The Strategic Energy Plan of Japan

-Meeting global challenges and securing energy futures-

(June 2010)

[Summary]

July 28, 2010

Ministry of Economy, Trade and Industry, Japan

METI
Ministry of Economy, Trade and Industry

Strategic Energy Plan of Japan

The Strategic Energy Plan of Japan articulates the fundamental direction of energy policy in Japan, based on the Basic Act on Energy Policy.

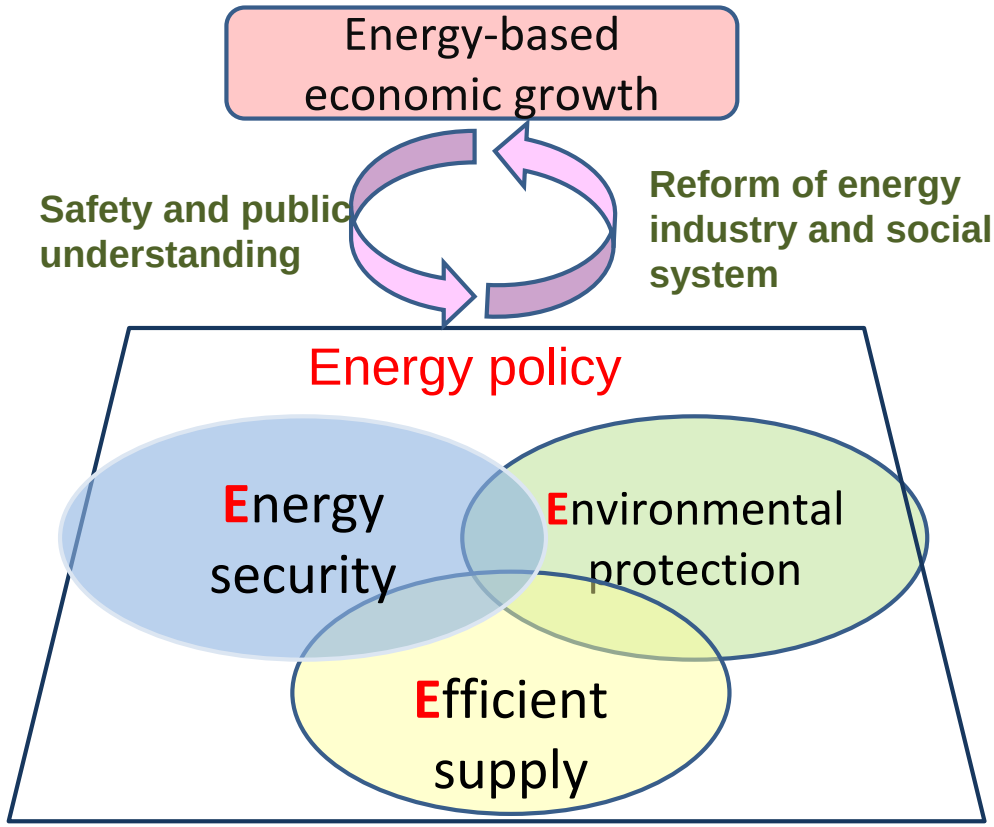
The Strategic Energy Plan of Japan is required to be reviewed at least every three years, and to be revised if needed. (Formulation: 2003, revision: 2007 and 2010)

Basic point of view

○The basic point of view in energy policy is **energy security**, **environmental protection**, and **efficient supply**.

○In this revision, two new points of views were added. These are: **energy-based economic growth** and **reform of the energy industrial structure**.

○Japan will **fundamentally change its energy supply and demand system by 2030**.



-Formulating the revised Strategic Energy Plan of Japan is consistent with the "New Growth Strategy"

-Directing bold and quantitative policy targets and specific policy measures

Ambitious targets toward 2030

- **Doubling the energy self-sufficiency ratio** (18% at present) **and the self-developed fossil fuel supply ratio** (26% at present) and as a result, raising **its "energy independence ratio"** **to about 70%** (38% at present).
  - The "energy independence ratio" is an indicator that combines the self-sufficiency energy with the self-developed energy supply divided by total primary energy sources. An average energy self-sufficiency rate among the OECD countries is almost 70%.
- **Raising the zero-emission power source ratio to about 70%** (34% at present).
- **Halving CO2 emissions from the residential sector.**
- **Maintaining and enhancing energy efficiency in the industrial sector at the highest level in the world.**
- **Maintaining or obtaining top-class shares of global markets for energy-related products and systems**.

- **Domestic energy related CO2 emissions will be reduced by 30% or more in 2030** compared to the 1990 level, if we promote policies sufficiently.
- **A 30% emissions reduction** means that about **a half of the reduction to be achieved from the current level to 2050 (▲80% compared to 1990) will have been realized in 2030**.

Specific measures to achieve targets

Securing resources and enhancing supply stability

- Deepening strategic relationships with resource-rich countries through **resource diplomacy by the PM and ministerial level** and **public- private partnership with the relevant industrial sectors**
- Enhancing **support for risk money** for upstream concessions (JOGMEC, ODA, policy-based finance, trade insurance, etc)
- Raising **self-sufficiency ratio of strategic rare metals** (including recycling and alternative materials development) to more than **50%**
- Enhancing development of domestic and overseas resources including methane hydrate and sea-floor hydrothermal deposits, etc.

Independent and environment-friendly energy supply structure

○**Expanding the introduction of renewable energy**

- **Expanding the feed-in tariff system** (wind, middle-small size hydro, geothermal, and biomass in addition to photovoltaic)
- Strengthening support for introduction (R&D support, FS, initial cost support, tax reduction for introduction, etc)
- Power grid stabilization and relevant deregulation

○**Promoting nuclear power generation**

- Building **9 new or additional nuclear plants** (with the overall plant capacity utilization rate at about **85%**) **by 2020** and **more than 14** (with the rate at about **90%**) **by 2030**
- Achieving long-term cycle operations and shortening operation suspensions for regular inspections
- Improving the power source location subsidy system (by considering measures to promote the construction and replacement of nuclear plants and place a greater weight on electricity output in calculating subsidies)
- Achieving the nuclear fuel cycle establishment including the development of “pluthermal” and fast breeder reactors
- International cooperation for nonproliferation and nuclear safety

○**Advanced utilization of fossil fuels**

- Requiring to **reduce CO2 emissions of the plants to the IGCC plant levels in principle**, when planning to construct new coal fossil power plants by the beginning of the 2020s.
- Accelerating the CCS (carbon capture and storage) technology development for an early commercialization (around 2020s), requiring **new coal thermal plants for future planning to be CCS-ready** and to be equipped with CCS technology by 2030, on the precondition of commercialization.
- Spreading its advanced clean coal technologies overseas and promoting further technology development and demonstration domestically.

○**Enhancing electricity and gas supply systems**

- Building **the world’s most advanced next-generation interactive grid network as early as possible in the 2020s**
- Considering specific measures to double the electricity wholesale market in three years.

Specific measures to achieve targets

Realizing a low carbon energy demand structure

○**Industrial sector**

- **Enhancing the world's most advanced energy efficiency** through introducing the most advanced technologies for replacing equipment
- Enhancing the energy conservation law operations, commercializing innovative technologies and enhancing support for fuel conversion, etc.

○**Residential sector (i.e. households and offices)**

- Making **net-zero-energy houses available by 2020** and realizing **net-zero-energy houses in average by 2030**.
- Setting **compulsory energy-saving standards for houses and compiling compulsory standardization targets,** timing and support measures within this year under the cooperation with the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
- Prevailing **highly efficient water heaters to the amount of 80-90% of all family units** in 2030
- Replacing **100% of lights with highly-efficient lights** (including LED and organic EL lighting) on **a flow basis by 2020** and on **a stock basis by 2030**

○**Commercial sectors (i.e. offices)**

- Realizing **net-zero-energy houses in new public building by 2020** and realizing **net-zero-energy buildings in average by 2030**
- Introducing **new integrated standards for energy consumption at all buildings for implementation in two years**
- Enhancing support and regulatory measures (including top-runner standards) to diffuse energy-saving consumer electronics, energy-saving information technology equipment, heat pump water heaters, fuel cells, hybrid construction machines and other highly efficient equipment

○**Transportation sector**

- Raising **next-generation vehicles' share of new vehicle sales to up to 50% by 2020 and up to 70% by 2030** by mobilizing all possible policy measures (including 2020 fuel efficiency standards, introduction support measures and diffusion of battery chargers)

