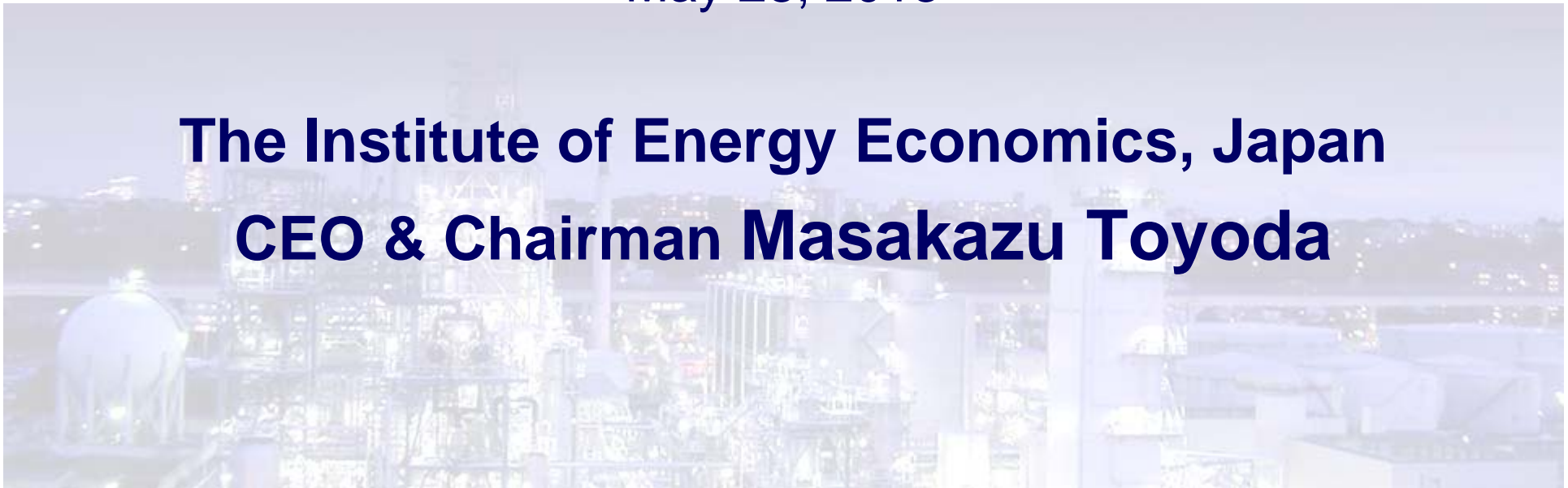




# **Energy Policy in Japan --- Challenges after Fukushima ---**

May 28, 2013

**The Institute of Energy Economics, Japan  
CEO & Chairman Masakazu Toyoda**



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# 1. Energy Policy before Fukushima

