



SYMPOSIUM ON PACIFIC ENERGY COOPERATION '99

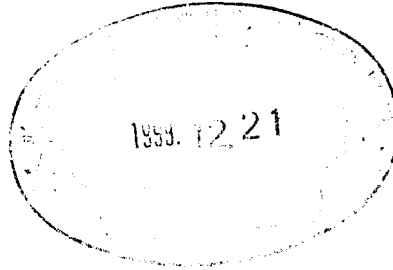
Changing Economic Environment and Energy Cooperation in Asia

Papers

February 16-17, 1999 Dai-Ichi Hotel Tokyo, Japan



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The Asian Crisis: Causes, Lessons and Prospects for Recovery

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“It seems safe to say that nobody anticipate anything like the current crisis in Asia.” (Krugman, Jan. 1998) “As is the case with most crises, the current financial crisis in Asia surprised virtually all observers.” (IMF, 1998). A year and a half after the beginning of the crisis, it comes as no surprise that most Asian observers have cataloged their causes of and lessons from the Asian crisis. Every Asian expert and many non-Asian pundits have expressed their opinions on this very interesting topic. It is useful to review what has been written recently, list the various reasons for the crisis, the multitude of policy recommendations, offer some observations, and explore the prospects for recovery in Asia.

I. Causes

The conventional analysis, as represented by the IMF and World Bank, suggest the following main causes of the crisis:

- 1) Financial market liberalization allowed excessive short-term borrowing in foreign currencies. The borrowing was unhedged for exchange rate and interest rate movements.
- 2) Structural problems in the Asian countries' banking sector contributed to and exacerbated the crisis. The structural problems include low capital adequacy requirements, weak regulatory oversight, lack of transparency in lending practices, unchecked cross-border lending and weak deposit insurance institutions.
- 3) Other structural problems also added to the crisis. First, corporate governance laws were weak, allowing corruption and poor accounting practices, which contributed to a lack of transparency. Also, bankruptcy laws are generally primitive. Non-banking intermediation is weak: the equity market is thin and the insurance market is weak.
- 4) Interestingly, the IMF and World Bank have somewhat different views on the macroeconomic policies of the crisis countries. The IMF characterizes the pre-crisis macroeconomic policies as strong. That is, the federal government budget deficits were not large relative to the size of the economies or were in surplus and inflation was low, implying sound monetary policy. The World Bank describes the macroeconomic policies as inconsistent. In the WB view, the exchange rate policy was inconsistent with the high domestic interest rates, providing an incentive for foreign borrowing.

On this score, we must give credit to the WB for a simple insight: High domestic interest rates, low foreign interest rates, a pegged exchange rate, and liberal access to foreign capital markets necessarily lead to a crisis. This set of circumstances provides an enormous incentive to borrow foreign currency at low interest rates, convert the foreign

currency to domestic currency, and lend it out at a high domestic interest rate. As long as the exchange rate is pegged — fixed in relationship to the foreign currency — this “carry over” type of transaction is extremely lucrative. Hence, once the current account balance begins to grow, and the monetary authorities raise interest rates to attract capital, it is also explosive because it provides the capital to worsen the trade balance, making the current account balance deteriorate further. The policy solution to this problem is also rather simple: either forcefully devalue the currency or let it freely float.

II. Lessons

Aside from more flexible exchange rates strongly recommended by the World Bank, the IMF and World Bank endorse the following policy initiatives:

- 1) Improve the international institutions supporting developing nations. This includes establishing accounting, bankruptcy, financial sector regulatory oversight, insurance sector standards. Encourage and support corporate, financial and fiscal sector transparency. Improve inter-country payment systems, increase support of private-to-private debt workouts.
- 2) For the financial sector, what is needed is stronger regulation and deposit insurance support, better capital adequacy requirements, improved transparency, and better risk management tools. To immediately alleviate the crisis the nonperforming loans need to be consolidated and auctioned off to the private sector so that the banking sector can begin to increase lending, rather than restricting it.
- 3) A mechanism for reducing “hot” money flows must be investigated. Perhaps it is necessary to impose some sort of tax on short-term capital flows to increase the cost of speculative capital flows.
- 4) The financial sector, as an institution, must be improved along with market liberalization so that it is capable of dealing with the next innovation in finance which potentially could cause a crisis.
- 5) Strong and consistent macroeconomic policies are still necessary.
- 6) An affordable social safety net needs to be implemented.

III. A Note on Moral Hazard

Moral hazard is a term widely used these days with reference to the Asian crisis. A simple example of moral hazard, which is common in the United States, is for rental cars. Apparently, many people who rent cars buy the full insurance (with no deductible) and then mistreat the car, because they have no liability for damage to the car. Thus, there are three features of moral hazard that are important. **First**, it involves insurance or guarantees from a large economic agent (the insurance company and the car rental agency) with respect to a smaller economic agent (the person renting the car). **Second**, it involves a costly action willfully undertaken by the small agent (mistreating the car) which is picked up by the large agent (the insurance company). This is referred to the moral hazard of insurance. **Finally**, ultimately the cost of the car repair is spread throughout society via higher insurance costs and rental fees.

In the case of Asia, there are many accusations of moral hazard. At the highest level, the IMF is accused of supporting policies which promote moral hazard. By bailing out countries and their lenders, the IMF has increased the likelihood that money will be lent to countries when they are in financial difficulties and encouraged countries to borrow excessively. This allegation has no merit. The countries have suffered, the local banks have suffered and the lending banks have suffered enormous losses from the Asian crisis. In short, the IMF bailout, as an insurance policy, has a very large “deductible,” so large that no sane person, institution, or country would willfully get into a current account crisis and view an IMF bailout situation with anything but horror.

At the next level, the accusation of moral hazard is leveled at the governments of the countries in crisis. These governments encouraged lending by the banks to many businesses. Some of the businesses were run by “cronies” of government officials. Implicitly, the government is guaranteeing or insuring these loans through its pressure to make the loan. Likewise, the cronyism can occur between bank officials and the private sector. Implicitly, the bank is guaranteeing or insuring a loan when this occurs. Effectively, the bank’s policy becomes “If this project does not work, more money can be lent.” Clearly, these type of implicit guarantees will lead to excessive borrowing — borrowing for marginally profitable or money-losing projects, excessive real estate lending in a boom situation, etc. These type of loans did occur and that is very much a part of the problem in Asia and very much the reason the IMF and WB are interested in tighter regulation of the banking sector. There is also a need to clean up government corruption and to reduce the number of projects which should be left to the private sector, rather than undertaken by the government.

Interestingly, the government guarantee of bailing out the banks is happening, though it is also very painful for the banks. Weak banks will be closed or merged with stronger banks and the losses are very large on non-performing loans. As the governments take on the bad loans and auction them off at a fraction of their face value, the cost of the bad loans will be borne partially by the banks and partially by the taxpayers. Loan guarantees — explicit and implicit — undermine the fiscal integrity of the government. To the extent such loan guarantees were consciously undertaken by the government, the relatively balanced fiscal budgets were an accounting fiction. They were really severely in deficit. Hence, the need for “transparency” in government accounts, as well as in private sector.

IV. Causes and Lessons from Other Observers

A. Paul Krugman: The Moral Hazard/Asset Bubble View

Relatively unregulated financial institutions, backed by implicit government guarantees and hence subject to severe moral hazard problems, lent excessively to the private sector. The excessive lending created asset price inflation — in real estate and company valuations. Asset inflation led to more asset inflation, making the banks seem sounder than they were. The bubble burst and asset prices began to fall. The crisis is very severe because the the asset inflation went unchecked for so long, the collapse in asset prices means the value of nonperforming loans is very large relative to the size of the economy.

Under this view, the currency crisis is merely a symptom of the financial sector crisis and the reason the macroeconomic policies looked strong is because the problem was off the government's balance sheet.

The solution to a crisis characterized in this manner is straightforward: Eliminate explicit and implicit government loan guarantees and regulate the financial sector.

B. Jeffrey Sachs and Steven Radelet: The Financial Panic View

Panic on the part of the international investment community caused the crisis and policy mistakes by Asian governments followed by policy mistakes from international institutions — particularly the IMF — exacerbated the crisis. The crisis was further aggravated by “disorderly workout” problems — creditors cannot easily coordinate their debt restructuring needs with other creditors leading to a lack of capital to distressed borrowers and a delay of discharging bad debts.

Under this view, there is a need for controlling short-term capital flows, reforming the IMF and other international institutions, create mechanisms for reducing bank panic, create institutions for managing orderly workouts.

C. Nouriel Roubini: Business Cycle View of the Crisis

First, overvalued currencies led to large and growing current account deficits. The overvalued currencies arose from the choice of fixed exchange rate regimes. Second, an excessive investment boom led to poorly chosen investment projects. Third, moral hazard created by government promises of a bailout led to excessive bank lending on risky investment projects. The banks borrowed on foreign markets and lent in domestic currency. When the currency devalued, the loans increased dramatically in local currency terms. Fourth, a significant fraction of the borrowing and lending went to speculative purchases of existing assets, creating an asset price bubble. Fifth, the contagion was based on real fundamentals — the countries after Thailand devalued were competitors and their currencies became even more overvalued on a trade-weighted basis after the baht collapsed. Weak and not very credible governments exacerbated the problem.

D. WEFA's View:

Interestingly, our analysis is most closely aligned with Roubini's. The exchange rates in Thailand, Indonesia, and South Korea became overvalued relative to competing currencies — the Chinese renminbi and the Japanese yen. This led to large and growing current account deficits. When the currencies collapsed, the fundamental problems of the asset bubbles, the under-regulated financial sector, and crony capitalism exacerbated the problem into a severe and prolonged crisis.

Put in this context the solution to the problem is straightforward, though far from simple: adopt a flexible exchange rate regime, reform the financial sector, and adopt measures to curtail corporate and government corruption. To alleviate the immediate crisis, it will be necessary for the governments in the region to purchase the bad loans from the banking

sector — passing on some of the loss to the banks to avoid the moral hazard problem — and sell them off at a discount. Lower asset prices, lower interest rates and depreciated currencies will lead most of Asia out of recession.

Asset bubbles occur in the most highly developed economies. For example, asset bubbles have occurred recently in Japan and, many would say, in lately in the U.S. equity market. They are extremely difficult to avoid. However, better regulatory oversight of the banking sector and flexible exchange rates should help to limit the overvaluation of assets. A more flexible exchange rate policy earlier would have reduced the size of the bubble, by discouraging excessive borrowing. However, the more fundamental problems would have needed to be addressed at some point and probably would have resulted in a recession in any case. The severity of the recession was increased by holding to an overvalued currency for too long.

In WEFA's view, the crisis was precipitated and aggravated by the currency devaluations. However, the fundamental problems would have to be addressed at some time. Now, they must be resolved for the Asian crisis countries to recover.

V. Prospects for Recovery in Asia

A. Asia, Outside of Japan (this section was written with assistance from Arun Raha of WEFA)

There is room for cautious optimism about Asia, although its crisis is not over yet. In the last year, with some notable exceptions, economies across the region continued to contract, but the pace of the contraction appears to have bottomed out. On the positive side, external accounts have improved, currencies have stabilized, asset prices have increased, and inflation is under control. On the downside, investment growth is still negative, consumer sentiment is poor, and the external environment remains weak. WEFA's current forecast has Asia coming out of the crisis by 2000 (Table 1), but there are some significant internal as well as external risks to that forecast.

TABLE 1: Real GDP growth rates

	1997	1998**	1999*	2000*	2001*	2002*
China	8.8	7.4	7.4	8.2	8.2	8.5
Hong Kong	5.3	-5.2	-1.6	1.0	3.0	3.9
India	5.1	4.4	5.1	6.0	6.6	6.5
Indonesia	4.6	-13.5	-3.9	3.2	4.3	6.0
Japan	1.4	-2.9	-1.3	0.5	2.1	1.9
Malaysia	7.8	-6.0	-0.8	4.1	5.6	6.3
The Philippines	5.2	0.3	3.7	5.5	5.9	6.0
Singapore	7.8	0.0	0.0	1.8	3.6	5.7
South Korea	5.5	-6.0	0.6	4.8	5.6	5.6
Taiwan	6.8	5.0	4.5	5.4	5.3	6.0
Thailand	1.3	-7.2	0.5	2.4	4.1	5.5
*WEFA forecast, 99Q1			** WEFA estimate, 99Q1			

In looking at the region, it is easy to categorize economies as those that are crisis stricken and those that have been only peripherally hurt by the Asian crisis. China and India were able to avoid the worst of the crisis largely because of closed capital markets. Taiwan,

whose capital account is not closed, but highly regulated, has also been able to grow. On the other hand, economies with open capital accounts saw their real economies deteriorate during the year. This should not, however, be viewed as evidence that the crisis was caused by open capital markets. The openness influenced the economies' vulnerability, but much of the financial crisis could have been avoided with freely floating exchange rates.

Of the countries most severely affected, South Korea and Thailand have undertaken significant structural reform and are most likely to recover first. Indonesia and Malaysia, however, are still very vulnerable. Indonesia is plagued by political unrest and a lack of political will to undertake necessary reforms. Malaysia's political situation is more stable, but its increasingly inward-looking stance has not endeared it to potential investors. Both Hong Kong and Singapore will recover by 2000, although Singapore's recovery is likely to be stronger. It has managed to survive the crisis without significant structural dislocation, its financial sector remains sound, and policy is actively trying to cushion the downturn. In Hong Kong's case, recovery is made more difficult by its exchange rate peg. The entire cost of adjustment must be borne by its real economy.

There has been considerable fiscal stimulus across the region. Governments that have traditionally been fiscally conservative have been compelled to increase budget deficits. Interest rates have fallen, but the slow pace of banking reform has prevented this from having the desired effect on investment growth.

The key to Asia's recovery is how quickly and effectively governments are able to undertake the needed financial reforms. This is the most significant internal risk to our forecast. The resumption of orderly capital flows is critical to the region. The external risk to our forecast comes from the risk of global recession. Asia's recovery will be severely hampered if the U.S. or Europe slips into recession. With Brazil succumbing to recession this risk is rising.

Brazil's recent move to a flexible exchange rate and the subsequent sharp depreciation of its currency is likely to have a minimal impact on Asia in the short-term. However, the long-term picture is less sanguine. Direct economic linkages between Asia and Latin America are weak, but indirect linkages, particularly those through the US economy could be significant.

Brazil's economy produces 45% of Latin America's output; Latin America receives 20% of US exports; and, the US receives 20% of Asia's exports. A slowdown in Latin America could spill over into Asia via a dampening of US growth. Moreover, currency devaluation in Latin America will mean increased competition for Asian goods in third markets, particularly steel and coffee.

The worsening of sentiment in general towards emerging markets also poses some risk to Asia. A widening of spreads on sovereign issues will make it more expensive to raise capital, and could affect the fiscal plans of Asian governments. A slightly smaller risk comes from the increased pressure on Hong Kong's currency board and the Chinese

renminbi. That risk could become significant, however, if — contrary to current expectations — the Argentine peg collapsed.

B. Japan

The Japanese economy is far from recovery. Though there has been some encouraging news from Japan over the past few months, the latest economic indicators exhibited signs of extreme economic weakness. Real GDP fell by 2.6% at an annualized rate in the third quarter of 1998, despite aggressive spending increases by the federal government. The unemployment rate rose to a record 4.4% in November, keeping the consumer sector in deep recession. Retail sales were down 5.5% in October year-on-year, while new passenger car registrations were down 23% in December. The government's widely-publicized stimulus packages have, so far, been unable to restore confidence or stimulate growth. The government's bank bailout program places a heavy emphasis on short-term loans for viable companies, but also needs to support the aggressive liquidation of bad loans. Since, at this time, the selling of assets at a discount is not proceeding rapidly, the financial crisis is unlikely to be resolved for another year. Real GDP is now expected to decline in 1999, by 1.3%, and rise an anemic 0.5% in 2000. The Brazilian crisis does not help and growth in 1999 could be much lower, perhaps as low as minus 2%.

The Liberal Democratic Party (LDP) has passed another fiscal stimulus package. The latest package, valued at ¥23.4 trillion (\$195 billion), includes permanent tax cuts worth ¥9.3 trillion, increased spending on public works projects (¥8 trillion, or \$67 billion) and more loans for various programs. Since the economy is only about ¥450 trillion (\$3,750 billion), these measures constitute substantial fiscal stimulus, worth about 5% of total output. The tax cuts are to begin early next year and the spending increase will become effective in the 1999 fiscal year, which begins next April. The fiscal stimulus package will tend to boost short-term growth, but the economy will not recover until 2000.

The latest package of bank reforms, worked out by the LDP and the opposition, have begun to be implemented. However, nationalizing banks does not solve the problem of excessive non-performing loans. The loans must be sold at a discount to dispose of them entirely and to free up the underlying assets for productive uses. This is not happening very rapidly. Real GDP growth for Japan is expected to decline by 2.9% in 1998, followed by a decrease of 1.3% in 1999.

Rather than recovering modestly in 2000 and 2001 with 0.5% and 2% growth, the Japanese economy could languish for another year or two. Japan has no room to cut interest rates and — given its aging population — it is running out of money to support fiscal stimulus packages. With a huge current account surplus, the yen is strong. The financial sector problem is not being addressed quickly, limiting Japan's options. Its economy could be entering a depression with weak to falling prices, a strong yen, low interest rates and a prolonged bad loan situation.

Unlike the other Asian economies, Japan does not have the option of lowering interest rates and its currency has been very strong recently. Asset prices are greatly reduced, but

that is of little help if these assets are not sold to the private sector. The government must assume ownership of the bad loans and sell them off at a discount. This will put the assets back to work. One hopeful sign recently was the Japanese government has hired Goldman Sachs to assist in liquidating the assets of the Long Term Credit Bank. This is a good start, but all of the assets need to be sold. Let us hope that this is the beginning of an aggressive campaign to put to rest the asset bubble problem and move forward productively into the 21st century.

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Asia Pacific Energy Outlook

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Speech Text

Presented at

SPEC '99

Tokyo

16 February, 1999

Ladies and Gentlemen. Good morning.

It is a great honour and privilege to present to you the Asia Pacific Energy Research Centre's "*updated* APEC Energy Demand and Supply Outlook". This was a result of the first task assigned to APERC after its creation in July 1996.

The Outlook aims at providing member economies with an analysis of future energy trends and developments in the Asia Pacific Economic Cooperation (APEC) region.

The first version of the Outlook was published in March 1998. However, the aggravation of Asian economic crisis required the update of our Outlook to be reported to the Third APEC Energy Ministers meeting in Okinawa in October 1998. My report today is basically this updated version of Outlook presented at the Okinawa Ministerial meeting.

APEC now consists of 21 economies, with three new members officially accepted at the Kuala Lumpur meeting of APEC Economic Leaders in November, 1998. But this outlook deals with eighteen APEC member economies.

Outlook Scenarios

It covers three scenarios over a fifteen-year period from 1995 to 2010:

The **1998 Baseline** assumes that Asian economies begin to recover from the current downturn after 2000.

The second scenario, the ***Protracted Crisis Scenario***, is a more pessimistic scenario that assumes the current downturn in Asia is prolonged, and has the effect of lowering economic growth throughout the APEC region.

Finally the *Environmentally Friendly Scenario* considers the effects of enhanced efficiency improvements coupled with environmentally benign fuel switching.

In this presentation, I would like to address some of the key findings that have emerged from the updated Outlook, and share with you some of the policy issues that APERC believe need to be carefully considered.

GDP Growth

The Outlook utilises GDP growth projections provided by the Australian Bureau of Agricultural and Resources Economics' MEGABARE model. These projections are current as of September 1998. The 1998 Baseline scenario projects an average APEC annual growth rate of 2.7 per cent over the period to 2010.

The Protracted Crisis Scenario averaged 2.5 per cent yearly growth across the APEC region.

In Asian economies, excluding China, short-term growth is substantially lower due to the economic down turn, however, strong growth is expected towards the end of the projected period.

Total Primary Energy Demand

Total primary energy demand in the APEC region is projected to increase by 41 per cent in the 1998 baseline, and by 34 per cent in the protracted crisis scenario. Natural Gas grows most rapidly, while oil and coal record large absolute increases.

The Environmentally Friendly Scenario, where efficiency is a key, projects an increase of total primary energy demand by 26 per cent to 2010.

In the subsequent discussion, the reference will be generally made to a Baseline case, unless otherwise indicated.

Industrial Sector Energy Demand

Industrial energy demand will show strong growth of 37 per cent in the APEC region as a whole and account for the largest absolute growth in total energy consumption. Particularly China and other Asian economies will show higher demand growth. China's growth will reach 63 per cent and Southeast Asia will register the highest growth of 104 per cent. Asian economies as a whole will increase industrial sector's energy demand by 52 per cent by 2010.

China alone accounts for 52 per cent of the increased energy demand in the industrial sector, and Asia, as a whole, accounts for three quarters of the overall increase. This growth is

centred in the energy intensive industries such as iron and steel and petrochemicals in developing economies.

Transportation and Residential/Commercial Sector Energy Demand

The transportation sector's energy consumption also grows rapidly (46 per cent) and is the biggest consuming sector for oil products. Over 95 per cent of the growth will occur in oil products.

There is also strong energy consumption growth of 40 per cent in the residential and commercial sector.

Although developing economies record the fastest growth, the largest absolute growth occurs in the United States in both sectors.

Total primary Energy Supply

The increased energy supply is provided by a combination of more energy production and higher energy imports. Energy production is projected to increase by 31 per cent to 2010. This growth is mainly in coal and natural gas where production grows by 39 and 44 per cent respectively.

Energy imports into the APEC are expected to almost double the 1995 level by 2010, despite the increased production of APEC's energy exporters. This results in an increase in APEC's energy dependence from 16 per cent in 1995 to 22 per cent in 2010.

Notably, oil imports into Other East Asian economies, increases by 51 per cent, maintaining the high dependency rate of 80 per cent

Oil Import Dependence

The high energy import dependency, particularly in Asian economies, highlights the need for securing and facilitating energy supplies. This points to the need for consideration of further oil stockpiling initiatives especially by importers, promoting supply infrastructure investment to facilitate greater supplies of energy and also energy efficiency and deregulatory programmes.

Carbon Dioxide Emissions

The increased production, delivery and consumption of fossil fuels will result in higher emissions of CO₂, a major greenhouse gas, SO_x and NO_x.

The APERC Outlook projects an increase in carbon dioxide emissions of 42 percent by 2010 under the baseline case and by 22 per cent in the Environmentally Friendly Scenario.

By region, emissions from East Asia will come close to that of the Americas, although Southeast Asia will show the fastest carbon dioxide emission growth. The Environmentally Friendly Scenario demonstrates the challenge facing Annex B economies in the APEC region, namely Australia, Canada, Japan, New Zealand and US, to meet emission abatement obligations under the Kyoto Protocol.

Energy Efficiency Improvement

Improvements in energy efficiency will be an important factor to reduce greenhouse gas emissions. The Environmentally Friendly Scenario, where efficiency improvements play a key role, also indicates benefits not only in environmental impacts but also in energy demand and net imports.

Compared to the baseline, energy demand in 2010 is reduced by 10 per cent and net imports are more than halved, while CO₂ emissions are reduced by 14 per cent.

Infrastructure Development and Regulatory Reform

Energy supply infrastructure must be expanded to support energy demand which is expected to grow faster towards the latter part of the Outlook period. It requires massive investments and long lead times.

But the recent Asian economic downturn is not likely to generate sufficient funds to satisfy the required investment. It would also moderate the need for building infrastructure. Indeed, some cancellation and delays in projects have taken place. They could lead to bottlenecks in supply systems. Infrastructure investment could also stimulate APEC economies to quicken the economic recovery.

Regulatory reforms will encourage energy markets to attract both domestic and international investment as well as promote trade and facilitate the transfer of technologies.

APERC Research

APERC is currently undertaking a range of research addressing many of these issues. Addressing potential oil supply concerns, APERC is undertaking a study aimed at evaluating the net benefit associated with oil stockpiling. APERC's natural gas infrastructure and electricity interconnections project both address infrastructural issues concerned with the provision and facilitation of energy. Finally, energy efficiency, energy pricing and deregulation issues are also being addressed.

At the Okinawa Ministerial Meeting, APERC received a general endorsement of its continuous research efforts to better understand the energy supply and demand issues confronting the Asia Pacific region.. In particular, Ministers encouraged APERC to advance its work on energy efficiency indicators. They also recognised that feasibility

studies on pipeline projects in this region should be conducted.

Policy Issues

APERC's projects not only cover the current issues being identified in the APEC region, but also address many of the 14 non-binding energy principles endorsed by ministers in Sydney.

In conclusion, APERC's Outlook highlights the long-term energy growth in the APEC region. Despite the current recession, low energy prices of the present, and considerable variability between APEC economies, energy policies should reflect long-term priorities. Addressing short-term fluctuations does not diminish the need to ensure supply security, infrastructure investment, energy efficiency improvements and deregulation in the long run. The projected increase in APEC's energy consumption over the period to 2010 supports the implementation of the 14 non-binding energy policy principles throughout the APEC region.

Key Results

APERC will continue its utmost efforts to provide an important input to your policy deliberations through its on-going and future research projects and will like to seek your guidance on our research direction to that end.

Thank you for your kind attention.

太平洋エネルギー協力会議'99（SPEC'99）1999年2月16日（火）
第1セッション「アジア諸国の経済改革とアジアのエネルギー情勢」

「APEC沖縄エネルギー大臣会合のメッセージ」

通商産業省資源エネルギー庁長官官房企画調査課長 宮本 武史

平成10年10月9～10日、第3回APECエネルギー大臣会合が与謝野通産大臣の議長のもと、沖縄県宜野湾市で開催され、宣言を採択、成功裏のうちに終了した。

1. 参加地域

加盟18地域に加え、平成10年11月からAPECに正式加盟した3地域（ペルー、ロシア、ベトナム）を含む21地域が参加。

2. 今時会合の意義と成果

(1) 意義

- ・ APEC地域のエネルギー需給の将来展望に関する共通認識を醸成できたこと。
- ・ アジアの経済危機の克服の観点でエネルギー分野の役割について議論したこと。

(2) 成果

- ・ 今後の政策協調に向けて政策対話を深めていくことに合意。
- ・ 天然ガスイニシアティブを含むインフラ整備の重要性に合意。
- ・ プレッジアンドレビュー制度を含むエネルギー効率の向上について合意。
- ・ 11月のAPEC非公式首脳会合に本会合の主要成果を報告。

3. アジア経済危機との関係

- (1) アジア地域では、経済危機ではあるが、将来エネルギー需要は生産を上回る率で伸びることをメンバーが認識。
- (2) エネルギーセキュリティの重要性を再認識。
- (3) 持続的成長と経済危機克服の両面から、インフラの整備、エネルギー効率の向上を進めるべき旨を議論。

4. 議事概要

(1) 議題1：与謝野大臣歓迎挨拶

議長国として与謝野通産大臣が歓迎挨拶を行い、特に以下の3点を強調。

- －域内のエネルギー需給の展望とエネルギーセキュリティの確保
- －経済危機に直面する中でのエネルギー政策のあり方
- －政策対話と協力の強化

(2) 議題2：エネルギー政策原則

’95年の大阪首脳会合で確認されたエネルギー政策非拘束14原則の政策への反映状況につき各メンバーから報告があり、経済情勢や実施方法についてはメンバー毎に様々であるものの、14原則の重要性・有効性は不変であり、着実に実践されていることが確認された。

(3) 議題3：産業界の参加

ビジネス・フォーラムから、エネルギー関連プロジェクトの推進が経済回復に寄与すること、エネルギー利用と環境との調和が重要である旨の指摘。

天然ガス、石油、電力・原子力、環境の各課題別に政策提言が行われた。

EWG（エネルギー・ワーキング・グループ）から、産業界との対話促進のための「EWG ビジネスネットワーク」の創設が報告され、評価された。

(4) 議題4：エネルギー需給見通し（以下下線は我が国のイニシアティブ）

APERC（アジア太平洋エネルギー研究センター）横堀所長から、APEC地域のエネルギー需給見通し（1995年～2010年）について発表、多くのメンバーから高い評価を受けた（域内のエネルギー需要は約41%増、他方、生産は約31%増に留まり、エネルギーの輸入量は、ほぼ倍増）。

エネルギーセキュリティ確保の観点から、エネルギー源の多様化、インフラ整備、エネルギー効率の向上等が必要。このため、これら重要課題について政策対話を強化。

EWGでの石油需給のセキュリティ問題に関する議論の開始を支持。

また、エネルギー分野での「コンピュータ2000年問題」への対応の重要性を強調。

(5) 議題5：エネルギーインフラ

エネルギーインフラの整備は、地域の持続的成長に必要であり、経済危機の克服に寄与する点でメンバーの共通認識が形成。投資環境整備の重要性を認識。

天然ガスに関するインフラの整備促進に関し、日米共同議長のもとで作成された「天然ガスイニシアティブ報告書」を承認、11月のAPEC非公式首脳会合に報告されること等が決定。

投資拡大や資金流動化への取組強化のための官民合同ワークショップの開催、

独立発電事業者のベストプラクティス原則の実施状況のフォローアップをEWGに指示。

(6) 議題6：エネルギー効率向上

持続的経済成長確保と経済危機からの回復のためエネルギー効率向上の重要性を多数のメンバーが指摘。途上国を含め多数のメンバーから「自主的プレッジアンドレビュー」制度が支持され、その創設が決定。

また、エネルギー効率指標の作成、エネルギー効率改善イニシアティブ等が承認。

Third Meeting of APEC Energy Ministers

"Energy: Driving Force for Economic Recovery and Development"

Ginowan, Okinawa, Japan

October 9-10, 1998

DECLARATION

1. The third meeting of APEC Energy Ministers was held on October 9-10, 1998 in Ginowan, Okinawa in Japan. Ministers and their representatives from Australia; Brunei Darussalam; Canada; Chile; the People's Republic of China; Hong Kong, China; Indonesia; Japan; the Republic of Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; the Philippines; Singapore; Chinese Taipei; Thailand; and the United States of America attended. They welcomed Peru, Russia and Vietnam, members designate, to the meeting and looked forward to their formal accession to APEC in November in Malaysia. Also present were representatives from the APEC Secretariat, the Energy Working Group Secretariat, and observers from the Pacific Economic Cooperation Council.
2. Ministers discussed the serious economic situation of several APEC economies. Ministers also discussed the implications for the energy sector of the economic situation and the future energy supply and demand outlook. Ministers considered several ways in which the energy sector can contribute to the recovery of economic growth in the region.
3. Ministers stressed the importance of implementing the 14 non-binding energy policy principles to address the current economic difficulties as well as to achieve the goals of sustainable economic growth, stable energy supply and environmental protection.
4. Ministers acknowledged that important stimulants to renewed growth and prosperity

are open and efficient energy markets which are guided by appropriate rules to ensure their smooth and equitable functioning and the development of efficient energy infrastructure. Ministers also noted the importance of improving living standards and of sustainability, and in this context the importance of mitigating negative local, regional and global environmental and social impacts of energy production, delivery and use.

5. Ministers reiterated the important role that the energy sector could play in stimulating regional economic activity, including by raising the technical capability and economic efficiency of member economies and creating employment, in addition to improving the quality of life. To draw the maximum potential benefits, Ministers agreed that appropriate policy reforms should be rigorously pursued in the energy sector with capacity- and infrastructure-building stimulated by investment, including from the business sector.

6. Ministers examined the policy implications arising from decisions by APEC Economic Leaders and at the two previous meetings of APEC Energy Ministers, as well as the energy outlook prepared by the Asia Pacific Energy Research Centre. They resolved to work cooperatively to secure tangible economic, social and environmental benefits for member economies by focusing on initiatives that will have an early and enduring impact.

7. Ministers agreed that the energy outlook prepared by the Asia Pacific Energy Research Centre should be used by the Energy Working Group as an important basis for policy discussion and that the Centre should continue its work to better understand the energy supply and demand issues confronting the Asia Pacific region. Ministers welcomed the decision of the Energy Working Group to further strengthen policy dialogue among member economies on important issues such as energy security, energy infrastructure, energy efficiency and energy and environment. Ministers also welcomed the actions of the Energy Working Group to facilitate improved communication with the business sector.

Energy Security

8. Ministers discussed the results of the regional energy outlook prepared by the Asia Pacific Energy Research Centre, considering the influence of the current economic difficulties. Ministers noted that according to the outlook, in spite of the current economic downturn in Asia and projected slower growth in demand, the region's demand for energy is expected to outpace its energy production by a wide margin, underscoring the APEC region's growing energy import dependence. Total primary energy demand in the region is projected to increase by 41 percent, while indigenous energy production will increase by 31 percent over the period of 1995 to 2010, with total imports to be doubled as a consequence. Ministers also noted that lower energy infrastructure and production investment as a result of the Asian downturn could induce bottlenecks, preventing the efficient delivery of energy to satisfy the higher energy demand growth expected beyond 2000. Ministers confirmed that energy supply diversification, intraregional energy infrastructure development and improvement of energy efficiency are vital issues from the viewpoint of enhancing energy security.

9. Considering the strong forecast growth in demand and increasing dependence on oil from outside the region, Ministers recognized the need to promote diversification of energy supply, including where appropriate natural gas, renewables and nuclear energy, and to promote market-driven energy infrastructure development. Ministers also recognized that well-functioning markets, market-based pricing, greater energy efficiency and information flows among market participants are important for enhanced energy security.

10. Ministers welcomed the initiation of information sharing on oil markets, and endorsed the decision by the Energy Working Group to discuss oil supply and demand security issues.

11. Ministers noted the recommendations from the report on "Energy Security: Fuel Supplies for the Power Industry," which emphasize the importance of encouraging the efficient operation of market-based mechanisms.

12. Considering the dependence of economic activities on energy, Ministers emphasized the importance of sharing information, among themselves and with others, that will assist in addressing potential disruption caused by the Year 2000 "millennium bug" computer problem. Ministers commended the Energy Working Group for referring this issue to its Energy Regulators' Forum for comment and report. Ministers instructed the Energy Working Group at its next meeting in April 1999 to propose actions that may help member economies and business in the remedial steps that they are taking.

Energy Infrastructure

13. Ministers recognized that continuous development of adequate energy infrastructure is essential as a stimulus for economic recovery as well as for sustainable development in the region. Under the current economic situation, development of efficient energy infrastructure should be actively pursued to improve the productivity of economic activities and to facilitate recovery. Estimates are that hundreds of billions of dollars will be required for energy power infrastructure alone in APEC economies over the next decade. Ministers reaffirmed their support for efforts that build markets and address the goal of reducing disparities among members. Ministers stressed the importance of the availability of funds and investments towards the development of such infrastructure in the developing economies.

14. In this regard, Ministers stressed the importance of promoting private sector participation in infrastructure development in those areas permitted by their respective legal frameworks, and re-emphasized the need for a predictable, transparent institutional and regulatory framework to enhance the investment climate.

15. With respect to the role of the energy sector in the region's economic recovery, Ministers agreed that existing action directed at improving investor confidence and mobilizing capital could be enhanced. To this end, Ministers instructed the Energy Working Group to hold a business/government workshop to develop recommendations for early action. The newly established EWG Business Network, as well as the Energy Regulators' Forum, should be involved in the development of the workshop agenda on an

urgent basis. This would be compatible with, and make an important contribution to, other APEC activities to assist in the region's economic recovery.

16. Ministers discussed progress in implementing the best practice principles for independent power producers agreed at the second meeting of APEC Energy Ministers and directed the Energy Working Group to effectively follow up the implementation of these principles in close communication with the private sector.

Natural Gas Initiative

17. Driven by the goals of promoting economic development and growth, increasing energy security and improving the environment, demand for natural gas in APEC is expected to grow significantly over the next 20 years. Meeting this demand will require increased natural gas production and significant new infrastructure development. The Asian Development Bank estimates that as much as \$70 billion in investment will be required for natural gas infrastructure in Asia over the next 15 years. In addition, it is estimated that hundreds of billions of dollars in investment will be required in other APEC economies over the next 15 years. Meeting increased demand for natural gas in the APEC region will also require increased trade in natural gas and natural gas-related products and services among APEC member economies, which will have a powerful multiplier effect on APEC economic growth prospects.

18. Ministers endorsed the recommendations contained in the report of the initiative "Accelerating Investment in Natural Gas Supplies, Infrastructure and Trading Networks in the APEC Region." Ministers agreed that implementation of the recommendations would be consistent with the priorities of individual economies and regularly reviewed. The APEC Natural Gas Initiative will promote the acceleration of investment in natural gas supplies, infrastructure and trading networks in the region. Natural gas trading networks comprised of internal and cross-border pipelines, LNG terminals and distribution systems would promote economic development within economies and further cooperation and trade between the APEC economies. Feasibility studies on pipeline projects in this region should be conducted.

19. Recognizing the necessity to minimize the adverse environmental impact of new energy infrastructure development, Ministers endorsed the Recommended Work Program on Environmentally Sound Energy Infrastructure in APEC Member Economies. They agreed that the work program would provide impetus to the application of environmental policy practices that are predictable, transparent and consistent. Ministers noted that such practices would facilitate energy investment while allowing investors flexibility in meeting environmental objectives, and charged the Energy Working Group to develop practical and effective means of implementation.

Energy Efficiency

20. Hundreds of billions of dollars are expended on energy annually in member economies. Ministers noted that even a one percent energy saving on infrastructure and energy use translates into literally billions of dollars of investment freed up for other purposes. Increased energy efficiency will not only contribute to the competitiveness of industrial activities, but will also reduce environmental impacts as the amount of energy required to produce a given level of goods and services is reduced.

21. Ministers recognized the importance of fostering continuing improvements in the production, delivery and use of energy and agreed to implement a voluntary pledge and review program comprising: developing and implementing programs to achieve efficiency gains where economic to do so; reporting on the programs developed, their specific objectives and the results achieved; sharing information and experience in achieving improved energy efficiency; and developing indicators and databases that will enable the measurement of performance over time.

22. Furthermore, Ministers instructed the Energy Working Group to develop a program to exchange information on policies, technologies and practices to improve the efficient production, transportation and consumption of energy. Ministers endorsed the recommendations on improving energy efficiency in the "Report of Guidelines for Improving Energy Efficiency," and agreed that energy efficiency should continue to be a priority of the Asia Pacific Energy Research Centre, encouraging the Centre to advance

its work on energy efficiency indicators.

23. Ministers welcomed the progress made in implementing cooperation on energy efficiency standards testing, and endorsed the Standards Notification Procedure. Ministers noted that this is an immediate step which will not only increase transparency to business and facilitate trade, but also help to minimize the proliferation of differing test procedures in the region.

24. Ministers emphasized the importance of regional cooperation to promote the development and deployment of energy technologies to reduce the growth of greenhouse gas emissions, noting the importance of progress in improving energy efficiency and the increased use of low or non-carbon emitting energy systems. Ministers encouraged greater efforts to attract private investment in advanced energy technologies as a way to produce vigorous economic growth while limiting emissions. Ministers noted that mechanisms to address this issue are being discussed within the context of the United Nations Framework Convention on Climate Change.

25. Ministers stressed the importance of promoting energy research and development, commercial and economic transfer of environmentally sound technologies, and continuing cost-reduction in the introduction of these new technologies, with the direct participation of the business sector.

26. Ministers welcomed progress made in promoting environmentally sound and efficient measures in the area of minerals and energy exploration and development.

Interaction with Business

27. Ministers welcomed the report from the business sector following their deliberations in the Okinawa Energy Business Forum and noted that energy-related investment and energy efficiency were seen as major business opportunities. Ministers referred the report to the Energy Working Group for further consideration. Ministers welcomed the actions of the Energy Working Group to improve and sustain the interface between the Group and the business sector, particularly the newly established EWG Business

Network. Ministers urged continued efforts on business and government communication.

Recommendations to APEC Economic Leaders

28. Ministers agreed to report the accomplishments and development of the third Energy Ministers Meeting to APEC Economic Leaders for their consideration at Kuala Lumpur in November 1998. Ministers recommended that Leaders highlight the important role that the energy sector could play in the recovery from the current economic difficulties through improvement of the business environment facilitated by expanded policy dialogue among member economies, development of efficient energy infrastructure and improvement of energy efficiency. Ministers agreed that the recommendations from the Natural Gas Initiative should go forward to APEC Economic Leaders for their consideration in November 1998.

第3回 APECエネルギー大臣会合

“エネルギー：経済の回復と成長への原動力”

沖縄県宜野湾市

1998年10月9日～10日

宣 言

(仮訳)

1. 第3回APECエネルギー大臣会合は、1998年10月9日～10日沖縄県宜野湾市で開催された。オーストラリア、ブルネイ、カナダ、チリ、中華人民共和国、香港中国、インドネシア、日本、大韓民国、マレーシア、メキシコ、ニュージーランド、パプアニューギニア、フィリピン、シンガポール、チャイニーズ・タイペイ、タイ、アメリカ合衆国の大臣及び代表が出席。ペルー、ロシア、ベトナムを本会合への公式オブザーバとして歓迎し、11月のマレーシアでの正式加盟に期待。また、APEC事務局、EWG（エネルギー・ワーキング・グループ）事務局の代表及び太平洋経済協力会議（PECC）からのオブザーバーが参加。
2. 各大臣は、APECの一部メンバーの深刻な経済情勢について議論。各大臣は、経済情勢がエネルギー分野に及ぼす影響、及び、将来のエネルギー需給に与える影響を議論。また各大臣は、エネルギー分野が地域の経済成長の回復にいかに関与していくかについて検討。
3. 各大臣は、持続的経済成長、安定的なエネルギー供給、環境保護という目標を達成するためのみならず、また現下の経済困難に対処するためにも、非拘束14エネルギー政策原則の実践が重要であることを強調。
4. 各大臣は、円滑かつ公平な機能を保証する適切な規則に導かれた開放的で効率的なエネルギー市場及び効率的なインフラ整備が新たな経済成長と繁栄への重要な要因となることを認識。更に、各大臣は、生活水準の向上と持続的成長の重要性やエネルギーの生産・輸送・利用による地方、地域や地球規模の環境、社会面への悪影響の緩和

の重要性について留意。

5. 各大臣は、域内の技術力や経済効率を高めること等による域内経済活動の活発化や生活水準の向上や雇用の創出に関するエネルギー分野の重要な役割を再確認。潜在的な効用を最大限に引き出すため、各大臣は、民間からのを含めた投資により活性化される能力増強とインフラの形成が図られるようエネルギー分野における適切な政策改革を強力に推進することに合意。
6. 各大臣は、APEC非公式首脳会合、過去2回のエネルギー大臣会合の決定及びAPEREC（アジア太平洋エネルギー研究センター）需給見通しから提起された政策課題を吟味。また、各大臣は、即効性があり持続的な効果がある提案に注力することにより経済・社会・環境面における具体的な成果を本地域にもたらすよう協力して取り組んでいくことを決意。
7. 各大臣は、APEREC需給見通しをEWGでの政策対話の重要な基礎とし、APERECが域内のエネルギー需給問題のさらなる理解のため活動を継続することに合意。各大臣は、EWGがエネルギー・セキュリティ、エネルギーインフラ整備、エネルギー効率やエネルギーと環境問題の重要な課題に関する政策対話を強化することを歓迎。また、各大臣は、EWGが産業界との対話を推進することを歓迎。

エネルギー・セキュリティ

8. 各大臣は、最近の経済的困難の影響を踏まえたAPERECの需給見通しに関し議論。各大臣は、現在のアジアの経済的停滞や需要の伸びの鈍化にもかかわらず、その見通しによれば、APEC地域のエネルギー需要は生産を大きく上回ると予想され、エネルギー輸入依存度の増大を顕在化させることに留意。各大臣は、1995年から2010年の間に域内の一次エネルギー需要は41%増加するが、域内の生産は31%しか増加せず、エネルギーの輸入量はほぼ倍増する見通しであることを認識。各大臣は、アジアの経済的停滞によるインフラや生産投資の低下は、2000年以降の高いエネルギー需要の増加を賄う効率的なエネルギー供給を阻む障害となり得ることにも留意。各大臣は、エネルギー・セキュリティの観点から、エネルギー源の多様化や域内のエネルギーインフラ整備、エネルギー効率向上が重要であることを確認。
9. 需要の増加の見通しと域外への石油依存度の増大に鑑み、各大臣は、天然ガス、再生可能エネルギー、原子力エネルギーの状況に応じた利用等エネルギー供給源の多様化、市場原則によるエネルギーインフラの整備を促進することの必要性を認識。また、各大臣は、有効に機能するエネルギー市場、市場による価格、エネルギー効率の向上、市場関係者の情報交換はエネルギーセキュリティ向上の観点から重要であることについても認識。

10. 各大臣は、石油市場に関する情報交換の着手を歓迎し、石油需給のセキュリティ問題について議論するとのEWGの決定をエンドース。

11. 各大臣は、市場メカニズムの効率的な運用の重要性を指摘した「電力への燃料供給に関するエネルギー・セキュリティ」に関する報告書の勧告に留意。

12. 各大臣は、経済活動のエネルギーへの依存性に鑑み、コンピューターの2000年問題により引き起こされる供給への支障の可能性への取り組みに役立つ情報を、域内域外を問わず共有することが重要であることを強調。各大臣は、EWGに本問題をエネルギー規制者フォーラム検討させ、その結果を報告させるよう付託。各大臣は、1999年4月の次回EWGにおいて各メンバーや産業界が取り組んでいる対応措置への支援に資する行動を提案する指示。

エネルギーインフラ

13. 各大臣は、適切なエネルギーインフラの継続的な整備が経済成長の回復と域内の持続可能な開発の観点から重要であることを認識。現在の経済情勢に鑑み、効率的なエネルギーインフラの整備は経済活動の生産性の改善を促進し経済成長の回復を容易にすることを認識。ある試算では今後10年間で域内の電力インフラ整備だけで数千億ドルが必要であるとしている。各大臣は、市場の構築と地域間での格差の縮小に向けての努力を支持することを再確認。各大臣は、発展途上国におけるエネルギーインフラ整備に向けた資金と投資の重要性を強調。

14. このため、各大臣は、各メンバーの法制度で許容された分野におけるインフラ整備への民間の関与を促進することの重要性を強調し、予見性、透明性のある制度・規制の枠組みが投資環境を改善する上で必要であることを再認識。

15. 地域の経済回復におけるエネルギー分野の果たす役割に関し、各大臣は、投資家マインドの向上や資金の流動化に向けた既存の取り組みの強化に合意。本目的のために、各大臣は、早期の行動に関する提言作成のための官民合同ワークショップの開催をEWGに指示。エネルギー規制者フォーラムとともに、新設されたEWGビジネスネットワークもワークショップの議題の作成にただちに参加すべき。本ワークショップ開催は、地域経済回復支援の他のAPEC活動と整合的であり、そうした活動に大いに貢献するもの。

16. 各大臣は、第2回エネルギー大臣会合で合意された独立発電事業者のベストプラクティス原則に関する実践状況の進展について議論。各大臣は、EWGに対し、産業界との密接な連絡を取りつつ、実践状況について効果的にフォローアップするよう指示。

天然ガスイニシアティブ

17. 経済成長と発展、エネルギーセキュリティの向上と環境改善の観点からみて、域内の天然ガスの需要は今後20年で急増する見通し。こうした需要に対応するために、天然ガスの生産の増加と新たなインフラ整備が必要。アジア開発銀行は、今後15年間のアジア地域の天然ガスインフラの整備に約700億ドルが必要と試算。更に、アジア以外のAPEC地域では、数千億ドルの投資が必要と見込まれる。増大する域内の天然ガス需要を賄うために、天然ガス及び関連機器・サービスの貿易の増加も要求され、域内の経済成長に乗数効果をもたらすものと期待。

18. 各大臣は、「APEC地域における天然ガス供給、インフラ、貿易ネットワークに対する投資促進」イニシアティブの報告書の政策提言をエンドース。

各大臣は、当該政策提言の実施は個々の地域の優先順位に従うべきこと、定期的に見直されるべきことに合意。

APEC天然ガスイニシアティブは、天然ガス供給、インフラ及び貿易ネットワークへの投資拡大を促進すると期待される。域内外とのパイプライン網、LNG基地、供給システムからなる天然ガスの貿易ネットワークは、地域の経済成長を促進するとともに、APEC域内の協力と貿易を更に促進するものと見込まれる。地域内のパイプラインプロジェクトに関するフィージビリティスタディが実施されるべきである。

19. 新たなインフラ整備による環境への悪影響を最小化する必要性から、各大臣は、「APEC地域における環境調和型のインフラに関する作業計画提案」をエンドース。当該作業計画が予見可能、透明かつ一貫性のある環境政策の実施に寄与することに合意。各大臣は、こうした政策の実施が、投資家の環境上の目的適合への柔軟な対応を可能とし、エネルギー投資を活性化することに留意し、また、EWGに対して、実効的かつ効果的な実施方法を発展させるよう指示。

エネルギー効率

20. 加盟地域では毎年数千億ドルがエネルギーに費やされている。インフラの効率やエネルギー利用が1%でも向上すれば、数十億ドルの投資を他の目的に振り向けることができる。エネルギー効率の向上は、産業活動の競争力向上に貢献するのみならず、同一の水準の財及びサービスを生産するために必要なエネルギーの量が削減されるため、環境へのインパクトを弱める。

21. 各大臣は、エネルギー供給、輸送、利用における効率の継続的改善の重要性を認識し、自主的プレッジ・アンド・レビュー制度の実施に合意。この制度は、エネルギー効率の向上を図る計画を経済合理性の範囲内で策定、実施し；策定した計画、その目的及び達成状況を報告し；エネルギー効率の改善に関する情報と経験を共有し；成

果を時系列的に計測できる指標とデータベースを構築するものである。

22. 更に、各大臣は、EWGに対し、エネルギーの生産・輸送・利用の効率を向上させる政策・技術・手段に関する情報交換のための計画を策定するよう指示。各大臣は、「エネルギー利用効率向上ガイドラインに関する報告」によるエネルギー効率の改善に関する勧告をエンドース。各大臣は、エネルギー効率の問題を引き続きAPECの主要課題とすることに合意し、APECのエネルギー効率指標に関する作業の進展を奨励。

23. 各大臣は、エネルギー効率の測定基準に関する協力の進展を歓迎し、「基準通知手続」をエンドース。各大臣は、この手続が産業界にとって透明性を向上させ貿易を促進させるのみならず、域内での異なった測定基準の拡散を最小限にとどめることとなる直接的な対策であることに留意。

24. 各大臣は、エネルギー効率向上やCO₂を排出しない、或いは低排出のエネルギー

システムの利用拡大における進展の重要性に留意しつつ、温室効果ガスの排出増加を抑制するためのエネルギー技術の開発、普及を促進する地域協力の重要性を強調。各大臣は、排出を抑制しつつ、経済の活性化のための手段として先端エネルギー技術に対する民間投資を促進するための更なる努力を奨励。各大臣は、国連気候変動枠組条約の下でこの問題に対応するためのメカニズムが検討されていることに留意。

25. 各大臣は、産業界の参加のもと、エネルギー研究開発の促進、商業・経済ベースでの環境調和型技術の移転及び新技術の導入コストの継続的な低減が重要であることを強調。

26. 各大臣は、鉱物及びエネルギー資源探鉱開発分野において、環境調和的かつ効率的な方法を促進することに関し、進展が見られることを歓迎。

産業界との連携

27. 各大臣は、沖縄エネルギービジネスフォーラムの討議に関する産業界の報告を歓迎

し、エネルギー関連投資とエネルギー効率はビジネスの大きな機会と捉えられたことに留意。各大臣は、本報告についてEWGにて更に検討するよう付託。各大臣は、EWGと産業界の連携を維持改善し、特に新設されたEWGビジネスネットワークに関するEWGの活動を歓迎。各大臣は産業界と政府との交流を強化する努力の継続を要請。

APEC首脳への勧告

28. 各大臣は、第3回エネルギー大臣会合の成果及び進展を、1998年11月のク
アラルンプールでのAPEC非公式首脳会合において検討されるよう報告することに
合意。各大臣は、メンバー間の政策対話の拡大により促進されるビジネス環境の改善、
効率的なエネルギーインフラの整備、エネルギー効率の向上を通じ、エネルギー分野
が現下の経済困難からの回復に重要な役割を果たすことをハイライトすべきことを勧
告。各大臣は天然ガスイニシアティブに基づく政策提言を1998年11月のAPEC
C非公式首脳会合における検討のため提出することに合意。

**ECONOMIC REFORM AND ENERGY POLICY,
ENERGY SUPPLY AND DEMAND IN INDONESIA**

By

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**Symposium on Pacific Energy Cooperation (SPEC '99)
Tokyo, Japan
February 16-17, 1999**

I. Introduction

The Rupiah unexpected devaluation exposed the financial weakness of the Indonesian economy. The eventual collapse of the financial system naturally shook public and investors confidence that, in turn, led to massive capital outflow and refusal of foreign financial institutions to requests for more funds. The Indonesian balance of payment structure and position were, therefore, found in deep trouble. It was then when the International Monetary Fund (IMF), which assists Indonesia experiencing foreign exchange and balance of payments problems, came into the picture. The Government of Indonesia successively entered into standby credit agreements with the IMF for a total of around US \$ 41 billion¹.

The current financial crisis that has shocked the Indonesian economy and caused the economy to tremble has at least slowed down energy consumption and will, undoubtedly, have similar repercussions on long-term energy demand and supply outlook. The devaluation of the Indonesia's Rupiah has made the domestic energy trade more expensive for the Indonesian people.

The economic contraction has brought the serious social consequences such as the lower purchasing power, social unrest and political sensitiveness of Indonesian people. This contraction has also the negative impacts on the energy consumption of all economic sectors and, thus, on the performance of energy producers. With recovery still uncertain, short and long term energy demand projections are continually being revised downwards and long-term energy supply expansion plans are similarly adjusted.

With declining activity in the industrial and transportation sectors, oil consumption has decreased, resulting in slump in Indonesia's total oil demand. Demand for oil products in 1998 decreased to 5.3% from 1997, while demand for gasoline (premium) to run transport sector increased by 1.8% over the same period².

On the contrary, electricity demand from industry fell because of reduced manufacturing output, which is a more vivid reflection of the economic downturn. Demand for this energy just grew at the rate of 4.04% in 1998. The low growth rate of electricity demand in 1998 is due to the decreased of the electricity demand in the industrial sector to -5.5%, while demand for this energy in the residential, commercial and other sectors increased at the rates of 13.8%, 7.6% and 10.4%, respectively over the same period. The decline in output from the industrial sector explains the change in energy consumption in Indonesia, which is affected by the crisis³.

I. Evolution and Anatomy of the Financial Crisis

The Indonesian financial crisis was triggered by a series of sharp and unexpected currency devaluation starting with the Thai baht in July 1997 and spreading to other

¹ KOMPAS, Indonesian daily news, 17 March 1998

² Meeting report on energy, between Minister of Mines and Energy and the DPR-RI, Jakarta, 9-12-1998

³ Management report, Ministry of Mines and Energy, Jakarta, second quarter 1998

countries in East and South-east Asia. For the three decades since 1970 to the mid of 1997, the Indonesian Rupiah had been trading at around 500-2600 to the US dollar, and was therefore very stable.

The unexpected Rupiah devaluation spread like fire and engulfed the Indonesian economy. The Indonesian Rupiah suffered and plunged by more than 75 per cent in January 1998. Still even worse, in reaction to the ensuing political tension and social unrest, the Rupiah dropped further by more than 80 per cent in June 1998 (compared to January 1997) when all the other local currencies appeared to be on the path of recovery⁴.

The IMF rescue plans called for the immediate implementation of a set of fiscal and monetary measures to revive the financial sector. But central to this plan were short and medium term measures to restructure and strengthen the ailing financial systems in Indonesia. Generally, the IMF identified three key areas from which Indonesia still unaffected by the crisis can learn, and which correspond to the key factors that are at the roots of the crisis⁵.

First is complacency in the face of economic problems and lack of preparedness to sudden change in market sentiment. This was comfortable attitude of the Indonesian economy, which had for three decades enjoyed robust economic performance and large foreign capital flows when the crisis caught it by surprise.

The second factor is the heart of this crisis namely weaknesses in the financial sector. There were several weaknesses in the financial sectors in Indonesia worst hit by the crisis:

- The financial sectors in Indonesia lacked proper prudential standards and supervision;
- The sizeable capital inflow had given rise to investment in equity and property and the risks associated with price bubbles;
- The authority has in some instances come to the rescue of insolvent financial institutions and prevented them from being liquidated.

The third factor at the root of the current financial crisis is the lack of transparency and adequate economic information. There were clearly shortcomings in availability of data on external debt and official reserves with regards to forward obligations, swaps, and other liabilities, and the usability of reserves. Disclosure of financial situation of banks was making cannot be overemphasized.

II. Impacts of Economic Crises on Energy Sector

The present economic turmoil has gravely affected energy demand in at least three ways. First, as discussed earlier, the depreciation of the Indonesian Rupiah has made energy trade in the domestic market more expensive. Second, the ensuing economic slowdown means reduced output or declining output growth, which, in turn, implies less energy

⁴ Asia Pacific Energy Watch, CERA, spring 1998

⁵ The impact of the financial crisis on the Asian energy sector, CEERD, AIT, Bangkok, December 1998

input needs than otherwise expected. The crisis has hit the manufacturing and transportation sectors, which are heavy energy consumers. Third, the economic contraction eventually translates to reduced corporate and personal income, or worse, firm's closures and unemployment that in turn reduce energy consumption.

Impact on Energy Demand

Energy price increases resulting from the crisis would probably not affect directly energy consumption, at least in the short run, especially if the price elasticity of energy demand is quite low. The main reasons that will explain the slump in energy consumption are the economic slowdown and the equivalent loss in per capita income. The economic crisis has indeed resulted in important reduction in the output, notably, of industrial and transportation sectors, which are the largest energy consumers.

Domestic demand for oil products has slightly dropped since the second half of 1997. Sales of petroleum products over the period of January-October 1998 dropped to 5.3% or 2.3 million kilo liters compared to the same period of the year 1997. Moreover, Indonesia as an oil exporting country is not only facing decline in domestic oil consumption but is also being affected by reduction in regional oil demand. Indonesia exports about two-thirds of its crude oil production mainly to Asian countries like Japan, China, the republic of Korea and Singapore account for around 76 per cent of Indonesia exports⁶.

The international trade exchanges of natural gas in the South-east and East Asian region are still largely in the form of Liquefied Natural Gas (LNG) as most of the cross-border pipeline projects are still under construction or negotiation. Indonesia is the key Asian LNG suppliers and the its main customers are Japan, Republic of Korea and the China-Taipei, which together account for 80 per cent of total world LNG demand. Japan imported around 37 per cent of Indonesian LNG, and the Republic of Korea about 28 per cent in 1997.

Consumption of natural gas in the various sector decreased during the first quarter of 1997 and 1998 with and percentage change of -10.8 per cent, from 37.8 thousand BOE in the 1st quarter of 1997 to 33.9 thousand BOE in the 1st quarter of 1998. Most of change came from the power generation and industrial sectors. The contraction in domestic demand and regional demand for natural gas combined to cut natural gas production and consumption in thhis country.

Coal is mainly used as an indigenous source of energy, but large quantities are also traded. Indonesia exports 75 per cent of its coal production but this share will decrease as the country is planning to increase the coal contribution in electricity generation.

Coal is mainly used for electricity generation and its utilization has been increased to substitute some amount of the oil consumed. Only few data are available on coal consumption, but they indicate that coal consumption has increased even with the current

⁶ International Energy Agency, Energy Statistics and Balance of non-OECD countries, October 1998

economic crisis. In Indonesia, there was also a tendency to increase indigenous coal production and consumption. Demand for coal in the various sectors increased during the first quarter of 1997 and 1998 with a percentage change of around 10 per cent, from 11.3 thousand BOE in the 1st quarter of 1997 to 12.6 thousand BOE in the 1st quarter of 1998.

Coal will continue to play a greater role in meeting the energy requirements in Indonesia over the next two decades despite international concerns about carbon emissions. The reason for this is largely energy security.

Similarly, the crisis has had different impact on the electricity consumption of the different sectors. Electricity consumption in the residential sector seems to have been not affected despite the perceived reduction in household income as a result of the economic slowdown. This may be true only for the short term, but can be explained by the low price elasticity of electricity demand in households. Moreover, the rising unemployment has meant more people staying at home and, thus, more opportunities for electricity consumption in the homes (for example, increased use of television and other electrical appliances).

Impact on Energy Supply

A slump in domestic energy demand would result in cuts or slowdown in domestic energy production and exports. Indonesia relies on oil and gas exports as a main source of Government revenues. Thus, the financial crisis would have consequences on energy production and exports as a net energy exporter.

Production cuts are indicative of the impact of the crisis on existing energy production capacity, and may have only short-term implications. However, the financial crisis also impacts on ongoing and planned capacities and the implications are long term and, maybe, worse.

The high economic growth of Indonesia that continued through the early 1990s encouraged the large inflow of private foreign capital in Indonesia. Thus, medium- and long-term electricity supply expansion and indigenous energy resource development plans were drawn up in anticipation of continued growth in energy demand.

When the crisis erupted in mid-1997, many energy projects were either ongoing or are scheduled to break ground in the next two to three years. Many still were lined up for implementation after 2000 and through 2005, and several projects have been identified to come onstream through 2010. The financial crisis has already delayed or cancelled several of these projects and threatens many others.

Moreover, many, if not most, of these projects will be undertaken by the private sector and financed through private investments as the currents of privatization, deregulation, and restructuring swept through the region. The financial crisis has dampened investor confidence and will delay the implementation of these reforms.

The sectors that are worst affected are the electricity and oil and gas sectors.

Electricity sector⁷

Generally, Independent Power Producers (IPPs) projects conducted in Indonesia have not been based on the open tender mechanism but most of them through the direct assignment, such that PLN as a public utility gets losses and has more risks. Participation of private power has currently not increased power sector efficiency. On the contrary, the invitation of private power participation produced a series of unanticipated complications among them as follows:

- An immense flow of unsolicited projects offers, regardless of sector plans;
- Development of projects without the process of competitive bidding;
- Cost of project development above international benchmarks; and
- Power purchase contracts that do not share risk equally.

A sensitive issue emerging from the economic crisis is the concern of IPPs on the return on investment. Under the current excess of generating capacity in the Java-Bali system, it will be extremely difficult for PLN to meet the 'take-or-pay' power purchase agreement (PPA) of the IPPs. On the other hand, losses of the sector may run to the order of several billion US\$, if no action is taken. The magnitude of the financial crisis of the power sector in the overall economic crisis, rank third after the total private sector foreign debt and the financial crisis of the banking sector. Considering the severity of the power sector crisis, the Government is currently in the process of formulating arrangement to resolve this matter in conformity to international norms.

On August 25th, 1998, the Minister of Mines and Energy promulgated a Government intention to restructure the power sector. One of the Government's main priorities is to restore the sector's financial viability, furthermore however, the Government will also fundamentally restructure the power sector. The objectives of power sector restructuring are to introduce competition, transparency and more efficient private sector participation.

Indonesia's power restructuring program has taken into consideration the country's geography, the different levels of development by region and the need to continue Government support to certain areas. Restructuring of Indonesia's power sector will begin in the island of Java, where its power system is more advanced and can be developed commercially. Restructuring of the sector will proceed gradually, initially a Single Buyer Multiple Sellers market, currently planned to be established in 2003. New players will enter the market such as power pools, the power wholesalers and power retailers.

To support the process of privatization of the sector, the Government is in the process of rationalizing electricity tariffs, and establishing a more sound mechanism to distribute subsidies to the needy.

⁷ Endro Utomo Notodisuryo, **Indonesia's Energy Policy and the Power Sector**, presented in the conference on Infrastructure Investment and Development in the Revitalization of the Indonesian Economy, LPPN-INDEF, Jakarta, November 1998

Activities on restructuring currently in progress include the drafting of the new Electricity Law, also regulations and codes governing the sector. The new electricity Law will replace Law (UU) N.15 of 1995 on Electricity. A detail timetable for the implementation of restructuring, which is being drafted, will be finalized in a workshop to be held next month, in December 1998.

In the process of sector restructuring, PLN will be unbundled into independent business units in generation, transmission and distribution. Transmission of power will however become a natural monopoly.

The major milestones on restructuring of power sector as stated by the Minister of Mines and Energy are as follows:

- August 1998 : Promulgation of Power Sector Restructuring Policy
- Mid of 1999 : Establishment of the Java Bali Power Company, and a Single Buyer Multiple Seller Market
- End of 1999 : The new Electricity Law and other regulations
- Beginning of 2000 : Establishment of an Independent Regulator, the Java Bali Transmission Company and the Regional Power Company
- In 2003 : Multiple Buyers Multiple Sellers market in Java-Bali

The opportunities of investing in the power sector is currently very limited, if not of existence at all, particularly in the Java-Bali system. The opportunities of private power participation in the future may however develop as economic growth and stability is restored.