○**Cross-sectional efforts**

- Considering municipal-level energy use optimization policy measures

Building next-generation energy and social systems

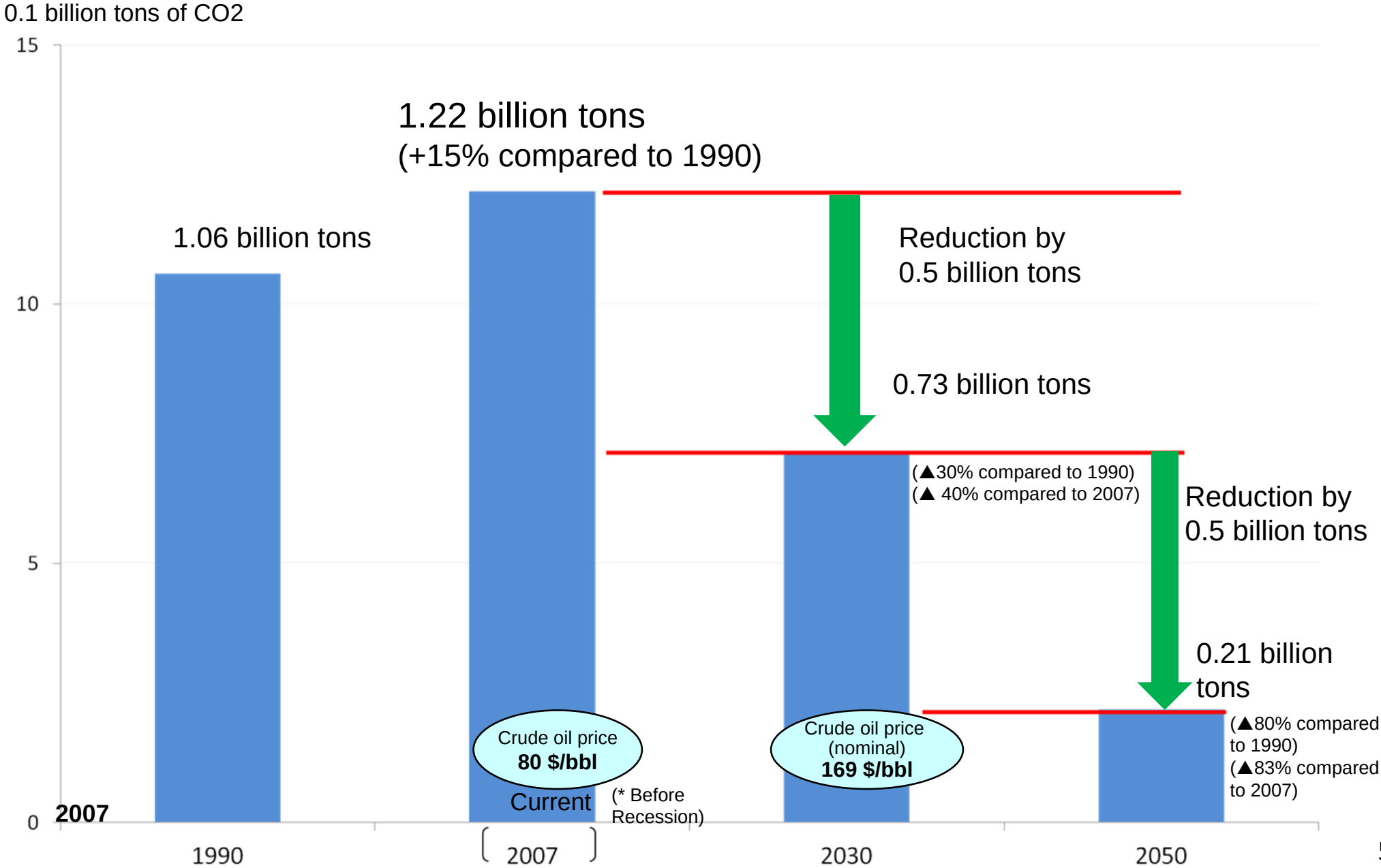
- Realizing the smart grid and smart communities by promoting an intensive cross-sectional mobilization of relevant policies, consideration of special zones, **demonstration projects both home and abroad**, and **strategic international standardization.**
- Promoting the development, installation of smart meters and relevant energy management systems (that can record detailed energy supply-demand data and control a variety of equipment), seeking to **introduce them for all users, in principle, as early as possible in the 2020s**
- **Diffusing fixed fuel cells and developing a hydrogen supply infrastructure**, including hydrogen stations for fuel cell vehicles

Developing and diffusing innovative energy technologies

- **Drafting a new energy innovation technology roadmap** (within 2010) to accelerate the development of innovative energy technologies
- **Developing the public-private cooperation** arrangements for supporting the international diffusion of highly efficient and low carbon technologies
- **Building a new mechanism to appropriately evaluate how Japan's international diffusion of its technologies, products and infrastructure contributes to reducing global greenhouse gas emissions**

Long-term CO2 emission reduction path

○ The long-term CO2 emission path provides an image that approx. 0.5 billion tons will be reduced from the current level in about 20 years until 2030. By that time, about a half of the reduction amount to be achieved by 2050 (▲80% compared to 1990) will have been realized.



Residential and commercial sector in 2030

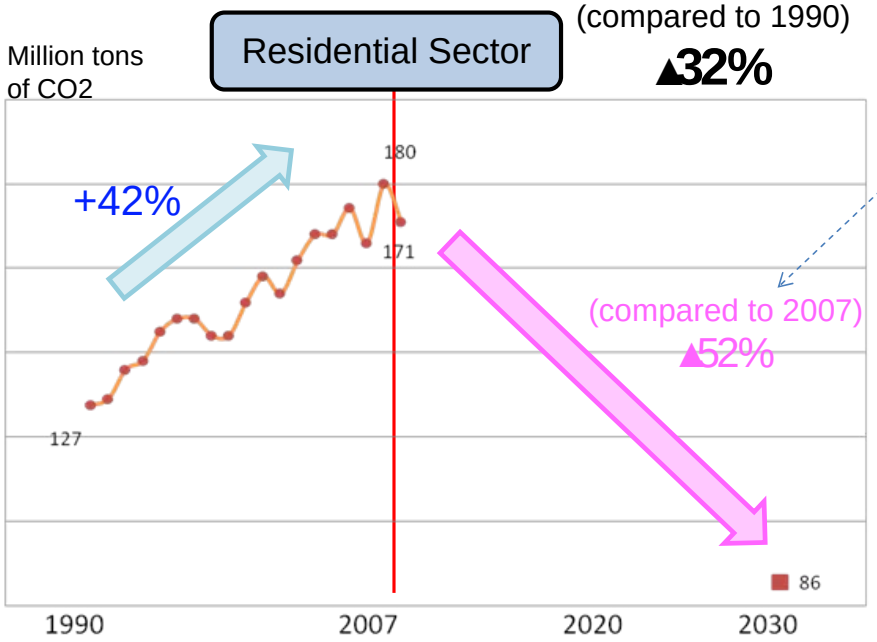
○ An estimate has been made with certain preconditions on business floor space and the number of households, while reflecting the following measures for the private sector listed in the energy basic plan.

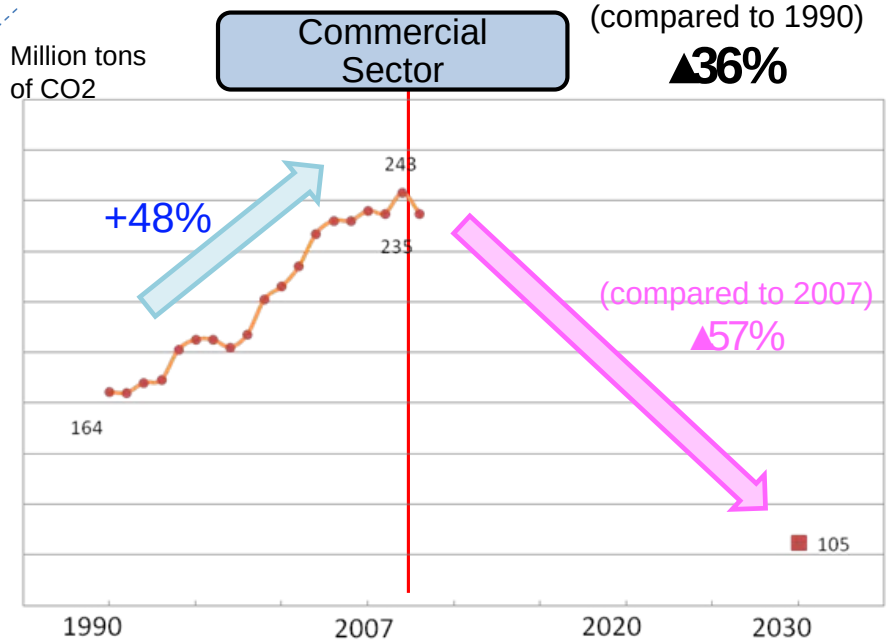
private sector	Major reduction measures	Picture in 2030
	○ Energy conservation in houses and buildings	ZEH will be realized in new houses, and ZEB will be realized in new buildings.
	○ High efficiency hot water supply devices (for households)	Will be introduced in 80 to 90% of all households
	○ Highly efficient illumination	Diffusion rate: 100% (stock base)
	○ Energy conservation in IT equipment (green IT)	Diffusion rate: 100% (to be realized by 2020)
	○ Other energy saving home appliances, etc.	

[Other major preconditions]
Business floor space: 1.79 billion square meters in 2007
→ 1.92 billion square meters in 2030
Number of households: 51.71 million households in 2007
→ 52.42 million households in 2030

(Estimation result)

○ CO2 generated by energy consumption in "Living" **will be reduced to half** from the present state.





Industrial and transportation sector in 2030

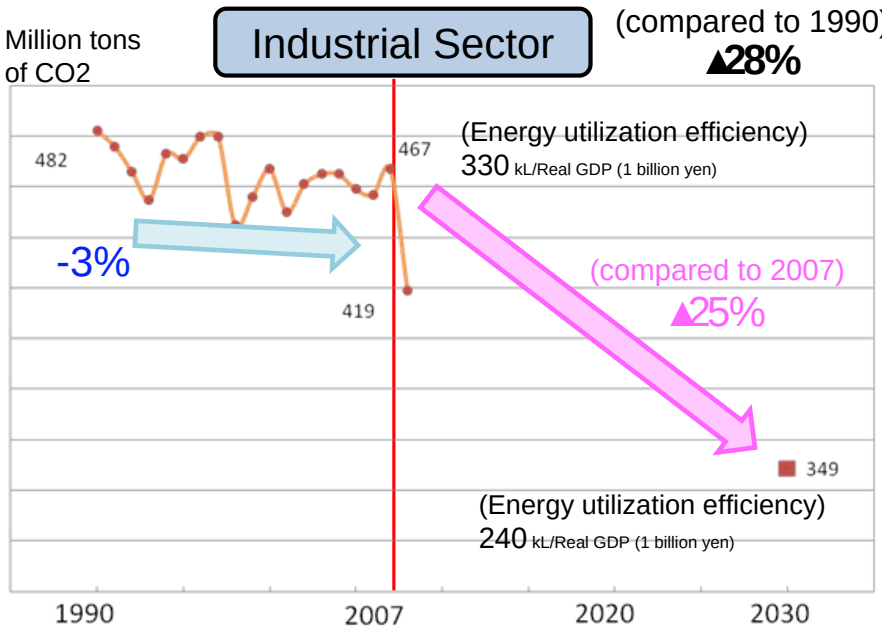
○ An estimate has been made with certain preconditions on macro frames, while reflecting the following measures for the industrial and transportation sector listed in the energy basic plan.