2. Challenges after Fukushima

3. Desirable Energy mix

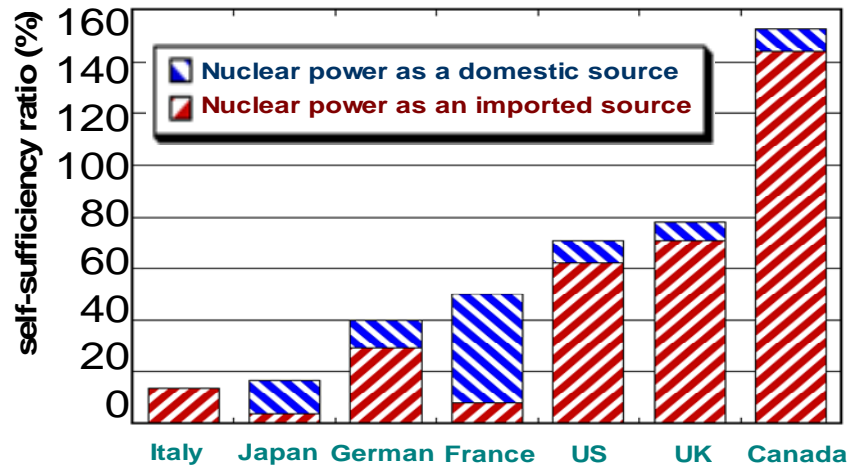
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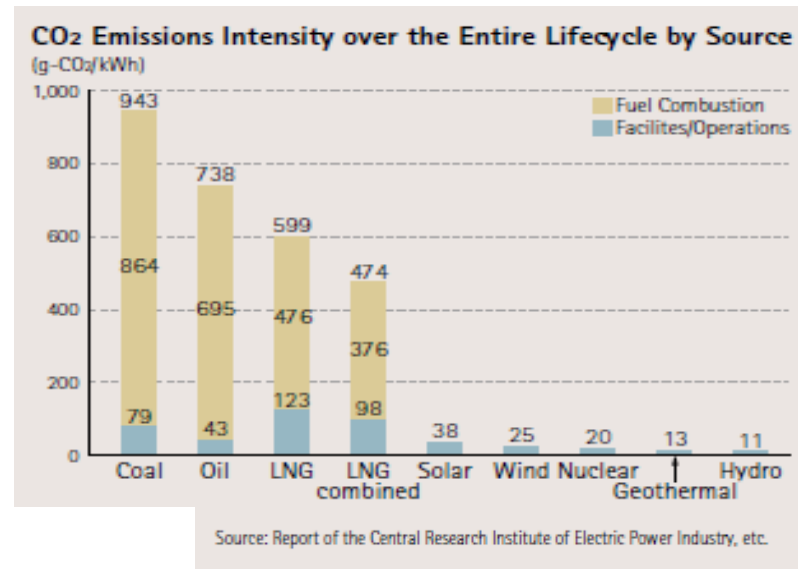
# 1-1) 3E as key elements

## ◆ Energy Security



Source: White Paper on Energy, METI

## ◆ Environment (Climate Change)



Source: Report of the Central Research Institute of Electric Power Industry, etc.

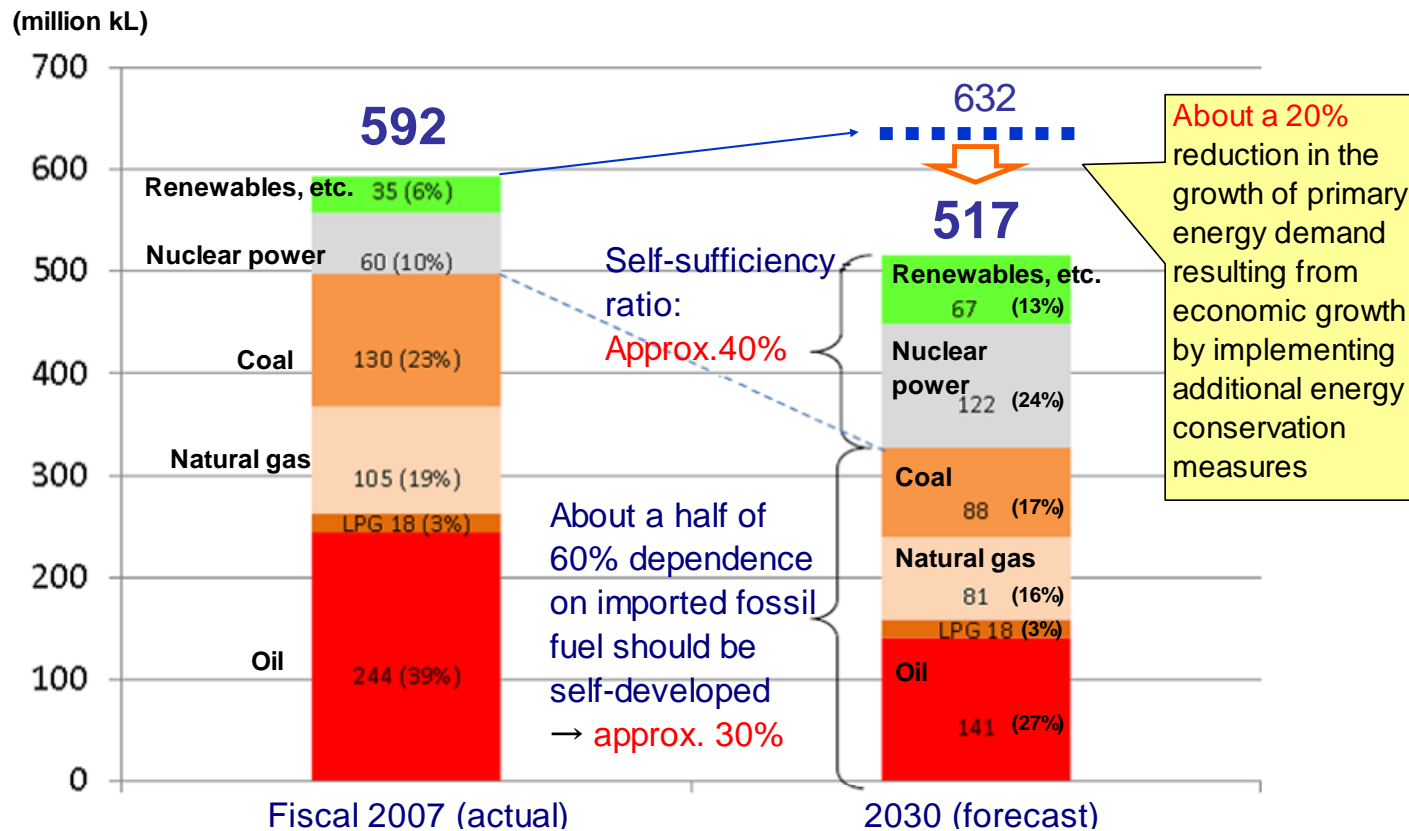
## ◆ Efficiency (Cost)