Indonesia is consistent to its policy to welcome private participation in the power sector that is based on competitive supply of power standard. The restructuring of the sector as above mentioned supports this agreement. The sector of the future will be more open to private investment since the Government expects to establish a power sector that is independent and self-sustaining. For this purpose, laws and codes of power sector will be fundamentally change to become similar to those that apply in competitive markets internationally.

Gas sector

The gas sector in Indonesia, like the electricity sector, is characterized by huge long-term investments that are protected by long-term contracts between gas developers and usually a national oil and gas company and a captive market, which in most cases is the electricity sector. The financial crisis has dampened expected domestic energy demand, and therefore, the prospects of these gas projects. A number of projects also face delay, if not outright cancellation.

In Indonesia, the Natuna D-Alpha natural gas field, one of the biggest in the region, is facing great concerns about its development. First, due to the impurities in the gas find

there, costs have been rising with the rupiah's devaluation. Second, with the current economic recession within the region, the consortium in charge of its development is encountering problems to find buyers for its gas reserves: an important deal with Thailand, for instance, has been renegotiated. Pertamina and Petroleum Authority of Thailand (PTT) has agreed to delay the start of the gas delivery from 2003 to 2007. The deal includes construction of a sub-sea pipeline between Natuna and Thailand via Malaysian waters⁸.

Although facing the economic crisis, Indonesia also succeeded in making the long term contract of natural gas trade with Singapore to support its demand for energy, especially to generate electricity and to fulfill other domestic demand for natural gas⁹.

Oil downstream sector

Indonesia has been studying ways to increase production capacity of its oil refineries in order to avoid building expensive new refineries as previously planned. The country's domestic demand for refined products is still expected to grow in the next few years but the Government cannot afford constructing new facilities in the light of the current economic crisis. To attract more foreign investors, the Government finally opened Indonesia's downstream sector to private investment. Under the new decree, private foreign and domestic companies can set up private refineries as joint ventures with Pertamina which will still remain the sole distributor of refined products in the domestic market, so private refineries will be allowed to sell their products to Pertamina or international markets.

The impact of the financial crisis on energy production has been varied and determined to a large extent whether the country is a net energy importer or net energy exporter. Net energy importing countries have increased-. production of indigenous energy resources in response to more expensive energy imports. Net energy exporting countries have suffered from decreased production of energy sources exported to the regional market as a consequence of reduced domestic and regional demand. On the positive side, however, the regional financial crisis has offered opportunities for getting the most out of indigenous energy resources and getting the most out of them. Yet, this is as far as existing production capacities are concerned.

The impact of the financial crisis on ongoing (under construction or development) and planned investments on energy supply maybe more severe. The crisis has delayed and canceled many of the ongoing and planned investments of uncertainties in future energy demand. A good example to illustrate this point is the impact of the crisis on private power projects in the region. In fact, in this case, even existing projects have been affected because most, if not all, of these projects are based on long-term contracts signed when the expectations on future energy demand were high and when exchange rates were very stable. The financial crisis has place in jeopardy both parties to these private power

⁸ Energy Information Administration, Department of Energy, USA, Country report, Washington, March 1998

⁹ The Economist, September 1998

contracts, but it seems that the government will have to assume more of the risks emanating from the economic downturn.

The financial crisis affects ongoing and planned investments, not only because of uncertainties in future energy demand, but also because the crisis has raised the costs of doing business in the region and, therefore, financing these projects has become more difficult. This, obviously, will have long-term implications on future energy investments in the region that could affect its economic sustainability.

III. Economic Reform¹⁰

International financing agencies – World Bank, International Monetary Fund, Asian Development Bank etc are committed to helping Indonesia to stabilize its economy, minimize the adverse social impact of the drought and the economic crisis, and implement the reforms which are needed in preparation for eventual economic recovery and growth. In the short term, these agencies will help to finance projects to protect those most vulnerable to the present crisis, while at the same time working on a number of fronts to promote structural reform in the Indonesian economy.

The economic reforms include efforts to restore domestic confidence by reducing structural inefficiencies and improving transparency; reviving the domestic financial sector; putting in place mechanisms to jump-start trade finance; and working out a framework for restructuring corporate debt. An area of special emphasis is to reform the banking sector, improving bank supervision and governance, and liberalizing the entry of foreign entities.

The economic situation has deteriorated since the beginning of 1998. The depreciation of the rupiah in recent months combined with a severe drought has resulted in a large increase in prices, with the consumer price index rising by 6.9 percent in January and 12.7 percent in February before slowing to 5.5 percent in March. Because of the drought, food prices have risen particularly sharply during the first quarter of the year 1998. The financial position of the domestic banking system has dramatically deteriorated, as the crisis in the economy has deepened. Bank- Indonesia (BI) granted very large scale liquidity support, creating additional pressure on the exchange rate and international reserves. At the same time, foreign banks have cut trade and other credit lines to Indonesian banks, and enterprises are having difficulty in obtaining the imported inputs needed for production.

The Government of Indonesia to improve its economy is trying to (i) stabilize the rupiah at a level more in line with the underlying strengths of the Indonesian economy, including through a tightening of monetary policy; (ii) strengthen and accelerate our strategy for restructuring the banking system; (iii) strengthen the implementation of the structural reforms that will create the foundations for a more efficient and competitive economy; (iv) provide a framework for comprehensively addressing the debt problems of

¹⁰ Supplementary Memorandum of Economic and Financial Policies between the GOI and IMF, Jakarta, April 1998

private corporations; and (v) restore trade financing to a normal basis, thereby allowing domestic production and especially the export sector to recover. The Government expects that its bold policy program will be reinforced by financial support from the international community, including, trade, financing and the provision of food and medical.

To help reduce monetary growth and restore confidence in the rupiah, interest rates on Bank Indonesia certificates (SBIs) have been substantially increased, and Bank Indonesia has publicly indicated its intention to adjust interest rates as necessary to reduce inflation rapidly and strengthen the exchange rate. Steps have also been taken to remove impediments to the pass through of higher money market interest rates to deposit and lending rates.

The budgetary position in 1998/99 will come under severe pressure as a result of the decline in economic activity, the need for temporary subsidies to protect low income groups from the impact of depreciation of the exchange rate on the prices of staple foods and other essential items, the large cost of restructuring the banking system, and the decline in international oil prices. Without offsetting measures, these factors could increase the deficit to at least 6 percent of GDP. However, the Government intends to limit the deficit to about 3.5 percent of GDP, almost all of which can be covered by foreign financing.

To achieve the program's budgetary objective, the Government has taken the following steps: (i) subsidies remain limited to a few items that have a large weight in the consumption baskets of low income groups, and the subsidies are being contained by large price increases for several food items, petroleum products and electricity. In the present environment, there is little or no scope to raise revenues by increasing taxes. Subsidies were substantially scaled down by October, 1998; (ii) low priority development expenditures have been reduced; and (iii) profit transfers from state enterprises, including from Pertamina, will be increased as a result of efforts to scale back state enterprise investment and accelerate management reforms. The remainder of the budgetary gap will be covered by divestiture proceeds. During the program period, the government of Indonesia has intended to conduct a revenue review in conjunction with the Fund that would aim to strengthen overall revenue performance and improve tax administration. The first stage of this review was undertaken by end-September 1998.

A detailed state enterprise reform and divestiture plan is being developed with the intention of improving the efficiency of the enterprise sector as well as helping to strengthen the public finances. Transparent procedures are being developed for the sale of state assets. Over the longer-term, at a minimum, all enterprises that operate in competitive markets will be privatized, with the government retaining only selected public utilities and strategic companies. For 1998/99, divestiture receipts have been estimated conservatively because of the uncertain market conditions.

The Government has already taken steps as part of its economic restructuring program to improve competitive conditions in a number of specific markets. In order to enhance the

overall efficiency of markets, the Government will write and implement a law on competition policy to establish guidelines for fair business practices and to avoid anti-competitive behavior. Competition policy will benefit consumers by making quality goods available at the lowest possible prices; small scale enterprises will benefit from improved access to the widest range of goods and trade facilities.

The Government will further strengthen and support the development of small and medium scale enterprises and cooperatives through various measures. In particular, the Government will ensure an adequate flow of credit to these enterprises and cooperatives during the period of general credit restraint. In the first instance, this will be done by improving the targeting and implementation of existing schemes with assistance from the Asian Development Bank and World Bank. If necessary, additional budgetary resources will be made available to these schemes. Over the medium-term, the Government will strengthen the overall institutional framework for enhancing efficiency of the small and medium enterprises and cooperatives. The Government will develop a specific plan of action, with assistance from the Asian Development Bank and the World Bank. Such a plan will include measures to (i) strengthen the capabilities of financial institutions involved in lending to small and medium scale enterprises and cooperatives, especially with regard to credit appraisal and project supervision; (ii) manage the risks and reduce the transaction costs associated with such lending; (iii) enhance access to trade financing and insurance facilities; (iv) develop technical skills and improve access to appropriate technologies; and (v) improve provision of suitable infrastructure and reduce administrative control.

It is imperative that the adjustment program does not result in a worsens of the economic and social conditions of the poor. The Indonesian policies stated previously on providing a social safety net will be continued and strengthened. As noted above, budgetary subsidies on food, fuel and electricity have been increased. The Government also is broadening subsidized credit schemes for small- and medium-size enterprises where most of the non-agricultural labor force is employed. In addition, community based work programs are being expanded, in cooperation with the Asian Development Bank and the World Bank- and to sustain the purchasing power of the poor in both rural and urban areas, especially those households suffering unemployment.

IV. Energy Policy¹¹

In general, the energy policy is formulated with the purpose to conduct the energy development mission, that is to ensure the continuity of energy availability, and to utilize energy resources in order to obtain the maximum value added to the people's welfare. The Indonesian energy vision in the future is the realization of the sustainable and environmentally sound development through the utilization of energy resources that yield the largest value added for the maximum benefit of the people's welfare.

Energy development itself is directed toward urging the development activities and promoting an equitable distribution of the benefit of the development, toward increasing

¹¹ General Energy Policy (GEP), National Energy Coordinating Board, Jakarta, February 1998

the people's welfare, and aimed at fulfilling the people's energy demand and at improving the quality of public service.

Energy policy is a directive for the creation of a desired climate for energy development. The overall parameters in energy management, encompassing direction and aims, energy strategy and policy that supports the implementation of the strategy, constitutes a national policy in the field of energy, or is referred to as the General Energy Policy.

Thus the aims of the formulation and the determination of the general energy policy is to create a climate that supports the implementation of the development strategy in the field of energy; and to provide certainty to elements of the private sector, the public at large, and to the state apparatus, on the direction, scope and degree of flexibility in the exercise of their choice related to the availability, supply and use of energy.

In order to implement the energy development strategy, the followings are the Indonesian principal policies, namely:

- to diversify energy resources used by every using sectors;
- to create a climate that supports efforts to find additional and new reserves
- to conduct conservation activities in the upstream and downstream sides for the benefit of the future generations;
- to apply market economy concept in the energy utilization;
- to include consideration on environmental impact on every aspect of energy utilization.

While the aims of energy development in Indonesia are such follows:

- To ensure domestic energy supply, either from domestic or foreign resource, commensurate with demand at appropriate prices, from the point of view of economic value, such that the pattern of energy supply is guaranteed and sustained, and in addition supportive of sustainable development;
- To make optimum the utilization of energy such that the economic added value and people's welfare are maximized;
- To use energy, either on the upstream or on downstream activities, in a safe manner and with an environmental perspective, through the pattern of the efficient and wise utilization of energy resources; and
- To enhance national resiliency in the management of the energy system, particularly when faced with the challenges and the constraints in meeting current and future energy demand, through the development of science and technology capability and their application in industry and in the execution of energy planning and management.

To achieve the above mentioned policy aims, a set of policy measures has to be implemented. The followings are details of the measures.

Energy Diversification. It is directed towards diversifying the utilization of energy, be it renewable or non-renewable, in the framework of economic optimization of energy

supply and in order to decrease the rate of depletion of hydrocarbon resources so that the maximum net benefit is obtained while sustainable development is implemented

Intensification of Exploration for Energy Sources. It is carried out through continuing surveys and exploration for energy, either from domestic or foreign sources, with the aim of increasing energy reserves, in particular oil and natural gas and coal. The search for energy sources will be focused in areas that had not been surveyed, while those areas with some indications will need efforts to upgrade their reserve status to more certainly

Energy Conservation. It will be applied on all stages of utilization, beginning with energy use at its source up to its end-use to ensure the fulfilment of the future generation's needs. The conservation effort will be applied on both the upstream and the downstream sides. Upstream energy conservation will be implemented through increasing the efficiency of energy source extraction, while downstream conservation will be implemented through increasing efficiency of energy end-use in all sectors.

The Average Energy Price. The average energy price in a planned and deliberate way will be adjusted such that it would more and more follow the market mechanism but will take into account a number of aspects, namely the optimization of the use of energy sources and the optimization of energy utilization, increasing economic competitiveness, protection of and the principle of equitable distribution.

Environment. Energy development will be implemented in support of environmentally sound and sustainable development. For this to be achieved, the environmental damage and the degradation of the ecosystem that accompanies energy development need to be continually decreased by decreasing negative environmental impacts, either local, regional, or global, related to the production, transportation and end-use of energy.

V. Economic and Energy Outlook

Economic Outlook¹²

The economy's growth performance and prospects have been severely dented by intensifying crisis of recent years and months, which has spread from the financial markets into the real economy and thence into the political sphere, with further ramifications for the growth outlook.

According to official estimates (Central Bureau of Statistics) for the first quarter of 1998, GDP contracted by 6.2% in real terms relative to the first quarter of 1997 and by 8.5% relative to the final quarter of last year. In view of the considerable additional damage caused by the recent economic and political upheavals, it now appears inevitable that the data for the second quarter will show an even more serious contraction. The Central Bureau of Statistics is forecasting a full-year GDP contraction of 13.4% on the basis of the first and second as well as third quarter data, but those data (particularly because of a

¹² The Economist Intelligence Unit, Country Report, Indonesia, 3rd quarter 1998

mystifyingly high growth rate for agriculture of 5%) probably underestimate the true extent of the contraction.

The breakdown of both internal and external trade, a banking sector close to collapse, sharply rising operating costs because of the rupiah's crash, high interest rates, the rundown of the net official external reserves to a mere \$ 16 billion at the 1998 and the suspension of disbursements from the IMF rescue package make the short to medium term outlook bleak.

A severe economic contraction of at 13.4 % appears unavoidable in 1998 even if a degree of political stability is restored and rapid success is achieved by the various efforts currently under way to restructure the banking sector, resolve the external debt issue and unlock the foreign assistance pledged by bilateral and multilateral donors under the IMF sponsored rescue package.

On the assumption that scheduled structural adjustment measures are in place by the end of 1998, the economy's performance will improve steadily over the following years. The recovery will be slow, however, and the economy will continue to contract over 1999-2000 before gradually picking up towards the end of the forecast period.

All expenditure components of GDP will be affected by the downturn. Private consumption growth will be hit by a sharp contraction of disposable incomes triggered by the increase in unemployment and the surge in inflation. The effects of the fall in disposable incomes will linger for some time even after the worst of the crisis has passed. Government consumption and investment will be restrained by falling public revenue and by the spending discipline required under the fiscal policies mandated by the IMF.

Private investment, both domestic and foreign, will be inhibited by the loss of confidence that recent events have caused. Trade flows will be hampered in the short term by lack of access to trade finance. The increased competitiveness gained through the depreciation of the rupiah will eventually help an export recovery. Since many of Indonesia's major manufactured exports are heavily dependent on imported inputs, the revival in export growth will be accompanied by a less rapid recovery in the growth of imports.

Energy Outlook

The resulting economic crisis implies much decreased demand for energy in coming years. For example, in Indonesia, the reduction in demand 1998 could be at least 20 per cent for both oil products and electricity.

Lower demand and also lower exports to other crisis affected Indonesia, means that existing energy production capacity may be sufficient for some time. This results in postponement of new projects: power plants and refineries as well gas infrastructure. Despite a slowdown in energy demand growth as a consequence of the current financial crisis, Indonesia will still account for much of the South east Asian energy demand.

Indonesia may soon see significantly slower energy demand growth, but it is expected to rebound after 2000¹³. Dramatic expansion in the use of cars and other fossil fuel-powered transportation, rapid urbanization, and electrification programs will result in primary energy demand at an annual rate of 3.4 per cent (crisis) through 2010, compared to 6.1 per cent (before crisis) over the same period.

As Indonesian economic recover economic growth, oil demand growth is likely to accelerate again to 3.2 per cent annually, while electricity demand will rise by 7 per cent per year.

The investment of foreign capital on domestic energy industry is expected to make energy market more competitive in the oversupplied domestic market. The intensified competition will facilitate the possibility of energy industry reform. The reform in electricity industry will have the form of the privatization and competition in energy market.

Energy Demand Outlook¹⁴

Energy demand in Indonesia is closely correlated to the economic outputs, population and the price of energy. The current economic crisis has had a profound effect on the all sectors of development, including the energy sector. Energy consuming sectors most severely effected by the economic crisis are the industrial and the transportation sectors. The effect of the crisis on household energy consumption is less significant.

Forecasts of energy demand based on energy-economic elasticities are presented in table 1 and figure 1. For purposes of comparison, three scenarios are examined specifically, (i). a BaU scenario assuming continued growth without the event of an economic crisis, (ii) crisis scenario, and (ii) protracted crisis scenario. The assumption of economic growths are as follows:

The scenario of continued economic growth assumes healthy economic growth at a pace of 7 % per annum, over 1995 to 2010. The forecast shows energy demand growth at an average of 8.6 % per year over the same eperiod.

The crisis scenario assumes economic growth at 0 % is achieved in 1999, 4% in 2000, and 7% growth over 2001 to 201 0. The average demand of the crisis scenario is found to be 6.3 % per annum over the forecast period.

¹³ Impact of the Asian crisis on the Indonesian energy sector, Mr. Budi Sudarsono, Regional workshop on Energy – Environment Planning and the Impact of the Financial crisis on the energy sector, Bangkok, 2-4 December 1998

¹⁴ Endro Utomo Notodisuryo, **Indonesia's Energy Policy and the Power Sector**, presented in the conference on Infrastructure Investment and Development in the Revitalization on the Indonesian Economy, LPPN-INDEF, Jakarta, November 1998

The protracted crisis scenario assumes -5% growth in 1999, 0% in 2000 and 6.5 % growth over 2001 and 2010. The average demand growth of the scenario is 4.4 % per annum. For both cases, an economic growth estimate of -15 % for 1998 is used.

The analyses indicate significantly curtailed energy demand to the year 2005. Part of the energy sector most seriously effected by the economic crisis and lower energy demand is the power sector. More detailed analysis shows that the economic crisis will create substantial excess of generating capacity in the near future.

New Generating Capacity

Confirmed new generating capacity by power plant type to come on line as of 1998, are listed in table 2. The capacity of new power plants to come on line total 6760 MW, of the sum, the total capacity constructed by PLN will be 1987 MW, while the capacity of private power will total 4775 MW. In addition, there are still some 6260 MW of private generating capacity at various sages of development that are currently postponed or rescheduled.

The balance of generating capacity supply and demand in the Java-Bali system, including the new generating capacities above mentioned is shown in Figure 2.

The analyses show that the Java-Bali system will experience excess of generating capacity until the year 2006. For system outside of Java-Bali, addition of supply are still required over the next 5 years, particularly in PLN Region IV, V, IX, X and XI.

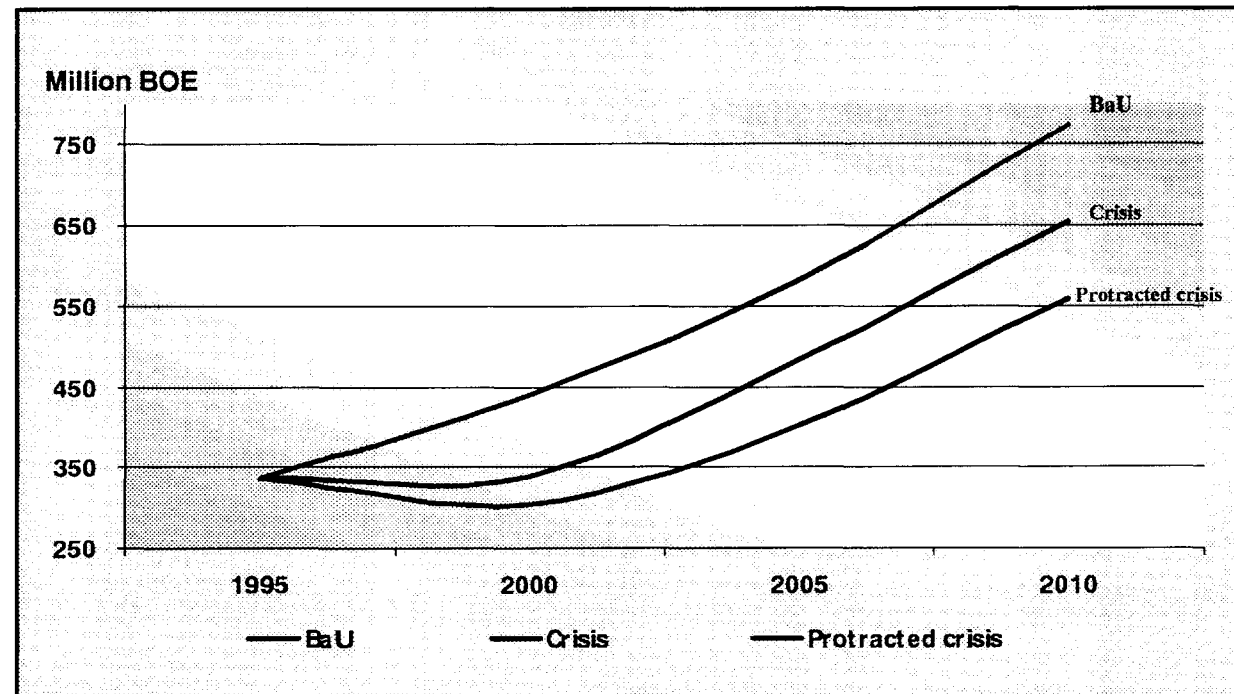
Table 1: Energy demand forecast (MMBOE)

	1995	2000	2005	2010
BaU	336	440	583	774
Crisis scenario	336	340	483	654
Protracted crisis scenario	336	304	402	559

Table 2: Confirmed total new generating capacities (MW, as of 1998)

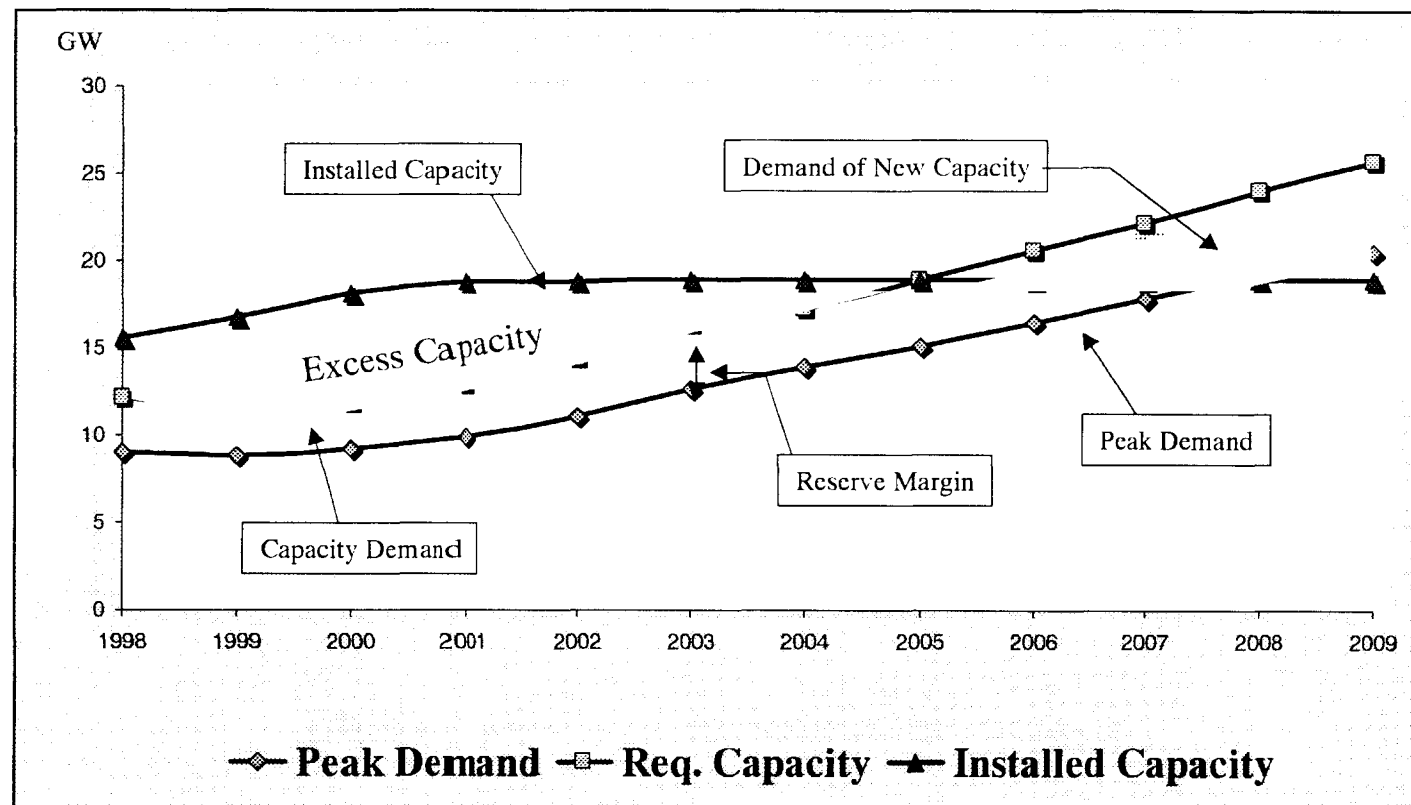
Power plant type	PLN	Private power
Hydroelectric	1007	-----
Steam coal	830	4080
Combined cycle	150	135
Geothermal	----	480
Diesel	----	60
Total	1987	4775

Figure 1: Forecast for final energy demand (1995-2010)



1. GDP BaU : 1995-2010 = 7.2 % per annum
2. Crisis GDP : 1998 : -15 %; 1999 : 0 %; 2000 : 4 %; 2001-2010 : 7,0 % per annum
3. Protracted GDP : 1998 : -15 %; 1999 : -5 %; 2000 : 0 %; 2001-2010 : 6,5 % per annum

Figure 1: Forecast for capacity supply-demand, Java-Bali System



Economic Reform and Energy Policy, Energy Supply and Demand in Korea

*Prepared for the Symposium on Pacific Energy Cooperation...SPEC'99
February 16-17, 1999, Tokyo*

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Economic Reform and Energy Policy, Energy Supply and Demand in Korea

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Abstract

The current financial turmoil wreaked havoc on Korean economy at a record level in the fourth quarter of 1997, leaving crippling effects on all sectors of the economy. Despite the sound economic fundamentals, the short-term shortage of foreign currencies for external debt services had placed Korea in the near-insolvent situation. In fact, the intervention of IMF was inevitable to rescue the nation from the imminent financial disaster. The newly established government has initiated economic reforms to rehabilitate the ailing economy, of which primary objective is to attract foreign capital to stabilize the foreign exchange market and to improve financial statements of both public and private sector companies. The reform package includes restructuring and reform of banking institutions, business conglomerates, and the public sector.

Included in the government reform package were privatization and deregulation of utility companies. Privatization is no more a question of "will there be" or "when and how.", but of "how soon." Korean utility companies i.e., KEPCO (Korea Electric Power Corp.) and KOGAS (Korea Gas Corp.) are to be privatized in the near future according to the government pre-announced plan. If they are privatized to the degree at which the government has aimed, the magnitude and speed of changes at which the Korean energy industry would evolve is likely to surpass our imagination. That is, the energy market will be open to foreigners at a full scale and energy pricing practice will be liberalized to the extent that full costs, including environmental one, would be reflected in energy price. A most likely outcome from the recent changes in energy industry in conjunction with climate change negotiations is the disproportionate increase in natural gas consumption in Korea as well as the Asia Pacific region.

Key words: Financial crisis, privatization and deregulation, climate change, natural gas

INTRODUCTION

Since the onset of the recent financial turmoil Korean economy has suffered from its crippling effects on all sectors of the economy. Despite the sound economic fundamentals, the short-term shortage of foreign currencies for external debt services had placed Korea in the near-insolvent situation. In fact, the intervention of IMF had rescued the nation from the imminent financial disaster then.

An issue of privatization of Korean utilities has surfaced around for, at least, couple of years. However the momentum had been neither created nor maintained if there had been any. Many believed that strong resistance from those giant utility companies in Korea had blocked the smooth transition of government monopoly to privatization. Now that the nation undergoes damaging consequences from the crisis, privatization issue comes into spotlight as an effective measure to attract much needed foreign capital.

For the last several years, even long before the financial crisis, both foreign and domestic companies had shown a great deal of investment interest in Korean utility companies, i.e., Korea Electric Power Corporation (KEPCO hereafter) and Korea Gas Corporation (KOGAS hereafter). However until recently it had been impossible for foreign companies, in particular, to penetrate into electricity and natural gas businesses as there are many regulations and constraints that could not be easily overcome. The lack of foreign capital being identified a major cause of the crisis, the government took initiatives for privatizing utility companies with a view to selling at least part of them to foreigner. With healthy economic fundamentals and well-established infrastructure, electricity and natural gas industries in Korea look attractive to foreign investors. Thus it is of my opinion that the privatization will come in full force sooner or later.

Privatization and deregulation in energy sector will change the nature of pricing practice as to reflect full costs in energy prices. Privatization and deregulation would help remove subsidies as well as entry barriers in the industry. Accordingly the energy demand will be influenced by such changes. In addition, environment will play an important role in determining the energy mix in the upcoming 21st century.

This note is intended to address issues related to the energy demand and supply in Korean in light of restructuring and then to go on to touch upon other issues, which would play important roles in shaping energy industry over the next century.

FINANCIAL CRISIS

On Nov. 21, 1997, Korea sent a humiliating request for bailout fund to IMF and in the following month a formal agreement was signed between the Korean government and the IMF.

The financial crisis has raised interest rate to a record level and lowered the purchasing power of domestic currency to a substantial degree. High interest rate coupled with weak currency is the emblem of financial markets under the financial turmoil. Interest rate has gone up quite substantially marking more than 25% a year and the Korean currency was devalued from 900 won/\$ to as high as some 1900 won/\$ at the outset of the crisis. These two figures have recently fallen considerably that the current exchange rate as of January 1999 is about 1180 won/\$.

It has been argued that the East Asia's financial crisis was triggered by international speculation. However, the fundamental and deep-rooted causes were the pervasive defects in the economic foundations and financial systems of the East Asian countries.

The development of Korea's financial crisis was as follows. First, there was a sharp currency depreciation, and then outflow of foreign capital. This was a direct cause of financial market collapse. Downgrading of sovereign rate accelerated this trend. As the financial crisis continued, the credit crash due to foreign capital withdrawal led to a recession of real economy.

The financial crisis resulted in successive corporate insolvency and enormous increase of unemployment rate. The drop in the value of assets then followed..

Evolution of the crisis in the Republic of Korea¹

The symptoms of the impending financial crisis began to appear when the economy started slowing down in 1996. Although this trend might seem to indicate a soft-landing, this turned out, later, as a downturn of business cycle. Despite the slowdown in the economy, the current account deficits was widened from 8.5 billion U.S. dollar in 1995 to 23 billion U.S. dollar in 1996. The deficit was financed mainly by inflows of foreign capital, resulting in a sharp increase in external debt.

Table 1. Main Economic Indicators of Korea (Unit: per cent, \$billion)

	1980-85	1986-91	1993	1996	97
GDP growth rate	6.3	9.9	5.8	7.1	5.5
CPI	10.9	6.1	4.8	4.9	4.5
Current account balance	-2.7	4.1	1.0	-23.0	-8.2
Current account / GDP	-3.8	3.0	0.3	-4.7	-1.9
External debt	46.8	39.1	43.9	157.5	154.4

Source: Yearbook of Energy Statistics, 1998, KEEL.

Since January 1997, a number of large companies had collapsed due to their huge burden of external debt service. Insolvency of large companies inevitably undermined the soundness of financial institutions, which had provided loans to these corporations. As a result, non-performing loans of the entire financial sector accumulated rapidly, amounting 56.5 trillion Won, equivalent to 13 per cent of nominal GDP at the end of March 1998.

Not only the domestic mismanagement of financial resources, but also external factors played important role in aggravation the already crumbling financial situation. As East Asian currency crisis quickly spread to neighboring regions, foreign investors apprehensively watched the weakening of financial muscles in private companies and financial institutions in Korea. The leading international credit rating agencies, S&P's and Moody's, downgraded Korea's long-term sovereign rating rapidly to a junk bond level. It led foreign investors to refuse roll-over requests by Korean banks and to reduce their financial exposure to Korean stock market. After all it became impossible for Korea to attract or even borrow foreign loans on a commercial basis.

As it became evident that the country was nearing a national moratorium in November 1997, the demand for foreign currency increased markedly in foreign exchange market. As Korean Won fell to its daily floor against U.S. dollar, foreign exchange market had to be suspended for the first time in history.

Being forced into a corner the government could not help but to request IMF bailout loans on November 21, 1997. Korea and the IMF reached an agreement for financial aid package totaling 58.3 billion U.S. dollar, conditional on a broad range of requirements including macroeconomic stabilization and structural reform.

ECONOMIC REFORM

In order to save the ailing economy and to avoid the danger of national default on the external debt, economic reform was inevitable and inescapable. There were not only a need for

¹ For this part, I am heavily indebted to Dr. In-Gang Na at KEEL.

the reform to improve efficiency and increase export earnings to service the external debt, but also requirements from the IMF for the country to fulfill, which were set out in the agreement for the IMF bailout package.

The immediate prescription of the IMF for the crisis includes high interest rates and tight fiscal policies. However it actually exacerbate the crisis, resulting in a large scale bankruptcy and soaring unemployment. As in the case of the world debt crisis in the early 1980's the IMF² the primary objective of the IMF's package was to prevent potential national default on external liabilities in view of the meager \$7.2 billion in usable foreign reserves available at the time.

In response to the crisis, the Korean government shifted its macroeconomic policy objective from growth to stabilization³ to expand its foreign reserves, while reforming the corporate and financial sectors, and laying a foundation for furthering the economic growth later on. Thus restructuring and reform of banking institutions and business conglomerates, which accounted for about 70% of the nation's GDP were the two main measures to counter act the crisis, along with labor sector reform.

In order to rehabilitate the financial institutions The 12 banks that failed to meet the 8 per cent debt/equity ratio, prescribed by BIS⁴, at the end of 1997 have submitted rehabilitation plans to the Bank Supervisory Board. If those plans turn out as inappropriate, a process of restructuring would be initiated, involving merger and acquisition, or closure. As for merchant banking corporations, 14 of them have been already shut down. The remaining 14 merchant banks are supposed to clear off their bad loans through an increase in equity capital. If they fail to do so, they will be also closed. In order to facilitate merger and acquisition in the financial sector the government has revised the security trading law and regulations to drop the required declaration volume of stocks owned by 10%.

Corporate sector reform policies and measures have been implemented with a view to achieving a major reduction in corporate debt-equity ratio and bringing in international standard accounting systems. Under the stewardship of both the IMF and the government, speedy restructuring in this sector is under way in particular among giant conglomerates in the form of "big deal" business swaps. In the midst of so-called big deals, all new cross payment guarantees among companies belonging to the 30 largest conglomerates have been forbidden since April 1998. Regulations related to foreign ownership of real estate have been also relaxed to a significant extent. To enhance transparency in corporate accounting system, the 30 largest conglomerates are required to provide combined financial statements from the fiscal year 1999.

It is noteworthy that representatives of labor unions accepted a reform package, spurring layoffs, considered as even unthinkable in the past, as part of their contribution to the national efforts combating the economic crisis in the Tripartite Committee, which is composed of labor, management and government. In view of the recent history of labor unions tainted with militant confrontation with the government and employers, the current labor agreement from the Tripartite Committee seem extremely conducive to stabilizing the deteriorating economy..

IMPACT OF THE CRISIS ON ENERGY SECTOR

Overview

Energy markets were seriously hit by the financial turmoil as the lack of foreign currency

² See Commonwealth Secretariat (1984)

³ To achieve this, the Bank of Korea has maintained a tight monetary policy, a stringent government budget was drawn up with 3.8 per cent growth rate, and the republic of Korea widened the daily band for exchange rate fluctuation to ± 10 per cent from ± 2.25 per cent of the market average rate on November 20, and shifted to a free-floating exchange rate system on December 16.

⁴ The Bank for International Settlement

coupled with near-insolvency of major banks almost stopped the flow of money supply for energy import. Energy prices went up sharply and energy demand fell.

Exchange rate hike resulted in the price increase for all imported materials including energy. The increase in the import price of energy was followed by worsening financial status of energy industry, in particular, public utility companies as the 97% of energy supply comes from abroad. The inability to secure foreign currencies in the wake of the fall in the credit rating made it much difficult for energy importing companies even to open Letters of Credit (L/C). On top of this, the marked depreciation of the Korean Won has led to the mounting interest burden on the external debt service.

The contraction-of-money-supply policy recommended by International Monetary Fund came into force and had negative impact on industrial production, which then reduced both growth rate and absolute level of energy demand.

The growth rate of energy consumption in the Republic of Korea had been more than 10 per cent in the last decade (see Table 2). In 1998, total energy consumption shows a negative growth rate due to the financial crisis. All energy industries have recorded negative growth rates for the first time since the early 1980s.

Table 2 Major Energy Indicators of Korea

		1980	1985	1990	1994	1995	1996	1997
Energy Consumption (1,000 TOE)	Primary	43,911	56,296	93,192	137,235	150,437	165,226	174,962
	Final	37,597	46,998	75,107	112,206	121,850	132,054	138,755
Per Capita Energy Consumption (TOE/Person)		1.15	1.38	2.17	3.09	3.35	3.63	3.80
Dependency on Imported Energy (%)	Nuclear included	73.5	76.2	87.9	96.4	96.8	97.3	97.5
	Nuclear excluded	71.6	68.8	73.7	85.7	85.6	86.1	-n/a
Share of Petroleum in Primary Energy Consumption		61.1	48.2	53.8	62.9	62.5	60.5	59.1
Share of Electricity in Final Energy Consumption		7.5	9.3	10.8	11.2	11.5	11.9	12.4
Energy Price Index		71.7	141.0	100.0	115.54	121.4	137.9	163.5
Energy/GDP Ratio (TOE/Million Won)		0.58	0.51	0.52	0.58	0.58	0.60	0.60
Economic Growth Rate(%) (GNP)		-2.7	6.5	9.5	8.4	8.7	6.9	4.9
Growth Rate of Primary Energy Consumption(%)		1.5	5.4	14.1	8.1	9.6	9.8	5.9
Energy Elasticity		-	0.83	1.48	0.96	1.10	1.41	N/a-

Source: Yearbook of Energy Statistics, 1998, KEEL.

Energy industry recorded a severe contraction in the aftermath of the crisis and a slowdown of other sectors. A sharp fall in demand coupled with delays in energy related projects led the industry to a ever difficult situation. For example, the new Long-Term Plan for

Electricity Demand and Supply was revised several times since the financial crisis. According to the plan some of the planned power projects would be under review for postponement.

Impact on energy price

Sharp currency depreciation following the crisis put upward pressure on costs in energy industry. A recent study by KEEI shows that cost increase was significant in the energy sector: around 24.8 per cent in oil industry, 20.3 percent in coal industry, 15.4 per cent in gas industry and 9.5 per cent in power industry. (See Table 3)

Table 3. The cost increment due to the depreciation of Korean Won

	Elasticity of exchange rate	Cost increment (%)
Oil	0.670	24.8
Coal	0.549	20.3
Power	0.257	9.5
Gas	0.415	15.4

Source: KEEI, Financial Crisis and Energy Industry, 1998.10.

The energy industry, having relied on foreign borrowing for infrastructure development, was exposed to a high level of foreign debt, amounting to 12.42 billion U.S. dollars as of December 1997. The enormous depreciation of Korean currency has led to the increased interest burden on remains of foreign debt. In addition, the foreign exchange loss due to the depreciation was substantial as shown in Table 4. Exchange losses would reach 637 million US\$ in oil industry, 2,385 million in power industry, and 12 million in gas industry by the end of 1998..

Table 4. The loss from exchange rate in energy industry

	Foreign debt (U.S. billion dollar)	The foreign exchange loss (U.S. million dollar)
Oil	2.59	637
Power	9.64	2,385
Natural gas	0.3	12

Source: KEEI, Financial Crisis and Energy Industry, Oct. 1998.

Immediately after the financial crisis, the government endeavored to maintain low energy prices to relieve upward pressure on the price of commodities to avoid inflation, which might hinder economic recovery. Since electricity tariff and natural gas prices were under the government control, the energy price increase was felt most in petroleum product. Traffic jams were gone for several months after the crisis and fuel-efficient compact cars became popular. The electricity tariff was increased by average 6.5 per cent January 1998. However, this increase was not enough to cover the incremental cost added by the crisis.

Impact on energy demand

As of July 1998, the growth rate of primary energy consumption is minus 6.8 per cent. This minus growth is recorded for the first time except the early 1980s. This new trend reflects the recession in the Republic of Korea. As seen in Table 5, the consumption of oil is reduced to 386.2 million Bbl, 13.6 per cent decline compared to the same periods in 1997. The growth rate in LNG consumption is also showing minus 14.1 per cent. While anthracite coal shows similar trend, the growth rates in consumption of hydro, nuclear and bituminous coal are positive.

Turning to sectoral energy consumption, the energy consumption in industrial sector has

increased by only 1.1 per cent. The energy consumption in transportation sector has decreased by 15 per cent. The biggest decrease in the energy consumption came in residential sector by 21.5%.

The energy consumption in 1998 is expected to follow a new trend. The growth rate of total energy consumption is expected to be negative 5 per cent. The growth rate of oil consumption is expected to be negative 12.2 %. As far as natural gas consumption is concerned, the impact of the crisis does not seem so devastating at least for now. In 1997 natural gas consumption reached 11Mt, consisting of city gas consumption, 5.7Mt and power generation consumption, 5.3Mt. In 1997 the natural gas consumption for power generation was higher but that for city gas was lower than previously projected because of the crisis and relatively warm weather. Electricity consumption, which grew about 10% in 1997, is also expected to fall -2% in 1998 to 196,722 GWH. The decline in electricity consumption would come mostly from the industrial sector over which the financial crisis has a significant impact

Table 5. The Primary Energy Consumption As of July 1998

	1997	1998.1-7	1998 (forecast)
Oil (million Bbl)	794 (3.8)	386.2 (-13.6)	697.4 (-12.2)
LNG (thousand ton)	11,379 (21.4)	5,877 (-14.1)	10,947 (-3.8)
Anthracite (thousand ton)	4,230 (-21.2)	2,304 (-6.0)	4,500 (6.4)
Bituminous (thousand ton)	49,712 (10.7)	30,303 (9.7)	53,768 (8.2)
Nuclear (GWH)	77,086 (4.3)	49,321 (16.5)	88,999 (15.5)
Hydro (GWH)	5,404 (3.9)	3,775 (18.5)	6,278 (16.2)
Other (thousand TOE)	1,344 (15.8)	859 (13.5)	1,504 (11.9)
Total (thousand TOE)	180,584 (5.9)	94,942 (-6.8)	171,504 (-5.0)
By Sector			
Industrial (thousand TOE)	77,853 (6.4)	44,063 (1.1)	78,471 (0.8)
Transportation (thousand TOE)	32,080 (3.5)	15,276 (-15.0)	27,494 (-14.3)
Residential (thousand TOE)	33,103 (4.1)	14,960 (-21.5)	29,008 (-12.4)
Final Energy			
Electricity (GWH)	200,784 (10.0)	110,135 (-3.1)	196,722 (-2.0)
City Gas (million m ³)	7,708 (16.3)	5,050 (3.4)	9,033 (17.2)

Source : MOCIE, Energy Consumption and Forecast, 1998.8.

Note: parenthesis denotes the growth rate compared to the same periods of previous year.

Energy Import

Table 6 shows the energy import as of July 1998. Total amount of energy import was 10.9 billion U.S. dollar up to July, which is a decrease by 31.2 per cent compared to the same period in 1997. Oil import is reduced by 31.2 per cent, and LNG import is also reduced by 36 per cent.

Based on the projection of MOCIE, the amount of energy import in 1998 is expected to be around 21 billion U.S. dollar. This figure is 6 billion U.S. dollar less than that of previous year's energy import.

Table 6. Energy Import as of July 1998

(Unit: Million U.S. dollar, %)

	1997	1998. 1-7	1998
Total energy import (B)	27,105 (11.9)	10,976 (-31.2)	21,046 (-22.4)
Oil	22,205 (12.2)	8,540 (-34.6)	16,545 (-25.5)
LNG	2,300 (21.9)	897 (-36.0)	1,850 (-19.6)
Bituminous Coal	2,329 (1.2)	1,382 (4.9)	2,369 (1.7)
Oil export (A)	5,156 (41.5)	2,745 (-6.3)	4,464 (-13.4)
Net energy import (A-B)	21,949 (6.6)	8,231 (-36.8)	16,582 (-24.5)

Source: MOCIE, Energy Consumption and Forecast, 1998.8.

Note: parenthesis denotes the growth rate compared to the same periods of previous year.

ENERGY POLICY IN TRANSITION

Economic reform was not limited to the private sector, but also extended to the public sector including energy sector. The major policies in response to the financial crisis involve the rationalization of energy price, adjustment of investment, and the reform of energy industry. Among various reform measures, the reform of energy industry may give rise to foreign investment an incentive on energy sector by strengthening competition and opening energy market.

Deregulation

The IMF bailout requirement includes, as a part of economic reform, rationalization of energy prices and energy tax reform. Thus, the government is obliged to rationalize the energy price and energy tax in the near future. While the prices of petroleum products have been fully decontrolled by the government since February 1998, electricity tariff and natural gas price are still under the government control. As IMF called for the Korean government to rationalize energy prices in order to reduce current account deficits, the government is currently

The government is making a further effort to liberalize the energy industry. For oil industry the government changed the business entry requirement from licensing to registration in refinery business in August 1998. The refinery and sales business have become accessible to foreign investors since august 1998. Natural gas industry is not an exception for the reform in energy industry. According to the government schedule, LNG import business will be open by 2001. The government intends to enhance competition in natural gas industry by introduction of third party access (TPA).

Adjustment of investment in infrastructure development

High interest rates and lack of capital resources in times of financial turmoil forced the

government to make a hard decision to either delay or even abandon some energy infrastructure development projects, in particular, projects requiring high initial capital investment. Examples are construction of power plants and domestic natural gas pipelines.

For the electricity generation sector, the delayed construction plan is summarized in Table 11. According to 1995 plan, 60 power plants are under construction. The effect of financial crisis makes the completion date of power plant construction delayed in consideration of the diminishing electricity demand. The completion dates of 42 power plants among 60 power plants are delayed more than 3 months. The delayed capacity is around 17,435 Mw, with average 15 months delay periods. As seen in Table 9, all kinds of power plants are included. In the case of nuclear power plants, total 6 nuclear power plants (5,700 Mw) are delayed, by average 9.2 months. In the case of imported coal-fired plants, 11 plants are delayed by average 10.5 months.

Table 7. The Delayed Construction of Power Plant

	1995 plan		1998 plan		Total Month
	No.	Capacity(MW)	No.	Capacity(MW)	
Nuclear	8	7,400	6	5,700	55
Oil	3	151	2	150	15
Domestic Coal	2	400	2	400	6
Imported Coal	15	8100	11	6,100	155
LNG	15	4970	8	3,474	143
Pumped	8	2300	6	1,700	112
Hydro	9	81	7	61	159
Total	60	23,402	42	17,435	645

Similar to electricity generation sector, natural gas industry revised its investment plan for the fiscal year 1998. The new plan cuts off about 50% of the investment expenditure compared to the old plan, of which total amount was reduced from 1,487 billion Korean Won to 733 billion. Included in the plan are grouping of projects based on the priority of projects determined by the interest of urgency as follows;

- Group 1: Urgently needed 6 projects including stage 2 expansion of Pyongtag receiving terminal, 1st stage 2 expansion of Incheon terminal.
- Group 2: 9 Projects that could be delayed including 2nd stage 2 expansion of Incheon terminal and national grid expansion in Yongnam, Honam, and the southern part of the peninsula
- Group 3: New projects including stage 3 expansion of Pyongtag terminal, 3rd stage 2 expansion of Incheon terminal, and Tongyoung terminal.

Depending on the availability of investment capital, the delay could be prolonged for quite some time in the future. The

Privatization of utility companies

Three government agencies have been involved in the privatization process of utility companies. These agencies are working closely with each other, but sometimes with different perspectives. According to Korean news reports until now indicates that the Fair Trade Commission has been the front runner in the privatization drive, keeping behind the National

board for Planning and Budget and the Ministry of Commerce, Industry, and Energy.

The Fair Trade Commission has been promoting privatization of utility companies in Korea for the last several years, but its voice had not been reflected in national policies. However recent changes in the government and economy strengthened the voice and placed the agency in the better position to advance the issue than ever before. The agency is aiming at the full-scale privatization including removal of entry barriers at all levels, i. e., import, wholesale, and retail and complete open access to the existing network. It's view seems to have in mind the British Model of privatization.

The National Board for Planning and Budget has been created recently by the new government and it assumed responsibilities of overseeing all macroeconomic policies and national budget allocation. As the main force behind the current wave of restructuring the board has announced plans for selling the utility companies to foreign investors for the purpose of attracting the much needed foreign capital. One of its plans is to sell off any publicly owned companies to private sector. Among them included are KEPCO and KOGAS. According to the plan, the government will sell a couple of power plants and reduce the government's share of KOGAS equity. This plan seems to provide a workable way in which gradual privatization would take place.

Unlike the above two, the Ministry of Commerce, Industry and Energy seems to have a great concern on this issue and has been maintaining a conservative position. The Ministry views that the privatization of KEPCO needs more study in parallel with energy industry restructuring and that of KOGAS must come after 2002, when the construction of the nationwide trunk-line would be completed

Despite differing views among those government agencies, the privatization of these two companies will be embodied and materialized one way or another as the government's initiative is getting momentum and support from general public. It is the view of many experts in Korea that the trend is irreversible and one could see the visible outcome in the near future.

Milestone

The Korean government announced its privatization initiative on July 3, 1998 including sales of 11 publicly owned companies. Certainly KEPCO and KOGAS are among them. According to the initiative the natural gas industry is likely to go through the following schedule:

- After 2001 direct import is allowed for POSCO and large volume consumers of which annual consumption is more than 2 LNG million ton per year
- Natural gas import for own use and IPPs will be deregulated after 2001
- During 1998-1999, a portion of KOGAS equity will be sold
- Competition enhancing measures will be introduced during 1999-2000 and one measure is Open Access.
- KOGAS will be fully privatized by 2002, concurrently with the completion of the national trunk-line construction.
- As of January 1999, the Ministry of Commerce, industry and energy consulted with Arthur Andersen consulting, Ahn Jin corporation, and the Korea Energy Economics Institute to produce a viable plan for restructuring of KOGAS by June 1999. The plan will outline introduction of greater competition into the import and marketing of natural gas and sharing of the distribution network.

Electricity industry will also go through the following steps into privatization;

→ IPP:

4 coal fired (2,000MW), 10 LNG fired (4,620MW), 2 Oil fired (1,000MW), and

2 small hydro plants are planned.

Currently 6 plants have been approved: 2 coal (POSCO), 4 LNG (LG, Hyundai, SK(2))

→ 4 power plants under consideration for sales

Anyang(478.4 MW), Buchon(473MW) : LNG

Samchonpo(3,240MW), Boryung(3,000MW): Coal

→ Most recently KEPCO announced that it would sell off five subsidiaries to Korea Power Engineering Co., including Korea Power Plant Service, Korea Nuclear Fuel, Hansung Global Industry and Seil Data Communication by 2002.

→ KEPCO is planning to issue DR (Depository Receipts) in February, 1999

The government is actively seeking ways and means to expedite privatization program for the state-run enterprises including utility companies.

Final Destination of the intended privatization

As in many countries industry restructuring does not come without cost. Often economies undertaking rapid change have paid hefty price for it. Thus governments tend to take a gradual step rather than an abrupt one in order to minimize anticipated friction from transition. The Korean government is no exception and will take measures to reduce transactions cost to the maximum extent. Thus it is not inconceivable that the pace of implementing the current plan could be adjusted. Nonetheless the objective of the privatization is clearly defined.

There are mainly three areas over which the privatization will bear significant impact: industry restructuring, pricing, and regulation and supporting measures. At the final stage of privatization, there will be changes in all three areas. First, regarding the industry restructuring, competition will be introduced at all levels from upstream to downstream. At the same time, open access to trunk-line and local distribution network will be institutionalized.

Second, in terms of pricing, subsidies across different energy sources will be removed and energy price will be liberalized except for network use fees. This will give a clear signal to consumers that price distortions will be minimized in future and the price gap between natural gas and other sources of energy will be reduced. In this process, true environmental cost will be reflected on all energy types and natural gas will become a more competitive fuel than otherwise would have been.

Thirdly, an independent regulatory body such as Public Utility Commission in the United States will be established to oversee the industry. It will ensure transparency in business practices through information diffusion and anti-cartel measures.

All these changes may look too idealistic or too good to be true, but there are many success stories in other countries. We believe that the government's strong commitment and the support from the general public will make a good recipe for the success.

Once we reach the level of privatization in mind, natural gas price will be reduced so that its demand will be boosted although there still remains a question as to the extent that the demand respond to the change in price. However we view that the demand for natural gas will grow faster than other energy sources due, not only to the decline in relative price, but also to other factors. They are expansion of IPPs (Independent Power Productions), increase in industrial demand, and environmental factors.

LONG-TERM PERSPECTIVES

How fast will the economy recover from the current crisis

There are many forecasts on the future course of Korean economy, produced almost every month and their variability is so substantial that no one seems to attach much significance to them. Forecasts on the next year's GDP have been revised month to month and they are widely different even across even respected institutions.

Table 8. Short-term Economic Outlook for '98, and '99

	GDP Growth Rate(%)		Balance of Payment, 98 (100 Mil. USD)	Exchange Rate (Won/USD, end of 98)
	1998	1999		
Gov't	-4	1% – 2 %	330-350	1300
KDI	-4.2	1.8	348	-
Finance Inst.	-5.5	-	256-313	-
DAEWOO R.	-5.2	-	327	-
S&P's DRI	-6.7	1.2	380	1618
WEFA	-4.8	0.6	393	1447
IIE	-6.5	1	400	1372

Note: Compiled by the author

As shown in Table 2, there are divergent projections on the economic performance even in the short run. GDP forecasts for the fiscal year 1998 from – 4% to pessimistic –6.7%. Recent projections, however, tilt toward the pessimistic side.

As thick clouds uncertainty are still hanging over the world economy, perhaps with more problems ambushed, one could neither easily nor confidently make a reasonable forecast. However one could easily notice that it is almost of a consensus view that the economic condition will improve from negative growth to positive one in 1999. It implies that the current crisis is likely to be short-lived and the economy will bounce back in the near future.

In January 1999, Korea's credit rating has been upgraded by Fitch IBCA to the lowest level of investment grade from "junk bonds" level. Following the upgrading, foreign banks resumed lending to Korean banks⁵. Now the IMF agreed to a growth target of 2 percent for Korea this year and pledged to minimize new demands for economic restructuring.

The future course of the Korean economy depends critically on the sustained export surplus as well as the economic reform under way. The move from large deficits to large surpluses in the trade account in 1997 was the key to increase the usable foreign reserves in Korea, which made possible the external debt service. However confronted with harsh competition and some protectionist practices international trade, Korea will continue to face considerable difficulties for some time ahead at least. For now, a glimmer of hope seems to be on the horizon as a high ranking government official predicts that the Korean economy will bottom out as early as the first half of 1999.

Long term demand forecast

⁵ Some commercial banks and state-owned banks have recently succeeded in introducing about US \$ 400 million from foreign institutions.//////

As is always the case, energy demand is closely linked to the level of economic activities i.e., GDP. The more uncertain GDP becomes the less likely the forecast will become accurate. Taking into account uncertainties at the moment a long term forecast was provided in Table 3.

The table clearly indicates that the decline in energy demands will last only for a few years and after 2000 those demand will pick up. Between 2000 and 2015 the projected growth rate of natural gas (LNG) demand will be around 4.2% per annum. Although this demand projection might be viewed as an optimistic one, it could still be a conservative forecast because environmental factors and other favorable factors are not fully accounted for in the projection.

Table 9. Primary Energy Projection for Korea

(Unit: MTOE)

	1995	2000	2010	2020
Oil	94.0 (62.5)	100.2 (56.2)	129.2 (50.2)	141.7 (43.7)
LPG	1.7 (4.4)	6.9 (3.9)	9.2 (3.6)	9.6 (3.0)
LNG	9.2 (6.1)	18.6 (10.5)	32.4 (12.6)	47.8 (14.8)
Coal	28.1 (16.7)	37.4 (20.9)	56.6 (22.0)	169.1 (21.3)
- Anthracite	25.1 (16.7)	34.6 (19.4)	54.6 (21.2)	67.7 (20.9)
- Bituminous	3.0 (2.0)	2.8 (1.6)	2.0 (0.8)	1.4 (0.64)
Hydro	1.4 (0.9)	1.2 (0.7)	1.1 (0.4)	1.6 (0.5)
Nuclear	16.8 (11.1)	20.1 (11.3)	36.7 (14.3)	60.4 (19.2)
Total	150.4 (100.0)	178.4 (100.0)	257.5 (100.0)	324.2 (100.00)

Source : KEEI, Long-term energy demand under IMF, 1998.6.

Note: Share is denoted in parenthesis

We have carefully examined the past records of natural gas demand and key macro indicator. It is our view that if the financial crisis is over within a couple of years as we would hope, natural gas demand will pick up and run its previously projected course of rapid growth with roughly two to three million tons less each year. Also it is anticipated that the privatization will add to increase the demand substantial if environment cost is taken into account. However one should bear in mind that there do exist great uncertainty in the world economy now. As demand for natural gas will also be influenced by factors related to the uncertainty, the projection may be wide out of the mark. It has a potential for the increase more than projected.

Taking into consideration of all the gloomy aspects of the financial crisis, natural gas still seems to have a huge growth potential in Korea for a number of reasons other than the privatization. They are expansion of IPPs, pressures from global environmental treaties – UNFCCC, and Kyoto Protocol, and uncertain future of nuclear, to name a few.

Until the recent financial crisis, the Republic of Korea had exhibited rapid energy consumption growth fuelling the fast developing economy since the early 1970s. Devoid of indigenous natural resources, the country has to rely on foreign imports for its energy sources. Thus energy security coupled with energy source diversification has been one of the most important issues in the national energy policy. The government has made successful efforts in pursuing the security of stable energy supply for the last two decades. However, the modern

environmentalism has shifted the energy security issue to a new realm. The new view adds the “right to use” dimension to the conventional one, meaning the physical ownership of energy resources.

Energy consumption and GHG emissions

Energy has been an essential element for economic development. The fast economic development was made possible in part by the stable energy supply. Since 1985, energy consumption had increased more than 10% per annum right before the current financial crisis. As a result, energy imports amounts to 16 percent of total imports in 1996, and energy emerged as a burden on trade balance.

Through 80's and 90's the shares of coal, and hydropower have decreased, while the share of petroleum and liquefied natural gas (LNG) has increased. The nuclear power shared 14.5% of TPES in 1987 and 1898 and since then it decreased to 11 % in 1996. In terms of final energy consumption by demand sector, the industry sector is the largest energy consumer and the residential and commercial sector ranked second. The energy consumption of the transport sector showed the fastest growth.

Korea has submitted the National Communication to the UNFCCC in 1998 as a part of its commitments. According to the Communication. The industry sub-sector emits the largest amount of GHG, followed by the residential and commercial sub-sectors in the energy sector. The share of the transport sub-sector ranked third, marking 17% as of 1990. However it has grown fastest among all sub-sectors recently due to the rapid increase in the ownership of passenger car ownership.

Table 10. GHG Inventory in Energy Sector of Korea (1990)

(Unit : Gg)

Sector	CO ₂	CH ₄	N ₂ O	CO ₂ equivalent
All Energy	238,990	264	11	248,063 (100%)
Energy Transformation	37,934	0.3	0.2	37,988 (15%)
Industry	87,282	1.3	2.4	88,060 (35%)
Transport	42,198	6.1	1.6	42,831 (17%)
Residential/Comercial	64,592	7.0	3.4	65,790 (27%)
Public	6,985	0.5	3.8	8,172 (3%)
Traditional Biomass burned for Energy	-	2.0	0.02	48 ()
Fugitive Emissions		346		5,175

Source : ALGAS Final Report of the Republic of Korea

Fuel switching and energy efficiency improvement look most promising measures in response to the Climate Change Convention. Inter-fuel substitution from carbon intensive fuels to the less intensive ones, e.g., coal to natural gas, is an option available. In this regard, the share of natural gas is likely to increase and that of nuclear too. However expanding consumption of both fuels are not easy to come by because both requires huge capital investment in infrastructure development. In addition expansion of nuclear power generation program has faced serious local opposition due to growing NYMBY phenomenon. Nevertheless the government has announced its plan to increase the consumption of natural gas and nuclear power. According to the plan by 2010 the share of natural gas is to go up as high as 7.3 % from 6.1 % in 1995 and that of nuclear power as up to 13.2 % from 11.1 % in 1995 in terms of total primary energy. Regarding the efficiency improvement, the government has been preparing a master plan for the investment in R&D projects.

CONCLUSION

Financial crisis is clearly a disaster in several dimensions in Korea, resulting in high unemployment, fall in GDP as well as in energy demand. Many factors had contributed to the outbreak of the crisis and the Korean government took bold measures to clean up the debris from it. Economic reform is under way in all walks of life and it aims to smooth the transition from state-controlled economy to market oriented one.

So far the reform has been successful and Korean economy has been stabilized to the extent that international financial institutions start lending commercial loans to Korean banks. Although caution needs to be exercised against the rosy forecast of the government on the future course of the economy, Korean economy has proved its potential for economic development.

The government is undertaking major restructuring in energy sector, as a part of economic reform. They are energy price deregulation, adjustment in investment, and privatization. Except the adjustment in investment, the other two is likely to enhance the application of market principles to the energy sector. Thus in the end of the restructuring energy markets will emerge as competitive ones with prices reflecting true costs, for example taking into account environment. Natural gas, as a clean fuel, would become more price competitive than before the restructuring.

Other internal factors such as income growth in the future, availability of the national grid system and expansion of IPPs would boost the consumption of natural gas in the future, let alone external factors like the inter-fuel substitution potential owing to climate change.

What lies ahead is not all that certain for the Korean energy sector. However the current trend of economic performance seems to indicate that Korea will resume its high rate of economic growth within a few years time and so will the energy consumption.

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**Economic Reform and Energy Policy,
Energy Supply and Demand in
Thailand**

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**Presentation to the Symposium on Pacific Energy
Cooperation 1999
16-17 February, 1999
Dai-ichi Hotel, Tokyo, Japan**

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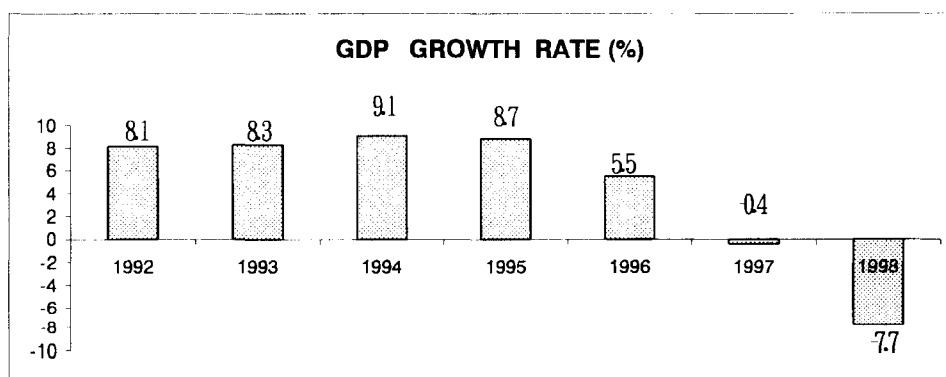
Economic Reform and Energy Policy, Energy Supply and Demand in Thailand

1. Economic Crisis

After the World War II, the most critical economic crisis Thailand has to face began in the middle of 1996, and the slump had run through 1997 and 1998. Various problems have had accumulated for a long time, such as problems on instability of financial institutions, a tremendous amount of foreign debts, instability of the local Baht currency, including liquidity problems in the business sector.

