. Yen
Target	Operating Rate	91%
	Maximum Output	150MW
	Electricity Supply at Transmitting End	873GWh/Year
	CO_2 Reduction	180,000tCO_2/Year
Economics	EIRR	19.1%
	FIRR	3.4%
Project Life		25 Years

Source: JICA/JBIC website

(5) Basic Checking Items of Planning and Implementation

Table 8.2-5 shows basic check items of project planning and implementation.

Table 8.3-5 Basic Check Items

Major Items	Medium Items	Minor Items	Remark
General Conditions	General Information	Population	➢ Total number, number of households, number of communities ➢ Future perspectives
		Basic Indices	➢ GDP, HDI, GDI, Cash income sources, Income distribution, average income
		Industrial Structure	➢ Primary industry, Secondary industry, Tertiary industry
		Rural communities	➢ Village locations, housing density, means of access ➢ Self-governing organizations in the villages ➢ Life and customs (daily and annual life patterns, gender roles)
	Electrification Rate		➢ Village electrification rate ➢ Housing electrification rate
	Renewable Energy Potential	Solar power	➢ Landscape, amount of solar radiation ➢ Promotion rate of batteries ➢ Developable potential
		Wind power	➢ Wind conditions ➢ Developable potential
Policy & Systems	National Plan & System	National Development Plan (Poverty Reduction Strategy)	➢ Social and economic development targets ➢ Need for electrification ➢ Positioning of renewable forms of energy ➢ Environmental countermeasures (including CDM)
	Energy Policy	Energy development and utilization plans	➢ Petroleum and natural gas, Coal, Hydropower, Nuclear power, Renewable forms of energy ➢ Energy conservation
	Electric Power Policy	Comprehensive electric power development	➢ Prospects for the demand and supply of electric power (plan) ➢ Innovation and privatization of electric power structures

		Related systems, laws and regulations	➢ Electric power law (rural electrification law) ➢ Financial resources for electrification, funds, subsidies ➢ Promotional organizations and systems (governments, quasi-governments, research institutions, etc.)
	Electrification policies and systems	Electrification Policies	➢ Targets of electrification ➢ Rural electrification policies ➢ Renewable energy promotion policies
		Electrification plans	➢ Rural electrification plans ➢ Compatibility of on-off grids ➢ Renewable energy development plans
Policy & Systems	Electrification policies and systems	Electrification systems	➢ Government (ministries, agencies), governmental organizations ➢ Electric power suppliers (electric power corporations and companies, electrification associations, etc.) Other private companies ➢ Others (research institutions, universities, educational organizations, NGOs, etc.)
		Utilization of renewable forms of energy	➢ Development objectives ➢ Promotional organizations and systems (governments, quasi-governments, research institutions, etc.) ➢ Preferential treatment for development
	Environmental policies and systems	Regulations and laws	➢ Environmental standards (air, water, etc.) ➢ Development restrictions (type, scale, etc.) ➢ Environmental impact assessment procedures
Record of Introduction	Trend among assistance agency	General	➢ Major fields of assistance ➢ Record in the relevant countries
	Trend in entire projects	Progress of plans	➢ Consistency with national plan, effectiveness ➢ Impediments (political, financial)
		General	➢ Development and introduction quantities (solar power, wind power) ➢ Project-based and program-based overview ● Objectives (social development,

			economic development) ● Data (locations, on-off grids, output, etc.) ● Program implementation entity
		Support systems (organizational systems)	➢ Assistance agencies (government, municipalities, NGOs, research institutions, etc. ➢ Relationship to national policies ➢ Financing (resources, funds, funding systems) ➢ Operation and maintenance systems ➢ Charge setting, charge collecting rate
		Technologies	➢ Simplification (standardization, local equipment and machinery) ➢ New technologies
		Impediments to sustainability	➢ Policies, systems, support systems ➢ Operation and maintenance ➢ Charge setting (economic efficiency)
		Utilization of CDM	➢ Adoption performance ➢ Relationship to rural electrification
	Special items based on the power source	Solar power	➢ Battery recovery routes ➢ Limited electric power supply ➢ Procurement routes for photovoltaic power generation systems ➢ Burden of initial costs
		Wind power	➢ Economic efficiency of decentralized small-scale wind power generation ➢ Hybrid with photovoltaic power generation

Source: JICA The Thematic Guidelines on Renewable Energy 2006 February

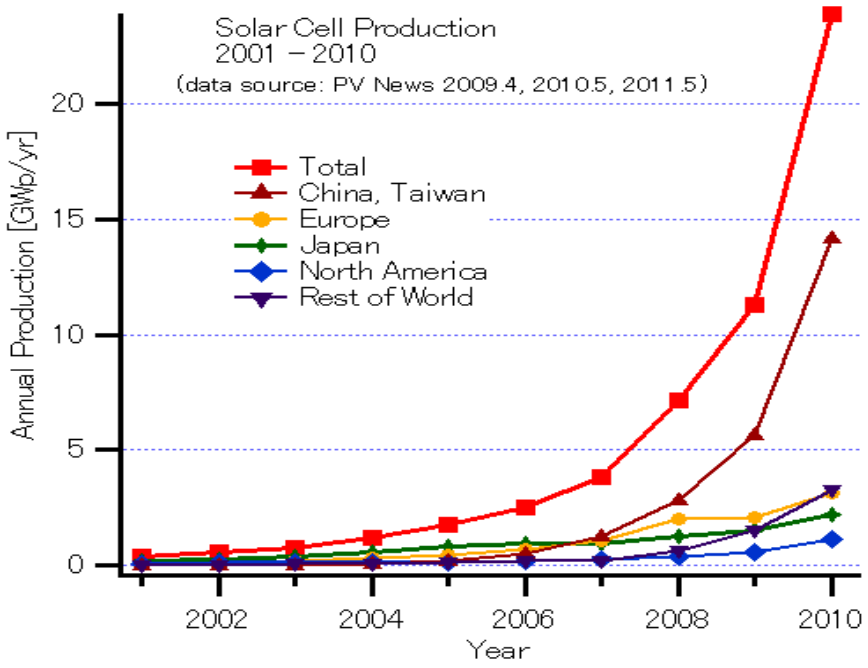
8.3.3 Performance of Japan in the Area of Wind Power and PV Power Generation

As shown in Table 8.3-6 (world installed wind power capacity) and Figure 8.3-8 (solar cell production trend), Japanese performance of wind and PV power generation is at the world top level. It is greatly expected to apply these results in the area of international cooperation.

Table 8.3-6 Worldwide Installed Wind Power Capacity for 2009

IEA Wind Members				Rest of World			
Country	MW	Country	MW	Country	MW	Country	MW
United States	35,086	Australia	1,712	China	25,104	Costa Rica	123
Germany	25,777	Sweden	1,448	India	10,926	Iran	91
Spain	19,149	Ireland	1,264	France	4,492	Tunisia	54
Italy	4,850	Greece	1,109	Turkey	801	Nicaragua	40
United Kingdom	4,051	Austria	995	Poland	725	Caribbean	35
Portugal	3,616	Norway	431	Brazil	606	Philippines	33
Denmark	3,480	Mexico	415	Belgium	563	Argentina	31
Canada	3,319	Korea	392	New Zealand	497	Jamaica	23
Netherlands	2,216	Finland	147	Taiwan	436	Colombia	20
Japan	2,056	Switzerland	18	Egypt	430	Uruguay	20
		Total	111,531	Morocco	253	Others	1,675
Grand Total	158,677			Chile	168	Total	47,146

Source: IEA Wind Energy Annual Report 2009



Source: PV News 2009.4, 2010.5, 2011.5

Figure 8.3-8 Solar Cell Production Trend

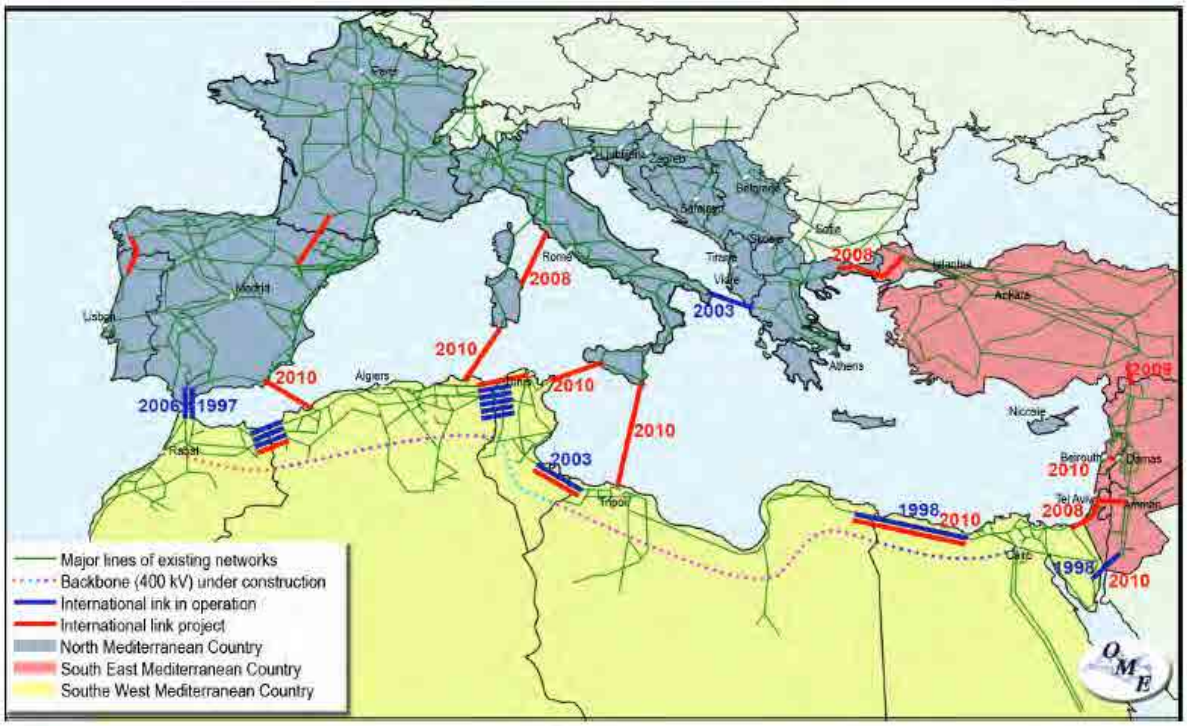
8.3.4 Renewable Energy Projects in Syria

As explained in 8.3.1, Syria has abundant renewable energy resources such as wind and solar. And NERC plays a central role in planning of renewable energy utilization. However as explained in Chapter 6, the Syrian tariff is considerably cheap. It doesn't seem not feasible to generate electricity from renewable energy, compared to fossil energy.

Under such circumstances, it is quite appraisable for NERC to study the utilization of

abundant renewable energy step by step. Especially the utilization of solar energy for heating use is quite reasonable strategy compared to electricity generation.

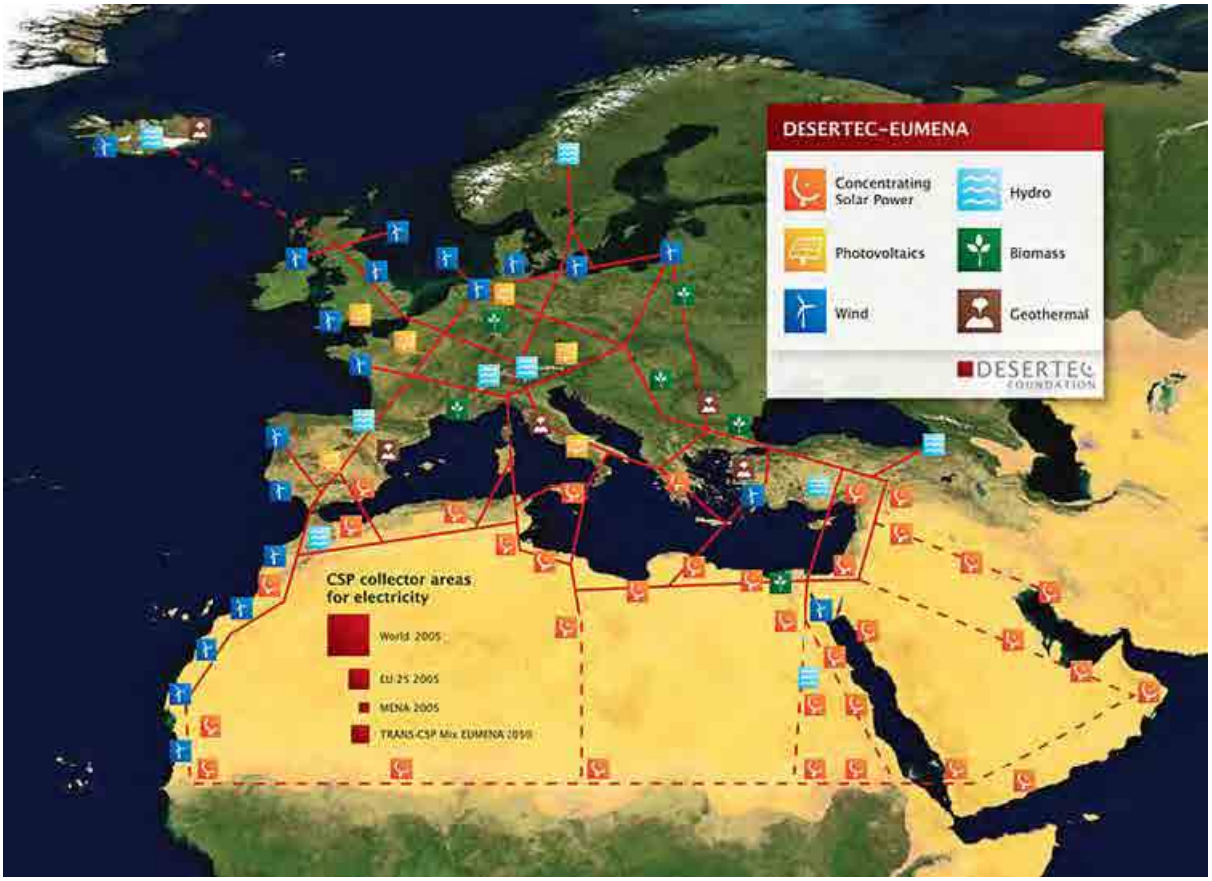
As Japan has conducted various international collaboration in the area of technical cooperation, yen loan and education/training by JICA, NEDO and JBIC, it is worth studying cooperation with Syria. Syria locates in geo-strategy central location surrounded by Turkey, Jordan and Egypt. The cooperation with Syria is quite important to Japan.