Power Source	Generation Cost (yen/kWh)	Capacity Factor (%)
Hydro	8.2~13.3	45
Oil	10.0~17.3	30~80
LNG	5.8~7.1	60~80
Coal	5.0~6.5	70~80
Nuclear	4.8~6.2	70~85
Solar	46	12
Wind	10~14	20

Source: White Paper on Energy, METI

# 1-2) A basic energy plan to address 3E was determined in 2010 (1) :Primary Energy

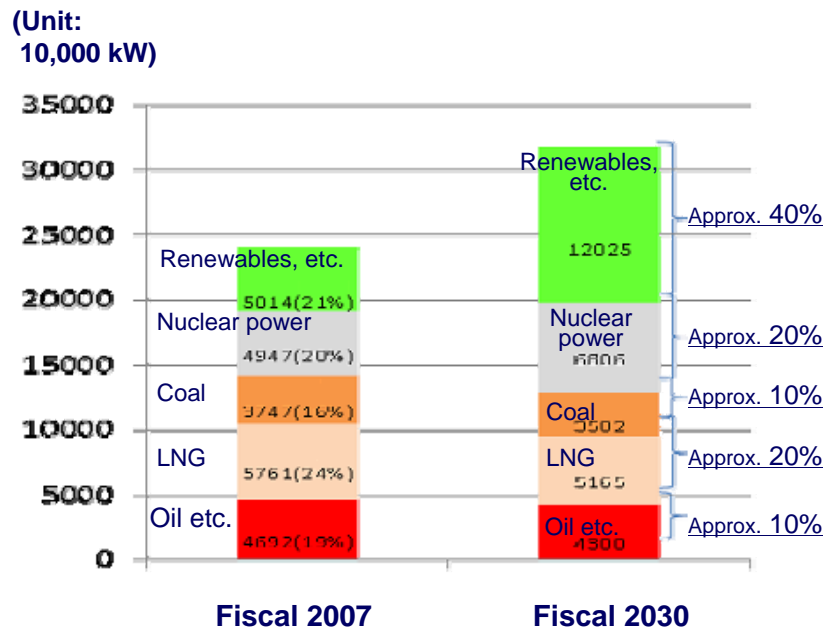
- Increasing the self-managed energy ratio (self-sufficiency ratio + self-development ratio) from 38% to ~70%
- Reducing CO2 emissions by 30% from the 1990 level