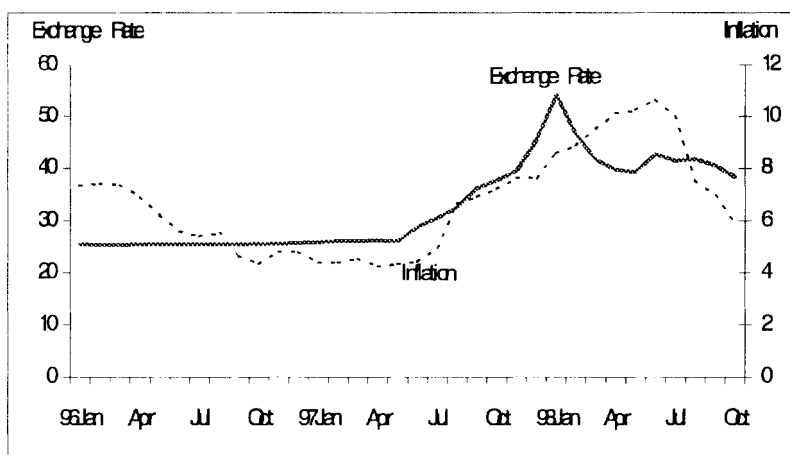
One factor of the mentioned problems relates to the structural problem which has been long time accumulated and no serious attention has been paid to solve such a problem. The past economic growth in Thailand had been "bubble" like; a considerable amount of foreign short-term capital of the private sector had flowed into the country and were invested only in high-risk activities, but which could bring about high returns in a short period, for example, investment in real estate deals and in profit-making in the stock market. Such investment is considered as inefficient utilization of financial resources.

Gross Domestic Product (GDP) had grown at a continuously lower rate, i.e. 8.7% in 1995, 5.5% in 1996, - 0.4% in 1997 and - 7.7% in 1998.



Consumer Price Index (CPI) In 1996 and 1997, the inflation rates stood at 5.9% and 5.6% respectively, and was expected to increase to 9.2% in 1998. Meanwhile, the devaluation of the Baht plunged rapidly, from a level of 25 Baht/1 US\$ in June 1997 to 53-55 Baht/1 US\$ in early 1998, then rebounded to a level of 40-42 Baht/1US\$ in mid-1998. The Baht currency has regained more stability as from the second half of 1998, remaining at a level of 37-38 Baht/1 US\$. It is interesting to note that the inflation rates in Thailand have been relatively low compared to the substantial devaluation of the Baht. This is partly due to high stock levels and the decline in the domestic purchasing power; consequently, prices of goods could not be much increased. Besides, efforts have been put by the government to control prices of major essentials.

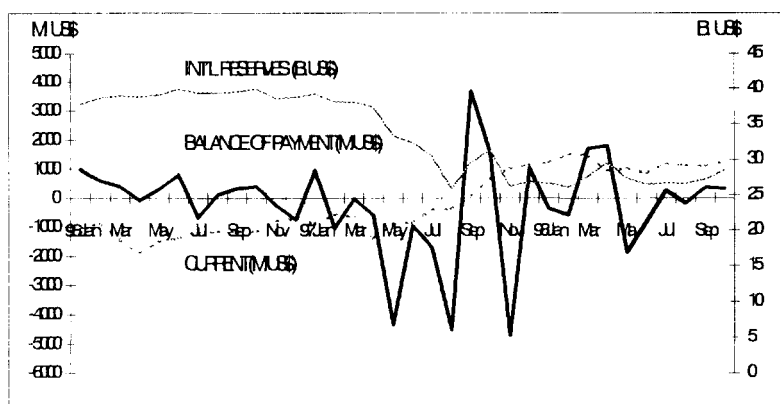
Inflation VS Exchange Rate



Current Account The current account deficit had much improved, reducing from US\$ 14,000 million in 1996 (or 7.9% of the GDP) to US\$ 3,400 million (or 2.1% of the GDP) in 1997. As for 1998, it had been expected that the domestic current account would meet a surplus of US\$ 10,000-12,000 million, accounting for a high percentage i.e. 10% of the GDP, because the import had greatly declined whereas the export had considerably increased due to the devaluation of the domestic currency.

Balance of Payments The balance of payments of Thailand had changed from a balance of payments surplus of US\$ 2,200 million in 1996 to a balance of payments deficit of US\$ 18,000 million in 1997 as a result of the private sector capital outflow, in particular after the change of the exchange rate regime to a managed float system since 2 July 1997. As for the year 1998, from the second quarter onwards, there had been influxes of foreign currency. This resulted from the buying of rights issue of various commercial banks and of energy-related companies, including the foreign investors' buying of 56 financial institutions' assets managed by the Financial Sector Restructuring Authority; hence the balance of payments deficit in 1998 was estimated to range between US\$ -6,000 and -8,000 million.

International Reserves, Balance of Payments and Current Account



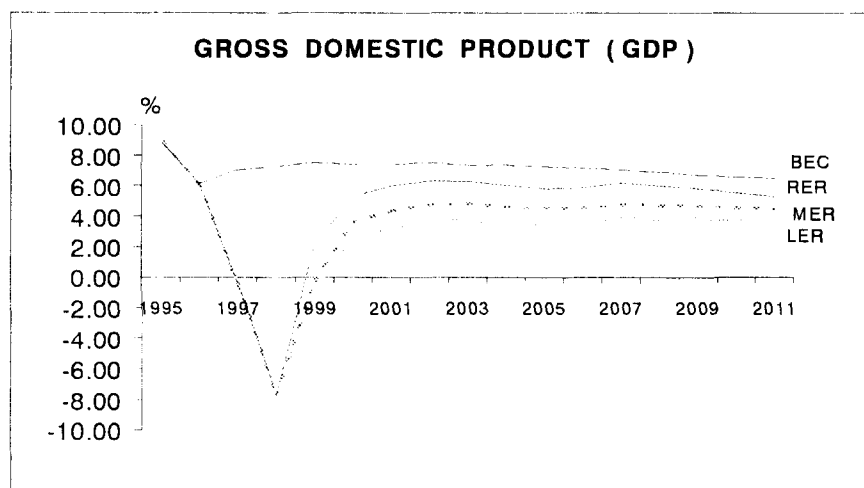
International Reserves The international reserves of Thailand had rapidly decreased from US\$ 38,700 million at the end of 1996 to only US\$ 25,900 million in August 1997. The government has requested loans from the International Monetary Fund (IMF) as well as other countries, accounting for a total amount of US\$ 17,200 million to be used as reserves of the country. The reserves regained its stability in the first half of 1998; in mid-1998 the reserves increased to a level of US\$ 26,700 million and it was projected to be US\$ 26,280 million at the end of 1998.

2. Economic Outlook

Thailand has requested loans from the IMF since August 1997. The restoration of the Thai economy commenced with the assistance from the IMF. At the first stage, emphasis was mainly placed on restructuring financial institutions so as to create confidence among foreign investors. In 1998 the economic crisis starting in Thailand penetrated into South Korea and Indonesia, as well as other countries both in and outside the region. The Thai economy seriously deteriorated in early 1998; the Thai government and IMF had jointly projected that the economics would shrink by 1-2%. However, after mid-1998 the government and IMF had reviewed the Thai economy, resulting in a revised projection of economic shrinkage of 4-5%. Another review of various economic figures was made in August 1998 and an updated projection of 7.7% shrinkage was derived.

The reform of the Thai economy experienced more difficulties when the economic crisis had penetrated through all over Asia and Latin America. Nevertheless, when compared with Indonesia and South Korea, the economic reform in Thailand has achieved much progress. It is expected that the Thai economy will improve in the second quarter of 1999 and that, in the long run, the domestic economic growth will increase at a low rate, compared with the past decade during which the growth rate was very high. The Thailand Development Research Institute (TDRI) has forecasted the Thai economy in the next 15 years under the following three scenarios:

- **Low Economic Recovery (LER)** It is forecasted that in 1999 the economic growth rate will remain at - 0.8% and will increase at a rate of 2.5% in the year 2000. During 2001-2011, the growth rate will increase at a level of 3.6-3.8%.
- **Moderate Economic Recovery (MER)** It is forecasted that in 1999 the economic growth rate will remain at - 0.2% and will increase at a rate of 3.6% in the year 2000. After that the economic conditions will improve and the economic growth rate is expected to be at a level of 4.5-4.8% during 2001-2011.
- **Rapid Economic Recovery (RER)** Under this scenario, the economic situation will commence to improve in 1999 with a growth rate of 2.1% and will increase to 5.3% in the year 2000. After that the economic growth rate will be at a level of 5.8-6.3% during 2001-2011.



3. GDP Assumptions

Since the economic crisis in 1997, Thailand has reviewed the forecast on energy demand and supply for three times; the latest review was carried out in November 1998. The rationale for such frequent reviews was that, during the mentioned period, volatility of the overall economic situation still prevailed. The growth rate of the domestic energy consumption had continually declined since mid-1997. The figures on energy consumption, which have served as an efficient economic indicator, also reflected a continual decrease in energy consumption. Until November 1998, the slowdown of the growth rate of energy consumption had not reached the bottom. It is estimated that the bottom will be reached during the second quarter of 1999.

The review of energy demand and supply has been made under three scenarios according to the assumptions of the economic recovery, i.e. LER, MER and RER, as previously mentioned. However, the following energy overview will elaborate only the MER case to illustrate the economic impact on the energy demand and supply, by comparing the assumptions of economic growth before and after the economic crisis.

GROSS DOMESTIC PRODUCT (GDP) GROWTH RATE (%)

	1997-2001	2002-2006	2007-2011
Before Economic Crisis (BEC)			
- Agriculture	2.7	2.6	2.5
- Manufacturing	8.0	7.9	7.1
- Construction	10.0	8.4	7.4
- Res & Commercial	7.5	7.1	7.0
Total	7.4	7.2	6.6
After Economic Crisis (AEC)			
- Agriculture	2.3	2.5	2.6
- Manufacturing	0.3	6.1	5.9
- Construction	0.3	8.6	7.4
- Res & Commercial	-0.6	3.3	3.36
Total	0.2	4.6	4.5

4. REVIEW OF ENERGY SUPPLY AND DEMAND

4.1 Energy Reserves and Supply

4.1.1 Reserves

Natural gas : Natural gas is an important energy resource of Thailand. There is currently a total reserve volume of 28.5 trillion cubic feet (TCF), divided into 27.4 TCF off-shore reserve (in the Gulf of Thailand) and 1.1 TCF onshore reserve (Namphong Field in Khon Kaen and Sirikit Field in Kamphaeng Phet).

Condensate : Condensate is a product obtained with the development of natural gas. The reserve volume as of the end of 1997 was 514 million barrels.

Crude oil : The total reserve volume is 400 million barrels, divided into 281 million barrels of onshore reserve and 119 million barrels of off-shore reserve.

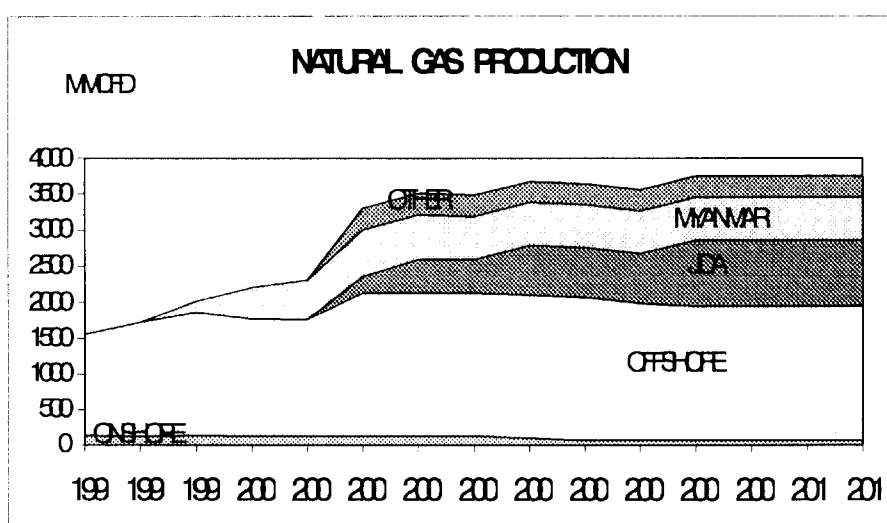
Natural Gas, Condensate and Crude Oil Reserves in Thailand (As of December 1997)			
Natural Gas (billion cubic feet)			
Type	Proven reserves	Probable and possible reserve	Total reserves
Offshore	11,676	15,690	27,366
Onshore	803	308	1,111
Total	12,479	15,998	28,477
Crude oil (m barrels)			
Offshore	48	233	281
Onshore	59	60	119
Total	107	293	400
Condensate (m barrels)			
Offshore	190	324	514

Lignite : Lignite is one of the major energy resources of the country. The total reserve volume amounts to 2,312 million tonnes. The reserve volume at Mae Moh operated by EGAT is 1,286 million tonnes, or 55.6% of the total reserve. Krabi and Li basins have a measured reserve of 112 and 3 million tonnes respectively. In the southern Thailand locate Saba Yoi basin in Songkha province, with a measured reserve of 350 million tonnes, and Sin Pun basin, with a measured reserve of 91 million tonnes. In the north, there are the following basins: Wiang Haeng, Ngao and Mae Tha, with a measured reserve of 93, 48 and 25 million tonnes respectively.

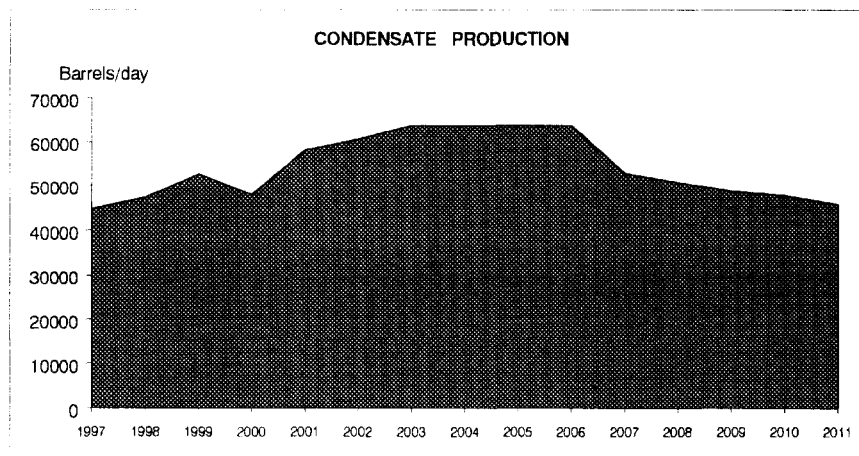
Measured reserves of lignite in Thailand (As of December 1997)		
Location	Quantity (M tonnes)	Share (%)
Mae Moh	1,286	55.6
Krabi	112	49
Li	3	0.1
Others	911	39.4
Total	2,312	100.0

4.1.2 Supply

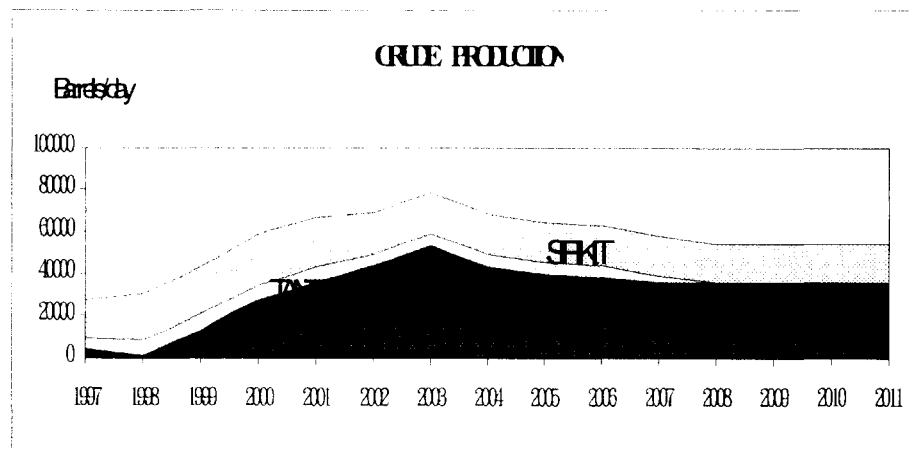
Natural gas : Most of natural gas fields are off-shore; a few are onshore. Besides, since 1998 natural gas has been imported from the Union of Myanmar (from Yanada and Yetagun fields). It is expected that the natural gas production will increase from a level of 1,560 MMCFD in 1997 to 2,200-2,500 MMCFD in the period of 2000-2011. Moreover, there are several fields which are under negotiation, comprising the Thailand-Malaysia Joint Development Area (JDA), Bong Kot (addition), and additional resources from Myanmar, which is projected to be 780-1,450 MMCFD during 2002-2011.



Condensate : The volume of condensate depends on the production of natural gas in the Gulf of Thailand. It is expected that the production volume will increase from a level of 44,800 barrels/day in 1997 to 65,150 barrels/day in 2006, and will continually decline to a level of 45,750 barrels/day in 2011.

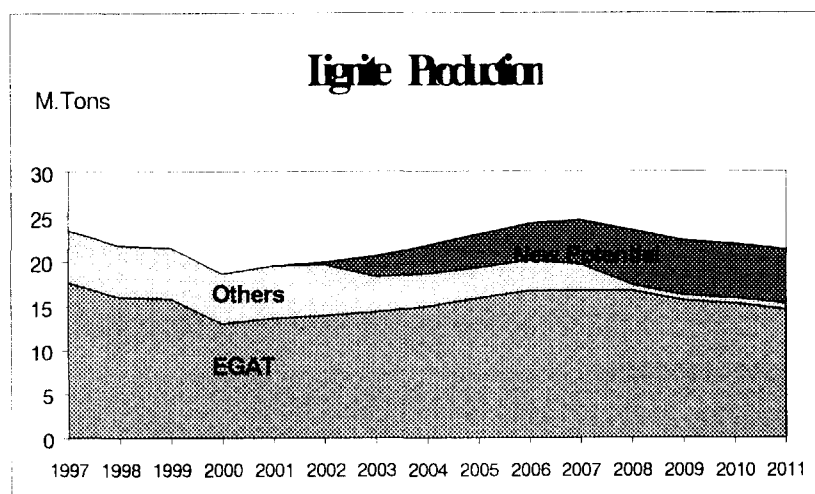


Crude oil : Currently, Sirikit field is the biggest crude oil resource of the country. The production is expected to be rather constant at a level of 18,000-25,000 barrels/day during the period of 1998-2011. Besides, there are other crude oil resources, such as Tantawan field, the production of which is estimated at a level of 5,000-7,000 barrels/day during 1998-2007; Benjamas field where the production is expected to commence in mid-1999, with a production capacity of 15,000-22,000 barrels/day; and Maliwan field where the production is expected to commence around 2001, with a production capacity of 19,000-20,000 barrels/day.



Lignite : The production of lignite at Mae Moh basin of EGAT to be used as fuel in power generation will be at a rather constant level of 11.1-14.6 million tonnes during 1998-2011. The production from other basins, in case new reserves are not developed, the production will decrease from a level of 5.75 million tonnes in 1997 to 3.37 million tonnes in 2006, and to 0.61 million tonnes in 2011. However, if the development of new lignite basins is

accelerated (preliminary surveys of some are being carried out), the potential production capacity is projected to be at a level of 4-6 million tonnes in the next decade.



4.1.3 Petroleum Products

In 1998 petroleum products by six refineries amounted to 700 thousand barrels/day (KBD), or 7.5% less than the previous year. In addition, the total volume of LPG production by the five gas separation plants was 35.1 KBD. LPG production by petrochemical plants, i.e. Bangkok Synthetic (BST), Thai Aromatics (TAC), and others, accounted for a volume of 2.5 KBD.

Forecast of Petroleum Production by Refinery
(Unit : KBD)

Refineries	1997	1998	2001	2006	2011
TORC	212	176	220	226	227
ESSO	143	124	163	163	163
BCP	108	96	114	110	114
RRC	120	119	150	142	152
SPRC	127	147	142	128	142
TPI	43	36	42	42	42
SUK	-	-	-	119	119
OTHERS	3	2	23	23	23
TOTAL	756	700	854	953	982

**Forecast of LPG Production by Gas Separation Plant and Petrochemical Plant
(Unit : KBD)**

	1997	1998	2001	2006	2011
GSP1	12.2	10.6	14.1	12.9	14.1
GSP2	10.3	10.3	10.2	10.2	9.3
GSP3	5.8	6.5	13.0	14.2	14.2
GSP4	5.5	4.4	5.0	4.5	5.0
GSP5	-	-	-	18.6	20.3
THAISHELL	3.5	3.3	3.2	3.2	3.2
TAC	2.0	1.4	4.8	4.8	4.8
BST	1.7	1.0	2.9	2.9	2.9
TOTAL	41.0	37.6	53.1	71.3	73.8

4.2 Primary Energy Demand

The primary commercial energy demand in 1998 was equal to 58,770 ktoe, 7.4% less than the previous year, comprising: natural gas, 25.7%; crude and petroleum products, 59.7%; lignite and imported coal, 12.5%; and hydro, 2.1%. If demand for renewable energy had been included, the total energy demand would have amounted to 78,400 ktoe, 81.5% of the renewable energy demand was for fuelwood; the remaining included charcoal, paddy husk and bagasse.

In 1999 the primary commercial energy demand will slightly increase, i.e. by 2.0%, and then will increase by 4.9% and 4.8% in certain years during 2001-2006 and 2007-2011 respectively.

Oil will remain the major energy of the country but the ratio of the total demand will continuously decrease, from 59.6% in 1998 to 54.0% in 2011. In the meantime, natural gas and coal will gradually replace oil, particularly for use as fuel in power generation and in the industrial sector. Utilization of natural gas in power generation will be more intensified as from the year 2000 onwards. Imported coal will play an important role as fuel in power generation of Independent Power Producers (IPPs) from 2002 onwards.

Since the domestic production is limited whereas the demand is continually increasing, imported energy (mainly crude oil and natural gas) will highly increase at a rate of 9.4% and 6.6% during the period of 2001-2006 and 2007-2011. The proportion of dependence on imported energy will increase from 54.5% in 1998 to 75.3% in 2011.

Demand, Production and Net Import of Primary Commercial Energy
(Unit : Ktoe)

	1997	1998	2001	2006	2011	GROWTH RATE (%)		
						1997-01	2002-06	2007-11
Production	26,115	26,944	26,903	29,184	26,555	3.6	1.6	-1.9
Crude	1,370	1,531	1,579	1,237	963	3.6	-4.8	-4.9
Condensate	2,035	2,151	2,709	2,959	2,078	10.8	1.8	-6.8
Natural Gas	14,017	15,425	15,784	16,501	15,362	6.7	0.9	-1.4
Lignite	7,123	6,733	5,961	7,280	6,836	-2.0	4.1	-1.3
Hydro	1,569	1,103	870	1,207	1,316	-11.5	6.8	1.8
Import (Export)	38,318	32,007	36,057	57,939	79,917	-0.1	9.4	6.6
Crude	38,762	35,569	42,777	48,527	51,044	-	2.6	1.0
Pet. Products	-1,493	-3,120	-11,914	-8,997	1,696	-6.2	-5.1	-
Condensate	-1,071	-1,132	-1,279	-1,397	-981	3.1	1.8	-6.8
Natural Gas	0	0	4,879	14,161	16,223	-	23.8	2.8
Coal	2,054	624	2,147	5,400	10,425	-2.5	20.3	14.1
Electricity	66	136	244	244	1,509	28.1	0.0	44.0
Consumption	63,629	58,770	65,372	82,675	104,740	1.6	4.9	4.8
Crude & PP	38,953	35,000	35,828	44,222	55,556	-1.5	4.3	5.0
Natural Gas	14,024	15,174	20,322	24,321	28,097	12.3	3.7	2.9
Lignite & Coal	9,017	7,357	8,108	12,681	17,261	-1.5	9.4	6.4
Hydro & Electricity	1,635	1,239	1,114	1,450	2,825	-7.8	5.4	14.3
Import/ Consumption (%)	60.2	54.5	56.7	70.1	75.3	-	-	-

4.3 Oil Demand and Import (Export)

4.3.1 Oil Demand

The economic regression during 1998-1999, together with the replacement of fuel oil by natural gas in power generation during 1999-2000 and onwards, has caused a decrease in oil demand during 1998-2000. The trend of oil demand during 2001-2003 will remain at a low level, namely 2.0-4.2% as natural gas will still be used instead of fuel oil. However, from 2006 onwards more fuel oil will be used in power generation, i.e. at Ratchaburi Thermal Power Plant, resulting in an increase of the total oil demand at a rate of 5.0-6.6% per annum during 2004-2011. Nevertheless, if utilization of fuel oil in power generation is excluded, oil demand during 2001-2011 will increase at a level of 4.7-5.4% per annum.

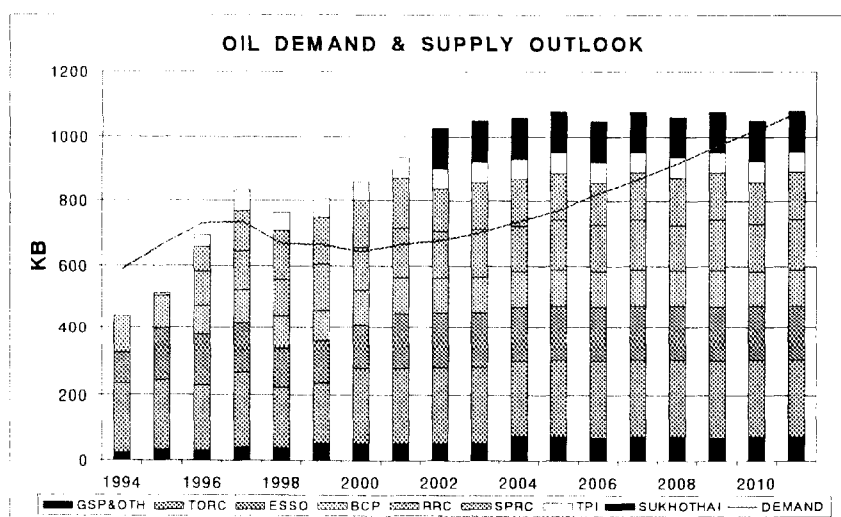
Forecast of Oil Demand by Product Type
(Unit : KBD)

	1997	1998	2001	2006	2011	Growth rate (%)		
						1997-01	2002-06	2007-11
Gasoline	126.8	122.9	141.3	189.4	256.4	3.5	6.0	6.3
Naphtha	20.5	21.4	25.8	25.3	25.3	17.4	-0.4	0.0
Kerosene	1.5	1.1	1.1	1.2	1.4	-8.4	1.8	2.5
Diesel	302.5	256.3	273.6	347.0	443.9	-2.3	4.9	5.1
JP	61.1	57.8	65.3	83.3	102.3	2.2	5.0	4.2
Fuel Oil	156.9	140.5	82.0	95.9	145.5	-13.2	3.2	8.7
LPG	57.0	53.6	65.6	78.9	97.1	3.9	3.8	4.2
Total	726.3	653.7	654.6	821.1	1,072.0	-1.9	4.6	5.5

4.3.2 Oil Import (Export)

In 1998, the oil production by the existing six refineries and the LPG production by four gas separation plants altogether amounted to 737 KBD while the demand was only 654 KBD; hence a (net) export of 83 KBD.

Oil production tends to increase to 907, 1,024 and 1,056 KBD in 2001, 2006 and 2011 respectively. Such production capacity will exceed domestic oil demand up to 2010, resulting in export of gasoline, fuel oil, and LPG in the corresponding periods. As for diesel, it is likely that export will be available for a period of time, i.e. 1999-2007, and after that import will be required.



4.4 Electricity Demand and Fuel Used in Power Generation

4.4.1 Electricity Demand

During 1992-1997, electricity demand highly increased at a rate of 10.6%. The demand has been slowed down since 1997 according to the economic recession. In 1998, the demand amounted to 92,134 GWh, a 0.6% decrease from the previous year, and it is expected to continually decrease by 2.0% in 1999. After that, the demand is expected to increase to 103,685 GWh in 2001 and to 141,300 and 194,930 GWh in 2006 and 2011 respectively, accounting for an increasing rate of 6.4% and 6.6% during 2001-2006 and 2007-2011 respectively.

Electricity demand in provincial areas will increase at a higher rate than that in the metropolitan areas due to the number of consumers. Particularly, numbers of medium and large consumers will increase in accordance with the economic expansion in the provincial areas. On the contrary, as the areas in the metropolis are limited, customer number cannot be much increased.

Forecast of Peak Demand and Power Generation

Year	Peak Demand (MW)	Power Generation (GWh)
1997	14,506	92,925
1998	14,180	92,134
2001	16,214	103,685
2006	22,168	141,300
2011	30,587	194,930
Growth Rate (% pa.)		
1997-01	4.0	3.8
2002-06	6.5	6.4
2007-11	6.6	6.6

4.4.2 Fuel Used in Power Generation

There will be more diversification of fuel used in power generation during 1998-2011 and dependence on imported energy will remain high, especially natural gas and coal, including power purchase from neighbouring countries.

Natural gas will be the major fuel in power generation. The proportion of power generation using natural gas will reach 73.8%, in 2001 and this ratio will decline to a level of 57-67% during 2006-2011.

The use of lignite in power generation will be restricted only at Mae Moh Power Plant and there will be no extension of the new plant. The proportion of power generation using

lignite will constantly decrease from 18.1% in 1998 to 11.8% and 8.4% in 2006 and 2011 respectively.

There will be coal import for use in IPP power plants, starting in 2002. The proportion of power generation using imported coal will continually increase and will cover a proportion of 12-19% during 2007-2011.

Meanwhile, the proportion of fuel oil and diesel utilization in power generation will constantly decrease, from a level of 21.0 % in 1998 to 3.0-5.1% during 2001-2011.

The proportion of hydro-power is at a level of 3-4% during 1998-2011. Simultaneously, the proportion of power purchase from Lao PDR will increase from a rate of 1.5% in 1998 to 2.0% and 9.0% in 2006 and 2011 respectively.

Proportion of Power Generation by Type of Fuel
(Unit : %)

	1997	1998	2001	2006	2011
Hydro	7.6	6.4	3.8	3.8	3.0
Natural Gas	45.8	50.9	73.8	66.7	55.7
Fuel Oil	20.6	19.7	3.9	3.0	5.1
Diesel	3.7	1.3	0.0	0.0	0.0
Lignite	20.3	18.1	13.0	11.8	8.4
Coal	1.0	2.1	2.7	12.7	18.8
Purchase	0.9	1.5	2.8	2.0	9.0
Total	100.0	100.0	100.0	100.0	100.0

4.5 Natural Gas

The total demand for natural gas in 1998 amounted to 1,692 MMCFD, divided by use in the following activities: in power generation, 1,351 MMCFD (accounting for 79.8% of the total consumption); as fuel in the industrial sector, 101 MMCFD (6.0%); and the remaining as input to gas separation plants to produce LPG to be used in cooking, industries and vehicles, and propane and butane to be used as raw materials in petrochemical industry, totaling 240 MMCFD (14.2%).

The natural gas used in power generation will increase from a level of 1,351 MMCFD in 1998 to 2,160 and 2,379 MMCFD in 2006 and 2011 respectively. The demand by the industrial sector will increase from 101 MMCFD in 1998 to 262 and 353 MMCFD in the corresponding periods.

Forecast of Natural Gas Demand
(Unit : MMCFD)

	1997	1998	2001	2006	2011
Gas Separation Plant	216	240	274	290	401
Industry & Co-generation	91	101	164	262	353
Power Generation	1, 257	1, 351	1, 828	2, 160	2, 379
Total	1,564	1,692	2,266	2,712	3,133

4.6 Coal

In 1998, the coal demand amounted to 22.8 million tonnes, classified into demand for the following: power generation, 16.8 million tonnes (16.0 million tonnes by EGAT and 0.8 million tonnes by SPP); the cement industry, 6.0 million tonnes; the tobacco curing process, 0.08 million tonnes; and the industrial boilers, 1.2 million tonnes.

EGAT's coal demand for power generation at Mae Moh is likely to remain at a constant level of 12-14 million tonnes during 1999-2011. The coal demand by IPP for power generation will commence in 2002, with a projected increase from a level of 0.3 million tonnes in 2002 to 5.4 and 8.1 million tonnes in 2006 and 2011 respectively; whereas the demand by SPP will be at a level of 2.6 million tonnes during 2001-2011.

Coal demand by the industrial sector, mainly (more than 75%) by the cement industry, will increase at a lower rate than that in the past. That is, during 1990-1997, the coal demand highly increased at a rate of 13.2%. It is projected that coal demand by the industrial sector will increase from 6.0 million tonnes in 1998 to 8.1 and 9.2 million tonnes in 2006 and 2011 respectively.

Forecast of Coal Demand
(Unit : M.Tonnes)

	1997	1998	2001	2006	2011	Growth Rate (%)		
						1997-01	2002-06	2007-11

Power Generation	18.69	16.77	15.39	23.03	28.92	-1.8	8.4	4.7
- EGAT	18.01	15.99	12.82	15.10	18.28	-4.8	3.3	3.9
- IPP	-	-	-	5.35	8.07	-	-	8.6
- SPP	0.68	0.78	2.57	2.57	2.57	42.3	-	-
Industry Sector	7.01	6.03	6.71	8.15	9.22	-2.4	4.0	2.5
- Cement	5.34	4.74	5.35	6.59	7.42	-1.5	4.3	2.4
- Tobacco curing	0.08	0.08	0.08	0.08	0.08	0.0	0.0	0.0
- Other Industry	1.59	1.21	1.28	1.48	1.72	-5.9	3.0	3.1
Total	25.70	22.80	22.10	31.18	38.14	-2.0	7.1	4.1

5. FINAL ENERGY DEMAND BY SECTOR

Before the economic crisis, it had been forecasted that the final energy demand would increase at a rate of 8.0% during 1997-2001 and that the increasing rate would be lowered to a level of 7.8% and 7.0% during 2002-2006 and 2007-2011 respectively. However, after the economic crisis, the final energy demand has substantially decreased and hence a revised forecast of the demand during 1997-2001 at an increasing rate of only 0.7%. The demand will start increasing again after 2000, with an increasing rate of 4.7% during 2001-2006 and 4.6% during 2007-2011.

In 1998, the final energy demand amounted to 47,748 ktoe, divided into the demand by the following economic sectors: agriculture, 1,455 ktoe (3.1%); industry, 15,380 ktoe (32.2%); transportation, 19,113 ktoe (40.0%); and residence and commerce, 11,800 ktoe (24.7%).

The demand by the transport and industrial sectors is likely to increase at a higher rate than that by other sectors, resulting in an increased proportion of energy utilization by the transport sector from 40.0% in 1998 to 41.9% and 43.6% in 2006 and 2011 respectively, and by the industrial sector from 32.2% in 1998 to 34.0% and 34.3% in the corresponding periods.

Oil has been the most important energy of the country. In 1998, it accounted for 54.2% of the total energy utilization. Next to it are renewable energy, with a consumption proportion of 23.8%; electricity, 12.5%; coal, 5.6%; and natural gas, 3.9%.

The trend of final energy demand indicates that oil will remain the prime energy, with a share remaining at a level of 54-57%. Utilization of renewable energy will gradually decrease whereas that of natural gas and electricity will continually increase.

Forecast of Final Energy Demand by Sector (Unit : Ktoe)

	1997	1998	2001	2006	2011	Growth Rate (%)
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						1997-01	2001-06	2007-11
Agriculture	1,488.8	1,455.2	1,513.4	1,642.9	1,749.5	-3.2	1.7	1.3
Industry	17,937.2	15,380.4	17,150.7	22,285.3	28,266.8	-1.2	5.4	4.9
Transport	21,394.9	19,112.5	21,151.7	27,497.8	35,857.2	1.0	5.4	5.5
Res. & Comm.	12,357.8	11,800.0	12,324.2	14,180.9	16,450.3	-0.9	2.9	3.0
Total	53,196.7	47,748.1	52,140.0	65,606.9	82,323.8	-0.4	4.7	4.6

5.1 Agricultural Sector

The agricultural sector utilizes considerably small amount of energy when compared with other sectors. In 1998, the amount of energy consumption was 1,455.2 ktoe, accounting for 3.1% of the total final energy consumption. Diesel is the most important fuel used in the agricultural sector; next is gasoline. In 1998, diesel consumption accounted for 95% of the total energy consumption by this sector, almost all of which was used in fisheries.

It is estimated that the total energy demand by the agricultural sector will increase at an average rate of 1.7% and 1.3% during 2001-2006 and 2007-2011 respectively. The total final energy demand will be at a level of 1,749.5 ktoe in 2011.

Forecast of Final Energy Demand in the Agricultural Sector (Unit : ktoe)

	1997	1998	2001	2006	2011	Growth Rate (%)		
						1997-01	2001-06	2007-11
Petroleum Products	1,479.6	1,445.9	1,503.3	1,631.6	1,736.9	-3.3	1.7	1.3
- Gasoline	49.7	46.7	47.7	49.9	52.3	-1.2	0.9	0.9
- Diesel	1,419.7	1,375.8	1,429.1	1,548.5	1,643.5	-3.3	1.6	1.2
- Others	10.2	23.3	26.5	33.2	41.1	6.2	4.6	4.4
Electricity	9.2	9.4	10.1	11.3	12.6	2.3	2.3	2.3
Total	1,488.8	1,455.2	1,513.4	1,642.9	1,749.5	-3.2	1.7	1.3

5.2 Industrial Sector

The industrial sector of Thailand consists of manufacturing, mining and construction sub-sectors. The energy consumption by this sector is ranked the second to the transport sector. The total consumption in 1998 amounted to 15,380 ktoe, broken down into the consumption of the following: renewable energy, totalling 4,220 ktoe (27.4%), most of which are fuelwood and charcoal used by the food and beverage industry; oil (mainly fuel oil), 3,877 ktoe (25.2%); electricity, 2,769 ktoe (18.0%); Coal, 2,670 ktoe (17.4) and natural gas, 1,845 ktoe (12.0%).

The final energy demand by the industrial sector tends to be not as high as that in the past, when the increasing rate was as high as 9.8%. The demand will slightly increase during 1999-2001, and after that it is projected that the demand will increase at a rate of 4.9-6.5% per annum, i.e. from 15,380 ktoe in 1998 to 28,267 ktoe in 2011.

Renewable Energy (e.g. fuelwood, charcoal, paddy husk and bagasse) is the main fuel used in the industrial sector. Its role tends to gradually decrease while commercial energy, such as natural gas, coal, electricity, and fuel oil, will take greater roles as follows:

(1) Natural Gas : The demand for natural gas has been increasing since 1998 after the completion of the Bangkok Ring Gas Pipeline Project at the end of 1997. The demand will sharply increase from a level of 1,845 ktoe in 1998 to 3,627 ktoe in 2003. After that the demand will increase at a lower rate, i.e. at a level of 4,713 ktoe in 2011. This is due to the hindrance in natural gas utilization pertaining to the limitation of the pipeline system; therefore, the industries using natural gas are limited within Bangkok and its vicinities. Besides, in some pipelining areas, there is restriction on construction of new factories.

(2) Coal : During the past five years, the coal consumption by the industrial sector increased at an average rate of 23.9%, most of which (more than 65%) was used in cement industries. The consumption sharply decreased during 1997-1998 according to the shrinkage of the cement industry. However, from 2001 onwards it is expected that coal consumption will gradually increase, at a lower growth rate than that in the past, though. The increase is expected at a rate of 3.5-4.6% during 2002-2011. Since there are inadequate domestic lignite reserves for use in the industrial sector, imported coal is then required. It is estimated that the coal import for use in industrial factories will reach 455.7 ktoe in 2006 and will increase to 1,604.2 ktoe in 2011.

(3) Fuel Oil : The fuel oil consumption will substantially decrease during 1997-1999 and will slightly increase during 2006-2007. This is partly due to the slowdown of the industrial sector and partly due to the replacement by natural gas. After that, fuel oil consumption is expected to increase at a rate of 7-8% per annum.

(4) Electricity : Electricity demand in industrial sector is projected to slightly increase during 1998-2000. Then demand will increase at an average rate of 6.0%, i.e. from 3,032 ktoe in 2001 to 5,464 ktoe in 2011.

Forecast of Energy Demand in the Industrial Sector
(Unit : ktoe)

	1997	1998	2001	2006	2011	Growth Rate (%)		
						1997-01	2001-06	2007-11
Petroleum Products	4,634.6	3,877.3	4,006.7	5,005.6	6,717.0	-4.2	4.6	6.1
- Diesel	816.4	786.2	861.3	1,136.5	1,490.2	-0.9	5.7	5.6
- Fuel oil	3,416.0	2,717.0	2,737.9	3,325.4	4,507.4	-5.2	4.0	6.3
- Others	405.2	374.3	407.5	543.7	718.9	0.3	5.9	5.7
Natural Gas	1,482.7	1,844.6	2,577.1	3,927.4	4,712.9	13.3	8.8	3.7

Coal & Lignite	4,135.8	2,670.1	3,088.9	3,690.3	4,503.2	-7.2	3.6	4.1
Electricity	3,030.1	2,768.6	3,031.8	4,093.8	5,463.7	0.3	6.2	5.9
Renewable Energy	4,654.0	4,219.8	4,446.2	5,568.2	6,870.0	0.1	4.6	4.3
Total	17,937.2	15,380.4	17,150.7	22,285.3	28,266.8	-1.2	5.4	4.9

5.3 Transport Sector

The transport sector represents the largest energy-consuming sector in Thailand. The overall transport system is disaggregated into different transport modes such as air, rail, water and road transport. The road transport, comprising personal vehicles, pick-ups, motorcycles, taxis, buses, and trucks, consumes the largest amount of oil; next to it are water, rail and air transport respectively.

The economic crisis has caused the number of vehicles and kilometers travelled to grow at a considerably low rate in 1998 and the low growth rate has continued into 1999. It is projected that after 1999 the number of vehicles and kilometers travelled will increase, especially the road transport by personal vehicles and pick-ups which will account for a higher growth rate than other modes. The kilometers travelled are projected to increase at a rate of 7.2% and 7.4% during 2002-2006 and 2007-2011 respectively. The road transport by taxis is expected to increase at a rate of 4.0% and 4.6%; by buses at a rate of 5.4% and 5.5%; and by trucks at a rate of 4.7% and 4.8%. With regard to the rail and water transport, the growth rate is expected to be low while the air transport is expected to increase at a rate of 5.0% and 4.1% during the corresponding periods.

Forecast of Vehicle-Kilometers the Travelled by Mode (Unit : M. Vehicle-kms)

Modes	1997	1998	2001	2006	2011	Growth Rate (%)		
						1997-01	2002-06	2007-11
Road Transport								
- Car	19,974	19,369	21,520	30,641	44,165	1.9	7.3	7.6
- Pickup	33,496	30,476	34,188	48,170	68,524	0.5	7.1	7.3
- Motorcycles	49,985	49,364	54,606	69,632	87,235	2.2	5.0	4.6
- Taxi	10,898	9,993	10,408	12,689	15,863	-1.1	4.0	4.6
- Bus	6,594	5,412	5,866	7,628	9,962	-2.9	5.4	5.5
- Truck	29,670	24,792	26,170	32,966	41,710	-3.1	4.7	4.8
Rail Transport (1,000 Ton-Km.)	4,987	4,900	5,137	5,517	5,797	0.7	1.4	1.0
Water Transport (1,000 Tons)	2,641	2,534	2,664	3,125	3,703	0.2	3.2	3.4
Air Transport (1,000 Tons)	4,173	4,131	4,726	6,033	7,370	3.2	5.0	4.1

In 1998 the oil consumption by the transport sector amounted to 19,113 ktoe, broken down into the following main types of fuel: diesel, 10,453 ktoe (54.7%); gasoline, 5,198 ktoe (27.2%); and jet fuel, 2,744 ktoe (14.4%).

The oil consumption by the transport sector was slowed down in 1998 and the trend seems to continue into 1999. The average growth rate of oil consumption during 2001-2006 and 2007-2011 is estimated at 5.4% and 5.5% respectively.

Premium gasoline consumption will increase at a rate of 7.2% during 2001-2006 and will increase at a bit lower rate during 2007-2011, i.e. at 6.9%. Regular gasoline consumption will increase at a rate of 3.0% and 4.1% during the corresponding periods.

Diesel consumption will increase at a lower rate when compared with premium gasoline, depending on the increasing number of pick-ups, buses and trucks which mainly use diesel. The increasing rate is expected to be at 5.2% and 5.4% respectively.

LPG consumption in the transport sector, only by old-modeled taxis and tuk-tuks in the Bangkok metropolitan areas, will continuously decrease.

Bunker oil consumption in the transport sector, mainly by boats/ships, is expected to increase at a rate of 4.2% and 4.7% respectively.

Jet fuel consumption which increased at a low rate in 1998 is expected to increase at a higher rate in 1999 and onwards, i.e. at a rate of 5.0% and 4.2% during 2001-2006 and 2007-2011 respectively.

Forecast of Energy Demand in the Transport Sector (Unit : ktoe)

	1997	1998	2001	2006	2011	Growth Rate (%)		
						1997-01	2001-06	2007-11
Petroleum Products	21,391.7	19,109.2	21,140.4	27,478.6	35,837.9	4.3	5.5	5.6
- Gasoline	5,400.4	5,197.7	5,985.3	8,039.8	10,904.3	3.8	6.1	6.3
- Premium	3,981.8	3,641.2	4,321.4	6,110.7	8,545.6	4.2	7.2	6.9
- Regular	1,418.6	1,556.5	1,663.9	1,929.1	2,358.7	2.6	3.0	4.1
- Diesel	12,253.9	10,452.7	11,341.0	14,647.0	19,039.2	-0.5	5.2	5.4
- Jet Fuel	2,895.8	2,744.0	3,096.4	3,951.9	4,853.3	2.2	5.0	4.2
- Bunker oil	708.4	605.6	634.3	780.8	983.5	-0.2	4.2	4.7
- LPG	133.2	109.2	83.4	59.1	57.6	-11.8	-6.7	-0.5
Natural Gas	3.3	3.3	11.3	19.2	19.2	1.0	5.4	5.5
Total	21,394.9	19,112.5	21,151.7	27,497.8	35,857.2	1.0	5.4	5.5

5.4 Residential and Commercial Sector

Final energy consumption in 1998 by the residential and commercial sector amounted to 11,800 ktoe, accounting for 24.7% of the total final energy consumption. Major commercial energy used comprised: electricity (26.9%) and LPG (11.0%), and the remaining marginal portion included fuel oil and kerosene. Renewable energy was the

prime energy used in households, accounting for 7,166 ktoe or 60.7% of the total energy used in this sector. Renewable energy widely used in households were fuelwood and charcoal.

The economic crisis impact on the energy consumption by this sector in 1998 and 1999 has not been as severe as that on other sectors. In 1998, the energy consumption decreased by 4.7%, but in 1999 it is expected to increase by 0.3%. After that, the consumption is expected to increase at a rate of 2.9-3.0% during 2006-2011.

Forecast of Energy Demand in the Residential and Commercial Sector
(Unit : ktoe)

	1997	1998	2001	2006	2011	Growth Rate (%)		
						1997-01	2001-06	2007-11
Petroleum Products	1,509.6	1,456.2	1,583.9	2,034.8	2,601.2	1.3	5.1	5.0
- LPG	1,455.0	1,294.6	1,415.5	1,840.1	2,372.0	0.7	5.4	5.2
- Fuel oil	21.2	133.9	141.6	168.0	201.7	12.5	3.5	3.7
- Others	33.4	27.7	26.8	26.7	27.5	-6.7	-0.3	0.8
Electricity	3,477.0	3,178.0	3,488.0	4,578.0	5,943.0	0.2	5.6	5.4
Renewable Energy	7,389.0	7,166.0	7,252.1	7,568.0	7,905.9	-1.8	0.9	0.9
Total	12,375.6	11,800.0	12,324.2	14,180.9	16,450.3	-0.9	2.9	3.0

6. Review of Energy Policy

The economic downturn in Thailand has enormously reduced the short-term demand for energy; whereas the long-term energy demand has also been much slowed down, when compared with the projection made prior to the crisis. The government has reviewed the energy policy of the country in various aspects, such as delaying energy procurement to correspond with the changing economic situation, setting measures to alleviate the impact of fluctuating exchange rates on the private sector investment in Independent Power Producers (IPPs) and Small Power Producers (SPPs) projects, speeding up state enterprise restructuring, selling of shares and equity injection of state enterprises, in order to be in line with the current economic condition and to reduce dispensable fuel costs. In addition, several measures have been set to help affected private sector and state

enterprises so as to enhance their liquidity. At the same time, efficient use of energy has been promoted, and environmental problems resulting from energy utilization has also been taken into consideration.

6.1 Revision of Energy Procurement Plan to Correspond with the Decreasing Demand

Due to the lower growth rate of energy demand both in the short term and in the long term, after the economic crisis, energy procurement capacity, whether electricity or natural gas, has exceeded the demand. Consequently, the Thai government has reviewed the natural gas procurement plan, from both indigenous resources and import from the Union of Myanmar, including the LNG import. Revision has also been made on the Natural Gas Pipeline Master Plan, approved since 1997. In addition, the long-term Power Development Plan (PDP) has been revised to be in line with the decreasing demand; follow-ups and review of the power purchase plan from Lao PDR has also been carried out to comply with the changing demand.

(1) Revision of the Natural Gas Pipeline Master Plan No. 1: In October 1997 the cabinet passed a resolution to review the Natural Gas Pipeline Master Plan No. 1, which was initially approved in November 1996. This is to have the Plan correspond with the decreased natural gas demand and with the Power Development Plan (PDP : 1997-2011) of the Electricity Generating Authority of Thailand (EGAT). During the period of 1998-2006, investment will be made in 12 projects, with a total capital investment of 78,078 million baht (or 1,952 million US\$), accounting for an investment reduction by approximately 34,316 million baht (or 858 million US\$), compared with the amount initially projected in the Plan No. 1.

(2) Review of Natural Gas Import: In order that natural gas procurement from abroad would correspond with the long-term demand, the government has entered into negotiations to delay the gas purchase from Natuna field in Indonesia and the LNG purchase from Oman. Initially, Heads of Agreement had been signed with Oman LNG L.L.C. (OLNG) to import 1-2 million tonnes of LNG per annum, for 25 years from 2004 onwards. Besides, the Thai government has initiated negotiation with the government of Myanmar to reduce the contracted purchase volume of natural gas due to the delayed completion of Ratchaburi Power Plant construction.

(3) Revision of EGAT's Power Development Plan (PDP): The economic crisis since mid-1997 has caused a continual decrease of power demand. EGAT reviewed the PDP twice in 1997 to be in line with the drastic change of the situation, and another revision was made in November 1998. However, as the domestic economic volatility still exists, the November revision has brought about a revised PDP under three scenarios, according to the three possibilities of economic recovery situations, i.e. Low Economic Recovery (LER), Moderate Economic Recovery (MER), and Rapid Economic Recovery (RER). The following guidelines have been taken into consideration in revising the PDP:

- EGAT's projects which have been approved should be delayed for approximately 3-4 years;
- Of the seven selected IPP projects, with a total generation capacity of 5,800 MW, five projects should be delayed for 6-48 months;
- It appears that certain SPP projects will not be able to proceed since the demand of their direct customers has declined. Therefore, it is estimated that the actual capacity to be synchronized to the EGAT's system from SPPs will be approximately 1,979 MW (compared with the former estimation of 3,200 MW);
- For power purchase projects from Lao PDR which are under negotiation, the commercial operation date (COD) for 1,600 MW of capacity has to be put off until December 2006, and for 1,700 MW until March 2008.

(4) Follow-Ups and Review of the Power Purchase Plan from Lao PDR:

Following the substantial slowdown of power demand and the existing volatile economic conditions which have impact on the power demand of the country and hence on the power development projects in Lao PDR, the governments of Thailand and Lao PDR had a consultation meeting in mid-1998. It has been agreed that there should be close follow-ups on the power purchase programme by arranging a bilateral meeting in every three months. Additionally, it has been agreed to adjust the purchase pricing formula so that it would appropriately reflect the fluctuation of exchange rates.

6.2 Measures to Alleviate Economic Crisis Impact on Energy-Related Activities

(1) Reduction of Oil Inventory Level: In order to alleviate the burden of domestic oil refineries facing liquidity problems, the government has made a temporary downward adjustment of the oil inventories, from a level of 5% to 3%. The measure has resulted in a payment reduction for import of crude oil and refined oil products, accounting for a total value of 9,437 million baht, or 236 million US\$. Also, it has improved liquidity of the national financial system, accounting for about 11,064 million baht, or 277 million US\$. Moreover, there has been relaxation on oil inventories to provide flexibility and to reduce costs, by allowing inventories of crude oil or component in place of refined products. Authorization has also been granted on that there would be no requirement for an inventory of crude oil for the excess capacity which will be exported or sold to the petrochemical industry.

(2) Improvement of Gasoline Quality: In order to promote efficient use of oil as well as to reduce cost for unnecessary additives, which will reduce not only oil import volume but also its retail prices, the cabinet passed a resolution on 9 December 1997 to discontinue the use of anti-valve seat recession additive and detergent in gasoline, to reduce the octane number of premium gasoline from 97 to 95, and to increase use of premium gasoline with the octane number 91, which will help reduce the domestic oil production cost by 1,969 million baht/annum, or 49 million US\$/annum.

(3) Solution to Problems on Power Tariffs: To alleviate the severity of liquidity

problem impact resulting from the economic crisis on the business and industrial sectors, the government has approved the extension of payment period for electricity for the concerned sectors, from the original payment period within 30 days to 60 days as from the billing date. In addition, consideration has been made to improve the criteria on calculating the minimum electricity charge so as to reduce customers' electricity cost according to the decreased production resulting from the economic regression.

6.3 Increase of Private Sector Participation in the Energy Sector

(1) Immediate Sale of the Government's Shareholding The cabinet resolution of September 1997 approved the acceleration of the energy sector privatization. The following implementations can immediately be carried out: sale of the Ministry of Finance's shares in Bangchak Petroleum Public Co., Ltd. and in Esso Standards (Thailand) Public Co., Ltd.; sale of Petroleum Authority of Thailand (PTT)'s shares in Petroleum Authority of Thailand Exploration and Production Public Co., Ltd. (PTTEP) and in Bangchak Petroleum Public Co., Ltd.; and sale of EGAT's shares in Electricity Generating Public Co., Ltd. (EGCO). Privatization of PTT and EGAT has also been speeded up. All these implementations are in line with the IMF conditions with an objective to reduce the investment burden of the government and to raise fund from abroad.

(2) Master Plan for State Enterprise Sector Reform -- Energy Sector: The cabinet resolution of 1 September 1998 approved the Master Plan for State Enterprise Sector Reform. The Master Plan will serve as the basic guideline for reform efforts in the years ahead so as to improve the country's potential to compete internationally, to reduce the public sector financial burden and to increase efficiency in the provision of fundamental services to the general public. The Master Plan comprises an action plan for the reform or privatization of the following four economic sectors: energy, telecommunications, transport and water. The major reform guidelines on the energy sector as stipulated in the Master Plan are as follows:

Power Sub-sector

- Determine the industry structure, both in the medium term and in the long term;
- Establish the third party access code to allow private power producers to use transmission network under a non-discriminatory access tariff;
- Promote a competitive bulk supply market;
- Establish an Independent System Operator (ISO) to operate the power pool in order to accommodate the competition in the wholesale level;
- Introduce retail competition.

Natural Gas Sub-sector

- Determine the future structure of the industry;

- Establish the third party access code to allow the private sector's access to gas transmission facilities under common pipeline tariffs;
- Open free competition in the transmission system.

Oil Sub-sector

There has been much progress in deregulating the oil sub-sector. PTT is presently a key player in oil refinery and trading. Besides, PTT has also made investment in oil exploration and production. Privatization of PTT is, therefore, essential and PTT has agreed on privatization of the organization at the holding company level.

However, there are still key issues to be further considered in order to determine a clear framework and action plan, for example, detailed structure of the regulatory system. Also, the nature and timing of the decisions to restructure and open the energy markets to further competition will require extensive studies and action from both the making agency and related state enterprises, including necessity to reform energy market as well as legal and regulations governing organizations.

policy
various

6.4 Prevention and Solution to Environmental Problems

Although Thailand has to face with the economic crisis, the policy and measures pertaining to prevention and solution to environmental problems resulting from energy production and utilization have not been much affected. This is due to the explicit policy and measures, issued by the government since 1993-1994 and effective up to 2000, on oil quality improvement, which has resulted in better air quality. Significant measures which have already been implemented include: the abolishment of leaded gasoline distribution since 1996; the reduction of sulphur content in diesel to 0.25% by weight, effective on 1 January 1996, and to 0.05% by weight effective on 1 January 1999; the reduction of sulphur content in fuel oil from 3.0% to 2.0% by weight since 1 January 1998; speeding up the installation of the Flue Gas Desulphurization system at Mae Moh Power Plant to be completed within 1999; and the enforcement for oil depots, oil tank-trucks and petroleum service stations to be installed with oil vapour traps.

In addition, since 1998 a guideline on the use of fuel in EGAT's power plants has been established, i.e. to use more natural gas and to use fuel oil with sulphur content of approximate 1.0% in plants which cannot be gas-fired. This is to comply with the new and more stringent pollution emission standards applied to the existing power plants so that the amount of pollution emitted would not be at the level which is harmful to the environment and human-beings.

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Economic Reforms and Energy Policy, Energy Supply and Demand in China

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1. General Information about Economic Reforms and Development in China in 1998

- In the year of 1998, China confronted two big challenges. One is the Asian economic crisis, in last year, it has spread to almost whole Asian area and will deteriorate further; the international financial market met turbulence continuously, and the global economy suffered serious impact. Moreover, China's economy got large impact too; the other is the heavy flood disaster happen in China in last summer, which caused the people's properties and lives in the flood area disastrous losses, and effected the national economic development directly. These newborn issues, plus a variety of contradiction accumulated in the social-economic life in long period, made the economic work face with austerity and complicated situation in last year. Surprisingly, China overcame these difficulties and kept the economic growth rate at 7.8%. The original set goal was realized basically, and exchange rate of RMB remained steady, each reform advanced step by step, the society kept stable and the people's living level was enhanced continuously. In general, the whole domestic economic condition of China in last year is good.
- When the economic development kept the good tendency, economic mechanism reforms leap an important step. The grain distribution system reform was deepening further. And there are lots of things done for state-owned enterprise reform and financial mechanism reform, which yielded some new fruitful outputs. In addition, housing mechanism, medical insurance mechanism reforms has already come out; the plan for financial and investment system reform and fiscal mechanism reform is under design; the work on disconnecting the military, the department of politics and laws and the communist party with operating companies has been carried on fully. The government restructure went smoothly and got fruitful results.
- There are some reasons of success in China. First, due to the reforms and opening to the world for 20 years more, the integrated national power rise obviously. Second, the government of China make a series of great decision with a firm hand, such as enlarging domestic demand, implementing positive fiscal policy, strengthening infrastructure construction, promoting economic development and keeping the exchange currency of RMB steady, etc.
- In China, the obvious problems exiting in the current economic work are that: suffering the international market shrinking, the export declined greatly; the residential income and expenditure has not improved yet, the farmers' income growth was slowed, and the final consumption demand without blooming either; quiet a bit of enterprises have difficulties on operating and the burden of personnel laid out and refinding new employment in state-owned enterprises (SOE) were increased continuously; the problem accumulated in the many years in the banking and financial agencies exposed gradually, and the contradiction between fiscal income and expenditure became standing out; the progress of economic structure readjusting is slow, and the quality of economic growth is not good, and so on. According to the above situation, it is very urgent to take a lot of effective measures to solve these problems.

2. Energy Departments Restructuring

Among the Council restructuring, the departments of energy carried out corresponding restructuring: Replacing the original Ministry of Coal Industry, China State Administration of Coal Industry is set up

under the management of State Economic and Trade Commission (SETC) to discharge government duty. To further stimulate the coal industry, the State Council this summer transferred supervision rights for 94 State key mines from the central government to provincial levels. Withdrawing Ministry of Electrical Power Industry, a general department of electrical power is set up under the management of SETC with the administration function, at the same time, the State Power Company (SPC) disconnect with the administration function to realize the separation of politics and enterprises and speed the progress of establishing modern enterprises mechanism; In the oil industry, the China Petroleum and Natural Gas Corp. and the China Petrochemical Corp (SINOPEC) were withdrawn, and two major groups are reshuffled, one is China National Petroleum Corp (CNPC), the other is Sinopec to reorganize and integrate the upstream, or production sector, and the downstream, or sales sector, and also their domestic and foreign trade as well as production and marketing. At the same time, parts of administration function once belong to the two Corp.s were transferred to the new China Petrochemical Administration, led by SETC, and the autonomy in the management of the enterprises was transferred to Group Corp.

3. Energy Supply and Demand in Recent Years

- Energy supply tense was mitigated

Table 1 and Figure 1 illustrates the changing pattern of the growth rate of GDP, energy production and consumption in China. Based on the figure, since China economy realized softland by macro control in 1992, GDP always is under the declining situation, and the decline of energy production and consumption lagged in phase. Up to recent 3 years, there is obvious decline of them. In 1997, the energy production declined by 0.5%; and during the period from January to November in 1998, it declined by 3.3%.

Table 1 The Growth Rate of GDP, Energy Production and Consumption (1991-1997)

	"Eighth Five-Year Plan"					"Ninth Five-Year Plan"	
	1991	1992	1993	1994	1995	1996	1997
GDP	9.2	14.2	13.5	12.6	10.5	9.6	8.8
Energy Production	0.9	2.3	3.6	6.9	8.7	2.8	-0.5
Energy Consumption	5.1	5.2	6.3	5.8	6.9	5.8	2.2

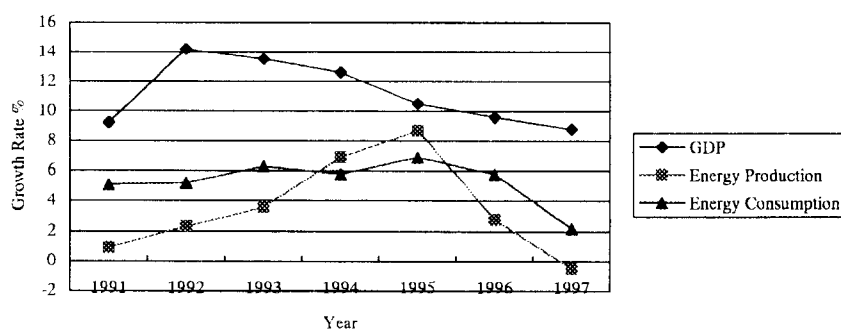


Figure 1 Growth Rate of GDP, Energy Production and Consumption

China relies on coal as main energy. For many years, the coal stock reaches 200 million ton, and the coal market dwindles. Due to the Southeast Asian financial crisis and the slow production growth of the SOEs, especially, the metallurgical and power industry, the major coal consumers, operated under capacity. By the end of September of 1998, the coal consumption amount is less 117 million-ton than

that of same period in last year, which make the hundred million ton coal saved from lowering production meaningless. The deficit of whole coal industry increased a bit. Based on prediction by relative departments, the coal production amount will reach 1200 million ton or so this year. In 1999, the coal industry will close 25.8 thousand mines. Through this way, the coal production will be brought down by 250 million ton. The total coal production in the whole country will be controlled in 1100 million ton, and the coal sale amount will hit 1200 million ton.

For the electrical power industry, it is predicted that, by the end of 1998, the total power installed capacity will reach 267 GW in China, the total electricity generation will be 1160 Twh. The above two index have been ranked second in the world. State Power Company (SPC) announced, after 20 years development, the tense situation of power supply in long time has been eliminated basically. In the most areas of China, electricity power hasn't been the bottleneck restricting national economy and people's living level.

According to the statistics from SPC, from January to October in last year, the total accumulated electricity generation in China is 2.09% more than that of the same period of the year before last year. And the accumulative growth rate in the whole year will be 2.5% by prediction. The electrical power production takes on four characteristics: first, the generation growth rate in the whole country is low, there is a bit increase in the third season, however, the increase of electricity generation in China is not balance. Second, the growth of hydro-electricity generation increased greatly. By the end of September in 1998, the increased generation of hydro-electricity has reached 8.4 Twh, sharing 87% of the new increased generation of 9.7 Twh in the whole country; Third, the contradiction between power supply and demand once existed in the most electrical grids are abated, there are quiet a bit backup power capacity. There about 15-20 GW power capacity shutdown in China, which is equal to the new increased capacity in one year of the whole country. Fourth, the line loss decreased and the plant service power consumption rate rise. It is estimated that the total electricity consumption of the whole country this year will increase about by 3%. Viewed from the power supply ability, the large and medium power capacity put into production in 1998 of the whole country exceeded 10 GW; in 1999, it can meet the power demand and will have some surplus capacity. However, some individual grids will exist conspicuous contradiction of the difference between power peak and valley, and will restrict the power consumption in some short time period.