Source: Identification Mission for the Mediterranean Solar Plan

Figure 8.3-9 Current and Future International Grid between Europe and Middle East

In the area of solar energy utilization, European countries plan DESERTEC (initiated by Germany). CSP power plant started in Morocco. It is big project to connect North Africa, Middle East and Europe. When studying solar energy utilization in Syria, harmonization with DESERTEC is required.



Source: Desertec website

Figure 8.3-10 DESERTEC Plan

Chapter 9 Confirmation of the EIA System and Approval Process

9.1 Confirmation of the EIA System and Approval Process

9.1.1 Environmental Policy in Syria

In 2003, "the Strategy & National Environmental Action Plan for Syrian Arab Republic" (hereafter called "the 2003 Environmental Strategy") was formulated as an environmental policy under the support of the World Bank and United Nations Development Programme (UNDP). In the 2003 Environmental Strategy, the current situation in Syria is analyzed with respect to water resources, soil, air, biodiversity, waste, urban environment, cultural heritage and global environment, and the priority issues are extracted from analysis of current situation. Then the short- and medium-term action plan up to 2015 is shown. Although the year 2015 is the target year for the 2003 Environmental Strategy, according to an officer of the Ministry of State for Environmental Affairs (MSEA) in charge, this is not refereed as an environmental strategy anymore at present. When the tenth five-year plan (2006-2010) was formulated, the 2003 Environmental Strategy was revised and incorporated into the tenth five-year plan. If the eleventh five-year plan (2011-2015) currently in the process of being approved by the President has been mapped out, this five-year plan will be adopted as a new environmental policy for Syria, according to this officer.

(1) Tenth Five-Year Plan

The tenth five-year plan basically focuses on the social and economic reform. This five-year plan stresses "adoption of development outlook that is keen on implementing sound environment management and preserving natural resources[1]" and promotion of clean and renewable energy. Moreover, it summarizes challenges face by the Syrian environment as follows[2]:

① Poor sector coordination, and failure to consider the environment an essential approach for formulating the development plans;

② Poor public awareness as regards the environment, and absence of deterrent controls for environment protection;

③ Lack of comprehensive environment surveys and lack of databases; and

④ Lack of clear-cut sectoral policies aimed at reducing the environmental impact of past

[1] Highlights on the Syrian Economy and the tenth 5YP Strategy (Syrian Arab Republic Prime Minister Office Planning and International Cooperation Commission webpage: http://www.planning.gov.sy/SD08/msf/1292968335_Syrian_Economy.pdf, as of August 4, 2011

[2] Delegation of the European Commission to Syria, Country Environmental Profile for the Syrian Arab Republic, April 2009, P.41

planning practices, which led to evident environmental damages.

(2) Eleventh Five-Year Plan

During the Study, the eleventh five-year plan has not been approved by the President. So the Study Team could not get the draft plan. It must be necessary to confirm the latest environment policy at the time of planning stage of the specific project since more specific environment policy such as the Strategic Environmental Assessment (SEA) will be adopted in the eleventh five-year plan. It was confirmed that the master plan which would be prepared before June 2012 would not be affected by SEA[3].

9.1.2 Legal System on Environmental and Social Impact

In Syria, after the minister of state for environment affairs was appointed in the Office of the Prime Minister, MSEA was established as the first among Arab countries in 1987. In 2002, the "Environmental Protection Law (Law No.50, 2002)" was formulated. This is now a basic framework law on environment in this country. In January 2004, the Directorate for Environmental Affairs (DFEA) was set up for all governorates. As of January 2011, DFEAs are active in all of the fourteen governorates, and are staffed with appropriate members.

(1) Environmental Protection Law (Law No.50, 2002)

The Environmental Protection Law (Law No.50) was promulgated on July 8, 2002. This law consists of eight chapters and 37 articles, and defines the organization system for environmental protection, objective, scope of authorities, and inspection by the experts specialized in environmental affairs having inspection rights. Moreover penal regulations for when violation of the law has been detected by these inspections were introduced. However, this law does not define the specific emission standards, environmental monitoring system, or environmental impact assessment system. Study of the detailed rules for enforcement is included in the scope of authority of MSEA. This law triggered the study of the specific standards, detailed rules for enforcement and environmental impact assessment system.

As of January 2011, this law is in the process of being revised.

(2) Related Laws and Environmental Standards

There are a number of environmental standards and environment-related laws and

[3] Interview with the MSEA officer during the second site survey on January 2011

regulations[4]. Of these, the standards, laws and regulations related to power sector development are given below:

① Maximum emission limits of air pollution parameters
② Maximum limits of pollution parameters for discharge in the water environment
③ Industrial operation that produce hazardous solid wastes
④ Classification of hazardous solid industrial wastes according to the concentration of the hazardous components in these wastes
⑤ Protected area in Syria

The following describes the specific standards for each of them:

1) Maximum Emission Limits of Air Pollution Parameters

In Syria, emission standards are provided for 21 types of air pollutants. The following Table summarizes the substances to be studied in EIA, which may be emitted from power plants:

Table 9.1-1 Maximum emission limits of air pollution parameters related to power sector

Pollutants	Unit	Maximum limits
CO	mg/m^3	250-500
NO_X	mg/m^3	300-3000
SO_2	mg/m^3	1000-3000
TSP	mg/m^3	50-200

(Source)Extracted from the maximum emission limits of air pollution parameters
(Note)TSP: Total Suspended Particulate

2) Maximum Limits of Pollution Parameters for Discharge in the Water Environment

Emission standards are set for 39 types of pollutants in the water environment. The following table shows the pollutants in the power sector (power plant construction and extension) to be studied in EIA.

[4] As references, major environment-related laws, titles of environment standards, name of related laws and those established years are listed on Appendix 1.

Table 9.1-2 Maximum emission limits of air pollution parameters in power sector

Parameters	Unit	Types of recipients (recipient water environment)			
		Ocean	Land	River	Agricultural drainage canal
pH	–	6-9	6-9	6-9	6-9
TSS	mg/l	60	30	30	60
Oil and grease	mg/l	15	10	10	10
Residual chlorine	mg/l	-	1	1	-
Chromium (Cr)	mg/l	0.5	0.5	0.5	0.5
Copper (Cu)	mg/l	1.5	1	1	1
Iron (Fe)	mg/l	2	1	2	2
Zinc (Zn)	mg/l	2	1	2	2
Temperature increase at the edge of the mixing zone	℃	Average water temperature <10	Average water temperature <5	Average water temperature <5	Average water temperature <5

(Source)The maximum limits of pollution parameters for discharge in the water environment
(Note)TSS: Total Suspended Solids

3) Industrial Operation that Produce Hazardous Solid Wastes

According to the classification of the industries that produce hazardous solid wastes and industrial hazardous solid wastes, the construction and operation of power plants and accompanying facilities do not fall under the category of the industrial operations that produce hazardous solid wastes.

4) Classification of Hazardous Solid Industrial Wastes according to the Concentration of the Hazardous Components in these Wastes

Article 26 of the Environmental Protection Law requires determining the noise sources and the upper limit for all noise sources in order to avoid or to reduce to the minimum. However, no specific standard has been set yet. In "Noise-- The permissible limits of sound intensity and duration of safe exposure to it", the noise survey report (conforming to ISO37442[5] and ISO8297[6]) for the Nasiriyah power plant extension project is attached as a document showing a case study. In the Deir Ali combined cycle power plant construction EIA report, the standards of the World Bank are adopted (See "7)" for the details of the noise standards of the World Bank.

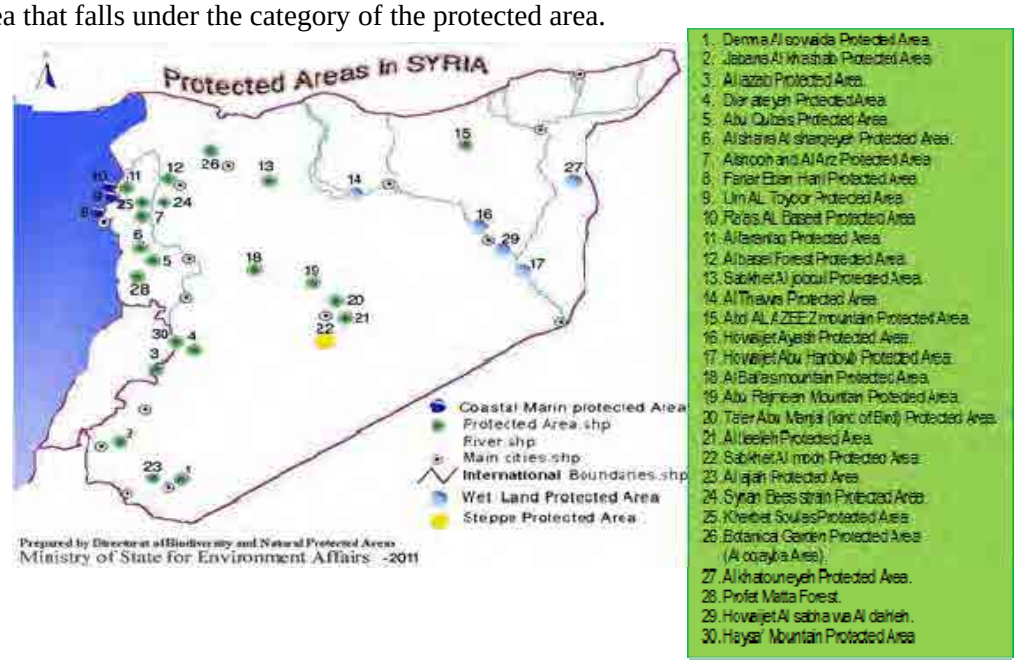
5) Protected Areas in Syria

In Syria, there is no law but there is only a “Decision” on the protected areas at present.

[5] ISO 3744: Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane, 1994-05-01
[6] ISO 8297: Acoustics – Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment – Engineering method, 1994

Legal preparations are currently under way in the Global Environmental Facility (GEF) project. This law was supposed to be approved before the end of 2011[7]. When a specific project will be formulated in future, it will be necessary to pay attention to this law.

At present, MSEA designates 31 protected areas and 68 quasi-protected areas (grazing for sheep[8] and areas for wildlife in general). The protected areas and quasi-protected area are managed under the jurisdiction of different ministries concerned. The forest in protected area is managed by the Ministry of Agriculture and Agrarian Reform (MAAR), whereas the oceans and coasts are managed by the Ports and Harbors Bureau of the Ministry of Transportation. The wetlands are placed under the jurisdiction of the Ministry of Irrigation. In this way, the protected areas are managed by wide-ranging authorities concerned. In the meantime, the quasi-protected areas are placed under the jurisdiction of the General Commission of Development. Fig. 9.1-1 shows the protected area designated by the MSEA, as of January 2011. A map illustrating the protected area in two-dimensions is not yet created. When a concrete project is to be formulated, it is necessary to verify a specific area that falls under the category of the protected area.