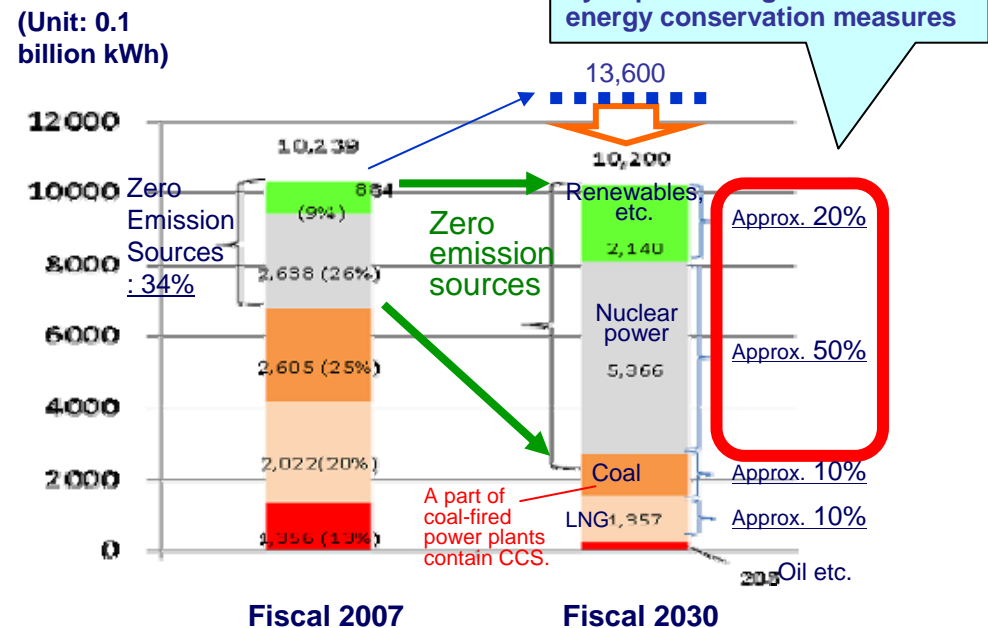
# 1-2) A basic energy plan to address 3E was determined in 2010 (2) :Generation Mix

- Building 14 reactors at new and existing sites and improving the operating ratio from 60% to 90%
- Increasing the introduction of renewable energy by 2.4 times (by 15 times, excluding hydropower)
- Increasing the proportion of zero-emission power sources from 34% to ~70%

## Installed capacity



## Power generation



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## 2-1) The trust on nuclear safety was seriously damaged

<Global shift in opinion on nuclear energy after Fukushima>

(Unit: %)

	<u>Before (Pro: Con)</u>	=>	<u>After (Pro: Con)</u>
(1) <b>Japan</b>	52:28		<b>39:47</b>
(2) USA	53:37		47:44
(3) France	66:33		58:41
(4) <b>Germany</b>	<b>34:64</b>		<b>26:72</b>
(5) Russia	63:32		52:27
(6) Korea	65:10		64:24
(7) China	83:16		70:30

Source: Gallup International (April 19,2011)



## 2-2) From 3E to 3E + S +M

### a. Energy Security

- \* Geopolitical situation in Middle East continues to be uncertain.

### b. Environment

- \* The importance of Global warming remains unchanged.

### c. Economic Efficiency

- \* Nuclear energy seems to be less costly for Japan.

..... In addition .....