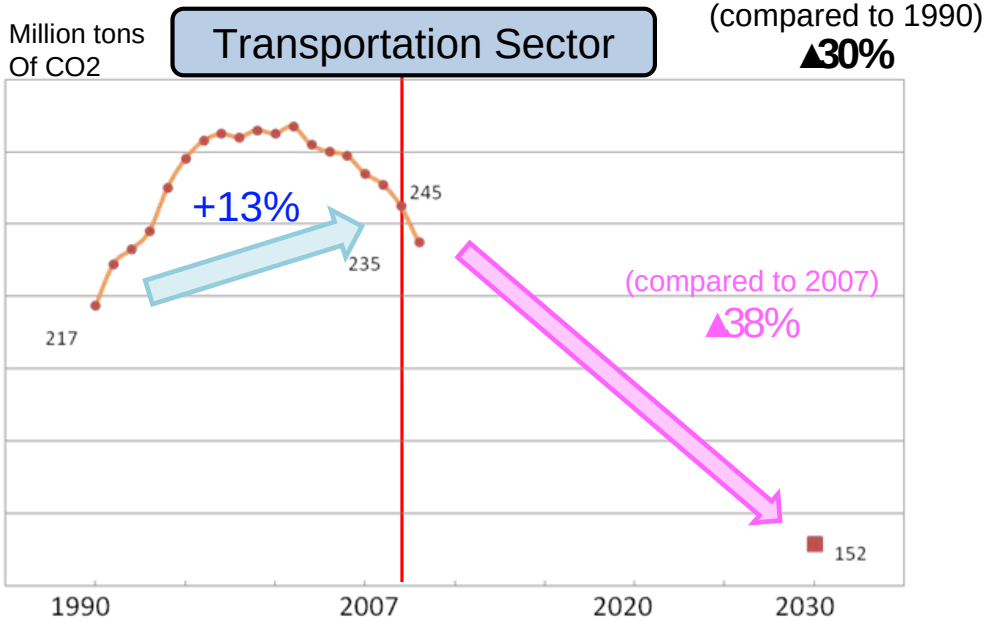
	Major reduction measures	Picture in 2030
Industrial sector	○ Energy conservation in the manufacturing sector	State-of-the-art technologies will be introduced to the maximum extent when equipment is renewed. □13 next-generation coke ovens were introduced, etc.
	○ Innovative technological development	Commercialization of hydrogen reduction steelmaking, blast furnace gas CO2 separation and collection technology, etc.
	○ Conversion to gas	Ratio of gas in fuel consumption will double.
Transportation sector	○ Diffusion and fuel efficiency improvement of next-generation automobiles	70% of new cars will be next-generation automobiles. * Currently, approx.10% (Estimated on 2009 actual data after eco-car subsidy was implemented)
	○ Biofuel	Introduction to transport fuel will be expanded to the maximum extent.
	○ Modal shift	Railroad and coastal shipping will account for 80% of mid and long-distance transportation.

[Other major preconditions]
Crude steel production amount: 1215.1 billion tons in 2007
-> 1192.5 billion tons in 2030
Transportation demand: 1307.2 billion men kilometers in 2007 –
> 1303.6 billion men kilometers in 2030

(Estimated result)

○ In the industrial sector, the world's highest energy utilization efficiency at present will be further **improved by approx. 30%.**



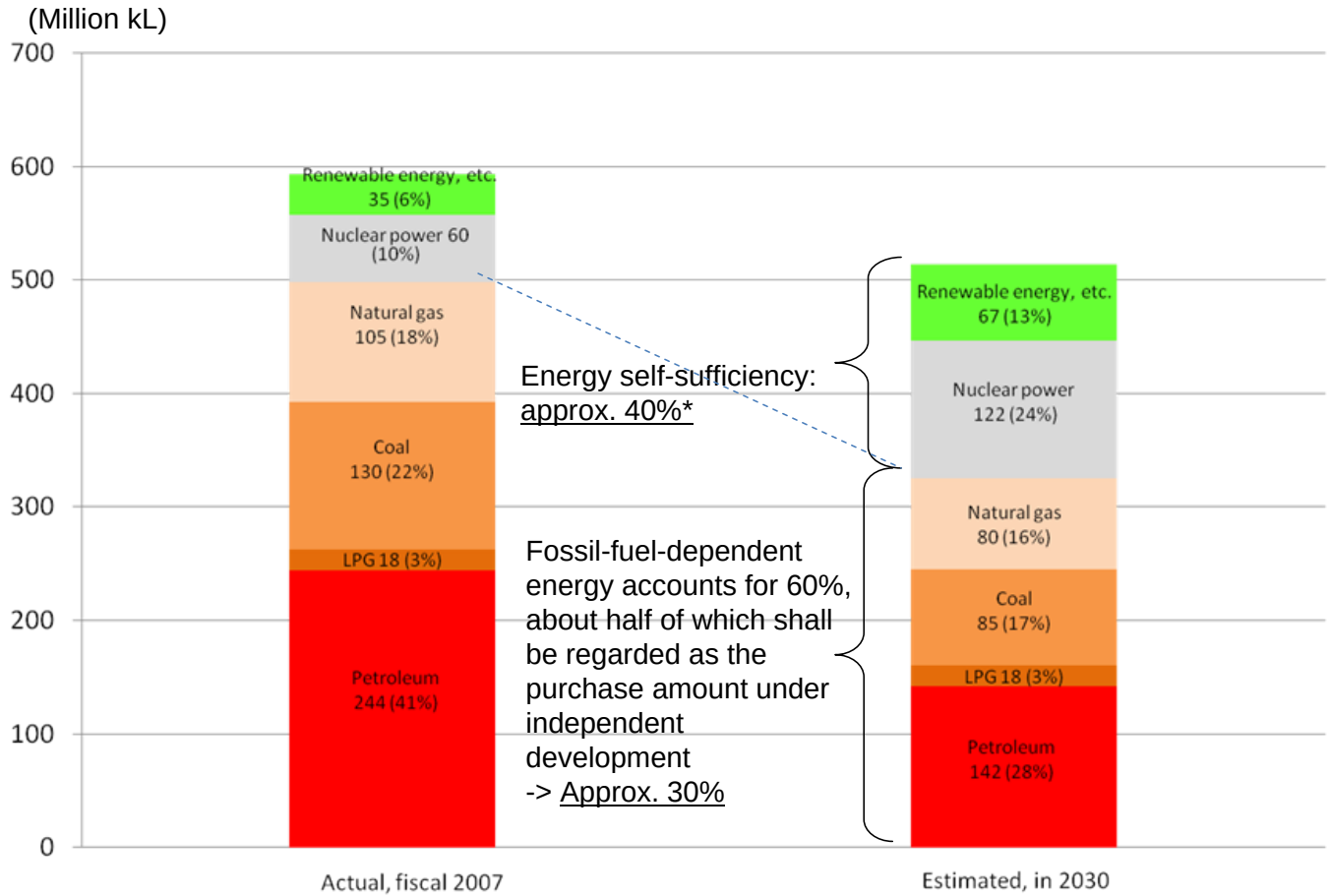


Balance of primary energy supply

Sector of conversion		
	○ Renewable energy	Implementation of feed-in-tariff system (depending on institutional design)
	○ Nuclear power	Building additional 14 plants, facility utilization rate 90%

(Estimation result)

○ Conventional energy self-sufficiency (18%, currently) will double. In addition, the energy independent ratio will become approx. 70% (38%, currently) by doubling the self-developed fossil fuel supply ratio (26%, currently).



Energy self-sufficiency: approx. 40% + purchase of fossil fuel under independent development: approx. 30%
= independent energy ratio: approx. **70%**

Energy self-sufficiency includes renewable energy, etc., nuclear power, and fossil fuel produced in Japan.

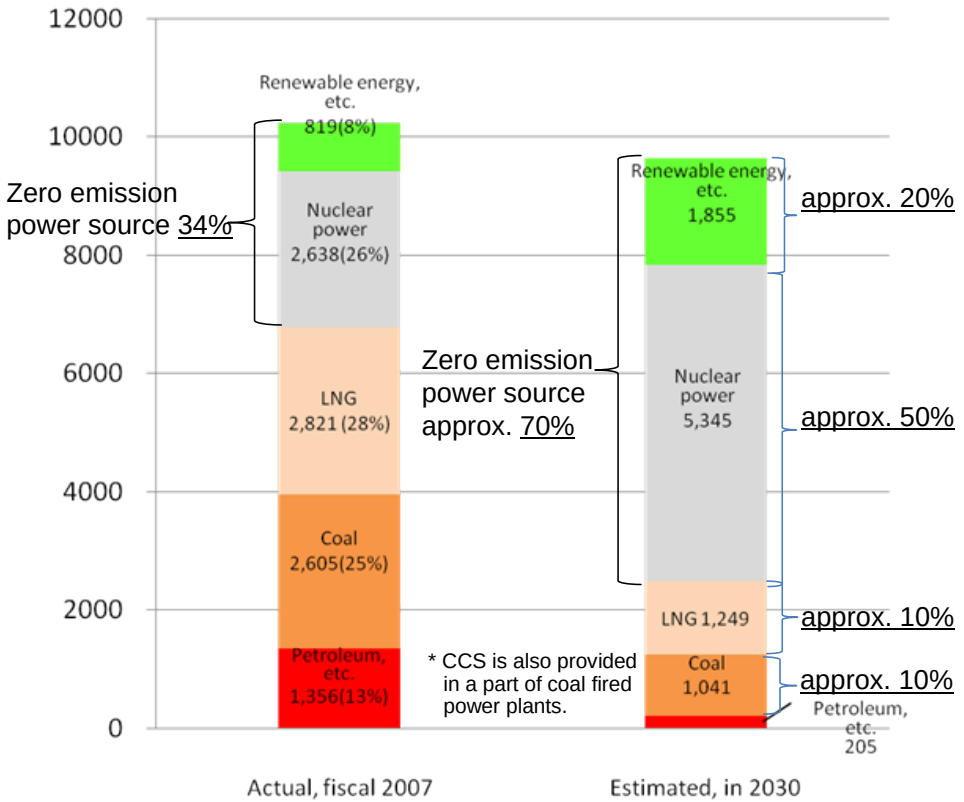
Balance of power generation

○ Zero emission power source ratio will become approx. 70%* (34% currently).

• "Renewable energy, etc." in 2030 includes electricity generated in households, etc.

(10MW) [Breakdown of Generation Capacity]

(0.1 bil. kWh) [Breakdown of Generated Electricity]



- This estimation is premised on considerable energy conservation, additional building (at least 14 plants) and increased facility utilization rate (approx. 90%) of nuclear power plants based on ensured safety while acquiring understanding and trust of the public on installation location, etc., as well as introduction of renewable energy to the maximum extent. Stability of the power system needs be separately studied.
- Coal-fired thermal power plants assume that, in response to commercialization, CCS will be provided together with all power plants when they are replaced. It should be noted that the estimate may change depending on future technological development and securing of CO_2 storage locations, etc.