(Source)MSEA

Fig. 9.1-1 Environmental Protected Areas in Syria

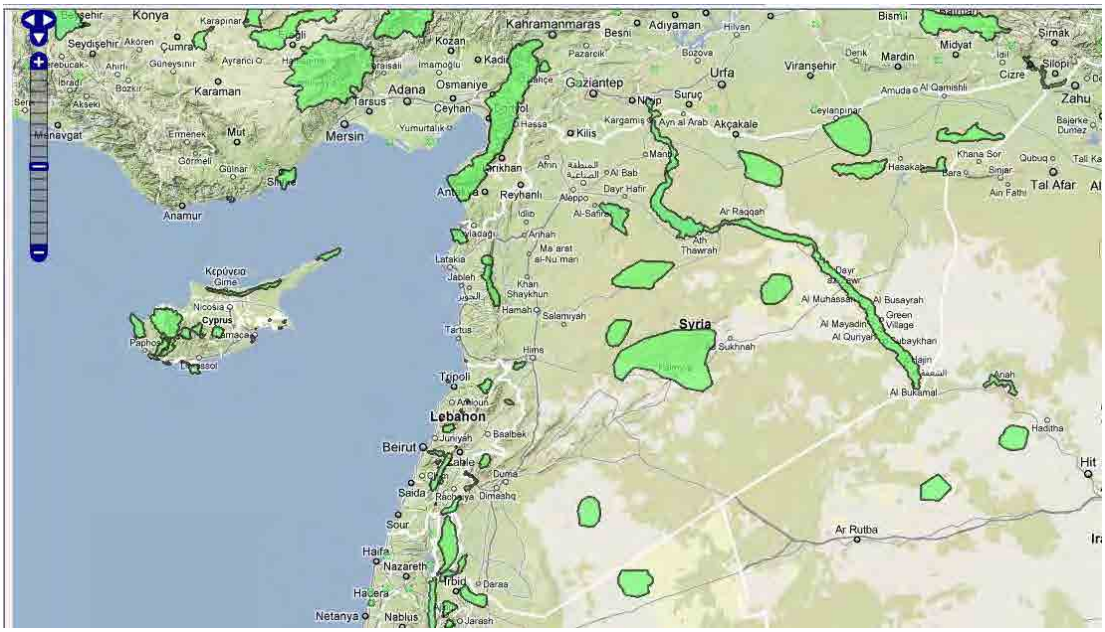
Further, Syria provides stopover sites for the migratory birds coming to Europe or Asia from Africa. Therefore, it is necessary to pay attention to routes of the migratory birds in

[7] Interview with a MSEA officer in charge
[8] The grazing area accounts for 55% of the whole land in Syria.

planning of wind-power generation. In the mid-1990s, the Birdlife International conducted a survey on bird protection and designated 22 Important Bird Areas (IBAs) (Fig. 9.1-2)[9]. This survey data, however, is outdated, and should be updated. Even so, this survey includes not only outline data and challenges and problems on each IBA but also conservation infrastructure and protected-area system in Syria. According to "Important Bird Areas in the Middle East"[10], Syria has no area-based environmental laws or protected-area system dedicated explicitly towards conserving biodiversity. However, there is a system of protected rangelands (Enclosed Rangeland Reserves) and forests (State Forest Protection Zones).

Enclosed Rangeland Reserves are administered by the Directorate of Rangeland and Countryside of MAAR, with the aim of developing vegetation cover in order to ameliorate and prevent land degradation in arid and desert areas, by controlling grazing intensity of livestock and by a forestation schemes. As of 1994, two sites covering 42,000 hectares were designated and a third site of 40,000 hectares had been proposed.

State Forest Protection Zones are administered by the Directorate of Forests and Afforestation of MAAR. This survey said that the total number of sites was not known to BirdLife International.



(Source)Bird Life International website
http://www.birdlife.org/datazone/geomap.php?r=i&c=204 (as of 2011/07/07)

Fig. 9.1-2 Important Bird Areas (IBAs) in Syria

[9] Please refer to Appendix 2, the list including area data of each IBA.
[10] Important bird areas in the Middle East、pp. 314-315

6) Other Considerations: Legal System of Land Expropriation and Compensation System

In addition to consideration of above 1) to 5), the legal system of land expropriation and involuntary resettlement including compensation system must be confirmed.

Article 14 in Syrian Constitution of 1973[11] stipulates three kinds of ownerships, i.e. public ownership, collective ownership and individual ownership[12]. Regarding to the individual ownership, Article 15 stipulates as follows:

Article 15 [Expropriation][13]

(1) Individual ownership may not be expropriated except for public interest and in return for just compensation in accordance with the law.

(2) The public seizure of funds is permissible.

(3) Private seizure cannot be effected except through a judicial decision.

(4) Private seizure ordered by law is permissible in return for just compensation.

For the system related to the land acquisition and involuntary resettlement, land expropriation is placed under the jurisdiction of the Ministry of Local Administration, while involuntary resettlement is placed under the jurisdiction of the Ministry of Housing.

7) Adoption of Various Standards in EIA Reports

As described above, there are drainage and emission standards in Syria. However, the donors' standards are used in some of the projects supported by the international agencies. The following discusses the case of the Deir Ali combined cycle power plant extension project:

This is a turn-key project for extending a 700 MW combined cycle power plant with the financial aid of the European Investment Bank (EIB) and Arab Fund for Economic and Social Development. According to the EIA Report on this project, the Syrian environmental standards are considered as not constituting a major factor, although they do exist, and the environmental standards of the World Bank and EU are adopted.

It should be noted that the Syrian environmental standards are preferably adopted according

[11] The media reports that Syrian President Bashar Assad requires forming a "National Committee" to draft a constitutional amendment within four months (Sankei News: http://sankei.jp.msn.com/world/news/111016/mds11101600400001-n1.htm as of Oct. 16, 2011). In the case of amendment, revised articles and executive laws related to land expropriation and involuntary resettlement must be confirmed.

[12] Article 14 [Ownership] of 1973 Constitution: The law regulates ownership, which is of three kinds: (1) Public ownership includes natural resources, public utilities, and nationalized installations and establishments, as well as installations and establishments set up by the state. (2) Collective ownership includes the property belonging to popular and professional organizations and to production units, cooperatives, and other social establishments. (3) Individual ownership includes property belonging to individuals.

[13] http://www.servat.unibe.ch/icl/sy00000_.html (English translation of the Constitution)

to MSEA and its EIA procedures. However, if the environmental standards of the international agencies or donors are more appropriate, other environmental standards can be adopted.

The following table illustrates comparison of the major environmental standards of Syria and donors adopted in the Deir Ali combined cycle power plant extension project:

Table 9.1-3 Comparison of environmental standards

	Unit	Syrian environmental standards	EC guideline	World Bank guideline
Emission				
NO2	mg/Nm3 t/day	300 -	120 -	125(gas)/165(oil) -
SO2	mg/Nm3 t/day	1000 -	- -	2000 120(for 700MW)
TSP	mg/Nm3	50	-	50
CO	mg/Nm3	250	-	-
Ambient Air Quality				
NO2 - Average: 1h - Average: 24h - Annual average	 mg/Nm3 mg/Nm3 mg/Nm3	 0.4 0.15 —	 0.2 — 0.03	 — 0.15 0.10
SO2 - Average: 1h - Average: 24h - Annual average	 mg/Nm3 mg/Nm3 mg/Nm3	 — 0.125 0.05	 0.35 0.125 0.02	 — 0.15 0.08
TSP - Average: 1h - Average: 24h - Annual average	 mg/Nm3 mg/Nm3 mg/Nm3	 — 0.12 —	 — — —	 — 0.23 0.08
PM10 - Average: 1h - Average: 24h - Annual average	 mg/Nm3 mg/Nm3 mg/Nm3	 — 0.12 —	 — 0.05 0.02	 — 0.15 0.05
Wastewater Discharge				
Rise of water temperature	°C	No standards	No standards	≤3
pH	—	No standards	No standards	6-9
TSS	mg/l	No standards	No standards	50
Oil	mg/l	No standards	No standards	10
Residual chlorine	mg/l	No standards	No standards	0.2
Noise (industrial area)				
In the daytime (7:00 - 22:00)	dB(A)	No standards	No standards	70
In the nighttime (22:00 - 7:00)	dB(A)	No standards	No standards	70
Noise (residential area)				
In the daytime (7:00 - 22:00)	dB(A)	No standards	No standards	55
In the nighttime (22:00 - 7:00)	dB(A)	No standards	No standards	45

(Source) PEEGT Syria, Extension of Deir Ali CCPP, EIA Report- Section A, p.6

9.1.3 Procedures for Environmental Impact Assessment

The EIA procedures are defined in the Environmental Impact Assessment Executive Procedures in the Syrian Arab Republic (hereafter called "EIA procedures"). The General Commission for Environmental Affairs (GCEA) in MSEA and DFEAs established in each province are responsible for execution of the procedures.

The EIA procedures define the assessment procedures on environmental impact formulated by embodying Article 4 of the environmental protection law (Law No.50) in 2002. At present, when a power plant is to be constructed or extended, the developer is required to submit the EIA Report conforming to the EIA procedures, to both the GCEA of MSEA and the DFEA of the province where the project site is located to get their approval.

The following describes the specific procedures:

(1) Project requiring EIA

Article 3 of the EIA procedures stipulates that the EIA procedures apply to the projects listed in Annex 1. It is stipulated that MSEA shall be empowered, based on the advice of GCEA, ① to include in Annex 1 projects which in view of their type, scale or location may have significant impacts on the environment, and ② to exclude those projects which, do not give reason to fear any significant impacts on the environment and the projects mentioned in Annex 1 shall be evaluated every two years or when needed. At present, this list remains unchanged from the date of creation.

The projects requiring EIA, regarding power sector, are as following table:

Table 9.1-4 List of Projects requiring EIA

No.	Project	Need of EIA	Need of screening
1.	**Heat generation, mining and energy**		
1.1	**Construction and operation of an installation for generating electricity, steam, hot water, process heat or heated flue gas by using fuels in a combustion system (such as power plant, CHP plant, heating plant, gas turbine, combustion engine system, other firing system) including the associated steam boiler, having a firing rate of**		
1.1.1	more than 200 MW	Required	
1.1.2	50 MW to 200 MW		G
1.1.3	20 MW to less than 50 MW when using light heating oil, methanol, ethanol, untreated vegetable oils or vegetable oil methyl esters, untreated natural gas, liquefied gas, gases from public gas supplies or hydrogen, excluding combustion engine systems for drilling equipment and emergency power systems		S
1.1.4	10 MW to less than 50 MW when using gaseous fuels (especially coke furnace gas, mine gas, steel gas, refinery gas, synthesis gas, petroleum gas from tertiary petroleum production, sewage gas, biogas), excluding the gases listed in no. 1.1.3, excluding combustion engine systems for drilling equipment and emergency power systems		S

No.	Project	Need of EIA	Need of screening
1.1.5	1 MW to less than 50 MW when using coal, coke including petroleum coke, coal briquettes, turf briquettes, fuel turf, untreated wood, emulsified natural bitumen, heating oils excluding light heating oil, excluding combustion engine systems for drilling equipment and emergency power systems		S
1.1.6	1 MW to less than 50 MW when using solid or liquid fuels other than those listed in numbers 1.1.3 to 1.1.5		G
1.1.7	100 kW to less than 1 MW when using solid or liquid fuels other than those listed in numbers 1.1.3 to 1.1.5		S
1.2	**Construction and operation of a combustion engine system for driving machinery, having a firing rate of**		
1.2.1	more than 200 MW	Required	
1.2.2	50 MW to 200 MW when using light heating oil, diesel fuel, methanol, ethanol, untreated vegetable oils, vegetable oil methyl esters or gaseous fuels (especially coke furnace gas, mine gas, steel gas, refinery gas, sewage gas, biogas, untreated natural gas, liquefied gas, gases from public gas supplies, hydrogen)		G
1.2.3	1 MW to less than 50 MW when using the fuels listed in number 1.2.2, excluding combustion engine systems for drilling equipment		S
1.3	**Construction and operation of a combustion engine system for generating electricity, steam, hot water, process heat or heated steam, excluding combustion engine systems for drilling equipment and emergency power systems, having a firing rate of**		
1.3.1	1 MW to less than 20 MW when using light heating oil, diesel fuel, methanol, ethanol, untreated vegetable oils or vegetable oil methyl esters, untreated natural gas, liquefied gas, gases from public gas supplies, hydrogen		S
1.3.2	1 MW to less than 10 MW when using gaseous fuels (especially coke furnace gas, mine gas, steel gas, refinery gas, synthesis gas, petroleum gas from tertiary petroleum production, sewage gas, biogas), excluding the gases listed in number 1.3.1		S
1.4	**Construction and operation of a gas turbine system for driving machinery, having a firing rate of:**		
1.4.1	more than 200 MW	Required	
1.4.2	50 MW to 200 MW when using light heating oil, diesel fuel, methanol, ethanol, untreated vegetable oils, vegetable oil methyl esters or gaseous fuels (especially coke furnace gas, mine gas, steel gas, refinery gas, sewage gas, biogas, untreated natural gas, liquefied gas, gases from public gas supplies, hydrogen)		G
1.4.3	1 MW to less than 50 MW when using the fuels listed in number 1.4.2, excluding closed-cycle systems		S
1.5	**Construction and operation of a gas turbine system for generating electricity, steam, hot water, process heat or heated steam, excluding closed-cycle systems, having a firing rate of**		
1.5.1	1 MW to less than 20 MW when using light heating oil, diesel fuel, methanol, ethanol, untreated vegetable oils or vegetable oil methyl esters, untreated natural gas, liquefied gas, gases from public gas supplies, hydrogen		S
1.5.2	1 MW to less than 10 MW when using gaseous fuels (especially coke furnace gas, mine gas, steel gas, refinery gas, synthesis gas, petroleum gas from tertiary petroleum production, sewage gas, biogas), excluding the gases listed in number 1.5.1		S
1.6	**Construction and operation of a wind park with systems having a height of more than 35 metres each or a capacity of more than 10 kW each, and comprising**		
1.6.1	20 or more wind power systems	Required	
1.6.2	6 to 19 wind power systems		G
1.6.3	3 to 5 wind power systems		S