### d. Safety

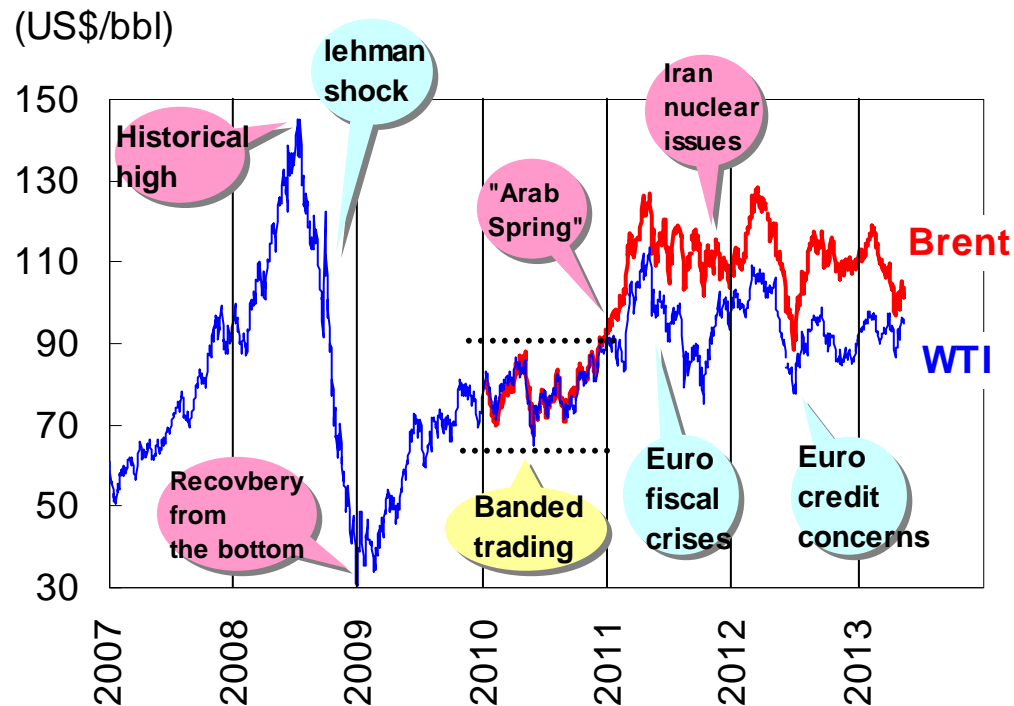
- \* The challenge is whether nuclear safety is comfortably assured.

### e. Macro Economic Impact

- \* Appropriate energy mix should be found to minimize the adverse effect on economic development

## 2-2) a. Energy Security(1) : Trend of Oil Prices

- Crude oil price have remained at a very high level in 2012.
- Average Brent crude oil price is forecasted at \$105/B ( $\pm$ \$10/B) for 2013



- Average Brent crude oil is \$111.7/B (WTI \$94.2/B)
- The price level remained at a historically very high level since 2011.
- Brent exceeded \$120/B in February to March 2012 due to geopolitical concerns.
- Although Brent fell since May 2012 due to European fiscal crises, it regained another momentum afterward.
- Since the beginning of 2013, Brent has tended to decline while WTI has tended to rise, thus the price gap between them has narrowed.

## 2-2) a. Energy Security(2) : Uncertainty in Middle East and North Africa

(1) The Arab spring spread in middle east and north africa, and increased the uncertainty of social stability in this region.



(2) Sanction again Iran might lead to closure of Hormuz strait.

- Passage of oil through the Strait of Hormuz: more than 17 million B/D (approx. 20% of worldwide oil production; approx. 85% of oil imported by Japan)

