# Global Energy Outlook and the Importance of Petroleum

## from the Perspective of Global Warming and Energy Security

**January 26, 2011**

**Masakazu Toyoda,**

Chairman and CEO

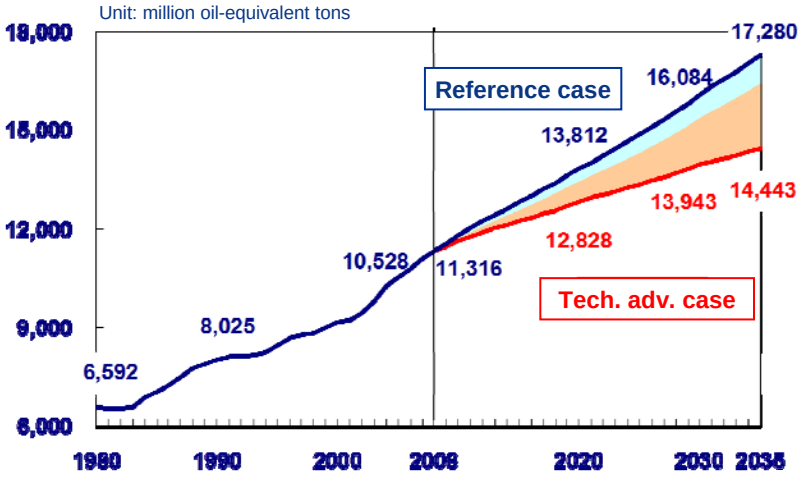
The Institute of Energy Economics, Japan (IEEJ)

# Contents

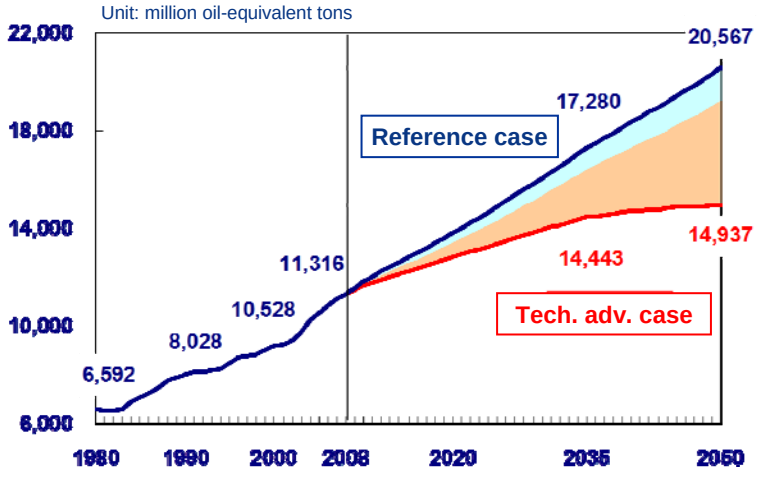
# 1-1. Importance of Petroleum

**In the reference case (assuming business-as-usual continuation of existing policies), global primary energy consumption is expected to increase 53% by 2035 and 82% by 2050 (from the 2008 level). In the technologically advanced case (assuming acceleration and diffusion of technologies), primary energy consumption is expected to increase more moderately, 27% by 2035 and 31% by 2050 (from the 2008 level).**

## Primary energy consumption of the world (2035)




## Primary energy consumption of the world (2050)



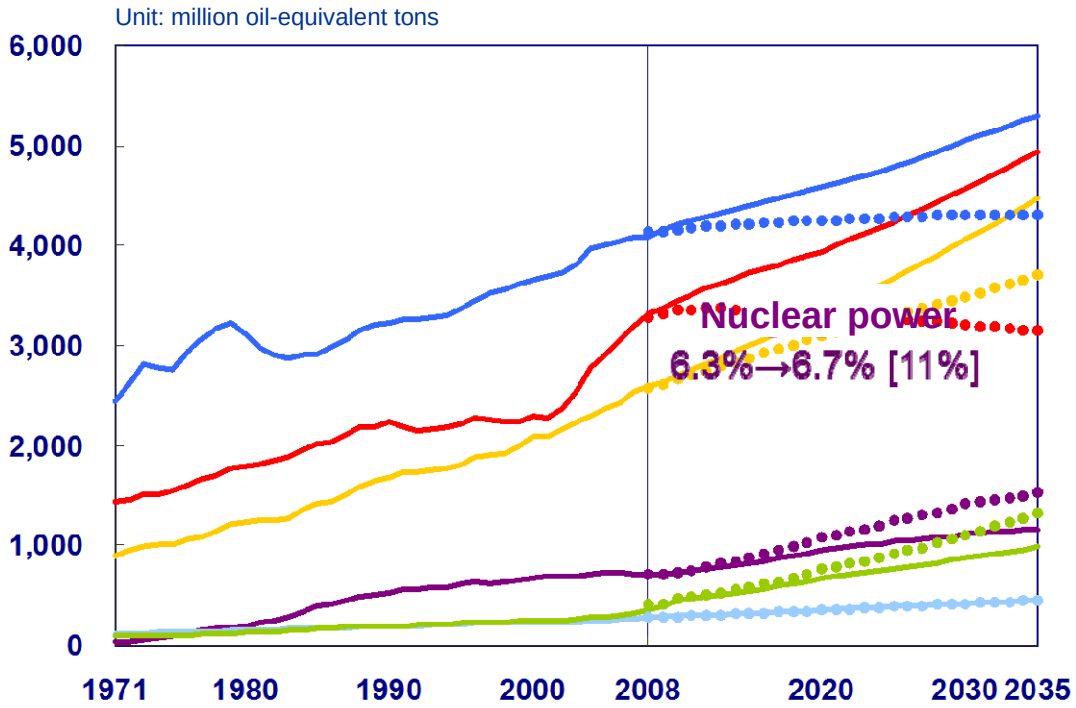

Source: Asia and World Energy Outlook 2010 (IEEJ)

# 1-2. Importance of Petroleum

## (estimated demand for different types of primary energy supply in 2035)

**In the reference case, the demand for petroleum will still be growing in 2035, which could be the upper limit of the growth trajectory. In the technologically advanced case, the demand for petroleum is expected to level off by 2035. In terms of share, petroleum will still lead natural gas and remain the greatest source of energy. The demand for petroleum would be the lower limit of the growth trajectory under this case.**