Total accumulated investment

	Major reduction measures	Reduction amount (approx.)	Total investment amount
Private sector	○ Energy conservation of houses and buildings	59 million tons	50.3 trillion yen
	○ High efficiency hot water supply devices (for households)	19 million tons	3.5 trillion yen
	○ Highly efficient illumination	17 million tons	4.2 trillion yen
	○ Energy conservation in IT equipment (green IT)	26 million tons	3.9 trillion yen
	○ Other		13.6 trillion yen
Industrial sector	○ Energy conservation in the manufacturing division ○ Innovative technological development ○ Conversion to gas	35 million tons	6.6 trillion yen * Cost for the entire industrial sector
Transportation sector	○ Diffusion and fuel efficiency improvement of next-generation automobiles ○ Biofuels	57 million tons	13.6 trillion yen
Section of conversion	○ Renewable energy * Photovoltaic, wind power, medium and small hydroelectric, geothermal, biomass	36 million tons	26.1 trillion yen * Entire renewable energy (Assuming that buyback cost is approx. 8 trillion yen and system stabilization cost is approx. 18 trillion yen)
	○ Nuclear power plants	140 million tons	5.6 trillion yen
	○ Improvement in efficiency in thermal power generation	25 million tons	3.0 trillion yen

Total:
131 trillion yen

If energy saving merit is taken into account:
62 trillion yen

* Total investment amount needed by 2030 has been roughly estimated. (Accumulation of differences in price from existing products. Provided that the price difference is assumed to be gradually decreased, in principle.)

reference

2010 Annual Report on Energy
(Japan's "Energy White Paper 2010")
<Outline>

June, 2010

Ministry of Economy, Trade and Industry

Government of Japan

2010 Energy White Paper

Energy White Paper

○ The Energy White Paper is a legal white paper reported annually to the Diet following a cabinet decision based on Article 11 of the Basic Act on Energy Policy.
○ The white paper is usually made of Part 1 which sets themes and topics in accordance with the recent situation, analyses the policies and introduces trends; Part 2 which shows domestic and overseas energy trends with the use of graphs and data; and Part 3 which looks back on the resource and energy policies in the previous fiscal year.
○ Important issues in the subject fiscal year have been selected as the themes of Part 1. For example, in the 2008 white paper, factors for the sharp rise in the crude oil price up to 2008 were analyzed.

Objective of the 2010 white paper (challenges and future policies on energy)

This white paper aims to transmit information particularly on the following 2 points.

(1) Country-by-country comparison through quantitative evaluation of energy security

○ With the growing need to respond to energy security and global warming issues when planning energy policy, the white paper aims to show the necessity and direction of the energy policies from the viewpoint of energy security by diachronically analysing and comparing the energy security of major consuming countries.

(2)Trend of introduction and efforts toward future expanded introduction of renewable energy

○The white paper explains the growing international interest in renewable energy while touching on trends on investment and business deployment. It introduces renewable energy introduction trends and the actual situation on renewable energy in Japan and other major countries, as well as explaining the details of Japan's policy measures including the two energy-related laws established in July 2009 and the viewpoints toward future dramatically expanded introduction.

Date of the Cabinet decision

June 15 Cabinet decision and report to the Diet

Contents

I. Country-by-Country Comparison through Quantitative Evaluation of Energy Security

1. The fundamentals of energy security

Energy security refers to being able to secure energy in the "quantity" necessary for people's lives, economic and social activities, and national defense, etc. at affordable "prices."
With changes through the years in the political situation, economic/industrial structures, and risks threatening them, the environment around the fundamentals have also changed.

[1] In the 18th century, the Industrial Revolution dramatically expanded the use value of energy resources for production & transportation and germinated the strategic importance of energy resources

[2] In the 20th century, energy was secured to enhance national power and prosecute wars.

[3] After the oil shocks, supply disruptions became a major risk and the key policy target was to minimize their effects.

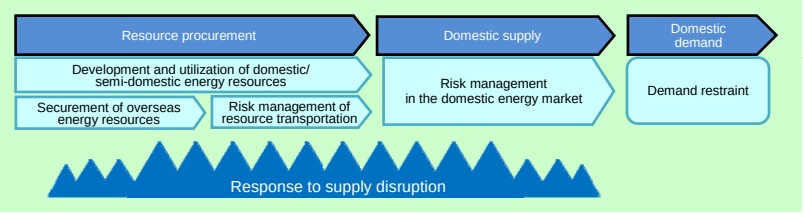
[4] In the 2000s, on top of supply disruption risks, avoidance of supply and demand tightness risk and minimization of their effects have also challenged us.

2. Risk threatening energy security

- Geopolitical risk (Countermeasures: increase in self-sufficiency, diversification of import counterparts, diversification of energy sources, response to supply disruption by stockpiling, etc.)
  - Political and military situations (wars, civil wars, embargos, etc.) of individual countries (resource producing countries and neighboring countries + countries near the transportation route)
  - International relations
  - Risk used as diplomatic tool (crude oil embargos, stopping of gas delivery via pipelines, etc.)
  - Resource nationalism (seizure/nationalization, levy increase, export regulations, etc.)
  - Scramble for resources among resource consuming countries
  - Other geopolitical risks
    * In recent years, risk of terrorism, piracy, etc. has become apparent.
- Geological risk (Countermeasures: increase in self-sufficiency, diversification of energy sources, etc.)
  - Reduction of reserves
  - Uneven distribution of resources
- Risk in domestic supply system (Countermeasures: enhancement of supply reliability, etc.)
  - Reduction in equipment investment (aging of equipment)
  - Stagnant technological development
- Supply and demand tightness risk (Countermeasures: increase in self-sufficiency, diversification of import counterparts, diversification of energy sources, etc.)
- Market price risk (Countermeasures: international cooperation toward market stabilization, etc.)
- Risk of natural disasters, accidents, strike, pandemic, etc. (Countermeasures: increase in self-sufficiency, enhancement of supply reliability, response to supply disruption by stockpiling, etc.)

3. Concept of quantitative evaluation

◇ Indices (key indices) related to core elements among comprehensive energy security components are quantitatively evaluated. In addition, indices that can supplement key indices (supplementary indices) are also quantitatively evaluated.
◇ For evaluation, at each stage of the supply chain, specific key indices and supplementary indices have been selected, from the viewpoint of understanding changes with age and country-by-country comparison.

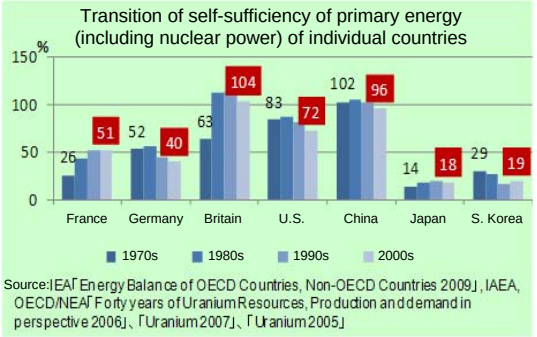


Stage in the supply chain	Key indices	Supplementary indices
1. Development and utilization of domestic/semi-domestic energy resource	A. Primary energy self-sufficiency (including nuclear power)	➢ Utilization rate of power supply facility
2. Procurement of overseas energy resources, and risk management of resource transportation	B. Diversification of countries from which energy is imported C. Diversification of energy source D. Reduction of dependency on choke points	➢ Amount of direct investment into resource-producing countries
3. Risk management in the domestic energy market	E. Reliability in electric power supply	➢ Energy-related governmental R&D expenses
4. Demand restraint	F. GDP specific energy consumption	➢ GDP specific energy consumption at each sector
5. Response to supply disruption	G. Response capability to supply disruption by stockpiling	➢ Usable years of domestic resources

I. Country-by-Country Comparison through Quantitative Evaluation of Energy Security

4. Evaluation of key indexes

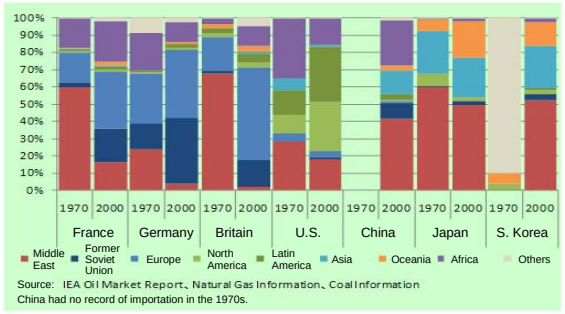
A. Primary energy self-sufficiency
(including nuclear power)



Source:IEA「Energy Balance of OECD Countries, Non-OECD Countries 2009」, IAEA, OECD/NEA「Forty years of Uranium Resources, Production and demand in perspective 2006」、「Uranium 2007」、「Uranium 2005」

- France increased its self-sufficiency from 26% in the 1970s to the current 50% or more by adopting measures for promoting nuclear power plants.
- Britain secured a high level of self-sufficiency by promoting maintenance and increase of the production amount of domestic resource energy.
- China sharply increased domestic demand through industrialization and economic progress. It has been a net importer of petroleum since 1993 and of natural gas since 2006.

B. Diversification of import counterparts



Source: IEA Oil Market Report、Natural Gas Information、Coal Information
China had no record of importation in the 1970s.

- It is important to promote diversification of import counterparts in order to strengthen energy security.
- China has diversified import counterparts to countries in Latin America and Africa while accepting certain country risks.
- Western nations have decreased dependency on the Middle East, while shifting import counterparts to neighboring resource-producing countries. However some of such countries have certain country risks.
- In Japan, despite the decreased dependency on the Middle East in the 1980s, dependency on the Middle East subsequently increased. Expanded use of coal has increased its share in Oceania.

◆ Evaluation on import counterpart diversification for crude oil and natural gas based on the import quantity (in the 2000s) Herfindahl-Hirschman Index (HHI)

Crude oil	HHI
China	1,032
U.S.	1,077
France	1,190
S. Korea	1,459
Japan	1,736
Germany	2,187
Britain	4,162

○ China is rated high since it has advanced diversification to the Middle East, Asia, and Africa, etc.
○ Britain is rated low since Europe accounts for a high percentage of the imported crude oil.

