Impacts of Financial Crisis on Asian Energy Supply and Demand and Outlook

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Introduction

The financial crisis since July 1997 caused serious economic damages to the once booming Asian economies except a few areas. Above all, the three of South Korea, Indonesia and Thailand were harshly devastated by the crisis. And the economic stagnation induced by the crisis very much affected the energy supply and demand of the Asian economies, including the three.

Truly, it is often reported that signs of recovery are shown in recent economic trends. However, there is a possibility that crisis-led economic slump, which brought about significant impact on energy sector, can lead to affect future energy and environmental configuration.

Given these concerns, this report picked out from the Asian economies twelve countries & areas (China, South Korea, Taiwan, Hong Kong, Singapore, Indonesia, Malaysia, the Philippines, Thailand, Brunei, Vietnam and India, hereinafter referred to as the "Asian-12"). Then, for the Asian-12, we made a long-term energy supply and demand forecast up to the year 2020. What subjects can be drawn from the forecast results is discussed as well.

The forecast results and other data referred to in this report are based on "The Asian Financial Crisis and Energy Supply and Demand Outlook by 2000," a study that IEEJ conducted on behalf of the Committee for Energy Policy Promotion. Acknowledgements are due to the CEPP for its kind permission of our releasing the forecast results here.

1. Impacts of the Asian Financial Crisis on Energy and Environment

1-1 Asia having continued a high growth

Asia has achieved a remarkable growth, which conferred the title of the world's growth center on this region. In addition, Asia is showing a high population growth, and its population share is more than half of the world's population. Because of these factors, its energy demand is growing high as well. Asia's share in the world's total primary energy supply jumped from 14% in 1971 to 26% in 1996 (see Table 1-1). In per capita terms, Asia's primary energy supply grew 3.6%/year (on average in 1990 - 96), higher than any other regions (up 0.7% in OECD and down 4.0% in the rest of the world over the same period). Yet, in absolute terms, Asia's per capita primary energy supply remains still low, about one sevenths of OECD and about two thirds of the rest of the world.

Followings are major characteristics of energy supply and demand of the Asian-12 [*1] covered by this study (see Tables 1-2 - 1-4). First, by region, China and India share massive amount in energy consumption (about 70% of the Asian-12's total on a primary energy supply basis as of 1996). But, focusing on the incremental portions, the Asian NIEs and ASEAN have made greater contributions these years in response to their high economic growth (see Table 1-2 & Fig. 1-1).

On energy mix by source, the high shares by coal and oil remain unchanged little from the past (see Table 1-3 & Fig. 1-2). For this reason, the emissions of CO_2, a greenhouse gas, have been increasing. Indeed, Asia is responsible for most of the world's incremental CO_2 emissions in 1990 - 1996 (see Table 1-1 & Fig. 1-3).

1-2 Impacts of the financial crisis on the economy

With the financial crisis arising from Thailand in the summer of 1997, the burgeoning Asian-12 suffered severe economic blows[*2]. Except a few, notably China and India, whose currencies were not subject to the sell-off drive, each of the Asian-12 was severely hit by the crisis. Above all its destructive impacts were visible in South Korea, Indonesia and Thailand (see Figs. 1-4 & 1-5).

*1 The Asian-12's energy demand (on a primary energy supply basis) accounts for more than 95% (1996) of Asia's regionwide (excluding Japan).

*2 Blamed for the blows are a rapidly worsening current account balance of external payments and volatile-ever fluctuations in the exchange rate due to fleeing short-term private capital. The poorly-established financial system and overheated investments worsened by shrinking exports are also pointed out as the underlying causes.

Table 1-1 Asia's Population, GDP, Primary Energy Supply and CO_2 Emissions

(Units: million persons, US$ billion, MTOE, Mt-C)

		1971	1980	1990	1996	80/71	90/80	96/90	96/71	Share ('96)
Population	Asia	1,904	2,293	2,757	3,026	2.1%	1.9%	1.6%	1.9%	52.9%
	OECD	845	920	995	1,043	0.9%	0.8%	0.8%	0.8%	18.2%
	Rest of the world(ROW)	984	1,192	1,477	1,650	2.1%	2.2%	1.9%	2.1%	28.8%
	World total	3,733	4,405	5,230	5,718	1.9%	1.7%	1.5%	1.7%	100.0%
Economy	Asia	1,755	2,665	4,313	5,489	4.8%	4.9%	4.1%	4.7%	25.7%
	OECD	7,011	9,119	11,626	12,911	3.0%	2.5%	1.8%	2.5%	60.5%
	ROW	1,747	2,694	3,156	2,943	4.9%	1.6%	-1.2%	2.1%	13.8%
	World total	10,513	14,479	19,094	21,342	3.6%	2.8%	1.9%	2.9%	100.0%
Primary energy supply	Asia	679	1,051	1,649	2,230	5.0%	4.6%	5.2%	4.9%	26.3%
	OECD	3,089	3,674	3,964	4,347	1.9%	0.8%	1.5%	1.4%	51.2%
	ROW	1,142	1,753	2,190	1,920	4.9%	2.2%	-2.2%	2.1%	22.6%
	World total	4,909	6,478	7,803	8,497	3.1%	1.9%	1.4%	2.2%	100.0%
CO_2 emissions	Asia	593	901	1,389	1,842	4.8%	4.4%	4.8%	4.6%	30.2%
	OECD	2,453	2,797	2,805	2,878	1.5%	0.0%	0.4%	0.6%	47.2%
	ROW	955	1,387	1,620	1,379	4.2%	1.6%	-2.6%	1.5%	22.6%
	World total	4,000	5,085	5,814	6,099	2.7%	1.3%	0.8%	1.7%	100.0%

(Note) Japan and South Korea are included in, not OECD, but Asia.
(Source) EDMC, "Handbook of Energy & Economic Statistics in Japan"

Table 1-2 Asian-12's Energy Situations: Primary Energy Supply (by Area)

(Unit: MTOE)

	1980	1985	1990	1996	85/80	90/85	96/90	96/80	Share ('96)
China	413	517	656	891	4.6%	4.9%	5.2%	4.9%	10.5%
Asian NIEs	83	104	164	266	4.5%	9.5%	8.4%	7.5%	3.1%
South Korea	44	55	92	163	4.8%	10.7%	10.0%	8.6%	1.9%
Taiwan	28	33	48	67	3.5%	7.6%	5.9%	5.7%	0.8%
Hong Kong	6	7	11	12	5.9%	7.0%	2.4%	4.9%	0.1%
Singapore	6	8	13	24	5.3%	11.3%	10.1%	9.0%	0.3%
ASEAN-6	65	87	137	230	6.0%	9.4%	9.0%	8.2%	2.7%
Indonesia	26	36	58	88	6.8%	10.1%	7.3%	8.0%	1.0%
Malaysia	10	15	22	39	9.8%	7.5%	10.1%	9.2%	0.5%
Philippines	13	14	18	28	0.5%	6.2%	6.9%	4.6%	0.3%
Thailand	12	16	30	59	5.5%	13.8%	11.7%	10.4%	0.7%
Brunei	0.3	2.1	2.6	3.3	45.2%	4.4%	3.9%	15.5%	0.0%
Vietnam	4	5	6	13	2.6%	3.9%	14.9%	7.5%	0.2%
India	94	130	184	262	6.7%	7.2%	6.0%	6.6%	3.1%
Asian-12 total	656	838	1,140	1,648	5.0%	6.4%	6.3%	5.9%	19.4%
Japan	346	367	439	510	1.2%	3.6%	2.5%	2.4%	6.0%
OECD total	4,065	4,121	4,495	5,020	0.3%	1.8%	1.9%	1.3%	59.1%
World total	6,478	6,972	7,803	8,497	1.5%	2.3%	1.4%	1.7%	100.0%

(Note) The shares are those in the world total.
(Source) IEA, "World Energy Statistics and Balances of Non-OECD Countries"; EDMC, "Handbook of Energy & Economic Statistics in Japan"

Table 1-3 Asian-12's Energy Situations: Primary Energy Supply (by Energy Source)

(Unit: MTOE)