**Primary energy consumption of the world (2035)**




**Petroleum**
36%→31% [30%]

**Natural gas**
23%→26% [26%]

**Coal**
29%→29% [22%]

**Renewables, etc.**
3.1%→5.7%
[9.2%]

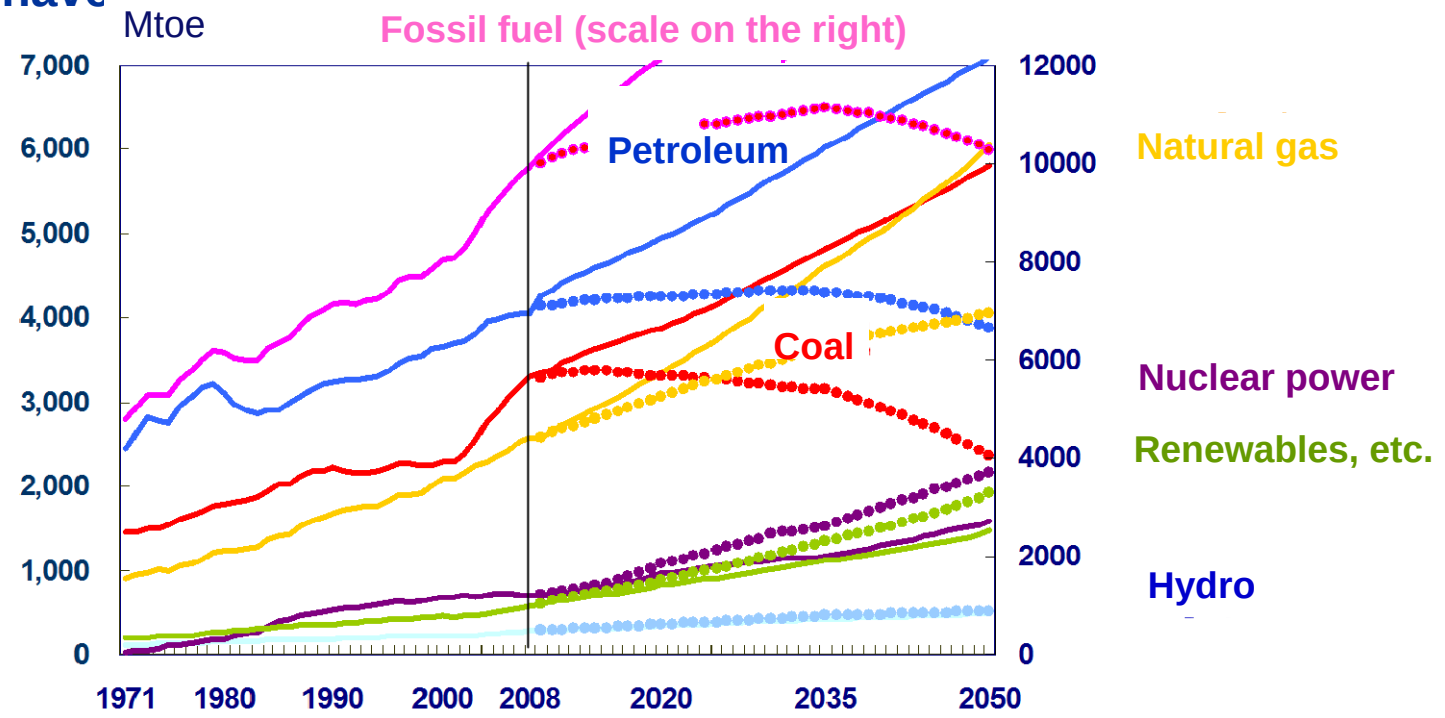
**Hydro**
2.4%→2.6%
[3.1%]

Source: Asia and World Energy Outlook (IEEJ)

# 1-3. Importance of Petroleum

## (estimated demand for different types of primary energy supply in 2050)

- In the reference case, the demand for petroleum will still be growing even in 2050.
- In the technologically advanced case, the demand for petroleum will drop below the 2008 level. Petroleum and natural gas will have almost equal shares.
- In the technologically advanced case, GHG emissions will decrease by 40%, not by half. Halving GHG emissions will require extra efforts, which may make natural gas have a greater share than petroleum




Source: Asia and World Energy Outlook (IEEJ)

# 2-1. Three Risks with Petroleum

**Petroleum involves the following three risks, which may disrupt the supply and demand for petroleum and cause its price to fluctuate wildly. These risks must be minimized by cooperation among oil consuming and producing countries.**

**1) Global warming risk**

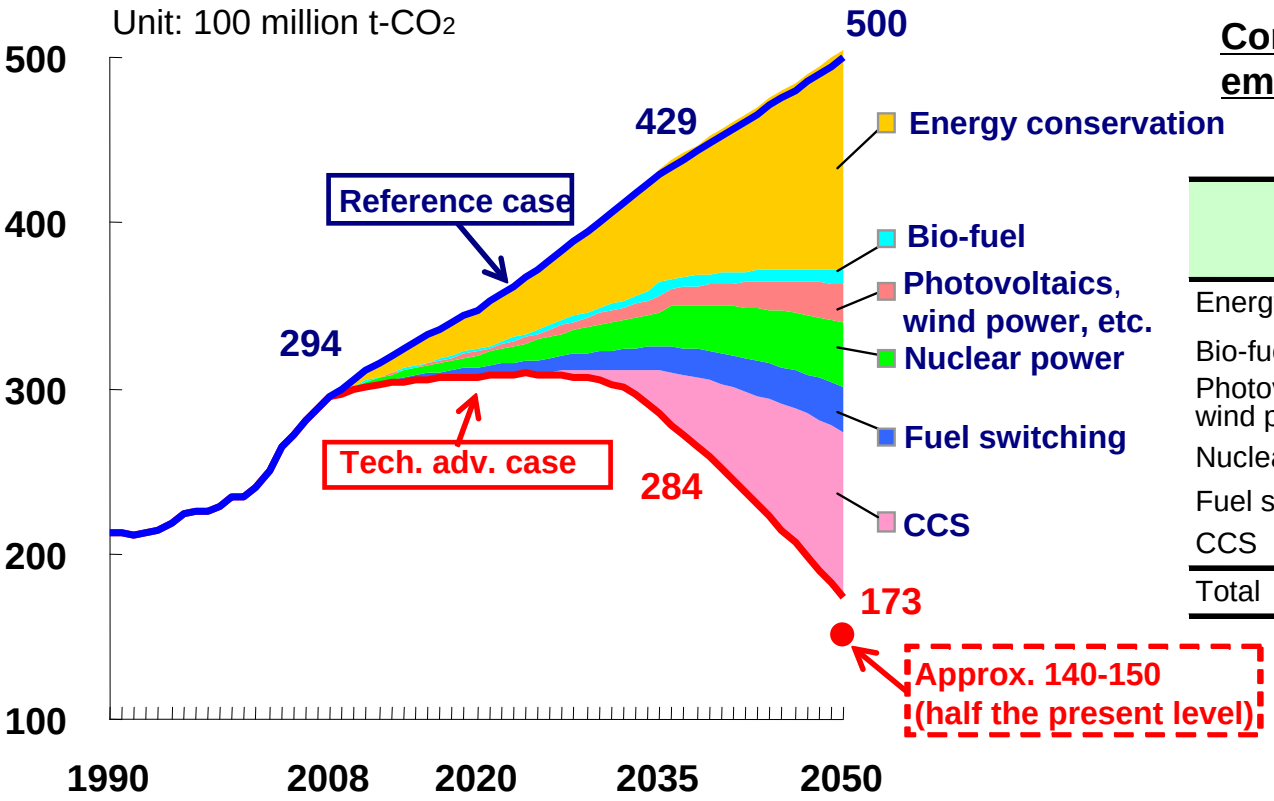
**2) Supply-demand mismatch risk**

**3) Financial/speculative risk**

# 2-2. Three Risks with Petroleum

## 1) Global warming risk, ① Feasibility of reducing $CO_2$ emissions

- At the 2007 Hokkaido Toyako Summit, G8 leaders agreed on the target of halving global $CO_2$ emissions by 2050.
- Even under the technologically advanced case assumed by IEEJ, however, reduction will not exceed 40% unless technical development can be accelerated.
- For petroleum consumption to increase, carbon capture and storage (CCS) is essential.