Natural gas	HHI
Japan	1,680
France	1,934
S. Korea	2,119
Germany	3,259
Britain	4,905
China	7,281
U.S.	7,858

○ Germany is rated medium since it depends approx. 40% on former Soviet Union and approx. 50% on Europe.
○ China is rated low since it substantially solely depends on Oceania.

☐Evaluation on diversification of import counterparts by multiplying import quantity by country risk

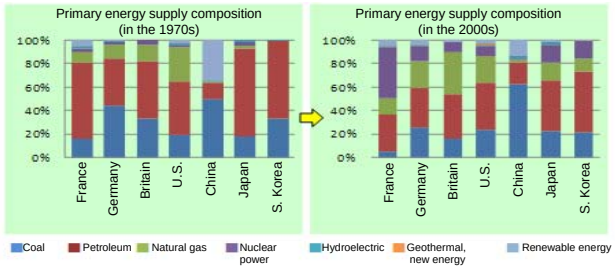
Crude oil	HHI
France	1,306
U.S.	1,347
S. Korea	1,411
China	1,487
Japan	1,733
Britain	2,085
Germany	3,401

○ Evaluation for China which aggressively promotes diversification to Africa, etc. has been slightly lowered.
○ Evaluation for Britain which highly depends on Europe with low country risk improves.

Natural gas	HHI
S. Korea	2,418
France	2,518
Japan	2,613
China	3,272
Britain	3,896
U.S.	4,972
Germany	6,654

○ Evaluation for Germany worsens reflecting dependency on the former Soviet Union.
○ Evaluation becomes better since country risk of Oceania is low.

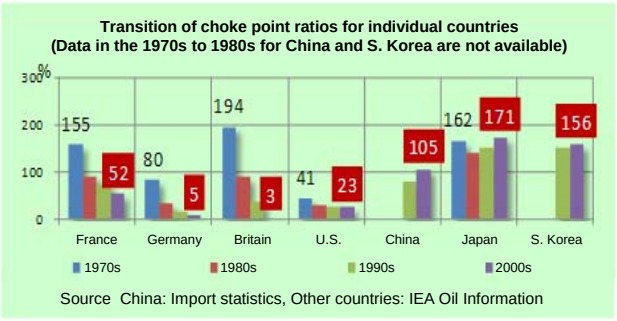
C. Diversification of energy source



Source: IEA Energy balance of OECD Countries, Non-OECD Countries, 2009 edition

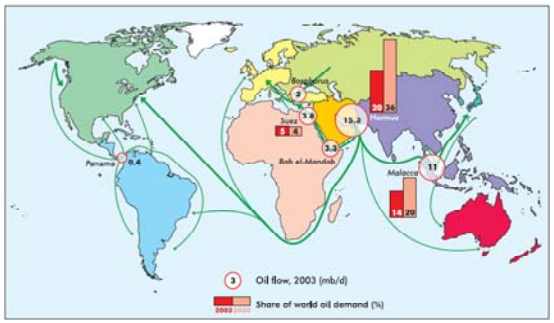
- France strongly promotes nuclear power, while suppressing the ratios of coal-fired and petroleum-fired power generation.
- Germany promotes introduction of natural gas and nuclear power, replacing coal and petroleum. Currently, it is moving toward the phase-out of nuclear power and the expansion of the introduction of renewable energy.
- Britain promotes the expanded use of domestic natural gas.
- Japan and S. Korea take measures to expand the utilization of alternatives to oil, and particularly encourage diversification of energy sources for power generation.

D. Dependency on choke points



Source China: Import statistics, Other countries: IEA Oil Information

Flow of petroleum and major choke points
(Sauce: IEA World Energy Outlook 2004)

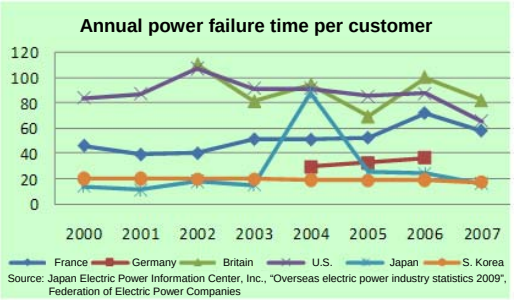


- A choke point refers to a strategic point on a sea route or on water such as a straight or a canal that is strategically important from the viewpoint of geopolitics, and economy and defense, etc. A choke point is, in many cases, used for transporting a large quantity of energy and extremely vital for energy security.
- The choke point ratio is a ratio of the total quantity of crude oil which passes a choke point with respect to the total import quantity. The ratio can sometimes exceeds 100% because when a choke point is passed multiple times all the multiple times are calculated.
- Decrease in Britain and Germany is remarkable. Among China, Japan and S. Korea, all of which have high dependency, the dependency of China which has diversified import counterparts ranging from Africa and South America, etc. is relatively low.

I. Country-by-Country Comparison through Quantitative Evaluation of Energy Security

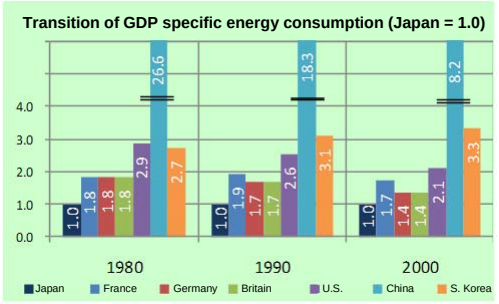
4. Evaluation of key indexes (continued)

E. Reliability in electric power supply



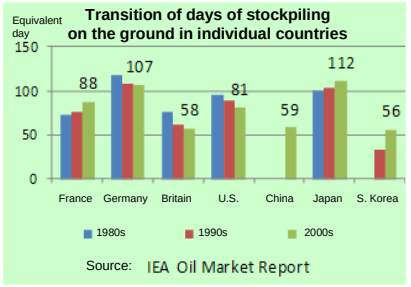
- In Britain and the U.S., electricity deregulation caused the selection of inefficient power sources and sluggish investment in building new power supply facilities, etc. Accordingly, their power failure time is longer than that in other countries in the 2000s.
- Power transmission and distribution facilities were established by large scale electric power supply businesses including EDF in France and E. On in Germany. As a result, the power failure time has been fluctuating between approx. 30 to 50 minutes.
- In Japan, general electricity utilities undertake obligations for supplying sectors for which retail sales are to be regulated and for ultimately assuring the supply to consumers subject to deregulation. Accordingly, the power failure time is generally low.

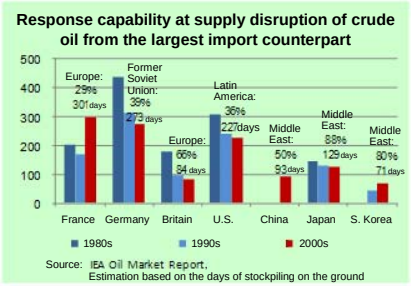
F. GDP specific energy consumption



- Specific energy consumption in advanced countries has improved due to low economic growth and population increase rates, changes in industrial structure, progress of introduction of energy saving equipment, etc.
- Though the evaluation for China has improved because of the expanding GDP due to recent economic progress, there is still a great difference compared to other countries.
- In S. Korea, specific energy consumption deteriorated due to negative growth caused by the Asian currency crisis.

G. Response capability to supply disruption

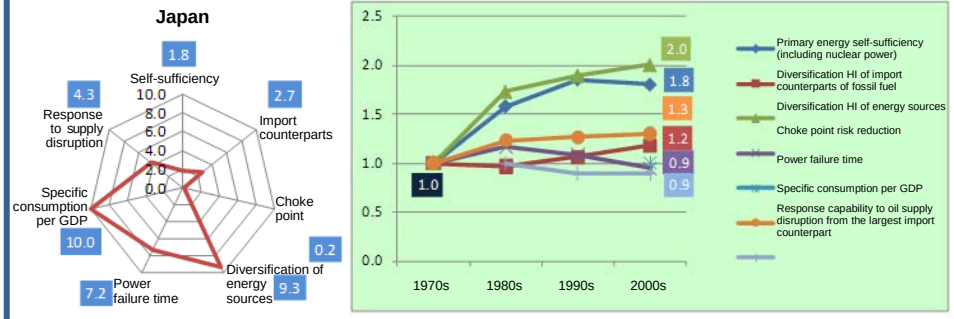




- IEA member countries are promoting the establishment of stockpiling based on the agreement related to stockpiling.
- China clarified the establishment of state oil stockpiling in the 10th 5-year plan (2001 to 2005), and promotes its establishment.
- France, which has an energy dependency rate of 29% even in Europe, has a strong response capability to supply disruption.
- Germany has a sufficient stockpile despite high dependency on Russia (39%).
- Both in Japan and S. Korea, with 80-90% dependencies on the largest import counterpart, the Middle East, their response capability to supply disruption by oil stockpiles are only 129 and 71 days, respectively.
- Britain's response capability to supply disruption by oil stockpiling is approx. 80 days because it has as high as a 66% dependency on Europe and no mandatory stockpile amount. China is on the way to establishing state stockpiling, with a current response capability to supply disruption being 93 days.
- Britain, the U.S. and China are capable of covering domestic consumption for a considerable period of time by domestic crude oil in addition to their stockpiles.