	1980	1985	1990	1996	85/80	90/85	96/90	96/80	Share('96)
TPES	656	838	1,140	1,648	5.0%	6.4%	6.3%	5.9%	100.0%
Coal	383	520	675	907	6.3%	5.3%	5.1%	5.5%	55.0%
Oil	234	247	353	556	1.1%	7.4%	7.9%	5.6%	33.8%
Gas	20	37	61	115	12.7%	10.9%	11.0%	11.5%	7.0%
Nuclear	4	13	24	35	28.0%	12.7%	6.5%	14.8%	2.1%
Hydro	10	15	21	26	7.6%	6.9%	3.6%	5.9%	1.5%
Others	4	7	7	9	8.5%	0.4%	5.6%	4.8%	0.6%

(Source) EDMC, "Handbook of Energy & Economic Statistics in Japan"

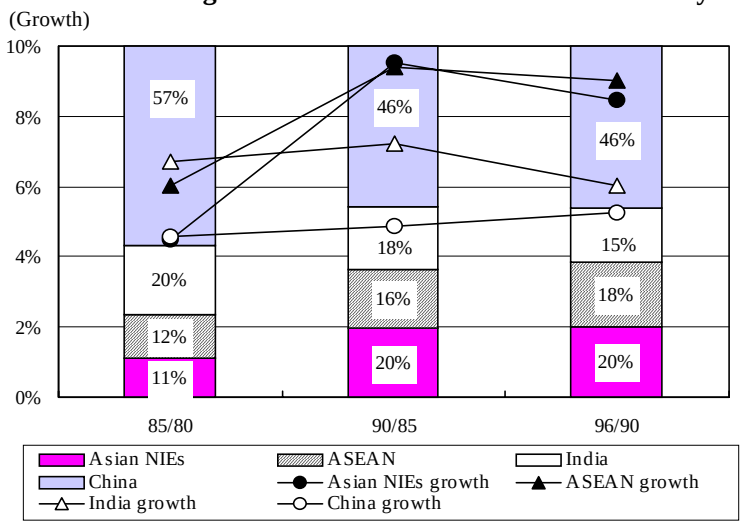
Table 1-4 Asian-12's Energy Situations: Final Energy Consumption (by Sector)

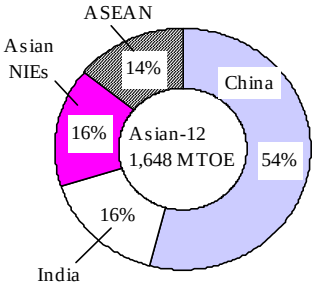
(Unit: MTOE)

	1980	1985	1990	1996	85/80	90/85	96/90	96/80	Share('96)
Total final consumption	500	638	826	1,154	5.0%	5.3%	5.7%	5.4%	100.0%
Total Industry sector	280	359	464	647	5.1%	5.3%	5.7%	5.4%	56.1%
Iron and Steel	73	79	102	130	1.5%	5.2%	4.2%	3.7%	11.3%
Chemical and petrochemical	62	78	111	189	4.8%	7.4%	9.2%	7.2%	16.4%
Others	145	202	251	328	6.9%	4.4%	4.6%	5.2%	28.5%
Total Transport sector	71	91	129	203	5.0%	7.4%	7.8%	6.8%	17.6%
Automobiles	41	58	89	154	7.4%	8.9%	9.5%	8.6%	13.3%
Others	30	32	40	49	1.5%	4.5%	3.5%	3.2%	4.3%
Total Other sectors	136	177	217	275	5.4%	4.2%	4.0%	4.5%	23.8%
Agriculture	25	27	35	45	2.2%	5.1%	4.3%	3.9%	3.9%
Commercial & public services	13	23	37	70	12.0%	9.9%	10.8%	10.9%	6.0%
Residential	88	120	141	157	6.2%	3.3%	1.8%	3.6%	13.6%
Others	9	6	3	4	-8.1%	-12.2%	2.4%	-5.6%	0.3%
Non-energy use	13	12	15	27	-1.4%	4.2%	10.7%	4.7%	2.4%

(Source) IEA, "World Energy Statistics and Balances of Non-OECD Countries"

Fig. 1-1 Fluctuations in Asian-12's Primary Energy Supply

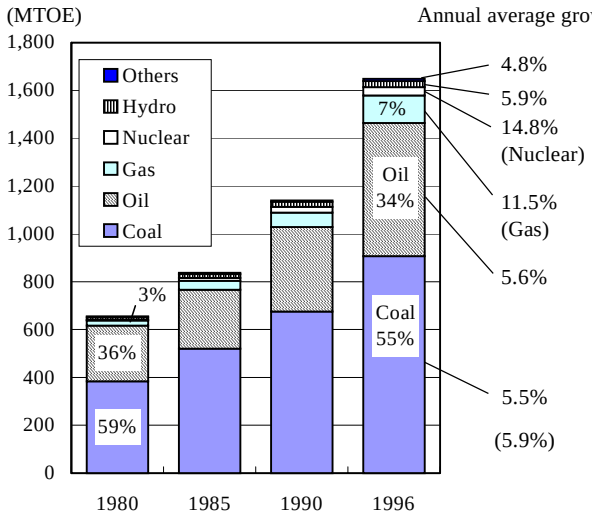




Cf. Asian-12's Shares in Total Primary Energy Supply in 1996

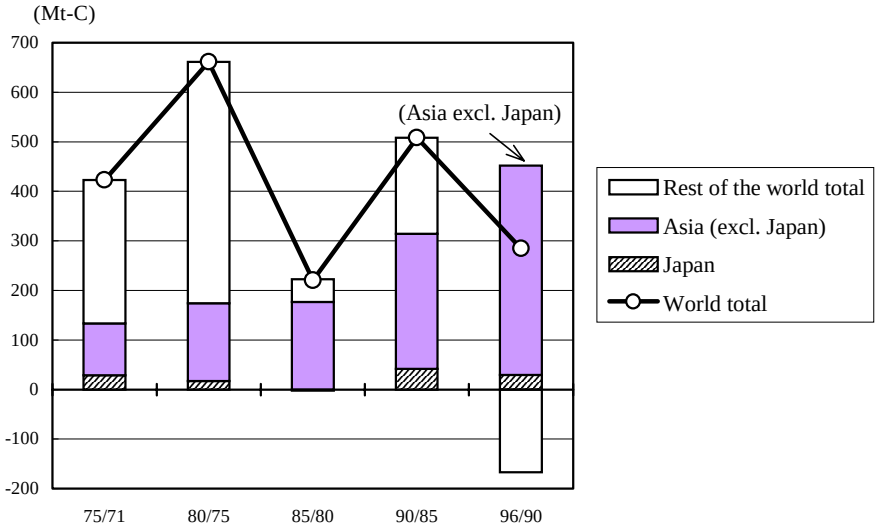
(Note) The figures in the bar graphs are those in total (the same applicable to all the subsequent graphs).
(Source) IEA, "World Energy Statistics and Balances of Non-OECD Countries"; EDMC, "Handbook of Energy & Economic Statistics in Japan"

Fig. 1-2 Asian-12's Primary Energy Supply (by Energy Source)



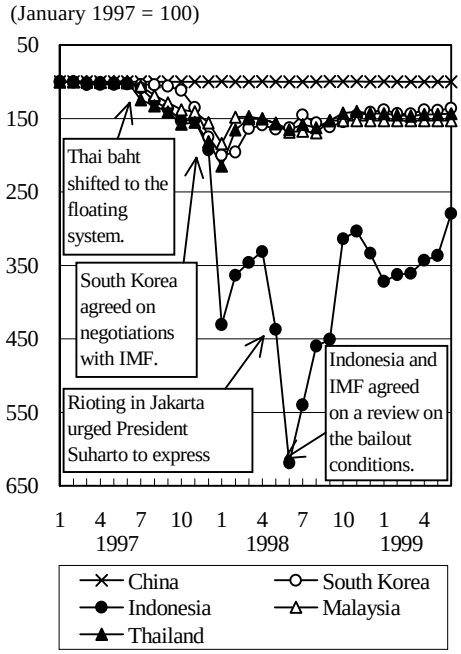
(Note) Of the growth rates, those in parenthesis represent the growth of the total (the same applicable to all the subsequent graphs).
(Source) EDMC, "Handbook of Energy & Economic Statistics in Japan"