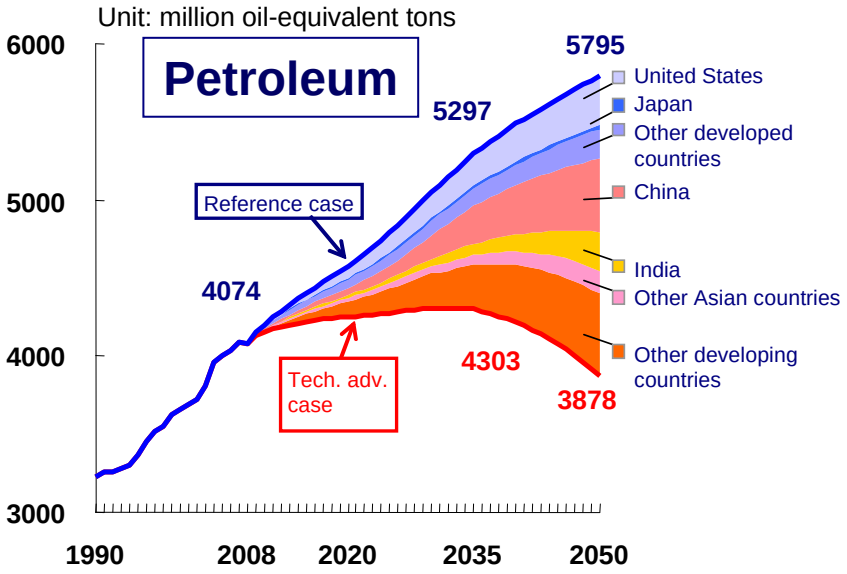



**Contributions to $CO_2$ emissions reduction by 2050**

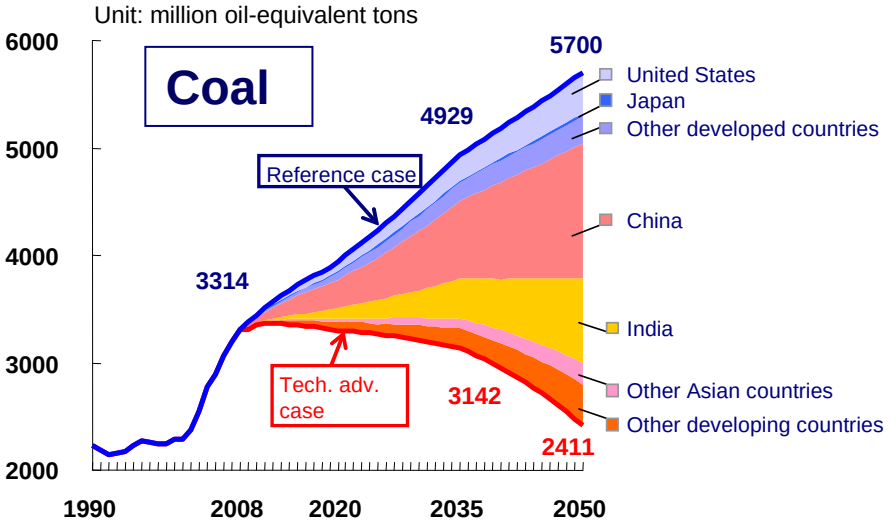
| | x 0.1 Billion tons | Contribution |
|---|---|---|
| Energy conservation | 131 | 40% |
| Bio-fuel | 9 | 3% |
| Photovoltaics, wind power, etc. | 23 | 7% |
| Nuclear power | 39 | 12% |
| Fuel switching | 27 | 8% |
| CCS | 99 | 30% |
| Total | 327 | 100% |

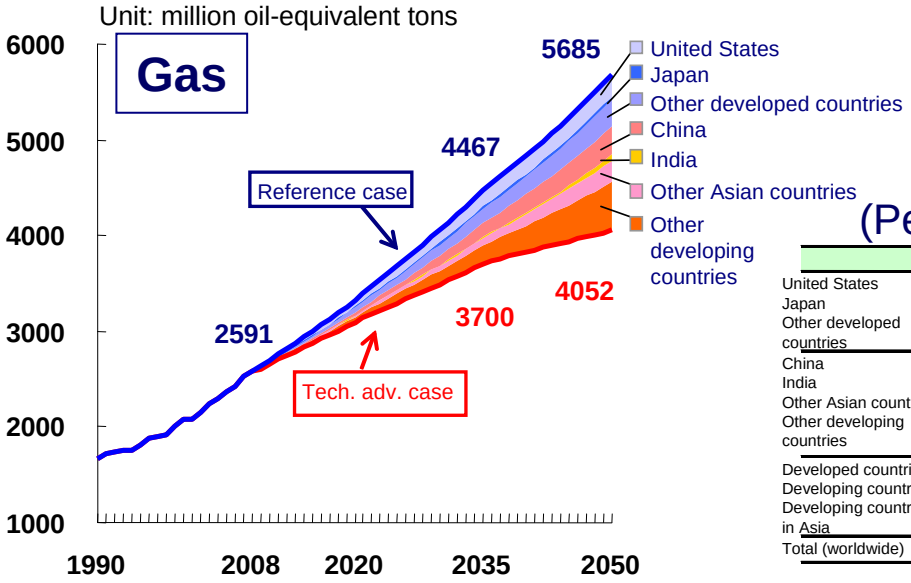
# 2-3. Three Risks with Petroleum

## 1) Global warming risk, ② A wide gap in petroleum demand between the 2 cases




To drastically decrease fossil fuel consumption, it is important to transfer technologies for efficient coal fired plants (e.g. clean coal technology) to developing Asian countries.




## Regional contributions to fuel saving by 2050

(Petroleum)

| | Mtoe | Contribution |
|---|---|---|
| United States | 315 | 16% |
| Japan | 25 | 1% |
| Other developed countries | 188 | 10% |
| China | 471 | 25% |
| India | 253 | 13% |
| Other Asian countries | 141 | 7% |
| Other developing countries | 525 | 27% |
| Developed countries | 528 | 28% |
| Developing countries | 1389 | 72% |
| Developing countries in Asia | 865 | 45% |
| Total (worldwide) | 1917 | 100% |

(Coal)

| | Mtoe | Contribution |
|---|---|---|
| United States | 384 | 12% |
| Japan | 27 | 1% |
| Other developed countries | 247 | 8% |
| China | 1260 | 38% |
| India | 795 | 24% |
| Other Asian countries | 191 | 6% |
| Other developing countries | 384 | 12% |
| Developed countries | 658 | 20% |
| Developing countries | 2631 | 80% |
| Developing countries in Asia | 2247 | 68% |
| Total (worldwide) | 3289 | 100% |

(Gas)

| | Mtoe | Contribution |
|---|---|---|
| United States | 233 | 14% |
| Japan | 31 | 2% |
| Other developed countries | 281 | 17% |
| China | 296 | 18% |
| India | 67 | 4% |
| Other Asian countries | 212 | 13% |
| Other developing countries | 512 | 31% |
| Developed countries | 545 | 33% |
| Developing countries | 1087 | 67% |
| Developing countries in Asia | 575 | 35% |
| Total (worldwide) | 1632 | 100% |

# 2-4. Three Risks with Petroleum
## 1) Global warming risk, ③ CCS vs. CCU

- If carbon capture and storage (CCS) is available at low cost, fossil fuel consumption, including petroleum, could increase.
- Furthermore, if carbon capture and utilization (CCU) technology becomes available, fossil fuel, including petroleum, could be consumed almost without contributing to global warming.