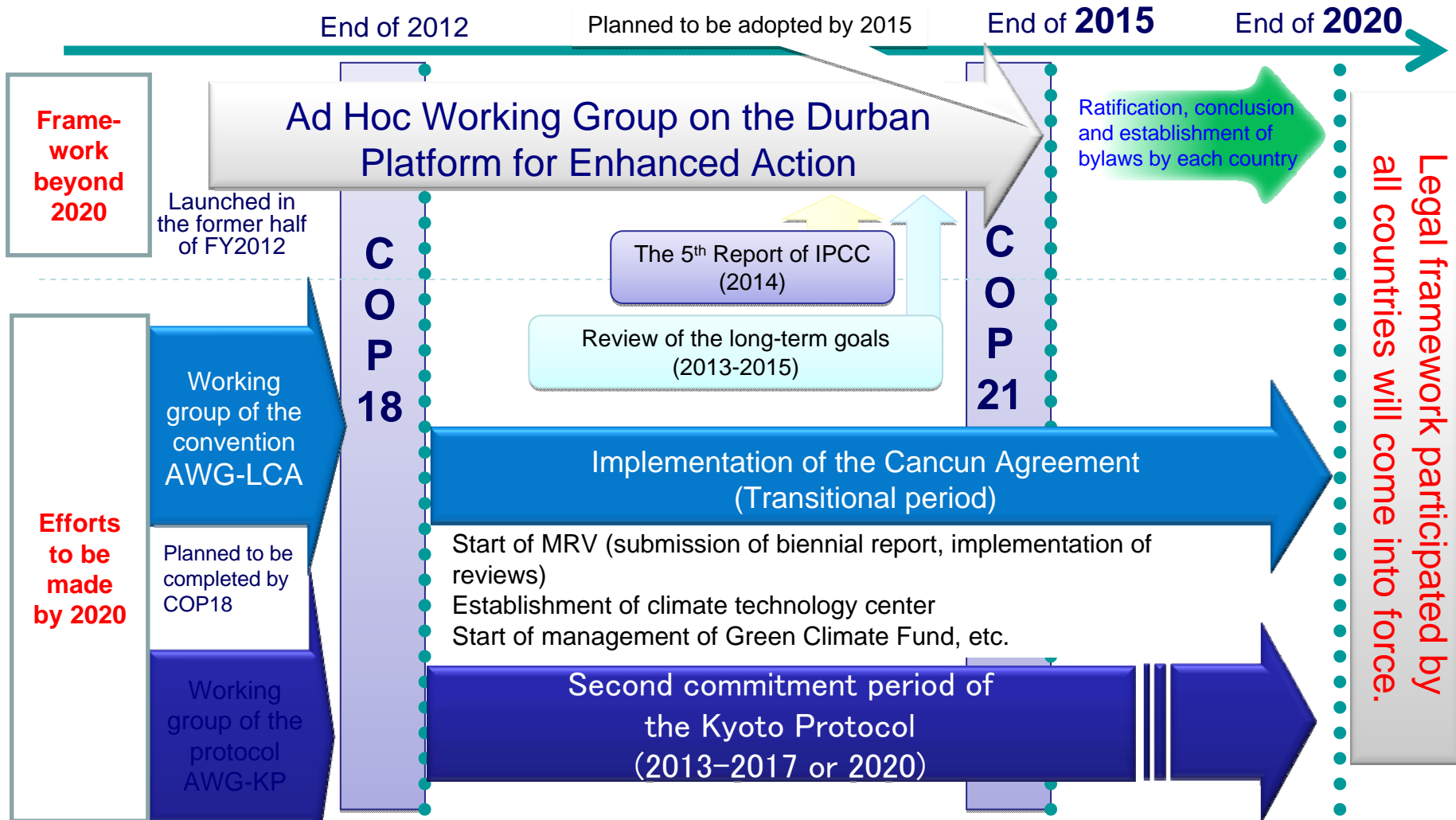
- Passage of LNG through the Strait of Hormuz: More than 82.60 million tons (approx. 30% of world LNG production; approx. 25% of LNG imported by Japan)

Notes:

- Based on Foreign Trade Statistics of 2010. Imports from Iran, Iraq, Bahrain, Saudi Arabia, Kuwait, Qatar and UAE are assumed to pass through the Strait of Hormuz.