Fig. 1-3 Asia's Contribution to the World's Incremental CO_2 Emissions



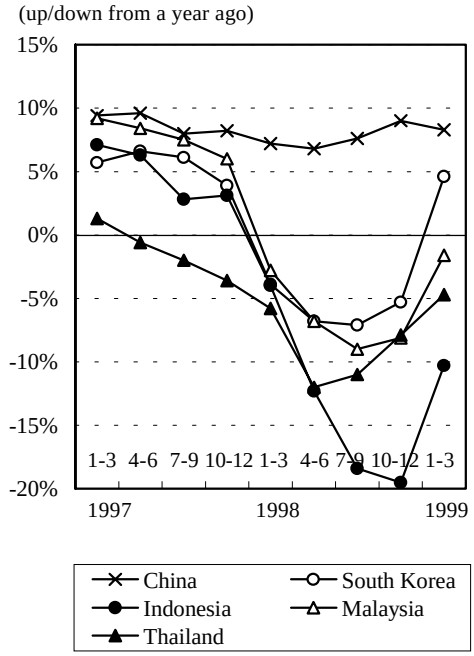
(Source) EDMC, "Handbook of Energy & Economic Statistics in Japan"

Fig. 1-4 Changes in Exchange Rates



(Source) The Toyo Keizai, "Statistical Monthly Reports"

Fig. 1-5 GDP Trends



(Source) Prepared by IEEJ from various materials.

But, even these countries now set to show signs of recovery as they are striving toward economic reform programs under the IMF bailout package that they received in return for economic liberalization, etc. (see Figs. 1-4 & 1-5).

1-3 Impacts on energy supply and demand

Even if the economy is on gradual recovery, it remains unchanged that the latest financial crisis considerably affected the energy configuration, on both supply and demand sides, of South Korea, Indonesia and Thailand.

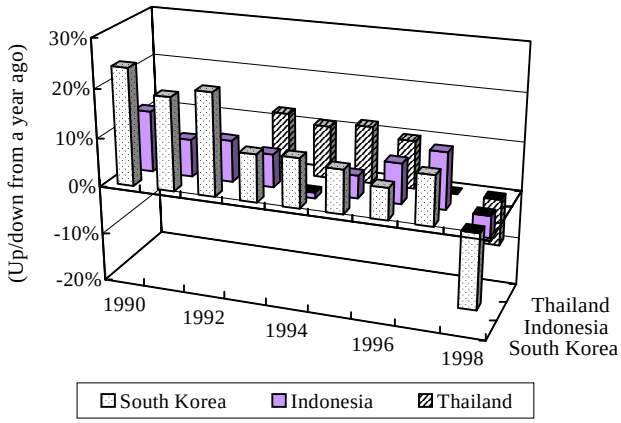
On demand side, energy demand went down considerably by axed energy subsidies, energy-related tax increases, etc., on top of the economic stagnation. For example, entering 1998, the petroleum product demand growth set to go down below the previous year in all of the three countries. In 1998 electricity demand also marked the first drop in the 1990s from a year ago in South Korea and Thailand. In

Indonesia, total electricity demand ended in a slight increase over the previous year, but the industrial sector plunged by a sharp 9% from a year ago. Likewise, South Korea's natural gas demand showed the first decline in the 1990s from a year ago particularly due to the decrease in demand for power generation (see Figs 1-6 - 1-8).

On supply side, the most visible impact can be seen in many facility construction projects reviewed or postponed due to fund shortages and/or diclining demand. For example, Indonesia grouped IPPs with already signed power purchase agreements into three classes: to be continued, reviewed, or postponed. But, even those grouped in the to-be-continued class, some projects are reportedly under renegotiations on the already agreed power purchase price (wholesale power price) in response to worsening financial conditions of the national power corporation (PLN). In Thailand and Malaysia, too, IPP projects screened in the pre-crisis days were postponed or downsized. In these countries, the impacts of the latest crisis are also noted in such forms as postponements and scale down of natural gas projects and refinery construction plans (see Tables 1-5 - 1-7).

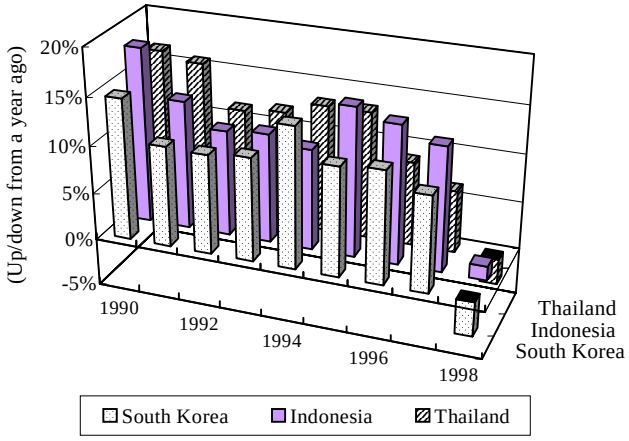
As a result, the fuel-switching policies were influenced as well. In South Korea, before crisis fuel switching policy encouraged shift from coal to natural gas, at the same time reducing reliance on oil. However, with the crisis, coal demand surged particularly in electricity sector because of the utilities' cost minimization effort. In Indonesia, where coal was highly prioritized even before the crisis, the coal shifts became more visible than ever in the post-crisis days. It is because that natural gas is more export oriented as a means to acquire foreign currency. In Thailand, though limited to the electricity sector alone, there is little change in policy terms even after the crisis, that is, the top priority is given to natural gas as in the past. Yet, hearing[*3] surveys made to electric utilities found that they would prefer less

Fig. 1-6 Petroleum Product Demand Trends in Crisis-Hit Countries



(Source) Prepared by IEEJ from various materials.

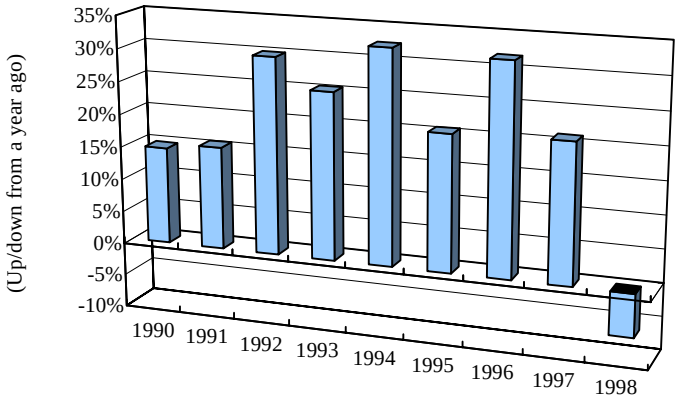
Fig. 1-7 Electricity Demand Trends in Crisis-Hit Countries



(Source) Prepared by IEEJ from various materials.

*3 According to our interview survey made to EGAT, the national electric power corporation of Thailand (in January 1999).

Fig. 1-8 Natural Gas Demand Trends in Crisis-Hit Country (South Korea)



(Source) KOGAS homepage

expensive oil than natural gas, if allowed.

Given these impacts surfacing, oversupply is temporarily likely in reflection to shrinking demand. But, depending on the degree of demand recovery, a supply capacity can run short. In addition, along with the IMF-led structural reform programs, various moves, notably liberalizing the energy markets and selling national enterprises to the private sector including foreign capital, are about to take place rapidly. In this point too, shifts to cheaper energies can distort an energy balance.

1-4 Worsening regional environmental problems

The financial crisis urged some energy projects to be postponed or dropped and also caused the shifts to cheaper energies, which led to growing use of fossil fuels, typically coal and oil. As a result, worsening regional environment is worried. While environmental problems can roughly be divided into regional and global ones, the Asian-12 is deeply involved in either of the two.