- Comment by Prof. Negishi, a Nobel Prize laureate in Chemistry:

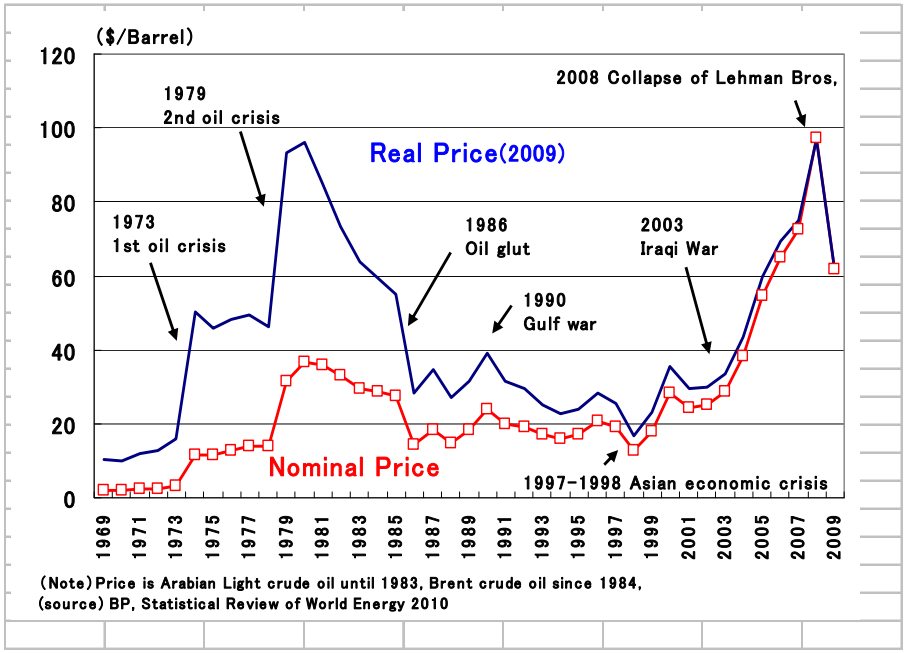
"Solving global warming requires a paradigm shift. $CO_2$ is the ultimate carbon source that can be used to produce the organic substances and compounds we require. To create a sustainable society, almost everything must be recycled somehow."

E.g. photosynthesis

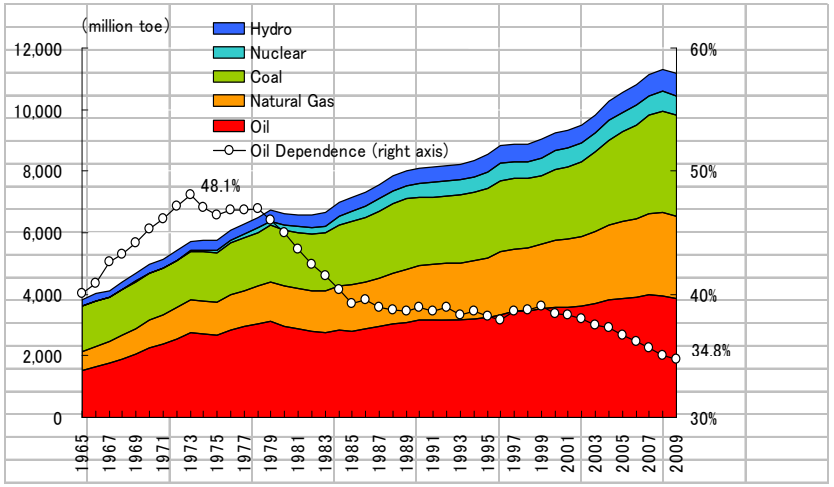
# 2-5. Three Risks with Petroleum
## 2) Supply-demand mismatch risk

- Falling demand would depress prices, which may threaten supply stability in the mid to long term by discouraging investment.
- Excessively tight supply-demand would cause prices to soar, accelerating the shift to non-fossil energy options and suppressing the demand for petroleum in the mid to long term.