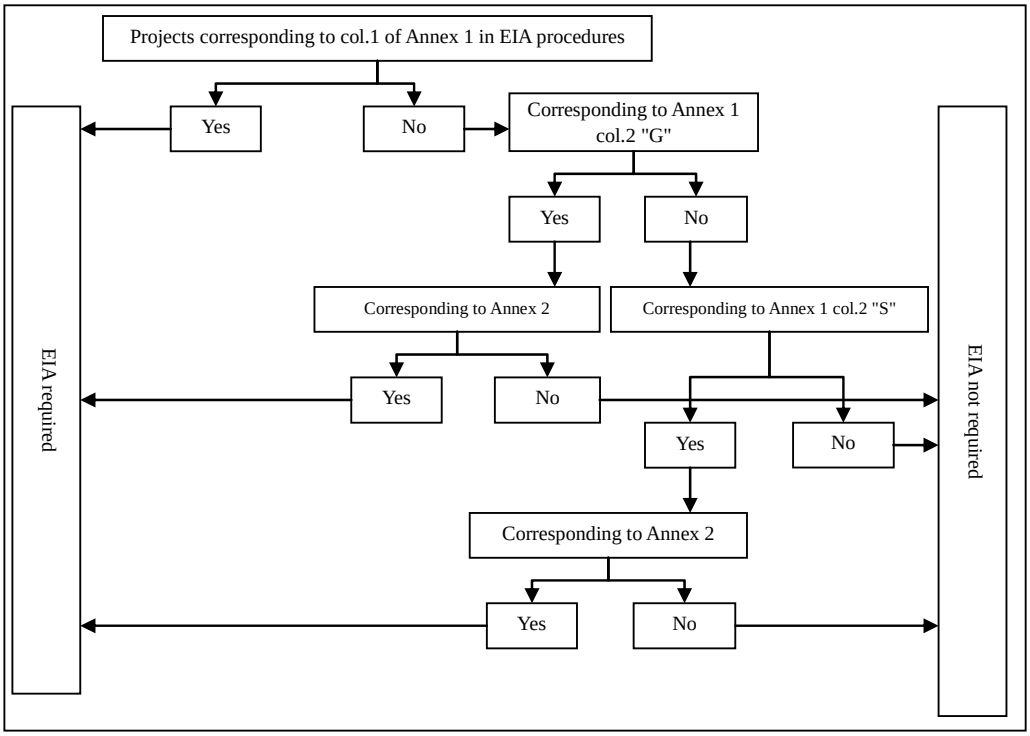
No.	Project	Need of EIA	Need of screening
18.	**Utility lines and other installations:**		
18.1	**Construction and operation of overhead electrical power lines, having**		
18.1.1	a length of more than 15 km and a rated voltage of 220 kV or more	Required	
18.1.2	a length of more than 15 km and a rated voltage of 110 kV to 220 kV		G
18.1.3	a length of 5 to 15 km and a rated voltage of 110 kV or more		G
18.1.4	a length of less than 5 km and a rated voltage of 110 kV or more		S

(Source) Environmental Impact Assessment Executive Procedures in the Syrian Arab Republic, Annex 1 List of Projects requiring EIA

(Note) G=General Screening、S=Site Screening

The projects that require EIA include: ① the projects requiring preparation of an EIA Report (ones corresponding to "Required" in the column "NEED of EIA" of Table 9.1-4); ② the projects requiring general screening (ones that correspond to "G" in the column "Need of screening" of Table 9.1-4 and the screening criteria of the Annex 2 (Appendix 3)); and ③ the projects which are considered to have a serious negative impact on the environment, although the scale and capacity are so small that EIA is necessary (ones corresponding to "S" in the "Need of screening" column of Table 9.1-4).

Fig. 9.1-3 is a flow chart representing the above-mentioned process.



(Source) Created with reference to the Environmental Impact Assessment Executive Procedures in Syria, Annex 1 List of Projects requiring EIA

Fig. 9.1-3 Flow chart for determining the need of EIA

(2) Flow of Procedures before Approval

When it has been determined as a result of screening that EIA is required, the developer

① prepares a scoping document,

② holds public consultation,

③ prepares an Environmental Impact Statement (EIS),

④ holds public consultation on EIS, and submits EIS to the GCEA and the DFEA in the province of the project site.

Then the GCEA and DFEA of each province:

⑤ review the EIS,

⑥ disclose the environment information,

⑦ prepare the Environmental Impact Assessment Report (EIA report), and send this report to the developer.

This completes the process of EIA procedures.

The following describes the details of each process:

1) Preparing a Scoping Document (Article 5 of the EIA procedures)

The scoping document is prepared by the developer at the earliest stage of the preparatory phase and is submitted to the GCEA and the DFEA of each province. The scoping document includes the following description:

① Project outline and positional impact on the environmental

② Project site and the alternative

③ Information on the project site

The scoping document containing the above-mentioned items is reviewed by the GCEA and the DFEA of the governorate, where the project site is located, through consultation with related organizations. A comment to this document will be made within one week[14]. During this time, the developer is in a position to start the construction process, but has to complete the environmental study. The final environmental approval will not be issued until the EIS is approved according to Article 7 of the EIA procedures (the environmental approval will be described later). If approval is not awarded by the GCEA and Environment DFEA of the governorate, the reasons for disapproval will be notified to the developer. The defects pointed out must be corrected. It should be noted that this scoping document will be invalid and a new scoping document must be prepared if the developer fails to submit the EIS within one year after the scoping document is approved.

[14] If the environmental impacts may extend to another country, the GCEA and the DFEA shall forward the scoping document together with an opinion to the MSEA within two weeks

2) Public consultation

After preparation of the scoping document, the developer shall hold a public consultation in cooperation with the GCEA and DFEA in the governorate in order to inform the public about the project. Further, the public consultation must be held again after completion of the EIS (to be described later).

The mechanism and procedures of public participation are defined in the Annex 4 of EIA procedures (Appendix 4). According to Annex 4, in addition to the above-mentioned two meetings with the public, public information must be given by means of newspaper etc. The public information must include the description of the project overview and summary of the scoping document. Further, project period and the dates of two public consultations must also be shown in the public information. Furthermore, the project information must be accessible to the public at least at the DFEA in the governorate. Annex 4 also stipulates the details of the method for the public meeting. After the meeting, the DFEA in the governorate is required to create the Minutes of the Meeting to be shared among the developer and other concerned parties.

3) Preparation of Environmental Impact Statement (EIS)

After the above-mentioned procedure, the developer is required to prepare the EIS. The EIS must be prepared by the EIA experts licensed by the Syrian Engineers Syndicate[15]. Further, the TOR for preparation of the EIS which conforms to the TOR of the World Bank's Environmental Guideline is adopted. A sample TOR is given in the Annex 5 of the EIA procedures.

The EIS is required to include the description of the following items:

① Executive summary
② Policy, legal and administrative framework
③ Project overview
④ Description of environment
⑤ Significant environmental impact
⑥ Analysis of alternatives
⑦ Mitigation management plan
⑧ Monitoring plan
⑨ List of reference documents
⑩ Appendices (List of Environmental Assessment Preparers, Records of Inter-Agency and Public/NGO Communications, and Data and Unpublished Reference Documents)

[15] The details of licensing the EIA experts are given in Annex 3 of the EIA procedures.

These items meet all the requirements of the JICA Environment Guideline, and are considered to be appropriate.

4) Review of EIS

The EIS is submitted to the GCEA and DFEA in the governorate and is reviewed by them. The period of review is within one month after receipt of the EIS. If any comment is given, the developer shall be given the opportunity to respond or explain the aspects they mention.

5) Approval

The GCEA and DFEA in the governorate shall prepare a report, which includes the following:

① EIS assessment,
② The adequacy of the EIS,
③ Summary of monitoring measures,
④ The reporting ways of the monitoring measures,
⑤ The principles for granting the approval, and
⑥ Other statements and opinions.

The assessment procedure shall be concluded when the GCEA and DFEA in the governorate hands over the assessment report to the developer.

9.2 Environmental and Social Consideration on the Candidate Sites for Electric Power Development

Under the original study plan, it was planned to consider the priority of the candidate sites from the environmental and social aspects after the Study Team visited the sites, confirmed the situation and made interviews with personnel in charge and DFEA officers. However, it has become difficult for the Study Team to conduct the site surveys within Syrian borders since the third site survey due to Syrian security situation. The Study Team alternatively decided to conduct a questionnaire survey on the location of each candidate site, land acquisition, and ambient surrounding. In the end, the Study Team received the answer that the requested information was not available from PEEGT on January 8th, 2012.

Therefore, the Study Team finally decided to make general screening of the candidate sites for electric power development, which are proposed in Chapter 4, by making the following hypotheses and based on the available information through maps and internet if the city names of the candidate sites are identified.

【Hypotheses on the Candidate Sites】

- The Study Team will regard the PEEGT's Development Plan from 2012 to 2015 as the already-arranged projects and assume that those clear the conditions for the environmental and social consideration. Therefore, the Study Team will exclude them in this report.
- The Study Team will conduct the environmental and social consideration regarding the candidate sites which are proposed in Chapter 4.
- As for the renewable energy, the Study Team will pay regard to PEEGT's plans and conduct the environmental and social consideration regarding only sites which names are identified.
- The Study Team will assume locations of the candidate sites from the name of power plant because any site to construct a new plant has not been specified yet.
- The Study Team will regard the candidate sites where there are existing power plants as extension projects in the adjacent land. The Study Team will assume that the adjacent land has already been secured.
- The Study Team will assume that there is a possibility of involuntary resettlement on the candidate sites which are located in densely-populated areas such as big cities and costal areas.

9.2.1 Current Situation of the Candidate Sites

This report proposes the electric power development plan after exceeding 10,700MW as follows:

Table 9.2-1 Electric Power Development Plan after Exceeding 10,700MW

Area	Name	Fuel/Type	Output(Plan 1)	Output (Plan 2)
North	Rasem Alhamam	HFO ST	500 MW	500 MW
	North Aleppo	Coal ST	900 MW	900 MW
	Rasem Alhamam	Gas CC	900 MW	900 MW
	Trefawy	Gas CC	450MW	450MW
	North Aleppo	Gas CC	900 MW	900 MW
West	Latakia	Gas CC	750 MW	750 MW
	Banias	Coal ST	600 MW	600 MW
	Latakia	Coal ST	600 MW+ 600 MW	600 MW+ 600 MW
	Banias	Gas GT	300 MW	300 MW
Central	Palmyra	Gas CC	750 MW	750 MW
South	Abo Shamat	Gas ST	300 MW	300 MW
	Dimas	Gas CC	900 MW + 900MW	900 MW
	Tishreen	HFO ST	750 MW	750 MW
	Tishreen	Gas GT	300 MW + 300 MW	300 MW + 300 MW
East	Swedieh	Gas CC	450 MW	450 MW
	Altayem	Gas CC	900 MW + 900 MW	900 MW
	Thawara	Gas CC	0 MW	900 MW + 900MW
	Al Shadeh	Gas ST	300 MW + 300 MW	300 MW + 300 MW
	Dir Alzour Industry	Gas ST	300 MW	300 MW
	Total		13,850 MW	13,850 MW