# 2-2) b. Environment (Climate Change) : Future Schedule for New Framework





# 2-2) c. Economic Efficiency (Cost) : Nuclear power seems less costly in 2030

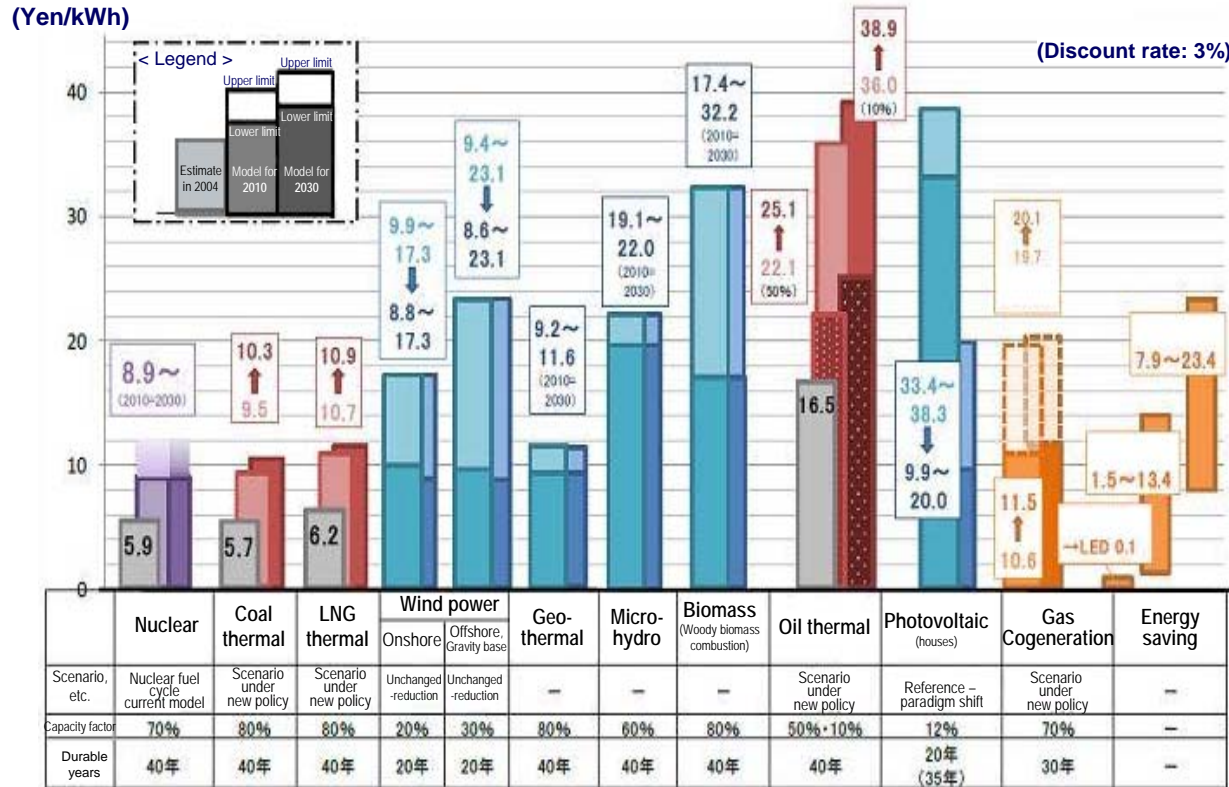
### Points to estimate costs

- Model plant form (Based on plants which started to operate these 7 years, subsidies paid these 3 years, etc)
- Including social costs such as cost for countermeasures against nuclear accident risks and political policy costs
- As for models for 2020 and 2030, estimated the cost expecting increase of fuel cost and CO2 reduction cost, and decrease of the price caused by technology innovation

- The Cost Investigation Committee was established to reexamine the generation cost after the Fukushima accident.

- Due to reasons such as the cost of accident prevention measures, the increase of construction cost and the rising crude oil price, the costs of thermal power and nuclear power generation have risen from the previously estimated levels. Even according to the lowest estimations, the generation cost was given as follows:  
8.9 yen/kWh by nuclear power, 9.5 yen/kWh by coal-fired generation and 10.7 yen/kWh by LNG-fired generation.

- As the presently confirmed loss caused by the Fukushima accident, 5.8 trillion yen was added to the cost of nuclear power generation. The additional cost of each trillion yen will raise the generation cost by 0.09 yen/kWh.



## 2-2) d. Safety (1) : Nuclear Policies of Major Countries

### A. (1) Consistently promoting

- US :** The government has been consistently promoting nuclear power in terms of security and more recently, in terms of anti-global warming.
- France :** It has been promoting nuclear power in terms of security. Even after the recent change in administrations, its energy policy based on nuclear power has remained unchanged.
- Ukraine :** It keeps nuclear option in order to prevent too much dependence on Russia, taking due consideration for the Chernobyl accident. (The Prime Minister of Ukraine once said “only the wealthy nations can discuss elimination of nuclear power.”)
- Korea :** It has been consistently promoting nuclear power in terms of security and is very eager to export nuclear infrastructure.
- China :** It is promoting nuclear power to cope with the increasing electricity demand and to ensure security, and more recently, in terms of anti-global warming.