Among regional environmental problems, acid rain and air pollution can be cited first. Particularly,

Table 1-5 Impacts of Financial Crisis on Power Projects

	General situations
South Korea	Even in the pre-crisis days, the South Korean government pledged to allow IPPs to participate in the power production market. After the crisis, the government unveiled a policy to expand IPP introduction more than originally planned from the standpoint of introduction of competition and efficiency improvement.
Indonesia	Due to the financial crisis, the Indonesian government grouped IPPs with already signed power purchase agreements (PPAs) into three: (1) continued, (2) reviewed or (3) postponed. But, financially squeezed PLN is worried not able to implement even the continued projects. Thus, PLN started negotiations on full-scale wholesale power price cuts (though what's negotiated is not disclosed).
Thailand	Based on the pre-crisis strong demand outlook, IPP bids were held and nearly 6 GW projects were contracted. But, due to an oversupply capacity caused by the crisis, many projects were renegotiated on postponements, which were generally agreed.

(Source) Prepared by IEEJ from various materials.

Table 1-6 Impacts of Financial Crisis on Natural Gas (LNG) Projects

	Impacts on natural gas (LNG) projects
South Korea	On already signed LNG import contracts with Indonesia (short-term), Malaysia (short-term) and Brunei (long-term), lifting of the contract volumes was partially postponed. Negotiations under way with Abu Dhabi, Canada and Yemen were defered for the time being. On-going LNG purchase projects, South Korea is reportedly requesting reductions in taking amount.
Indonesia	In addition to shrinking demand of natural gas-importing countries, typically South Korea and Thailand, advancing deregulation in various Asian countries, among others, makes new projects hardly started up as scheduled.
Thailand	Including those from Oman, Indonesian Natuna gas fields, Myanmar's Yadana gas fields, and Malaysian-Thai joint development fields, many natural gas (LNG) import projects were changed from original plans in such points as the starting time. Some projects were virtually nullified

(Source) Prepared by IEEJ from various materials.

Table 1-7 Impacts of Financial Crisis on Refinery Projects

	Changes in capacity construction projects, etc.
South Korea	The entry rules into refining businesses were eased (conventional licensing system replaced with a registration system which allowed the entry of anyone who has a refining capacity of 45-day needs plus a storage capacity of 60-day needs; the ceiling of foreign capital ownership raised from conventional 50% to 100%). But, new and additional capacity construction projects were totally absent.
Indonesia	Large numbers of private refinery construction projects were approved. But, many of them are postponed or scaled down due to the funds shortage. The Weekly Petroleum Argus, an oil technical journal, reported in its 1998 November 16 article that the government would introduce tax incentives to stimulate 16 private projects, none of which has been in progress so far.
Thailand	PTT (Petroleum Authority of Thailand) The economic crisis urged the postponement, for the present, of a PTT plan to build an about 300,000 b/d grassroot refinery by around 2003 in the Malay Peninsula as part of the Thai Southern Coast Development Project. To be reviewed again in around 2005. TPI (Thai Petroleum Industry) TPI planned to build an additional 65,000b/d refinery in Map ta put (in the southeast of Bangkok), then increase its capacity to 150,000 b/d and further to 300,000 b/d in the future. For a while, capital participation in this project was favorably negotiated with Kuwait Petroleum Corporation (and necessary parts for the first-phase capacity expansion to 150,000 b/d were already ordered). But, the project was cancelled after the economic crisis. The parts were resold.

(Source) Prepared by IEEJ from various materials.

not only because the Asian-12 features a high share of coal-fired power but because few are well-equipped with flue gas desulfurizers (FGDs) which can push the cost up, the damage of acid rain[*4] is seriously spreading. Many of planned capacity additions to meet incremental electricity demand in the future are likely to be coal-fired power (see Fig. 2-2). To make newly built capacity equipped with FGDs will be one of key measures to alleviate acid rain problems in the years to come.

1-5 Involvement in global environmental problems

Among global environmental problems, most concerned is the relation between global warming and this region. While the Third Session of the Conference of the Parties to the Framework Convention on Climate Change (COP3, in 1997) agreed on the introduction of flexibility mechanism (Kyoto Mechanism), many projects to be get involved in the mechanism are postponed or dropped due to the financial crisis. How the mechanism can be in practice under such circumstances will pose above all a crucial question in the days ahead.

Kyoto Mechanism is the market-based systems designed to achieve GHG emissions reduction targets by taking the most cost-effective means. It consists of three systems: emissions trading, joint implementation (JI) and clean development mechanism

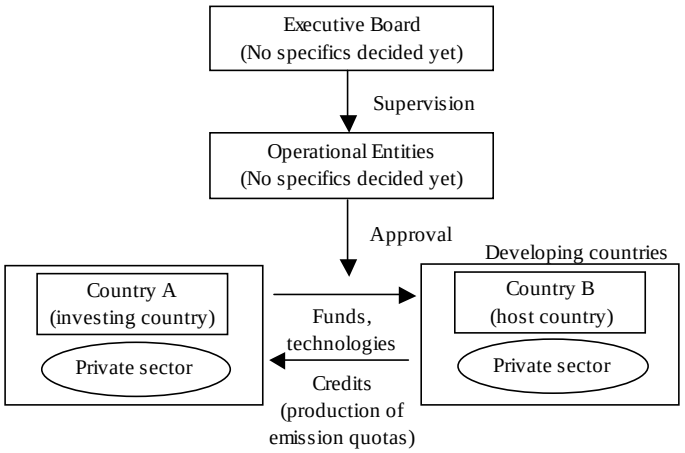
Table 1-8 Outline of Flexible Mechanism

	Emissions trading	Joint Implemention (JI)	CDM
Character	To utilize market mechanism.	To utilize market mechanism.	To utilize market mechanism.
Primary participants	Limited to industrialized countries and the like (Annex B parties)	Limited to industrialized countries and the like (Annex I parties)	Between industrialized countries (Annex I parties) and developing countries
Transfer of emissions	Transferred within a pre-allocated emissions quota.	Transferred after a reduced amount becomes definite.	Transferred after a reduced amount is confirmed.
System	Trading within an allocated emissions quota (allowance system).	On a project basis (credit system)	On a project basis (credit system)
When trading can be started?	From the first commitment period (starting 2008)	From the first commitment period (starting 2008)	Possible from 2000 onward
Increased emissions quotas allowed or not?	Trading results won't be added to a given party's emissions quota.	Project-based results won't be added to a given party's emissions quota.	Project-based results can be added to a given industrialized party's emissions quota.
Supplementarity	To be utilized as a supplementary option to domestic reduction efforts.	To be utilized as a supplementary option to domestic reduction efforts.	Can be conducted independent of domestic reduction efforts.

(Source) Prepared by IEEJ from various materials.

*4 Acid rain is defined as the rain showing a smaller pH value than 5.6 (incl. acid substances in gaseous or particulate states). Acid rain acidifies soils and lakes & swamps, the former causing trees to wither upright and the latter such damages as an extinction of fishes by elution of hazardous substances.

Fig. 1-9 Mechanism of CDM-based Trading



(Source) The Industrial Bank of Japan, "Responses to Global Warming Problems and Impacts on Japan of Flexible Mechanism Introduction," IBJ 1998 October issue

(CDM) (see Table 1-8). Emissions trading, usable among the industrialized parties, including the former Soviet Union and East Europe, allows the parties to trade part of their reduction targets under the Kyoto Protocol. JI, also among the industrialized parties, including the former Soviet Union and East Europe, features GHG reduction projects and GHG reductions achieved with such a project are counted as credits and allocated among the project partners. CDM provides similar deals to JI between the industrialized and developing parties.