(Source) JICA Study Team

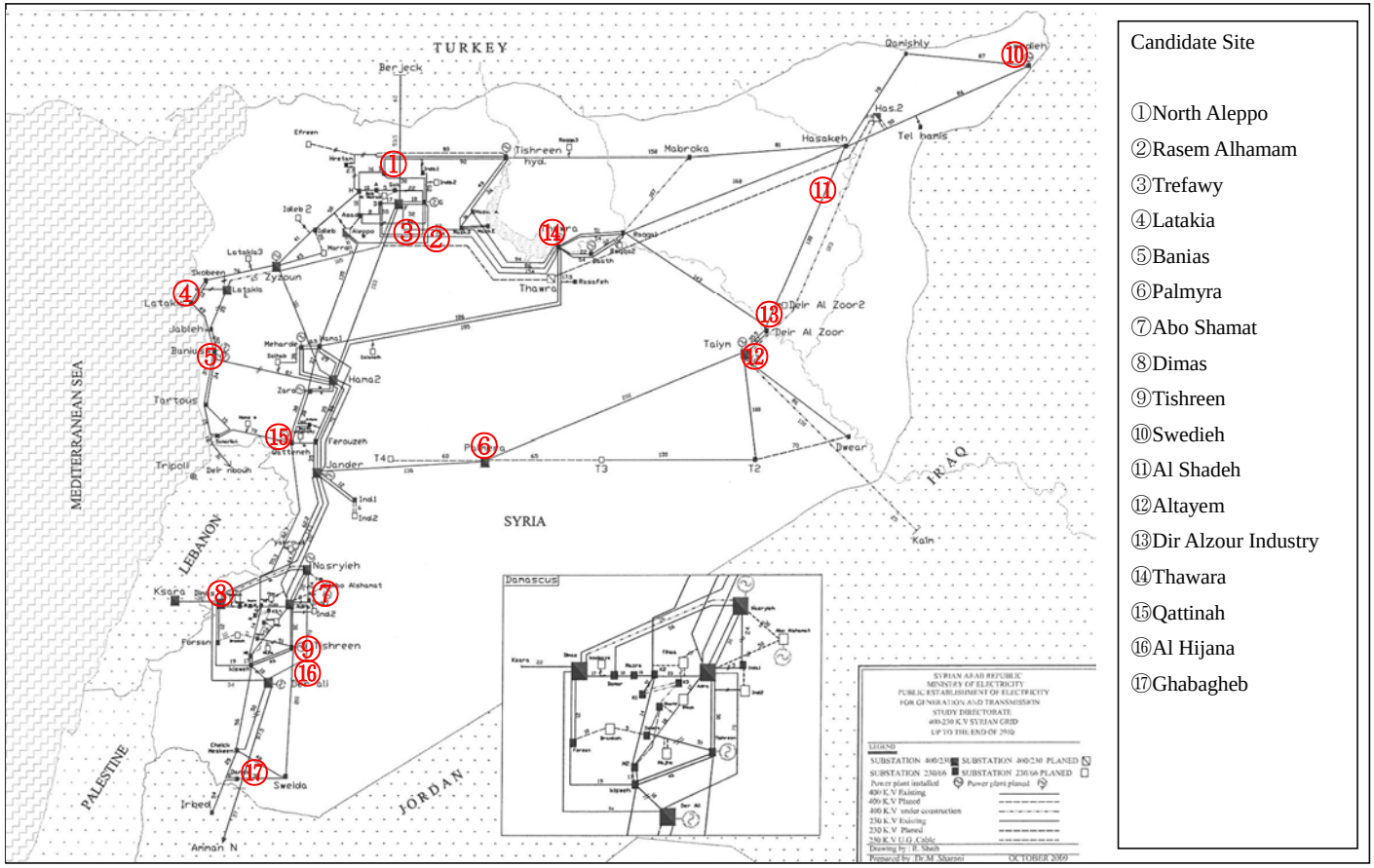
According to documents provided by PEEGT, moreover, the renewable energy projects whose names are identified are as follows:

Table 9.2-2 PEEGT Renewable Energy Project Plan

Area	Name	Type	Output
Central	Qattinah	Wind	250 MW+250MW (Total: 500 MW)
South	Al Hijana	Wind	150 MW
	Dimas	Solar	250 MW
	Ghabagheb (Dara'a)	Wind	250 MW

(Source) Created by JICA Study Team based on PEEGT reference

In the following section, the situations of the abovementioned eighteen candidate sites are organized based on the available information collected through internet, etc. It is necessary to note that the candidate projects will not always affect the environmental protected area because the Study Team assumes the wider area as candidate sites rather than the site where a plant will be actually constructed based on the name of candidate power plants.



(Source) Created by JICA Study Team based on PEEGT map

Fig. 9.1-4 Candidate Power Development Site

(1) North Aleppo

It is assumed that a new power plant will be constructed in the north area of Aleppo City, the central city of Aleppo Governorate. Aleppo Governorate is located in the northern part of Syria and has a border with Turkey. According to the data of Syrian Central Bureau of Statistics[16], the population of Aleppo Governorate is 5,927,000, as of January 1st 2011, which is equivalent to 24.2% of the total population of Syria. The population density is 320 person /km².

Aleppo City is one of the cities that prospered from the ancient era. It was designated as a World Heritage site by UNESCO in 1986. In addition to the Old City of Aleppo designated as a World Heritage, historical architecture is scattered around this area. Moreover, Botanical Garden Protected Area is located in northwestern area of Aleppo City (No. 26 of Fig. 9.1-1 Environmental Protected Areas in Syria). Aleppo City has flourished as a trading city through the ages so that the transportation system between major cities in neighboring countries and Syria is very extensive. There is not only road network but also railway system between Aleppo and major cities in Syria such as Latakia and Damascus.

(2) Rasem Alhamam

It is assumed that a new power plant will be constructed between Sabkhat Rasem Arwam, salt lake, located in southeast of Aleppo City, and Bi'r al Hamam. Sabkhat Rasem Arwam is a salt lake linked with one of the environmental protected areas, Sabkhat al Jabbul (No. 13 of Fig. 9.1-1 Environmental Protected Areas in Syria). There are some small salt lakes around here. There are also some dry ephemeral riverbeds, called Wadi, in Bi'r al Hamam. Because of the waterside area, Sabkhat Rasem Arwam is the habitat of wild birds and is designated as the IBAs by BirdLife International. On the other hand, it is some distance from Aleppo City so that it is assumed that there are a few residents in this area.

(3) Trefawy

Trefawy is located near Rasem Alhamam. Detailed information on the surrounding environment is not available; therefore it is regarded to have similar environmental condition to Rasem Alhamam. It seems that there is no an existing power plant.

(4) Latakia

Latakia Governorate is located on the Mediterranean Sea in northwestern part of Syria.

[16] Syrian Central Bureau of Statistics
http://www.cbssyr.org/yearbook/2011/Data-Chapter2/TAB-1-2-2011.htm (As of January 10, 2012)

Latakia City, the central city of Latakia Governorate, is located at the tip of the peninsula. It is the primary port city in Syria. Although the population makes up only about 5% of the total population, which is equivalent to 1,229,000, as of January 1st of 2011, the population density is 535 person/ km², the second highest after Damascus Governorate due to the small area (2,297 km²). Mediterranean region, a few dozen kilometers north from Latakia, is designated as a Coastal Environmental Protected Area (No. 8, No.9 and No.10 of Fig. 9.1-1 Environmental Protected Areas in Syria). And there are a lot of remains from the coastal area to the inland area.

Although most of the area of Syria is arid zone in which the annual amount of precipitation is less than 250mm, the average annual precipitation of Latakia between the year 2002 and the year 2006 is relatively high, 697mm[17]. It is in the first zone of five agricultural settlement zones[18].

(5) Banias

Banias is a Mediterranean town, about 55 km south from Latakia City. It belongs to Tartus Governorate. It is about 35 km to Tartus City, the center city of Tardus Governorate. Tartus Governorate does not have large population (954,000 as of January 1st of 2011) but the population density is high (504 person/ km²) because it has the second smallest area in Syria (1,892 km²). There are some remains in the suburbs of Banias. The climate is similar to Latakia. It has been prosperous in fishery, agriculture and forestry but it is also famous for oil refining. Banias Thermal Power Plant Extension Project had been assisted by Japanese ODA Loan from 1980s to 1990s.

(6) Palmyra

Palmyra is in Homs Governorate in the central part of Syria. Homs Governorate has large area (42,223 km²) and large population. The population is estimated as 2,147,000 as of January 1st of 2011. The population density is low (51 person /km²). Palmyra is located in an oasis 155 km east from Homs City, the central city of Homs and has been designated to UNESCO World Heritage site in 1980. Palmyra is adjacent to Tadmor, a town with 50,000 to 60,000 population but there is no big city around Palmyra. Jabal Abu Rujmayn (mountain range), located in the northern area of Palmyra, is designated to the environmental protected area (No. 19 of Fig. 9.1-1 Environmental Protected Areas in Syria). In addition, there are Ta'er Abu Manjal Bird Protected Area (No. 20 of Fig. 9.1-1 Environmental

[17] Syrian Central Bureau of Statistics "2007 Statistical Abstract"
http://www.cbssyr.org/yearbook/2007/chapter1/TAB-14-1-2007.htm (As of January 11, 2012)
[18] Syrian Central Bureau of Statistics "2011 Statistical Abstract"

Protected Areas in Syria), Al tleeleh Protected Area (No. 21 of Fig. 9.1-1 Environmental Protected Areas in Syria) and Sabkhet Al mooh Steppe Protected Area (No. 22 of Fig. 9.1-1 Environmental Protected Areas in Syria) around Palmyra. The whole area is also designated as the IBAs by BirdLife International.

(7) Abo Shamat

Abo Shamat is located in the southern part of Syria, 50 km northeast from Damascus. It belongs to Damascus Rural Governorate. The population is 1,877,000 (the population density is 104 person /km²) as of January 1st, 2011. Abo Shamat is in desert area. And there is an existing power plant. There is no area designated as environmental protected area by MSEA or as the IBAs by BirdLife International.

(8) Dimas

Dimas is located in the southern part of Syria, west of Damascus and near to Lebanon border. It belongs to Damascus Rural Governorate. There is no area designated as environmental protected area by MSEA or as and as the IBAs by BirdLife International. There is no existing power plant but an existing substation. The electricity is supplied to Lebanon through this existing substation.

(9) Tishreen

Tishreen is located in the southern part of Syria, east of Damascus. There is an existing power plant. There are few residents around the existing power plant and the power plant has a large area although the expansion work of the existing plant is ongoing. There is no area designated as the environmental protected area by MSEA and as the IBAs by BirdLife International around this area.

(10) Swedieh

Swedish belongs to Hasakeh Governorate, eastern part of Syria. It is close to Iraqi border. There is an existing power station. The area of Hasakeh Governorate is 23,334 km². The population is 1,604,000 (the population density is 51 person/ km², as of January 1, 2011). Swedieh is along a tributary of the Tigris and Hasakeh City, a central city of Hasakeh Governorate, is along a tributary of the Euphrates. The main industry of Hasakeh Governorate is irrigated agriculture. Crude oil is also produced. Although there are a lot of ancient Tigris and Euphrates remains, there are no major remains around Swedieh. There is also no area designated as the environmental protected area by MSEA or as the

IBAs by BirdLife International around this area.

(11) Al Shadeh

Al Shadeh is located in 50 km south from Hasakeh City. There is no existing power plant. It seems that there is no area designated as the environmental protected area by MSEA or as the IBAs by BirdLife International around Al Shadeh.

(12) Altayem

Altayem belongs to Dir Alzour Governorate and is located in southwest of Dir Alzour City, a central city of Dir Alzour Governorate. The area of Dir Alzour Governorate is 33,060 km² and its population is estimated as 1,692,000 (the population density is 51 person/ km², as of January 1st, 2011). Dir Alzour City is along the Euphrates. The river basin is agricultural zone. And there are many historical sites along the river. Moreover, the river basin is designated as an environmental protected area (No. 16, No. 17 and No. 29 of Fig. 9.1-1 Environmental Protected Areas in Syria) by MSEA and the IBAs by BirdLife International. However, it seems that the existing power plant is not located in such designated areas but rather in dry desert zone.

(13) Dir Alzour Industry

It is assumed that a new power plant will be constructed in the industrial estate near Dir Alzour City. As is the case in Alzerbah Alzerbah Industrial Area near Aleppo, supposing that the power plant will be constructed in the industrial estate, it is considered that the plant is close to bulk customers, the residents near by the power plant are few, and the area has a distance from environmental protected area. However, it should be noted that Dir Alzour City itself is along the Euphrates where is designated as the environmental protected area and the IBAs.

(14) Thawara

The existing power plant is located in the north side of the outlet of Lake Assad (man-made lake) in Ar-Raqqah Governorate. This area is designated as the environmental protected area by MSEA (No. 14 of Fig. 9.1-1 Environmental Protected Areas in Syria). The area of Ar-Raqqah Governorate is 19,616 km² and its population is estimated as 1,008,000 (the population density is 51person/ km², as of January 1st, 2011). There are a lot of ancient remains such as Qalaat Jaabar at the edge of the lake. Euphrates River basin including Lake Assad is also designated as the IBAs by BirdLife International.

(15) Qattinah[19]

Two sites, north side of Lake Qattinah and south side of Lake Qattinah, near Homs City (15km southwest) are planned as the wind park. There is a plan to construct the industrial estate 1 to 2 km south from the north wind park so that bulk customers are expected. The surrounding area is an industrial zone. Although there are some relatively high buildings, it is not assumed that they will affect to the power generation by the wind park. The agricultural land is around the lake but there are few residents. Most of the candidate site is vacant. According to the pre-feasibility study (pre-F/S) supported by Europeaid, however, the candidate site is used for sheep grazing. Moreover, a part of the site is used as a waste dump. But the pre-F/S report said that the site had been officially designated as the planned construction site for the wind park already.

Lake Qattinah is not designated as an environmental protected area by MSEA but is designated as the IBAs by BirdLife International. In addition, there is a historic site south of the lake.

(16) Al Hijana[20]

Al Hijana village is located in Damascus Rural Governorate, 50 km southeast of Damascus and south of Damascus international airport. The proposed site is located 5 km south of the Tishreen power plant. Although it is dried desert area around the proposed site, several spots of irrigated agricultural area are found. The planned construction site is mixed site of desert, irrigated agricultural land and afforestation. It is planned to extend the existing unused governmental land next to the proposed site. Two sites in Al Hijana village will be allocated for the wind park[21].