As the oil sector, affected by the Asian financial crisis, the international oil price fell steeply, and the domestic market dwindled, the oil market trapped in a situation that the oil products couldn't be sold out, which has not happened for many years. The refineries were forced to reduce their production, and some oil fields had to be closed. Additionally, since last June, the Daqing, Jilin and Liaohe tree oil fields suffered flood disaster only happens once in hundred years, 6549 oil wells were flooded and 1911 oil wells were closed. All those caused the 520 thousand ton crude oil production reduction. To keep the market stable, the Central government takes a series measures, such as enlarging domestic demand, strengthening infrastructure construction, driving the oil demand effectively, beating the smuggle, adjusting the structure etc. Finally, the oil production is near with the level of last year by those measures. Due to the increase in import oil, the oil supply and demand stay in balance status in general.

- Obvious trend of consuming high quality energy

Since the 8th Five-Year Plan, China's economy grows at amazing speed, per capita GDP increases greatly, which not only promoting China's industry structure updating, but also pulling the energy consumption toward high quality energy. Especially the implementation of sustainable development strategy on economy-energy-environment coordination, and the internalization of environmental cost, enhance the people's environmental concern. To develop and consume the high quality energy (oil, gas and electricity), some people are able to pay, and there are market for them to buy these energy. Thus, the end-use energy structure in China transferred toward consuming high quality energy. Especially in the southeast coastal areas where short of energy, the degree of using high quality energy is higher. In light of the energy balance sheet of China, the ratio of coal, oil and electricity changed fiercely from

1991 to 1996, see Table 2. For natural gas is limited by the increase in domestic production and without import too, the percentage of natural gas shared in the total energy consumption declined a bit.

Table 2 Variation of the Coal and High Quality Ratio in the End-use Consumption Structure (%)

	1991	1996
Coal	46.2	39
Oil	14.8	16.4
Natural Gas	2.0	1.72
Electricity	7.9	9.25

- Energy supply facing to the international market

Due to the exploit and production shortage of the domestic oil and gas resource, and the blooming demand for high quality energy, under the opening condition of domestic and foreign energy market, China imports high quality energy from overseas, the crude oil and product oil amount increased year by year. Since China became the oil import country in 1993, in 1996, China turned into a net crude oil import country. According to the statistics by Custom, in 1993, the net oil import was 9.61 million ton, in 1996, was increased to 13.93 million ton, and in 1997, hit 33.85 million ton. The LPG import also increased from less than 1 million ton in 1994 to 3.35 million ton in 1996. The internationalization of energy supply not only optimizes energy consumption structure, improves environment, but also promotes the energy efficiency, brings down the overspeed increase of the energy consumption.

4. Energy Supply and Demand Forecast by the End of 2000

- Coal: The original forecast for 2000 is that 1500 million ton of production, in which, 50 million ton for export, 1450 million ton for domestic consumption. In 1996, the annual production is 1397 million ton, in 1997 the annual production is 1373 million ton. The production amount in 1998 is under statistics, it is estimated to be 1250 million ton. In 1999, China decides to shutdown the illegal small mines, bring down the production of 250 million ton. And the production plan is 1100 million ton, with the stock of 100 million ton, the total consumption is 1200 million ton. And, the production in 2000 is set at 1200 million ton.

The main reasons for the decline of coal production and consumption are: first, replacement with high quality energy, especially energy used in the residential sector; second, result of energy conservation; third, improvement of coal quality, especially the carbolic value of the coal used for generation.

- Crude oil: The original forecast for 2000 is that, oil production is 165 million ton, and import is 38 million ton, therefore the energy consumption reaches 203 million ton. In 1996, the annual oil production was 157.33 million ton, 160.7 million ton in 1997, and it is estimated to be 154.5 million ton in 1998. Now, it is forecasted that, by 2000, the demand and supply will remain at the original level. But the net oil import (crude plus product oil) possibly exceeds 50 million ton.

- Natural Gas: The original forecast for 2000 is that, gas production is 30.0 billion m³, the annual production in 1996 is 20.1 billion m³, and 22.7 billion m³ in 1997. It is estimated now that, in 2000, the gas production keeps between 25.0 and 30.0 billion m³ generally.

- Electricity: The original forecast for 2000 is that, installed power capacity will be 300 GW, and electricity generation will be 1400 Twh, then it is adjusted to 290 GW and 1350 Twh later. The power capacity in 1996 was 236.54 GW, and 254.24 GW in 1997, 267 GW in 1998; the electricity generation in 1996 was 1079.4 Twh, 1134.2 Twh in 1997 and 1160.0 Twh in 1998. It is estimated now that, the power capacity in 2000 will reach 290 GW, the original set goal. The electricity generation will reach

the original goal of 1350 Twh, depending on the rebuild of the town and village grids. The installed capacity of 290 GW in 2000 includes 68 GW hydropower and 2.1 GW nuclear power.

5. Recent Energy Industry Policy

- Coal Industry

In 1999, first, coal industry will close mines to reduce production, do well on structure adjustment, and spend more attention on solving the excess of total coal amount. All those are the important components of the general reform in the coal industry, and the basic escape for the state-owned coal enterprises broken away difficult position. Second, central administration would guide the SOEs to deepen reform, speed the conversion of the operating method. The general thoughts are that, strengthening a batch, making a batch active, breaking a batch and developing a batch. Third, the administration continues to guide the work to drive the whole industry changing from deficit to benefit and establish the solid material base for enterprise to solve difficulty. Fourth, continue to strengthen increasing benefit by laying out workers, and re-employment. The coal enterprises should decide the worker number based on production, the non-coal enterprises should decide the worker number by benefit, the department and no-profit units should decide the worker number by work station. All the surplus staff should be reduced. Fifth, promoting the technology development in the coal industry, strengthening technology renovation and increasing the quality of economy operating.

- Oil and Natural Gas Industry

In 1999, first of all, the oil and natural gas industry should bring the advantage into play, make the benefit obvious, and maintain the sustainable and stable oil and gas production. And the exploitation effort should be strengthened further to find more commercial oil and gas reserve.

The economic production should be considered, it is necessary to take market oil price and economic benefit as standard, and remake economic assessment on the old oil fields exploitation, adjust exploitation scenario and management mode to ensure the cost-effective oil and gas production. In addition, it is urgent to develop natural gas market well, then make the mid-western natural gas resource turned as new economic growth point.

Second, the enterprise reforms need to be deepened further, and get some breakthrough on structure adjustment, changing from deficit to benefit and workers laying out. Third, focused on cost reduction, the industry should strengthen the enterprise management, establish the internal incentives system and restrict system.

- Electrical Power Industry

The electrical power industry should make some new breakthrough in the following reforms. First, to separate the power plants with power grid, and bid for grid connection. And to establish the power market in the electricity generation side. Second, to promote the reform of "separate politics and enterprises, the provinces become the entity " further, set up provincial electrical power company in the location where the power grid company situates, put the autonomy in the enterprise operating and management of the provincial power company into effect, create the property right restriction system, improve the management lever of the electrical power group corp. Third, to do some pilot project on the multisubject of investment for the provincial electrical power company, push the enterprise system to be innovated with originality, explore the new implementation form of state supervises power grid. Fourth, rural electrical power management reform. It is important to strengthen work intensity, try to transfer the county power enterprises into the limited companies, which are controlled by provincial power company through sole investment, holding share or share. Thus the county power enterprises become the individual power distribution companies. Finally, through the rural electrical power reform, rural electrical power grid rebuild, it can to realize the same price in same grid in the rural and urban electricity consumption.

On the electrical power industry development, there are some very important and urgent things to do as following: first, to speed the rebuild of urban and rural power grid, organize and execute the urban and rural power grid construction and rebuild seriously, exploit the electrical power market further, and make the existing production capacity function effectively. second, improve the quality of power development, optimize electrical power structure, develop fossil fuel-fired power plants in priority, and spread hydro power in great effort and develop nuclear power properly. It should adjust measures to local conditions to develop many kinds of new energy for generation, and extend the power grid at the same time. Third, it is necessary to pay more attention on technology research and development and the personnel cultivation. Fourth, to concern much on the pollution control, and promote the new technologies about energy conservation, electricity saving and environmental protection with more effort.

Stable Supply of Oil & Gas in the Asia Pacific Region

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Abstract

Two pervasive energy sectors are experiencing major changes in the global arena. While the electricity sector is being unbundled, major oil & gas private companies are merging and poised to enter the electricity market. The two industries have always been interlinked for over one century, with the power industry providing ready markets for oil products (particularly fuel oil and diesel) and recently base demand for gas to justify huge investments in gas infrastructure. Eventually, it is anticipated that a single energy industry would emerge blurring the separation of oil & gas from coal and electricity. Vertical integration with electricity generation is expected to add value to the business of oil, gas and coal suppliers.

Public pressures in some countries are expected to affect the economic viability of nuclear and hydro electricity. In Germany, the new coalition Government is pushing for phased dismantling of existing nuclear power plants putting pressure on its neighbour, France and even Japan to reconsider their ambitious nuclear programme. Threats of trade and financial boycotts may restrict the development of major hydroelectric projects in Asia. Ignoring this threat can be costly, as experienced by Shell in decommissioning the Brent Star platform.

It appears that the world will be restricted to clean technologies burning fossil fuels to meet future growth in energy demand unless major breakthroughs in renewable energy technologies are forthcoming. The Kyoto Protocol has given the developed countries added incentives and urgency to seek sustainable green energy solutions. The current depressed oil price is also expected to slow down exploration activities in marginal areas leading to higher global reliance on Middle-East oil & gas supply. Will these developments impact the stable and continuous supply of oil and gas in the Asia Pacific region, taken for granted for almost two decades since 1979.

The views expressed herein are those of the authors and do not represent those of Pusat Tenaga Malaysia nor other related organisations in Malaysia.

SPEC '99, Tokyo 16-17 Feb. 1999

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Introduction

In and after July 1997, many East Asian economies experienced a minor “revolution” causing economic contraction, reduction in purchasing power and slower growth in energy demand. This “revolution” is less widespread compared to that caused by the two oil price shocks in the 1970s, over two decades ago. After the Arab oil embargo in 1973, many countries became preoccupied with energy security and various policy measures were instituted including the creation of national oil corporations and their wholly-owned marketing subsidiaries. Some of these measures are being dismantled under the banner of LDP – liberalisation, deregulation and privatisation (not the ruling party in Japan). Indeed, the energy sector has experienced its own “revolution”, more or less bloodless, but the changes have been profound and sometimes painful and they continue to this day. Most power utilities lost their monopoly in the generation business while Government-owned oil companies are privatised. One example is PETRON of the Philippines which was privatised, with ARAMCO of Saudi Arabia acquiring a major stake signalling the entry of Middle East investment in East Asian oil refining and retailing.

Will this wholehearted embrace of LDP ensure stable oil and gas supply in the region? Should we explore other options and adopt a balanced policy stance based on reality and practical solutions? Strong armed forces have very little role in the global market place and yet, many unlikely military events (including Indian and Pakistani nuclear tests) took place recently reinforcing the need for caution and preparedness. The mega mergers of Exxon-Mobil and BP-Amoco are clear signals of threats faced by Asia Pacific economies including their national oil companies. The sudden withdrawal of private capital from East Asia could be emulated by private oil companies implying a potential vacuum and bottleneck in oil & gas supply. Already, some players have sold their interests due to depressed oil market and inadequate margins, while mergers have resulted in

reduced competition in the retail and wholesale market and even planned closure of marginal refineries.

This paper will discuss the changing energy landscape in Asia Pacific region, impact of the East Asian crisis on regional energy demand and probable impacts of energy industry restructuring on the stability of regional oil & gas supply. One major concern is public pressures on nuclear and hydroelectric projects. As traditional exporters become net importers, intra-regional trade in oil & gas would decline resulting in higher reliance on Middle East oil & gas supply. In view of this likely scenario and despite the depressed regional oil & gas market, energy planners are bold enough to put into motion the Asian Gas Pipeline initiative, the ASEAN Gas Grid and ASEAN Power Grid projects. When completed, these energy highways are expected to contribute positively towards stable regional oil and gas supply.

The Changing Energy Landscape in the Asia Pacific

Many oil companies and electric utilities in Asia celebrated their centenary anniversaries in recent years. Both energy supply industries are mature and have a long tradition in the Asia Pacific economies. While electric utilities are virtually monopolies within a service area, the oil companies face keen retail competition. In contrast, oil & gas production is monopolistic within exploration and production blocks while electricity production is becoming more competitive.

As they simultaneously operate under monopolistic and competitive environments, these over 100-year industries are governed by various rules and regulations, even under the so-called deregulated market environment. By analogy, the Olympics is also over a century old and is governed by its own rules. Qualifying standards for athletes are continuously raised and yet, records are broken at recent Olympics – very exciting events watched by millions of

spectators across the five continents. There is no substitute to adventure, human ingenuity and sense of accomplishments.

The traditional energy players must strive to make energy an equally exciting phenomenon. Fortunately, energy sector deregulation is a significant catalyst to open new opportunities and energy sector is no longer taken for granted and becoming very relevant, particularly to international investors. In some countries, new players are entering the energy market peddling “technology solutions” for mundane daily needs like home heating, air-conditioning, home entertainment and security. Unlike traditional utilities, these players do not sell just electricity but other value added services [1]. The kWh is just one part of the product that are being sold.

The energy sector landscape is fast changing and like the internet and e-commerce, it will soon give the ultimate customers more choices to meet their daily energy and technology requirements. Already, many petrol stations double up as convenience stores while supermarket chains offer cheap petrol as a service to regular patrons.

Some of these trends are good for consumers while the benefits from others may not yet be obvious. One example is the merger and acquisition among major oil companies e.g. Exxon-Mobil, BP-Amoco and Total-Fina, which will reduce the number of players, and hence competition. The likelihood of international cartel will increase to push and swallow small and medium size competitors. Indeed, like the aborted American-British Airways merger in the airline industry, the Exxon-Mobil deal is being challenged under the anti-trust and monopolies law of the United States.

Nevertheless, it is expected that more mergers and acquisitions will take place, especially among small and medium-size oil companies. Mergers of well-known equipment manufacturers e.g. BBC-ASEA (to become ABB) and GEC-Alsthom

have successfully reduce cost and maintain their global competitiveness. Many analysts predict that the 7 Anglo-American sisters (Exxon, Shell, Mobil, Texaco, BP, Chevron and Amoco) will become 3-4 sisters to take on national oil companies blessed with substantial oil & gas reserves.

While oil companies are merging, liberalisation, deregulation and privatisation (LDP) of the electricity supply industry is dismantling monopolies and encouraging open access and competition particularly in the heartland of capitalism (USA) and Europe. This apparent contradiction is affecting traditional and long-standing relationships. Vertically integrated power utilities (traditional customers of oil & gas companies) are fast disappearing because new players are entering the lucrative electricity production market. This may affect future gas infrastructure projects, perhaps even compelling oil & gas companies to enter the electricity generation business. The East Asian economic crisis is actually speeding the process, exemplified by the Philippines Malampaya deep water gas to power project by Shell [2].

Thus credit-worthy oil companies, accustomed to raising capital in the international market are invited to assume greater risk in putting energy infrastructure in some countries. With less domestic capital, national energy companies are relegated to become minority partners. It is uncertain how this will evolve but oil & gas companies have the skills and experience to operate power plants, no different from refineries, LNG and petrochemical plants. As more oil & gas companies commit their expertise and energy products to their own power plants, less oil & gas products are available for the global market. Will this mark the entry of electric utilities into the oil & gas industry? Already, some utilities (e.g. EGAT of Thailand) operate their own coal mines, while TEPCO and Kansai negotiate directly with LNG and coal suppliers.

Economic Crisis & Regional Oil & Gas Demand

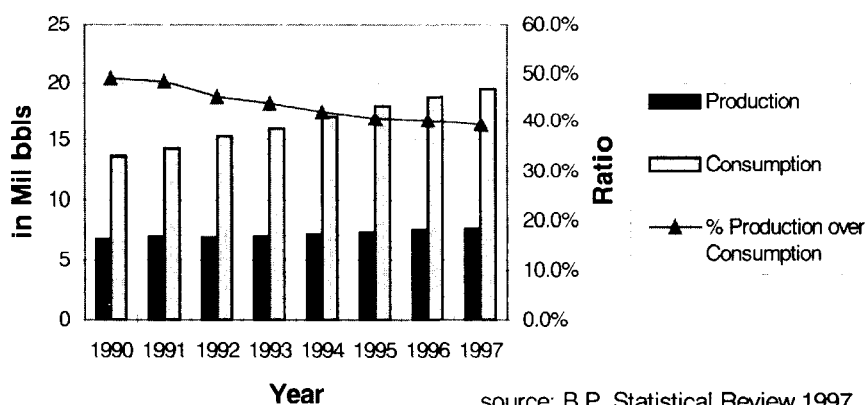
Table 1: Asia Pacific's Source of Oil Supply for 1997 (in mbd)

Middle East	10.6
West Africa	0.6
Within Asia Pacific	5.9
FSU	0.2
Other Regions	1.1
Total	19.5

Source: B.P Statistical Review 1997

The Asia Pacific is a net importer of oil and gas. As shown in Table 1 above, more than 50% of Asia Pacific oil supply in 1997 comes from the Middle East. This fact can also be deduced from Figures 1 and 2. While regional gas production is only slightly below consumption, oil supply is more vulnerable with imports satisfying over half of regional oil consumption. Throughout the 1990s, there has been a steady growth in oil & gas consumption but this came to an abrupt halt recently caused by the East Asian economic crisis.

Figure 1: Oil Production & Consumption in Asia Pacific Region



**Figure 2: Production & Consumption of Natural Gas
in Asia Pacific Region**

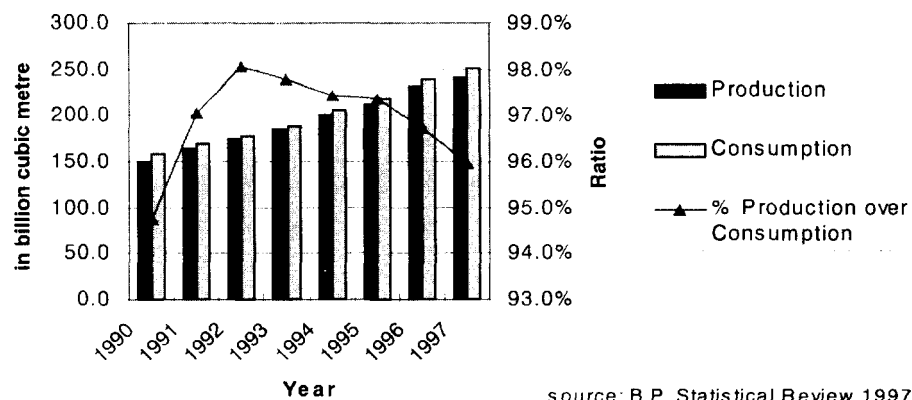
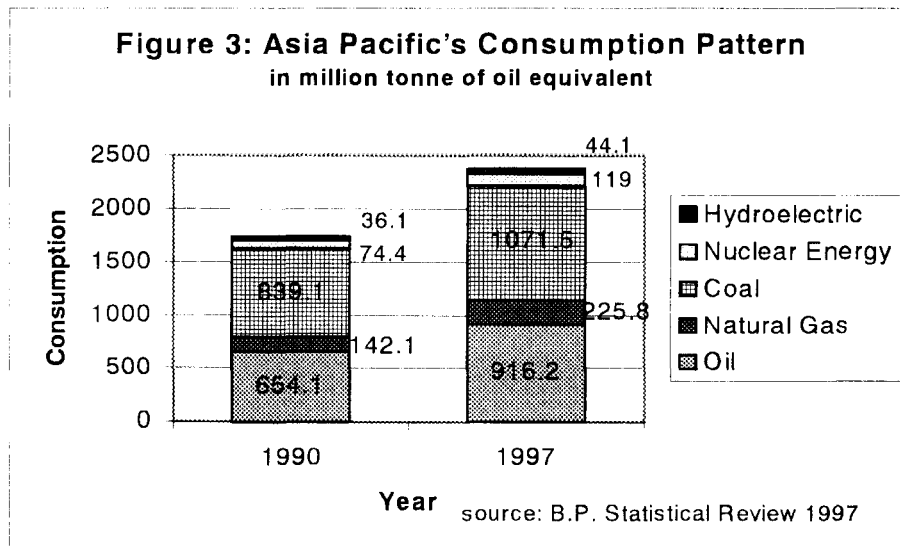


Table 2: Selected Asian Countries at Glance

Countries	Real Gross Domestic Product (GDP) 1997E	Real GDP Growth Rate (%)		Energy Consumption			
		1990-96 Average	1998 Forecast	1996 Total (Quadrilli on Btu)	Oil Share (%)	Average Annual Increase Total (%)	Average Annual Increase Oil (%)
China	802.0	11.6	7.2-7.5	37.04	19.9	5.4	7.5
Indonesia	184.8	7.1	(13.5)-(20.0)	3.51	50.4	8.3	4.4
Japan	3342.8	1.8	(1.8)	21.37	55.8	2.8	2.2
Malaysia	75.8	8.7	(1.3)-(3.5)	1.66	51.6	9.3	7.7
Philippines	54.9	2.7	1.0-1.5	0.98	73.4	5.0	6.3
South Korea	411.0	7.4	(4.0)-(4.8)	7.16	63.0	11.7	13.2
Taiwan	249.2	6.2	5.0-5.2	3.11	53.5	7.3	6.5
Thailand	135.2	8.2	(5.8)-(9.0)	2.33	61.2	10.9	9.0
Singapore	65.2	8.1	0.5-1.3	1.22	95.3	7.2	6.4

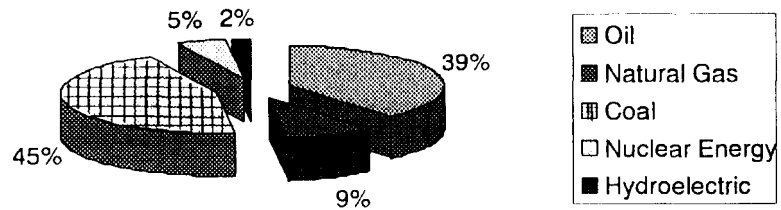
Source: U.S. Energy Information Administration, WEFA, Asia Economic Outlook (11/97), U.S. Census Bureau

Table 2 gives average annual growth rate of GDP and energy consumption of



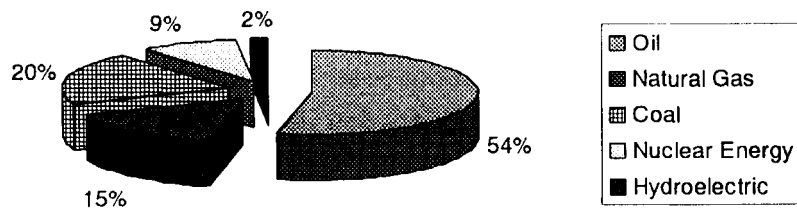
East Asian countries. As shown in Figure 3, total energy consumption in Asia Pacific increased from 1746 Mtoe in 1990 to 2376 Mtoe in 1997, an increase of 36% over 7 years. The East Asian financial crisis, which began in July 1997 caused economic contraction in some countries and this has some impact on future oil & gas demand. It was mentioned at the APEC Energy Ministers' Meeting in July 1998 at Okinawa that the East Asian economic crisis has introduced uncertainty in energy planning process (as reflected by the APERC energy outlook) and hence energy investment decisions. Indeed, several LNG projects will be put on hold as a result of lower demand for LNG in Japan, Korea and Taiwan as well as delay in expected LNG offtake by India, China and Thailand [4].

Figure 4a: Asia Pacific's Primary Energy Mix 1997



Source: B.P Statistical Review 1997

**Figure 4b: Asia Pacific's Energy Mix 1997
w/o China & India**

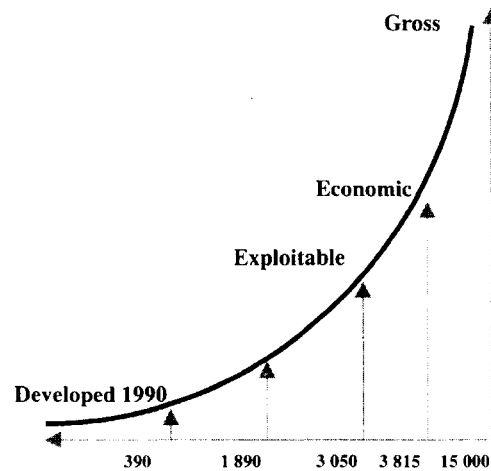


Source: B.P Statistical Review 1997

Figures 4a & 4b show the breakdown of primary energy supply in Asia Pacific with and without China and India in 1997. The region is 93% dependent on fossil fuels (coal 45%, oil 39% and gas 9%) with nuclear and hydro electricity the remaining 7%. The contribution from nuclear and hydro resources is significant. As shown in Figure 5 below, hydroelectric potential in Asia is quite substantial and majority is not yet developed. It is likely that the energy options for future

growth in electricity production would be limited to coal, gas and perhaps renewable energy.

Figure 5: Asia Hydropower Potential (TWh/A)



Source: UNPEDE, Hydropower resource Study 1997.

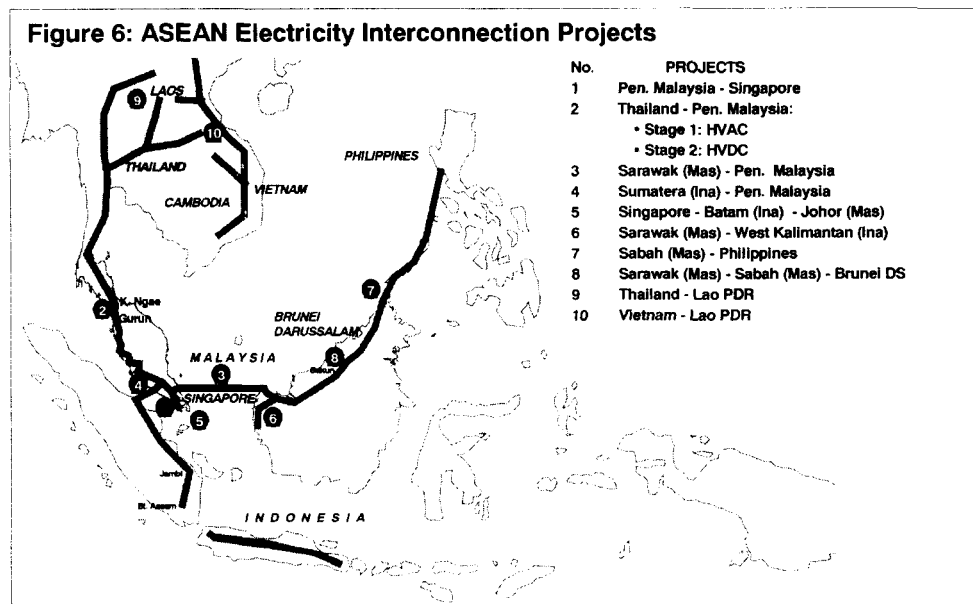
If the new German Government is successful in phasing out its nuclear power program, it is likely that France would follow suit leaving only China, Japan & perhaps Korea with a nuclear future! Western environmentalists who oppose large hydroelectric projects in Asia are employing new tactics. They threaten and put pressures on Western companies intending to finance and supply equipment and know-how. Such tactic was fairly successful in persuading Shell to reverse its decision with the Brent Star platform.

It appears that both nuclear and hydro electricity will become energy options of last resort, especially to private energy companies, which are less prepared and may not have the patience to confront the "new" breed of environmentalists. The Kyoto Protocol was a hard-earned "victory" for environmentalists in their quest to persuade businesses to adopt a sustainable energy future. It is unlikely they will ever relent, and in my humble opinion, these environmentalists will become more entrenched and no match to profit-motivated private investors.

No Nuclear, No Hydro and Energy Highways

If this prediction becomes a reality, the shortfall caused by non-nuclear and non-hydro energy development would be met by four options:

1. gas and coal for power generation (oil is reserved for transport)
2. energy efficiency to manage the rate of growth in electricity demand
3. “green electricity” from renewable energy such as solar, wind and biomass
4. regional Gas and Power Grids to increase operational efficiency and intra-regional energy trade

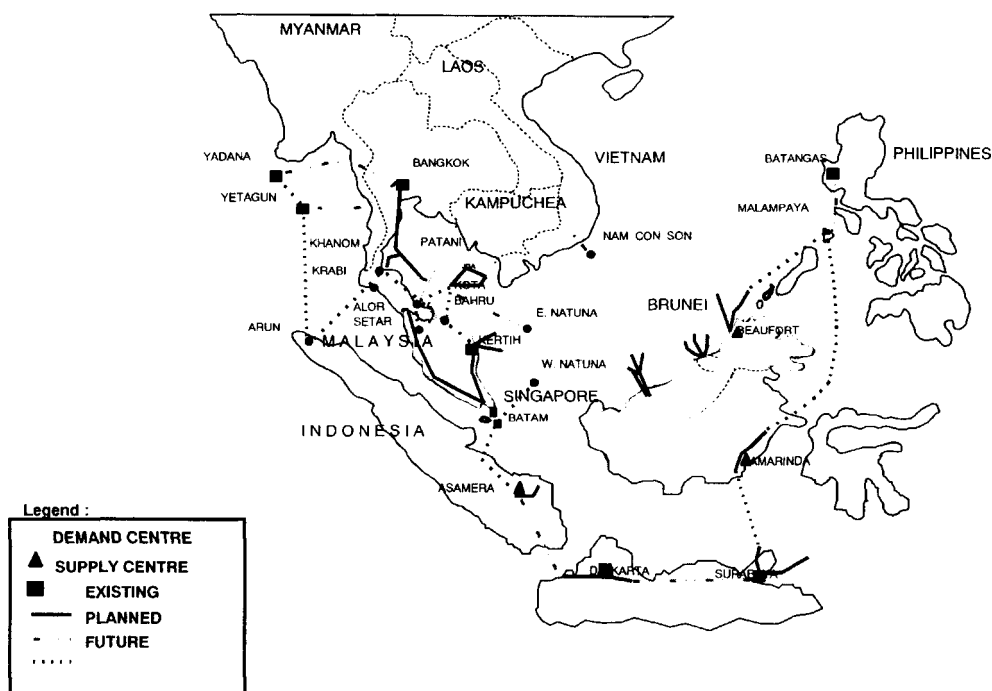


The first option is expected to put a strain on ocean transport. It is reported that world oil trade by tanker represents about 40% of total sea borne tonnage. The shares for coal and LNG are smaller but still sizable – 435 million tonnes of coal and 75 million tonnes of LNG [3]. Increasing concerns regarding safety and

pollution will lead to more stringent maritime regulations, perhaps less competition and higher freight charges.

The second and third options are noble and have been pursued for a number of years but the results are not easily quantifiable and verified. Hence a lower priority was accorded by many Governments. In ASEAN, the concept of “think big and think small” is officially advocated but big businesses are attracted to large projects. Hence the bold move to put into motion the ASEAN Gas Grid and Power Grid projects (see Figures 6 & 7).

FIGURE 7: ASEAN GAS GRID BY 2010



The North American and European energy infrastructure (gas pipeline and electricity transmission network) act as dedicated energy highways to facilitate energy trade. In fact, these “highways” are the enabling factor and foundation in

the deregulation of American and European energy sector, allowing open access. Having witnessed the ease and benefits of energy trading, Asian planners are ready and willing to put into motion the Asian Gas Grid initiative to link energy-rich areas with energy-scarce demand centres. The eastward expansion of the European Power Grid may one day merge with the ASEAN Power Grid, perhaps via China or Indian sub-continent. There is no substitute for human ingenuity and adventure.

If the energy highways become reality, the Middle East and Caspian oil and gas resources can be piped or transmitted as electricity to East Asia countries. The smaller scale ASEAN Gas Grid and Power Grid projects can become useful models of how the ASIAN energy highways can be realised. The former is guided by the recently endorsed Hanoi Plan of Action (1999-2004) and the ASEAN 2020 vision. ASEAN dialogue partners are especially welcome to assist in this bold and challenging endeavour.

Concluding Remarks

The East Asian financial crisis has resulted in economic contraction and slower growth in energy demand. The glut in oil, coal and gas supplies resulted in lower spot prices implying a windfall gain to many energy consuming countries. Over investment in capacities caused energy producers to scramble for buyers. Naturally, consuming countries will prolong the buyers' market situation. The depressed market is expected to continue despite attempts by some OPEC members to cut oil production to boost price. Almost two decades after the 2nd oil shock, oil producers and buyers are talking the same language i.e. price and not supply disruption. This is indeed very encouraging for supply stability.

Although technological development has lowered production cost to less than US\$ 5 per barrel, many oil producing countries must rely on oil income to fund

national development efforts. Accustomed to past high oil premium, many of them took loans which must be repaid promptly. Will this “no-win” situation (to some oil producers) end soon? Low oil price becomes a disincentive to embark on expensive and high risk oil exploration activities, especially in new areas like the Caspian region. This could have negative impact on long-term supply stability.

Of more significant is the energy sector reform and more importantly, the entry of “new” players in the oil & gas, and electricity sectors. In some cases, the new players are long-time friends not adversaries e.g. Shell’s entry into gas-electricity generation in the Philippines, a friendly business deal. The changing energy landscape is expected to have an impact of oil & gas supply. Instead of selling into the open market, oil & gas companies may keep the oil & gas for their own power plants. Expected mergers of oil companies will reduce competition and put pressure of prices.

If the ASEAN Gas Grid becomes a reality, new LNG supply would not be available for global market from ASEAN gas producers. In any case, most available gas is committed to existing and planned LNG plants under long term gas contracts. The ASEAN Power Grid may affect ASEAN coal export potential but would make hydroelectric projects very attractive. Like China, it is likely that ASEAN will develop its hydroelectric resources with or without the blessing of Western environmentalists. Nevertheless, delays would occur as land ownership is usually dear to the hearts of affected people, even without any prodding or instigation from environmentalists. What would be the alternative to postponed or shelved hydroelectric resources? The same argument can be asked regarding possible alternative to nuclear electricity.

Although oil and gas supply stability is an important issue, it is likely that Asia Pacific Governments would be more preoccupied with solving the current economic crisis and potential threats from the Y2K bug. 1999 would probably be

“a dull energy year”, certainly not as exciting and hot as Y2K or even attempts to introduce rules to regulate the over 300-year old private banking [5].

Nonetheless, energy sector is still relevant and as more players enter the arena, it will become exciting to the players, Governments and the public. The more the merrier to ensure a dynamic and exciting energy sector development. In our view, therein lies the assurance of a stable oil & gas supply. By analogy, food security is not given any special agenda perhaps because of diverse groups of players are involved in the food industry.

We look forward to a more predictable “energy” industry and an early resolution of private capital market and a return to financial stability in the Asia Pacific.

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- [3]** East-West Centre, Hawaii, Energy Security Issues in the Asia Pacific region, May 1998
- [4]** Mr Muri Muhammad, “Regional Gas Market”, 3rd Asia Oil & Gas Conference, Kuala Lumpur, 1-2 June 1998.
- [5]** Private Banking: Lifestyles of the Rich & Secretive (Just hide me the money), Time Magazine, Vol. 152 No. 23, 14 Dec 1998, pg. 28.

ENERGY SECURITY AND NUCLEAR POWER GENERATION IN ASIA

— 119 —

Katsuya Tomono
Executive Vice President
Tokyo Electric Power Company
Tokyo, Japan

CONTENTS

1. Energy outlook and future perspective
2. Coping strategies and role of nuclear power
3. Conclusions

ENERGY OUTLOOK

1) Energy sources in Asia

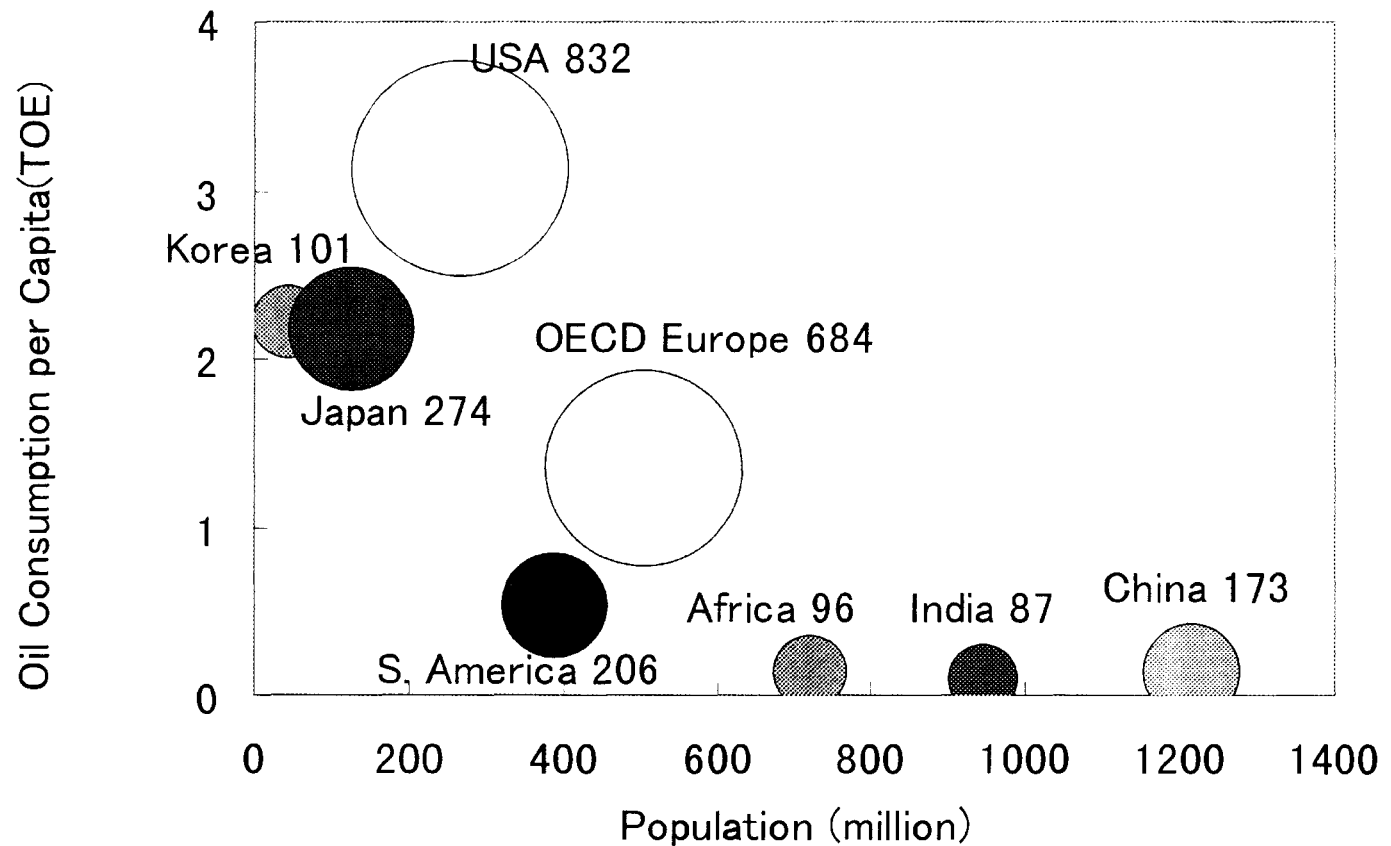
Renewable/waste	1/5
Oil	1/3
Coal	1/3

2) Low 'per capita energy consumption' (average)

3) Diversity in country specifics

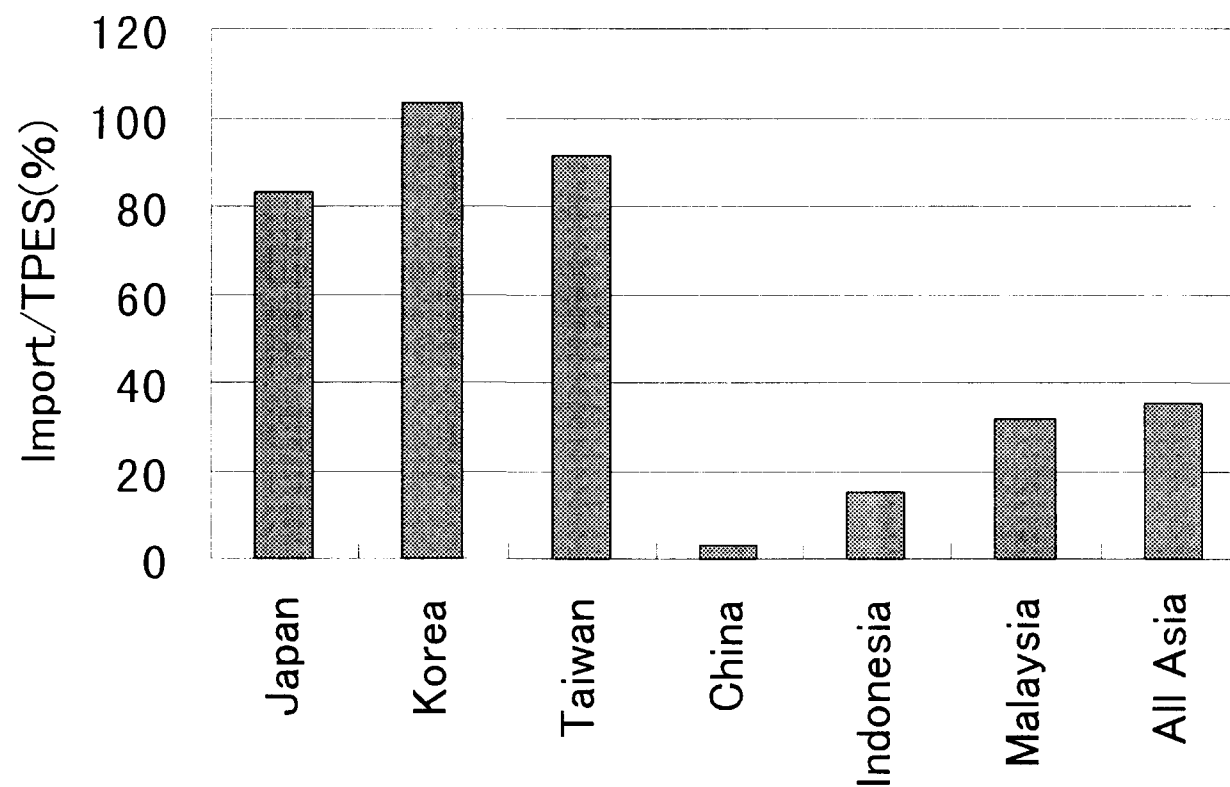
- 'per capita energy consumption'
- Domestic supply ratio
- Energy supply sources

Population and Oil Consumption



Source : IEA Energy statics & Balances of OECD Countries 95-96
IEA Energy statics & Balances of Non OECD Countries 95-96

Import / TPES

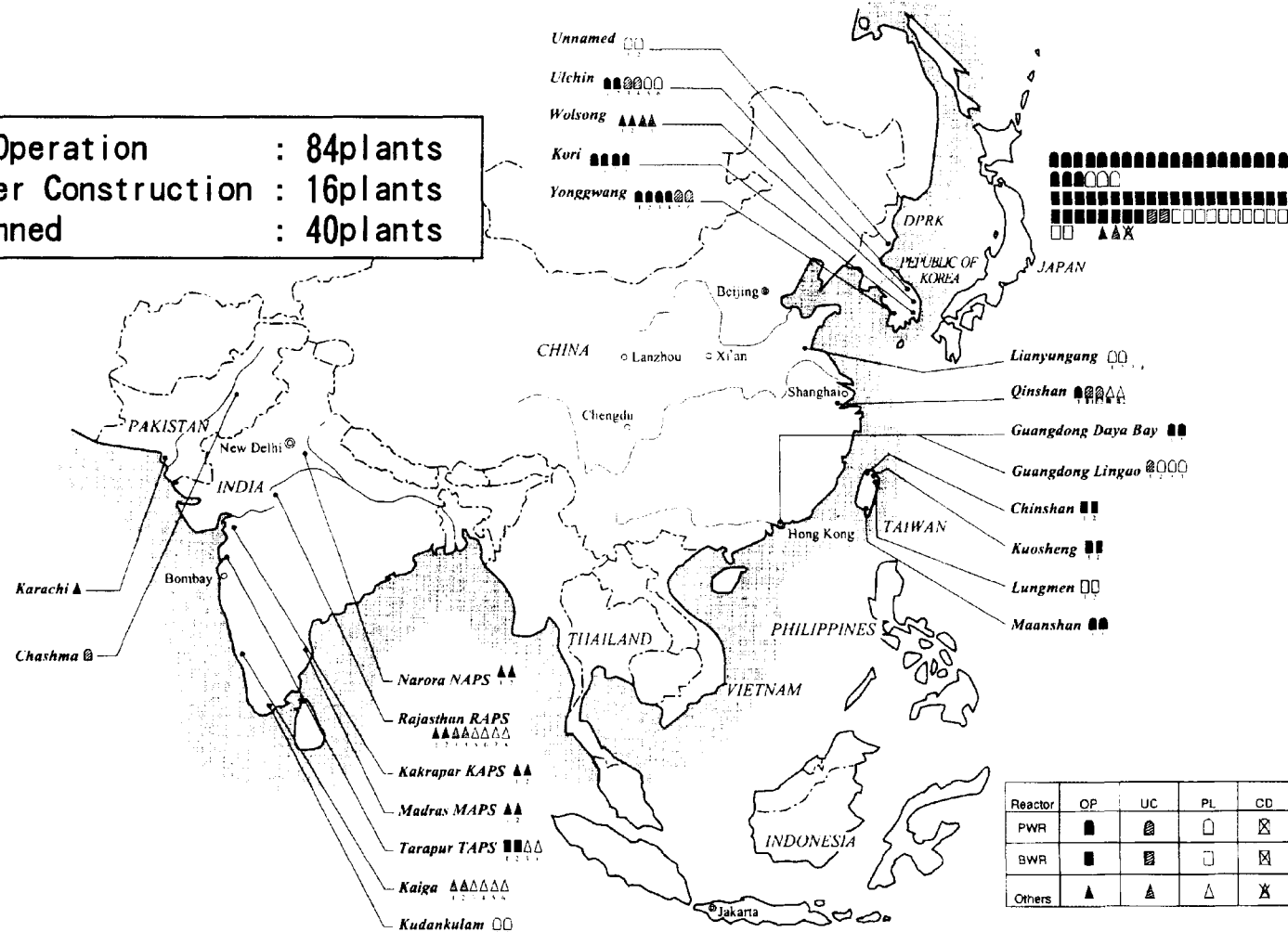


TPES : Total Primary Energy Supply

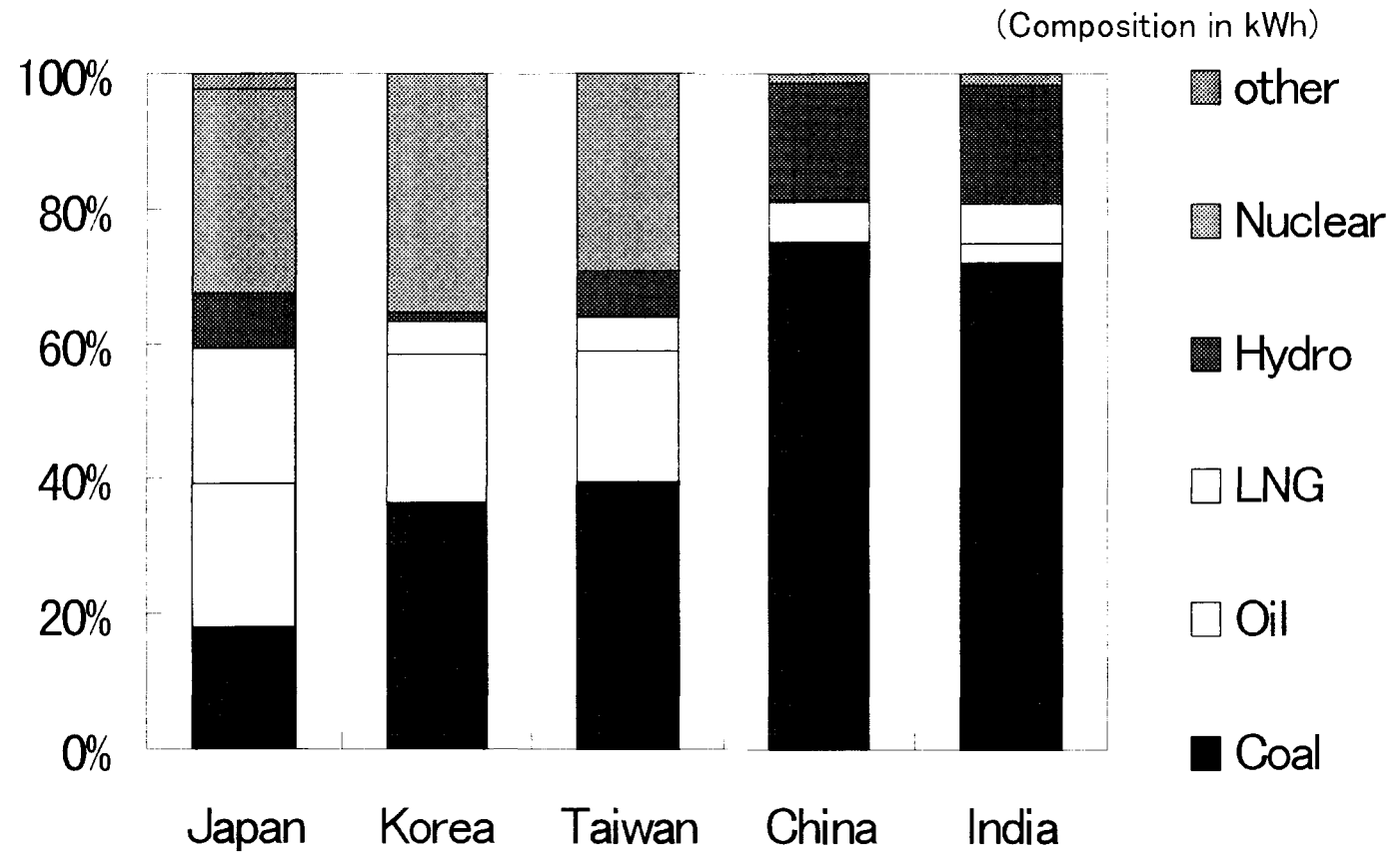
Source : IEA Energy statics & Balances of OECD Countries 95-96
IEA Energy statics & Balances of Non OECD Countries 95-96

Nuclear Power Plants in Asia

- In Operation : 84plants
- Under Construction : 16plants
- Planned : 40plants

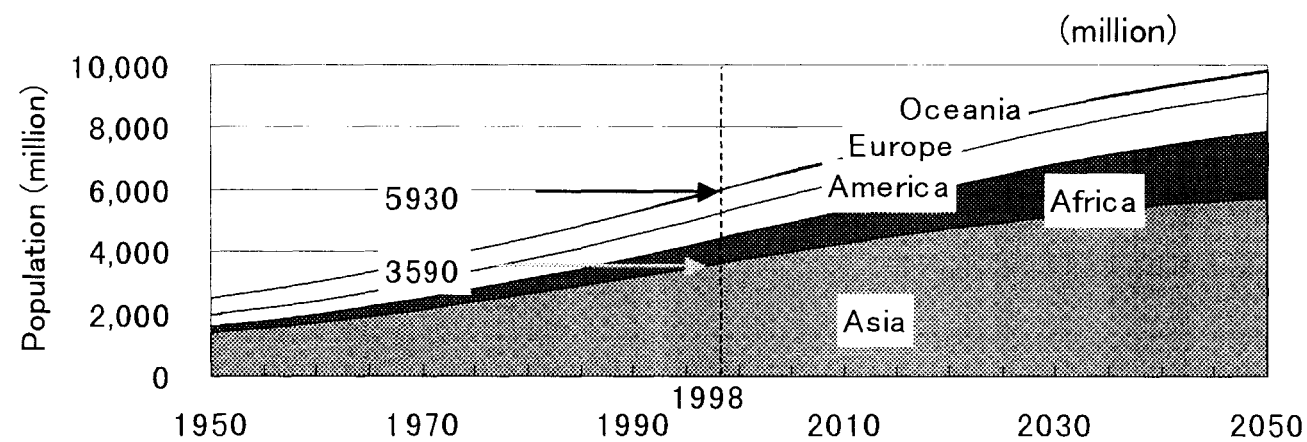
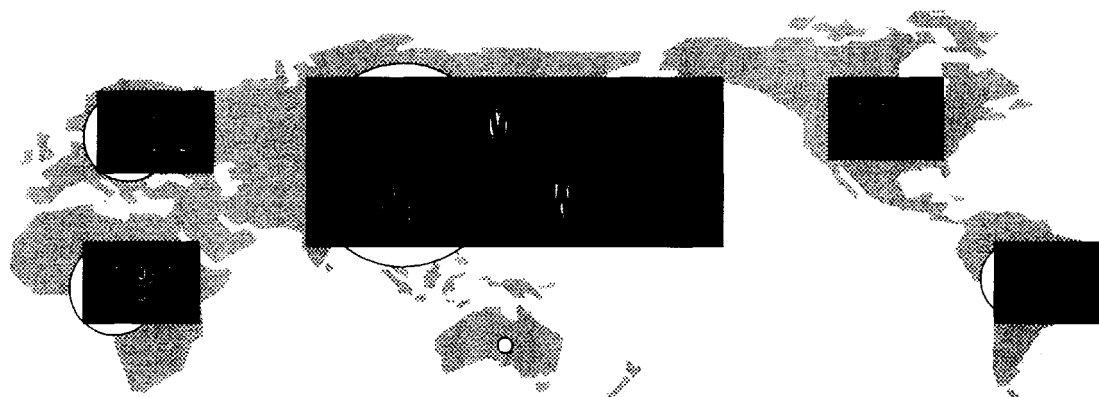


Power Generating Sources



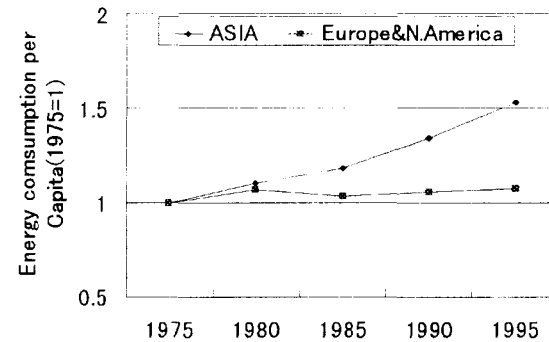
Asian Population

Source : UN World Population Prospects 1950 -> 2050

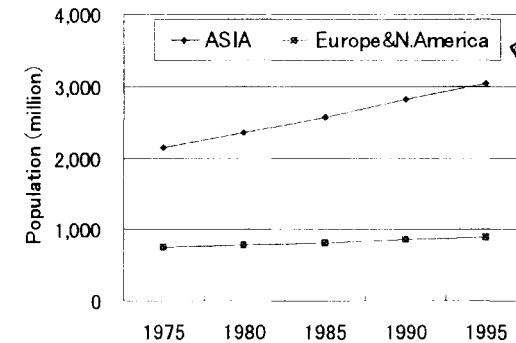


Change of TPES in Asia

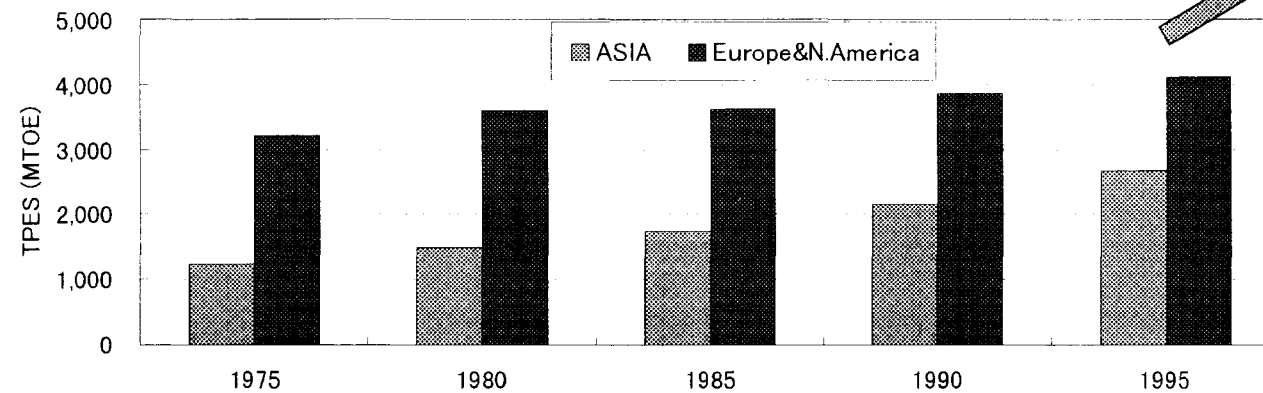
Energy Consumption per Capita



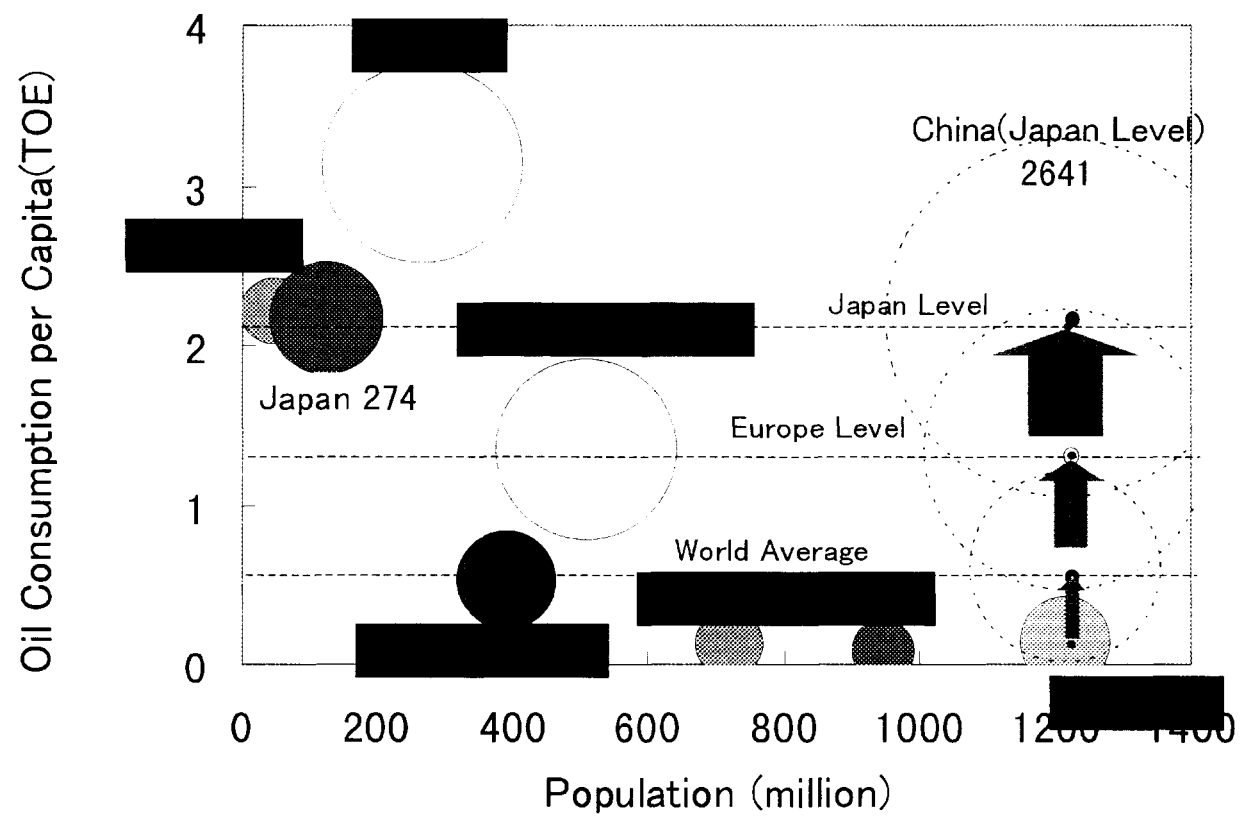
Population



Total Primary Energy Supply

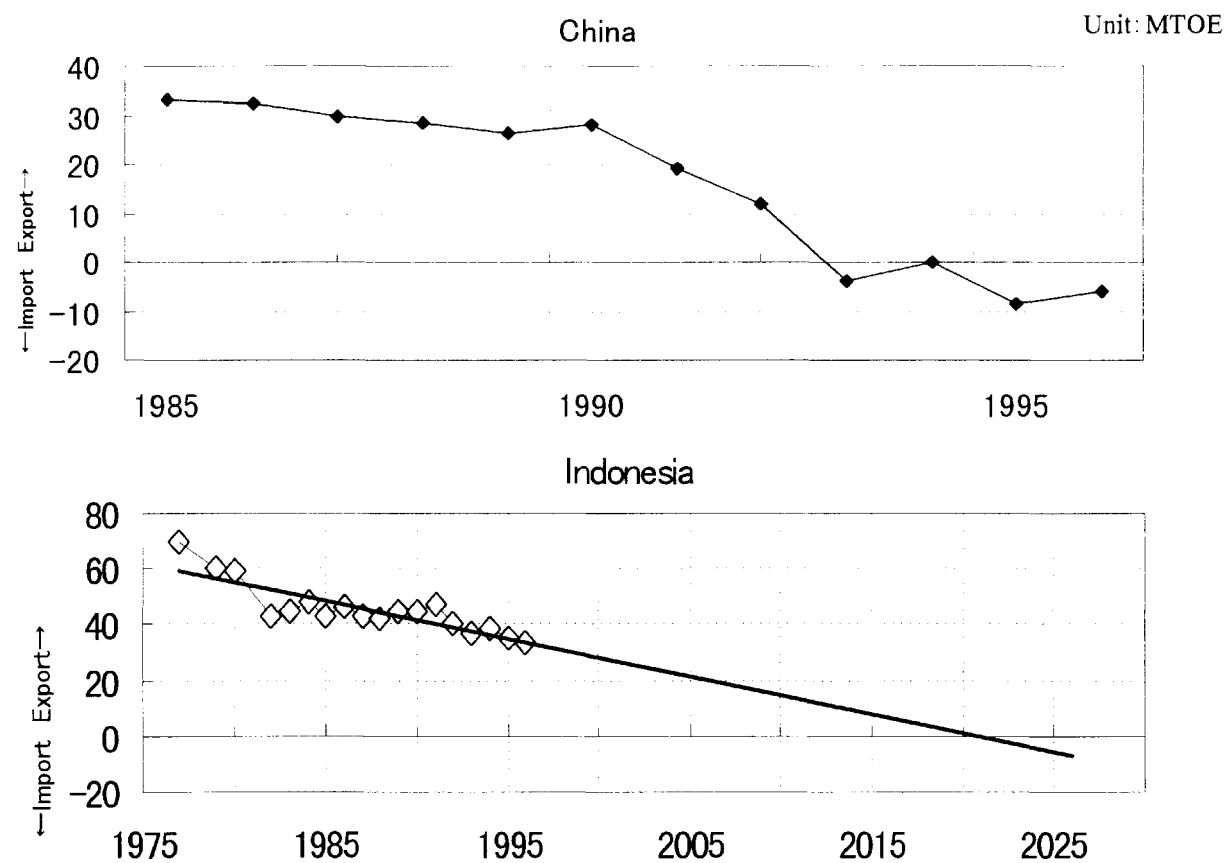


Population and Oil Consumption



Source : IEA Energy statics & Balances of OECD Countries 95-96
 IEA Energy statics & Balances of Non OECD Countries 95-96

Crude Oil Export and Import of China/Indonesia



Source : IEA Energy statics & Balances of Non OECD Countries 95-96

Coal Production and Reserves

Coal	Reserves (Million tonnes)	Production (Million tonnes /y)	R/P Ratio (Year)
China	114,500	1,375	83
USA	240,558	878	274
Former USSR	241,000	308	784
(World)	1,031,610	3,705	278

Reserves : 1995

Production : 1996

Source : MITI Energy Statistics 1997

Crude Oil Production and Reserves

Crude oil	Reserves (Million Barrels)	Production (1000Barrels/day)	R/P Ratio (Year)
China	24,000	3,210	20.5
Indonesia	4,979	1,380	9.9
Malaysia	3,900	645	16.6
Brunei	1,350	145	25.5
Saudi Arabia	259,000	7,900	89.8
Kuwait	94,000	1,825	141.1
(World)	972,559	61,123	43.6

Reserves : 1998

Production : 1997

Source : MITI Energy Statistics 1997

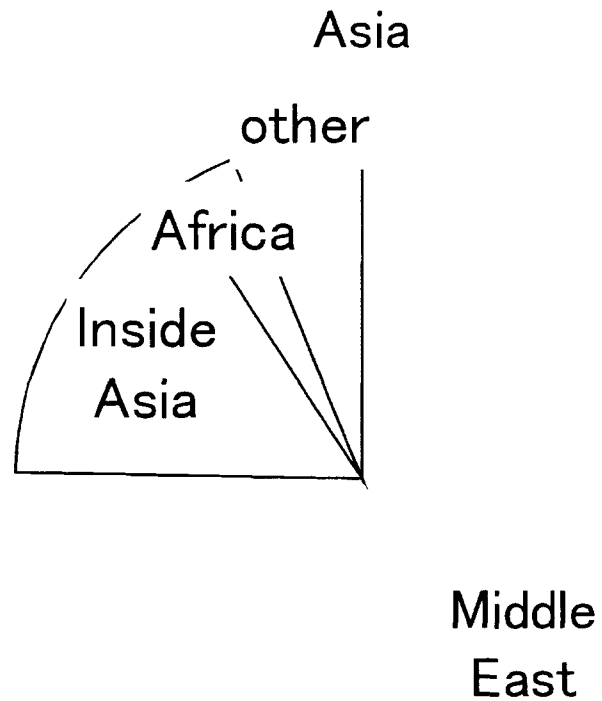
Natural Gas Production and Reserves

Natural Gas	Reserves (Billion cf)	Production (Billion cf/y)	R/P Ratio (Year)
Malaysia	80,200	910	88
Indonesia	72,268	2,283	32
Former USSR	1,977,000	25,754	77
Iran	741,609	1,163	638
(World)	4,945,362	8,261	60

Reserves : 1997
Production : 1996

Source : MITI Energy Statistics 1997

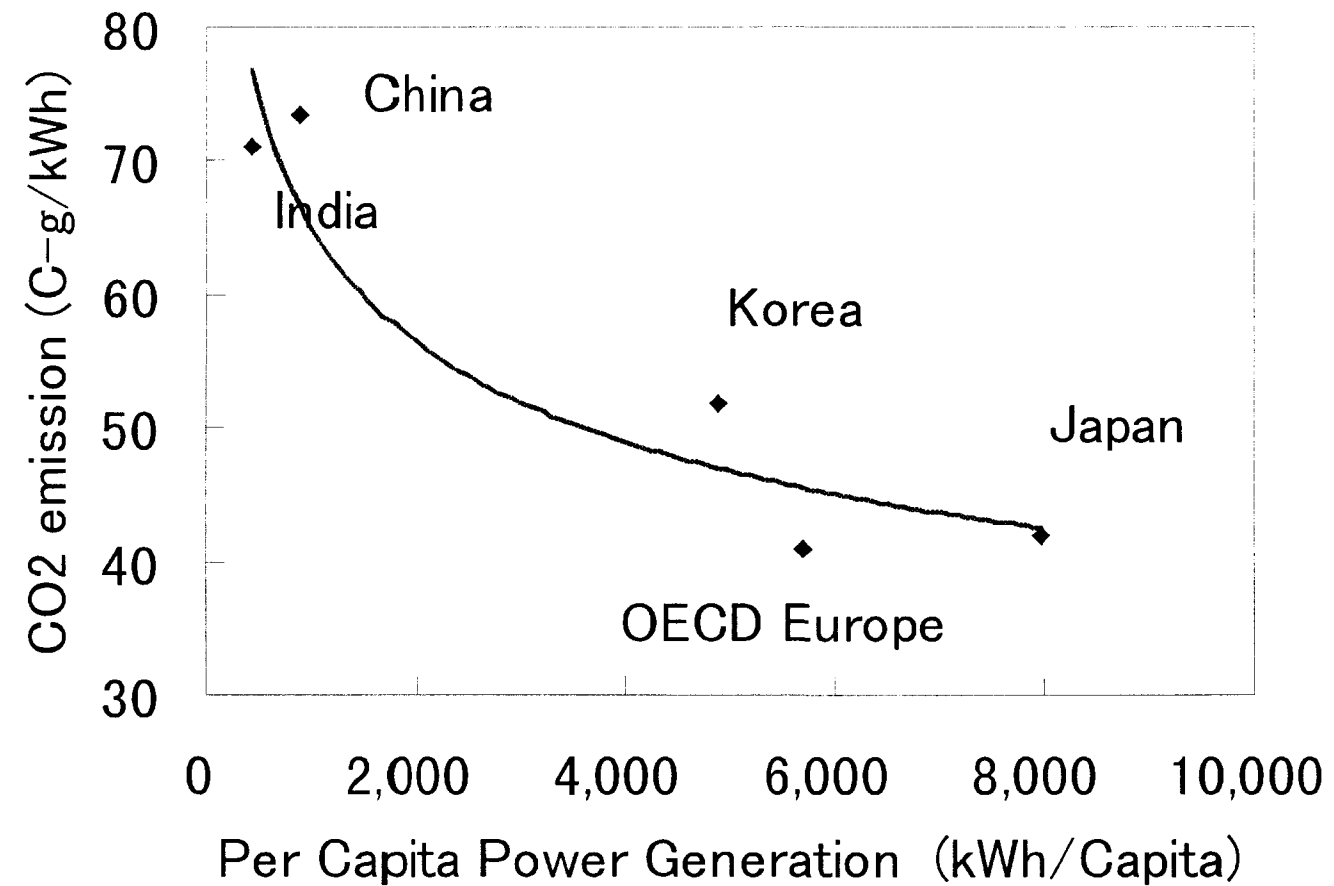
Dependency on Imported Oil



Source : BP Statical Review of World Energy 1996

Asia depends 75% oil on Middle East

CO₂ Emission by Power Generation per Capita



SUMMARY OF THE ASIAN ENERGY OUTLOOK

1. Share : in the world in energy consumption

Increase of per capita energy consumption

Population growth

leading to increase of the share of Asian countries in world's energy consumption

2. Dependence on countries other than Asian region

Low R/P in fossil

Increase in demand

leading to lower domestic supply in primary energy consumption

– China , Indonesia

– dependence on middle-east oil producing countries

3. Outcome

Financial burden of energy import

Emission of greenhouse gasses & air pollution

GENERIC COPING STRATEGIES

- a) Decrease of per capita energy consumption by improved efficiency of energy use
- b) Development of natural gas resources in this region and increase in the use of renewable energy, and
- c) Expansion of nuclear power generation.