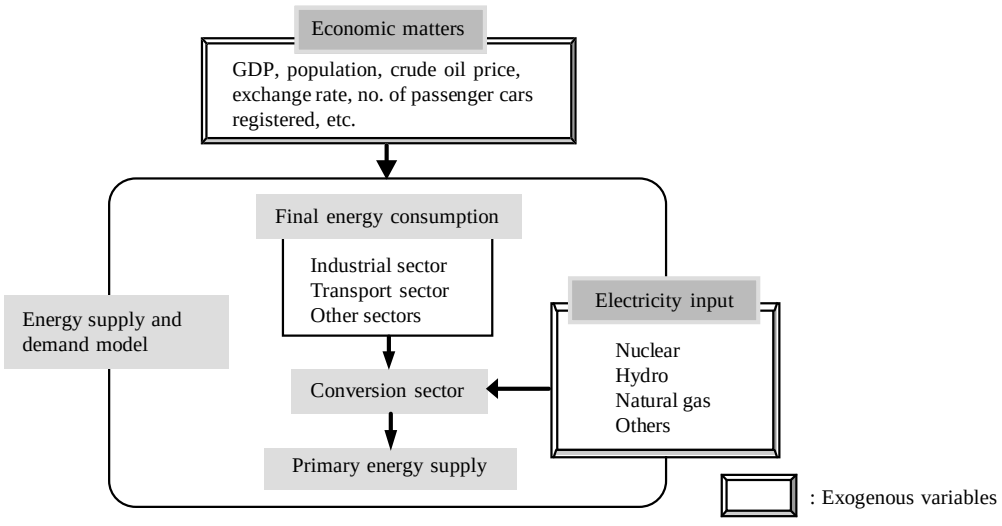
Of these, only CDM expects developing countries, including Asian ones, as participants (articulately in the language of the Kyoto Protocol that specifies the flexible mechanism). CDM is characterized in the point that it can help the severely crisis-hit countries promote their infrastructure projects, delayed due to the recent financial crisis, by inviting foreign investments (from industrialized countries)(see Fig. 1-9 for the mechanism of CDM). Also, because the Asian-12's CO_2 emissions are likely to grow sharply ahead, and because the cost to reduce CO_2 emissions can be lower than in industrialized countries, many industrialized countries expect Asia to be the promising partners of their CDM efforts.

But, developing countries on their part are not necessarily friendly enough to get on the table of negotiations. It is because the widely agreed views among them are that the past economic growth of the industrialized countries is responsible for today's global warming and that they need to prioritize their domestic economic growth.

2. Asian-12's Long-term Energy Supply and Demand Outlook and Concerns for Future

In addition to the general trends described above, we made a long-term energy supply and demand forecast for the Asian-12, based upon the following assumptions.

Fig. 2-1 Structure of Outlook Model



The population was assumed based on the long-term forecasts made by the United Nations, the World Bank, etc. The economic trend having a significant impact on energy demand was assumed that, in the long run, a steady growth would continue as the crisis-hit countries are expected to bounce back on top of the sustainable growth of China and India. (GDP of the Asian-12, up 5.3%/year on average in 1996 - 2020, will become 3.4 times larger than in 1996 by 2020.) The crude oil price was assumed to remain stable in real terms and stand at the level of $18.9/bbl (in 1997 price) by 2020.

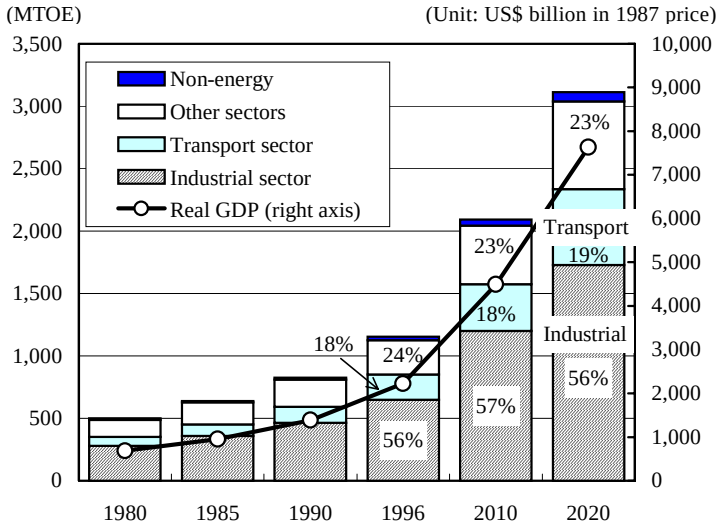
2-1 Final energy consumption

The Asian-12's final energy consumption, 1,154 MTOE (million tonnes of oil equivalent) in 1996, will increase by an average 4.2% a year from now on and reach 3,112 MTOE by 2020 (see Fig. 2-2).

By sector, energy consumption will be up 4.2%/year on average over 1996 - 2020 in the industrial sector, up 4.6% in the transport sector, and up 4.0% in the other sectors, largely the residential & commercial sectors (see Figs. 2-2 & 2-3). The higher growth in the transport sector reflects advancing motorization expected in the Asian-12, particularly the Asian NIEs.

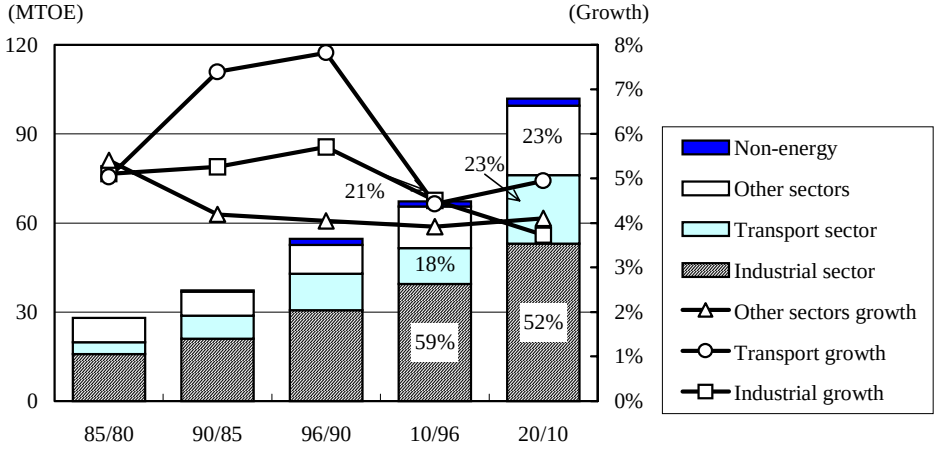
By energy source, 1996 records show that coal held the largest share at 42%, followed by 39% of oil. As of 2020, the oil share is likely to remain unchanged at 39%, but coal will have its share shrinking to 32%. It is because the shares of electricity and gas are likely to grow high, up 6.2% and 6.7%, respectively, on average between 1996 and 2020. Par-

Fig. 2-2 Final Energy Consumption Outlook (by Sector)



(Source) Actual records from IEA, "Energy Balances of Non-OECD Countries."
Forecast by IEEJ.

Fig. 2-3 Fluctuations in Final Energy Consumption Outlook (by Sector)



(Source) See Fig. 2-2.

ticularly, backed by economic development and advancing urbanization, an increasing popularity of electricity is likely, with its share expanding from 13% in 1996 to 20% by 2020 (see Fig. 2-4).

2-2 Generated electricity

The Asian-12's generated output, 2,184 TWh in 1996, will grow by an average 6.2%/year from now on and reach 9,199 TWh by 2020 (see Fig. 2-5). It is equivalent to about ninefold of Japan's generated output in FY1996. The share of fossil-fired power in the power source mix, having already risen to 80% in 1996 from 76% in 1980, is projected to rise further to 84% by 2020 (see Fig. 2-6).

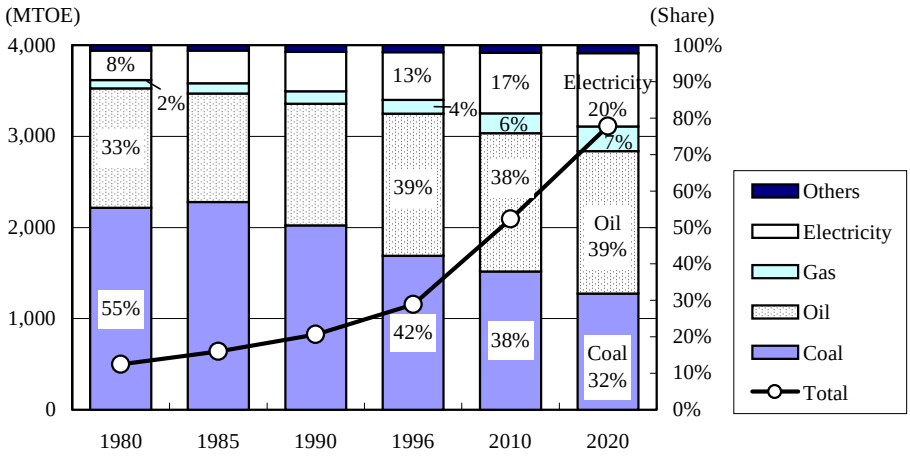
By fuel, coal is expected to keep playing the principal role and hold almost 70% of the whole, with its share, 62% in 1996, increasing to 68% by 2020. So far rapidly swelling natural gas will continue the high pitch, or up 7.3%/year on average in 1996 - 2020, and its share will expand to 9%. Thanks to steadily advancing nuclear introduction in the past, nuclear power has expanded its share to 6% by 1996. In the years to 2020, however, the nuclear share is likely to remain at 5% (see Fig. 2-6). The decline in the nuclear share reflects our assumption that, given individual governments' commitments to nuclear issues and their existing energy policies, the Asian-12's nuclear introduction is expected to be limited.