5. State of energy security in individual countries

Radar chart: Country-by-country comparison in the 2000s (assuming the OECD average is 100, any difference from the OECD average is converted into an index for each key evaluation. Ten points are given to the highest rated country, and scores for other countries are given on the relative evaluation.)
Line graph: Increase and decrease in each key evaluation when a value in the 1970s or the oldest identifiable value is assumed as 1.0

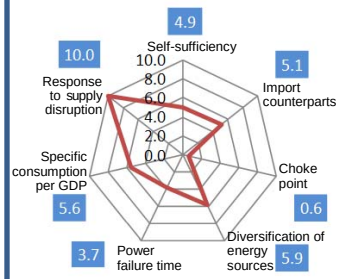


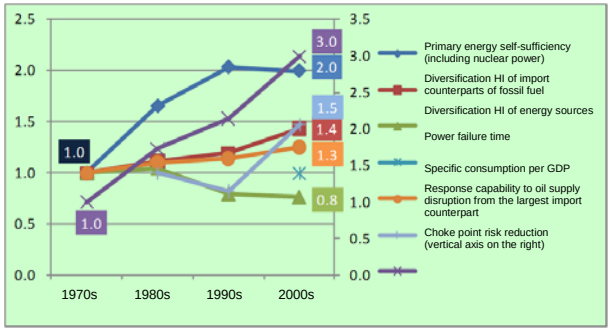
- In the 1980s and thereafter, primary energy self-sufficiency increased through continuous promotion of nuclear power utilization. Since however Japan is poor in domestic energy resources, it is rated low in the country-by-country comparison.
- Despite an decrease in dependency on the Middle East for petroleum after the oil shock, dependency increased again in the 2000s, so did dependency on choke points. Diversification of import counterparts are ongoing for natural gas. Though dependency on Australia for coal is high, its country risk is low.
- As a result of the expansion of the utilization of coal, natural gas and nuclear power as alternatives to petroleum, Japan is highly rated in the country-by-country comparison on supply source diversification.
- The average power failure time is the second shortest after S. Korea. Because deregulation-induced competitive pressures that were weaker than those of western nations and because of other reasons, liberalization in power distribution has been advanced since the 1980s.
- An expansion of the Law Regarding the Rationalization of Energy Use (the Energy Conservation Law) established and enforced in 1979 has led to the application of the regulatory scope from energy consuming manufacturing industries to the transportation, business, home electric appliance and housing sectors and the promotion of energy conservation in individual sectors.
- Dependency on Middle East for petroleum is structurally high, and thus the response capability to supply disruption by stockpiling is rated low in the country-by-country comparison.

I. Country-by-Country Comparison through Quantitative Evaluation of Energy Security

5. State of energy security (continued) in individual countries

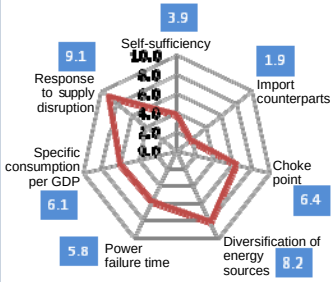
France

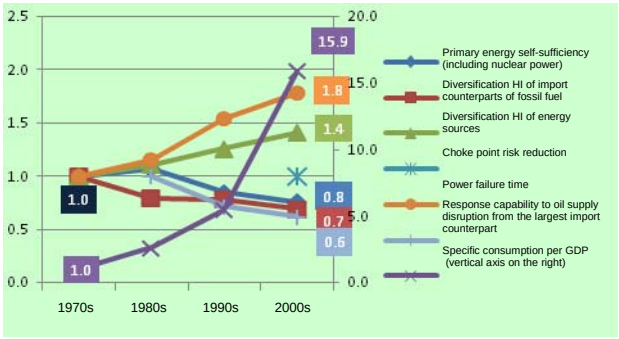




- Though France is poor in domestic fossil energy resources except coal, it increased its primary energy self-sufficiency by aggressively promoting nuclear power development at an early stage.
- France has promoted diversification of import counterparts by nurturing powerful energy supply businesses such as GDF, EDF and TOTAL, and by strengthening its presence in the competition for acquiring resources. France imports from Europe, the former Soviet Union, Africa, and Middle East in a balanced manner.
- The power failure time is rated as medium. Monopolistic business conducted by vertically-integrated national and public companies is presumed to have been advantageous in the aspect of capital investment.

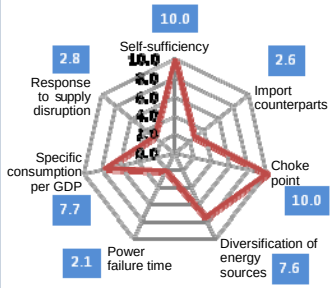
Germany

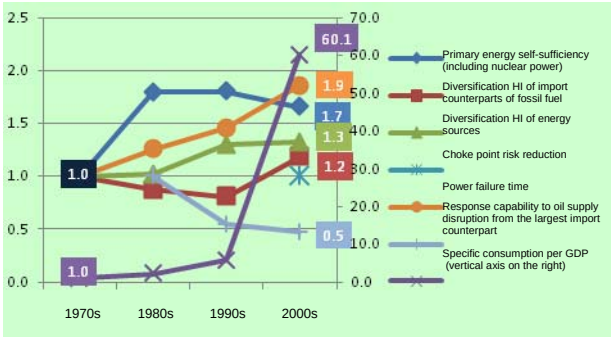




- The German government maintains a nuclear phase-out policy and promotes the introduction of renewable energy.
- In Germany, the dependency on the Middle East for oil substantially decreased. The basic energy security strategy is to enhance a stable relationship with Russia, and as a result, dependency on former Soviet Union countries in fossil fuel imports has increased.
- As for the natural gas supply, construction of a direct pipe line from Russia has been committed to.
- Due to excess transmission capacity , the power failure time is relatively short.
- Energy efficiency has been increased through the improvement of the energy demand structure in the former East Germany.

UK



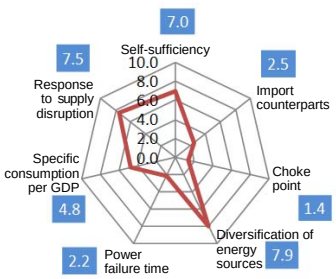


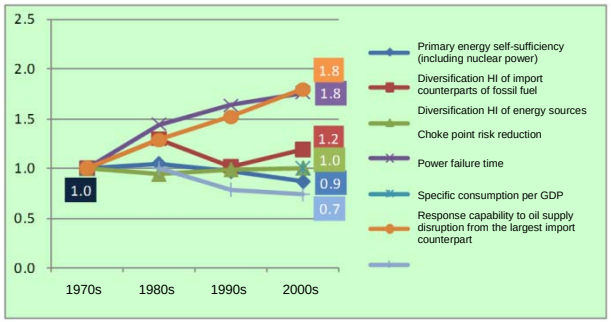
- In accordance with the exploration and development of North Sea oil and gas fields, Britain's energy self-sufficiency ratio dramatically increased. Because production of oil and gas in North Sea is diminishing these days, however, the UK's energy self-sufficiency is expected to decline gradually.
- Dependency on gas has increased because of the promotion of the utilization of domestic natural gas. In response to lesser diversified energy sources, the UK has reevaluated the importance of nuclear energy and promoted renewable energy.
- Due to deregulation in the electricity market, suspensions and closures of power generation facilities have been accelerated. Thereafter, reliability in electric power supply is a challenge.
- In response to "the Energy Performance of Buildings Directive" of the EU in 2002, energy efficiency in the residential sector has dramatically increased. It is more efficient than that in Japan.

I. Country-by-Country Comparison through Quantitative Evaluation of Energy Security

5. State of energy security (continued) in individual countries

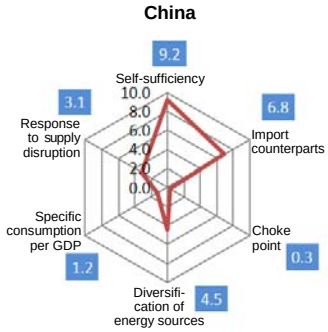
U.S.

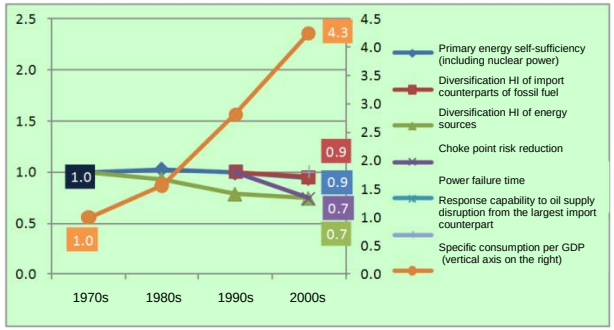




- With abundant energy resources, the U.S. maintains relatively high self-sufficiency.
- The U.S. is gradually shifting import counterparts from the Middle East and Africa to North America and Latin America. It imports resources from these 4 regions in a balanced manner.
- Development and utilization of domestic coal and natural gas has progressed, and diversification of energy supply sources has been advanced.
- Though building of new nuclear power plants was at a standstill in the 1980s thereafter, the momentum of reviewing this stance has been building recently.
- The U.S. has an inferior capacity to invest in power transmission and distribution networks because of the small size of businesses particularly in local areas, on top of electricity deregulation.

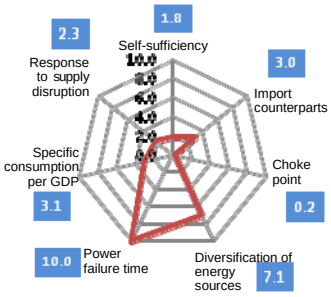
China

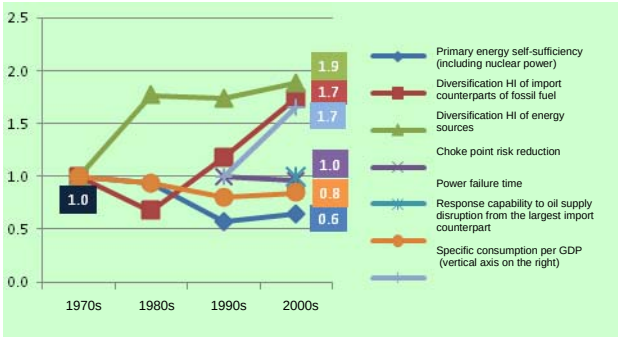




- While China has abundant domestic resources and maintains high self-sufficiency, self-sufficiency dropped due to a sharp increase in demand in accordance with rapid economic progress. Because of its high dependency on domestic coal, China faces challenges in diversification of energy sources.
- China, mainly lead by national oil companies such as CNPC, CNOOC, and SIONPEC has been aggressively promoting the acquisition of overseas interests, and diversified import counterparts for oil to Russia, Viet Nam, Venezuela, and African countries. Dependency on the Middle East for entire fossil energy supply is approx. 40%.
- Since in the 2000s, China has been promoting the building of state oil stockpiling bases. Currently, China is presumed to have secured an oil equivalent of 59 days.