INHERENT ADVANTAGE OF NUCLEAR POWER

1. High energy production / fuel mass

2. Waste

Reduced in volume and controlled (Management)

Repository pending on institutional issues and public acceptance

Essentially no emission of greenhouse gas

3. Reduced burden in transportation, Easy for storage

4. Environmentally benign

Essentially no release of radioactivity to the environment

Comparative risk study (EC, BNL etc.)

Fossil > renewable > gas, nuclear

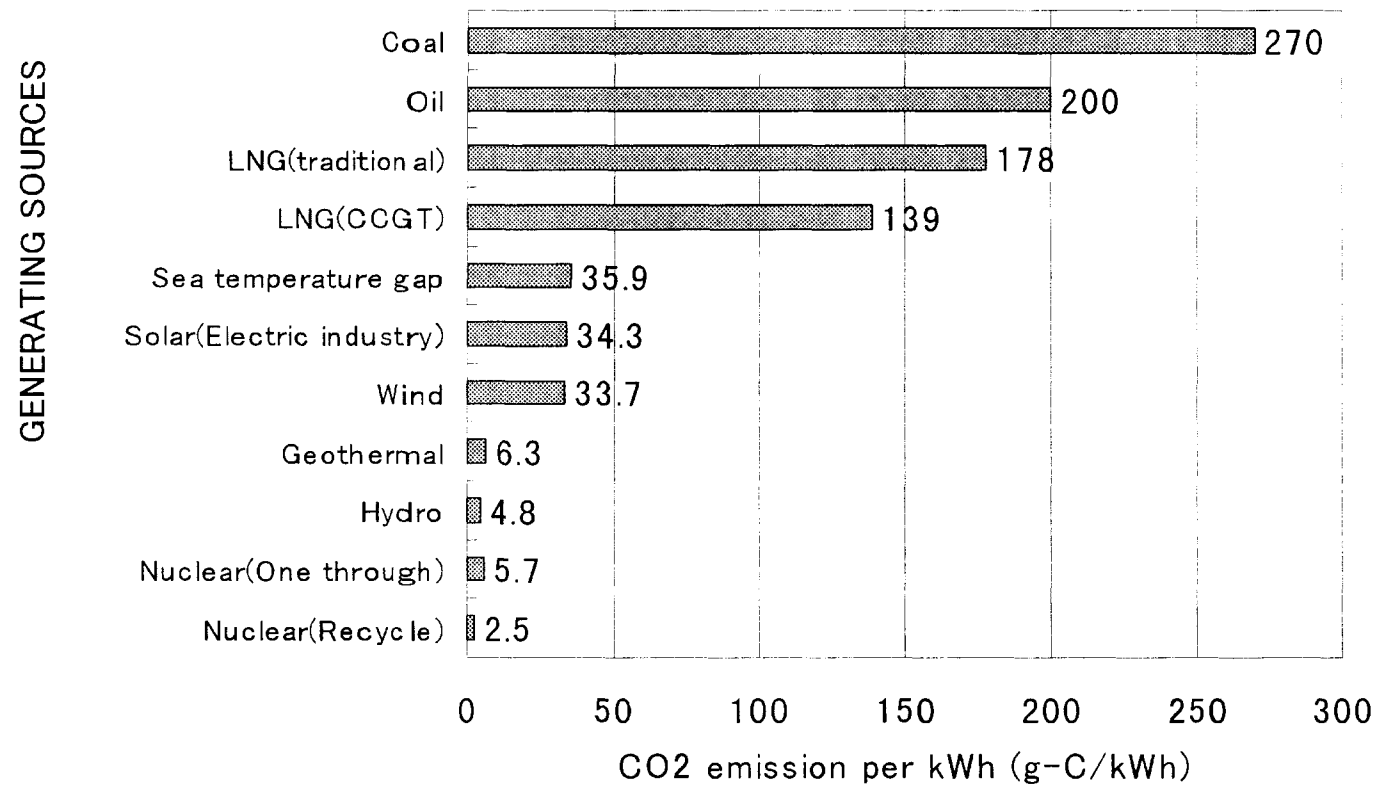
Analysis of external cost (ExternE, for instance)

5. Quasi-domestic energy source through recycle policy

Energy security , Bargaining power to fossil price

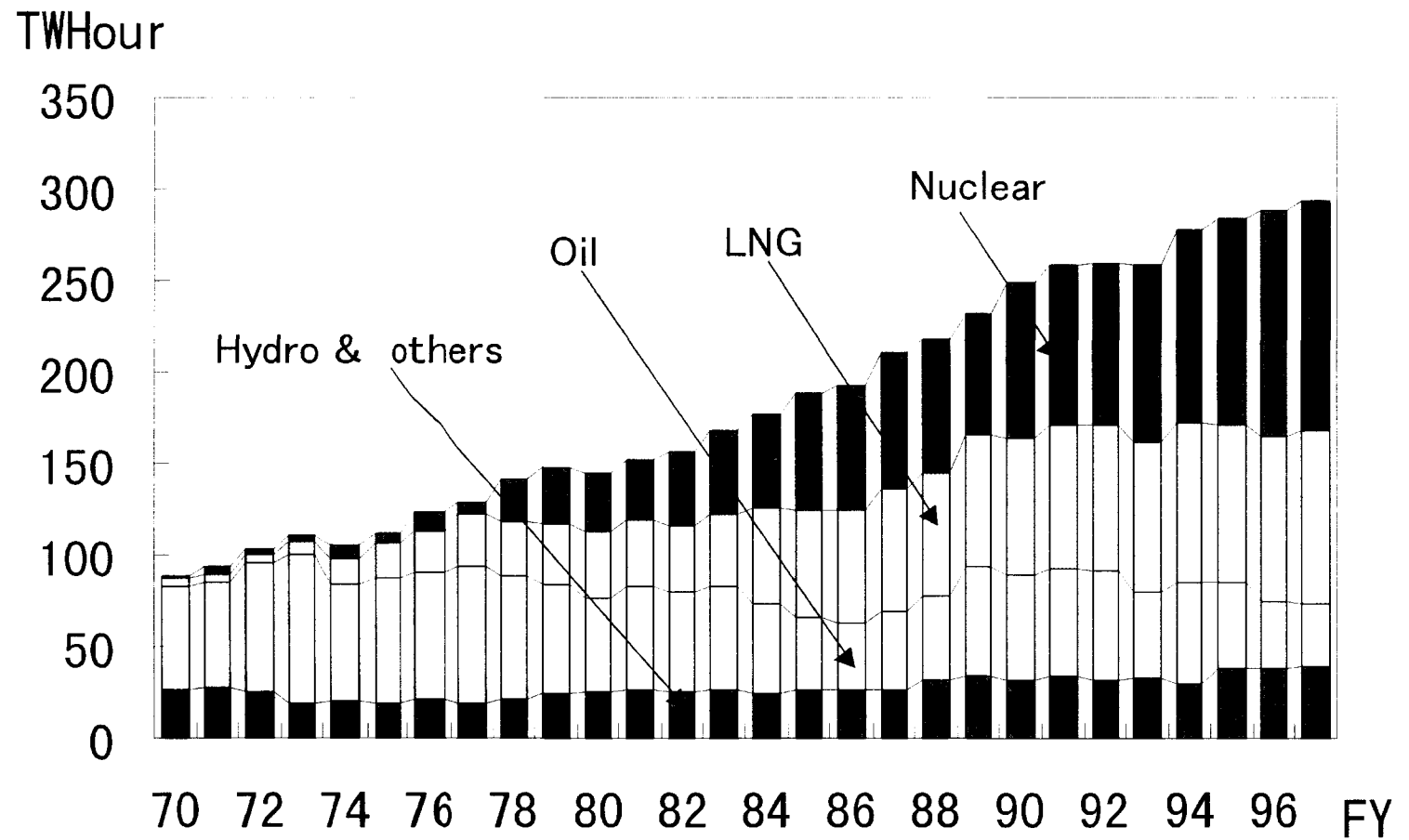
Use of Plutonium can extend R/P to 100 times as compared to LWR only use

Emission of Greenhouse Gas



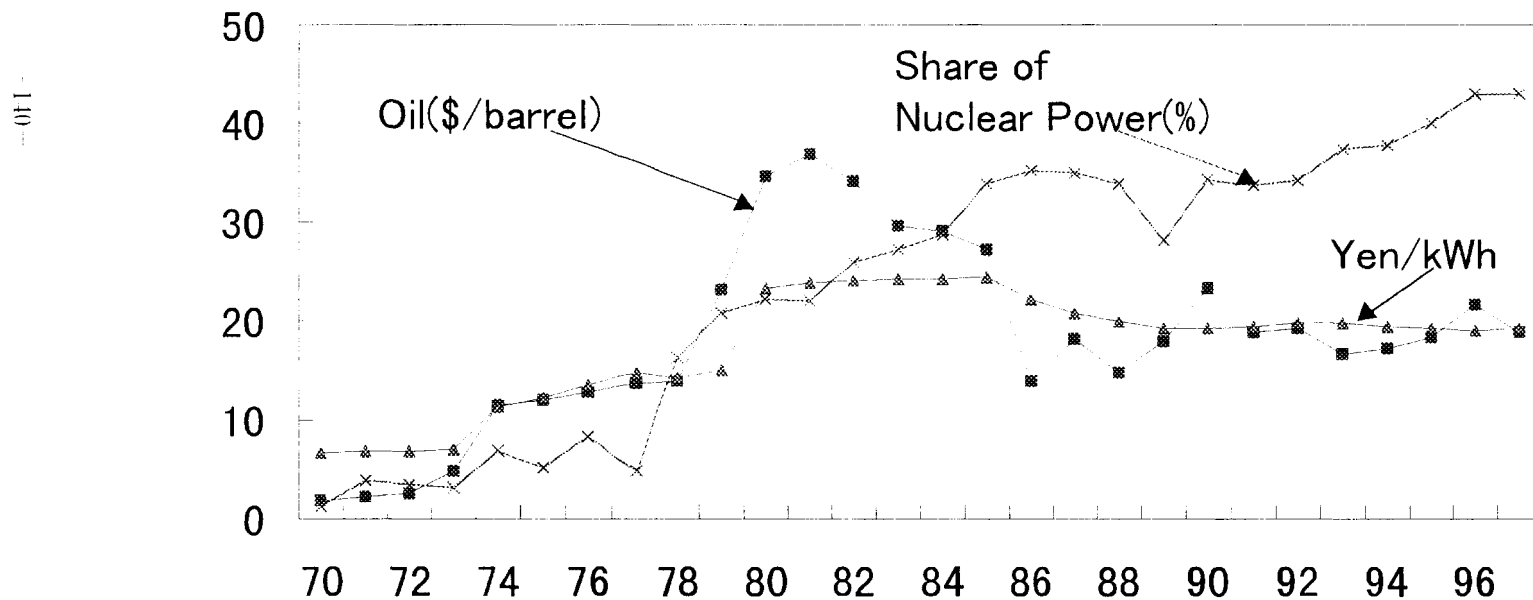
Source: Uchiyama, "Life cycle analysis of various power generating systems" (1995)

Diversification of Power Generating Sources(TEPCO)



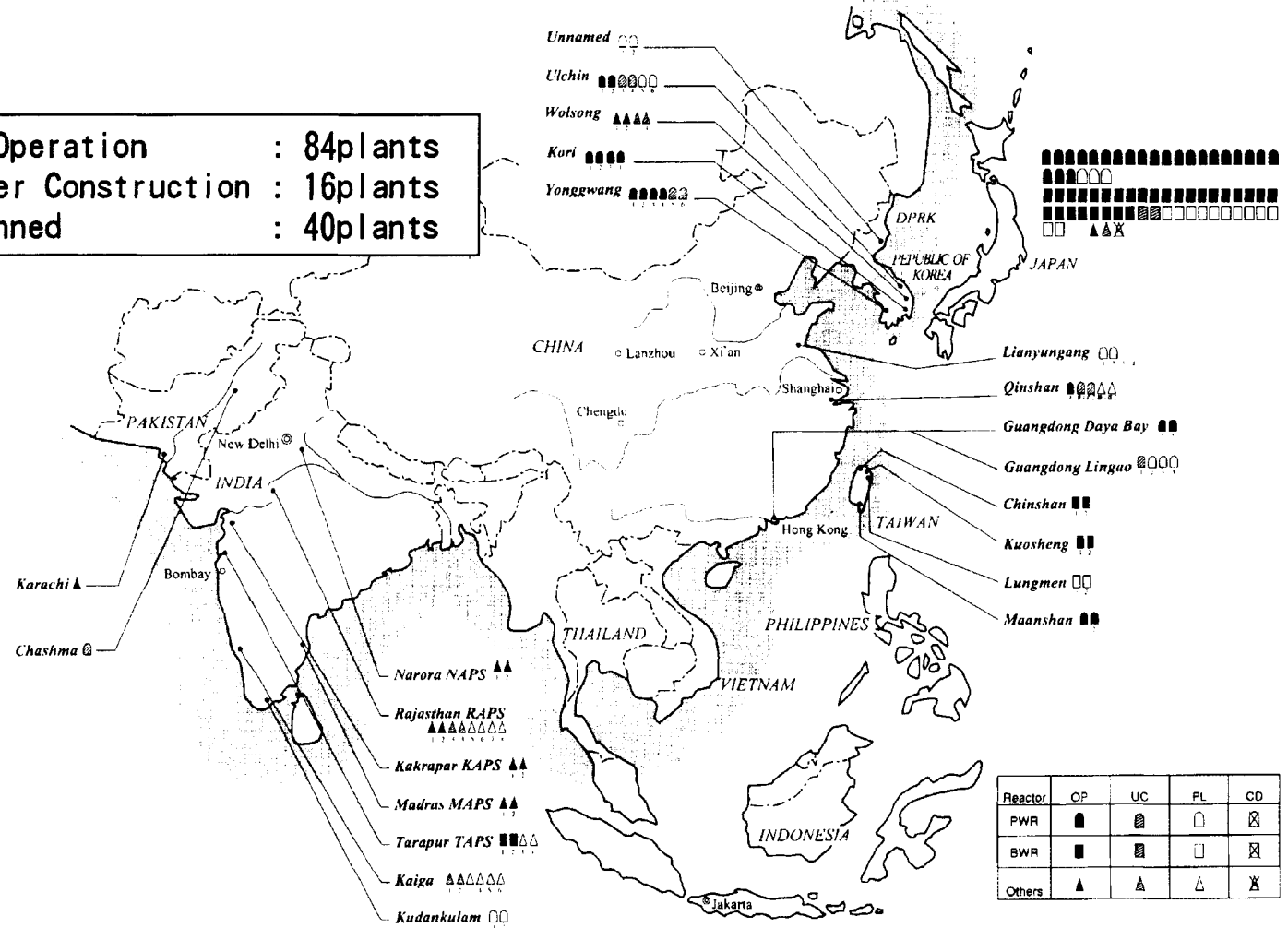
Contribute to Stabilize Electricity Rate (TEPCO)

- a) Reduced oil price
- b) Surge of yen in currency exchange
- c) nuclear power



Nuclear Power Plants in Asia

- In Operation : 84plants
- Under Construction : 16plants
- Planned : 40plants



Use of Nuclear energy for Methanol Synthesis

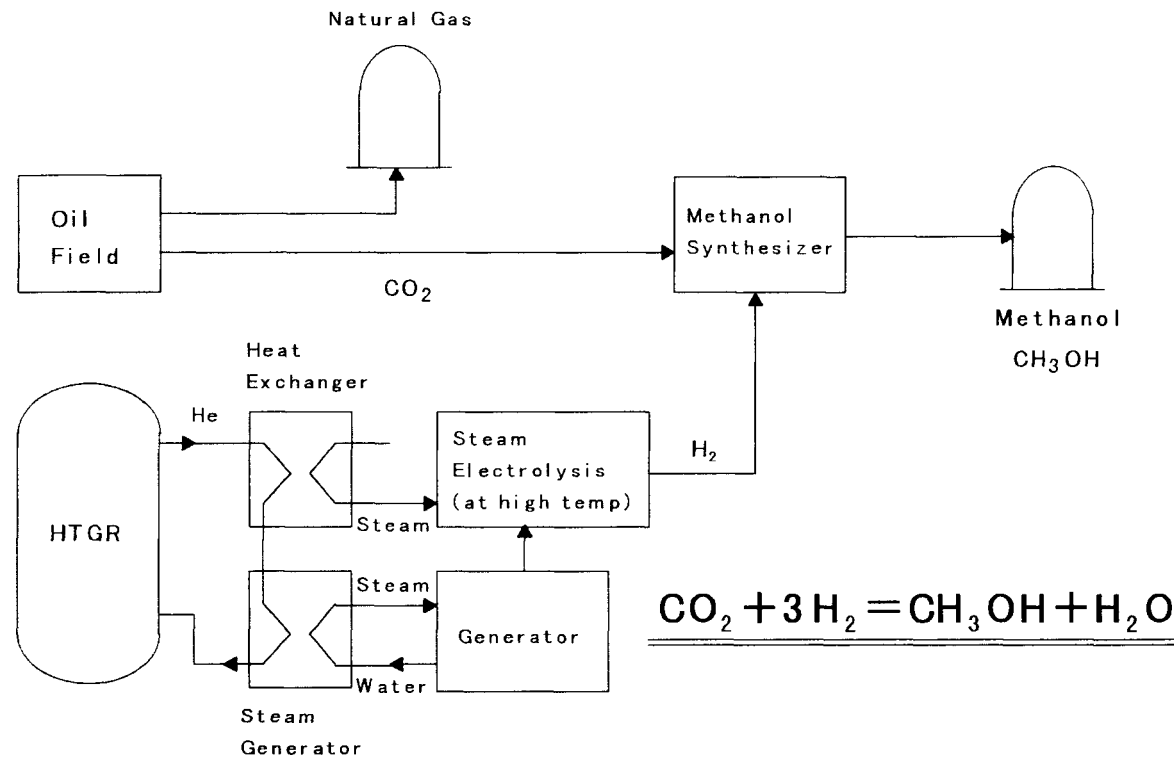
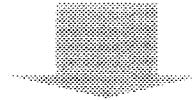


Figure : A Concept of use HTGR at Oil Field

(HGTR : High Temperature Gas Reactor)

PARADIGM SHIFT

- 1) UTILITY BUSINESS DEREGULATION
- 2) CCGT TECHNOLOGY INNOVATION
- 3) SOCIO-POLITICAL ELEMENTS

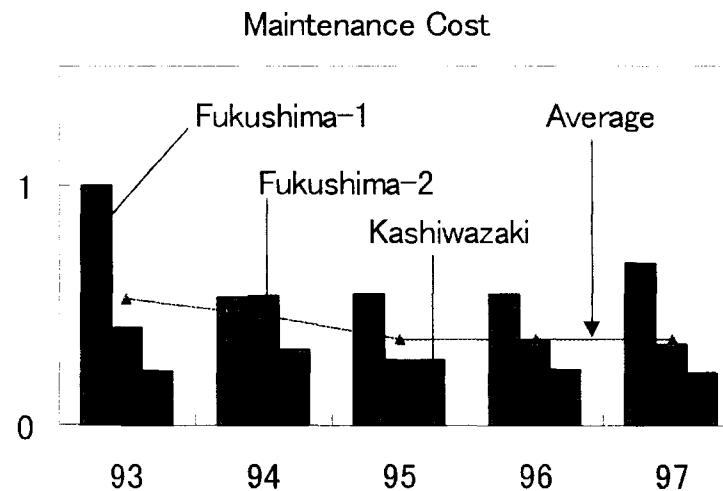


Utility focus on short-term economics/politics
rather than on energy policies
& environmental agenda

Nuclear Power in the Competitive Power Market

TEPCO's coping strategy for nuclear to remain competitive

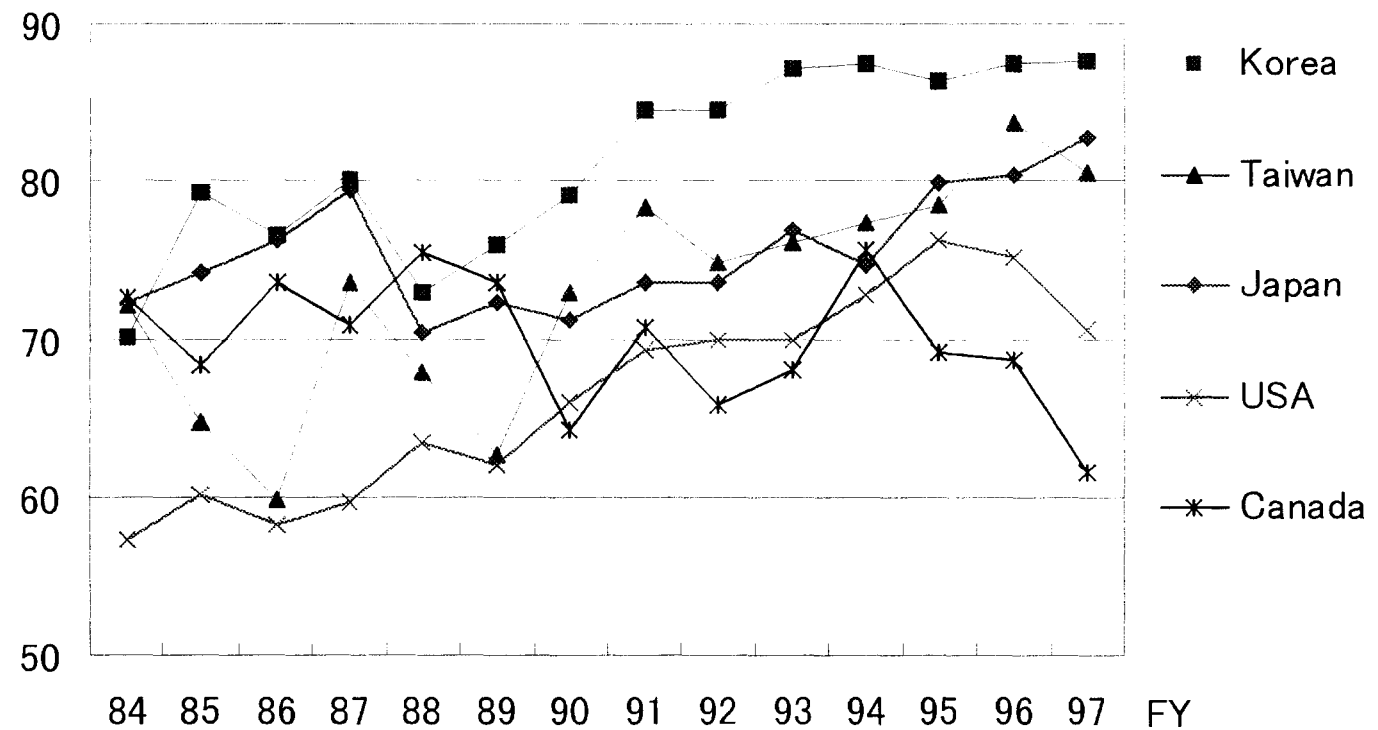
- a) Existing plants (depreciated) reduces fuel cost, short outage
- b) target for Next Plant Investment Level in TEPCO :
competitive power generating price with most advanced CCGT
- c) Next generation BWR plant design activities
 - ABWR 1.00 → ABWR-II (1500Mwe) 0.85 (relative PG cost)
 - ABWR-II (1700Mwe) 0.70 (relative PG cost)



Operational Performance

Availability [%]

-Pacific-rim nations-

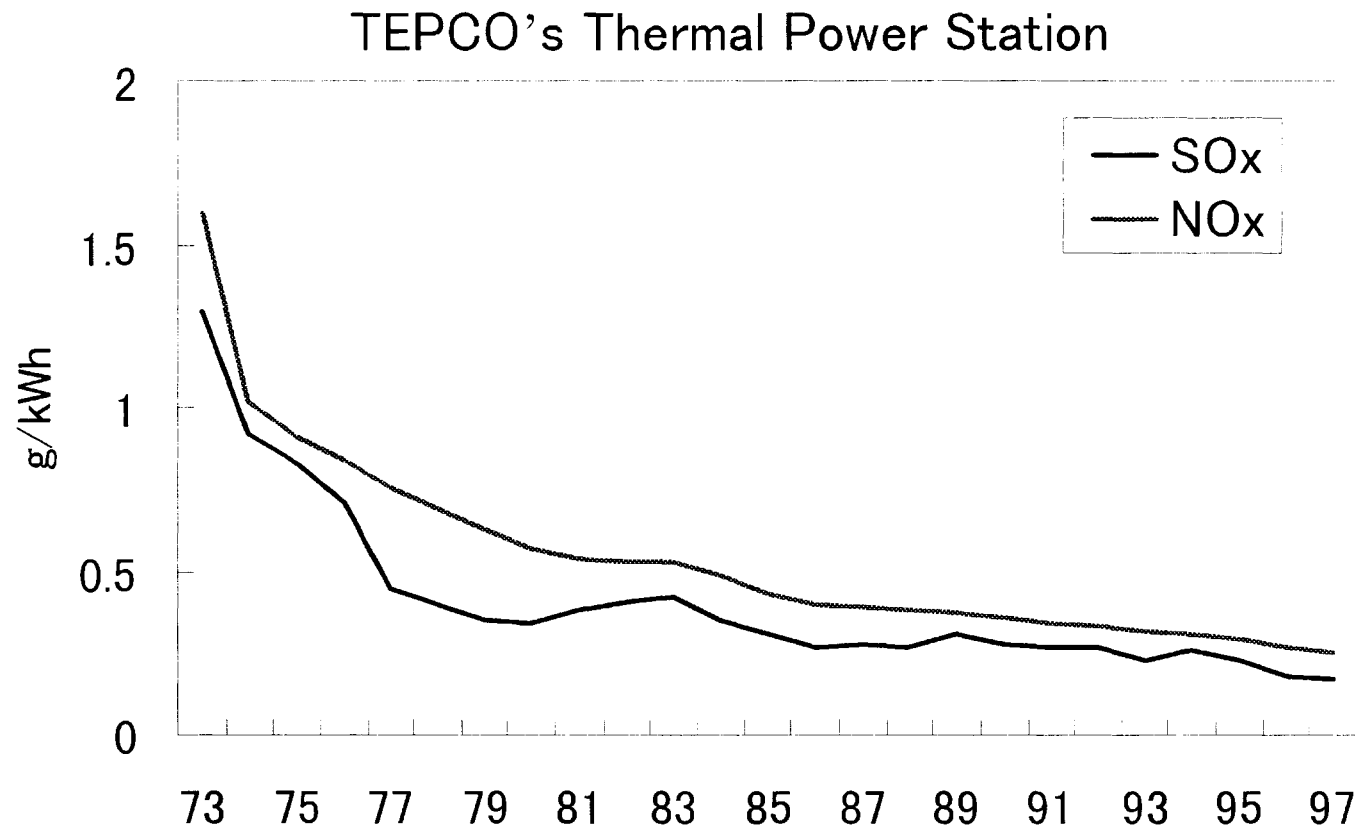


(source : MITI Nuclear Power Station Operation annual report.)

Cooperation in Nuclear Power Generation

- Technical cooperation in
 - plant construction technique
 - design engineering
 - operation & maintenance
 - waste treatment & disposal

Change of SO_x NO_x Emission Rates



Source : TEPCO ILLUSTRATED 1998

CONCLUSIONS

1. Economically vibrant and environmentally whole future Asia will need :
 - energy with environmentally benign nature
 - energy affordable without depending much on foreign countries
2. Inherent advantage of nuclear energy in meeting future energy agenda
3. Cooperative programs for peaceful use of nuclear power energy among Asian neighboring countries

Regulatory Reforms of the Electricity Supply Industry in the Asia-Pacific

Masayuki Yajima, Ph.D.
Associate Vice President
Central Research Institute
of Electric Power Industry

First, we take a short look at deregulation development of the ESI in the Asia-Pacific. Japan has liberalized the generation market since 1996, and further regulatory reforms to open the retail market is under way in the governmental committee. Other Asian countries are privatizing the state-owned electric utilities and allowing IPPs to enter into the generation market. California and Massachusetts in the U.S. introduced full-scale retail competition in 1998, and other states are following this trend. Australia, Chile, and New Zealand have already liberalized the generation and retail markets along with the privatization of the ESI in Chile and Victoria in Australia.

Along with these regulatory reforms, California, Australia, New Zealand, and Chile established a power exchange accompanied by complete vertical disintegration of the ESI. As backgrounds common to these structural changes, it can be pointed out: strong demand growth and capital shortage in case of privatization and allowing IPPs to enter into the generation market, and efficiency improvement of the ESI by introducing of thoroughgoing competition in case of full liberalization of both markets in generation and retail supply accompanied by vertical disintegration.

Based on the investigation of regulatory reforms in each selected country/region, interregional comparisons are conducted with respect to the characteristics of the regulatory reforms. And ,then, further possible liberalization of power markets are considered. Finally, some issues in relation with regulatory reforms of the ESI, especially in case of Japan, are mentioned.

Regulatory Reforms of the Electricity Supply Industry in the Asia-Pacific

電力部門における規制緩和とその問題点

Central Research Institute of Electric Power Industry

電力中央研究所

Associate Vice President

研究参事

Masayuki Yajima, Ph. D.

矢島 正之

Contents

内 容

- ・ Regulatory Reforms in the ESI of the Asia-Pacific Region

アジア太平洋地域における電力規制緩和の実態

- 日本, その他アジア, 豪州 (オーストラリア, ニュージーランド), 南米 (チリー), 北米
- Japan, Other Asian Countries, Australia, New Zealand, Chile, U.S.

- ・ Interregional Comparisons

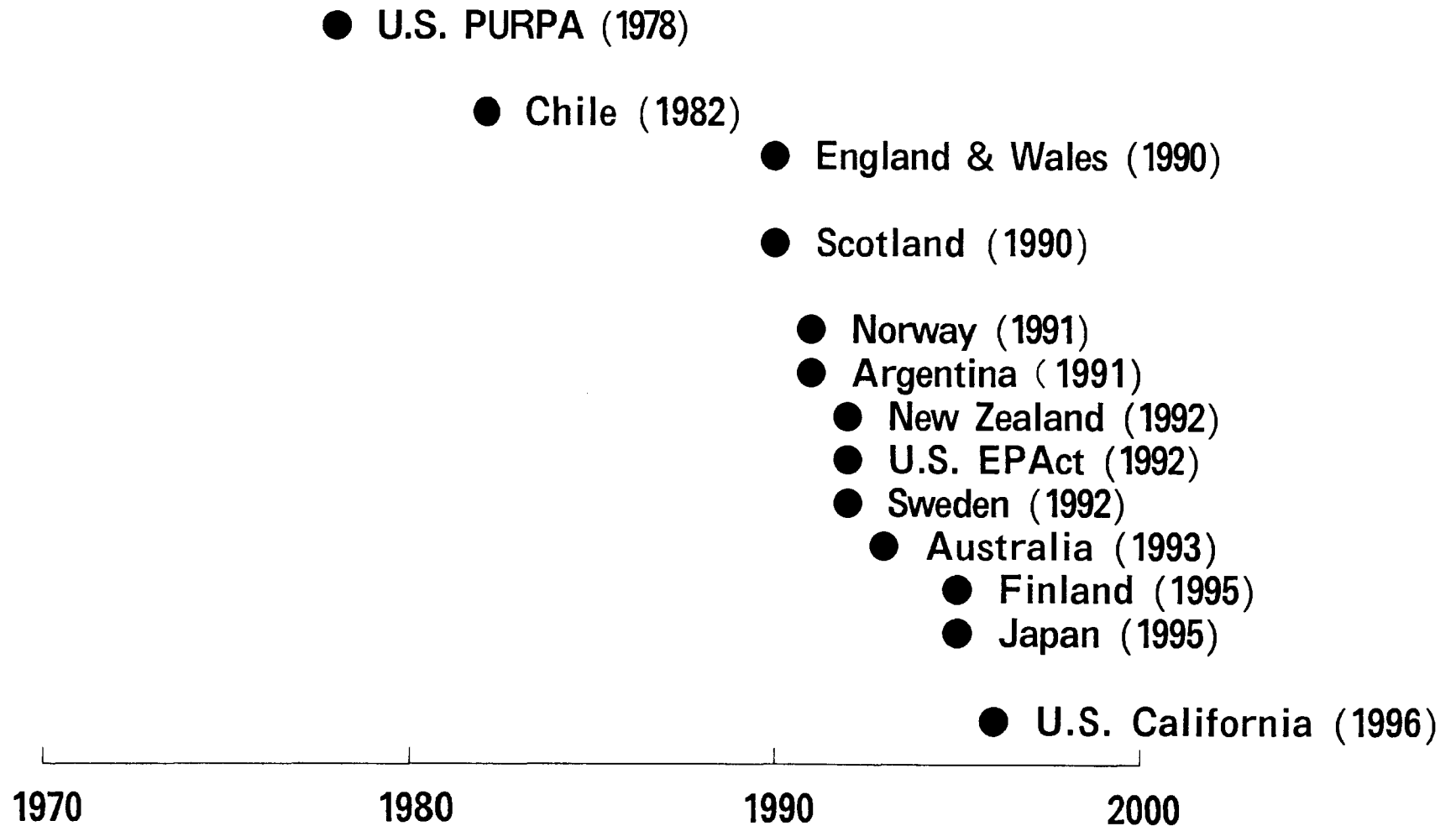
地域間の相互比較

- Characteristics of Regulatory Reforms in the ESI in Each Region
- 各地域における規制緩和モデルの特徴点

- ・ Further Deregulatory Steps in Asia

アジア地域の今後の展望

Global Tendency toward Deregulation of the ESI 電力市場自由化の潮流



Regulatory Reform in the ESI of the Asia-Pacific Region

— Overview —

電力規制緩和の実態 — 概 観

Region 地 域	Privatiza- tion 民 営 化	Liberalization 市場自由化		Backgrounds 背 景
		Generation 発 電	Retail Supply 小 売	
Japan 日 本		Yes 有	Yes (Partially) 有 (一部)	High Utility Rates by International Comparison 中長期的需給逼迫と内外価格差
Other Asian Countries その他アジア	Yes 民 営 化	Yes (Partially) 有 (一部)		Strong Demand Growth and Capital Shortage 需要の増大と資金不足
U.S. 米 国		Yes 有	Yes 有	Introduction of Thorough Competition and Increasing Efficiency in the ESI 徹底した競争導入と事業の効率化
Chile 南米(チリー)	Yes 民 営 化	Yes 有	Yes 有	
Australia New Zealand 豪 州	Yes (Partially) 民 営 化	Yes 有	Yes 有	

Japan

日本の電力規制緩和

Report of the Committee on Basic Policy of the Electric Utility Industry Council (Jan. 21, 1999)

電気事業審議会基本政策部会報告（1999年1月21日）

- ・ Partial Liberalization of the Retail Market

部分自由化

→ Liberalization of the Grid: >20,000V

系統開放：2万V特別高圧系統以上

- ・ Eligible Customers: >2,000kW: Ultra-High-Voltage

有資格需要家：2,000kW以上の需要家

- ・ Characteristics of Supply to Eligible Customers: 28% of Total Consumption

自由化部門の需要家への供給のあり方

→ No Supply Obligation, No Price Regulation, No Special Conditions for Entry

供給義務・料金規制・参入規制は課さない。

- ・ Last Resort by Incumbent Utilities(Notification of Tariffs, Reservation of Rights to Order Changes of Conditions)

交渉不成立・戻需要家に対する電力会社による最終保障（料金届出制，行政による変更命令権の留保）

Japan

日本の電力規制緩和

**Report of the Committee on Basic Policy of the
Electric Utility Industry Council (Jan. 21, 1999)**

電気事業審議会基本政策部会報告（1999年1月21日）

- ・ Retail Wheeling: Priority Given to Negotiation
(Notification of Wheeling Conditions, Reservation
of Rights to Order Changes of Conditions)**

**託送は当事者間交渉優先・事後規制（約款届出制,
行政による変更命令権の留保）**

- ・ Voluntary Publication of Standard Tariff Menus
and Backup Tariffs by Utilities**

**有資格需要家への標準的料金メニュー・バックアップ
料金のメニューは電気事業者による自主的公表**

J a p a n

日本の電力規制緩和

Report of Committee on Basic Policy of the Electric
Utility Industry Council (Jan. 21, 1999)– Continued
電気事業審議会基本政策部会報告(1999年1月21日)(続)

- ・ Prevention of Cross-Subsidization

└ 内部補助防止の仕組み

→ Appropriate Allocation of Total Costs into
the Competitive Sector and Regulated Sector
at the Rate Review

料金改定時に全体の費用を自由化部門と規制部門
に適切に配分

- ・ Confirmation of the Appropriateness of Cost
Allocation by the Neutral Third Party at the
End of the Accounting Period

各期末の結果は中立的な第三者が確認

- ・ Compatibility with Public Service Obligations–
Energy Security, Environmental Protection,
Reliability, Universal Service

公益的課題（エネルギー・セキュリティ、環境、供給
信頼度、ユニバーサル・サービス）との両立

- ・ Review of the Implementation

└ 成果の検証

→ Within 3 Years After Implementation of the
Initial Liberalization

制度開始後概ね3年目途

Other Asian Countries

— Backgrounds —

その他アジアの電力規制緩和

— 背景 —

Asia アジア

- ・ Strong Demand Growth
旺盛な電力需要
- ・ Capital Shortage
資金不足
- ・ Liberalization of Generation Markets by Introduction of IPPs
Privatization of State-Owned Electric Utilities
IPPの導入による発電市場の自由化・国有企業の民営化
- ・ Strong Business Opportunities in Asian Markets
アジアのIPP市場
- ・ 387GW of IPP Markets at Operation/Construction/Planning Stages
運転中・建設中・計画中の合計：387GW, 世界に占めるシェア約6割

Europe and U.S. 欧米

- ・ Low Demand Growth → 需要の低成長
- ・ Thorough Competition
競争激化
- ・ IPP Activities in Asia, Latin America etc.
アジア, ラテン・アメリカでIPPビジネス
- ・ More than Half of the Share Dominated by U.S. IPPs
アジアでは半数以上が米国企業

Other Asian Countries

その他アジアの電力規制緩和

— Corporate Restructuring —

— 再編と一層の競争導入 —

- Vertical Distintegration to Improve Management

Efficiency

経営効率化の観点から垂直統合の分離を実施・計画する
ケースが多い

- • Indonesia, Thailand, Malaysia, Korea
インドネシア，タイ，マレーシア，韓国など
- Former State-Owned Electric Utilities Remain
as Single Buyers and Single Sellers at Least
at the Transitional Stage and Competition is
Limited, in Principle, to New Capacity
当面は，旧国有電力会社の独占的地位は存続し，
競争導入は新規電源に限定
- In Thailand, Korea etc. Retail Competition
Is Planned to Be Introduced in the Long-Term.
ただし，タイや韓国などでは長期的には小売自由
化を実現

Australia

オーストラリア

- ・ Vertical Disintegration in NSW, VIC, QLD, SA
NSW, VIC, QLD, SAにおける発・送・配電の垂直統合の完全分離
- ・ Introduction of Mandatory Pool in NSW and VIC
NSWとVICにおける強制プールの導入
- ・ Privatization of Generation and Distribution Companies in VIC
VICにおける発電・配電会社の民営化
- ・ National Market Established Among NSW, VIC, and Australian Capital Territory in 1997
全国大での電力プールがNSW, VIC, 首都部間で1997年発足
- ・ Complete Retail Competition Around the Year 2000
2000年頃に小売の完全自由化

New Zealand

ニュージーランド

- **Separation of ECNZ into Generation (ECNZ) and Transmission (Trans Power) – 1990**
ECNZの発電（ECNZ）と送電（Trans Power）への分割（1990年）
- **Separation of ECNZ into New ECNZ and Contact– 1996**
ECNZのECNZとContactへの分割（1996年）
- **Full Competition in Retail Supply**
小売の完全自由化（同）
- **Introduction of Voluntary Pool**
非強制プールの導入（同）
- **Separation of ECNZ into 3 Generation Companies–
New Electricity Law of 1998**
ECNZを3社に分割（1998年電力再編法）
- **Separation of Distribution and Retail Supply**
発電と小売供給の完全分離（同）

North and South America

北米・中南米の電力規制緩和

Chile

チリー

- ・ Separation of State-Owned Electric Utilities, Endesa and Chilectra, and Privatization
二大国有電力会社 (Endesa, Chilectra) の分割・民営化
- ・ Vertical Distingration into Generation, Transmission, and Distribution
発・送・配電の垂直統合の完全分離
- ・ Generators' Cooperative Pool
発電事業者の協調的プール
- ・ Introduction of Retail Competition (>2MW)
小売りの自由化 (>2MW)

California

カリフォルニア

- ・ Introduction of Full Competition in Retail Supply in 1998
1998年より小売りの完全自由化
- ・ Establishment of Voluntary Pool and Introduction of ISO and PX in 1998
非強制プール設立

U . S . 米国の電力規制緩和

Common Features of Retail Competition in Each State

小売り自由化の共通した特徴点

- Direct Access for All Customers
最終的に全需要家を対象にダイレクト・アクセス導入
- Functional Unbundling (in Some Cases, Corporate Unbundling)
垂直統合の分離
- Establishment of ISO/PX
ISO／PXの設立
- Introduction of Incentive Regulations
インセンティブ規制の採用
- Rate Freeze/Reduction for Domestic Customers
住宅用需要家に対する料金引き下げ又は凍結
- Recovery of (Full or Partial) Stranded Costs
回収不能コストの（全体又は部分的）回収の承認
- Recovery of Costs for Public Policy Objectives
公共的プログラムのための費用回収の承認
- Protection of Customers (Obligation to Connect, Standard Offer, Default Service etc.)
需要家保護に関する規程の設定

Interregional Comparisons
 — Degree of Competitive Opening —
 地域間の相互比較
 — 競争導入の程度 —

Degree of Competitive Opening 競争導入の程度		Countries 国
Generation 発電	Retail Supply 小売供給	
Yes 導入	All 全ての需要家	California (U.S.) 米・カリフォルニア (1998～) New Zealand ニュージーランド (1996～) Australia オーストラリア (2000前後～)
Yes 導入	Yes, Limited 大口需要家	Chile チリ — Japan 日本 (2000～)
New Capacity Only 新規電源のみに導入	No 無	Other Asian Countries その他アジア

Interregional Comparisons
 — Application of Deregulation Models —
地域間の相互比較
 — 市場自由化モデルの適用状況 —

Deregulation Models 市場自由化モデル		Countries 適用国
Competitive Procurement of New Capacity (e.g. Competitive Bidding for New Capacity) 電源の競争的調達（競争入札）		Asian Countries アジア
Competitive Bidding with Limited Retail Wheeling 競争入札＋小売託送		Japan 日本
プ ー ル	Mandatory Pool with Retail Wheeling (Distribution) 強制＋小売託送（配電レベル）	Australia オーストラリア
	Voluntary Pool with Retail Wheeling 非強制＋小売託送	New Zealand ニュージーランド California (U.S.) 米・カリフォルニア
	Generators' Cooperative Pool with Limited Retail Wheeling 発電事業者の協調的プール＋ （限定的）小売託送	Chile チリ

Interregional Comparisons — Vertical Disintegration — 地域間の相互比較 — 垂直統合の分離 —

Separation of Grids ネットワークの分離		countries 国
Transmission 送電	Distribution 配電	
Corporate Unbundling 分 離	Corporate Unbundling 分 離	New Zealand ニュージーランド
Corporate Unbundling 分 離	Functional Unbundling アンバンドリング	Australia オーストラリア
Corporate Unbundling 分 離	Bundled with Supply 統 合	Chile チ リ
Functional Unbundling アンバンドリング	Bundled with Supply 統 合	U.S. 米 国
Bundled with Supply 統 合	Bundled with Supply 統 合	Japan 日 本

注) 分離は所有関係の分離, アンバンドリングは会計上・部門別分離を意味する。

Future Deregulatory Steps in Asia アジア地域の今後の展望

- ・ Deregulatory Development in World-wide Economy
経済のグローバル化と世界的な規制緩和の動向の中で競争
圧力の一層の高まり
- ・ Increased Pressure to Enhance Management Efficiency
一層の競争の導入

⇒ ・ Impact on Environment

└ 環境への影響

- └ Bias Toward Fossil-Fuel Generation
化石燃料を使用する電源への片寄り
- ・ Reduction of Incentives for DSM due to Vertical
Distintegration
垂直統合分離によるDSMインセンティブの削減
- ・ Role of Government in Hamonizing Introduction
of Competition with Environmental Protection
競争と環境との調和のための政府の役割はこれまで
以上に重要

⇒ ・ Impact on Energy Security

└ エネルギー・セキュリティへの影響

- └ Bias Toward Less Capital-Intensive Generation
非資本集約的・短期的に経済的な電源への片寄り
- ・ Harmonization of the Introduction of Competition
with Energy Security in Countries with Scarce
Energy Resources
需要の伸びが旺盛で資源をもたない国におけるエ
ネルギー・セキュリティ確保が最大の課題

SPEC'99
Symposium on Pacific Energy Cooperation
Tokyo, Japan
Session Three, February 17, 1999, 9:30-11:30, "Deregulation of the
Energy Sector in the Asia-Pacific Region"

Deregulation in an Asian Context
By Karim Garcia

Outline

Summary:

The Asian crisis has increased the urgency of energy deregulation and privatization. We have learned that the approach of opening markets piecemeal does not work. Beginning in the late 1980s, the Philippines and Malaysia, followed by Thailand, Indonesia, and more recently South Korea and Japan have introduced IPPs (independent power producers). But in each case, state power monopolies maintained control of pricing, transmission, and distribution. Indonesia was the worst case. Financing of the IPPs was linked to long-term supply contracts that had to be abandoned after the rupiah plunged by 80 percent. But the Indonesian lesson applies to other markets as well. Transmission, generation, and distribution should be unbundled. The state does not have to disappear from the picture, but its role must be transformed. We should apply the lessons learned from our mistakes in the power sector to natural gas, which remains a weak link in the Asian energy chain. Asia accounts for 20 percent of the world's natural gas trade but less than ten percent of its consumption. State monopolies have provided significant blockage to the development of Asian infrastructure. In both power and natural gas sectors, we should learn from the experience of others in the APEC community, particularly Latin American economies for which the process of deregulation began with a devastating financial shock.

- I. Learning from neighbors: The "Southern Cone" model in power deregulation
 - Pioneered by Chile in 1980, with unbundling of power sector and privatization of state utilities by 1989
 - Use of central dispatch and clearing system (a "pool")
 - Basic principles outlined early, privatization conducted gradually
 - Benefits included active entry by new generators, improved supply, lower prices
- II. Bite the bullet: Time for the state monopolies to accept change

- Napacor's woes: 3 billion peso debt in 1998; highest power prices in Asia after Japan; long-term supply contracts with IPPs.
- KEPCO's dilemma: High cost of refinancing debt; subsidized power rates squeezing margins; inflexible labor union resisting change.
- EGAT's difficulties: Poor management; high prices; capacity cutbacks.
- PLN's shame: Opaque, corruption prone process of granting IPPs under Suharto regime; unsustainable low electricity prices; long-term supply contracts with IPPs priced in dollars; virtual bankruptcy of national power authority.
- Each problem is different, and solutions will be different, but each situation points to the inadequacy of an IPP approach when not coupled with flexible pricing through a pool or other market-based system.
- The Philippines, Korea, Indonesia, and Thailand are all speeding up energy reform in response to the crisis, a good thing although each faces major political issues in pushing reforms through. The need for foreign capital has helped to spur change.

III. Re-inventing the Asian model: Let energy take the lead

- The Asian "approach" to growth has been to put international sectors of our economies on a fast track. But piecemeal internationalization may lead to huge problems, when domestic markets are dominated by monopolies or cartels.
- Asian economies have grown strong through close collaboration between business and government. This is a great strength, but we should take advantage of it in a new context. We should charge government with the role of setting the rules of the game, and keeping the players honest.
- Liberalization of the energy sector has been shown to have major benefits to the real economy. Economies that free their energy sectors will establish new standards of productivity. Asia should not have to play this catch up game when it has the opportunity to conduct reforms now.

New Energy Development and Utilization
and its Relation to the Global Environment

Shuichi TSUNODA

Director General

Policy Planning Dept.

New Energy and Industrial Technology

Development Organization (NEDO)

1. Background and Status of New Energy Technology Development in Japan
 - 1) Energy Situation in Japan and the Establishment of NEDO
 - 2) Long-term Energy Outlook and New Energy Introduction in Japan
 - 3) Global Environment
2. NEDO's R&D Projects on New Energy and Energy Conservation
 - 1) Photovoltaic Power Generation
 - 2) Wind Power Generation
 - 3) Coal Liquefaction and Gasification
 - 4) Geothermal Power Generation
 - 5) Waste Power Generation
 - 6) Fuel Cells
3. NEDO's International Cooperation Projects in Asia
 - 1) Model Projects for Energy Conservation
 - 2) Model Projects for Clean Coal Technology
 - 3) Cooperative Demonstration Projects
 - 4) Cooperative Research Projects
4. Future Development and Global Environment Issues
 - 1) NEDO's New Projects in Asia
 - 2) Contribution to Environmental Protection

新エネルギーの開発利用と地球環境について

新エネルギー産業技術総合開発機構

企画部長 角田 周一

1. 新エネルギーの技術開発と導入の現状

- 1) 日本のエネルギー政策とNEDOの役割
- 2) エネルギー需給の見通しと新エネルギー導入
- 3) 地球環境意識の高まり

2. NEDOの新エネルギー技術開発動向

- 1) 太陽光発電
- 2) 風力発電
- 3) 石炭
- 4) 地熱
- 5) 廃棄物発電
- 6) 燃料電池

3. NEDOの国際協力事業

- 1) 省エネルギーモデル事業
- 2) クリーンコールテクノロジーモデル事業
- 3) 共同実証事業
- 4) 研究協力事業

4. 今後の展開と地球環境問題への対応

- 1) アジア地域における新エネルギー事業展開
- 2) 地球環境への貢献

New Energy Development and Utilization and its Relation to the Global Environmental

Shuichi Tsunoda

Director General, Policy Planning Dept.

NEDO

February 1999

Energy Situation in Japan

Long-term Energy Supply and Demand Outlook

Oil Equivalent Million kl

	FY1996	FY2010
Oil	329	291
Coal	98	91
Natural Gas	68	80
Nuclear	74	107
Renewable (Hydro, Geothermal)	21	27
New Energy	7	19
Total	597	616

Source: Advisory Committee for Energy (MITI), June 1998

To reach the GOAL of long-term energy supply and demand

- ◆ Acceptance by the demand side of burden in short-term
- ◆ Change in energy supply structure
- ◆ Effort to adjust the whole economic society to accommodate an efficient energy system

- Demand Side - Energy Conservation

- ◆ Law Concerning the Rational Use of Energy
 - ◆ Industrial Sector (21 Million kl oil equivalent)
 - Voluntary Action Program created the Federation of Economic Organizations to be implemented in 36 different industries
- [examples]
- ◆ Steel: By 2010, energy consumption will be reduced by 10% compared to 1990 levels.
 - ◆ Chemical, Pulp and Paper: By 2010, energy consumption per unit of production will be reduced by 10% compared to 1990 levels.

- ◆ Private sector (17.4 Million OE kl)
 - Improvement on efficiency of appliances and house insulation
- ◆ Transportation (17.3 Million OE kl)
 - Improvement of fuel efficiency
 - Introduction of clean energy vehicles

Source: Advisory Committee for Energy (MITI), June 1998

- Supply Side -

Shift to Non Fossil Energy

(Contribution to total primary energy supply 1996 → 2010)

- ◆ Nuclear (12.3% → 17.4%)
- ◆ New Energy (1.1% → 3.1%)
 - Enhancement of new energy introduction
 - Law concerning promotion of the use of new energy
- ◆ Renewable Energy (3.6% → 4.4%)
 - Hydroelectric power
 - Geothermal energy

[Reference]

- ◆ Fossil Energy (83% → 75.1%)

Source: Advisory Committee for Energy (MITI), June 1998

Greenhouse Gas Reduction

▲6% Reduction

▲2.5% Innovative Technology

- ◆ New Energy
- ◆ Energy Conservation
- ◆ Transportation

▲3.7% Forestry

+2.0% Alternative Fluorocarbons

▲1.8% Joint Implementation, Emission Trading

Guidelines for New Energy Introduction in Japan

(MW)

Organization of NEDO

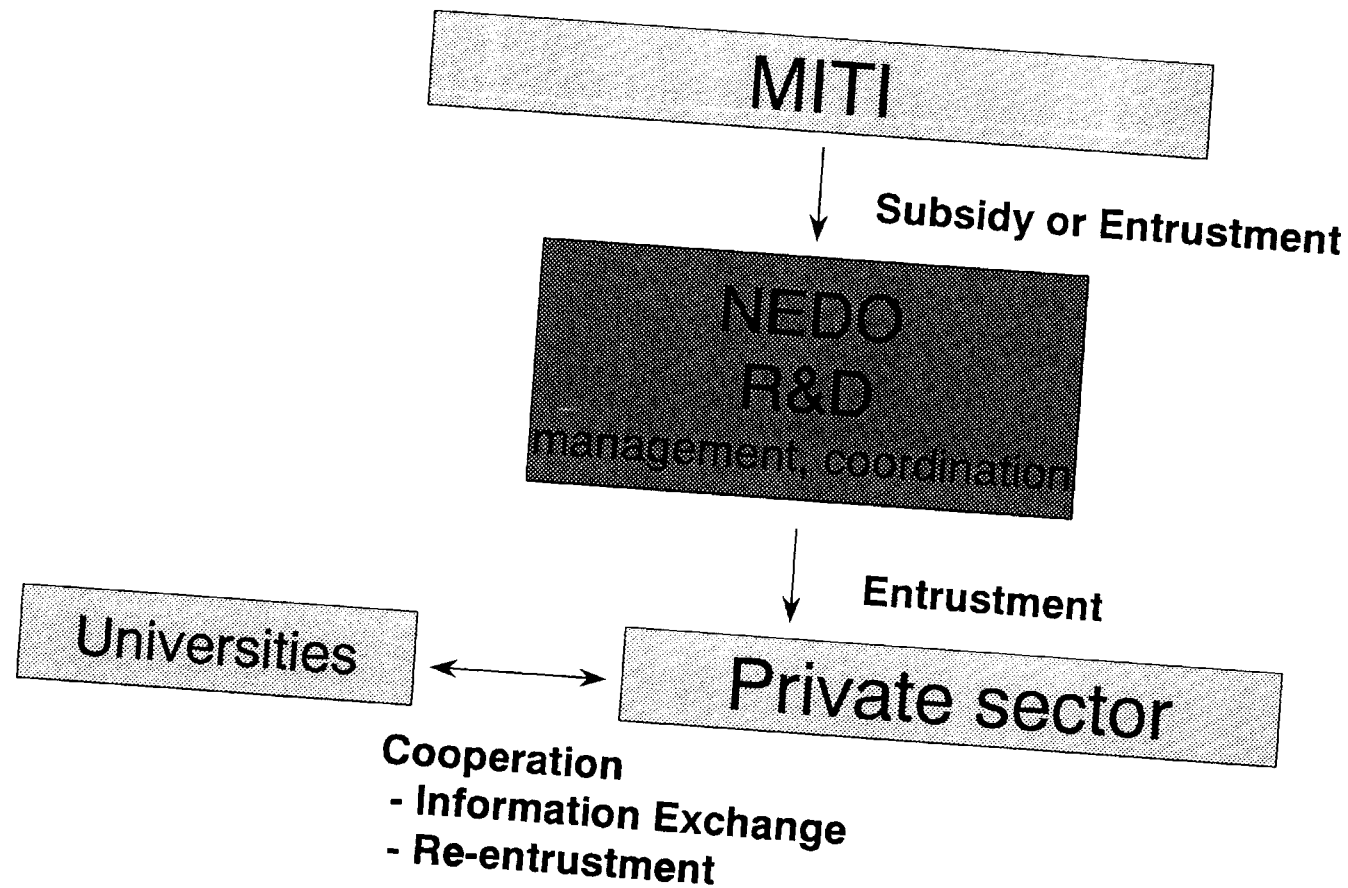
- 1, Established in October 1980 for the purpose of promoting the R&D of oil-alternative energy technology, under the jurisdiction of MITI.
- 2, New fields have been added to NEDO's responsibilities, including the R&D of
 - 1) Energy Conservation Technology
 - 2) Industrial Technology
 - 3) Environmental and Medical Technology.
- 3, Annual Budget : about 350 billion yen (FY1998)
Number of staff : 1,165 (April ,1998)

Major Activities and Budget of NEDO

(1998FY)

1, R&D and Introduction of New Energy and Energy Conservation Technology	¥billion 105.8
2, R&D of Industrial Technology	111.5
3, Restructuring of Coal Mining Industry	119.6
4, Manufacturing of Industrial Alcohol	12.3
	total 349.3
	(US\$ 3.0 billion (\$1=¥115))

System for R&D at NEDO



R&D Projects for New Energy and Energy Conservation

- ◆ Solar Cell Development
- ◆ Wind Power Generation System
- ◆ Coal Liquefaction and Gasification
- ◆ Geothermal Generation
- ◆ Waste Power Generation
- ◆ Fuel Cell

Total Budget ¥ 46.7 billion 1998FY

R&D Projects for Environment Protection

- ◆ Environment Friendly Manufacturing Technology
- ◆ Environmental Pollutants Reduction
- ◆ CO2 Fixation and Utilization Technology
- ◆ Recovering Environment
- ◆ Waste Management and Recycling

Total Budget ¥ 12.6 billion 1998FY

Programs to Promote the Introduction of New Energy and Energy Conservation

- ◆ Field Tests
- ◆ Support of the Introduction of New Energy
- ◆ Support of the Introduction of Energy Conservation

Total Budget ¥ 39.1 billion 1998FY

Field Tests

- ◆ New Energy Power Generation (PV, Wind)
- ◆ Photovoltaic Power Generation for Industrial Application
- ◆ Highly efficient industrial furnace
- ◆ Fuel Cell

Support of the Introduction of New Energy

- ◆ Support of Programs Using New Energy
- ◆ Promotion of the Introduction of New Energy in Local Areas
- ◆ Promotion of Clean Energy Vehicles

Support of the Introduction of Energy Conservation

- ◆ Model Projects for Introducing Leading Energy Conservation Technology
- ◆ Environmentally-friendly Energy Community Project
- ◆ Load Leveling (Cold Heat Storage Using Ice, Gas Air-conditioner)

NEDO's International Cooperation Projects

Energy Situation in Asia

- By 2010, primary energy demand will be approximately doubled from 1992.
- Between 1992 and 2010, estimated required investment in the power industry (excluding Japan) will amount to about \$1.3 trillion US dollars.
- By 2010, the demand for new energy in Asia will be 300 million TOE, around 9% of total.
- By 2010, CO2 emission in Asia will be doubled from 1992, and the region will account for 25% of total world CO2 output.