There are few residents around the site. There is no area designated as an environmental protected area by MSEA or as the IBAs by BirdLife International around this area.

[19] The pre-F/S was prepared between 2005 and 2006 by Europeaid. Europeaid, 2006, Power Sector Action Plan: Wind Data Evaluation and Pre-Feasibility Study Qatina

[20] The pre-F/S was prepared between 2005 and 2006 by Europeaid. Europeaid, 2006, Power Sector Action Plan: Wind Data Evaluation and Pre-Feasibility Study Al Hijana

[21] Refa't Hasoneh, 2011, Grid Integration of Al Haijana Wind Park in Syria: http://cms.uni-kassel.de/unicms/fileadmin/groups/w_460600/thesis/batch1/Master_Thesis_-_Refa_t_Hasoneh.pdf (as of January 11, 2012)

(17) Ghabagheb (Dara'a)[22]

Ghabagheb belongs to Dara'a Governorate. The proposed wind park is located in a chain of smooth hills where 4 to 5 km east of the city of Ghabagheb. Although the cultivated area reaches to about half the height of the mountain range, on the top the soil is hard and rocky without vegetation and there are no major obstacles such as high buildings and trees. The site is unused governmental land but the available area for the wind park is unknown.

This area is not designated as an environmental protected area by MSEA but it is designated as the IBAs by BirdLife International.

9.2.2 Consideration of Candidate Sites from the Viewpoint of Environmental and Social Aspects

The information on each candidate site mentioned in the previous section is organized by estimated CO_2 emissions from the planned power plant, land acquisition, involuntary resettlement, ancient remains, the environmental protected area, the important bird areas and some remarks if any, and evaluated in accordance with the marked numbers as shown in Table 9.2-3. The explanation of each item is as follows:

【CO_2】

In this report, only CO_2 emitted by fuel combustion is calculated as CO_2 emission from the planned power plant. It is avoided to calculate amount of CO_2 emission including energy consumed for mining of fuel, construction, transportation, refinery, operation and maintenance of plant facilities, because the detail plan on each power plant is not available. Therefore, amount of CO_2 emission from solar power and wind power is zero (0) Gg/year. As the proposed power development plan is planned in order to meet the necessary demand and avoid disproportion of fuel, the amount of CO_2 emission, which is automatically calculated in accordance with type of fuel and output size, is excluded from the screening criteria. It is described for the reference when specific projects will be formulated.

【Site/ Land Acquisition】

In the "Site" column, it is described whether it is necessary to acquire land for a new power plant. As assumed in the previous section, the candidate sites where power plants already exist are regarded as extension projects in the adjacent land that has already been secured. In the others it is assumed that the land acquisition will be needed. However, Banias is

[22] The pre-F/S was prepared between 2004 and 2006 by Europeaid. Europeaid, 2006, Power Sector Action Plan: Wind Data Evaluation and Pre-Feasibility Study Ghabagheb

judged to require land acquisition because it is obvious that there is no space for extension in the existing power plant according to the ex-post evaluation report of Banias thermal power plant extension project.

"N" (Need) is marked for the site where land acquisition might be necessary and "E" (Existing) is marked for the site that might have extension plot.

【Involuntary Resettlement】

This column shows whether the involuntary resettlement is needed or not. Based on the hypotheses made in the previous section, the construction work which is planned in the high population density area possibly needs the involuntary resettlement and is marked as "X", except when the surrounding condition has been confirmed.

【Ancient Remains】

There is a problem that chemicals from power stations and industrial plants cause ancient remains to deteriorate in Syria. From the viewpoint of consideration for flue gas, "X" is marked where there are ancient remains near a candidate site.

【EPA/ Environmental Protected Area】

"X" is marked on the candidate sites that are located in the environmental protected areas designated by MSEA or are close to the environmental protected areas so that there is a possibility to affect the protected areas.

【IBAs/ Important Bird Areas】

"X" is marked when there is a possibility of being designated as an Important Bird Areas by BirdLife International.

【Remarks】

Remarks are described if something should be considered other than above mentioned items.

【Evaluation】

It is difficult to make exact screening due to the environmental and social consideration based on some assumptions. Therefore, the number of the following items are marked in this column; "N" in "Site" (land acquisition) and "X" in "Involuntary Resettlement", "Ancient Remains", "EPA" (environmental protected area), and "IBAs" (Important Bird Areas). When other considerations might be needed, the number of consideration items is

added. The figures are from zero (0) to six (6). The larger number means more consideration is needed. Each screening item cannot be treated at the same level so that the large number does not necessarily mean less priority and more difficulty. However, it is true that cases where the land is already secured and the consideration items are less are easier to materialize than the cases where the land has to be acquired and there are a lot of consideration items. Based on this point of view, the feasible candidates from the aspect of environmental and social consideration might be Tishreen, Altyem, and Abo Shamat.

Table 9.2-3 Consideration of Candidate Sites from the Viewpoint of Environmental and Social Aspects

Name	Location (Governorate)	Fuel/Type/Output	CO_2 (Gg/yr)	Site	Resettlement	Remains	EPA	IBAs	Remarks	Evaluation
North Aleppo	Aleppo	Coal ST 900 MW	4,048	N	X	X	X		- Although the railway network between Latakia and Aleppo exists, it is necessary to consider the transportation system for coal. - It is necessary to develop the unloading system for coal at Latakia Port.	6
		Gas CC 900 MW	1,896	N	X	X	X			4
Rasem Alhamam	Aleppo	HFO ST 500 MW	1,743	N	X		X	X		4
		Gas CC 900 MW	1,896	N	X		X	X		4
Trefaway	Aleppo	Gas CC 450MW	948	N	X		X	X		4
Latakia	Latakia	Gas CC 750 MW	1,580	N	X	X	X			4
		Coal ST 1,200 MW	5,398	N	X	X	X		- It is necessary to develop the unloading system for coal at Latakia Port.	5
Banias	Tartus	Coal ST 600 MW	2,699	N	X	X			- Although the railway network between Latakia/ Tartus and Banias exists, it is necessary to consider the transportation system for coal. - It is necessary to develop the unloading system for coal at Latakia Port or Tartus Port.	5
		Gas ST 300 MW	1,087	N	X	X				3
Palmyra	Homs	Gas CC 750 MW	1,589	N		X	X	X		4
Abo Shamat	Damascus Rural	Gas ST 300 MW	1,087	E		X				1
Dimas	Damascus Rural	①Gas CC 1,800 MW	3,792	N						1
		②Gas CC 900 MW	1,896	N						1
		Solar 250 MW	0	N						1
Tishreen	Damascus Rural	HFO ST 750 MW	2,615	E						0
		Gas ST 600 MW	2,178	E						0
Swedieh	Hasakeh	Gas CC 450MW	948	E						0
Al Shadeh	Hasakeh	Gas CC 600 MW	1,264	N						1

Name	Location (Governorate)	Fuel/Type/Output	CO_2 (Gg/yr)	Site	Resettlement	Remains	EPA	IBAs	Remarks	Evaluation
Altayem	Dir Alzour	①Gas CC 1,800 MW	3,792	E						0
		②Gas CC 900 MW	1,896	E						0
Dir Alzour Industry	Dir Alzour	Gas ST 300 MW	1,087	N			X	X		3
Thawara	Ar-Raqqah	②Gas CC 1,800 MW	3,792	E		X	X	X		3
Qattinah	Homs	Wind 500 MW	0	N		X		X		3
Al Hijana	Damascus Rural	Wind 250 MW	0	N						1
Ghabagheb	Dara'a	Wind 250 MW	0	E				X		0

(Source) JICA Study Team

Appendix 1

Major Laws and Regulations on Environment

Law / Secondary Law	Reference
Environmental Law	Law No. 50 (2002)
Implementing Regulation of Law No. 50 of 2002 on Environmental Protection (executive act)	No. 478/S/B/GH/J of 2004 (Official Gazette No. 10, 9.3.2005)
Executive Procedures for Environmental Impact Assessment	MoLAE, Ministerial Order No. 225, 29.1.2008
Forest Protection Law	No.25 (2007)
Protected Areas Conditions	Adopted by the Supreme Council for Environmental Protection (2003)
Protection of Animal Wealth	No. 29 (2008)
Badia Area as a Part of Government Ownership (Badia Protection Law)	No. 62 (2006)
Licensing System for Ozone Depleting Substance	2006
Resolution Classifying the Course of Al-Asi (Orontes) River as a Natural Site Subject to the Protection of the Ministry of Environment	Resolution No. 189/1 of 1998 (Official Gazette No. 55, 10.12.1998)
Resolution Issuing the Implementing Regulation of the General Authority for Water Resources established by the Legislative Decree No. 90 of 2005	Resolution No. 1916 of 27.11.2005 (Official Gazette No. 52, 28.12.2005)
Water Regulation	Legislation No.31 of 2005
National Legislations for the Protection of the Marine Environment from Pollution	Legislative Decree No,9 of 2006
Law on Regional Planning	Draft adopted by the Council of Ministers; expected to be issued in the near future.
Criteria for Energy Efficiency for Hope Applications	Law No. 18 (2008)
Energy Conservation Law	To be issued February 2009
Decree for the Establishment of Industrial Zones	
Decree for the Classification of Industries	Decree No. 2680
Ambient Air Quality Standard	SNS No. 2338/ 2004
Maximum Discharge Limits of Pollutants to the Water Environment	Adopted by the Supreme Council for Environmental Protection (2003)
Maximum allowable limits for the discharge of pollutants from economic activities to national sewer network	SNS No. 2580/ 2002
Maximum Discharge Limits of Air Pollutants at Source	Adopted by the Supreme Council for Environmental Protection (2003)
Classification of industrial solid wastes according to their content of hazardous materials	Adopted by the Supreme Council for Environmental Protection (2003)
Maximum Noise Thresholds	Adopted by the Supreme Council for Environmental Protection (2003)

(Source)Created with reference to Country Environmental Profile for the Syrian Arab Republic, p.38, EC, April 2009

Appendix 2

Important Bird Areas in Syria

IBA Code	International name	County / Territory	Area (ha)	Criteria
SY019	Abu Zad	Damascus Rif	10,000	A1, A2, B2, B3
SY008	Baath Lake	Raqqa	100	A4i, A4iii
SY017	Bahrat Homs	Homs	5,300	A1, A4i, A4iii, B1i, B2
SY007	Buhayrat al-Assad	Aleppo, Raqqa	70,000	A1, A4i, A4iii, B1i, B2, B3
SY005	Buhayrat al-Khatuniyah	Hasakeh	80,000	B2
SY016	Buhayrat al-Laha	Tartous	50	B1i
SY010	Euphrates valley	Aleppo, Raqqah, Deir ez-Zor	n/a	A1, B2, B3
SY024	Golan Heights	Quneitra	60,000	A1, A4i, A4iv
SY025	Ibis Protected Area	Homs	23,000	A1, A4i
SY004	Jabal Abdul Aziz	Hasakeh	45,000	B2
SY015	Jabal al-Bilas	Homs	40,000	B2, B3
SY014	Jabal al-Bishri	Raqqah, Deir ez-Zor, Homs	20,000	B2, B3
SY013	Jabal al-Shuah	Latakia	20,000	A3
SY021	Jabal Sis	Damascus Rif	40,000	B1i, B2, B3
SY011	Jabal Slenfeh	Latakia	4,000	A3, B1iv, B2
SY023	Mount Hermon	Quneitra	10,400	A1, A2, A3, B2, B3
SY001	Ras al-Ayn	Hasakeh	100,000	A1, B2, B3
SY006	Sabkhat al-Jabboul	Aleppo	15,000	A4i, A4iii, B1i, B2, B3
SY018	Tadmur & Sabkhat Muh	Homs	45,000	A1, B2, B3
SY003	Tual al-'Abba	Raqqah	30,000	A1, B1i, B2
SY009	Umm al-Tuyyur	Latakia	12,000	A3, B2
SY012	Wadi al-Azib	Hama	24,200	B2, B3
SY020	Wadi al-Qarn-Burqush	Damascus Rif	4,500	A1, A2, A3, B2, B3
SY002	Wadi al-Radd	Hasakeh	48,000	B1i
SY022	Yarmuk valley	Dar'a	20,000	B2, B3

(Source) Country Environmental Profile for the Syrian Arab Republic, p.22, EC, April 2009

Note：Criteria in the above table are as follows:

A: Important Bird Areas – Global importance:

A1. Species of global conservation concern, A2. Restricted-rage species, A3. Biome-restricted species, A4. Congregations

B: Important Bird Areas – Middle Eastern importance:

B1. Regionally important congregations, B2. Species with an unfavorable conservation status in the Middle East. B3. Species with an unfavorable conservation status but concentrated in the Middle East.

（Please refer to BirdLife International webpage for detail information）

Appendix 3

EIA Procedures Annex 2 Screening Criteria

The following criteria shall be applied insofar as reference to Annex 2 is made in Art. 4 para. 1 and 2.