Korea

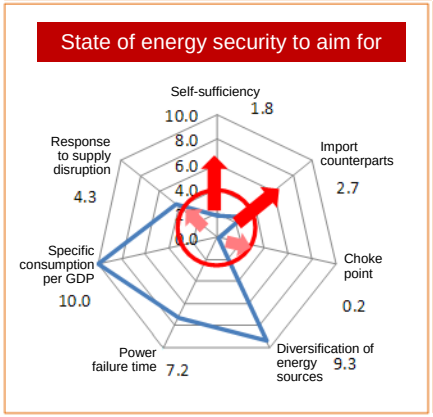




- Because Korea is poor in domestic energy resources except lignite, dependency on imports of fossil fuel increased and energy self-sufficiency declined. Through the promotion of nuclear power generation, the energy self-sufficiency ratio has been successful in that it has been maintained at the same level as that of Japan.
- As for natural gas, import counterparts have been diversified among the Middle East, Indonesia, and Australia, while dependency on the Middle East is still high.
- Due to the industrial structure in electric power generation, investment on facilities for power transmission and distribution was sufficient, and power outage times are short.

I. Country-by-Country Comparison through Quantitative Evaluation of Energy Security

6. Viewpoints for future measures



Energy security refers to being able to secure energy in the necessary amount at an acceptable price. Japan, with its poor domestic resources, needs to ***pursue securing a necessary amount and strengthening its resistance against situations such as increased resource prices, rising resource nationalism and others***.

(1) Enhancement of independent energy ratio including promoting independent development

An appropriate business portfolio in the energy/resource supply chain should be constructed. The **development of domestic resources and independently explored & developed energy & natural resources should be promoted**, as well as construction of optimum production systems & the maintenance and strengthening of the domestic supply network.

◆ Significance of independently explored and developed energy and natural resources

Independent development of resources by Japanese companies is likely to enable the stable acquisition of a certain amount of resources for an extended period, since the companies are directly engaged in production/operation. Independent development also contributes to strengthening a wide range of mutually-dependent relationships with resource-producing countries, early detection of changes in supply and demand based on the policies of resource producing countries, and understanding the strategies of resource producing countries/majors and technical trends, etc.

Independent development can help for reduce risks of physical supply disruption and enhance the upstream development and the competitiveness of Japanese companies. Even at the time of oil shock or similar events, despite decrease in the entire supply amount, the import quantity of crude oil under independent development mainly in the Middle East increased, which has contributed to the securing of a stable supply in emergencies.

Petroleum import quantity in times of emergency (unit: 10 thousand BD)
Examined by Agency for Natural Resources and Energy

	First oil crisis			Gulf crisis		
	Fiscal 1973	Fiscal 1974	Increase/ decrease	Fiscal 1990	Fiscal 1991	Increase/ decrease
Total import quantity	498	476	-22	412	412	0
Crude oil under independent development	42	47	5	45	50	4
Crude oil not under independent development	456	429	-27	366	362	-4

(2) Promotion of support by supplying risk money in order to secure interest of Japanese companies

Dependency on overseas procurement is unavoidable in order for Japan to secure a necessary amount of energy resources. It is important to pursue **diversification of risks by diversifying the energy sources themselves and by diversifying import counterparts for each energy resource**.

When diversifying the import counterparts, it is necessary to take into consideration the country risk of each resource producing country. When promoting diversification of import counterparts through securing independent development, there are many cases where the energy resource interests which will be accessible in the future exist in countries/regions with relatively higher country risks. Such risks cannot be taken merely by the resource developing company, and it is necessary, **as a nation,** to **promote support by supplying risk money, risk taking with use of trade insurance, etc. or the establishment of appropriate risk management system, etc**.

(3) Reduction of choke point risk and establishment of stockpiling

It is impossible to completely avoid the choke point risk itself under the situation where overseas dependency for energy resources is high. Accordingly, it is necessary to promote international cooperation to ensure safe sea lanes, as well as **to steadily establish state stockpiling of petroleum/petroleum gas in preparation for supply disruption caused by straight blockades in emergencies or the delayed supply of energy resources**.

II. Trend of Introduction and Efforts toward Future Expansion of Renewable Energy

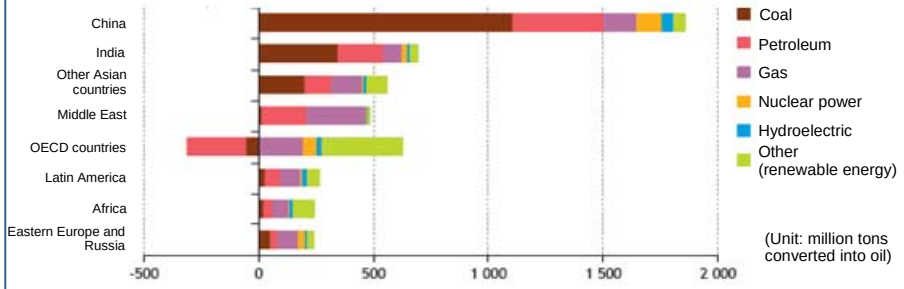
1. Growing international interest in renewable energy

○ Demand for renewable energy is expected to expand from now because of the hike in fossil fuel prices due to increased energy demand in emerging countries and the accelerated scramble for energy resources.

[Prospects of increases/decreases in global energy demand]

Prospects of increases/decreases in primary energy by energy source in individual regions

* Comparison between 2007 and 2030 in the case where the current demand growth rate continues



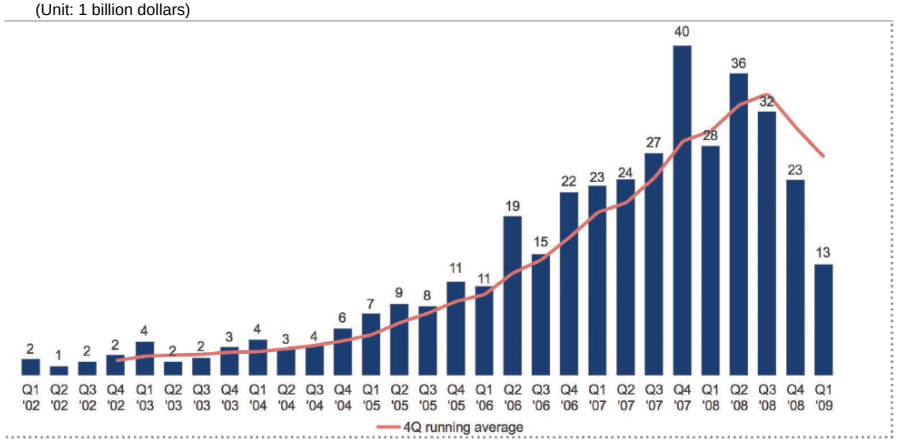
* "Other" energy sources include biomass, waste, wind, geothermal, photovoltaic, solar heat, tidal wave power.

(Source) IEA "World Energy Outlook 2009"

○ Investment started increasing dramatically around 2005 when a sharp increase in fossil fuel prices started. Individual governments are aggressively increasing public spending in order to create employment and foster industries. Such investments triggered expanded inflows of private money to the renewable sector (which started decreasing in the latter half of 2008 due to financial crisis and other reasons).

[Global trend of investment in renewable energy (by quarter)]

(Unit: 1 billion dollars)



(Source) Created based on UNEP SFEI "Global Trends In Sustainable Energy Investment 2009"

○ Renewable energy has been aggressively deployed targeting advanced countries in the fields such as photovoltaic, solar heat, and wind power, etc. Japanese companies are also advancing efforts in joint-venture businesses with overseas companies and in business operations taking advantage of their technological advantages. Cases in which electric utilities, trading companies, and manufacturers, etc. participate in overseas power generation businesses also increased.

[Examples of business being deployed by Japanese companies]

Mitsubishi Heavy Industries, Ltd. (MHI): Wind power generation (Britain)
MHI and its motor section headquarters in Europe Power Systems Europe (MPSE), signed a memorandum with the British government to work for a demonstration and development project of offshore wind turbines with subsidies from the Department for Business, Innovation and Skills (BIS). This is the first time for a Japanese manufacturer to enter the offshore wind turbine market.

Sumitomo Corporation: Photovoltaic power generation (Spain)
Sumitomo Corporation started operation of mega solar (large-scale photovoltaic) power plants in Tenerife Island in the Spanish Canary Islands, which have been aggressively introducing wind power and photovoltaic power generation recent years from the viewpoint of protecting environmental resources. This is the largest power plant in the world with the output of 12.6 MW among the power plants operated mainly by a Japanese company. Sumitomo procured photovoltaic panels manufactured by Sharp.

Sharp Corporation: Solar cells (Italy)
Sharp made a joint venture contract related to business for manufacturing thin-film photovoltaic cells with Enel greenpower (EGP) and STMicroelectronics, and a joint venture contract on independent power producing businesses with EGP.

Mitsubishi Corporation: Photovoltaic, solar heat and wind power (Spain)
Mitsubishi Corporation is jointly developing and operating a new energy power generation business with Acciona, which owns new energy power generation facilities with an output of approx. 7 million kW.

NGK Insulators Ltd.: NAS cells (UAE)
NGK received an order for a sodium-sulfur (NAS) battery system with the output of 50 MW from the Abu Dhabi Water and Electricity Authority of the United Arab Emirates. Operation of gas turbine electric generator has been made more efficient by leveling the electric load using energy efficient NAS batteries with a high energy density. NGK is studying future application to the Abu Dhabi mainland where demand for electric power is expanding remarkably and to large scale photovoltaic power generation.

Showa Shell Sekiyu K.K.: Photovoltaic (Saudi Arabia)
Showa Shell started a feasibility study with the national oil company, Saudi Aramco, on a small-scale distributed power generation business utilizing solar light in Saudi Arabia.

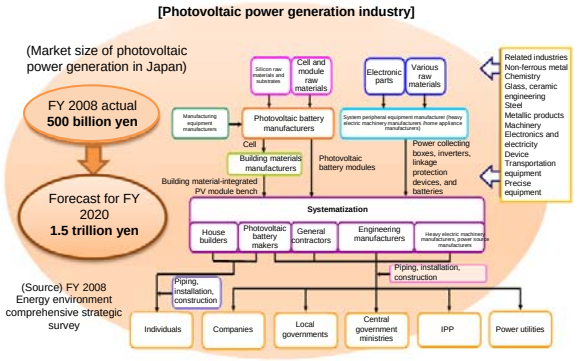
Eurus Energy: Wind power generation, etc. (Europe and America)
Eurus Energy, a joint venture company between Tokyo Electric Power Company and Toyota Tsusho Corporation, will build and operate new power generation plants with the total output of 1 million kWs in the coming 5 years.