Source: International Energy Subcommittee (MITI), 1995

International Cooperation Projects

- ◆ Energy Conservation Model Projects
- ◆ Clean Coal Technology Model Projects
- ◆ Cooperative Demonstration Projects for Solar Energy Utilization System
- ◆ Research Cooperation Projects

Energy Conservation Model Projects (Asia)

[Ongoing]

- ◆ Coke Dry Quenching (96-00)
- ◆ Utilization of Paper Sludge and Solid Waste (96-00)
- ◆ Effective Utilization of Energy in Re-heating Furnace in the Steel Industry (96-00)
- ◆ Reduction of Electric Power Consumption in Cement Plant (97-00)

[Reference]

- ◆ Total Projects: 4 countries, 19 projects as of Dec., 1998

Clean Coal Technology Model Projects (Asia)

[Ongoing]

- ◆ Low-grade Coal Combustion System (96-99)
- ◆ Combined Coal Utilization System (97-00)
- ◆ Briquette Production Plant (96-99)
- ◆ Circulating Fluidized-bed Boiler (97-99)

[Reference]

- ◆ Total Projects: 4 countries, 21 projects as of Dec., 1998

Cooperative Demonstration Projects for Solar Energy Utilization Systems

- ♦ Lumber drying system utilizing solar thermal energy (Indonesia, 93-98)
- ♦ Solar and Mini-hydro Hybrid System (Viet num, 97-00)

THE END

Promotion of Energy Conservation and the Global Environment

Current activities in the field of energy conservation
in Japan and international cooperation

Kazuki Tanabe
General Manager
International Cooperation Department
The Energy Conservation Center, Japan

1. Present situation

After the first oil crisis in 1973, Japan achieved a substantial improvement in its energy consumption rate equivalent to over 30% in GNP terms. Recently, however, an innovative government action has become necessary in order to further energy efficiency.

In the Third Conference of Parties to the UN Convention on Climate Change held in Kyoto (COP 3) in December 1997, Japan declared its adoption of a stiff commitment for a basic reduction of average CO₂ emission by 6% from the 1990 level over a period of five years from 2008 to 2012. The details of commitments, including the support of developed countries and the cooperation with developing countries as well as circum-pan-Pacific nations, were discussed in the COP4 conference held in Buenos Aires in November 1998.

Following COP3, the Japanese government amended its laws to strengthen energy efficiency, which is the key to achieve the target of protecting the global environment. The newly amended energy efficiency act includes such factors as expanding the

registration scheme for model energy management factories and designating the most advanced devices which will be the standards to follow (known as the “top-runner system”).

Together with the active participation of policy makers and specialists for energy management and technologies who are taking part in the field of energy efficiency, the energy saving movement should be extended to the general public. It is also essential that the government and the private sector should collaborate in their efforts to promote further international cooperation for training and transfers of environmental and energy conservation technologies.

2. Promotion of energy conservation

- 1) The basis for energy conservation promotion is to establish a government energy policy which matches forthcoming trends, maintaining national energy security, economic growth and environmental protection.
- 2) Following international concern about global environmental protection as well as the current domestic energy consumption situation, it is necessary to improve energy efficiency. Since the amended act has been implemented, energy efficiency programs in both industries and commercial and residential sector and public campaigns for these programs have been accelerated.
- 3) At the same time, the improvement of energy efficiency in the use of household electrical devices, such as effective labeling, reducing stand-by electricity (known as “energy star”) and the “top-runner system”, have been introduced internationally.

- 4) International cooperation is becoming more important in the field of training and technology transfers which utilize extensive technological assets in Japan.

3. Development prospects

International coordination and cooperation are vital and it is essential to follow international trends, such as setting global standards in certain fields. Various measures have been put into practice for improving energy efficiency in the commercial and residential sector, which is one of the international trends. The improvement of energy efficiency in industries should be stressed continuously, and the results obtained by the improvement should be transferred to developing countries together with other measures. Japan has undertaken a commitment to contribute to the international promotion of energy conservation, coordinating a comprehensive system of policies and technologies to the actual needs and situation in each country.

省エネルギーの促進と地球環境

－日本の省エネルギー活動と国際協力－

財団法人 省エネルギーセンター

国際協力部長 田 鍋 一 樹

1. 現状認識

我が国は、1973年の第一次石油危機以降、エネルギー消費の対GNP原単位を30%以上改善するという大きな成果を上げた。近年、更なる省エネルギーの推進のために、新たな施策が必要となってきた。

また、1997年12月の地球温暖化防止京都会議（COP-3）において、2008年から2012年の二酸化炭素の平均排出量を1990年レベルよりも6%削減するという大変厳しい目標を国際公約とした。また、1998年11月のブエノスアイレスにおける会議（COP-4）では、具体的な取り組み、先進国の支援、途上国の協力等が議論されたところであり、これは、環太平洋地域においても同様である。

地球環境保全のための、課題解決の大部分を占める省エネルギーの強力な推進のために、我が国では、1998年、エネルギー管理指定工場の拡充や、トップランナー方式の導入等を含めて省エネルギー法が強化改定された。

今後、省エネルギー政策責任者や省エネルギー管理、技術の専門家等による精力的な活動と共に、国民的な運動の展開を図って行くべきであり、地球環境保全と持続的な発展を維持確保するために、環境省エネ技術の移転や人材育成等を含めた、政府、民間が一体となった多面的な国際協力の一層の推進が不可欠である。

2. 省エネルギーの推進

- （1）基本原則は、エネルギーセキュリティの確保、経済成長の持続、環境保全を堅持して、時代の潮流と調和を図りながら、エネルギー政策を構築していくことである。
- （2）国際的な地球環境確保動向と国内エネルギー消費状況から考え省エネルギーが必要である。省エネルギー法が改定され、省エネルギー施策の国内普及と産業、民生各分野にわたる一層の省エネルギーが推進されることとなった。
- （3）一方、ラベリング、エネルギースター（待機電力削減）、トップランナー等、民生部門での電気使用機器に対する省エネルギー推進が国際的な潮流となってきた。
- （4）国際的な潮流に対する協調、日本の膨大な蓄積を活かした技術移転、人材育成両面からの国際協力がより重要となってきた。

3. 今後の展開

これからは、国際協調、国際協力は極めて大切であり、グローバルな基準化も含めた国際的な動向は、きっちりと把握して対応する必要がある。省エネルギーの一つ国際的な潮流は、民生の重視であり色々な施策が展開されつつある。一方、産業省エネ技術は引き続き重視されるべきであり、技術移転等も、色々な支援策とセットにしながら、各国の実状と調和を図りつつ、政策、技術等の全体システムを視野に入れて国際貢献していきたいと考えている。

以上

省エネルギーの促進と地球環境

－日本の省エネルギー活動と国際協力－

財団法人 省エネルギーセンター

国際協力部長 田 鍋 一 樹

はじめに

我が国は、1973年の第一次石油危機以降、官民を挙げて省エネルギー推進に力を入れた結果、エネルギー消費の対GNP原単位を30%以上改善するという大きな成果を上げた。近年は、エネルギー価格の低位安定化傾向のもと、更なる省エネルギーの推進のために、新たな施策が必要となってきた。

また、昨年12月の地球温暖化防止京都会議（COP-3）において、日本は2008年から2012年の二酸化炭素の平均排出量を1990年レベルよりも6%削減するという大変厳しい目標を国際公約とした。また、先月11月のアルゼンチンのブエノスアイレスにおける会議（COP-4）において、具体的な取り組みや、途上国の協力等が議論されたところである。

地球環境問題は、二十一世紀に向けて、今後地球規模で人類が具体的に取り組むべき大きな課題として提起された。

地球環境保全のための、課題解決の大部分を占める省エネルギーの強力な推進のために、我が国では、今年度、エネルギー管理指定工場の拡充や、トップランナー方式の導入等を含めて省エネルギー法が強化改定された。

今後、省エネルギー政策責任者や省エネルギー管理、技術の専門家等による精力的な活動と共に、省エネルギー型ライフスタイルの定着を指向した、国民的な運動の展開がより重要な状況となっており、企業存立の条件ともなりつつある。更に、地球環境保全と持続的な発展を維持確保するために、環境省エネ技術の移転や人材育成等を含めた、政府、民間が一体となった多面的な国際協力の一層の推進が不可欠である。

（OHP 1）概略内容

1. 省エネルギーの必要性：

我が国の省エネルギー政策の基本原則及び国内エネルギー消費等の状況

2. 省エネルギーの推進：

省エネルギー法改定のポイント及び省エネルギー活動（省エネルギーセンターの活動を含む）

3. 省エネルギー推進の潮流：

海外国内動向

4. 国際協力

(OHP 2) 基本原則

エネルギー政策の基本原則は、3Eを堅持しながら、情勢変化や時代の要請等との調和を図り、エネルギー政策を構築していくことである。

3E エネルギーセキュリティの確保 (Energy Security)

経済成長の持続

(Economic Growth)

環境保全

(Environmental Protection)

今後海外の方針や実務的な情報の把握、及び日本の政策の海外PRが重要

(OHP 3) CO2排出量推計

我が国の2010年までの、CO2総排出量推計値

ケース1：現状のまま何も追加的な手を打たなかった場合

ケース2：追加の諸施策を実施した場合、1990年レベルを達成のケース

(OHP 4) 産業 エネルギー消費

製造業のエネルギー消費のIIP（鉱工業生産指数）原単位は'96年度には若干改善したものの91年度から95年までは、連続して増加傾向で推移している。産業部門は、依然として日本のエネルギー消費の約50%を締めているので、省エネ対策が必要である。

尚、途上国は、1986年頃からエネルギー消費が増えだし、先進国は省エネが鈍化しており、この後1990年過ぎより、先進国を中心に新たなエネルギー対策が打ち出されるようになった。

我が国でも1979年に制定された省エネ法が、1993年に改訂された。

(OHP 5) 各部門エネルギー需要

産業部門で依然として50%のエネルギー需要があり、民生部門等では、生活の利便性や快適性の追求を背景として、エネルギー消費は、増加傾向である。

(OHP 6) 同上 増加傾向

詳しく見ると、産業部門は横這いの傾向である。産業部門は、過去、日本のエネルギー消費の70%近くを占めていたので、日本の省エネ政策は、産業部門重視型であり、省エネについては、大きな成果を上げてきたが、依然として、国内消費の50%を占めているので、産業部門の省エネ推進は、省エネ政策の基本である。

一方、民生部門等の増加が著しいが、電力消費が増加していることが、大きな要因の一つとなっている。従って、民生部門の、省エネが重視されてきている。

(OHP 7) 省エネ対策 産業

自主行動計画に基づく対策、中堅工場等における省エネルギーの推進のため

- ・経団連自主行動計画のフォローアップ：各関連審議会等
- ・省エネルギー法の改正・強化

エネルギー使用合理化に関する将来計画提出：エネルギー管理指定工場

エネルギー使用合理化の徹底：工場総点検

中規模工場・事業場対策：第2種エネルギー管理指定工場の創設

(OHP 8) 省エネ対策 民生

民生部門においては、エネルギー消費機器の効率改善や住宅・建築物等の省エネルギー基準の強化等である。

- ・エネルギー消費機器等の効率改善：省エネルギー法の改正により、家電OA機器等の省エネルギー基準にトップランナー方式の考え方を導入
(トップランナーの省エネルギー基準については、年内に具体化すべく進められている)
- ・住宅・建築物の省エネルギー性能の向上等：省エネルギー基準の強化他E S C Oへの支援強化
- ・技術開発の推進：超低消費電力型OA機器、高効率照明等の開発・普及
- ・国民のライフスタイルの変革：省エネルギー型スマートライフの追求

(OHP 9) E C C 国内活動

省エネルギーセンターは、省エネルギー法等の積極的な措置のもとに、国の関係省庁および賛助会員企業等の支援を得ながら、省エネルギー推進の公報普及活動を行っている。

主な国内活動としては、産業部門では、省エネルギー教育、エネルギー管理士国家試験、省エネ優秀事例発表会、省エネ診断、技術開発等である。民生部門では、省エネルギー優秀機器の発掘・表彰・普及、エネルギースタープログラムの推進、各社電気使用機器の性能表示、ビルの省エネ診断等である。

また、全般的には、省エネ調査、公報、各種のキャンペーンをベース活動として、E S C O研究会、I S O 1 4 0 0 1 環境審査員コースセミナー、さらにスマートライフの研究等を行っているところである。詳しくは、次の通りである。

(1) 産業部門

①省エネルギー教育

我が国の産業界における省エネルギーを一層推進させるため、核となるべき人材の育成を目的に、「エネルギー管理士」受講講座、エネルギー管理技術研修、技術講座、エネルギー管理従事者研修、エネルギー管理を統括する経営トップ層を対象とした省エネルギートップセミナー等、企業の末端からトップまでの各層を対象にした各種の教育研修を、ニーズに合わせて充実を図りながら行っている。

②エネルギー管理士国家試験

また、１９８４年「エネルギー管理士試験」の指定試験機関、１９８５年「エネルギー管理研修」の指定研修機関として通商産業大臣の「指定」受け、夏に実施するエネルギー管理士試験、冬に実施する「エネルギー管理研修」の試験・研修機関として実務を行っている。

本年度の省エネ法改正にともない、従来のエネルギー管理指定工場に加え第二種エネルギー管理指定工場が新規創設されたので、これらの事業活動は、大幅に拡大される見込みである。

③省エネルギー優秀事例の蓄積

一方、省エネルギー技術の普及啓蒙のために、省エネルギー優秀事例地区大会、全国大会を毎年行い、審査委員会を経て選考された特に優秀な事例については、通商産業大臣賞、資源エネルギー長官賞、通商産業局長賞、省エネルギー会長賞等の表彰を行い、企業内小集団活動の活性化や省エネルギー技術の交流、向上に努めている。この活動は、省エネルギーセンター発足当初より実施しており現在までの２０年間に膨大な事例蓄積があり、我が国の省エネルギーの実現に大きく寄与してきた。

④省エネルギー診断技術指導

- ・技術指導は、エネルギーの使用状況調査・測定・解析、エネルギー使用合理化についてアドバイス等を行うものである。産業界における中小企業に対するの省エネルギー推進を図るための技術指導は、省エネルギーセンター発足当初より実施しており、本活動の実効性が強く認識されてきた。
- ・更に、省エネルギー法に基付く適切なエネルギー管理の確実な実施を促すために、全国約３６００事業所の全エネルギー管理指定工場を対象としたヒアリング調査を行っているところである。
- ・当センターの調査結果から省エネルギーの可能な余地もかなり残っていると推定されるので、中堅以上の工場等に対する指導を全国的に拡大しつつある。

⑤省エネルギー技術開発

- ・技術開発としては高効率エネルギー有効利用技術（広域エネルギー利用ネットワークシステム：通称エコ・エネプロジェクト）として、内部熱交換型蒸留塔や熱電発電等、近い将来において実質的な高度の省エネルギー効果が得られる要素技術の開発を、有力企業の協力を得て、総合調整と推進を行っているところである。また、国家プロジェクトの高性能工業炉開発における高温高圧低酸素空気燃焼技術のように、日本において開発完了間近な技術等についても、タイミング良く普及促進を図っている。

(2) 民生部門

①省エネルギー優秀機器の発掘・普及

- ・ 21世紀型省エネルギー機器システム発掘普及を目的として、省エネバングード21（1998年度省エネルギー大賞と改称）として、民生用のシステム・機器に関する優れた省エネルギー機器を公募表彰し省エネルギーを推進してきた。企業においてもP/R効果も期待されるので積極的な応募が多く、認識が高まっている。

②エネルギースタートプログラム

- ・ さらに、OA機器（5品目）の待機電力の抑制を目的に、1995年にスタートした国際エネルギースタートプログラムの制度の広報、ロゴマークの登録等を促進しており、登録件数も急速に増加している。

③電気使用機器の性能表示

- ・ 冷蔵庫、テレビ、エアコン等の電気使用機器についても各機種についての省エネ性能表を作成し、情報提供を開始したが、企業や一般市民にかなりの意識高揚を促すものと考えられる。

④ビルの省エネルギー診断技術指導

業務用ビルのエネルギー消費は年々増加していることから、ビルに対し専門的な立場から総合的に省エネルギー診断と技術指導が必要になってきている。

これは、世界各地の都市域において同様と考えられるので、次に述べるESCOの実証研究においてはビルに対する重点を置いた取り組みが必要とされている。

(3) ESCO研究推進

- ・ ESCO（Energy Service Company）事業とは、「省エネルギー」を企業のビジネスとして行う事業のことを言う。

これまで、省エネルギーについては、我が国では、工場等において省エネルギー法に基づくエネルギー管理の専門家、エネルギー管理士、を置いて各企業がそれぞれの技術、人材、資金を持って対応してきた。

- ・ 設備改善等を含む抜本的な対策を実施する場合、専門的なESCO企業によって新しいビジネスとして、省エネルギー投資を合理的に誘導することが出来れば、省エネルギーを更に推進することが可能と考えられる。現在、当センターでは、通産省の補助事業として「ESCO事業導入検討会」を設置し、200社以上の企業の参加を得て、日本版ESCO事業の導入可能性について研究中である

(4) 広報活動

①省エネルギーキャンペーン

- ・ 市民の省エネルギー行動促進広報として、夏の冷房期間、冬の暖房期間、2月の「省エネルギー月間」を中心に、マスコミ、各種のコンクールや国民的な著名人

等の協力も得ながら、判りやすくきめ細かな広報活動を行っている。

国民各層に広く省エネルギー意識の一層の浸透を期待しているところである。

- ・一方、技術的な面でも、環境とエネルギーの調和を目指して、民生用エネルギー消費機器の効率改善、住宅断熱化の推進等を含め最新のエネルギー技術・機器・システム、設備、断熱建材、地球環境に寄与する機器、リサイクル等に関する広報紹介を行っており、特に2月の「省エネルギー月間」はこれらを集中的に行うキャンペーン期間として設定し、活用を図っている。

②省エネ支援策（省エネ優遇税制）等の広報支援

我が国に於いてエネルギー基盤にかかわる民間設備投資を促進する通称「省エネ優遇税制」は、1978年から施行され、現在まで引き継がれており、一昨年度税制改正で、「エネルギー需給構造改革投資促進税制」について、200設備以上を対象として、技術発展等の実情に応じた見直しが図られた。また、特定の廃熱回収設備や、エネルギー有効設備に対しては、日本開発銀行や中小企業金融公庫等の政府系金融機関による低利融資制度がある。

- ・これらの制度の役割は、益々重要なものになりつつあり、省エネルギーセンターは、税制等対象設備、および製品・メーカー等の情報について、実績のあるものを中心に網羅的かつ体系的に周知徹底を図るために広報活動を、事業所や工業協会等に対して行っており、制度の有効活用を支援している。

③調査広報

- ・多様化している情報ニーズに対応するために、国内外の情報収集や地球環境問題への取り組み方、省エネルギー技術動向、環境と調和の取れた省エネルギー型社会の構築、ライフスタイルの変化と対応等、サマertime導入等についての調査研究と調査結果の広報を含め多岐にわたる活動を行っているところである。

（OHP 10）国際協力

①国際協力の実績（省エネルギーセンターの活動）

産業分野について、省エネルギー推進に関するマスタープラン作りや具体的な提言等を行う調査団の派遣、省エネルギー管理技術や手法紹介、海外での省エネセミナーの開催、海外からの省エネルギー研修生受け入れによる技術・政策・優秀工場視察等の研修実施、大連の海外研修センターとの連携等を、国際協力事業団（JICA）、海外技術者研修協会（AOTS）、日本貿易振興会（JETO）新エネルギー・産業技術総合開発機構（NEDO）等の委託を承けながら、省エネルギーセンターの専門的な知見を活かして、内外の関係諸機関と連携を持って国際的な協力支援を行っている。

②協力支援の内容特記（省エネ研修の例）

上記の、日本で開催する省エネルギー研修の内容は、日本の省エネルギー政策、省エネルギー管理技術（熱・電気理論、省エネ手法）、産業分野各技術及び技術政

策（既存技術、新技術）、省エネルギー診断ケーススタディ・討議、省エネルギー優秀工場視察等である。各国の研修参加者は、政府のエネルギー政策担当責任や企業の経営等管理責任者、エネルギー専門家等が主体となっている。いずれも帰国後、責任ある立場でエネルギー対策を推進される方々と考えられる。推進の成果が期待されるところである。

（OHP 11） 協力ネットワーク

①ネットワークの活用

省エネルギーセンターは、日本国内での活動と今までの蓄積、政府・民間並びに産業部門や大学・研究機関及び関連団体・省エネルギー専門家とのネットワークを活かすことの出来る実務機関である。今後国際潮流を把握しながら、各国とのネットワーク作りを相互的、開発的に進めることにより、国際協力活動もさらに充実していくものと期待される。

②国内経験の活用

既に述べたように、現在の日本国内における産業・民生等各分野での多様な省エネルギー推進活動活動と今までの蓄積をベースとして、国際的に可能な限りの情報提供や技術移転を行っていくことが、世界の環境省エネルギーの課題解決に向けて貢献することになる考えられる。

（OHP 12） 省エネ 推進潮流

省エネルギー推進の一つの潮流

当初、省エネルギー推進については、主に産業部門に力が注がれていた。近年の傾向としては、民生部門の省エネルギーの重要性が大きくなっており、ESCOも含めビルの省エネルギー診断の強化や、トップランナー方式の導入に見られるように、電気使用機器等一般市民の協力も視野に入れた政策も重視されつつある。また、欧米等においても同じく電気使用機器のラベリング方式の強力な実施と情報提供を行っており、市場や一般市民の支持を得ていると考えられる。

従って、産業部門の省エネルギーや推進責任者や専門家等による省エネルギー推進は基本的な活動として堅持しつつ、国民的な活動へと移行して行くことが極めて大切であり、我が国はそうように進路を取っており、これは世界の潮流である。

従って、この面での施策が、世界各国・地域において、特色を持った施策が進行中である。代表的な例は、日本のトップランナー、欧州を中心に強力に推進されているラベリング、米国がにわかに力を入れたエネルギースターである。

（OHP 13） 平均省エネ可能性

産業部門については、当センターのアンケート結果では平均5%程度の省エネの可能性があると見られる。従って、依然として産業部門における省エネの推進は、必要である。

(OHP 14) 産業 電力需要変化

一方、電力需要は、日本における代表的なエネルギー多消費産業である鉄鋼、化学工業においては、横這いないしやや低減しているが、先端技術を含む金属機械製造業では増加傾向が現在でも続いており過去10年間に2倍の使用増となっている。

(OHP 15) 金属機械製造業

電気機械器具製造の増加が目立つ。

(OHP 16) 電気機械製造

その中でも、電子部品製造による電力使用の増加が、大きなウエートを占める。製造メーカーに対しては、地球的な規模での社会性が要求されるようになってきており、特に、環境アネジメントシステム・環境監査、すなはちISO14000への取り組みは、いわゆる気候変動枠組み条約と同様に、産業界の環境に対する国際規格への対応とすることで、来るべき将来の企業のあり方を示すものと考えられる。

(OHP 17) ESCO

ESCOの仕組みは次の通り。

省エネ診断を行い、現状のエネルギー使用量と省エネ節減量を設定し、投資により顧客とESCOの間で契約により回収期間（7年程度が良いと検討されている）と利益配分を設定するものである。

一番の問題は、エネルギー節減量の設定と、これを担保としたファイナンスではないかと考えられる。日本では、200社以上の企業が参加して、当センターが事務局となり、委員会と分科会を設け研究を行っている。

現状は、ビル等の民生部門に注力して、実証研究も含めて研究推進する方向となっている。

(OHP 18) ビルのエネルギー

ビル部門のエネルギー消費の推移については、エネルギー消費原単位は変わらないが、オフィスビルが増えることによりトータルのエネルギー消費は増加傾向である。このため、ビル建築物について、全体としてより効率的なエネルギー活用が出来るよう、専門的な立場から診断と改善の必要性が強く認識され実行されつつある。

(OHP 19) 家電製品

我が国の家電製品の普及動向

電気冷蔵庫等は、1970年代に飽和しているが、居住空間の快適性追求によるルームエアコン他、次々に新たな電気製品が加わり、トイレの保温便座や、ウォッシュレットの普及、更にオフィスの効率性、通信機能の充実等、コンピュータ機器の普及がこれに拍車をかけていると考えられる。

(OHP 20) 電力消費率

各部門別の電力消費比率を見てみますと、民生部門がエネルギー消費の中で電力消費の割合が最も多く、ここ10年間でその増加が顕著である。従って、電気使用機器に対する省エネの必要性は、明かである。

特に一般消費者の協力が必要不可欠で有り、システマチックで、適切な情報提供を進めていく必要がある。

(OHP 21) 基準一覧

世界の主な、省エネに関する基準関連の活動状況を見ると、日本は、トップランナー方式を来年4月から実施の予定であり、待機電力の省エネを目指したエネルギースターは米国の環境庁で実施されてから、日本でも1995年から導入実施されている。欧州では、数年以上前から、ラベリング方式が推進されている。

米国では、エネルギースターに力を注いでおり、環境庁とエネルギー省の協力で対象品目を大幅に拡大中である。

APECでは、別の視点で、電気機器の省エネ性をテストするためのテスト基準の統一に向けて、検討が推進されている。

(OHP 22) ラベル(例)

AからGまでの7段階表示で省エネ性能を表示して市場に商品を提供している。

(OHP 23) ラベリングの効果

1993年から1996年までのある製品の市場での購入実績を指数で示しているが、年の経過と共に、エネルギー効率の良い製品(A～Cランク)の購入比率が上昇しており、ラベリングは、省エネの手段であることが、実証された。

(OHP 24) エネルギースターロゴ

国際エネルギースターロゴマークは、待機時消費電力が所定時間内にあるレベル以下に自動的に下がる機種について、認定され、エネルギースターマークをつけることが出来る。日本ではOA関連機器のコンピューター、ディスプレイ等5品目を対象としている。

(OHP 25) エネルギースター登録件数

最近登録件数が急増している。

(OHP 26) エアコン省エネ表示(例)

省エネセンターでは、ユーザーへの最新情報提供と言うことで電気使用機器について、各社の機種について性能比較表を提供しており、メーカー、ユーザー共に相当の関心を持っているようである。

(OHP 27) エアコン性能分布

性能にかなりの分布がある。

(OHP 28) 冷蔵庫性能分布

冷蔵庫の例では、同じ容量の、例えば、有効内容積301から350リッターの場合年間で336～672kWh/年というように大きな性能の幅がある。

(OHP 29) 米国 冷蔵庫性能分布

米国の例として、1990年以前は性能はばらつきが大きいですが、厳しい省エネ基準設定後は、性能が向上し、ばらつきが減少した。従って、日本のトップランナー方式は、効果が期待される。

(OHP 30) APEC

省エネルギーの潮流、省エネルギー技術の動向として、国際協力も含め、APECでの、活動の一部を紹介する。

APECの会議は環太平洋18経済地域で構成されている。昨秋、ロシア、ベトナム、ペルーが参加することが決まった。APECはますます重要な会議になっていくと考えられる。首脳会議、担当大臣会議、政策責任者会議、専門家会議以下各層各分野それぞれに、自由な討議が行われている。基本的に会議は政府間協議であるが、専門家会議以下は民間も参加できることになっており、全体として、21世紀を先取りした優れた国際会議形式ではないかと考えられる。

省エネルギー関係では、国際標準に向けての活動や、産業及び民生の省エネ技術WS等世界に潮流に沿った活動が推進されている。

SPECは、APECの民間分野への協力、外務省や通産省等の政策担当局への提言を、各国の出席者が行うことにより、環太平洋アジア地域における、より強力で有意義な活動につながるものとする。

(OHP 31) まとめ

これからは、国際協調、国際協力は極めて大切であり、グローバル基準化のような動向は、きっちりと把握して対応する必要がある。

省エネルギーの一つ国際的な潮流は、民生の重視であり色々な施策が展開されつつある。

一方、産業省エネ技術は引き続き重視されるべきであり、国際協力の観点から、技術移転等も、色々な支援策とセットにしながら、各国の実状と調和を図りながら、政策、技術等の全体システムとメソドロジーを重視して推進することが大切である。

以上

SPEC '99

Promotion of Energy Conservation and Global Environment

Current Activities in the field of Energy Conservation in Japan and International Cooperation

Kazuki Tanabe

General Manager

International Cooperation Department

The Energy Conservation Center, Japan

<Outline>

1. Necessity of Energy Conservation

Fundamental principles (The 3E's)

Necessity of energy conservation (Condition In Japan, COP-3)

2. Promoting Energy Conservation

Revising energy conservation laws (industry, Residential)

Activities of the Energy Conservation Center (dissemination in Japan, international cooperation)

3. Overseas

Energy conservation measures (standard, labeling, ISO14001, etc)

Technological trends (e.g. APEC energy conservation technology WS)

4. Promotion of Environmental Improvement and Energy

Conservation (technology transfers, international cooperation, etc)

Fundamental Principles of Energy Policies

The principle is to harmonize with the trends world and to establish energy policies that are firmly grounded in the “Three E’s”.

“3 E”

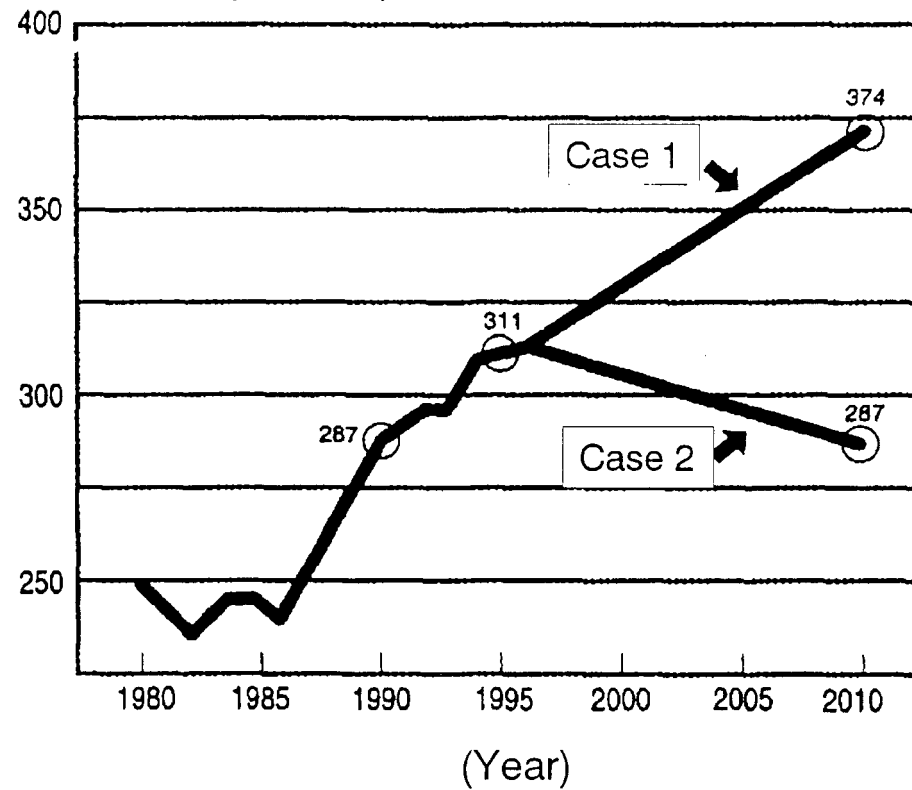
Energy Security

Economic growth

Environment Protection

Total CO2 Emissions in Japan to 2010

(Million tons of Carbon equivalent)



Source: Advisory Committee on Energy, Interim report of supply and demand, June 1998

< Energy Consumption Unit >

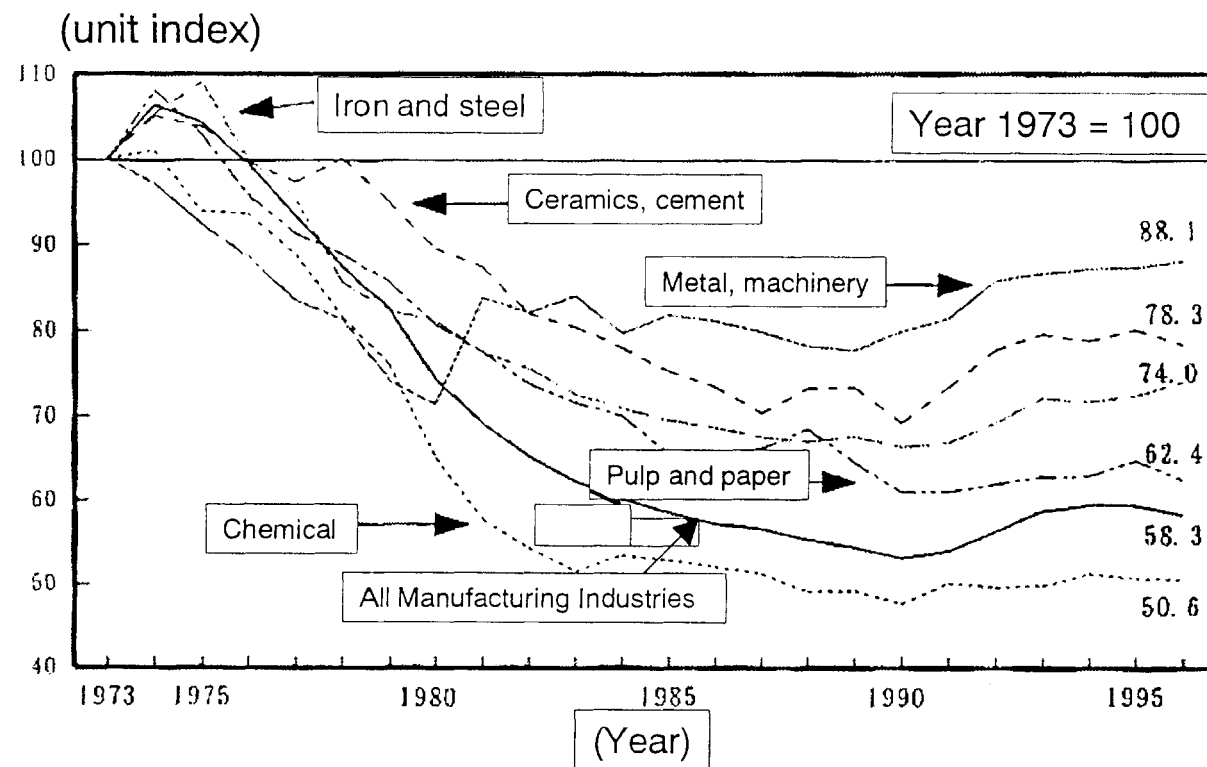


Figure: Energy consumption basic unit per IIP Indies of industry production
Source: Economic Statistics Survey on Energy

<Energy Demand of Sectors and GDP Growth>

Industry consumes about 50% of the total energy consumption.
Transport and residential sectors demands are increasing.

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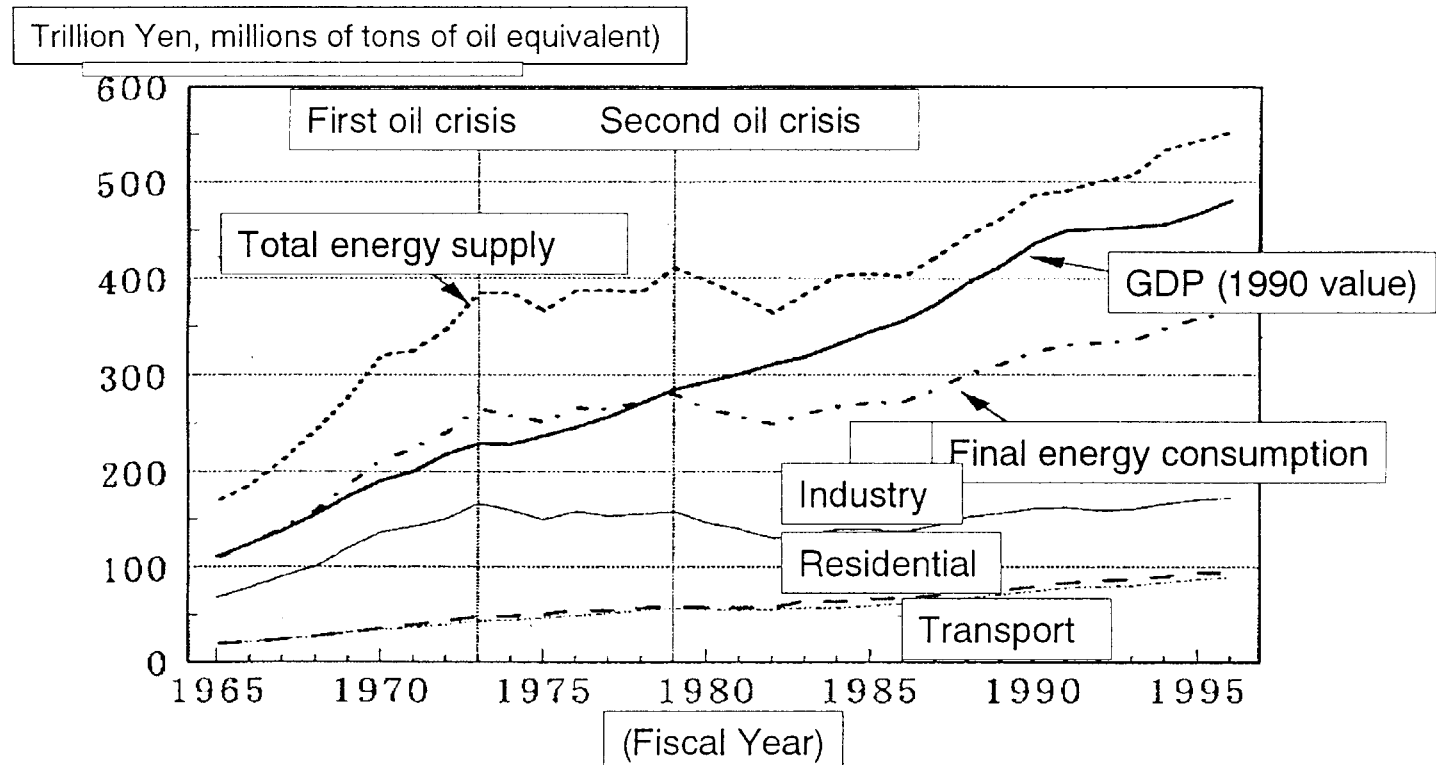


Figure: Energy Demand of Sectors and GDP Growth
Source: Economic Statistics Survey on Energy

Energy Consumption : Increasing

(Crude oil equivalent 100 million kl)

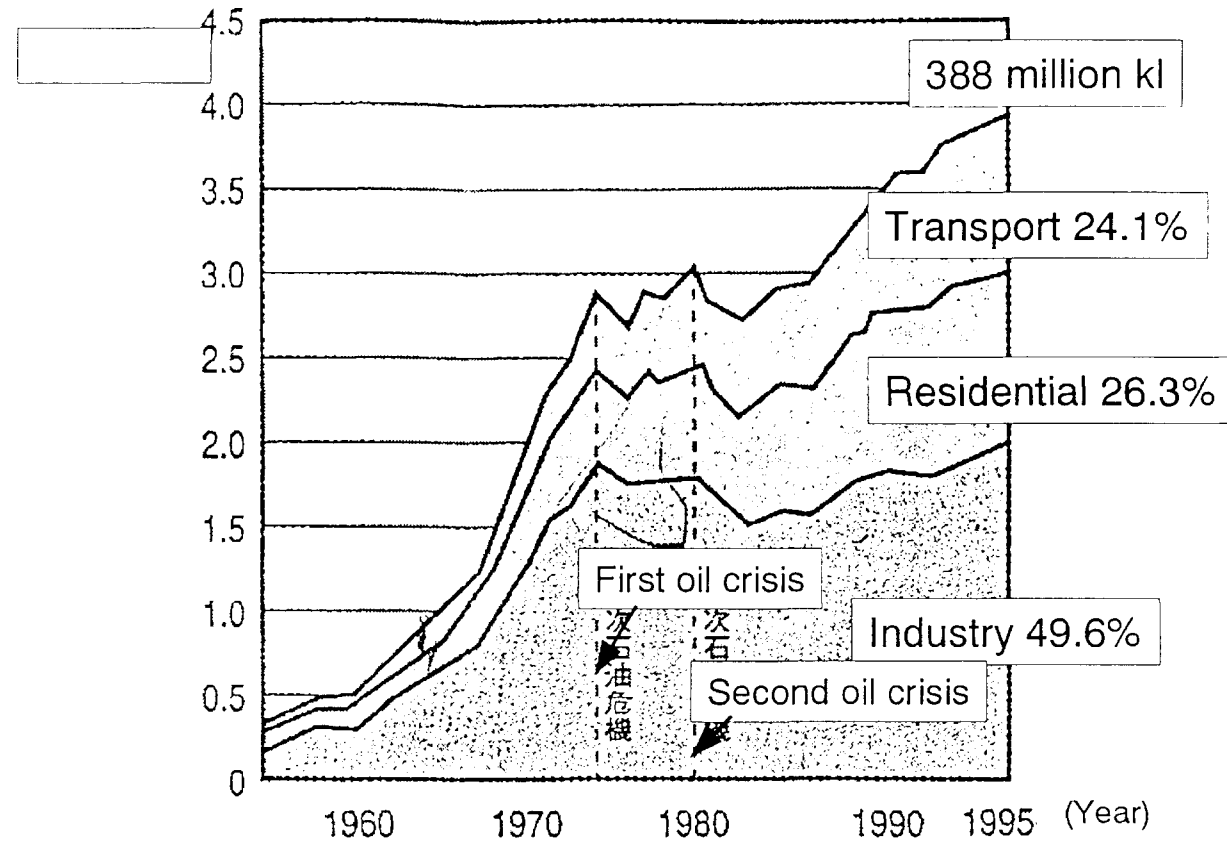


Figure: Final Energy Consumption Trends in Japan

Energy Conservation Plan

Industrial Sector

- Follow up Federation of Economic Organizations Voluntary Actions : Various related commissions
- Revision and Strengthening of Energy Conservation Laws
Providing future plans for reducing energy usage: Energy management designated
- Promote rationalization of energy usage: Complete examination of factories
Mid size factories, work site plan: Establish second type energy management designated factories.

Energy Conservation Plan

Residential Sectors

- Improving efficiency of energy consuming equipments
Introduce the concept of the top runner method
- Improving the energy efficiency of homes and buildings
Improving energy conservation standards, improved support for ESCO
- Technological development: Development and spread of low energy consumption OA equipment, high efficiency lamps
- Lifestyle Changes:
The “Smart life” of energy conservation

Main Activities of the Energy Conservation Center in Japan

Industry

- Education on energy conservation
- National testing for energy managers
- Reports on successful cases of energy conservation
- Energy conservation audits and proposal and technological development

Residential

- Discovering and disseminating excellent energy conserving equipment
- Energy Star program
- Display performance on electrical devices
- Energy conservation audits and proposal for buildings

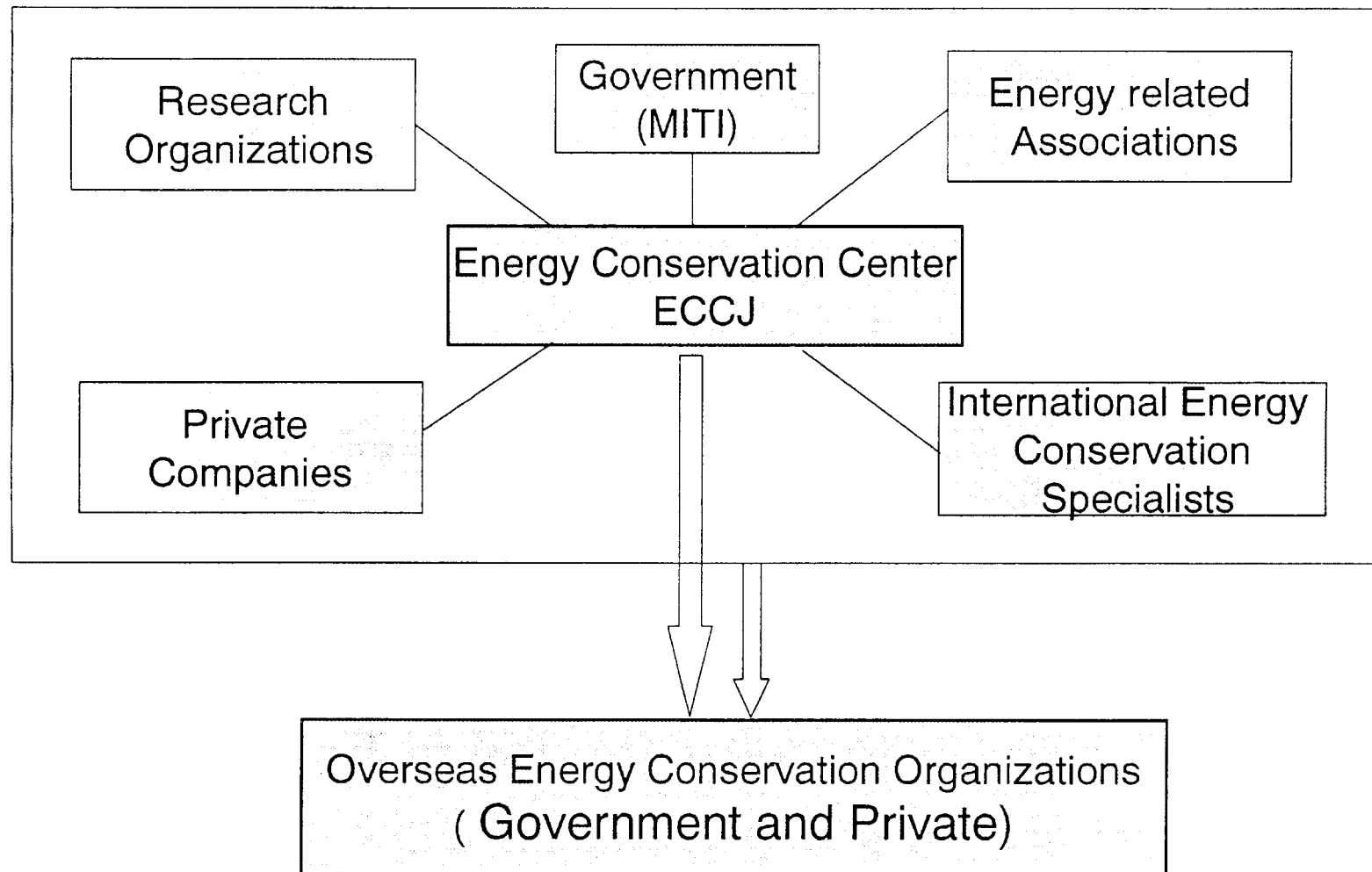
Overall

- ESCO research and develop
- ISO14001 seminar on Environmental inspectors course
- Energy conservation campaign “smart life”
- Advertising support, various research and surveys

Chart: International Cooperation Achievement (at the Energy Conservation Center since 1982)

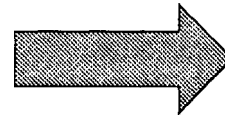
Cooperation, support item	No. of times	Remarks
• Dispatch of investigation group (project)	7	Energy conservation master plan, etc
• Receiving people from overseas	60	Energy conservation training, etc
• Training and seminars overseas	45	Technological training
• Dispatch of instructors to overseas	64	Seminars/ symposium, etc
• Dispatch of energy conservation specialists to overseas	72	Energy conservation investigations, etc
• International forum in Japan	18	Energy related international forums

Co-operation Network



Energy Conservation Promotion Trends (Increasing electricity demand, focus on the residential sectors)

Industry



Residential

Various measures

ASCO (US, Europe are ahead)

Building Diagnosis

Top Runner

Labeling (mostly in Europe)

Energy Star

Possibilities of Average Energy Conservation in Mid-sized Factories

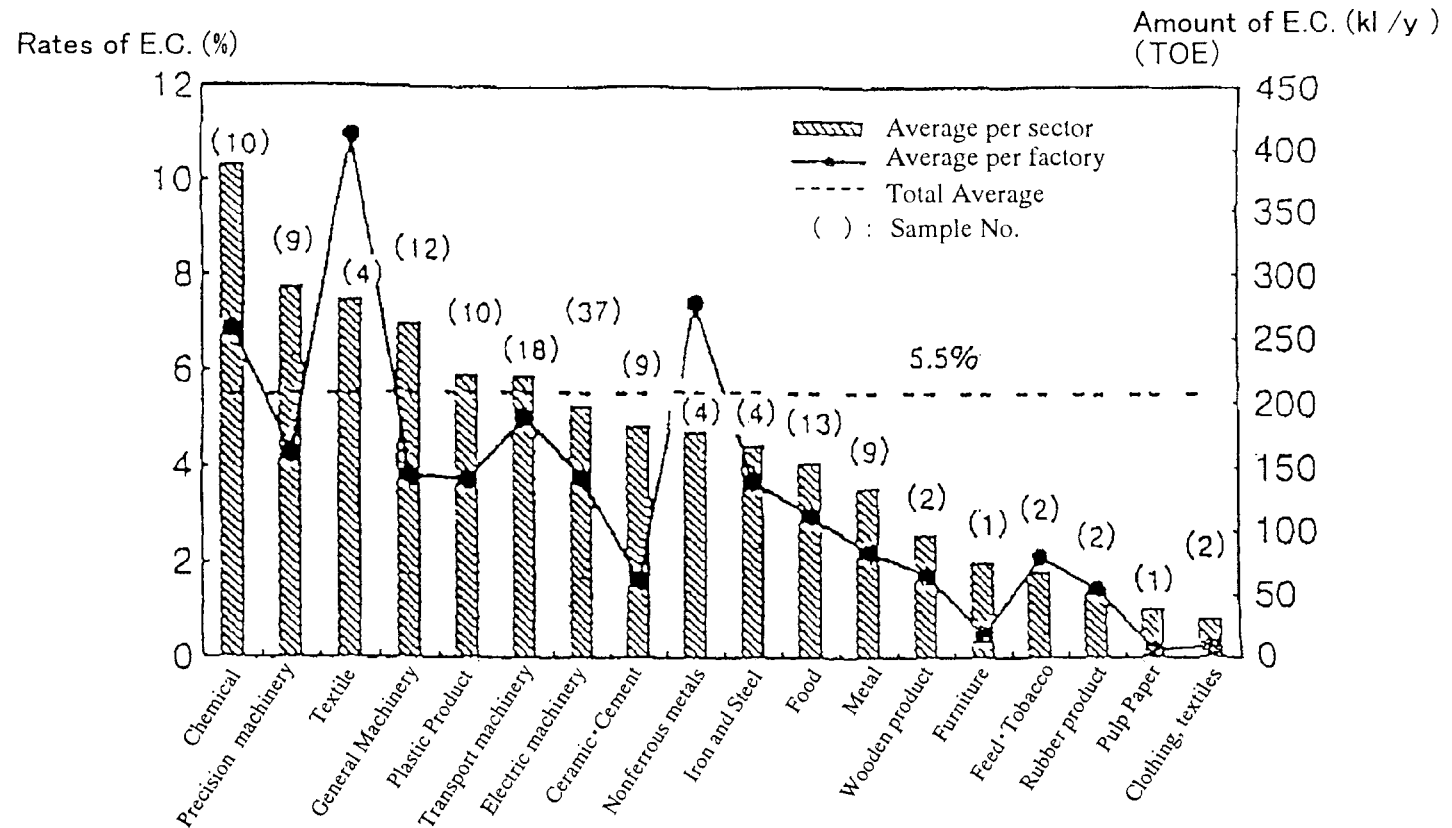


Figure: Average Energy Conservation in Mid-seized Factories (estimated values)
Source: Energy Conservation Center assessment results, March 1998

Industry Structure and Trends of Electricity Demand

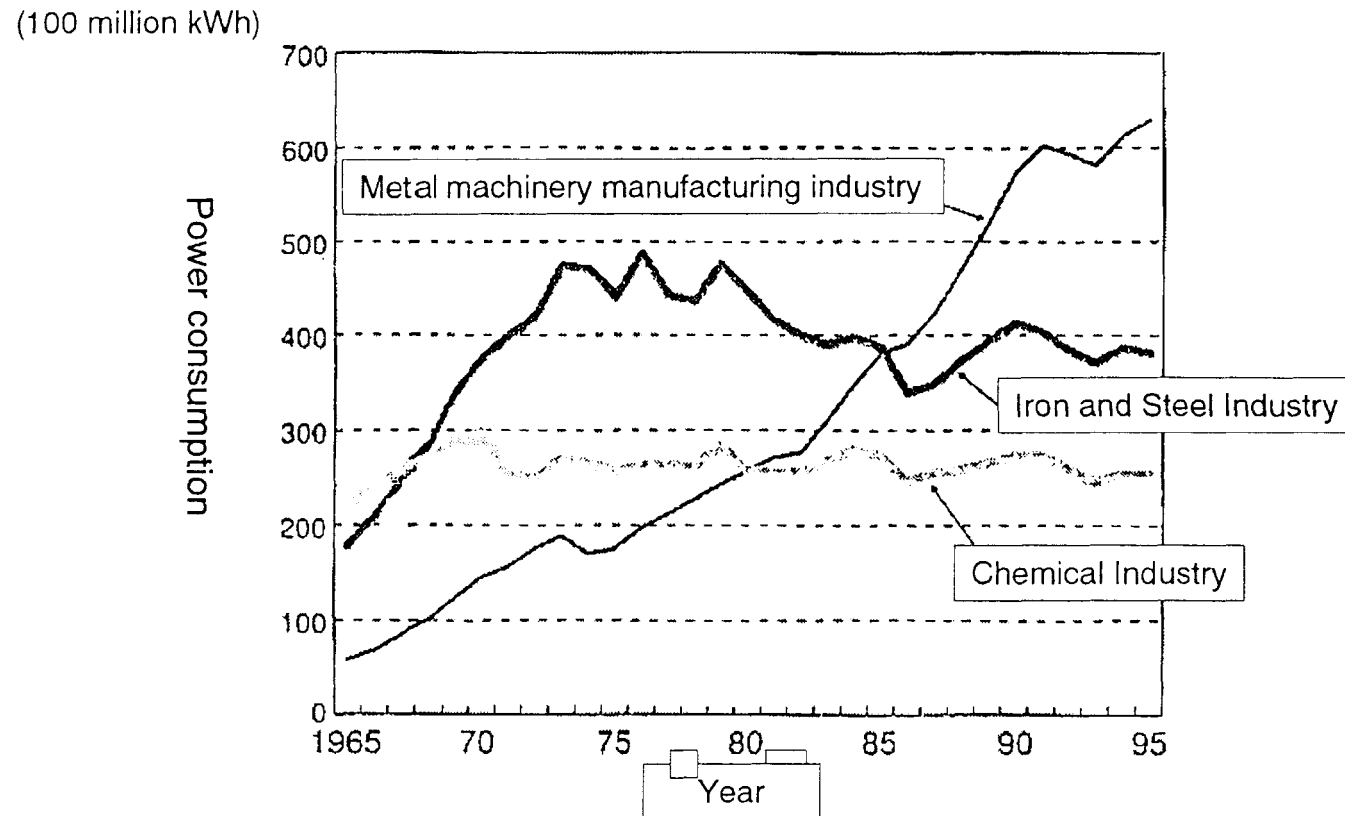
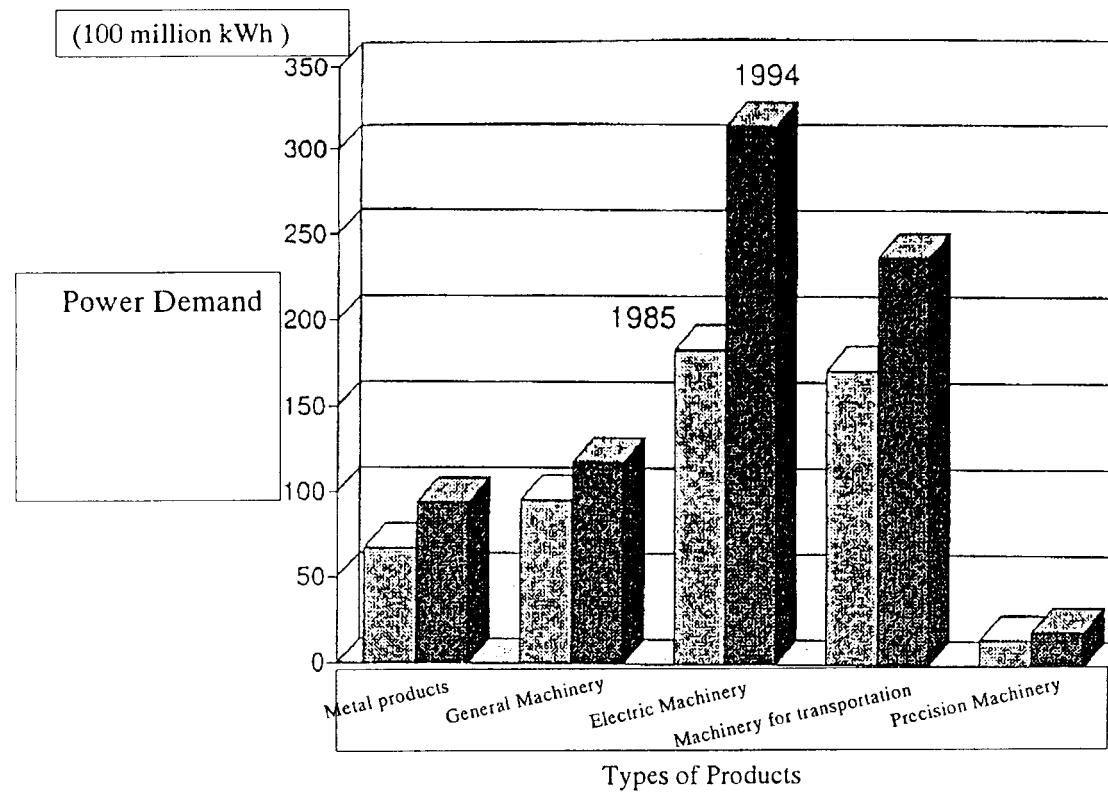


Figure: Trends in electricity demand in main industries

Comparison of electricity consumption in the metal machinery manufacturing industry



Comparison of electricity consumption in the metal machinery manufacturing

Breakdown of electricity consumption change in electrical machinery manufacturing

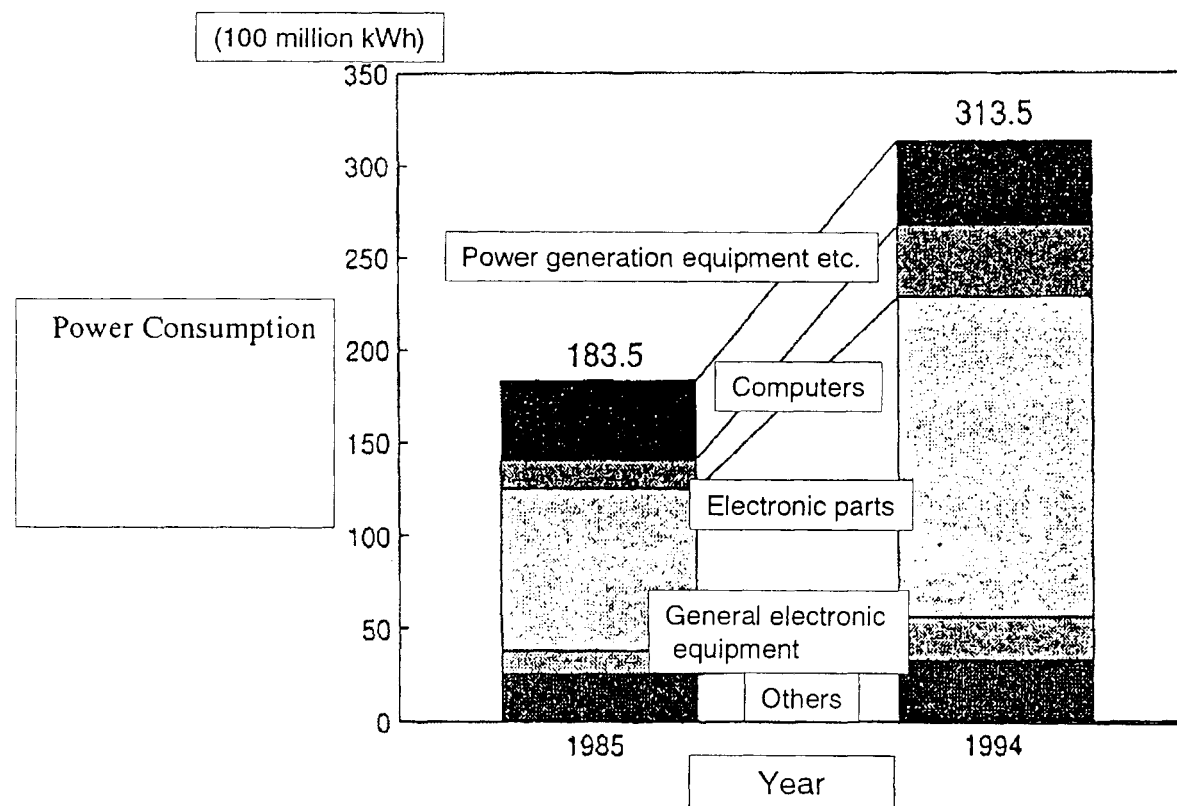
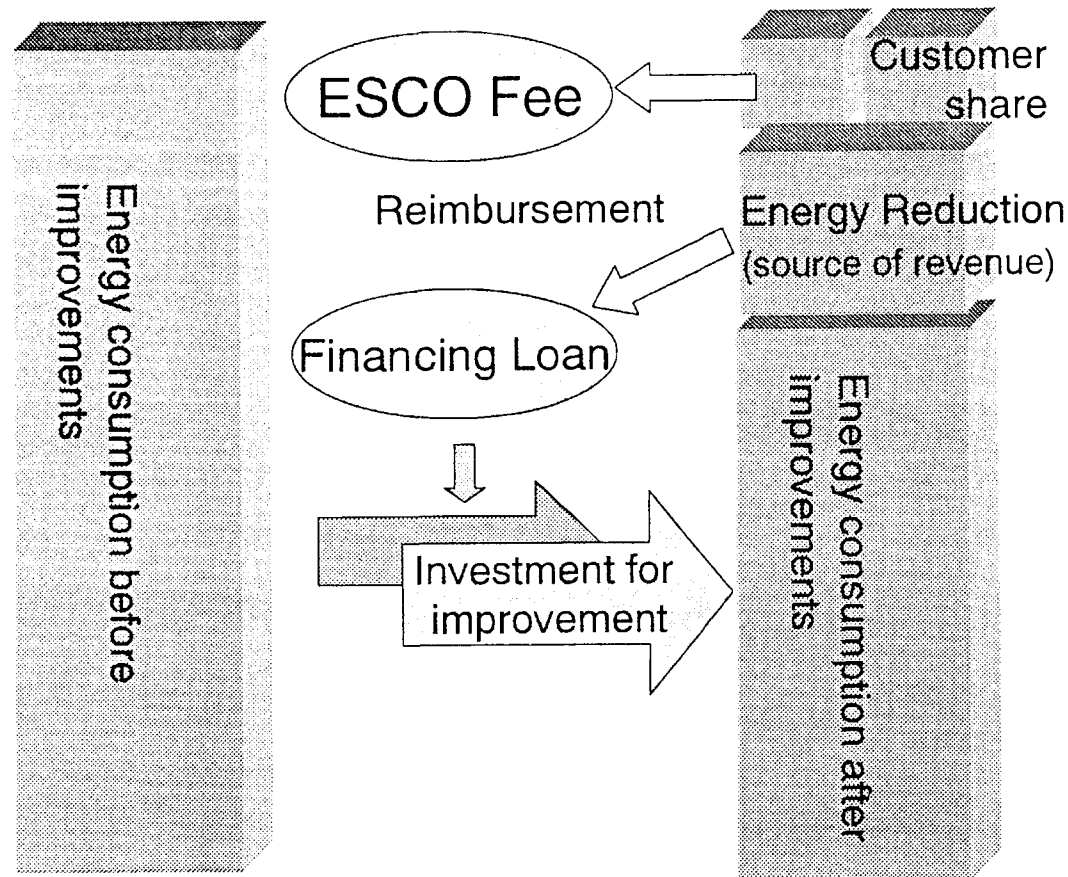


Figure: Breakdown of electricity consumption change in electrical machinery manufacturing

ESCO (Energy Service Company) Research

1. ESCO system



2. Committee structure

(1) Case study of factory, building (energy conservation audits and improvement)

- Energy conservation related audits
- Energy management
- Improving facilities
- Changing to energy efficient equipment