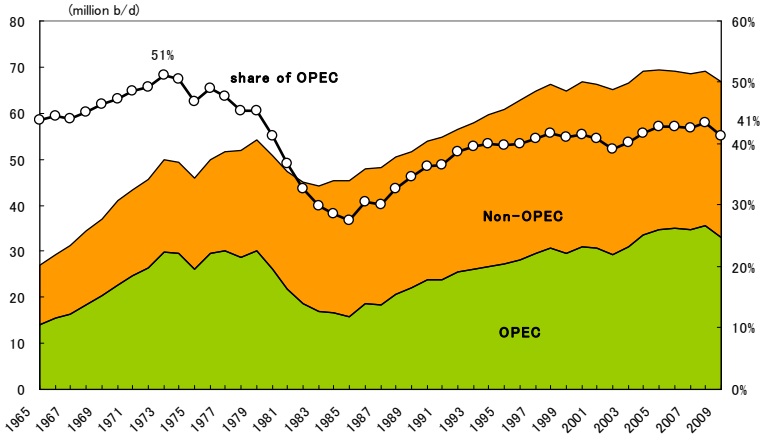
### Evolution of crude oil prices




### Evolution of the world's energy demand

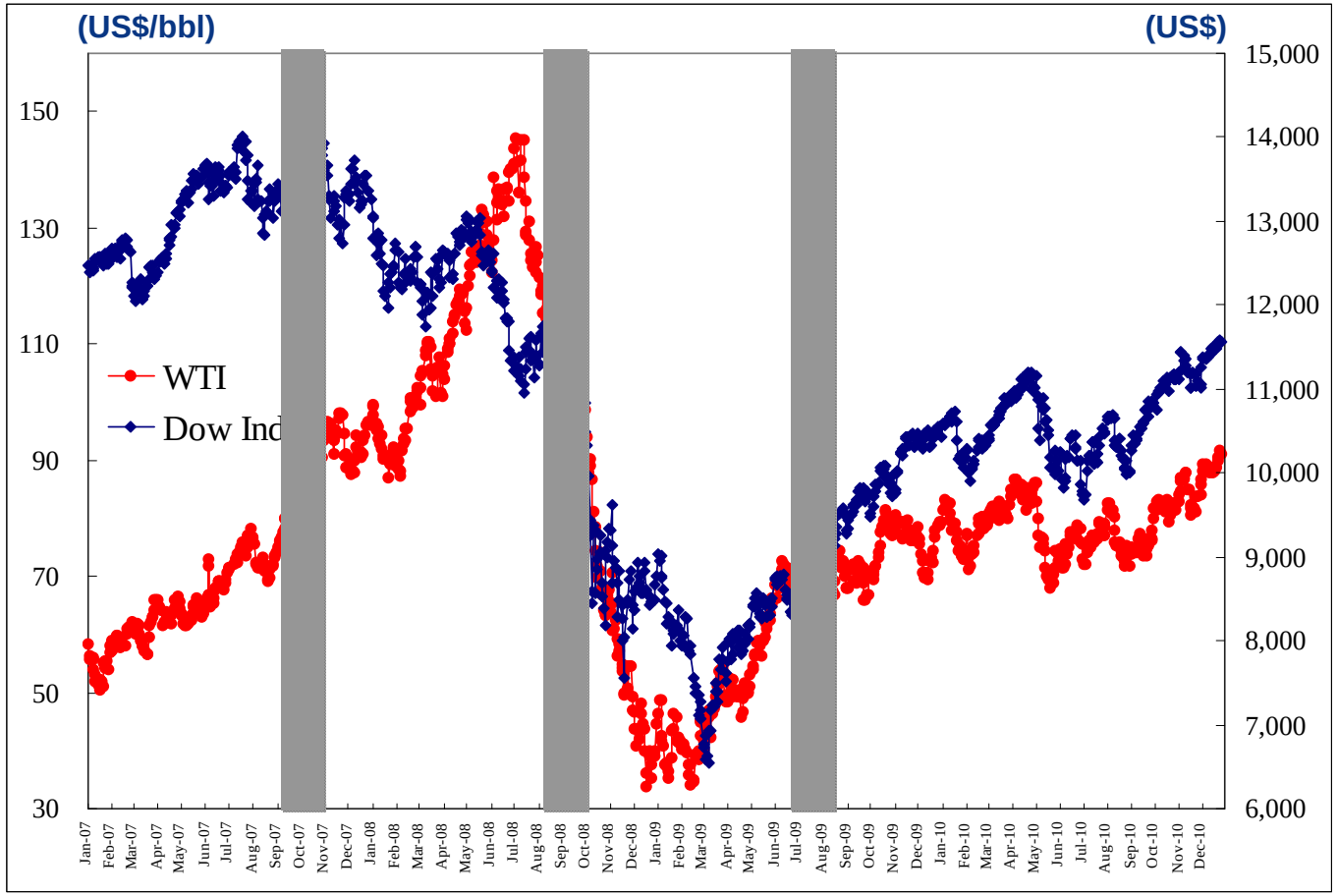



### Evolution of the OPEC dependency ratio



# 2-6. Three Risks with Petroleum
## 3) Financial/speculative risk

**Apart from the supply-demand fundamentals, speculative investment may amplify price fluctuations, causing wild swings.**



# 3-1. Strategies for Minimizing the Risks

## 1) Global warming risk

- It is important to promptly establish a post-Kyoto framework, which covers major economies in a meaningful way, narrow the gap between the reference and the technologically advanced cases, reduce future risks, and ensure adequate investment.
- In Cancun, the need for a new framework that includes the United States and China was acknowledged. As reduction targets, the following cases can be considered:

a. Aim for drastic reduction by 2020 based on the IPCC's 450ppm case.

b. Adhere to the 450ppm case but allow temporary overshoots, assuming agreement on a realistic but less ambitious target for 2020 based on the Copenhagen Agreement. Present damage should be mitigated by adaptation.

c. Abandon the 450ppm case and switch to the 550ppm case or others. Future damage is to be mitigated by long-term adaptive measures.

# 3-2. Strategies for Minimizing the Risks

## 1) Global warming risk: IPCC cases and anticipated damages

**IPCC presented six cases and, rather than stating which is the best, estimated the consequences of each.**

| Category | Temperature rise from pre-industrial revolution (℃) | GHG concentration (PPM) | GHG peak year | GHG emissions in 2050 (percentage from 2000) | Number of cases |
|---|---|---|---|---|---|
| I | 2.0-2.4 | 445-490 | 2000-2015 | -85 to -60 | 6 |
| II | 2.4-2.8 | 490-535 | 2000-2020 | -60 to -30 | 18 |
| III | 2.8-3.2 | 535-590 | 2010-2030 | -30 to +5 | 21 |
| IV | 3.2-4.0 | 590-710 | 2020-2060 | +10 to +60 | 118 |
| V | 4.0-4.9 | 710-855 | 2050-2080 | +25 to +85 | 9 |
| VI | 4.9-6.1 | 855-1,130 | 2060-2090 | +90 to +140 | 5 |

# 3-3. Strategies for Minimizing the Risks

## 2) Supply-demand mismatch risk ①

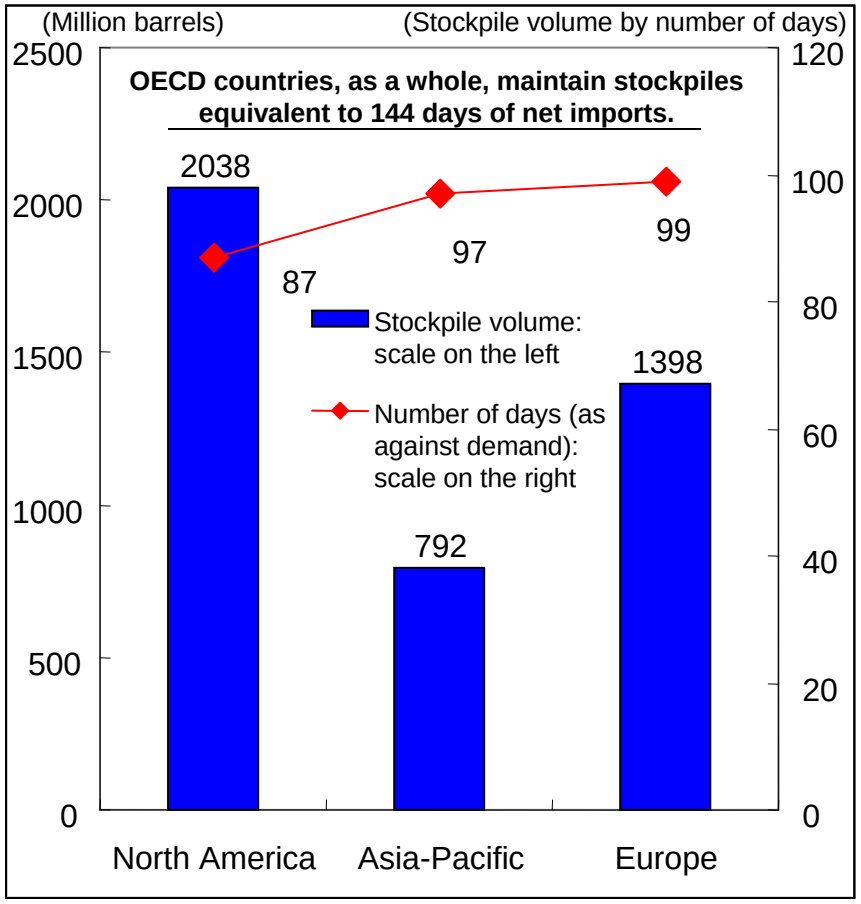
- Strategies for minimizing the supply-demand mismatch:
  - a. Oil producing countries should ensure sufficient investment while oil consuming countries should establish sufficient supply chains.
    - Note: Insufficient stockpiles and information in Asia, for example, could be a matter of concern.
  - b. Close dialog and trust between oil producing and consuming countries as well as information-sharing are essential.
  - c. Preventing mismatches downstream is crucial.
    - Flexibility must be secured by improving refining facilities to cope with structural changes.
    - Businesses must be strengthened to allow the investments required by downstream petroleum industries.
- The steady implementation of b. should be combined with the implementation of a. and c. with well-coordinated collaboration between oil producing and consuming countries.