1. Characteristics of projects

The characteristics of projects must be considered having regard, in particular, to the following criteria:

1.1. the size of the project,
1.2. the use and design of water, soil, nature and landscape,
1.3. the production of waste,
1.4. environmental pollution and nuisances,
1.5. the risk of accidents, having regard in particular to substances or technologies used.

2. Location of projects

The environmental sensitivity of geographical areas likely to be affected by projects must be considered, having regard, in particular, to the following use and protection criteria and taking account of accumulation with other projects in their common impact area:

2.1. existing uses of the area, especially as an area for settlement and recreation, for agricultural, forestry or fisheries uses, for other commercial or public uses, transport, supply and disposal (use criteria),
2.2. richness, quality and regeneration capacity of water, soil, nature and landscape of the area (quality criteria),
2.3. absorption capacity of the protected assets, paying particular attention to the following areas and to the type and extent of the protection allocated to them (protection criteria):
    2.3.1. areas of bird sanctuaries,
    2.3.2. nature conservation, where not already covered by number 2.3.1,
    2.3.3. national parks, where not already covered by number 2.3.1,
    2.3.4. biosphere reserves and landscape reserves,
    2.3.5. biotopes enjoying statutory protection,
    2.3.6. water conservation areas or medicinal spring conservation areas,
    2.3.7. areas in which the environmental quality standards have already been exceeded,
    2.3.8. densely populated areas, especially central cities and settlement concentrations in densely settled areas,
    2.3.9. monuments, monument complexes, earthwork monuments or areas classified as archaeologically important landscapes by the historic monument authority, specified in official lists or maps.

3. Characteristics of the potential impact

The potential significant effects of projects must be considered in relation to the criteria set out under 1 and 2 above, and having regard in particular to:

3.1. the extent of the impact (geographical area and size of the affected population),

Appendix 4

EIA Procedures Annex 4 Mechanism and Procedures of Public Participation

1: Publication of the Project

(1) If the project application and the description are complete, the licensing authority will ask the environment authority to announce the project in a proper method in the account of the developer (local news paper, agricultural and community based extensions etc).

(2) If the project is amended, widened, or in another way extended, the same procedures are applicable.

(3) There will be two public meetings, the purpose of the first meeting will be to announce and explain the project at the beginning (Period of one week) and the second meeting after preparing the Environmental Impact Statement.

2: Content of the Publication and its period

(1) The publication shall contain

- Technical and environmental necessary information (project description and draft scoping report) in non technical summary.
- The information on location and time of execution with mentioning the starting and ending day and the dates and the program of the two meetings.
- The access to the project documents must be minimum available at the environment directorate(s)
- In addition project documents could be available in other places as per agreements between the developer and the authority.
- The information that objection/views can be raised unrecognisably.

3: Public Notification of the Project Application and Description

1. The project application and description and all relevant information and documents concerning the possible effects of the projects on the environment shall be notified to the public at the environment directorates.
2. The documents shall be accessible as a minimum during office hours and on web site if possible.

4: Objections/ views

1. Objections and views can be raised at the environmental directorate(s), where the documents are publicly notified.
2. The authority shall provide the developer and the granters of consent copies of all objections and views.
3. Objections and views shall be assessed by the developer.

5: Public Meeting

During the public meeting the objections and views raised in time shall be discussed. The objector shall be given possibility to explain the objection and views.

6: Cancellation and Shifting

1. *A public meeting shall not take place if*
   - *No objections or views against the projects are raised, or*
   - *Objection or views are taken back before the public meeting assigned date.*
2. *The environmental directorate may shift the public meeting to another time or place, if this is necessary for a practicable carrying out. Place and time of the*

new public meeting shall be announced in accordance to Art. 1 para 1 at the earliest possible time.

3. *The developer shall be informed if the public meeting does not take place or has been shifted.*

7: Procedure

(1) The public meeting is public.

(2) The public meeting is directed by a responsible facilitator. Facilitator may be a responsible member of the Environmental directorate, an expert or any other reliable and independent third party.

(3) The meeting agenda shall be announced in advance. The facilitator may summate objections or views for discussion. In this case the facilitator may restrict the right of the objectors for explanation of the objection or views.

(4) The facilitator distributes the right to speak and sets time limits. The facilitator may withdraw the right to speak in case of extension of time limits or in case of negotiating arguments which are not bound to the respective objection/views.

(5) The facilitator is responsible for the public order. Therefore he may exceed people disturbing the public meeting or not following any order of the facilitator. The public meeting may continue without exceeded people.

(6) The facilitator closes the public meeting if all objection/views are negotiated. The public meeting may be closed in case of severe disturbance. Not negotiated objections or views shall be negotiated in a written procedure. The facilitator shall inform the objectors thereof.

8: Documentation

(1) The public meetings shall be documented by a written protocol. The protocol shall contain

1. place and time of the public meetings,
2. name of the facilitator,
3. name and place of the project,
4. procedure and results of the public meetings, and
5. list of participants (voluntary base).

The protocol shall be signed by the protocol secretary and the negotiator. The environmental directorate(s) may copy the public meeting on tape for protocol purposes. The tapes shall be deleted at the time when no objection/views could be raised or are subject of any administrative or judicial procedure.

(2) A copy of the protocol shall be submitted to the developer. A copy of the protocol shall also be accessible to objectors and other interest parties.

Chapter 10 Proposed Plans for Future Electric Power Source Development

10.1 Proposal Related to the Electric Power Source Development Plan

From the studies and results of analyses of the Study Team, the optimum power source constitution ratios and development volumes in the Syrian domestic system are as given in Table 10.1-1 below.

- From the results of investigations of the electric power demand estimates, energy demand estimates, and power source development simulation, as the peak power supply capacity it is most economical to possess facilities of about 10 percent of the overall capacity (about 25,000 MW in the year 2030) of the facilities. While it is economical to have this 10 percent of the facilities as gas turbines, it is also necessary to develop pumped-storage hydroelectric power generation as an alternative supply capacity to gas turbines if we consider the reduction in the amount of gas consumption.

- Although it depends on the future cost of fuel, as the base supply capacity, it is economically most advantageous to develop based on coal thermal power plants. Further, considering that there is a limit on the amount of supply of fossil fuels (gas + HFO), in addition to the facts that the region suitable for coal thermal power plants is limited to the western region, the amount of CO_2 generated per kWh is high, and also other countries have to be depended upon for all coal, and the environmental aspects of global warming, if development is carried out leaning excessively on coal thermal power generation, there is the danger that stable supply of electric power will be hurt when there is a stoppage of coal supply or when the coal price becomes excessively high. In order to reduce such risks, we propose that excessive dependence on coal thermal power be avoided and that it should be limited to less than about 15 percent of the overall capacity of the facilities (about 4,000 MW).

  Due to this, although the dependence on gas CC exceeds 50 percent, since the supply source of gas is mainly domestic, and also since the neighboring countries have high amounts of excess gas supply capacity, and since it is considered that the risk of gas supply being stopped is low, and also since it is possible to distribute the risk by increasing the number of countries from which gas is imported, the high rate of dependence on gas CC is considered to be within permissible limits.

- Regarding the development of renewable energy sources, we propose the promotion of the developments that contribute to the reduction in the amount of fossil fuels uses and the suppression of the amount of CO_2 emissions. However, we propose that the amount of such development be suppressed to about 5 to 10 percent of the capacity of the system until the stability of the system is established.

Table 10.1-1 Power source constitution in 2030 and capacity development from 2016 to 2030

	2030		2016 - 2030	
	MW	%	MW	%
Hydroelectric power	1,200	5	0	0
Pumped-storage hydroelectric power	0 - 1,200	0 - 5	0 - 1,200	0 - 5
Oil-fired thermal power	2,500	10	1,000	5
Gas-fired gas turbine thermal power	1,500 - 2,500	5 - 10	1,000 - 2,000	5 - 10
Gas-fired combined thermal power	10,000 - 13,000	50 - 55	8,000 - 9,000	50 - 55
Coal thermal power	3,000 - 4,000	10 - 15	3,000 - 4,000	20 - 25
Renewable energy	500 - 1,500	2 - 5	500 - 1,500	5 - 10
Total	25,000	100	16,000	100

Prepared by JICA Study Team

Table 10.1-2 Region-wise capacity enhancement plan up to 2030

Station	Units	Installed	type of plant	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
JANDER-CC-EXT1	GT1	150	CC		150																		
	GT2	150			150																		
	ST1	150			150																		
DIRALI-EXT1	GT1	250	CC			250																	
	GT2	250				250																	
	ST1	250				250																	
DIR-ALZOOR	GT1	250	CC			250																	
	GT2	250				250																	
	ST1	250				250																	
TISHREEN-ST	ST1	200	THERMAL		200																		
	ST2	200			200																		
SWEDIEH	GT1	150	CC					150															
	GT2	150						150															
	GT3	150						150															
NASRIEH-CC	GT1	350	CC (SS)				350																
	ST1																						
TREFAWY	ST1	250	THERMAL					250															
	ST4	250						250															
QATTENAH-TASK1	ST1	250	WINDY					250															
NORTH ALEPPO TASK 1	ST1	250	COAL							250													
	ST2	250								250													
	ST3	250									250												
	ST4	250									250												
NORTH ALEPPO TASK 2	ST1	250	COAL									250											
	ST2	250										250											
	ST3	250											250										
	ST4	250											250										
LATAKIA-CC	GT1	350	CC (SS)						350														
	ST1																						
SHADADEH-CC	GT1	350	CC (SS)							350													
	ST1																						
QATTENAH-TASK2	ST1	250	WINDY										250										
DAMAS-HEJANA	ST1	150	WINDY								150												
HALBIA-ZALABIA	HT1	200	HYDRO										200										
	HT2	200											200										
	HT3	200												200									
	HT4	200												200									
BANIAS-EX1	ST1	250	THERMAL												250								
	ST2	250														250							
MEHARDA-EX1	ST1	250	THERMAL														250						
	ST2	250																250					
DRAA-GABAGB	ST1	250	WINDY												250								
DAMAS-SOLAR	ST1	180	SOLAR													180							
NO SITE TASK 1	ST1	250	COAL/ OIL SHALE											250									
	ST2	250												250									
	ST3	250													250								
	ST4	250													250								
NO SITE TASK 2	ST1	250	COAL/ OIL SHALE													250							
	ST2	250														250							
	ST3	250															250						
	ST4	250															250						
NO SITE	ST1	1000	NUCLEAR															1000					
	ST2	1000																					1000
BANIAS-EX2	ST1	250	THERMAL																250				
	ST2	250																		250			
MEHARDA-EX2	ST1	250	THERMAL																	250			
	ST2	250																			250		
RASM ALHMAM TASK 1	ST1	250	OIL-SHALE																250				
	ST2	250																	250				
	ST3	250																		250			
	ST4	250																		250			
RASM ALHMAM TASK 2	ST1	250	OIL-SHALE																		250		
	ST2	250																			250		
	ST3	250																				250	
	ST4	250																				250	
NORTH AREA	ST1	250	WINDY																		250		
NORTH AREA	ST1	180	SOLAR																			180	
TOTAL GEN. PLANING		16660		0	850	1500	350	1200	350	850	650	500	1150	900	1000	930	750	1250	750	1000	1000	680	1000
TOTAL GEN. EXISTING		8725		8060	8020	8000	8000	7850	7685	7605	7605	7215	7205	7145	7145	7105	6625	6625	6430	6430	5810	5810	5810

Source: PEEGT

While the above table is the capacity enhancement plan provided by PEEGT, according to the results of the study by the Study Team, the amount that needs to be developed after 2016 is 16,000 MW.

From the above table, it can be seen that there is a large difference in the amount to be developed. The reason for the excessively small amount of development given by PEEGT is considered to be that the amount of disbanded power treated is rested.

The results of the study by the Study Team are used as the basis for the capital procurement plan of the development plan.

10.2 Capital Procurement for Electric Power Source Development

As was explained in 10.1, according to the results of study by the Study Team, the amount that needs to be developed after 2016 is 16,000 MW.

Table 10. 2-1 Power source constitution in 2030 and capacity development from 2016 to 2030

	2030 (JICA)		2016 - 2030 (JICA)	
	MW	%	MW	%
Hydroelectric power	1,200	5	0	0
Pumped-storage hydroelectric power	0 - 1,200	0 - 5	0 - 1,200	0 - 5
Oil-fired thermal power	2,500	10	1,000	5
Gas-fired gas turbine thermal power	1,500 - 2,500	5 - 10	1,000 - 2,000	5 - 10
Gas-fired combined thermal power	10,000 - 13,000	50 - 55	8,000 - 9,000	50 - 55
Coal thermal power	3,000 - 4,000	10 - 1 5	3,000 - 4,000	20 - 25
Renewable energy	500 - 1,500	2 - 5	500 - 1,500	5 - 10
Total	25,000	100	16,000	100

Prepared by JICA Study Team

This means that every year a power supply source development of 1,000 MW has to be made.