(2) System subcommittee

(3) Contract, standard subcommittee

Trends of energy consumption for office buildings

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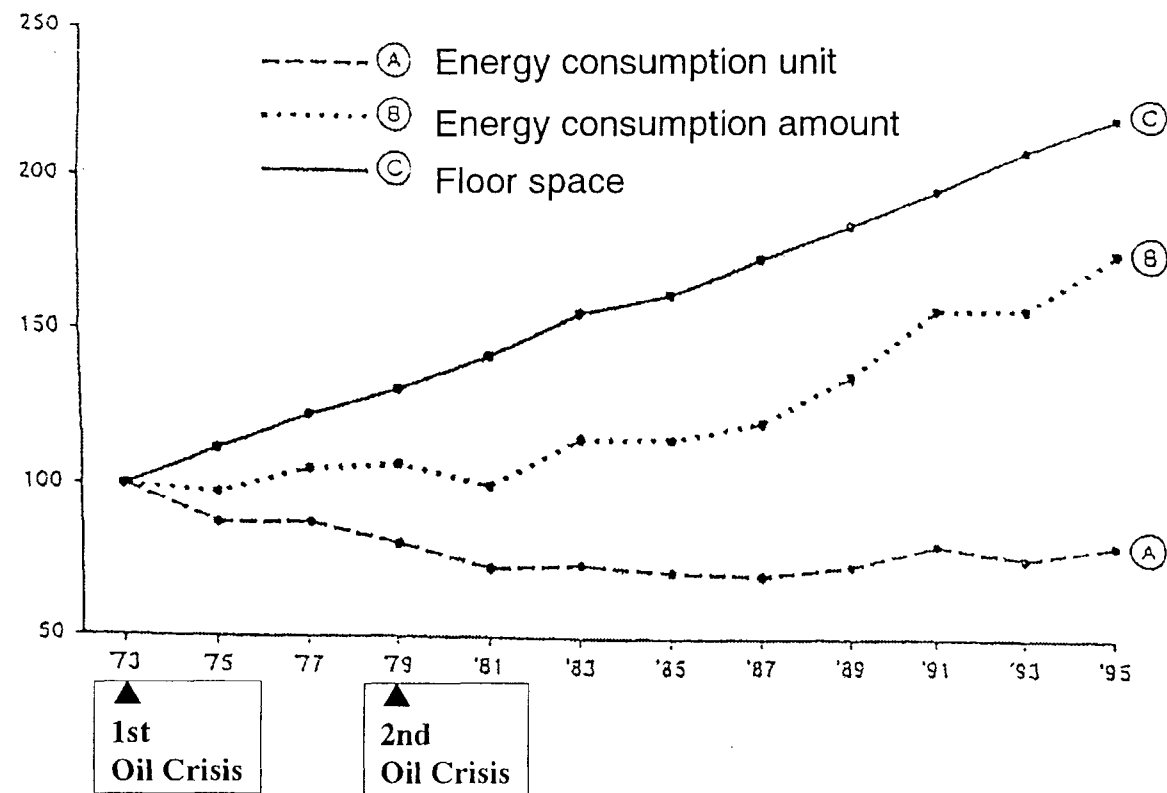


Figure: Trends of energy consumption for office buildings
Source: Calculated from the Energy Economic Statistics Bulletin

Spread of home appliances in Japan

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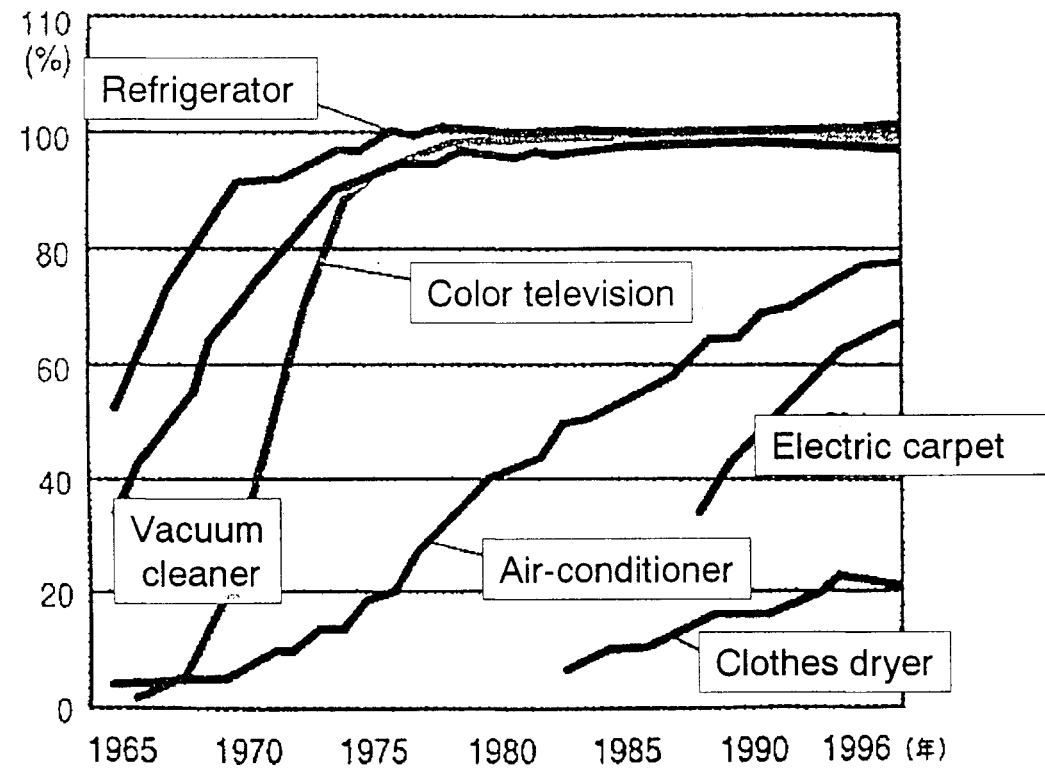
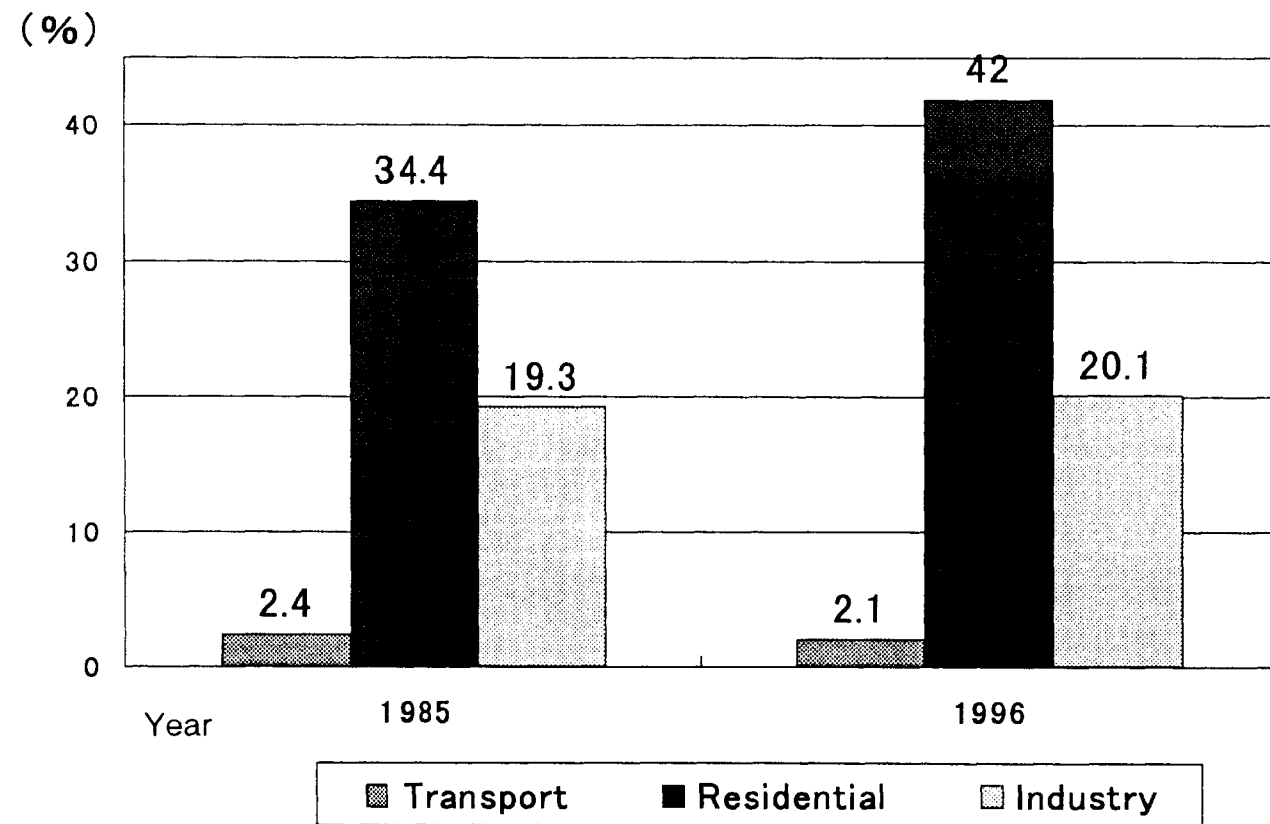


Figure: Spread of home appliances in Japan

Source: Consumption Trends Investigation (Economic Planning Agency Investigation Bureau)

Power Consumption Rate by Sector



Standard Related Equipment List

Energy Conservation Center

	Japan		EU Labeling	USA		APEC Standard
	Top runner	Energy Star		Labeling	Energy Star	
Air conditioners	○		○	○		○
Refrigerator	○		○	○		○
Fluorescent lamps	○		○	○		○
Washing machine			○	○		
Television sets	○			○		
VCR	○					
Plate washer			○	○		
Oven			○	○		
Copying machines	○	□			□	
Magnetic disk unit	○				□	
Calculator	○	□			□	
Display		□			□	
Printer		□			□	
Facsimile		□			□	
Motor						○
Gasoline-fueled passenger cars	○					
Gasoline-fueled trucks	○					
Diesel powered passenger cars	○					
Diesel powered trucks	○					

EPA, DOE
Cooperation
expand to items

European Union Energy Efficiency Label for Refrigerators

Energy	
Manufacturer Model	Logo ABC 123
More efficient Less efficient	
Energy consumption kWh/year <i>(Based on standard test results for 24 h)</i> Actual consumption will depend on how the appliance is used and where it is located	XYZ
Fresh food volume l Frozen food volume l	xyz xyz
Noise (dB(A) re 1 pW) Further information is contained in product brochures	xx
Norm EN 153 May 1996 European Label Directive 94/CEC	

Trends of purchasing result in market, effect of labeling in Europe

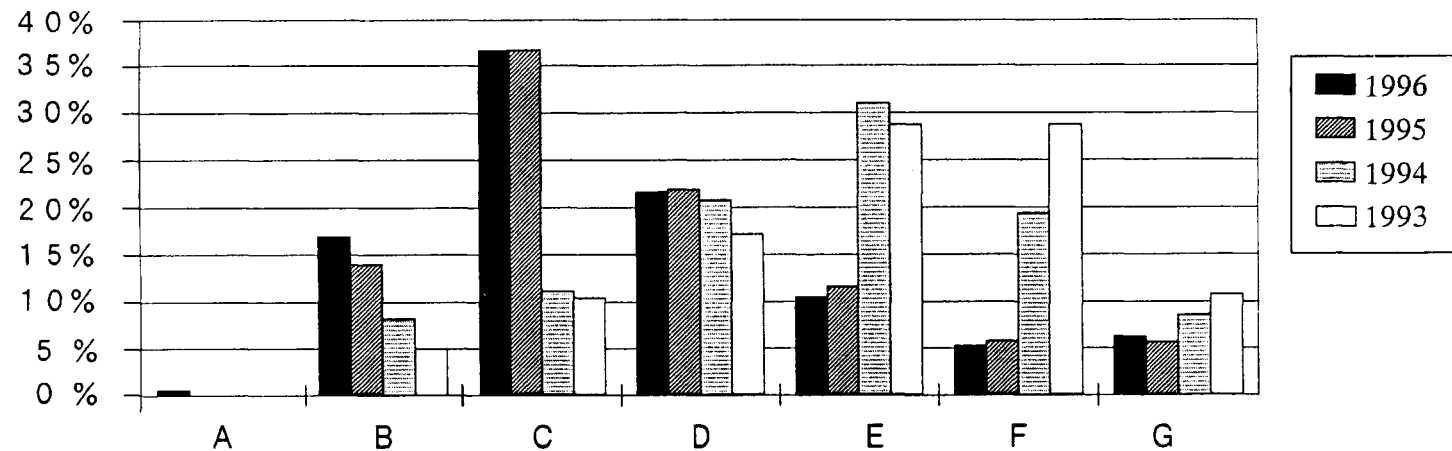


Figure: Trends of purchasing result in market, effect of labeling in Europe Source: IIEC forum, July 1997

International Energy Star Logo



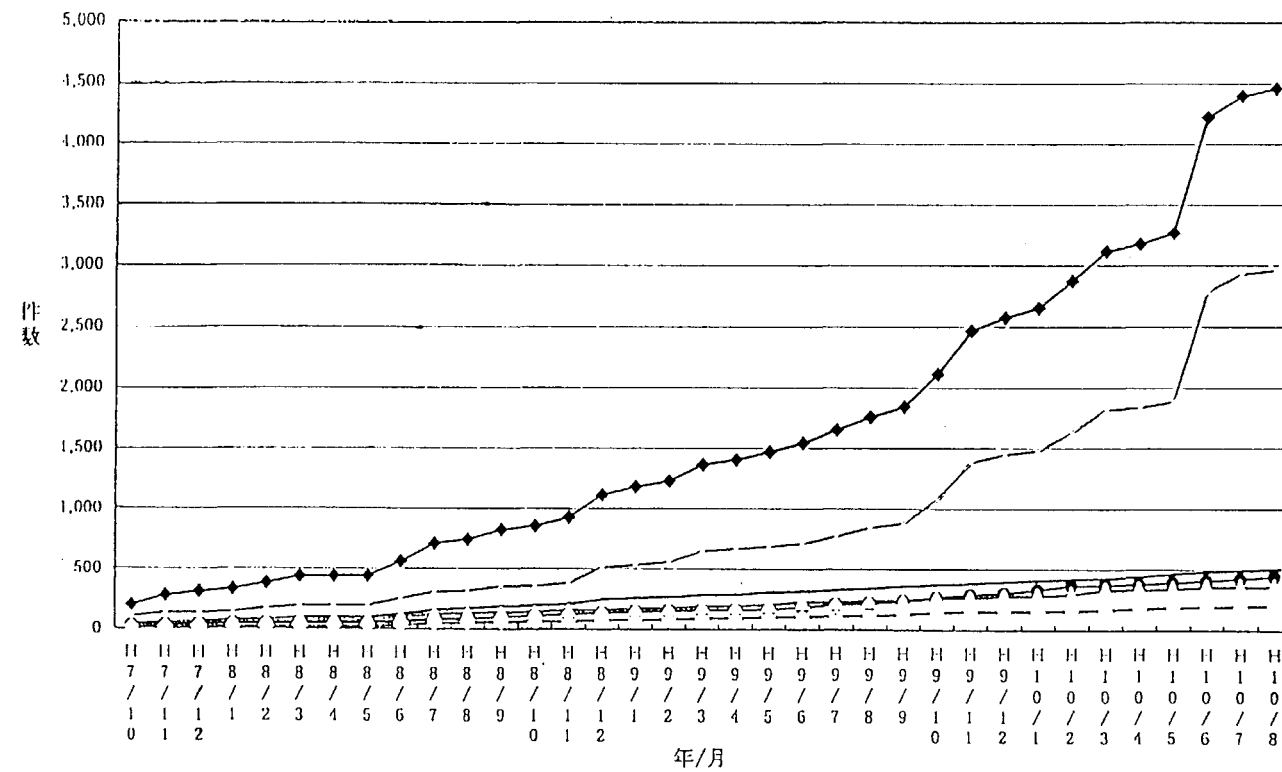
The international energy star logo is displayed on products themselves, as well as boxes, catalogs, advertisements, etc. It is used in colors, or monochrome.

International energy star logo. It is displayed on energy-saving OA equipment.

製品登録累積件数・国際エネルギースタープログラム

(公開日基準・H10年8月末現在)

Energy Star Program



◆ 累計(全体)
— プリンタ 累計

--- コンピュータ 累計
--- ファクシミリ 累計

● ディスプレイ 累計
--- 複写機 累計

Air-conditioner Cooling Capacity: 2.5 kW (7 to 10 Tatami Mat sized room)

	Model	Voltage 1P 100v-Nonmarked 2P 100v ★	Standard Price (¥)	Cooling				Heating					Average COP	Annual power rates (¥/m)	Function			
				Cooling Capa (kW)	Power Consump- tion (W)	COP	Power in Cooling (kW/m)	Cost (¥/m)	Standard Power open air at 7°C (kW)	Power Consump- tion (W)	COP	Power in Heating (kW/m)			Cost (¥/m)	Power open air at 2°C (kW)	de- humid	Clean- ness
SANYO	SAP-F25A		195,000	2.5	530	4.72	55	1,265	3.6	720	5.00	130	2,990	4.3	4.86	20,999	●	●
NEC	RC-VZ25L		195,000	2.5	530	4.72	55	1,265	3.6	720	5.00	130	2,990	4.3	4.86	20,999	●	●
DAIKIN	SRK250RZ		195,000	2.5	530	4.72	-	-	3.6	750	4.80	-	-	4.1	4.76	-	●	●
SANYO	SAP-E25BVS		-	2.5	550	4.55	-	-	3.6	740	4.86	-	-	4.0	4.71	22,700	●	●
NEC	RC-VZ25G		195,000	2.5	550	4.55	59	1,357	3.6	740	4.86	141	3,243	4.0	4.71	22,722	●	●
HITACHI	RAS-251QJX		195,000	2.5	540	4.63	53	1,219	4.0	740	4.86	122	2,806	4.1	4.66	19,821	●	●
NATIONAL	CS-G25M		197,000	2.5	555	4.27	58	1,334	3.6	855	4.86	142	3,266	4.0	4.57	22,765	●	●
NATIONAL	CS-G25M(★)		197,000	2.5	555	4.27	-	-	3.6	740	4.86	-	-	4.0	4.57	-	●	●
NATIONAL	CS-G25MR		202,000	2.5	555	4.27	-	-	3.6	740	4.86	-	-	4.0	4.57	-	●	●
DAIKIN	SRK28B		-	2.5	1,090	2.29	-	-	3.6	1,190	2.88	-	-	2.9	2.66	-	●	●
NEC	RC-VS25G		-	2.5	1,030	2.29	-	-	3.4	1,180	2.88	-	-	2.9	2.66	-	●	●
NEC	RC-VS25F		-	2.5	1,030	2.43	-	-	3.4	1,180	2.88	-	-	2.9	2.66	-	●	●
SANYO	SAP-V25A		-	2.5	1,030	2.43	-	-	3.4	1,180	2.88	-	-	2.9	2.66	-	●	●
SANYO	SAP-25BLVR		-	2.5	1,030	2.43	-	-	3.4	1,180	2.88	-	-	2.9	2.66	-	●	●
NATIONAL	CS-AG25K		-	2.5	1,100	2.27	-	-	3.4	1,160	2.93	-	-	2.9	2.60	-	●	●
PANASONIC	FC25BA1HE	190,000	2.5	1,140	2.19	-	-	-	3.4	1,280	2.66	-	-	2.8	2.43	-	●	●
PANASONIC	FC-25A1C		-	2.5	1,140	2.19	-	-	3.4	1,280	2.66	-	-	2.8	2.43	-	●	●
PANASONIC	FC-15A1		-	2.5	1,140	2.19	-	-	3.4	1,280	2.66	-	-	2.7	2.43	-	●	●
MAX			225,000	2.5	1,140	4.72	86	1,978	4.0	1,280	5.00	190	4,370	4.7	4.86	30,937	-	-
AVERAGE			190,061	2.5	792	3.33	65	1,497	3.6	974	2.77	152	3,497	3.4	3.55	25,119	-	-
MIN			150,000	2.5	530	2.19	53	1,219	3.4	720	2.66	119	2,737	2.4	2.43	19,442	-	-

Figure: Example of electrical equipment performance
Source: Energy-saving electronic products comparison catalog '97

Difference in Energy-saving Performance of Air-conditioners, by Types

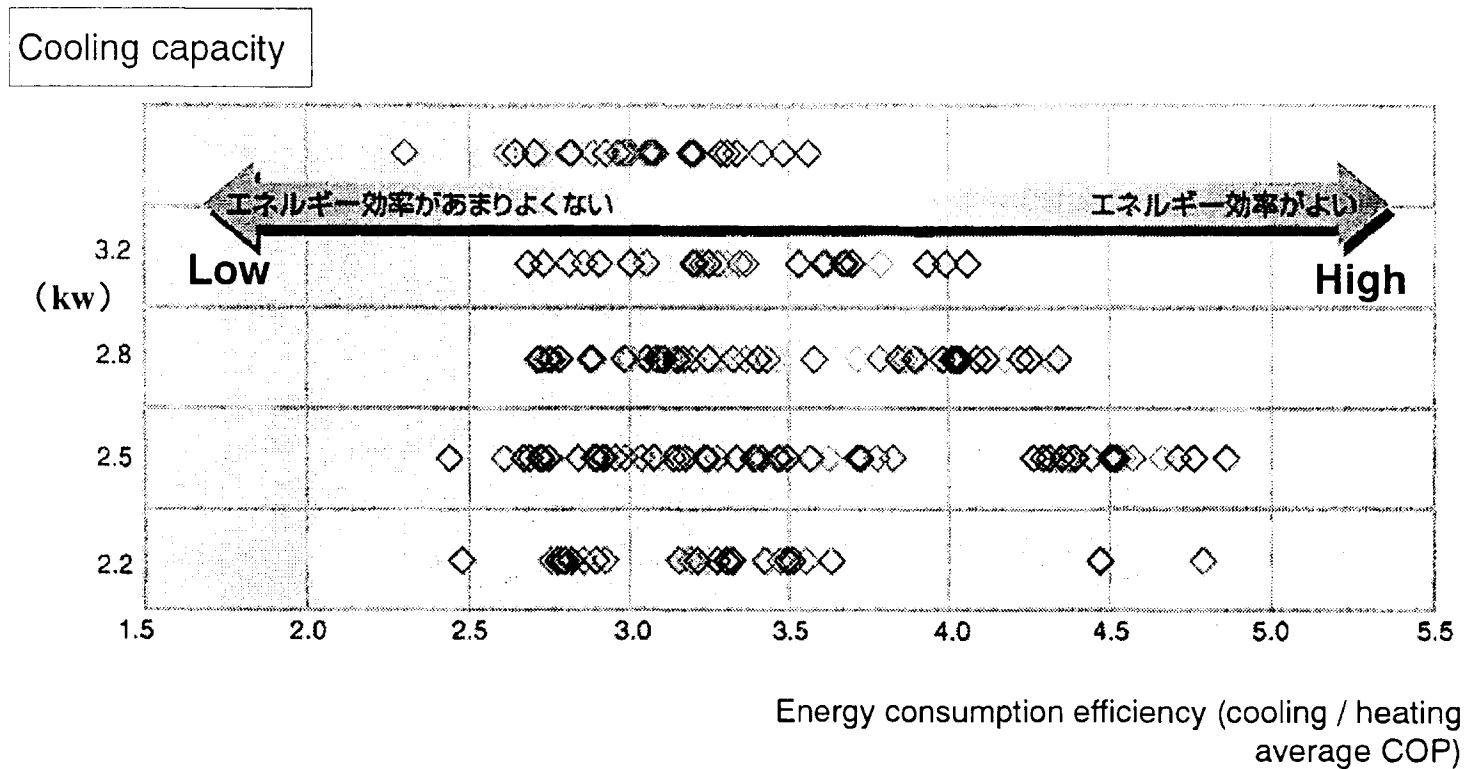


Figure: Average COP distribution of heating and cooling of air-conditioners

There is a huge difference in energy-efficiency
between different types

Effective unobstructed capacity

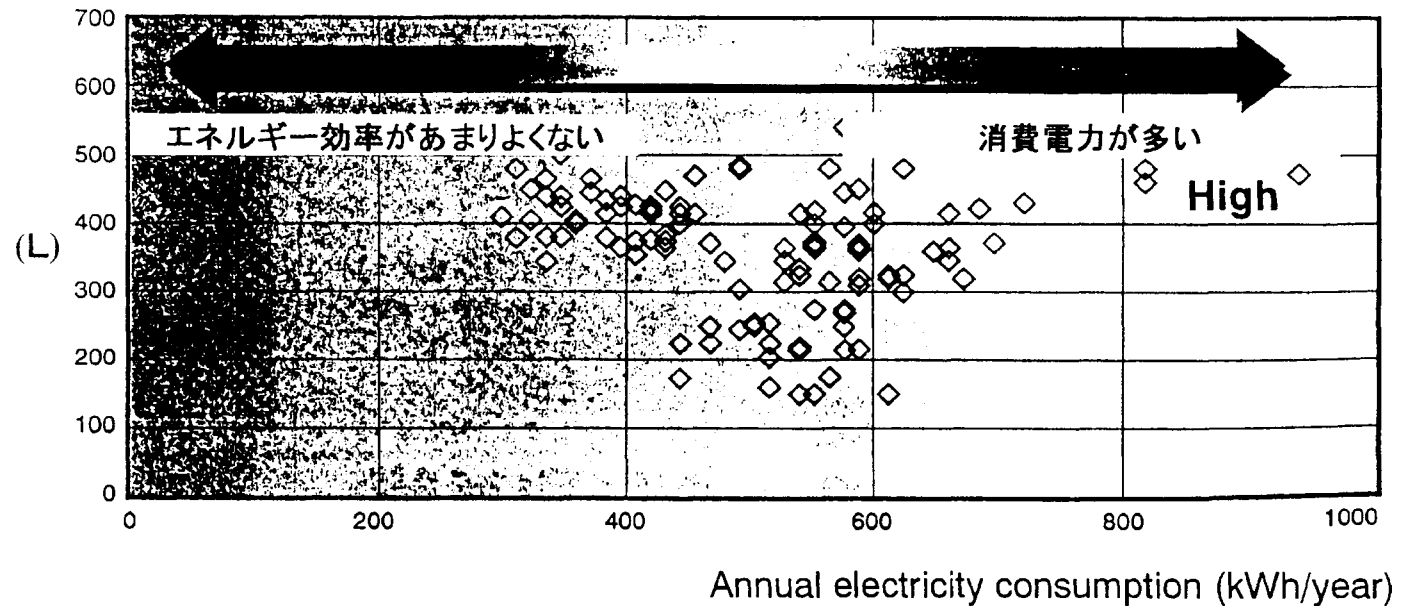


Figure: Distribution of annual electricity consumption for refrigerator

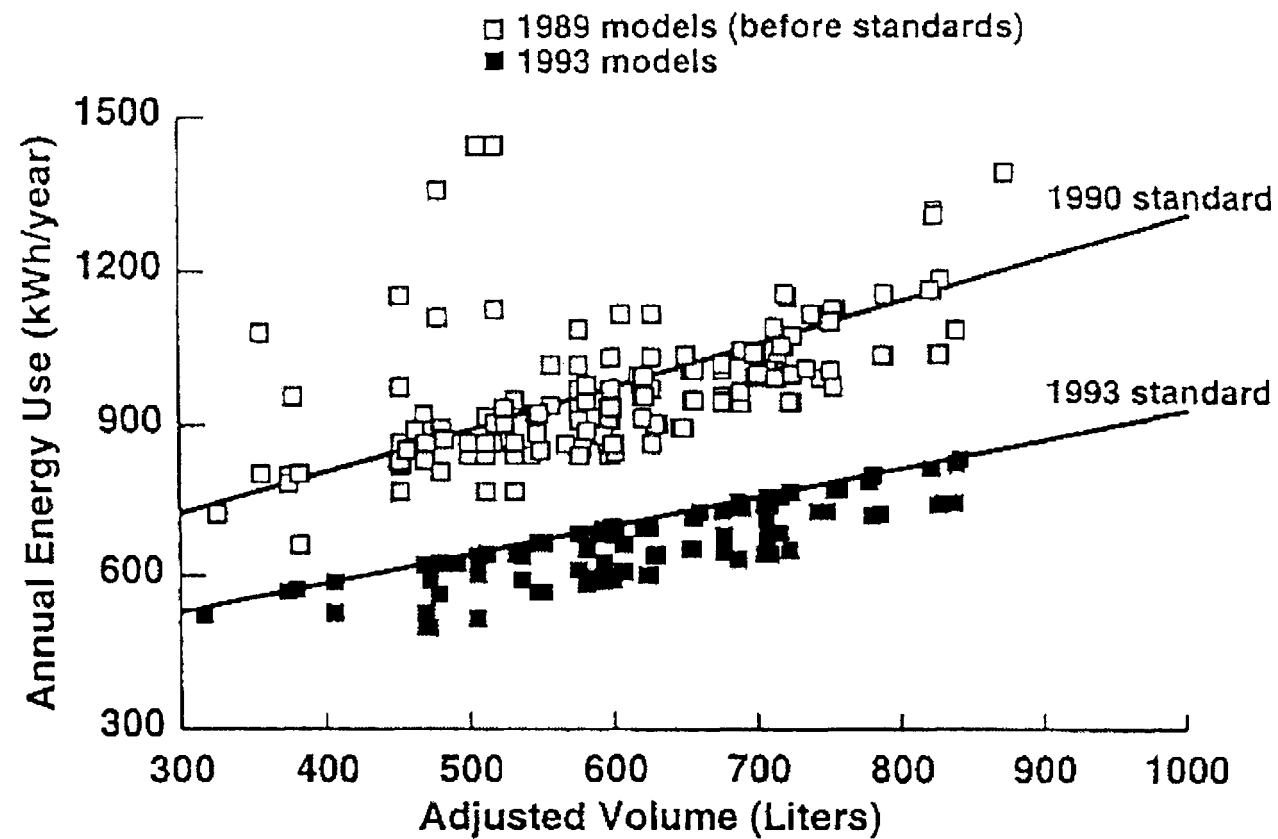
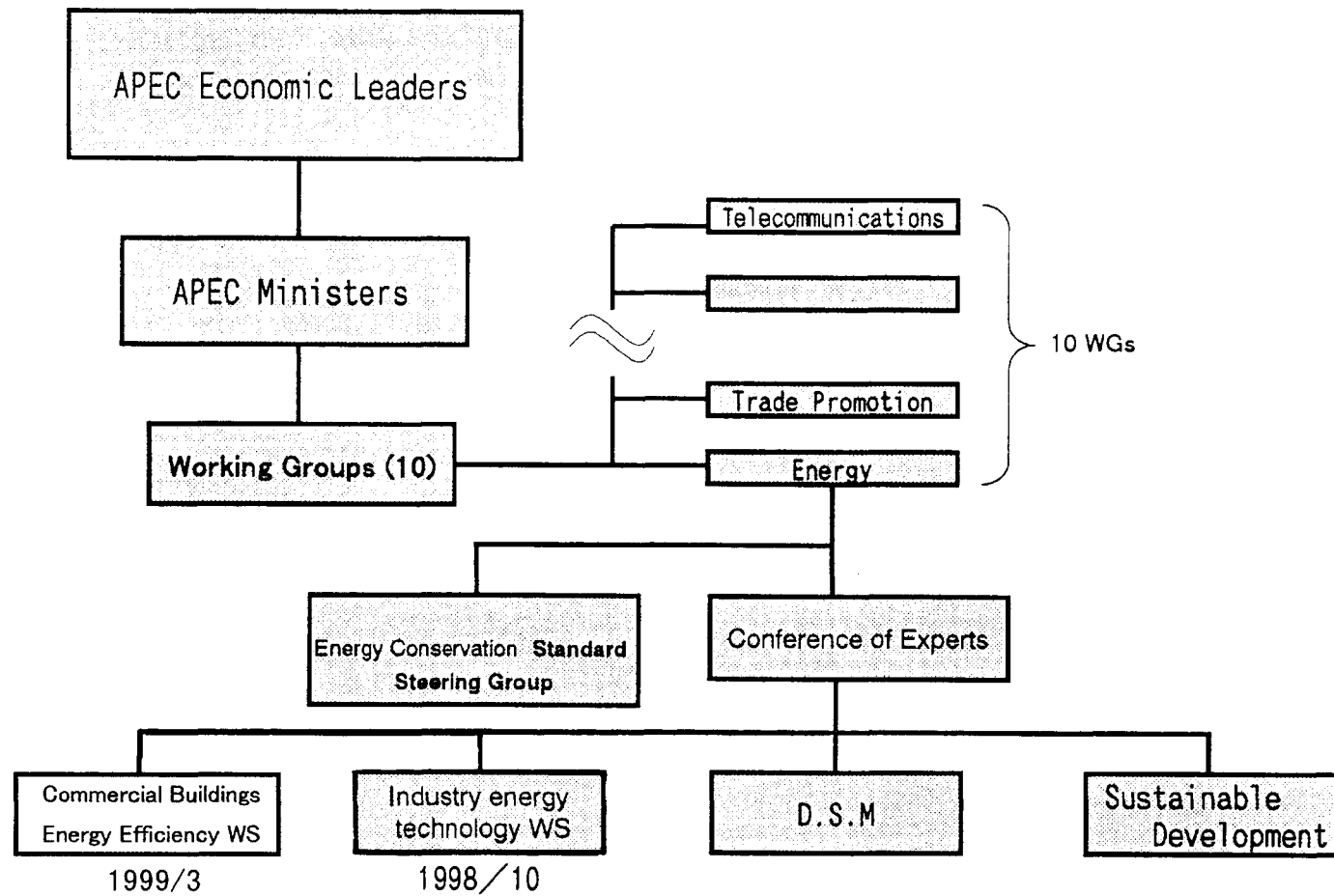


Fig. 2. Annual electricity use of top mount refrigerator freezers with automatic defrost. Source: Ref. [24].

Asia Pacific Economic Cooperation



Strong Promotion of Environmental Protection and Energy Conservation

International Harmonization	-----	Framework on Climate Change Standard of energy conservation measures ISO 14001 etc
International Cooperation	-----	Application of Experience in Japan Industry, residential
Technology transfer	-----	Single technology→ Technology in the configuration of the system (process, methodology)

Global environmental measures and the Kyoto Protocol

An evaluation of international emissions trading

Frank Jotzo, Cain Polidano, Stephen Brown and Roger Stuart

Symposium on Pacific Energy Cooperation – SPEC '99
Dai-ichi Hotel, Tokyo, 16–17 February 1999

Ratification of the Kyoto Protocol will have significant medium and long term implications for the economies of both Annex B and non-Annex B countries. The protocol is one of the most ambitious and far reaching environmental policy initiatives ever attempted. It is therefore particularly important to evaluate the cost and environmental effectiveness of the different global environmental policy measures that can be used to achieve the protocol's objectives. These measures include independently achieving a country's emission reduction target entirely through national abatement actions and international emissions trading.

In this paper the cost effectiveness of meeting the Kyoto Protocol's targets with international emissions trading is evaluated relative to independent national abatement without trading. It is shown that a system of internationally tradable emission quotas could simultaneously decrease the economic cost and increase the environmental effectiveness of achieving the Kyoto Protocol's objectives.

ABARE project 1590

ABARE

Innovation in Economic Research

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Introduction

On 11 December 1997 the international community adopted the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Developed countries collectively agreed to reduce their aggregate emissions of greenhouse gases by at least 5 per cent from 1990 levels over the period 2008–12. The emission reduction targets are comprehensive in their coverage of greenhouse gases across all sources and sinks.

The purpose in this paper is to evaluate the economic costs and environmental effectiveness of meeting the Kyoto Protocol's targets with international emissions trading relative to independent national abatement without trading. The evaluation is conducted taking into account emissions of the three major greenhouse gases: carbon dioxide, methane and nitrous oxide. Estimates of the impacts of emission abatement policies are based on simulation results from ABARE's Global Trade and Environment Model (GTEM). The paper draws on and adds to the analysis in Kennedy, Brown, Graham and Fisher (1998).

Key elements of the Kyoto Protocol and developments at Buenos Aires

Target commitments

Parties listed in Annex B of the protocol (mainly developed countries) have collectively agreed to reduce their aggregate anthropogenic carbon dioxide equivalent emissions of greenhouse gases to at least 5.2 per cent below 1990 levels for the first commitment period.

This collective Annex B target will be achieved through individual Annex B parties meeting differentiated targets that were agreed at Kyoto (table 1). Japan, the United States and members of the European Union have commitments to reduce greenhouse gas emissions to 6 per cent, 7 per cent and 8 per cent below 1990 levels respectively in the first commitment period. Australia's target was set at 8 per cent above the 1990 level. This is comparable with the emission reduction commitments agreed to by other parties relative to their projected 'business as usual' emission growth paths.

Since Kyoto, the European Union has agreed to a differentiated internal European burden sharing arrangement for the purposes of collectively meeting its commitments. Under this new burden sharing arrangement, Portugal and Greece, for example, can increase emissions by 27 per cent and 25 per cent respectively, while Germany and Denmark have each agreed to reduce emissions by 21 per cent. These revised figures are shown in parentheses in table 1.

Anthropogenic sources of six greenhouse gases, including emissions from land use change, are to be included in national greenhouse gas emission inventories. However, emissions

ABARE CONFERENCE PAPER 99.7

Table 1: Kyoto Protocol target commitments for Annex B countries

Percentage of base year or period

Party	Target	Party	Target
	Percentage of base year or period		Percentage of base year or period
Australia	108	Liechtenstein	92
Austria	92 (87*)	Luxembourg	92 (72*)
Bulgaria ^a	92	Monaco	92
Canada	94	Netherlands	92 (94*)
Croatia	95	New Zealand	100
Czech Republic	92	Norway	101
Denmark	92 (79*)	Poland ^b	94
Estonia	92	Portugal	92 (127*)
European Community	92	Romania ^a	92
Finland	92 (100*)	Russian Federation	100
France	92 (100*)	Slovakia	92
Germany	92 (79*)	Slovenia	92
Greece	92 (125*)	Spain	92 (115*)
Hungary ^c	94	Sweden	92 (104*)
Iceland	110	Switzerland	92
Ireland	92 (113*)	Ukraine	100
Italy	92 (93.5*)	United Kingdom of Great Britain and Northern Ireland	92 (87.5*)
Japan	94	United States of America	93
Latvia	92		

^a Base year: 1989. ^b Base year: 1988. ^c Base year is average of years 1985–87.

*Agreed European Union internal burden sharing arrangement.

from land use change are not included when defining the emission targets (shown in table 1) unless the changes were a net source of emissions in 1990. The six greenhouse gases covered by the protocol are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride.

Whether a country meets its commitments will be assessed by comparing its target with its emission inventory averaged over the period 2008–12. An average is used to reduce the influence of annual fluctuations in emission levels that can arise from external shocks or circumstances such as unusual weather conditions or a cyclical increase in economic activity.

Reductions in greenhouse gas emissions from sources and removals of carbon by sinks, such as forestry activities (subject to certain limitations, and future agreement on rules and methodologies), can be used to meet target commitments.

Flexibility mechanisms

There are a number of provisions in the protocol that provide flexibility in the way in which Annex B countries can meet their commitments and, thereby, capture opportunities for

reducing the costs of meeting abatement targets. The allowed flexibility measures are emissions trading, emissions banking, the 'clean development mechanism' and 'joint implementation'.

International emissions trading is a market based instrument that allows countries to meet their Kyoto commitments more cost effectively than through independent abatement by allowing abatement to be undertaken first in countries where the marginal cost of abatement is lowest. Tradable emission quotas that specify the right to given volumes of emissions over a specified time period are issued to, and then traded between, participants. The parties can then decide whether to abate nationally or, if the marginal cost of abatement in the country is higher than the price of emission quotas, to purchase the right to emit in another country. While the Kyoto Protocol provides for international emissions trading, the principles and guidelines governing the operation of such a regime have yet to be negotiated.

Emissions banking allows emission reduction credits achieved in one commitment period to be transferred to a subsequent commitment period. This provides additional flexibility in the timing of abatement actions. Joint implementation is a mechanism for generating greenhouse gas emission reduction credits from abatement projects arranged jointly by Annex B parties. The clean development mechanism allows generation of credits from abatement projects financed by Annex B parties in non-Annex B countries. These credits can be used by Annex B countries to meet their emission targets. The clean development mechanism presents an opportunity for non-Annex B participation in addressing climate change while also providing opportunities for technology transfer to non-Annex B parties.

Policies and measures

The protocol recognises that countries will need to implement policies and measures to reduce greenhouse gas emissions in accordance with their national circumstances. The protocol lists a range of policies and measures. The list is illustrative rather than mandatory.

'Bubble' arrangements

The protocol provides for the establishment of 'bubble' arrangements between the members of any groups of parties that choose to fulfil their aggregate commitments jointly. The European Union internal burden sharing arrangement is an example of a bubble arrangement. The protocol also requires transparency in the modalities of the operation of bubbles. In the event of failure, each party will be responsible for meeting the target inscribed for it in its instrument of ratification.

Noncompliance

No agreement was reached on how to determine or deal with cases of noncompliance. Approval of the procedures and mechanisms to determine and address cases of noncompliance, including penalties, are issues for further negotiation. However, the adoption of any mechanisms for dealing with noncompliance that would entail binding consequences would require an amendment to the protocol.

Entry into force

The protocol will enter into force when it has been ratified by at least 55 parties to the convention and by Annex I countries representing at least 55 per cent of total carbon dioxide emissions in 1990 from Annex I countries.

Developments at Buenos Aires

International climate change negotiations continued at the Fourth Conference of the Parties (COP4) to the UNFCCC in Buenos Aires, 2–13 November 1998. A key outcome of the conference was the adoption of the ‘Buenos Aires Plan of Action’ aimed at strengthening the implementation of the UNFCCC and preparing for the future entry into force of the Kyoto Protocol (a preliminary version of the COP4 decisions and resolutions can be found at <http://www/unfccc.de/>). The Buenos Aires Plan of Action is a comprehensive work program to develop the operational frameworks for a wide range of issues relating to the implementation of the UNFCCC and the Kyoto Protocol that were left unresolved in Kyoto.

A central feature of the Plan of Action is the work program on the three flexibility mechanisms of the Kyoto Protocol — international emissions trading (Article 17), the clean development mechanism (Article 12) and joint implementation (Article 6). Parties have been invited to submit proposals to various technical workshops and negotiating sessions with the aim of agreeing on the underlying principles, modalities, rules and guidelines for the three flexibility mechanisms at COP6 in late 2000.

Framework of analysis

The analysis of emission reduction scenarios in this paper is based on simulation results from the Global Trade and Environment Model (GTEM). GTEM is a dynamic general equilibrium model of the world economy developed at ABARE to address global change policy issues. It is derived from the MEGABARE model (ABARE 1996) and the GTAP model (Hertel 1997). A key development in GTEM since MEGABARE is an extension of the coverage of greenhouse gas emissions.

Regional and sectoral detail

GTEM is an ideal tool for analysing international policies with wide ranging intersectoral ramifications because of its detailed regional and sectoral coverage. At its most disaggregated level, GTEM models 50 industries in 45 countries and regions. The version used to simulate policy responses to the Kyoto Protocol has been aggregated to 24 commodity groups and 19 regions. The particular commodity coverage was chosen to represent explicitly the products that emit greenhouse gases (fossil fuels and agricultural commodities) and the industries that are intensive consumers of energy inputs (such as electricity, iron and steel, nonferrous metals and processed agricultural products), as these activities are most heavily affected by greenhouse gas abatement policies (tables 2 and 3).

Table 2: Regional coverage

Annex B
Australia
New Zealand
United States
Canada
Japan
European Union (12)
Former Soviet Union
Central European Associates
Non-Annex B
South Korea
China
Chinese Taipei
Indonesia
Other ASEAN
India
Mexico
Brazil
Rest of America
Rest of world

Dynamics

GTEM is a dynamic model that permits growth in variables to be tracked over time. Population growth and capital accumulation are determined endogenously (within the model). This is in contrast to comparative static models, which compare two equilibriums (one before a policy change and one following it), and do not include changes in the supply of factors of production. The dynamic nature of GTEM is important when analysing climate change policies since both the timing of policy changes and the adjustment path an economy follows are highly relevant in the policy debate.

In GTEM, a 'business as usual' simulation, or 'reference case', is compared with policy simulations. The reference case simulation projects growth in labor and capital in each country or region, and the associated growth throughout the rest of the economy, in the absence of any policy changes. The results of a policy simulation are then interpreted as deviations from the reference case scenario and represent the influences of the policy change. For example, the influence of an emission reduction policy can be isolated by comparing emissions growth in the simulation against emissions growth in the reference case, as illustrated in figure 1. The effect on emissions (the distance *ab* in figure 1) may be reported, for example, as a 10 per cent reduction from the reference case emission projection at 2010 (the distance *de* in figure 1).

Table 3: Commodity and greenhouse gas emissions coverage

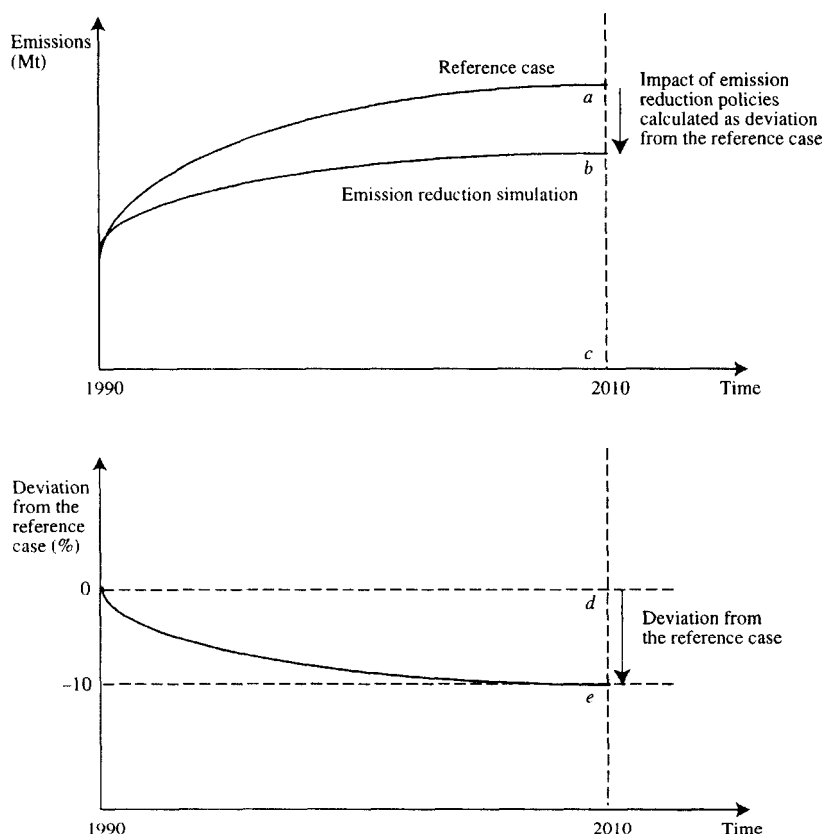
Commodities	CO₂ from fossil fuel	CO₂ from other sources	Methane	Nitrous oxide
Energy				
Coal	✓		✓	
Oil	✓	✓	✓	
Natural gas	✓	✓	✓	
Electricity	✓			
Minerals and metals				
Nonmetallic minerals	✓	✓		
Other minerals	✓			
Iron and steel	✓			
Nonferrous metals	✓	✓		
Manufacturing				
Chemicals, rubber and plastics	✓			✓
Fabricated metal products	✓			
Resources processing	✓			
Petroleum products	✓			
Manufacturing	✓			
Investment goods	✓			
Services				
Trade and transport	✓			✓
Services	✓			
Agriculture				
Paddy rice	✓		✓	✓
Grains	✓			✓
Nongrain crops	✓			✓
Livestock	✓		✓	✓
Forestry and fisheries	✓			
Processed food				
Processed rice	✓			
Meat and milk	✓			
Processed food	✓			

Emissions in GTEM

GTEM models emissions of three greenhouse gases – carbon dioxide, methane and nitrous oxide. Together, these three gases are responsible for 89 per cent of radiative forcing in the atmosphere (IPCC 1996). In Annex B regions, carbon dioxide, methane and nitrous oxide account for around 99 per cent of anthropogenic greenhouse gas emissions, excluding land clearing (United Nations 1998). For Australia the corresponding figure is 99.7 per cent (Environment Australia 1997).

GTEM identifies three fossil fuels — coal, natural gas and petroleum, and coal products — that emit carbon dioxide when converted into energy. (Emissions from the conversion of crude oil are negligible as only a very small proportion of crude oil is used directly for

Figure 1: Deviation from reference case in a GTEM simulation



energy conversion purposes: it is principally transformed into the petroleum and other products that are then used for producing energy and for other purposes.)

Nonenergy carbon dioxide emissions from industrial processes are also represented in GTEM. These comprise fugitive emissions of carbon dioxide from oil and natural gas systems, emissions from metal production (iron, steel and aluminium) and emissions from the manufacture of lime and soda ash in the nonmetallic minerals industry.

Livestock is the most significant source of methane emissions. Emissions per head of livestock vary significantly between animal types, with cattle, sheep and pigs being the most emissions intensive. Methane emissions from poultry are negligible. Other sources of methane are paddy rice cultivation, fugitive emissions from oil and natural gas systems and coal mining.

required in each country depends on the projected level of emissions growth for that country in a 'business as usual' reference case. These projections are discussed in the following section.

Revenue from the carbon emission penalty is assumed to be returned to the economy in a lump sum fashion, thereby having a neutral effect on the economy. Changing the way in which revenue is returned to the economy can alter estimates of the economic impacts of emission abatement.

International emissions trading

International emissions trading allows countries to meet their Kyoto commitments more cost effectively by allowing abatement in other countries where the marginal cost of abatement is lower. If the marginal cost of abatement in a country exceeds the quota price it is more cost effective for that country to purchase a unit of quota than to abate. Conversely, if the marginal cost of abatement is less than the quota price it is possible to undertake the abatement and sell the emission credit on the world market at a profit. These activities will occur until the carbon emission penalties are equalised across abating countries and a quota price emerges that is equal to the Annex B carbon equivalent penalty.

The individual Kyoto commitments represent an initial allocation of 'rights to emit', or emission quotas, among the participating countries. These can be traded between countries. The uniform carbon emission penalty determined in the model is sufficient to meet the aggregate emission target and can therefore be interpreted as the price of the international emission quota. Income (payments) from the sale (purchase) of emission permits are accounted for as foreign income transfers that add (subtract) to gross national product (GNP). For example, if Japan or the United States purchased emission quotas from the Russian Federation, it would be conceptually equivalent to paying the Russian Federation to include some of the United States' or Japan's greenhouse gas emissions in its inventory.

A number of design and implementation issues are critical to achieving a least cost outcome in any emissions trading scheme (see, for example, Hinchy, Hanslow, Fisher and Graham 1998). Ensuring that the market for tradable permits is competitive and that transaction costs are minimised are central to these design issues. To simplify the analysis it is assumed that no trader is able to exercise market power, that there are no transactions costs and that there is perfect compliance with the scheme.

Reference case projections

The reference case does not include the impacts of energy policies that are currently being either implemented or negotiated in response to climate change. It thus constitutes a

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Table 4: Projected average annual growth in emissions, population and output, 1990–2010: reference case

	Carbon dioxide	Methane	Nitrous oxide	Carbon equivalent emissions	Population	Output (GDP)
	%	%	%	%	%	%
Annex B	0.86	–0.50	1.02	0.74	0.41	2.75
Non-Annex B	5.50	2.72	3.79	4.85	1.40	5.79
Global	2.74	1.59	2.52	2.56	1.18	3.43

‘business as usual’ projection. The reference case serves as a base against which to determine the magnitude of the constraint implied by the Kyoto targets for emissions growth in Annex B regions, using 1990 as the base year. The reference case projections for greenhouse gases emissions, population and GDP are shown in table 4.

In the absence of abatement measures, global anthropogenic emissions of methane, nitrous oxide and carbon dioxide from fossil fuel combustion are projected to grow by approximately 66 per cent between 1990 and 2010. This represents an increase of around 18 billion tonnes of carbon dioxide equivalent greenhouse gases. Emissions from developing countries are projected to increase more rapidly than those from Annex B countries over the projection period in the reference case. On average, total carbon equivalent emissions from Annex B countries are projected to rise by 0.7 per cent a year over the period 1990–2010, compared with 4.9 per cent a year for developing countries. Accordingly, the Annex B share of world emissions is projected to fall from 65 per cent in 1990 to 45 per cent in 2010.

Carbon dioxide is the primary source of emissions growth in Annex B regions. Carbon dioxide emissions accounted for 88 per cent of Annex B emissions in GTEM in 1990 and this share is projected to increase to 90 per cent in 2010. Methane emissions from Annex B regions are projected to decrease over the period 1990–2010 because of technological improvements in the production of coal, oil and gas and the slower growth in agricultural production relative to overall GDP growth. While nitrous oxide emissions account for only a small proportion of greenhouse gas emissions their high growth rate makes nitrous oxide an important gas to model. The high growth in nitrous oxide emissions is driven by the projected higher than average growth in the transport and chemicals, rubber and plastics industries.

The projected emissions for Annex B regions are presented in table 5.

The strong projected growth in emissions from non-Annex B regions is largely a result of high projected population and GDP growth (see table 4) and the consequent growth in the demand for energy and emission intensive production. The demand for fossil fuels is

projected to rise due to the generally lower costs and greater accessibility of these fuels than hydropower and nuclear energy.

The inclusion of methane and nitrous oxide in the model leads to lower projections in the rate of growth of total greenhouse gas emissions than when the analysis is restricted to carbon dioxide. For example, the average annual growth in Annex B carbon dioxide emissions is projected to be 0.86 per cent over the period 1990–2010. Over the same period, the average annual growth in Annex B carbon equivalent emissions is projected to be 0.74 per cent.

The lower growth in Annex B carbon equivalent emissions reflects a projected decline in methane emissions in Annex B regions. Consequently, the relative magnitude of abatement required to meet the Kyoto commitments is smaller.

Table 5: Projected emissions of the three major greenhouse gases ^a

Annex B regions: reference case

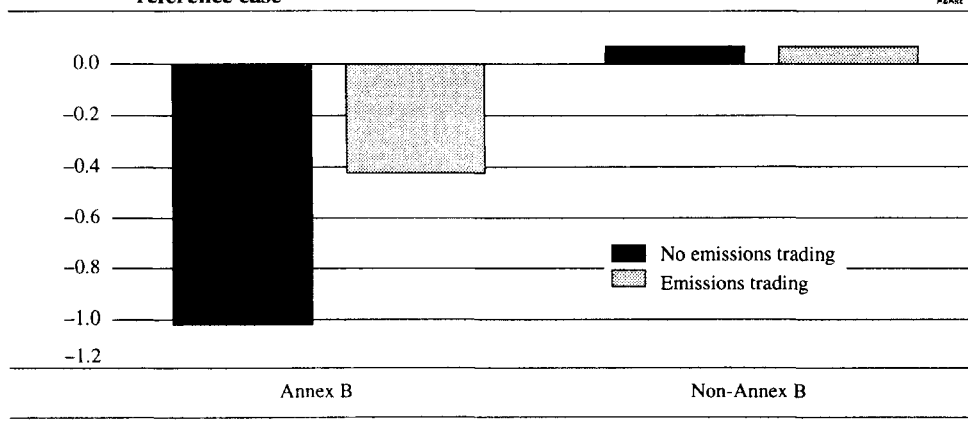
	1990	2000	2005	2010
	Mt	Mt	Mt	Mt
Australia	382	445	481	519
New Zealand	44	52	56	61
United States	6 064	6 683	7 216	7 737
Canada	585	621	689	759
Japan	1 190	1 333	1 386	1 432
European Union	3 108	3 490	3 677	3 827
Former Soviet Union	5 042	3 873	4 108	4 588
Eastern Europe	1 583	1 426	1 618	1 887
Total Annex B ^b	18 124	18 082	19 405	20 997

^a Carbon dioxide, methane and nitrous oxide. ^b Includes other Annex B countries not listed above.

Global impacts of the Kyoto Protocol

By allowing emissions to be reduced where it is least costly to do so, an emissions trading scheme is projected to reduce the aggregate economic cost to Annex B countries of meeting their Kyoto commitments to around a third of what they would be in the absence of international trading (figure 2). The aggregate GNP of Annex B countries is projected to be 0.4 per cent lower at 2010 than in the reference case, compared to 1.0 per cent in the absence of trading. The net real GNP impact in non-Annex B countries as a whole is

Figure 2: Change in real GNP under the Kyoto Protocol at 2010, relative to the reference case



projected to be slightly positive, whether or not there is an international emissions trading scheme in place.

Impacts on Annex B regions

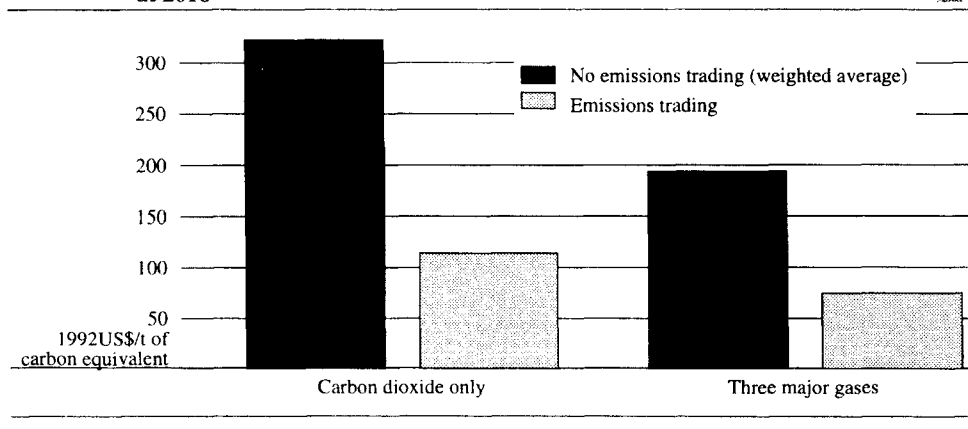
Changes in GNP can be decomposed (to a first order approximation) into impacts from a range of sources — the direct impact on an Annex B country of an increase in the cost of emitting carbon within that country; a trade impact; and a foreign income transfer impact arising from international quota purchases and sales (if any).

Carbon equivalent penalties

The relative magnitude of GNP changes with and without emissions trading is partly correlated to the size of the carbon equivalent penalty. The major source of the economic costs of meeting the abatement targets in Annex B countries is an increase in industrial production costs and consumer prices as emission restrictions force producers and consumers in Annex B countries to move away from, for example, carbon intensive fossil fuel use or methane-emission intensive production processes, and into more expensive alternatives. The increased costs to industry and consumers of using fossil fuels and some agricultural inputs tend to dampen economic activity. The resulting decline in demand for labor and capital reduces real returns to labor and capital, in turn leading to reduced aggregate income and lower levels of economic activity. Projected carbon emission penalties at 2010 with and without emissions trading are shown in figure 3.

Under independent abatement, each Annex B country must meet its emissions target domestically, irrespective of cost. The average carbon equivalent penalty is significantly greater in the case without trading, as regions with higher abatement costs require a higher penalty to induce abatement. Emissions trading reduces the carbon equivalent emission penalty because it permits abatement activities to occur wherever they are least expensive

Figure 3: Annex B carbon equivalent emission penalties under the Kyoto Protocol at 2010



The most significant sources of nitrous oxide emissions are the transport and chemicals industries. Within the chemicals industry, the major sources are the manufacture of nitrogenous fertilisers, explosives and nylon products. Livestock manure and the application of fertilisers in agricultural industries are other sources of nitrous oxide emissions.

Emissions of methane and nitrous oxide are represented in GTEM in carbon dioxide equivalents. The carbon dioxide equivalent is derived by multiplying the emissions by the appropriate global warming potential, a measure of the relative radiative forcing of different greenhouse gases. The global warming potential values are 1, 21 and 310 for carbon dioxide, methane and nitrous oxide respectively over a 100 year time horizon (IPCC 1996). A molecule of nitrous oxide, for example, is 310 times more potent in terms of climate forcing than a molecule of carbon dioxide over a 100 year time horizon.

Limitations of emissions coverage

A number of greenhouse gas emission sources that are not currently included in GTEM are:

- carbon dioxide emissions from changes in land use and sequestration by sinks;
- methane and nitrous oxide emissions from burning agricultural residues and savannas;
- methane emissions from the disposal of solid waste, wastewater handling and waste incineration; and
- methane and nitrous oxide emissions from various industrial processes and combustion activities.

Emission reduction responses

GTEM contains two mechanisms for industries to reduce emissions in response to policy measures designed to limit greenhouse gas emissions. The first and most important way is to substitute away from emissions intensive inputs or products. GTEM contains a number of such substitution possibilities. The second response is to increase the efficiency of emission generating activities. GTEM's treatment of efficiency responses is described in Kennedy et al. (1998).

Measuring economic costs

A range of macroeconomic variables has been used in the recent literature to measure the impact of climate change policies on national economic welfare. These include gross domestic product (Manne and Richels 1998), gross national product (McKibbin and Pearce 1996; Kennedy et al. 1998), gross national expenditure (Brown et al. 1997), direct net cost measures (Jacoby, Schmalensee and Wing 1998), real consumption and equivalent variation (Montgomery et al. 1998).

In this paper, changes in gross national product (GNP) are used to measure the aggregate economic impacts of policies. GNP is equal to gross domestic product (GDP) plus foreign income transfers and therefore provides a complete measure of the flow of income available to an economy for consumption and saving. In the context of international emissions trading, for example, changes in GNP from reference case levels account for both the changes in GDP resulting from increases in the cost of emitting carbon and the income transfers associated with quota purchases and sales.

Modeling emission abatement policies

In the policy simulations presented in this paper, countries are assumed to gradually reduce national emissions until they reach their Kyoto target in the year 2010. The model specification requires that a particular year be defined as the time at which the Kyoto targets are met. In practice, countries would meet their emissions target over an average of the years 2008–12.

The two policy options for limiting greenhouse gas emissions that are examined here are independent abatement (without international emissions trading) and the implementation of an international system of tradable emission quotas.

Independent abatement

In modeling independent abatement it is assumed that governments adopt policy instruments that impose the smallest possible cost on their economies. A discussion of efficient approaches to reducing carbon dioxide emissions within a country is provided in Fisher et al. (1996). If least cost approaches are not adopted the estimated economic costs of implementing the Kyoto Protocol will be higher than those reported here.

In GTEM, least cost modeling of independent emission abatement involves imposing a per unit tax on carbon dioxide emissions or a 'carbon equivalent emission penalty' in each period for which emission restrictions apply. The carbon equivalent emission penalty can be interpreted as the marginal cost to the economy of implementing any least cost policy designed to achieve a given level of emission abatement — that is, the increase in the costs of abatement resulting from reducing emissions by an additional unit. It therefore represents the broad class of least cost economic instruments that could be used by governments to reduce emissions. This includes, for example, domestic emissions trading, where the penalty would be interpreted as the price of emission permits.

The carbon equivalent penalty will be sufficiently large to achieve the assumed emission target and it will differ from country to country. The carbon emission penalty raises the costs of emission producing activities and encourages a shift of resources into less emission intensive activities, thereby reducing emissions. The magnitude of emission reduction

within Annex B countries. In practice, marginal abatement costs differ substantially across countries. A regime of tradable quotas shifts emission reduction activities to regions with lower abatement costs, thereby reducing aggregate marginal abatement costs. As shown in figure 3, the projected carbon equivalent penalty for the weighted average of Annex B countries is nearly three times as high as the corresponding uniform penalty with trading. This result is achieved whether or not methane and nitrous oxide are included with carbon dioxide.

Including methane and nitrous oxide emissions in the analysis does, however, lower the carbon equivalent penalties below those in the simulation with carbon dioxide only (see figure 3). The projected price of emission permits is more than a third lower when the two other major gases are accounted for. There are two main reasons for this. First, the projected growth rates of industries emitting methane and nitrous oxide, particularly in agriculture, are lower on average than those for energy intensive industries (see table 4). This results in a lower baseline projection of the emissions growth rate, and thus a smaller abatement target relative to the reference case. While the total abatement required is higher than if carbon dioxide only is considered, the target as a percentage of total emissions is lower. Second, a larger base of activities generating emissions provides additional possibilities for substituting inputs and improving the emission efficiency of production processes to reduce emissions. With more opportunities for replacing emission intensive activities, a smaller carbon equivalent penalty is needed to induce the required reductions in emissions.

Trade impacts

The impacts of Annex B policies under the Kyoto Protocol on international trade can also be an important determinant of economic costs. The trade impacts arise because actions to limit emissions in Annex B countries will affect the relative prices of products traded on world markets. For example, abatement policies will tend to reduce global demand for fossil fuels, thereby exerting downward pressure on global fossil fuel prices. Revenue from fossil fuel exports from Annex B and non-Annex B regions can therefore be expected to decline.