# 3-4. Strategies for Minimizing the Risks

## 2) Supply-demand balancing risk ②

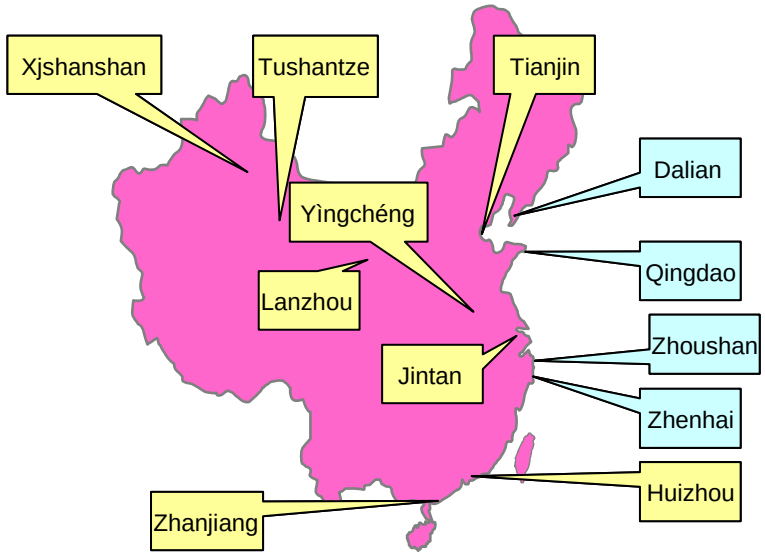
- The OECD (IEA) maintains sufficient stockpiles.
- Asian countries are making efforts to increase stockpiles.

**OECD stockpile status (end of 2009)**




Source: Compiled from IEA's Oil Market Report

**China's national stockpile strategy**




- The first phase of the project, which was completed in March 2009, aimed to build four terminals for stockpiling 103 million barrels in total.
- The second phase began in September 2009, and aims to build eight terminals for stockpiling 169 million barrels in total. Scheduled to be completed in 2015.
- The third phase aims to stockpile 169 million barrels in total, and is scheduled to end by 2020.

# Reference: Stockpile Conditions in Asian Countries

| | Governmental scheme for stockpiling | Obligatory stockpiling by oil companies, etc. | Current stockpiling status |
|---|---|---|---|
| China | The first-phase construction project (for stockpiling 103 million barrels) has been completed, and the second phase is now in progress. Upon completion of the third phase, China will have stockpiled the equivalent of more than 90 days of imports. | No obligatory stockpiling by oil companies | National projects for constructing stockpiling facilities are in progress. (The actual stockpile level is unknown.) |
| Taiwan | National 30-day stockpile | State-owned CPC and also private companies are obliged to maintain stockpiles. | 90-day stockpile (total stockpile including the national stockpile) |
| India | The first-phase construction project (for stockpiling 5 million tons) is in progress, and there are plans to expand the stockpile to 15 million tons. | None | The actual stockpile level is unknown. |
| Thailand | None | Obligatory stockpiling practiced by oil companies, etc. (to maintain the equivalent of 36 days' domestic consumption) | The actual stockpile level is about 45 days. |
| Indonesia | None | State-owned Pertamina adheres to the policy of maintaining a 23-day stockpile. | The actual stockpile level is unknown. |
| Vietnam | National stockpiling facilities are being constructed based on the stockpiling master plan | | The country plans to expand the stockpile to at least 90 days (pure import basis) by 2015, including the 30-day stockpile by private companies. |
| Singapore | None | Power stations are obliged to maintain a 90-day heavy oil stockpile. | Power stations are obliged to maintain a 90-day heavy oil stockpile. |
| Philippines | None | Petroleum refining industries are obliged to maintain a 15-day stockpile and petroleum product importers a 7-day stockpile. | The actual stockpile level is about 40 days. |
| ASEAN+3 | The ASEAN+3 Oil Stockpile Road Map (OSRM) was agreed. Each country is pursuing voluntary programs according to the agreement. | | The actual stockpile level is unknown. |

# 3-5. Strategies for Minimizing the Risks

## 2) Supply-demand mismatch risk ③

There are increasing examples of partnerships between oil producing and consuming countries.

Examples:

1) Companies in oil producing countries investing in refining facilities, marketing infrastructure, etc. in oil consuming countries

-- Saudi Arabia and ExxonMobil have launched a joint venture for an oil refinery in Fujian, China (240,000 B/D).

-- Countries such as Saudi Arabia and Abu Dhabi have been investing in oil companies, etc. in Japan, South Korea, etc.

2) Companies in oil consuming countries investing in the upstream sector of oil producing countries

-- The rights to crude oil production in other countries acquired by Chinese entities (CNPC, SINOPEC, CNOOC, etc.) amounted to 1.01 million B/D in 2009.

-- India (ONGC), South Korea (KNOC), Japan (INPEX, JAPEX, etc.) are also making overseas investments.

3) Leasing of crude oil tanks in the Okinawa Oil Terminal to Saudi Arabia

-- Period: three years from December 2010

-- Crude oil tank capacity: 600,000 KL

# 3-6 Downstream Investment by Japanese Oil Companies

- **Japanese companies are actively involved in downstream projects in oil producing countries.**
  - **Cosmo and Idemitsu invested in the Laffan condensate refinery with QP in Ras Laffan, Qatar.**
    - **Other partners are Mitsui, Marubeni, ExxonMobil, and Total.**
    - **Construction of the refinery began in 2006 and operation started in 2009.**
    - **Processing capacity is 164,000 b/d.**
  - **Idemitsu is participating in a joint venture to evaluate a refinery project in Nghi Son, Vietnam.**
    - **Other partners are Petrovietnam, Kuwait Petroleum International, Mitsui Chemical, and JGC Corporation.**
    - **Expected total investment is US$200 million.**
    - **The joint venture aims to start operation by 2013.**

# 3-7. Strategies for Minimizing the Risks

## 3) Financial/speculative risk

**・Recently, the problems of speculative investments are being discussed not only between oil producing and consuming countries but also at international organizations such as the IEA.**

**・In the United States, the following actions are being taken under the Financial Reform Act:**

a. Regulatory authorities, such as the U.S. CFTC, are seeking to improve the situation by increasing transparency through the disclosure of information on futures transactions and by imposing a limit on positions, for example.

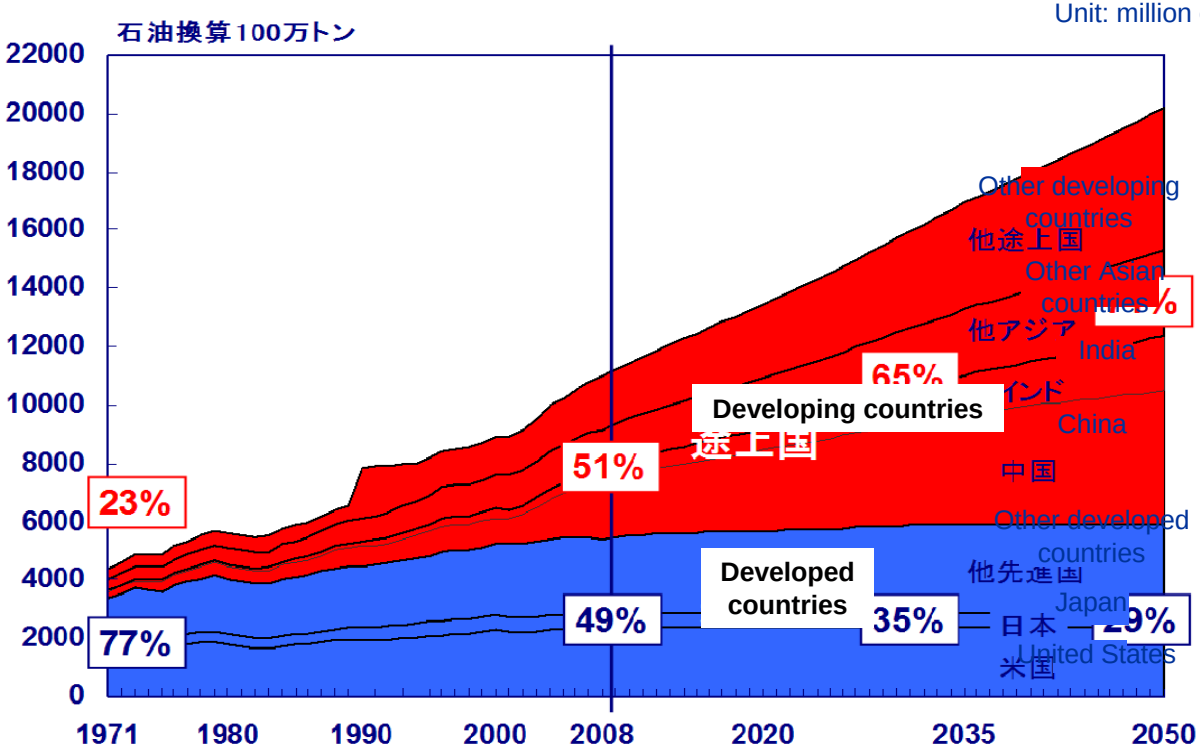
b. Preliminary discussions are under way to improve broader markets, including the over-the-counter (OTC) market in addition to the futures market.