In order to carry out construction of 1,000 MW every year, considering the domestic financial status of Syria, enhancement of the electric energy source becomes a big burden on the government.

In view of this, in order to enhance power plants to meet the electric power demand from now on, while naturally it also becomes necessary to verify the financial status of PEEGT, the price of power has been suppressed to a low value as was described in the section on price of electric power and even the distribution loss is high, it is difficult to procure capital for construction, and it should be considered that it is even more difficult to get the support from governmental funds for only the electric power sector.

10.2.1 Estimation of annual fund procurement amounts

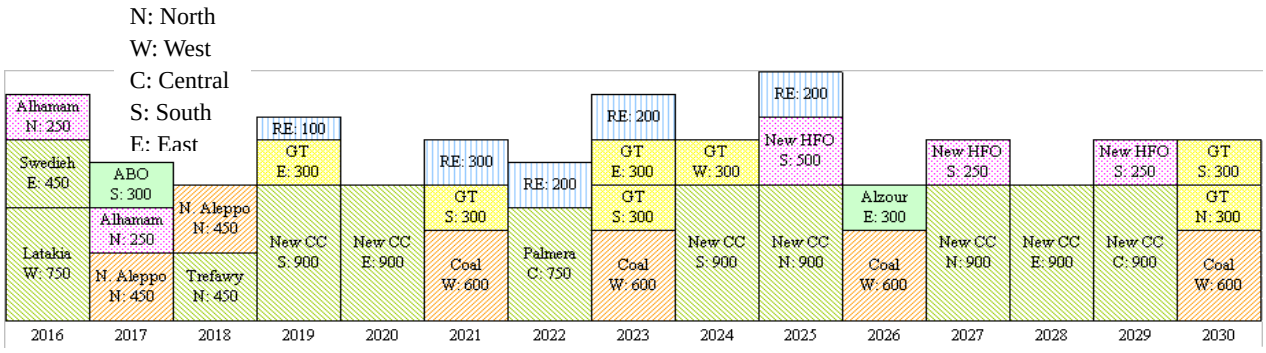
Based on the results of evaluation in Chapter 4, an estimate of the annual capital expenses for the construction of new power plants that need to be procured by the government or PEEGT is given below using the construction cost of power plants of different types of power sources.

Table 10.2-2 Standard unit costs of construction of different types of power sources

	Construction cost
Gas-fired thermal (C/C: 750 MW)	610 USD/kW
Gas-fired thermal (GT: 150 MW)	340 USD/kW
Oil-fired thermal (ST: 250 MW)	1,200 USD/kW
Coal-fired thermal (ST: 250 MW)	1,800 USD/kW
Pumped storage hydro	800 USD/kW

Prepared by JICA Study Team

Use of wind power is assumed as the renewable energy source in this study, and the unit price per kWh used is 1,900 USD/kW which is the cost of the project supplied by JICA recently to Egypt as a yen loan business.



Prepared by JICA survey team

Fig. 10.2-1 Region-wise new power plant construction cost

Table 10.2-3 Capital for construction of new power plants

Unit: Million USD

2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
300.0	360.0	274.5	190.0		380.0	380.0	380.0		380.0		300.0		300.0	102.0
					102,0	457,5	102.0							
	300.0		102.0				102.0	102.0	600.0	102.0	549.0	549.0	549.0	102.0
457.5	274.5	274.5	549.0	549.0	1,080.0		1,080.0	549.0	549.0	1,080.0				1,080.0
757.5	934.5	549.0	841.0	549.0	1562.0	837.5	1664.0	651.0	1529.0	1182.0	849.0	549.0	849.0	1284.0

Prepared by JICA Study Team

Table 10.2-4 Trend of finance for enhancing transmission lines

Unit: Million USD

Case	2016 - 2020	2021 - 2030	Total
Development without large scale CC plant in North-East area	15	166	181
Development with large scale CC plant in North-East area	15	156	171

Source：JICA Study Team

Table 10.2-5 Trend of finance for enhancing transformer stations

Unit: Million USD

Case	2016 - 2030
Development without large scale CC plant in North-East area	180
Development with large scale CC plant in North-East area	182

Source：JICA Study Team

10.2.2 Recommendations on the capital procurement plan

Since the disbandment of existing power plants due to age has been included based on the discussions between PEEGT and the Study Team, the reserve power supply capacity suddenly becomes poor. If the reserve power supply capacity of 6 percent of the level between 2013 and 2020 is to be maintained up to 2030, a total power supply development of 16,000 MW becomes necessary over the 15 years from 2016 to 2030.

1) Increase in self-finance

As was shown in Chapter 6, up to 2007, although the actual performance record of the integrated financial condition of PEEGT and PEDEEE was good in terms of cash flow, it started to deteriorate after 2007 due to increases in the price of fuel. Although this is considered to be the difference in the timing of increasing the electricity charges corresponding to the increase in the fuel cost, in order to improve the cash flow base quickly, it is recommended not only to review the current electricity charges system at an early date but also at the same time to carry out improvement in the distribution loss which is as high as 25%, and thereby increase the ratio of self-finance for the construction capital that will become very big from 2016 onwards.

2) Utilization of international ODA funds

Apart from the ODA funds of JICA (Japan International Cooperation Agency), use funds that can be obtained by making the plan for the long term durable assets necessary for building

up social infrastructure, and obtaining the different low interest loans, long pay back term loans, etc., that are being offered to developing countries by the developed countries such as World Bank, Asian Development Bank, European Development Bank, etc.

3) Utilization of private capital (IPP: Private electric power development businesses)

In order to drive forward the electric power source development plan of Syria, it is important to keep in view the utilization of private capital, and also to promote urgently the establishment of laws, technical design (establishing a system for the exchange between national power and private electric utility companies regarding technical aspects), etc.

However, in order to include private electric power development companies, it is necessary to establish the governmental policies for ensuring safety of the country's energy.

Even when we look at the examples of different countries in the world, in the case of most of the electric power generation facilities installed by private electric utilities companies, the investment recovery period has been set at seven years to ten years, and a number of concessions will have to be provided to private electric power generation companies.

For example, a study was made in Indonesia about the effect of introducing private electric power generation companies, and this study gave a warning that "the usage ratio of the power plants owned by the electric power supplier of Indonesia (the public company) would decrease and also the financial status would worsen" if the private power generation companies are given an electric power generation energy ratio of 80 percent (base load contract), and also priority for setting the selling and buying of electricity charges.

In this way, we recommend that the entry of private electric power generation companies should be allowed after thoroughly discussing the design of the system inside the country, and after investigating the balance within the system between Syrian electric power company (PEEGT) and IPP. Based on the experience of the Study Team, even for ensuring the safety of the energy of the Syrian nation, it is recommended that the amount of such entry should be limited to 2 percent to 25 percent of the capacity of the facilities constituting the system.

Therefore, it is desirable to promote the entry of private electrical power generation companies after paying attention to the following aspects.

- Establishing an electric power development plan which is balanced between Public Establishment of Electricity for Generation and Transmission (PEEGT) and the IPP project builds a healthy electric power system that efficiently satisfies the growing demand for electric power, and matches with the energy policies of Syria.

- The IPP project should be evaluated considering the economical aspects such as the electric power purchasing price, technical consistency with the Syrian electric power

system, effect on the environment, timely development of the electric power necessary for healthy social advancement and economic development towards meeting the goals of the 2025 vision established by the Syrian government, the costs and benefits, etc.

- The avoidable cost of Syria, which is the sum of the power generation cost, expenses for connection to the system, and integrated system expenses should be made clear when a new electric power plant is to be established by Syria, and the electricity purchase price should be set considering the avoidable cost.

- Fair competition between PEEGT and IPP should be promoted, and in order to reduce the uncertainties of the IPP project, project transparency should be achieved regarding the tenders, contract negotiations, and contract establishment.
  When introducing private funds such as in a joint venture with IPP as well as PEEGT, the base load, middle load, and the peak load, etc., should be evaluated for each power supply type and fuel type in order to efficiently meet fluctuations in the future demand pattern, and the entry of IPP should be promoted. At the time of such entry, power purchasing menus should be prepared such as purchasing peak load power which has a low usage rate at a high power purchasing price, etc., in order to carry out electric power development in a timely manner, and the electric power development plan should be supported in synchronization with the country's energy policies.

An example of the avoidable cost published by a Japanese electric power company for introducing IPP is given below.

- Avoidable cost

The avoidable cost is defined as follows as the sum of power generation cost, transmission interconnection expenses, and supply interconnection expenses.

Avoidable cost = Power generation cost + interconnection expenses + supply interconnection expenses

(a) Power generation cost

The power generation cost is calculated as the expenses of new additional facility installation. These expenses consist of the capital expenses, fuel expenses, and operating expenses (O&M).

The number of years used for calculating the depreciation of the facilities for calculating the capital expenses is as follows.

Thermal power generation facility: 25 years

Pumped-storage hydroelectric power: 34 years

Interconnection facilities (transmission lines): 27 years

Discount rate: 5.25 percent (ROR: Rate of Return matching the electricity charges)

(b) Interconnection expenses

These are the expenses for the interconnection facilities that are necessary for connecting a new power generation facility to the existing interconnection lines.

(c) Supply interconnection expenses

This is the sum of the expenses of the transmission facilities possessed by the electric power company and the transmission loss equipment expenses.

Based on this type of thinking, an example of the avoidable costs published by a Japanese electric power company at the time of a tender notice is given below.

Table 10.2-6 Examples of avoidable costs disclosed publicly in the call for tenders

Power supply type	Fuel type	Calendar day power generation amount (%)	Avoidable cost (Yen/kWh)
Base load	Coal, LNG	80% 70% 60%	9.3 10.2 11.4
Intermediate load	LNG, Oil	50% 40% 30%	12.4 14.6 18.1
Peak load	Pumped-storage hydroelectric power	20% 10%	19.5 33.4

Source: Prepared by SAPS: OECF survey team

The above is an example of the values published at the time of calling for tenders at the time when the electric power company introduced IPP. These are given here so that they can be referred to at the time when Syria aims to introduce IPP in the future. Therefore, it is important that even PEEGT strictly examines its own capital account, plans a system configuration matching with IPP, and sets the electricity charges.

4) Diversification of fund procurement sources at the time of privatization of PEEGT

If we think back about the mission of an electric power company, there will be a big load on the

supplier of electric power when a governmental organization of the country is to be privatized in spite of having a part that is for public good. Further the balance between the electric power demand and supply is important, and as the scale of the economy becomes bigger, even the scale of this supply becomes larger. Looking back at the transition that the electric power industry has gone through in Japan, centralized management was done by the country in the 1940's carrying out a policy of uniform low electricity charges all over the country, and as a result it was inevitable that subsidies from the government had to be pumped in. In addition, the responsibilities for supply and the location of those responsibilities among the government, the electric power supply, and distribution were vague, leading to frequent power failures, and reduction in the level of service was very clearly visible. In view of experience and consequent repentance, in the 1950's the entire country was divided into nine regions, and a private company with its own autonomy and responsibilities for integrated management of transmission and distribution was born with an organization that would aim to provide stable supply in each region. As a result, the establishment of electric power which has a major role in the infrastructure of social life was separated from the control of the governmental organizations, providing the electric power company with self-management with responsibilities for operation and supply, and an organization was built again that could quickly achieve supply and demand balance in each region. Because of this, establishment of electric power facilities progressed in each region, which later contributed greatly to the economic development of Japan. When the scale of electric power supply becomes big in this manner, it is necessary and unavoidable for Syria to reduce the influence of the country's government to the smallest possible extent, and to build up a system which makes it possible to establish an electric power supply infrastructure under speedy decision-making.

5) Procurement of loan funds from other friendly Arab countries

Among the recent construction plans and projects under construction, there are two plants under construction that were supported by loans from Iran (450 MW class, 750 MW class: combined cycle plant), and a conventional type power generation plant is under construction with finance from India, both of which have friendly relationships with Syria.

For the sake of reference, the status of funds is shown below for the plants that are currently under construction and the plants that are scheduled to be constructed from now on (2014).

No. 1 Project finance: Iran
Output: GT: 150 MW × 2, ST: 150 MW Total: 450 MW
Project expenses: 240 million Euro, in Syrian pounds: 2.4 billion (equivalent to 37

million Euros)

No. 2 Project finance: Soft loan from India (India finance: 60%, own finance: 40%)
Output: ST (manufactured by Bharat): 200 MW × 2 Total: 400 MW
Project expenses: 307 million Euros, in Syrian pounds: 3.5 billion (equivalent to US $75 million Euros)

No. 3 Project finance (Iran)
Output: 150 MW × 2, ST: 150 MW Total: 450 MW

No. 4 Project (Alstom: Supplier's loan)
Output: 250 MW × 2, ST: 250 MW Total: 750 MW

Further, before the Syrian internal turmoil, there was good internal security status, and the construction plans are progressing well up to 2015. However, when we consider how the electric power generation businesses should be, it is desirable to aim at diversifying the funds procurement considering the fact that the autonomy of the business organization is likely to be lost due to the dependence on the government (transferred loans) becoming too high or because the procured resources become too polarized.