2-3 Primary energy supply

The Asian-12's primary energy supply, 1,647 MTOE in 1996, will grow by an average 4.4% a year to 4,659 MTOE by 2020. It represents a level about nine times larger than Japan's primary energy supply in FY1996.

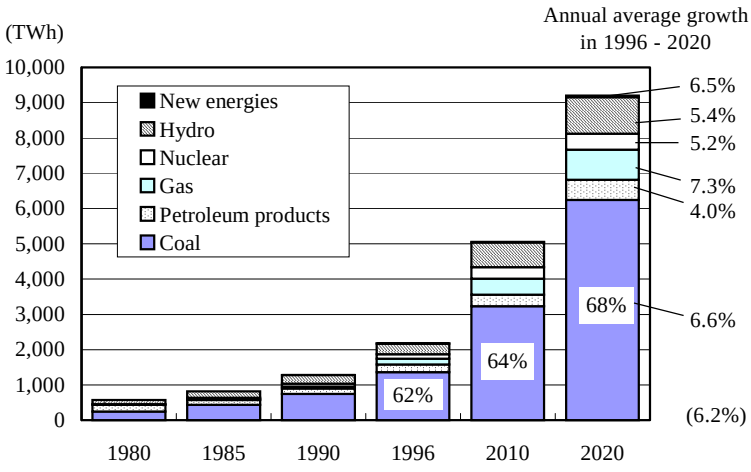
By energy source, the coal share is expected to stay virtually flat from 55% in 1996 to 54% in 2020. The coal share, on the gradual decline in final en-

Fig. 2-4 Final Energy Consumption Outlook and Energy Mix Outlook



(Source) See Fig. 2-2.

Fig. 2-5 Generated Electricity Outlook (by Fuel)



(Source) See Fig. 2-2.

ergy consumption terms, will be maintained at present level on a primary energy supply basis due to surging coal demand for power generation. The oil share will drop a little from 34% in 1996 to 31% by 2020. Natural gas, to grow a high 5.9%/year on average over 1996 - 2010 as it did in the past, will increase its share to 10% by 2020. Among others, massive increases are unlikely for all of nuclear, hydro and new energies (see Fig. 2-7).

As a result, in the long run, coal and oil are expected to keep the greater part of primary energy supply.

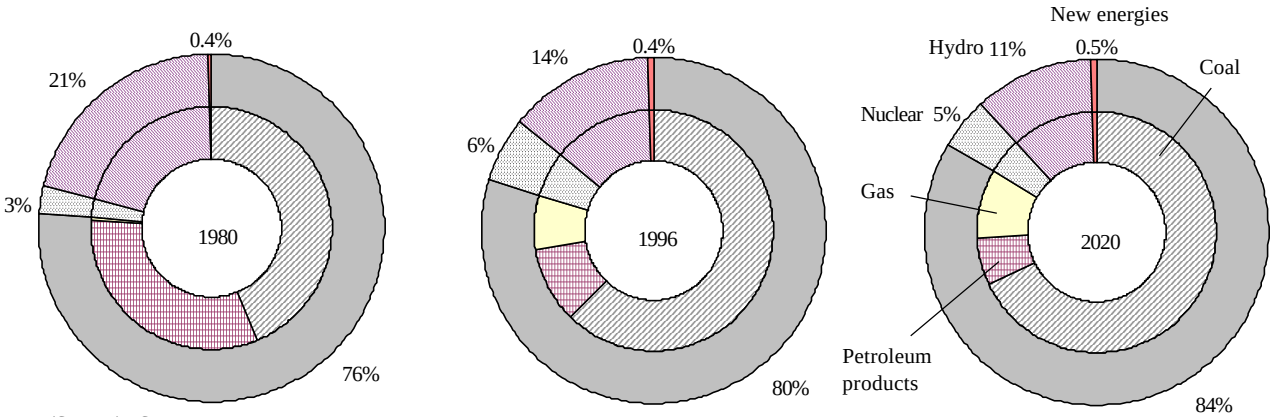
2-4 Energy demand of South Korea, Indonesia and Thailand

In the three of South Korea, Indonesia and Thailand, all severely hit by the financial crisis, a considerable slowdown in the energy demand growth is likely for the present. Later, however, along with the economic recovery, energy demand will also pick up and intensify an underlying upward trend.

As for final energy consumption by sector, the industrial and transport sectors, up more than 10% a year on average in 1990 - 96 alike, are projected to show a falling growth rate below 4% yearly on average between 1996 and 2010 due to an economic stagnation. But, from 2010 through 2020, the growth of the both sectors is expected to turn upward in parallel with the economic recovery.

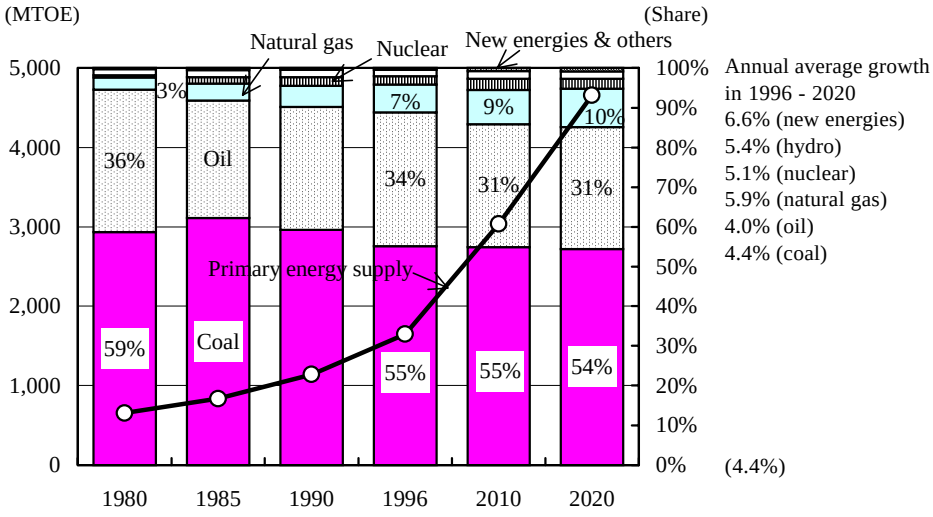
Similarly, the growth of primary energy supply is expected to plunge sharply in the years to 2010, then bounce back to an underlying recovery trend. Of the three countries, the plunge will be the steepest in Indonesia which still drags the severest damages of the currency crisis (see Fig. 2-9).

Fig. 2-6 Generated Electricity by Fuel



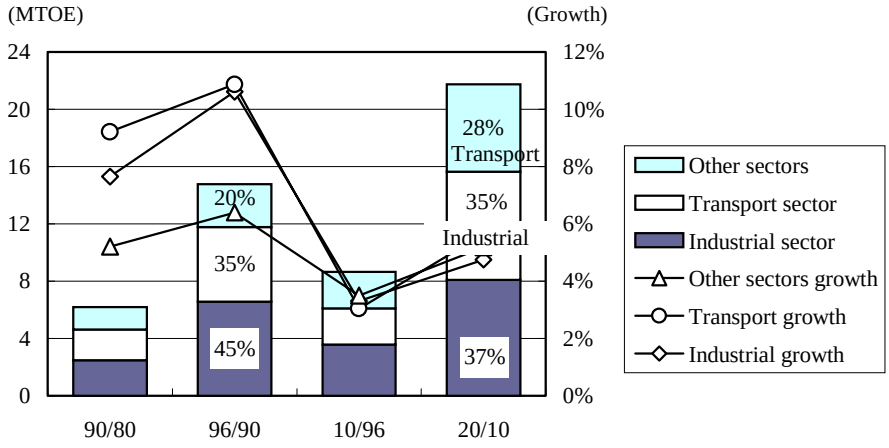
(Source) See Fig. 2-2.