| | | |
|---|---|---|
| **Regulations** | **July 2009** | **- On the Financial Services Committee of the Lower House, Gary Gensler, CFTC Chairman, requested (1) stronger control over OTC derivative transactions (target: swap dealers), (2) mandatory use of fully controlled trading centers or electronic trading, and (3) authorization for CFTC to impose position limits on traders and settlement by the clearing house, while acknowledging that (4) these proposals for stronger control are not intended to restrict speculative investments, which he believes are necessary for the market to function.** |
| | **July 2010** | **- President Obama signed the Dodd-Frank Wall Street Reform & Consumer Protection Act.<br>(1) By July of next year (i.e. within one year after passage of the bill), CFTC shall complete the establishment of all rules required under the Act.<br>(2) The scheme for position limits for the futures and swap markets shall be prepared by January 17 of next year.** |
| | **December 2010** | **- CFTC completed the definition of important terms (e.g. "swap dealers") on December 1, produced escape clauses on December 9, and formulated measures for improving the transparency of swap transactions (e.g. use of electronic trading) on December 16. The resolution concerning the proposed scheme for position limits (see the note below) was postponed (effectively making it difficult to finalize the scheme by January 17). The resolution needed to be followed by a public hearing.<br>Note: The proposed scheme for position control was to limit positions to 25% of the offerable quantity in the case of near-term contract months (before the closing day), and to 10% (for up to 25,000 sheets) or 2.5% (from 25,001) of the outstanding balance in the case of fully available contract months.** |
| **Challenge** | | **- CFTC originally expected to add 400 more staff to prepare for the enforcement of the Act, but lacks financial resources. (Congress declined the CFTC's request in September for a 2011 budget increase of about 117 million dollars.)<br>- The Republican Party, which is dominant in the Lower House, announced a policy to save government expenditure by slowing down the implementation of the Act. Gary Gensler, CFTC Chairman, was nominated by the Democratic Party.** |

# 4-1. Consumption increase in China and Promoting Cooperation

- Global primary energy consumption is expected to grow from 11.3 billion oil-equivalent tons in 2008 to 20.6 Btoe in 2050 (1.8-fold increase). In the years up to 2050, primary energy consumption will continue growing worldwide, and particularly in Asia.
- By 2050, the share of developing countries of global primary energy consumption is expected to reach 70%. Developing countries will then be consuming twice as much energy as developed countries.

Unit: million oil-equivalent tons

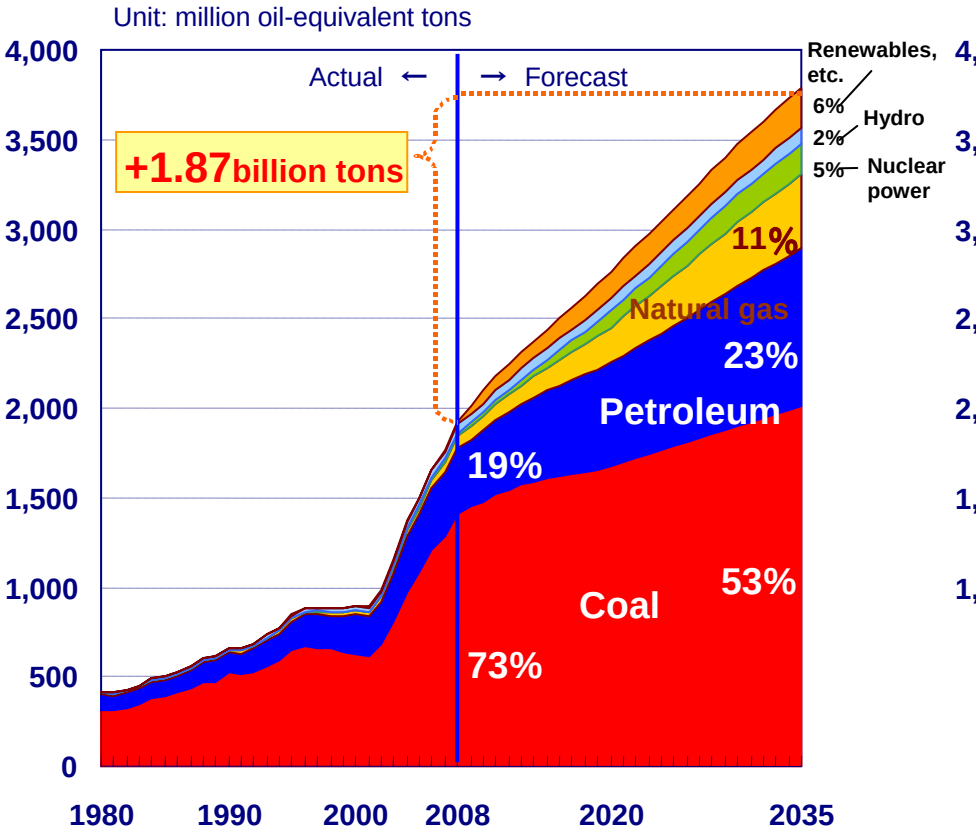


# 4-2. Consumption increase in China and Promoting Cooperation

**With fast economic growth, primary energy consumption in China is expected to grow by 2.5% annually in the reference case. The demand for both coal and petroleum is expected to grow sharply, driven by the demand for coal for power generation and the growing consumption of petroleum as a result of motorization.**