On the other hand, the competitiveness of fossil fuel exporters in non-Annex B regions is likely to increase relative to exporters in Annex B countries, where fugitive emissions of methane are subject to taxation, thus increasing production costs. Also, Annex B countries that export greenhouse gas intensive products, such as iron and steel, aluminium and, to a lesser extent, processed rice, could face a reduction in export demand as these industries begin to relocate to developing countries. The tendency to relocate is discussed in more detail below, but occurs because greenhouse gas intensive products become more price competitive in countries that do not have quantitative reduction targets under the protocol. Such trade impacts could be large for individual countries, depending on the composition and direction of their trade and extent of net foreign asset holdings (McKibbin and Pearce 1996; Brown et al. 1997).

Income transfers and regional emissions reductions

The trade in emission permits leads to income transfers between regions. Figure 4 shows projected net transfers from the buying and selling of emission permits at 2010 as a share of each region's GNP.

With Annex B emissions trading, the low abatement cost regions of the former Soviet Union and eastern Europe are projected to be net sellers of emission permits, undertaking more abatement than they would without trading. All other Annex B countries would be net buyers of permits, reaching their targets partly by paying the former Soviet Union and eastern Europe to increase their abatement efforts. For the former Soviet Union, emissions are projected not to exceed 1990 levels by 2010. Consequently, that region will more than meet its Kyoto Protocol abatement commitment by reducing its emissions below 1990 levels through economic contraction. Eastern Europe will have to reduce emissions to reach its target. Eastern Europe's marginal cost of abatement is, however, below the Annex B average and this will allow this region to become the second largest net seller of emission permits.

Measured as a percentage of GNP, the transfer payments are small for all countries that are net permit buyers. Canada, projected to be the largest net buyer of permits relative to the size of the economy, would spend less than 0.3 per cent of its GNP to buy emission credits abroad. All other net buyers are projected to spend less than 0.2 per cent of GNP on permits. The relative impact is much larger on the regions that receive payments in return for undertaking more abatement. Income transfers are projected to account for more than 3 per cent of the former Soviet Union's GNP in 2010. This asymmetry arises because the net payments are made to economies with relatively small GNPs.

The buying and selling of emission permits under international emissions trading will lead to changes in emissions by the different Annex B regions relative to those under

Figure 4: **Income transfers as a percentage of GNP at 2010 under the Kyoto Protocol with emissions trading**

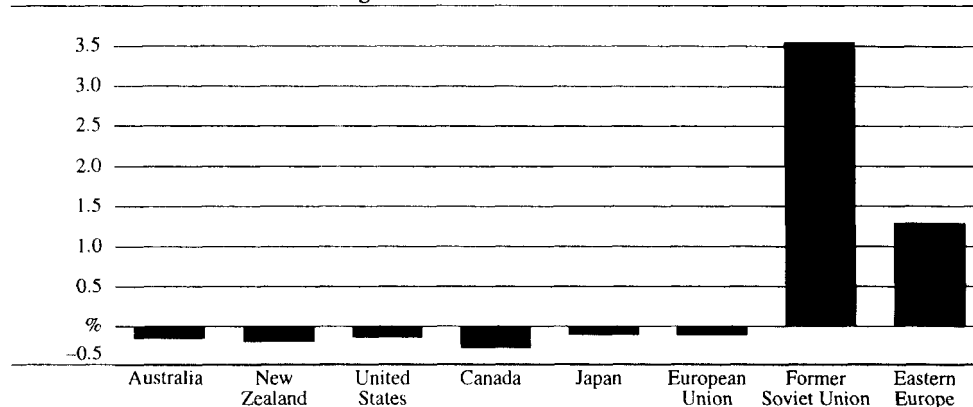
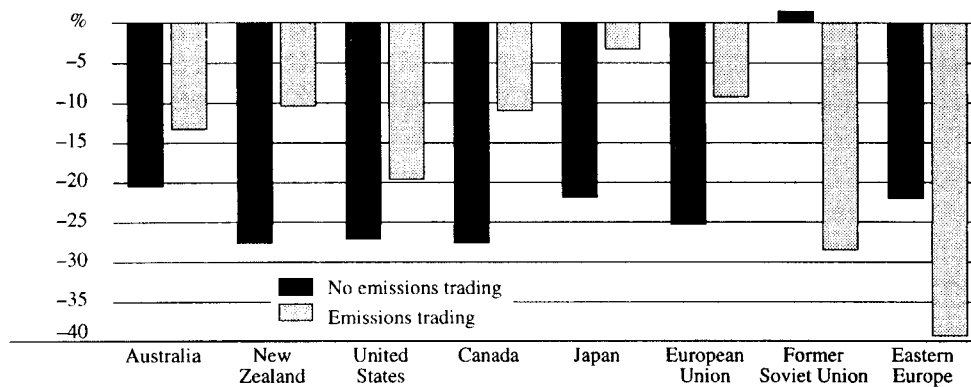


Figure 5: Emission reductions in Annex B regions at 2010 under the Kyoto Protocol, relative to the reference case



independent abatement. Buyers of permits can reduce their emissions by less than they would have to reach their target independently by domestic abatement only, while net permit sellers would increase their abatement efforts. On average, the countries buying permits are projected to reduce their emissions by 14 per cent instead of by 26 per cent under independent abatement. The regions that sell permits (the former Soviet Union and eastern Europe) increase their abatement from 5 per cent to 32 per cent. As shown in figure 5, Australia and the United States are projected to make below average use of emissions trading to reduce their domestic abatement. Japan is projected to undertake the greatest replacement of domestic abatement by the purchase of emission quotas.

Impacts on non-Annex B regions

Because of trade links between Annex B and non-Annex B countries, abatement policies in Annex B countries will affect non-Annex B welfare. Two largely offsetting influences drive these results.

First, the production of greenhouse gas intensive products in non-Annex B industries does not carry an emissions penalty, providing these goods with a competitive advantage over Annex B products. This will tend to increase export earnings and GNP in non-Annex B countries that rely heavily on exports of greenhouse gas intensive products.

Second, increased costs of Annex B production are passed on to consumers in non-Annex B regions through more expensive imports. This, combined with a reduction in demand for fossil fuel exports (as for Annex B countries) will tend to reduce non-Annex B GNP.

The overall result of those two opposing influences is that non-Annex B countries are projected to experience a small increase in GNP of around 0.07 per cent (as shown in figure 2). However there will be a significant variation in impacts among non-Annex B

countries — for example, large fossil fuel exporters will experience losses, while countries with a comparative advantage in the production of energy intensive exports based on imported fuels will gain.

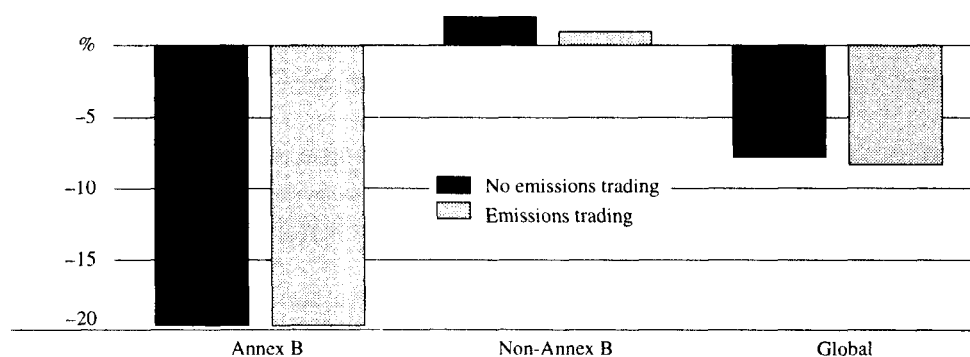
Emission reductions and carbon equivalent leakage

Annex B emissions under the Kyoto Protocol are projected to fall by around 20 per cent relative to the reference case at 2010 whether or not emission reductions are undertaken with trading. Non-Annex B emissions, however, are affected by the policy instruments used in Annex B countries. Emissions of the three major gases in non-Annex B countries are projected to increase by 1.0 per cent and 2.0 per cent, with and without emissions trading respectively, relative to the reference case at 2010 (figure 6).

This phenomenon is known as ‘carbon equivalent leakage’. It is the partial offsetting of emission reductions in abating countries by increases in emissions in nonabating countries. Leakage occurs because, for example, emission abatement increases the cost of fossil fuel use, and therefore the price of fossil fuel intensive products such as iron and steel and nonferrous metals, in Annex B countries. As a result, non-Annex B producers of fossil fuel intensive products gain a competitive advantage over producers in Annex B countries. In response, there is a partial shift in emission intensive industries from Annex B to non-Annex B countries. Leakage also takes place in industries that emit methane and nitrous oxide.

The increase in non-Annex B emissions of 2.0 per cent without emissions trading that is projected by GTEM implies a carbon leakage rate of 12 per cent; that is, for every one million tonnes reduction in carbon equivalent emissions in Annex B regions, carbon equivalent emissions from non-Annex B regions are projected to rise by 120 000 tonnes. With an emissions trading scheme, in contrast, the leakage rate is halved to 6 per cent.

Figure 6: Emission reductions in Annex B regions at 2010 under the Kyoto Protocol, relative to the reference case



Total global emissions of the three major gases are projected to be 0.5 per cent lower in 2010 than they would have been without emissions trading.

The extent of leakage is correlated with the size of the carbon equivalent penalty: the greater the penalty, the greater the impost on emissions intensive producers in Annex B countries and the greater the loss in competitiveness with developing countries. Introducing emissions trading, which results in lower penalties, therefore lowers the extent of carbon equivalent leakage and enhances the environmental effectiveness of climate change policy.

Conclusion

This paper uses a version of GTEM that includes carbon dioxide, methane and nitrous oxide to examine the economic impacts of the Kyoto Protocol. The results show that international emissions trading is a more efficient and effective mechanism than independent abatement for achieving the environmental objectives of the Kyoto Protocol. First, the cost of abatement to Annex B regions in aggregate is lower with international emissions trading. Second, the environmental effectiveness of the Kyoto protocol is increased because the extent of carbon equivalent leakage is reduced. Including methane and nitrous oxides also significantly reduces the economic impacts of meeting the Kyoto targets. Among other things, this will reduce the impacts on the energy sector.

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**CLEAN COAL TECHNOLOGY:
IT'S CURRENT STATUS AND FUTURE USE**

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INTRODUCTION

Now, in the early months of 1999, COAL as a viable source of energy faces numerous obstacles, the most prominent of these being increased environmental requirements and the issues of fossil energy in the era of Global Climate Change. The role of Clean Coal Technology as a bridge between Coal and the Environment faces an uncertain future.

Arriving with great promise in the United States in 1984 and in the Asia Pacific Region in 1993 under the auspices of the Asia Pacific Economic Cooperation (APEC), the concept of Clean Coal Technology now must recognize that recent changes in the financial structure of most economies and the increasing environmental demands (political as well as regulatory) have forced an intensive reevaluation of the tactics that must be employed if these technologies are to become that bridge. Although the distribution and use of Clean Coal Technologies have not proceeded at the rate earlier expected, there are some promising signs that new realizations of energy demand, environmental costs (economic and social), and murmurs of dissatisfaction with the rate at which societal benefits associated with adequate supplies of energy are being realized are supporting the need for an accelerated and broader use of Clean Coal Technologies.

STATUS OF CLEAN COAL - THE CONCEPT AND THE TECHNOLOGIES

THE CONCEPT

The convergence of environmental regulations and the increasing demand for energy, in particular from coal, has forged the term CLEAN COAL. Considered by many as an oxymoron, clean coal technology, its development and use, has become a major world wide initiative. This initiative promises to be a mechanism by which the projected increased demands for energy can be achieved while, at the same time, achieving the goals being established by the environmental community. The success of the initiative is evident in almost every sector of the economy in which coal plays a significant role. No longer are there debates about utilities, sulfur dioxide and acid rain; commercial equipment exists and is being employed to solve the issues surrounding the release of the oxides of nitrogen; and the costs of electricity generated from coal still remain among the lowest. However, all of these and numerous other accomplishments remain essentially unrecognized in the ongoing debates about the environment and energy. Rather new challenges have been given to the coal community. Hazardous air pollutants and global climate change are the new burdens now being placed on Clean Coal Technology Research and Development efforts. As with the issues of Acid Rain, these challenges have been accepted and second generation Clean Coal Technology is being developed that will keep coal in the long range energy plans of the APEC economies. Technologies already are in the demonstration stage that will dramatically increase the efficiency with which coal is converted into usable forms of energy. Increases in efficiency reduce costs as well as the amount of carbon dioxide generated per unit of energy produced. These same technologies have the ability to solve the environmental issues represented by hazardous air pollutants. Will these be the last obstacles in the road to acceptance of coal as an energy source? Probably not, and the recognition of that fact is causing changes in the direction, focus and priorities of coal research and development efforts.

Through the efforts of the Asian Pacific Community, Clean Coal Research and Development activities have resulted in the awareness of, and access to, a wide range of technology options with which the environmental requirements of the region can be addressed at a competitive economic cost. The importance of these technologies and the potential role that they might have within the region has been examined in depth through the technical seminars of the Experts' Group on Clean Fossil Energy and the Coal Flow Seminars of the Ad Hoc Coal Policy Group. Both activities are supported by the Energy Working Group (EWG) of the APEC. Numerous other activities of the individual economies implemented on a bilateral basis have served to provide emphasis and priority to the use of these technologies.

The assumptions made at the beginning of the effort, the factors used in determining technology priority, selection and use, the respective roles of government and industry and, least of all, the economic environment, are different today than when the Clean Coal Technology Initiative emerged. What has not changed is the role that coal must play in the economic and social

development of the region. Accordingly, the concept as well as the application of the Clean Coal Technology Initiative must respond to meet new needs.

THE TECHNOLOGIES

No longer is the environmental community focused on power generation and coal combustion as the source of acid rain. The Clean Coal Technology Initiative responded to the challenges given in this arena of coal-related energy supply, and a variety of technologies were developed that provided a wide range of options to the potential user. These technology options:

- Provided each power generator with a wide range of options that enables the utility to match the performance of the individual stations with the limitations imposed on the emissions of sulfur dioxide, nitrogen oxides, particulates, etc.
- Generated indispensable data to the U.S. Environmental Protection Agency for their efforts to set the standards of allowable limits for emissions of nitrous oxides. The utility industry also has responded by retrofitting large amounts of generation capacity with low NO_x burners and other controls.
- Increased the marketability of the low rank coals and increased the degree of carbon recovery in the coal utilization process.
- Demonstrated the feasibility, operability, reliability and potential role of several advanced more efficient concepts for power generation.

The EWG of APEC early recognized the potential of these technologies to be the bridge between coal as a source of the energy needed in the emerging economies of the region and the increasing demands of the environmental community. In response, the Experts' Group on Clean Coal Technology was formed. The Group was given the task of raising the profile of these technologies to the level of viable choices for the planners and providers of energy to consider in meeting the rising demand for electricity as the driver of economic growth. Considerable effort has been given to achieving that goal. Under the sponsorship of the EWG and the APEC Secretariat, five Clean Coal Technology Seminars have been held, each hosted by a different economy. In addition, with the support of the EWG, the Ad Hoc Group for Coal Policy has implemented five APEC Coal Flow Seminars that examined the issues of coal utilization within the Asia Pacific Region. As discussed in the SPEC '98 Symposium, numerous other programs within several of the APEC Economies also have dedicated efforts to raise the profile of the technologies and to make the public aware of the benefits to be gained through their use.

Clean Coal Technologies that currently exist or are being demonstrated include those for:

- Coal Preparation and Carbon Recovery
 - Fines Recovery
 - Mild Gasification
 - Heavy Metals Removal

- Environmental Emissions Control
 - Sulfur Dioxide Removal
 - Nitrogen Oxides Removal
 - Combined Sulfur Dioxide and Nitrogen Oxides Removal
 - Particulates Control
- Electric Power Generation
 - Integrated Gasification Combined Cycle
 - Fluidized-Bed Combustion
 - Slagging Combustors
- Coal Processing for Industrial Applications
 - Direct Injection of Coal and Direct Reduction Techniques for the Steel Industry
 - Flue Gas Cleanup for the Cement Industry
 - Liquid Phase Methanol Production for the Chemical Industry

STATUS OF CLEAN COAL - ITS ROLE

In retrospect, it is evident that these efforts to raise the awareness of the community to the availability and promise of the technology as well as to the potential role the technology options could have in the solution of specific problems; in meeting the requirements of numerous applications; or in gaining significant environmental and economic benefits has not been sufficient to ensure their commercialization and use. It is obvious that it is again essential to explore the reasons for the limited application of these technologies.

The consolidation of the opinions of numerous authors leads to a consideration of three factors that, either individually or integrated together, are believed to be the principal impediments to the current use of the technologies. These include:

- Technology Risk and Increased Cost as the Most Important Factors
- Capital Availability/Financial Stability
- Environmental Uncertainty

TECHNOLOGY RISK AND INCREASED COST

A number of very promising clean coal technology options that can increase efficiency, reduce costs and lower emissions have been demonstrated. However, full commercial penetration by these technologies has not been achieved. It is evident that to achieve this goal it also will be necessary to demonstrate the availability of construction and operating experience. These data can only be acquired from the following 2-3 early commercial applications of each major technology. In order to install these early commercial facilities, the designer, manufacturer,

financier and owner must be willing to accept the technological and economic risk associated with demonstration or the not yet fully commercial technology. In the absence of some strong incentives, it is difficult to encourage decision makers to accept this uncertainty rather than to select the known. This trend has become even more evident with deregulation, low energy costs of competing fuels, and the more prominent role that the independent power producer now has in the decision making process.

In a recent study⁽¹⁾, the following criteria for financial incentives applicable to the U.S. Economy were proposed as being able to assist in overcoming the barrier to early commercialization of these Clean Coal Technologies as represented by their "Technology Risk":

- Incentives would be preferable to direct subsidies.
- Incentives specifically should address technical and commercial risk associated with the development and deployment of a new technology.
- The incentives should be robust enough to encompass all fuels but have a primary emphasis on coal.
- The incentives should have a limited time-frame to address only the early commercial applications of new technologies.
- The incentives would apply only to those technologies that measurably increase thermal efficiency or substantially reduce emissions in comparison to conventional technologies.
- The incentives should first target domestic markets for deployment of the early commercial applications, but the incentives should be applicable to international applications of qualifying U.S. technologies by U.S. companies if domestic markets fail to offer sufficient opportunities for timely construction.

As would be expected, the guidelines for incentives applicable to the individual economies would be different in content and focus. However, it has been generally accepted by those that would commercialize Clean Coal Technologies that some kind of incentives are going to be essential. The incentives must be sufficient to have a developer assume the risk of an early commercial application of an emerging technology. It is also generally accepted that the level of incentives required is to be determined through a comparison of the revenue requirements for building and operating the clean coal technology plant and the LEAST COST ALTERNATIVE. The financial incentives must be great enough for the CCT to compete with the lowest cost alternative energy source.

FINANCIAL STABILITY AND CAPITAL AVAILABILITY

There certainly is no need to tell anyone here that these are difficult times in the global financial markets. One result of the market turmoil and volatility is that traditional sources of financing have dried up for emerging market economies. As reported recently⁽²⁾, the international commercial banks are limiting or reducing their credit exposures, and local and international

capital markets have quickly closed to new debt and equity issues. The importance of this observation is that the principal source of trade, export and project financing (e.g., CCT projects) are the international financial institutions and the export credit agencies.

Previous experience, as expressed by knowledgeable representatives of the financial community in earlier Symposia of The Energy Data and Modeling Center, reminds us that international rating agencies, creditors in the public or private sector, prospective equity investors, etc., all utilize essentially the same criteria for evaluation project credit and country risk. These criteria were recently summarized⁽³⁾ and are included here as Figure 1. In addition to these criteria, some additional areas of concern to a prospective equity investor in the international market place are reported to be⁽⁴⁾:

- Is the commercial code and the legal system able to protect foreign creditors and investors should legal actions be necessary?
- Is the local banking system liquid and does it have adequate capital? Is it regulated appropriately?
- Is privatization a priority?
- Are the right policies (e.g., transparent rate setting in the power sector) and the incentives in place to attract capital?

In response to the uncertainties that have essentially closed capital markets and which are the cause of the reluctant behavior of other sources of equity which do unlisted equities or “greenfield” projects, some innovative ideas have been suggested for ways to acquire needed equity⁽⁵⁾. These include:

- Debt/equity exchanges and to permit debt to be utilized in part payment for government assets being privatized.
- Rescheduled local and international debt.
- Public/private sector insurance fund to cover technological risk of CCTs.
- Special export finance programs which involve traditional incentives combined with significant rate subsidies.

Of equal or more concern to the technology developer in general and the developer of innovative new coal utilization processes in particular is the impact that these international uncertainties in the financial world are having on the internal availability of Research and Development (R&D) funds. For most economies a sense of realism must be generated about the relationship between R&D and the availability of new technology to meet the social, economic and environmental demands of a future society. In most cases these R&D funds have been reduced significantly, requiring prioritization and focus of R&D efforts. It must be remembered that the clean coal technologies that are positioned to resolve the energy issues of today started their evolutionary

path over 20 years ago. When thought is given to the CCTs needed to solve the energy supply problems of the 21st century, the innovative concepts upon which those CCTs will be based must be supported financially as part of the R&D efforts in progress today and in the many tomorrows to follow.

ENVIRONMENTAL REQUIREMENTS

One of the factors key to the success of the various Clean Coal Technology Development Programs has been the flexibility of the technologies and their associated capability to meet changing demands placed on feedstocks, application and performance. Past challenges in the area of environmental performance have been met and exceeded. CCT technology has responded to the need to reduce sulfur dioxides, nitrous oxides, particulates, etc. It is within the capabilities of these technologies now in, and those approaching, the demonstration stage to meet new requirements being generated as a result of various Global Climate Change Initiatives. The near term concerns about the emissions of carbon dioxide (the focus of the activity at the recent Kyoto meetings and the environmental issue of the decade) as they are generated through the combustion of coal are being addressed by the technologies being demonstrated. These technologies are increasing the efficiency of the processes by which coal is converted to useable forms of energy.

As reported recently⁽⁶⁾:

“Increasing coal combustion efficiency from 20% to 30% reduces carbon dioxide emissions by 33% for the same amount of electricity generated. Improving efficiency from 30% to 40% results in a carbon dioxide emission reduction of 25% per unit of energy produced. Average global efficiency of coal utilization currently struggles to reach 25%.”

These relationships are further defined in Figure 2.

The potential for reduction of carbon dioxide emissions through the use of these technologies also are reflected in another recent comparison⁽⁷⁾:

“Over its forty-year life a conventional 450 MW pulverized coal-fired electric generating unit would emit 32 million metric tons of carbon. By contrast, an advanced integrated gasification combined cycle (IGCC) would emit 29 million tons if installed today and would improve to between 26 million tons and 21 million tons if the advanced versions were available and installed in 2010 and 2020 respectively.”

Thus, the industry has available today the technology to reduce by 11 million tons for every 400 MW of installed capacity the amount of carbon discharged during the combustion of coal to generate electricity. It should be noted also that, while these technologies will contribute

significantly to the goals of the Global Warming Initiatives, further advances in the technologies are in progress with goals that anticipate conversion efficiencies of up to 60%.

International attention is now focused on global climate change and the capabilities of energy technologies to achieve the associated environmental goals. However, for the technology developer, it is important to realize that as these goals are achieved other environmental challenges are certain to appear. This trend already is evident to the R&D community as early warning signals about the need to control hazardous air pollutants have appeared and the discussions on particulates (e.g. PM10 and PM2.5) intensify⁽⁸⁾.

These performance characteristics which enable the developer to substantially reduce the investment risk associated with environmental uncertainties are key to the future selection and use of Clean Coal Technologies.

THE FUTURE ROLE OF CCTs

Any comparative assessment of the degree to which Clean Coal Technologies have been distributed and/or utilized to date will confirm that the distribution is considerably less than what had been anticipated. This lower than expected result should not be considered as a measure of their importance or a comment on the essential role that they must perform if energy, economic and environmental goals of the Asia Pacific Region are to be achieved. Many evolving issues, not recognized earlier, have become significant factors contributing to the limited success of the cooperative efforts being made to achieve the commercialization of the technologies. New strategies must be implemented. The overly simplified expectations of the past must be replaced with the realities of the marketplace and the evolving needs and limitations of respective Economies must be recognized if the purpose and goals envisioned for CCTs are to be realized. Not only must the previous cooperative activities be continued, but increased levels of cooperative effort are needed to define, challenge and resolve these new impediments.

This observation should not come as a surprise. Indeed, there is evidence that some needed changes already are being implemented. Increased cooperative efforts designed to emphasize past successes and to address the impediments created by change are confirming that it is possible to eliminate those impediments and that the Clean Coal Technology needed for coal to remain as a viable source of energy for the region will be available.

However, the future of Clean Coal Technology also is being determined, not only by what technologies exist commercially or are being demonstrated today to solve the current issues of coal utilization, but by what innovative concepts will become available in the future to meet new challenges. It is not certain that any of these next generation concepts will be developed. The same economic crisis that is impacting the utilization of today's Clean Coal Technologies threaten the development of the innovative next generation technologies.

A decline in funds available for Research and Development is being experienced in most APEC Economies and world wide. As noted earlier, the availability of advanced CCTs in future years does depend upon adequate funding to support today's R&D efforts. As a general rule, R&D efforts of 20 years or more are required to bring innovation into commercial readiness.

In response to this trend, actions are being taken to eliminate real and potential duplication of effort, to spend available funds with the upmost efficiency, and to actively seek cooperative support of R&D projects of mutual interest. Domestically, new prioritized and focused R&D Programs are evolving. Internationally, old memoranda of bilateral and multilateral cooperation are being updated and new discussions of expanded cooperative efforts are in progress. The APEC is becoming a stronger and more active vehicle by which cooperative efforts in areas of joint interest are being defined and implemented. The key words guiding these new efforts are evaluation, redirection, focus and, most of all, COOPERATION.

The results of these activities are becoming apparent in ongoing surveys and restructured R&D efforts that reflect a changing approach to the development of future Clean Coal and Coal Utilization Technologies. Examples of these activities and programs include:

- International Review of Coal Utilization Technologies and Their Use - Supported by the Japanese Economy's Center for Coal Utilization, Japan (CCUJ), an international survey of the status and practical application of Clean Coal Technologies in developed countries of the world is in progress. The results of the study are to be used to evaluate and discuss the future direction of Japanese Clean Coal Research and Development efforts.
- The Foresight Programme of the Department of Trade and Industry, United Kingdom (UK) where two of the priority themes identified by the Energy Panel are concerned with power generation - Clean Coal Power Generation Technology and Advanced Combined Cycle/Gas Turbine Technology. It has been stated that developments in this field should⁽⁹⁾:
 - Ensure that UK technology contributes to improved quality of life through reduced environmental impact.
 - Provide the UK with global market opportunities over the next 15-20 years and beyond.
- The Cooperative Research Center - New Technologies for Power Generation From Low-Rank Coal, Victoria, Australia, is⁽¹⁰⁾:
 - Enhancing the potential of low-rank coal as a competitive fuel for future power generation by increasing scientific understanding of its behavior in advanced technology systems.

- Increasing the effectiveness and collaborative synergy of low-rank coal research in Australia by strengthening the interaction between participants.
 - Providing the necessary technical support for the export of such technologies which have application in many developing economies where coal resources are low-rank and often low-grade.
 - Contribute significantly to UK wealth creation.
- The Cooperative Research Center for Black Coal Utilization, New South Wales, Australia, that is using the resources of the participating organizations for research on thermal coal utilization that⁽¹¹⁾:
 - Adds value to Australian black coal resources in overseas and domestic markets.
 - Transfers research results effectively to the coal, power and metallurgical industries.
 - Develops international collaboration.
- The Vision 21 Program of the U.S. Department of Energy that will⁽¹²⁾:
 - Integrate advanced concepts for high-efficiency energy production and pollution control into a new class of fuel-flexible facilities capable of coproducing electric power, process heat, and high value fuels and chemicals with virtually no emissions of air pollutants.
 - Be capable of a variety of configurations to meet diverse market needs including both distributed and central power generation.
 - Achieve the following goals:
 - a. Produce clean affordable transportation quality fuels, industrial grade heat/steam, innovative chemicals, and chemical feedstocks.
 - b. Achieve generating efficiencies greater than 60% using coal and greater than 75% using natural gas.
 - c. Demonstrate efficiency improvements sufficient to reduce carbon dioxide emissions by 40-50%, with the potential to reduce these emissions to near zero with the successful integration of sequestration technologies.

To achieve these goals of Vision 21, ongoing research and development activities (Figure 3) in advanced coal and biomass gasification and combustion, next-generation fuel cells, high performance turbine technology and advanced coal conversion technologies will be integrated, duplication of effort will be minimized, maximum cooperation between research activities implemented and efforts leading to cooperative (Government with Industry) projects intensified. The long-term goal is the Vision 21 Energy - Plex (Figure 4).

The near-term needs of the international community for coal utilization technologies that can produce significant environmental improvements, operate economically and be flexible enough to satisfy a wide range of siting and performance requirements can be met by the current

generation of clean coal technologies. However, the next generation of these technologies will be available only if sufficient R&D funds remain available and if the efforts now in progress to restructure existing programs are successful in identifying and including in the restructured efforts those concepts needed to meet future demands.

SUMMARY

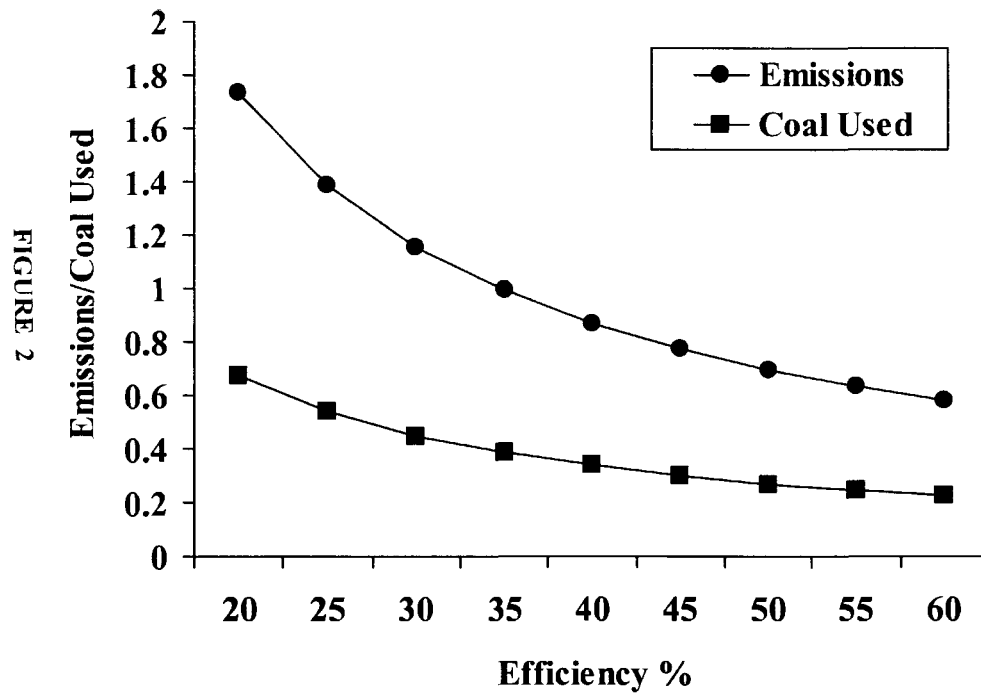
In the early years of the effort to develop and implement clean coal technologies, it was assumed that the merit of the technologies both from an economic and environmental point-of-view would be a sufficient incentive to insure their use once the performance characteristics were recognized. Much cooperative effort that involved activities in most of the APEC economies was focused on informing the public of these merits. Technologies and their applications were described, comparative examples of the benefits to be achieved through their use were explored in great detail, numerous training programs were implemented, etc. However, the slow progress made in the commercialization and use of these technologies to date has demonstrated that other factors directly related to the realities of the market place and the priorities of the individual Economies make any decision to utilize these technologies considerably more complex. A great deal of progress has been made in identifying these factors and in generating strategies to overcome the associated impediments. The implementation of these strategies will insure the role of clean coal technologies as the bridge between our ability to use coal as a viable source of energy and the achievement of environmental goals.

These efforts, now and in the foreseeable future, must be successful as the constant factor in the regions ability to meet its demands for electrical power is the need to use coal as an energy source.

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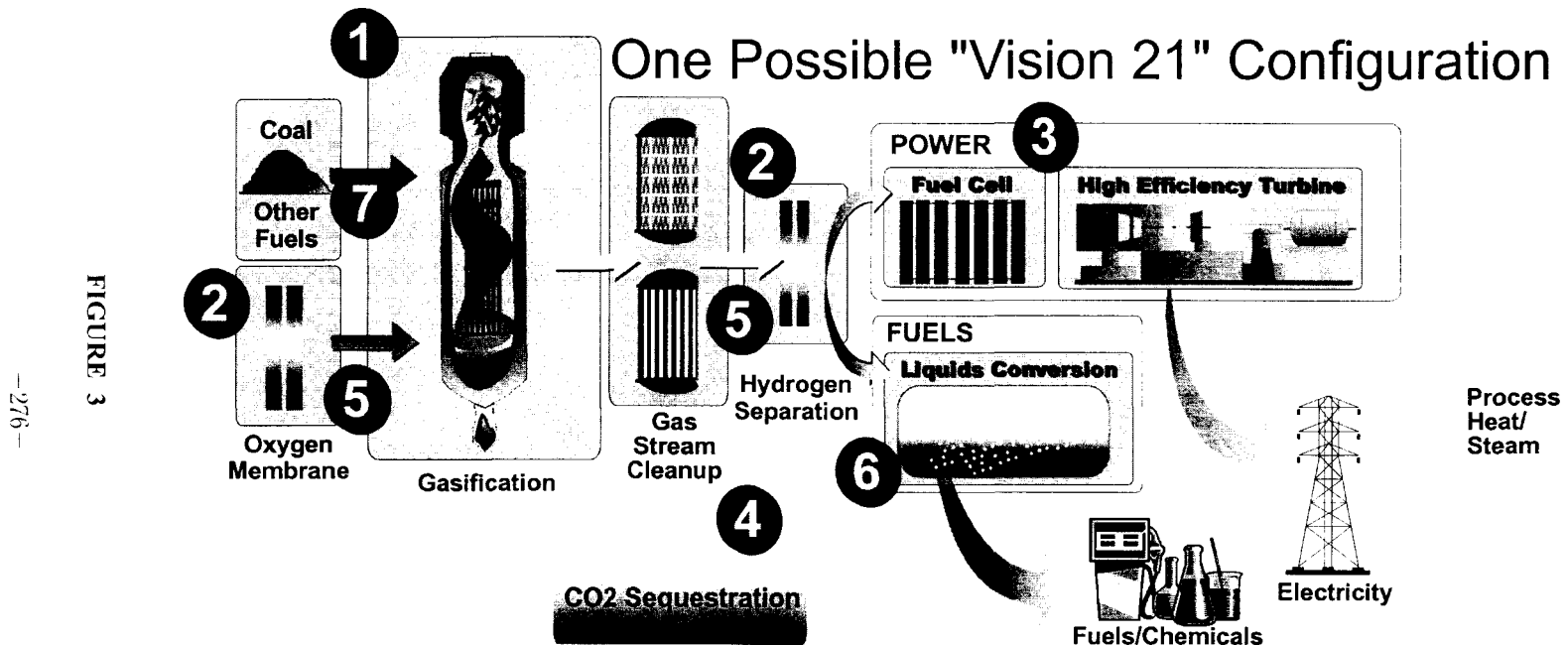
Efficiency vs. Emissions/Coal Used*



Efficiency %	CO2 Emissions	Tones of Coal Use
20	1.734	0.676
25	1.387	0.541
30	1.156	0.450
35	0.991	0.388
40	0.867	0.338
45	0.771	0.300
50	0.694	0.270
55	0.631	0.246
60	0.578	0.225

* World Coal Institute, Quarterly Newsletter Volume 27, September 1998

Relationship of Vision 21 Concept to Existing Fossil Energy Program



1. Improve fuel cell flexibility - Cogasification of coal and biomass/waste
2. Low cost gas separation technologies
3. Develop fuel cell/turbine hybrid
4. Advanced control systems for air toxics/pollutants, applied sequestration
5. New membrane materials, enhanced sorbents new catalysts
6. Co-product production/new conversion systems
7. Fines separation/premium feedstocks
- High temperature air heaters/
Presurized fluidized bed combustion

Symposium on Pacific Energy Co-operation

Tokyo, 16-17 February 1999

ENERGY POLICY IN A CHANGING WORLD

**Ambassador John P. Ferriter
Deputy Executive Director
International Energy Agency**

SLIDE 1

I am honored to have been asked to address this important gathering of experts and industry executives on behalf of the International Energy Agency and to present to you the IEA's views on global energy market developments and the challenges they pose for policy makers in the Asia-Pacific region.

Co-operation on and co-ordination of energy policy is a cornerstone of the work of the IEA. The objective of this co-operation was and still is ensuring energy security. When we were set up in 1974 in response to the 1st oil crisis that meant oil security. Today, we define energy security more broadly to encompass all forms of energy and cover all aspects of the way energy is produced, supplied and used. A key element of that new definition is the environmental impact of energy: after all, finding an environmentally sustainable way of producing and consuming energy is ultimately the only way we can count on a secure energy future.

Being the last person to address this conference, my presentation will inevitably touch on many of the issues that have already been addressed over the past 2 days. My aim will be to look forward at the way energy markets are likely to develop over the next two decades globally and in the Asia-Pacific region. I will also consider the direction that energy policy will need to take in pursuit of energy-related policy objectives as the region pulls itself out of the financial and economic turmoil of the past 18 months.

SLIDE 2

Let me start by briefly outlining the main points of my talk:

- I will begin with some thoughts about how energy markets are changing in terms of the key factors driving energy demand, supply and prices.
- I will go on to provide a short overview of the key results of the IEA's world energy outlook to 2020, which we published recently.
- I will then focus on the energy prospects for Asia-Pacific.
- Finally, I will consider the implications of these trends for energy policy generally in the region in the context of considerable economic uncertainty as we move into the new millennium.

I shall be brief. My aim is not to burden you with numbers but to highlight the key trends and implications for the region.

SLIDE 3

The world is always changing but never have the changes sweeping energy markets world-wide over the past two decades been so rapid and so profound. There are many facets to the changes that have occurred and are still occurring, which impact directly and indirectly on energy policies and energy markets.

The world has seen a major shift in the structure of the economy, with a maturing of the economies of the industrialised west and a surge in investment and manufacturing production in developing regions, notably in Asia. Economic growth has been the driving force behind rapidly rising demand for energy and oil in particular in Asia. I will come back to the implications of the recent financial crisis for energy markets and policy later.

Economic reforms and restructuring are having a major impact on the energy sector. Public ownership and state monopoly are giving way to privatisation and competition involving the reduction or removal of price controls and subsidies and the opening up of energy markets to foreign, private capital. In most OECD countries, competition in supply based on third party access is being introduced in the gas and electricity industries.

The world economy has become increasingly globalised, driven by the geometric expansion in trade (which has risen twice as fast as GDP over the past 25 years) and the even more dramatic growth of international investment. It has been spurred by the revolution in information technology, the expansion of financial markets and the sudden cessation of the Cold war.

The past quarter century has also seen a rapid increase in concern about the environmental effects of energy production, supply and use. In recent years, oil spills, nuclear accidents, polluted urban air and acid rain have politicised the environmental issue and thrust it to the top of the energy agenda. The threat now dominating the political debate, of course, is climate change brought about by emissions of greenhouse gases from the combustion of energy sources. **SLIDE 4**

Against this background, how do we see the world energy market developing over the next two decades?

Every two years, the IEA produces a study of long-term trends in energy supply and demand, with detailed projections by fuel, geographic region and type of energy related service or sector.

As we know, the future is uncertain. In view of these uncertainties, we do not attempt to predict what will happen to energy markets. Rather, we analyse the most important factors likely to affect the energy system within a quantitative framework. The approach we have adopted is a business-as-usual set of projections. This is best described as an illustration of how demand, supply and prices are likely to develop if recent trends and policies continue.

The results of our business-as-usual analysis shown in this chart point to continuing growth in energy use globally - driven essentially by economic expansion - and continuing heavy reliance on oil, gas and coal. In short, a fossil fuel future: fossil fuels are expected to provide about 95% of additional global energy demands to 2020.

Consumption of gas is expected to grow most rapidly, reaching the level of coal use by the end of the period.

Oil continues to dominate world energy consumption, with transport increasing its share of oil demand.

Oil prices, underlying these trends, are assumed to remain broadly flat through to 2010, rising to \$25 per barrel in 1990 prices by 2015.

SLIDE 5

We do not expect any major changes in the fuel or sectoral mix of energy demand - barring major unexpected changes in policy or the economic context. Nonetheless, our analysis points to a significant shift in the geographical pattern of energy use from the OECD region to the developing countries - particularly in Asia.

At present Asia-Pacific accounts for 23% of world primary energy demand. I define Asia-Pacific here as the OECD countries (Japan, Korea, Australia and New Zealand), China and the rest of East Asia (comprising virtually all the countries to the east of Myanmar). This share is expected to increase to 30% by 2020 in our business-as-usual projections, mainly at the expense of the share of the rest of the OECD. Asia-Pacific as a whole accounts for 42% of the total increase in world energy demand between 1995 and 2020.

Demand is projected to grow fastest in China. You can see that its share in world demand increases from 10% in 1995 to 15% by 2020. The share of the OECD Pacific countries, by contrast, falls from 7% to 6%.

I should emphasise here the considerable uncertainty with respect to the near-term economic situation underlying these projections. We have assumed that the region begins to recover from the impact of the Asian financial crisis from around 1999/2000. But the average rate of GDP growth is still assumed to be significantly lower over the period 1995-2020 than over the previous 2-3 decades, mainly as a result of the depressing effects of the crisis at the beginning of the projection period and the maturing of developing economies in the region.

SLIDE 6

Let me now focus on the Asia-Pacific region. The reasons for the more than doubling of the region's share in world commercial energy use over the period to 2020 show up very clearly in this chart.

Commercial primary energy demand is projected to increase at an average annual rate of 4.3% - driven mainly by economic growth which we have assumed to average around 4.5%, i.e. we expect very little change in the energy intensity of the region. Economic growth is driven in part by population growth.

Coal and oil are expected to continue to dominate the primary fuel mix, supplying almost 80% of total commercial energy in 2020. The increase in coal use is explained largely by increasing industrial activity, particularly in China, which is projected to account for 79% of the entire region's coal market by 2020 compared to 75% today. The transport sector is the main driver behind rising oil consumption.

However, natural gas experiences the fastest rate of increase of any fuel: its share of primary energy is expected to rise from 9% in 1995 to around 12% by 2020.

I should emphasise that these projections concern commercial energy: We should not forget that non-commercial energy - biomass - accounts for a significant proportion of total energy use - around 20% of final energy consumption in both East Asia and China according to estimates we have compiled. We expect non-commercial energy use to increase much less slowly than commercial energy use so that its share in total primary energy consumption should fall to around 10% by 2020.

SLIDE 7

The implications of these demand projections for the region's dependence on imports of energy are profound. In our base projections, we expect net imports of oil and gas into the Asia-Pacific region to increase substantially.

The trend towards increased reliance on imported oil will be most marked in China. Until the early 1990s, China was a net exporter of oil. By 1996, imports accounted for about 15% of total supply. In our base case, we project net imports to rise to about 55% by 2010 and over 80% by 2020 as surging demand outstrips the rate of growth in indigenous production.

Import dependency is also expected to increase in the rest of east Asia, from over 50% at present to close to 90% by 2020. This results from an expected peaking and decline in output in the region's two largest producing countries - Indonesia and Malaysia - over the next few years, only modest increases in production in Vietnam and Papua New Guinea and steady growth in demand throughout the region.

OECD Pacific oil dependency - already at 90% - is expected to increase even further to 96% by 2010.

Similarly, the projected growth of gas demand will only be possible through imports - most likely in the form of LNG - in the absence of major new gas discoveries.

SLIDE 8

Having reviewed the prospects for the Asia-Pacific energy market in the context of global trends, let me now briefly outline some of the key policy issues and uncertainties facing Asian energy as we move into the third millennium.

First, the trends which I have described point to very real concerns about energy security, because of the magnitude of the growth in energy demand and the expected sharp increase in imports - particularly oil and gas.

The policy challenges for the Government in facing up to the prospect of worsening supply security include raising indigenous oil and gas production, developing alternative energy sources, promoting the more efficient use of energy and strengthening oil emergency preparedness mechanisms. Most Asian countries do not have emergency oil stockpiles. The IEA strongly supports moves on the part of some countries to bolster their energy security, which is to the benefit of Member and non-Member countries alike. For example, in 1996, we signed a co-operation agreement with China on working together in a variety of ways aimed at enhancing their energy security.

The governments of the developing Asian countries as well as the developed Pacific Rim countries will also need to address the issue of environmental sustainability as economic expansion and rising energy use exacerbate already serious local pollution problems and add to the global threat of climate change.

Finally, the need to carry forward energy sector reforms remains a pressing concern throughout much of the region. Chronic market distortions persist in many countries - the legacy of past policies to help the poor and protect local industries from competition. Progress has been made nonetheless in recent years to eliminate distortions caused by price controls and subsidies, to restructure inefficient industries and to promote market forces and inward investment.

SLIDE 9

The economic fall-out from the financial crisis that hit Asia in 1997 continues to have a major impact on regional energy markets and casts a shadow over market developments in the near to medium term.

Demand for oil in China and East Asia surged by around 7% per annum over the ten years to 1995 - almost 5 times the rate of growth in the OECD. According to our latest Oil Market Report, demand in 1998 increased by only 2% in China, was flat in the rest of East Asia and fell by an astonishing 6% in the OECD Pacific region (mainly due a collapse in demand in Korea).

Oil demand is projected to recover slightly in 1999, but with persistent economic problems in some of the so-called Tiger economies and an expected slowdown in China, it may take two to three years before we see a return to steady oil demand growth rates.

The impact of the slump in Asian oil demand on international oil markets is only too clear: the financial crisis is the primary cause of the current depressed level of oil prices.

One consequence of the fall in demand for energy generally which is already perceptible is delays to major infrastructure projects - particularly planned power and LNG projects. For example, Korea has already cancelled LNG purchases under short-term contracts and Thailand has shelved plans to import LNG and to import gas by pipeline from the Natuna field. Currency devaluations and the increased risk of investing in those countries hit by the crisis have also contributed to higher project financing costs.

SLIDE 10

Let me finish here with some key messages from an IEA perspective with respect to the right way forward in addressing persistent and emerging energy policy challenges.

I have suggested some probable impacts of the Asian financial crisis on the energy sector. While they are mostly negative - falling demand, reduced investment, delays in projects - they do provide a clear occasion for governments to take stock of their circumstances and develop and implement appropriate economic policies. In this respect, a

crucial element is completing the process of reform in the energy sector. This involves giving prominence to market forces, removing barriers to trade and investment and promoting competition where possible. Transparent and open markets with price reflecting full economic costs provide the necessary signals for investing efficiently and using energy efficiently.

Related to this is the need to create a stable and attractive investment environment to ensure sufficient availability of capital to meet in a sustainable way increasing energy needs once the economic situation improves. Putting the emphasis on market forces is part of this. Fiscal, legal and institutional reform aimed at safeguarding investments and ensuring adequate returns is another part of the equation. It is through such reforms that Asian governments can restore investors' confidence in the region.

Finally, there are clear mutual benefits in co-operating on an international level - in terms of promoting international trade and investment, contributing to global energy security and addressing global climate change concerns.

Many of the fundamentals for the Asia-Pacific region remain sound, despite the severity of the financial crisis. I am optimistic about the prospects for eventual economic recovery. We should not forget that energy is a long-term business: I believe that when we look back in several years time, we will see this period as a significant blip, but not one that diverted underlying trends which are shifting the centre of gravity of the global energy economy firmly towards this part of the world.

Symposium on Pacific Energy Co-operation
Tokyo, 16-17 February 1999

Energy Policy in a Changing World

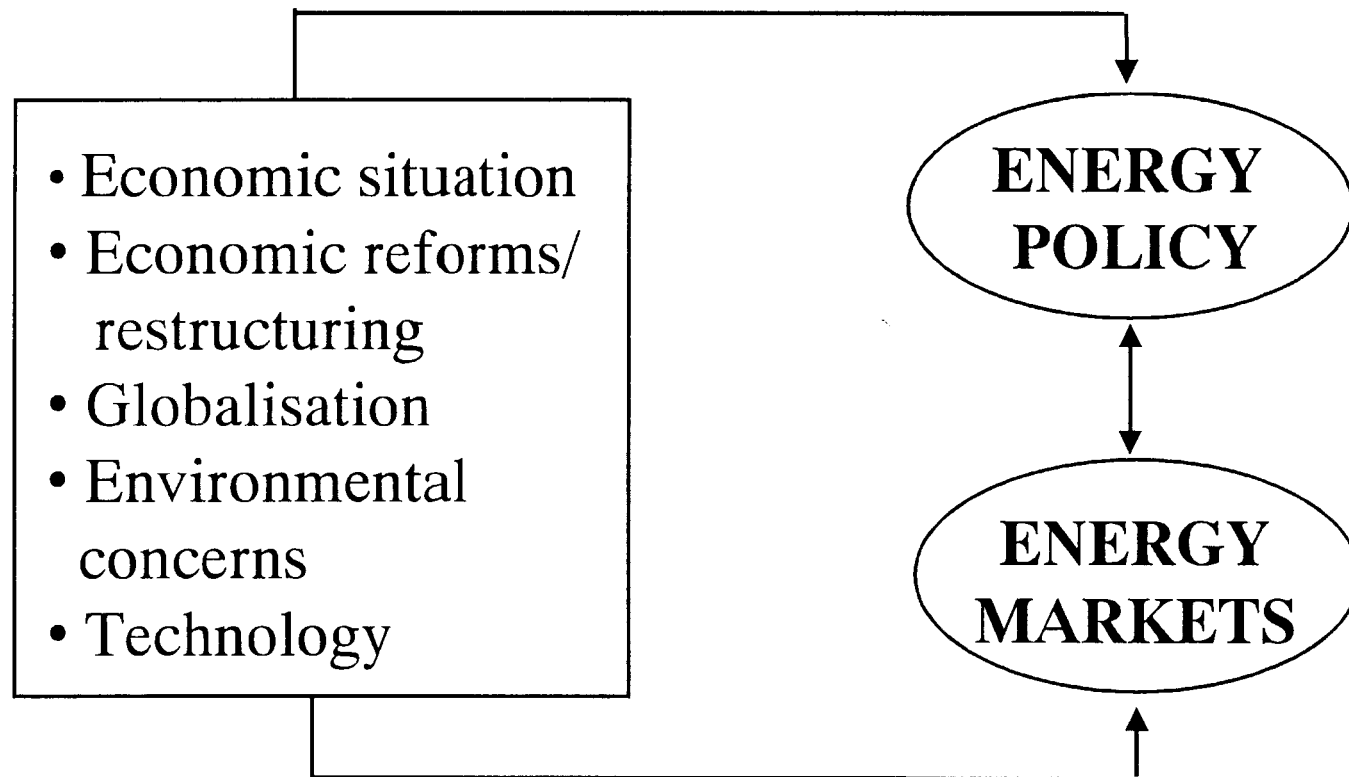
Ambassador John P. Ferriter
Deputy Executive Director
International Energy Agency



Main Points

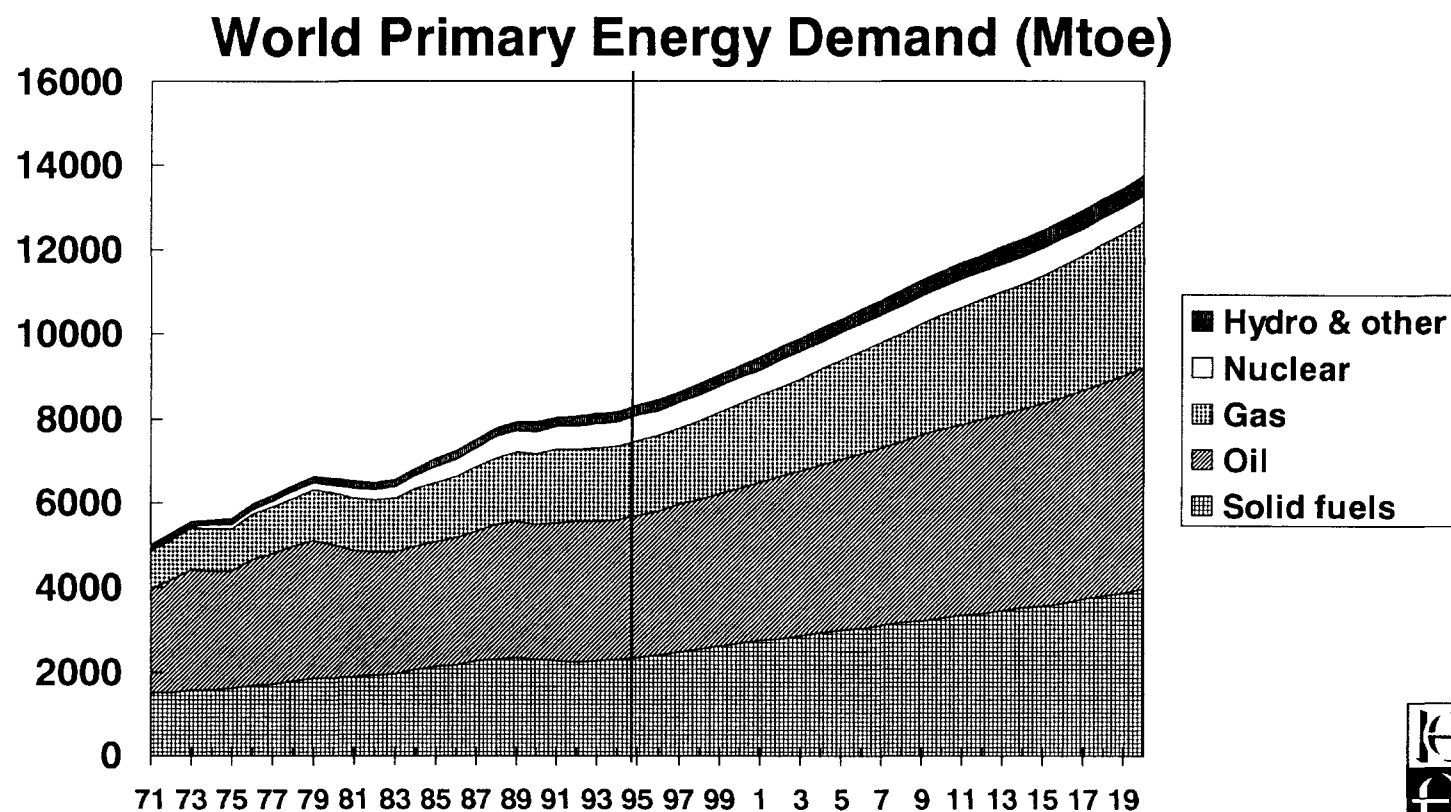
- ◆ What is changing?
- ◆ World energy outlook to 2020
- ◆ Energy prospects for Asia-Pacific
- ◆ Asia-Pacific energy policy challenges

What is Changing?

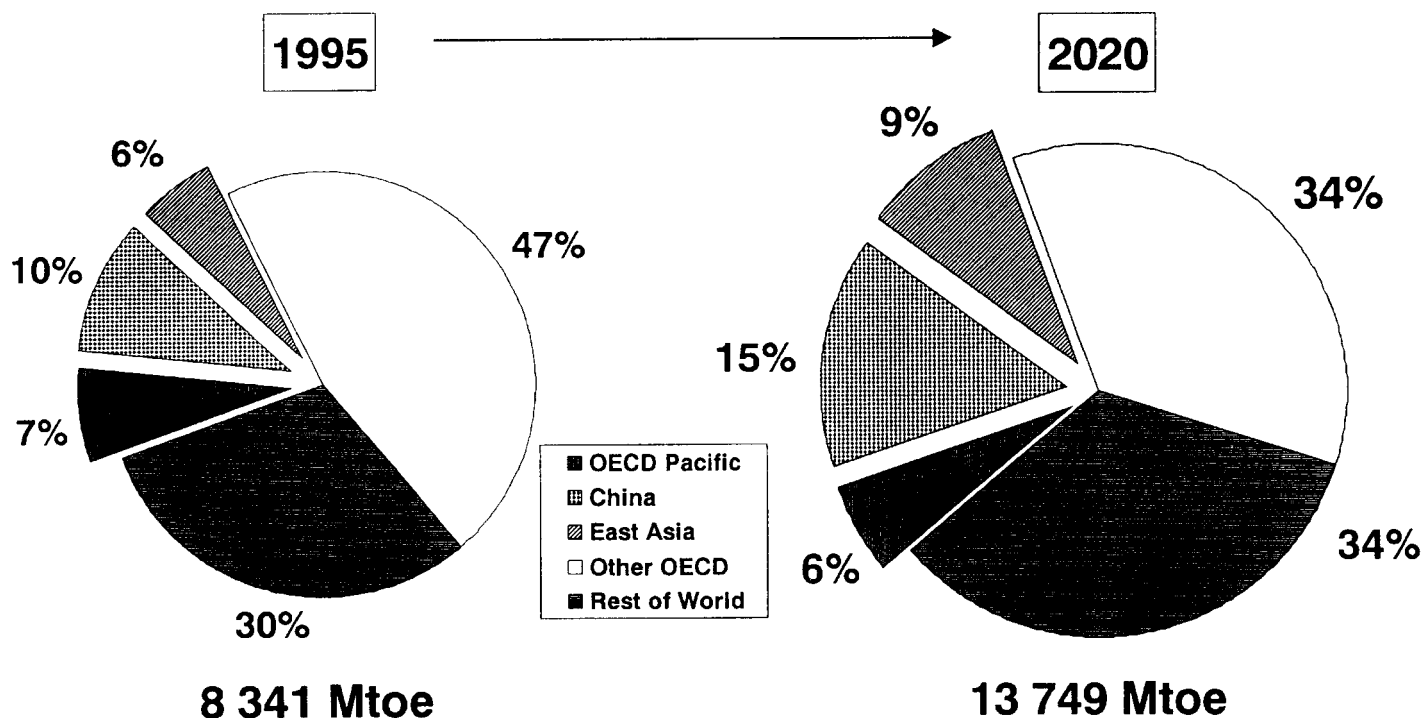


World Energy Outlook to 2020: A Fossil Fuel Future

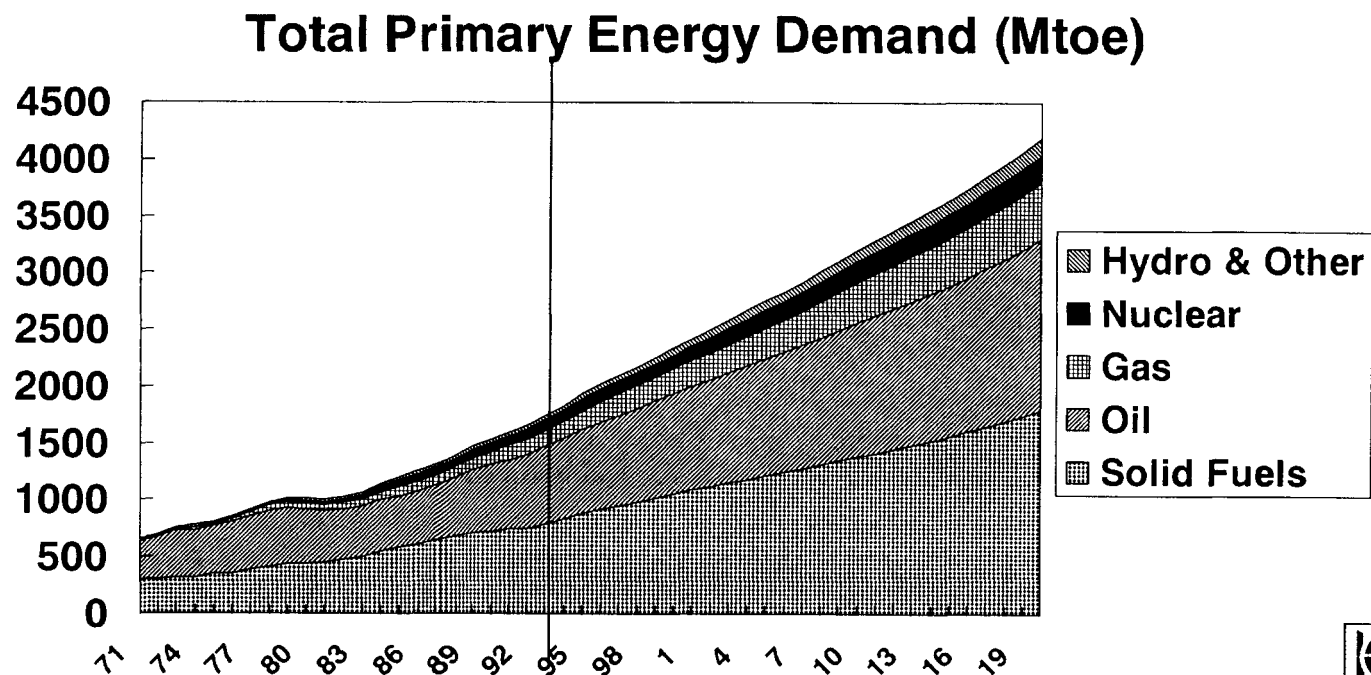
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World Energy Outlook to 2020: Primary Energy Demand: Regional Trends

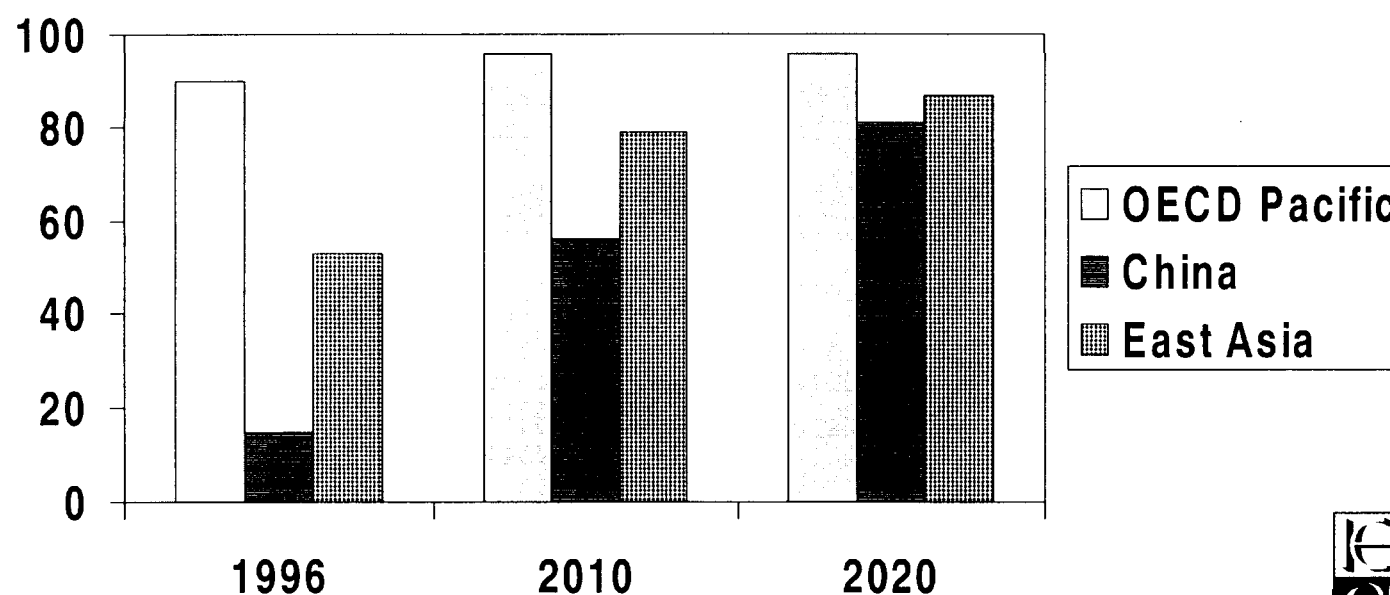


Energy Prospects for Asia-Pacific



Asia-Pacific Energy Prospects: Imports of Oil Set to Rise

Net Oil Imports as % of Total Oil Supply



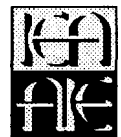
Asia-Pacific Energy Policy Challenges

- ◆ Enhancing energy supply security
- ◆ Environmental sustainability
- ◆ Energy sector reform:
 - removing market distortions
 - restructuring
 - liberalisation



Impact of Financial Crisis on Energy Sector

- ◆ Slower energy demand growth in short term
- ◆ Delays to major infrastructure projects
- ◆ Higher financing costs



Conclusions: The Way Forward

- ◆ Completing energy sector reforms
- ◆ Creating a stable, attractive investment framework
- ◆ Co-operating internationally to reconcile economic growth, energy security and environmental goals