Fig. 2-7 Primary Energy Supply Outlook and Energy Mix Outlook



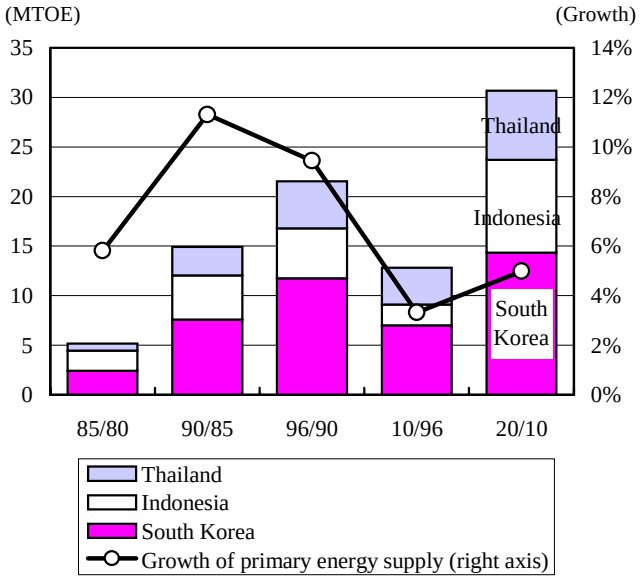
(Source) See Fig. 2-2.

Fig. 2-8 Fluctuations in Sector-Specific Final Energy Consumption Outlook for South Korea, Indonesia and Thailand



(Source) See Fig. 2-2.

Fig. 2-9 Fluctuations in Primary Energy Supply Outlook for South Korea, Indonesia and Thailand



(Source) See Fig. 2-2.

2-5 Net energy imports

One of the important points drawn from these forecast results is the Asian-12's net energy imports (defined in this report as a balance gained by subtracting domestic energy production from primary energy supply) will continue to expand.

The Asian-12's net energy imports have been almost well balanced during the 1980s. But, entering the 1990s, emerging signs showed that this group was shifting to a net energy importer. From now on, this trend is likely to get accelerated and the net energy imports are projected to increase to some 1,500 MTOE by 2020. It will be equivalent to about 3.6 times of Japan's net imports in FY1996.

Breaking down the Asian-12 by region, all regions will become net energy importers by 2020. Not to mention the Asian NIEs and India, which have been in the position of net importers for years, even China, barely in a net exporter's position as of 1996, will change into a net importer by 2010 as a result of its swelling energy demand. Moreover, the ASEAN, generally consisting of resources-aboundant members and long placed in a net exporter's position so far, is expected to get its imports and exports almost balanced by 2010, then become a net importer by 2020 (see Fig. 2-10).

By energy source, in part due to acceleratedly growing net imports by China and India[*5], coal and oil are expected to share most of the Asian-12's net energy imports (see Fig. 2-11). Particularly by 2020, oil will account for some 70% of the net energy imports. The Asian-12's net oil imports, around 200 MTOE in 1996 or a little less than Japan's net oil imports in that year, are expected to reach a high level than 1,000 MTOE by 2020. If so, judging from Japan's situations today, it's not difficult to imagine that the Asian-12 will have few alternatives but to depend on the Middle East in covering most of its import needs. For this reason, energy security can become not merely conspicuous but a serious-ever concern for this region.

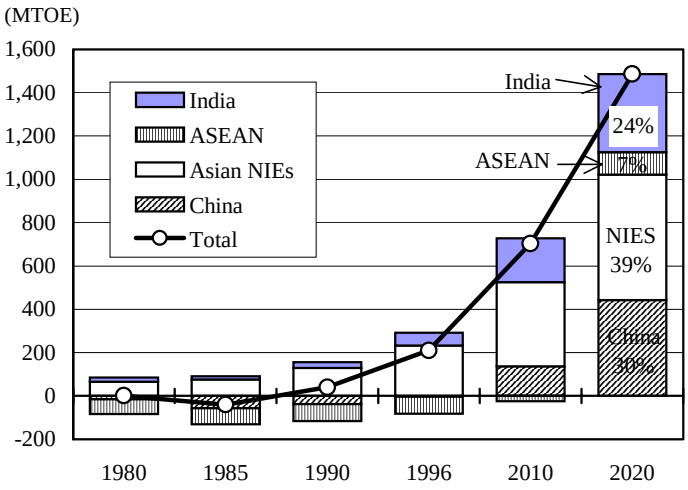
2-6 Increasing impact on environment

An additional point is increasing impact on environment.

Given such expected trends as the rising share of fossil-fired power in the power production sector, increasing energy consumption in the transport sector, aggravation of acid rain problems is worried, among others. Also, growing energy demand is expected to accompany with surging emissions of CO_2. The Asian-12's CO_2 emissions are projected to reach 4.19 billion t-C (tonnes of carbon equivalent), a little less than three times of 1996 records (see Fig. 2-12).

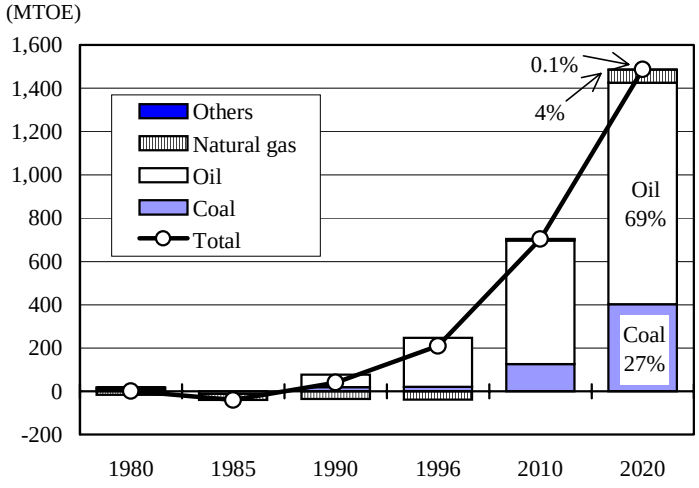
What's worried is many Asian countries and re-

Fig. 2-10 Net Energy Import Outlook (by Region)



(Source) See Fig. 2-2.

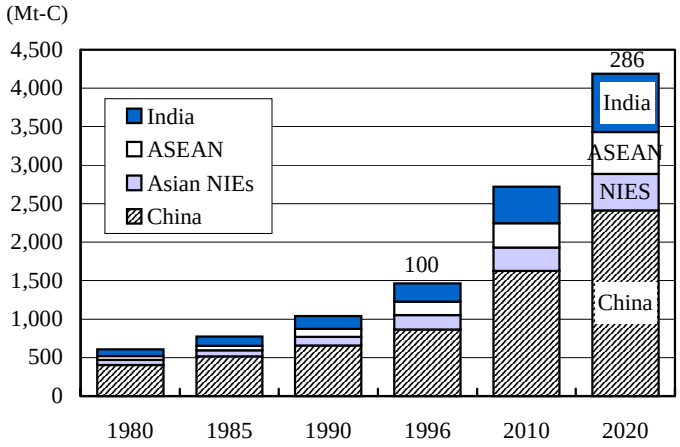
Fig. 2-11 Net Energy Import Outlook (by Energy Source)



(Source) See Fig. 2-2.

*5 According to the shares held by China and India in primary energy supply by source (1996), China accounted for 76% of coal and 19% of oil, and India did 57% and 37%, respectively.