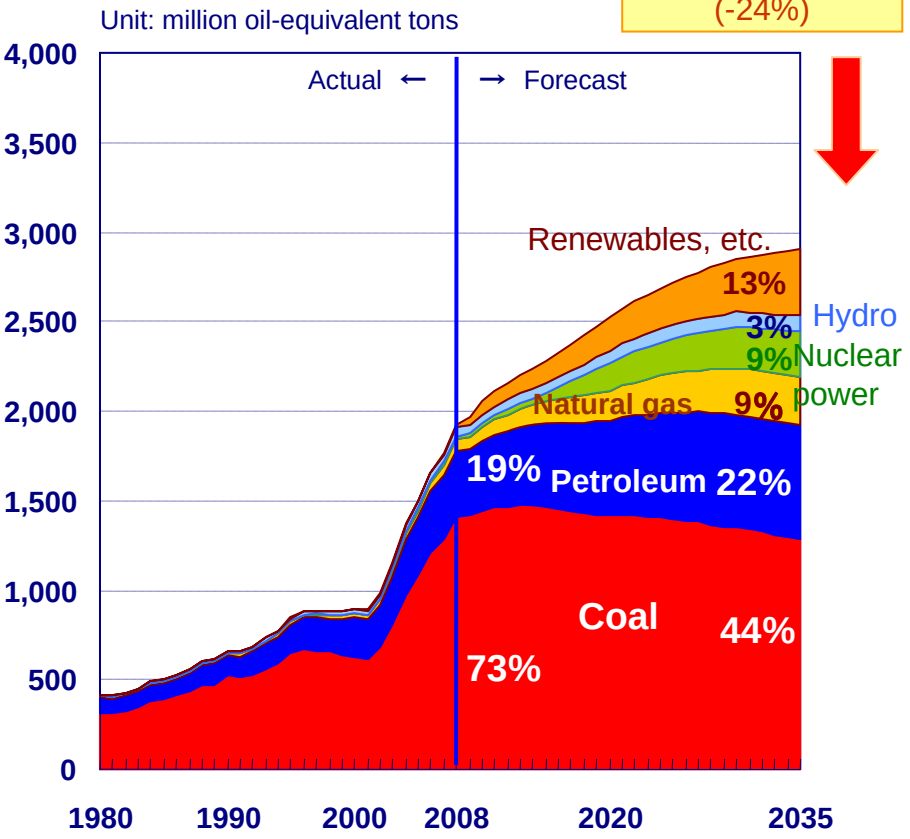
Reference case

1.+86 billion tons



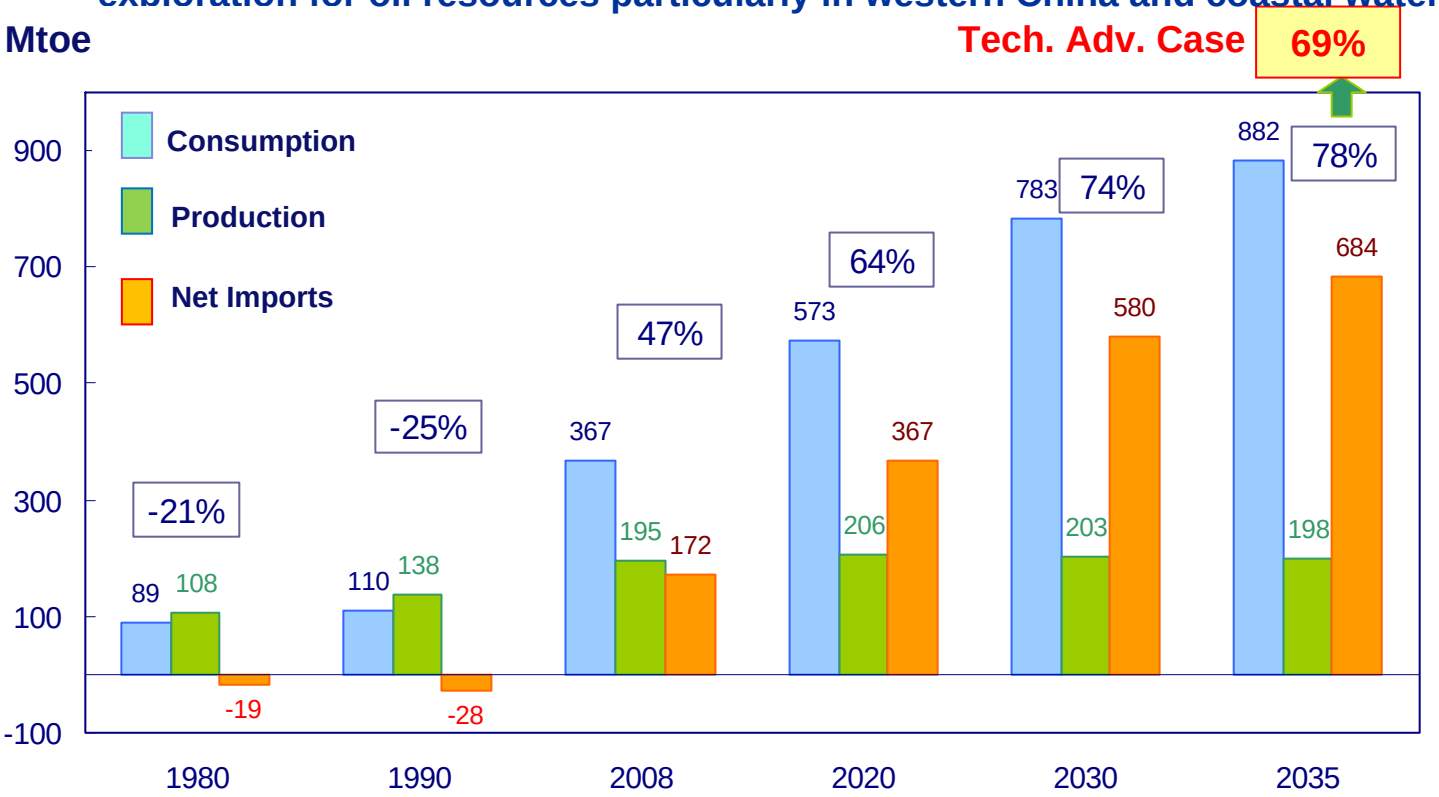

Technologically advanced case

-0.89 billion tons
(-24%)



# 4-3. Consumption increase in China and Promoting Cooperation

- In the reference case, China's net imports of petroleum will grow from 170 million tons (3.4 million B/D) in 2008 to 680 million tons (approx. 14 million B/D) in 2035, increasing the import dependency ratio to 78%.
- The technologically advanced case predicts moderate petroleum consumption, but still anticipates that the import dependency ratio will grow to 69%.
- In the future, China is expected to maintain oil production by stepping up exploration for oil resources particularly in western China and coastal waters.




**Quantity of imported oil**

**2008:**
3.4 million B/D
↓
**2035:**
14 million B/D (4.0-fold increase) in the reference case
9 million B/D (2.6-fold increase) in the technology development case

# 4-4. Consumption increase in China and Promoting Cooperation

**Necessary cooperation for ensuring stable supplies to China**

a. Closer dialog with China
- Participation in IEA initiatives (utilizing the Emergency Scheme, for example); sharing information as the minimum requirement
- Active participation in IEF initiatives

b. Avoiding unnecessary fluctuations in demand with technical support from Japan
- Promoting technology transfer from Japan by means of Japan-China Energy Conservation Forum, etc.

Note: The reference case assumes that petroleum consumption in China will approximately double between 2008 and 2035. Technology transfer from Japan, etc. can promote energy conservation and lower dependency on imports.

c. Exchange of investments between China and oil producing countries
- This will help develop relationships of trust.

# 5. Important Points

- Petroleum will remain an important energy source even in 2035 and 2050.
- Close partnerships between oil producing and consuming countries are essential to overcome the three types of risks associated with petroleum.
- The stabilization of oil markets requires sound development of downstream industries along with the maintenance and enhancement of the capacity and flexibility of supply chains. It is therefore important to improve profitability by creating additional value and participating in upstream products, for example.
- For petroleum to maintain its competitiveness as an energy option, it requires a stable supply and higher added value. CCS is particularly important.
- China will increase its petroleum consumption substantially, and cooperation is needed to help China stabilize its petroleum supply.
- To achieve the above, communication and partnerships among downstream petroleum industries in oil producing and consuming countries are most important. The JCCP International Symposium has an important role to play in this regard.

# Thank you for your attention.

Contact: report@tky.ieej.or.jp