(Source) Created based on press releases of individual companies

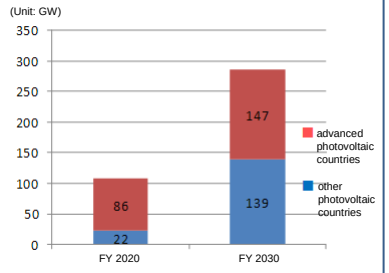
○ Renewable energy not only serves as a countermeasure to global warming while enhancing energy security, but also has features such as broad related industries and strong relationships with regional economies. Therefore, large positive effects both on economic growth and employment are also anticipated in Japan in relation to renewable energy.

* On the other hand, the fact has also been pointed out that imported products increased in Germany which rapidly expanded introduction of photovoltaic power recent years (share of Chinese products is 50%).

[Forecast of domestic market size (photovoltaic)]



[Forecast of amount of global photovoltaic power generation to be introduced in FY2020 and FY 2030]



(Source) IEA World Energy Outlook 2009

II. Trend of Introduction and Efforts toward the Future Expansion of Renewable Energy

2. Trend of introduction of renewable energy

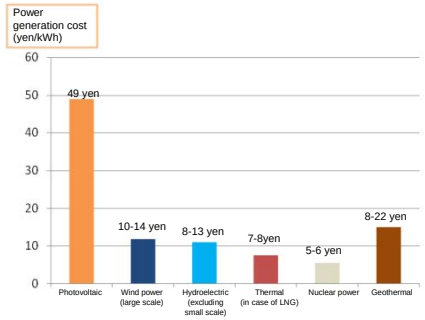
○ The actual achievement and future prospects related to the introduction of renewable energy in Japan are comparable to those in other major countries. On the other hand, the introduction of renewable energy always involves challenges such as unstable output, high costs, and installation constraints. So far, renewable energy has been introduced through various measures within a certain potential.

○ The stages of introduction and potential also differ greatly among major countries, depending on differences in geography and climate, retention and utilization conditions of resources, and social and economic scale, as well as other factors. It is important to promote introduction based on the various relevant conditions and characteristics of different types of renewable energy.

[Representative characteristics of renewable energy]

Photovoltaic	○ Considerable reduction in power generation cost is anticipated. Both residential and non-residential sectors have great potential in the amount to be introduced. There are a wide range of supporting industries. ○ Power generation cost is higher than other power generation methods.
Wind power	○ Since power generation cost is relatively low, the business is profitable. New technologies including offshore power generation have also emerged. ○ There are constraints on installation (wind conditions, natural parks, landscapes, bird strikes, noise issues, etc.). Power generation costs are gradually increasing.
Geothermal	○ Stable power generation is possible with matured technologies. There are abundant sources in Japan. ○ Constraint on installation (natural parks, hot spring regions, etc.) is large, and thus power generation cost will likely gradually increase in the future.
Hydroelectric	○ Stable power generation is possible with matured technologies. There is a growing interest in middle and small-sized hydroelectric power generations. ○ Since constraints on installation are large, power generation costs will likely gradually increase in the future
Biomass	○ Costs differ greatly depending on types and utilization method. ○ Depending on the future direction on the support system, increases in import materials may increase and affect the biomass industries in Japan. The imported materials may compete with power generation, heat utilization, and material utilization. ○ Biofuels need to be introduced in a sustainable manner while ensuring sufficient green house gas emissions reduction effects with LCA, energy security and cost reduction.
Air thermal, earth thermal	○ Heat pump technologies used in hot water supply systems and air conditioners have international competitive edges. ○ Initial costs are higher compared to combustion-type heaters and hot-water supply systems.

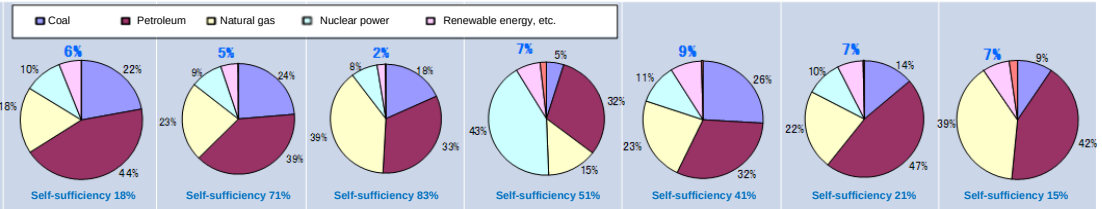
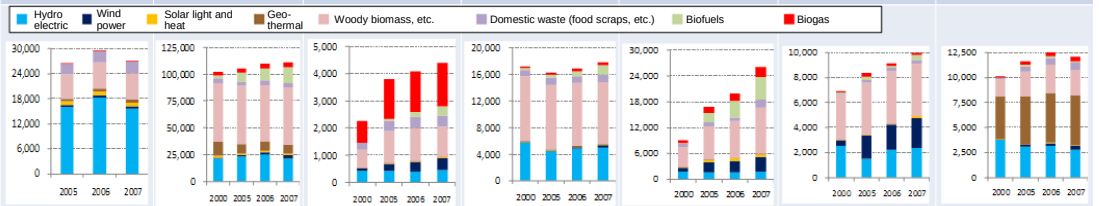
[Power generation cost for major energy source]



(Source) Created based on materials by project team on renewable energy feed in tariff

[Introduction status of renewable energy in major advanced countries (2007)]

* Renewable energy, etc. refers to photovoltaic, solar heat, wind, hydroelectric, geothermal, biomass (woody biomass, general waste, biofuel, biogas), etc.

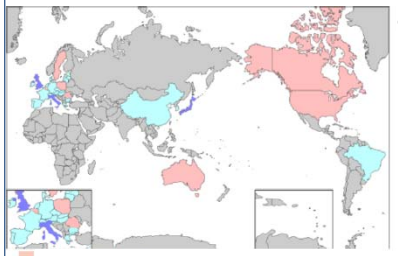
	Japan	U.S.	Britain	France	Germany	Spain	Italy
Primary energy supply composition (2007)		Self-sufficiency 18%	Self-sufficiency 71%	Self-sufficiency 83%	Self-sufficiency 51%	Self-sufficiency 41%	Self-sufficiency 21%	Self-sufficiency 15%
Transition in introduction of renewable energy recently (unit: converted into petroleum, thousand tons)								
Major measures for encouraging introduction (including R&D)	• RPS <since 2003> • Buyback program <since 2009> • Subsidies, tax system	• RPS (state) <since 2009> • Buyback program (state) • Subsidies, tax system	• RPS <since 2002> • Buyback program <since 2010> • Buyback program is only applicable to small size. • Subsidies, tax system	• Buyback program <since 2001> • Subsidies	• Buyback program <since 1991> * Momentum of reviewing the buyback program • Subsidies	• Buyback program <since 1994> * Momentum of reviewing the Buyback program • Subsidies	• RPS <since 2002> • Buyback program <since 2005> * Buyback program is only applicable to small size. • Subsidies
Trends of other related measures	• In addition to cross-sectional measures, some countries establish individual systems for guiding and supporting promotion of introducing renewable energy. (Examples) Britain: Renewable Heat Incentive (since 2008), Renewable Transport Fuel Obligation (since 2008), U.S.: Renewable Fuel Introduction Obligation (2007), Germany: Biofuel quota legislation(since 2008) • A recent trend is the full-fledged demonstration and support for establishing power distribution grid (smart grid) accompanying expanded introduction of renewable energy in Europe and America. (Example) Smart grid demonstration <U.S., France, Italy, etc.>						

Supplement: Supply composition of primary energy. The "transition in introduction of renewable energy" is created based on the statistics of the International Energy Agency (IEA).
(For Japan, this is created based on comprehensive energy statistics, etc.)
For Japan, renewable energy is set to account for 10% of the primary energy supply (in 2020). < Basic Law for Prevention of Global Warming: Cabinet meeting, March 2010 >
On the other hand, the EU decides the ratio of the renewable energy with respect to final energy consumption base as the target index, and sets the ratio as 20% for the entire EU (2020).
Future prospect (2020) for Japan, if calculated according to the same method as the EU, is expected to be approx. 20% (New and Renewable Energy Subcommittee, August 2009)

3. New policy deployment for expanding introduction of renewable energy

○ Measures for encouraging introduction in the world are roughly classified into two systems, on top of subsidies.
- RPS system (quantity-based regulations: requires electricity companies to use at least a certain amount of renewable energy)
- Feed-in-tariff law (price-based regulations: requires electricity companies to purchase renewable energy at a certain price)

○ Even the IEA has pointed out that effective measures are different depending on the cost difference from existing power sources.



Cost difference from existing power supply: Small ↓ Large

Type of energy	Effective policies
Hydroelectric (matured technology)	Voluntary introduction
Wind power	Credit system with technical characteristics, etc. being considered
Photovoltaic power generation	Feed-in-tariff system, subsidies
2nd generation bio (next-generation technology)	Support for investment cost (subsidies, tax-exemption due to investment)

Source: Created based on IEA "Deploying Renewables 2008"

(Source) Project team on an all-quantity buyback system of renewable energy (March 2010)

○ Japan has so far promoted the introduction of renewable energy through the expansion of demand by supporting introduction, voluntary efforts by electric utilities to purchase surplus electricity, and the RPS system, and achieved a certain result.

○ As institutional measures to effect a dramatic expansion of introduction in the future, it is important to have the following viewpoints in addition to support for introduction, and innovative technological development and demonstrations. It is necessary to take effective measures such as regulations and support suitable for the characteristics of each energy source.

(1) Establishment of a feed-in-tariff law in accordance with the circumstances of Japan

The Excess Electricity Purchasing Scheme for photovoltaic power started in November 2009 to promote the use of photovoltaic power. Currently, an all-quantity buyback program is being studied by the project team on an all-quantity buyback system for renewable energy.

(2) Building a next-generation smart energy system and community

Measures for an electric power system (building of smart grids) accompanying expanded introduction of renewable energy, and demand-side energy management

(3) Mitigating constraint conditions based on geographical conditions, etc.

Solving institutional and social challenges such as by the expanded introduction of wind power generation (e.g. projects in a natural park).