Fig. 2-12 CO_2 Emissions Outlook

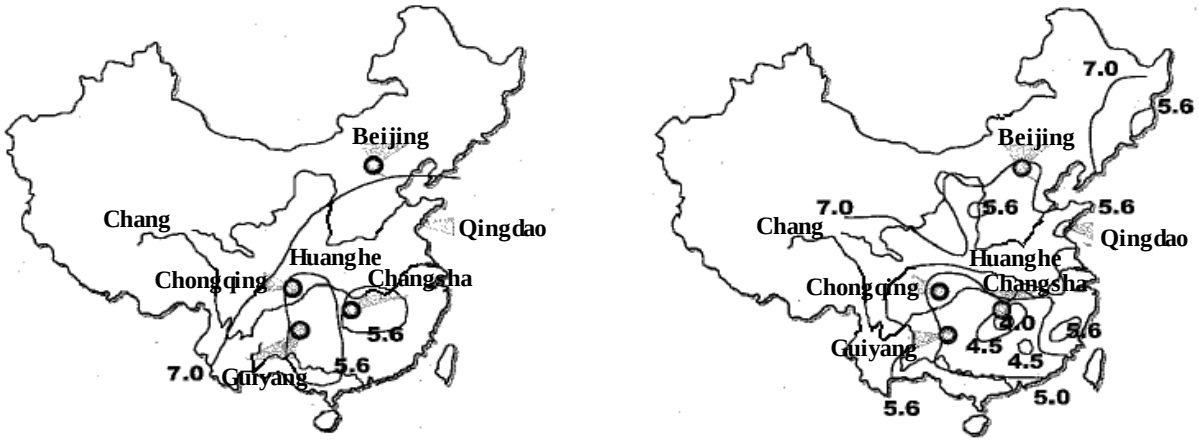


(Note) The figures on top of the bars are in index terms with 1996 records taken as 100.

(Source) Actual records from EDMC, "Handbook of Energy & Economic Statistics in Japan"; Forecast by IEEJ.

Fig. 2-13 Local Environmental Problems Getting Serious Ever - Spreading Acid Rain Damages in China

(FY1985) **(FY1995)**



(Source) Wang Qing-yao, "China's Air Pollution Problems - Present and Future," Sept. 1998, "Environmental Technology," vol.27

gions already face not only surfacing but worsening local environmental problems, typically air pollution and acid rain, that stem from poor environmental commitments, like scant progress in installing FGDs in coal-fired power plants. Taking China as an example, the distribution of acid rain has spread, from the southern part as of 1985, to the northern coastal areas by 1995. More serious acid rain damages can also be noted from an increasing number of areas that show a smaller pH value (see Fig. 2-13).

Taking these situations into consideration, Asia is likely to concentrate on local environmental problems for the time being. Focusing on unilateral commitments today, almost all countries and regions are specifically responding to local environmental problems , however, few take specific actions to mitigate global warming (Table 2-1).

Even if so, in advancing an international commitment to GHG reductions, developing countries are expected to play a key role. Given the so far described outlooks for Asian-12's energy supply and demand and CO_2 emissions, a debate on developing countries' participation in the operation of flexible mechanism (Kyoto Mechanism) will inevitably be spurred more than ever.

Table 2-1 Asian Governments' Environmental Policies and Stances toward Global Warming

	Domestic situations	
	Commitments to global warming (CO_2) control	Commitments to local environmental problems (acid rain, air pollution)
China	Currently primary environmental concerns are how to mitigate local air pollution by SO_2 and NOx, with little room left for CO_2 reduction efforts.	Concerned factories are required to report pollutant emissions, disposal facilities, and type, amount and transfer of pollutants. The National Environmental Protection Bureau disclosed the State Council issued a communication that notified production of leaded gasoline would be discontinued by late 1999.
South Korea	Positive commitments to global warming control were initiated. * A section responsible for the Framework Convention on Climate Change-related matters was newly formed under the direct control of the Prime Minister. * Sector-specific energy conservation potentials were surveyed, and conservation standards are applied to newly built buildings. In Dec. 1998 the Dept. of Trade and Industry signed a voluntary GHG reductions agreement with 11 firms, including Pohang Iron & Steel Company and LG Electronics.	Air pollution control measures have been taken, including the mandatory use of low-sulfur fuels, fuel switching to LNG, automobile pollution control, and particulate reductions. Among others, an increasing number of automatic air pollution monitoring systems are introduced, and the degrees of air pollution are made open to the public.
Taiwan	Though not a UN member, as a member of global community, Taiwan expressed it would take a policy to contribute to CO_2 reductions mainly through energy conservation and new energy use.	As air pollution control efforts, a stringent oversight is enforced (ex. By mobilizing the Air Police Force, etc., helicopters track down the sources from the air). This effort proves effective in mitigating air pollution problems. Also, with the "Law on the Collection of Air Pollution Control Cost" promulgated (in 1995), air pollution taxes are collected.
Singapore	At present no special measures are taken to combat global warming.	Designed to help observe the standards under the Clean Air Regulations, (1) existing plants are required to introduce desulfurizers, etc., and (2) monitoring of sources is in practice in the industrial sector. Also, in hopes to reduce exhaust gases from automobiles, unleaded gasoline was introduced since 1991, and the use of leaded gasoline is phased out by 1998.
Indonesia	So far few specific measures to tackle global environmental problems have been implemented.	Air Pollution Clean Up Program is under way, which includes shifts to unleaded gasoline and particulate control at cement plants, steelworks, power stations, etc. Environmental laws have been enacted but poorly followed up due to insufficient monitoring of sources, etc.
Malaysia	Global warming is cared with the measures and policy below: * Hydro and gas are positioned as energy sources to meet incremental demand (to avoid excessive oil dependence). * To promote energy conservation in the industrial and residential and commercial sectors.	Shifts to less-leaded gasoline and mandatory installation of scrubbers (flue gas cleaners) at industrial plants are taken as air pollution control measures.
Philippines	At present no special measures are in practice to fight global warming.	National Clean Air Standards were set. Business operators are required to obtain from EMB (Environmental Management Bureau) a construction permit and an operating license beforehand. If violating the standards, they are ordered a temporary halt of operation, or fined.
Thailand	A policy is set forth that, in the three of electricity, industrial and transport sectors responsible for most of CO_2 emissions, such measures as demand control (incl. DSM), efficiency improvement and use of low-carbon fuels (except nuclear) should be promoted.	Air pollution mitigating measures currently in practice are: (1) shifts to less-leaded and unleaded gasoline, and to lower-sulfur diesel; (2) mandatory introduction of catalytic units into gasoline cars; (3) introduction of car inspection system, incl. exhaust gas checks, and (4) mandatory installation of desulfurizers in newly built coal-fired power plants (regulated with operating licensing).
Brunei	Despite recognition of the need for the harmony between environmental protection and economic development, special measures for global warming are not necessarily taken right now.	So far air pollution problems have never worsened. But, from the standpoint of sustainable development, the need for adequate environmental management is recognized. Yet, actually no special measures are implemented for air pollution control.
Vietnam	Standards were set to improve air pollution, but no measures are taken for global warming problems.	Emissions standards were set, but no measures are currently taken to enforce their observation. Proposed now are to implement environmental measures in the industrial sector, and make environmental assessment prior to the implementation.
India	No special measures are taken for global warming. Rather, efforts are concentrated on SO_2 and NOx control to combat air pollution problems.	Provincial Pollution Control Commission is authorized to make on-the-spot inspections at plants and offices. When any plants and offices fail to meet relevant standards, the Commission can order a halt of plant or office operation.

(Source) Prepared by IEEJ from various materials.

Closing Comments

With the financial crisis, the Asian-12 had its economy stagnated, particularly in the most severely hit countries. Its energy demand decreased as well. However, in the longer run, it is likely that the economy will get back on the track and energy demand will also be on the steady rise again.

Then, the energy supply and demand structure will remain still reliant on coal and oil for various reasons: growing oil demand as a result of advancing motorization; soaring electricity demand in response to economic development; and constant energy demand increases in China and India. Interwoven in this outlook are many energy projects postponed or dropped due to the currency crisis, as well as energy shifts to inexpensive ones, typically coal, in the pursuit of economy. Thus, energy security and environmental issues will be highlighted more than ever as long-range concern for this region.

On energy security, soaring net imports, combined with the rising oil share to some 70% by 2020, are considered to increase Mideast dependence.

On environmental issues, it is likely that local environmental problems, such as acid rain, will get worse and CO_2 emission will increase sharply. Naturally industrialized countries have to fulfill an important role in mitigating global warming through technical cooperation, etc. However, the Asian-12's energy and CO_2 outlooks confirms that developing economies, including those in Asia, are also expected to join industrialized countries in an international commitment to global warming problems.

As an Asian member, Japan will be required to play a role of increasing importance as these issues become more distinct and arouse a debate on how to solve them.