### A. (2) Shifted to be pro-nuclear after declining nuclear popularity or moving back and forth between pro- and anti-nuclear

- UK :** It used to put priority on market fundamentalism; however, it shifted to be pro-nuclear in terms of security and anti-global warming measures.
- Sweden :** Although it once expressed to become a nuclear-free nation in response to the public referendum results in 1980, it continues to use nuclear power because of being unable to get future perspective of securing alternate power sources. The plant operator published a replacement plan in 2012.

### B. Shifted to be nuclear-free after moving back and forth between pro- and anti-nuclear

- Germany :** After announcing to become a nuclear-free nation and then withdrawing such decision, it announced again to phase out its nuclear power by the end of 2022.
- Italy :** Although it announced to become a nuclear-free nation by the end of 1990, a bill to re-introduce nuclear power was passed in 2009. Then, it shifted again to abandon nuclear power in response to the Fukushima accident.

## 2-2) d. Safety (2)

### : The cause of the Fukushima accident

#### A. The Japanese Government's Nuclear Incident Investigation and Verification Committee

- (1) Safety measures/emergency response measures  
: Introducing new techniques and findings covering complex disaster.
- (2) Safety measures taken in the nuclear power generation system  
: Severe accident measures
- (3) Preparation for nuclear disasters  
: Risk management system in time of a nuclear disaster
- (4) Measures to prevent/mitigate damages  
: Activities to disseminate risk information, monitoring, evacuation of residents, etc.
- (5) International consistency  
: Consistency with the international criteria including IAEA standards, etc.
- (6) How the related organizations should be  
: **Independence of nuclear safety organizations**
- (7) Continuous investigation  
: Continuation of investigation activities, etc.

#### B. The National Diet of Japan, Fukushima Nuclear Accident Independent Investigation Commission

- (1) Supervision of a regulatory authority by the national diet  
: Establishment of a permanent committee
- (2) Review of the government's risk management regime  
: Operators shall have the primary responsibility on the site.
- (3) The response of the government to the disaster victims  
: Information disclosure, prevention of escalation of contamination
- (4) Supervision of the electric utilities  
: Preventing the operators to put undue pressure to the regulatory authority.
- (5) Requirements of the new regulatory organization  
: **Independence**, high transparency, and expertise etc.
- (6) Review of nuclear regulation laws  
: Review and backfit based on the world latest technologies.
- (7) Utilization of independent investigation committee  
: Establishment of a third party committee in the diet.

## 2-2) d. Safety (3) : Significance of International Standards



### <10 fundamental safety principles set out by IAEA>

- Principle 1:** The prime **responsibility** for safety **rests with the licensees**.
- Principle 2:** An effective framework for safety, **including an independent regulatory body**, must be established and sustained by the governments.
- Principle 3:** Leadership in safety matters has to be demonstrated at the highest levels in an organization.
- Principle 4:** Only those facilities and activities whose benefits exceed radiation risks should be justified.
- Principle 5:** Protection shall be optimized to provide the highest level of safety and it shall be reviewed regularly.
- Principle 6:** Individual risk shall be controlled within the prescribed limits.
- Principle 7:** **People and environment**, present and future, must be protected against **radiation risks**.
- Principle 8:** Primary means of the **prevention and mitigation** of the accident consequence are the “**defense in depth**”. Good design and engineering features providing safety margins, and diversity and redundancy must be introduced.
- Principle 9:** **Emergency preparedness** and response should be established.
- Principle 10:** Protective actions to reduce radiation risk must be **justified and optimized**.



## 2-2) d. Safety (4) : Way to Regain the Public Trust on Nuclear Safety

### Abandoning safety myths and ensuring defense in depth

: The risk of recurrence of the accident shall be reduced from 3 viewpoints under the public-private partnership and radiation damage shall be prevented in case of accident.

#### a. **Enhancement of Measures** for severe accident and for station blackout etc.; **Restarting only the plants for which safety measures have been applied under the previous safety regime**

- Emergency safety measures + stress test
- Additional safety measures consisting of 30 subjects
- Continuous progress of the safety regulation framework
- Enhancement of countermeasures against emergency based on the idea that absolute safety never exists.

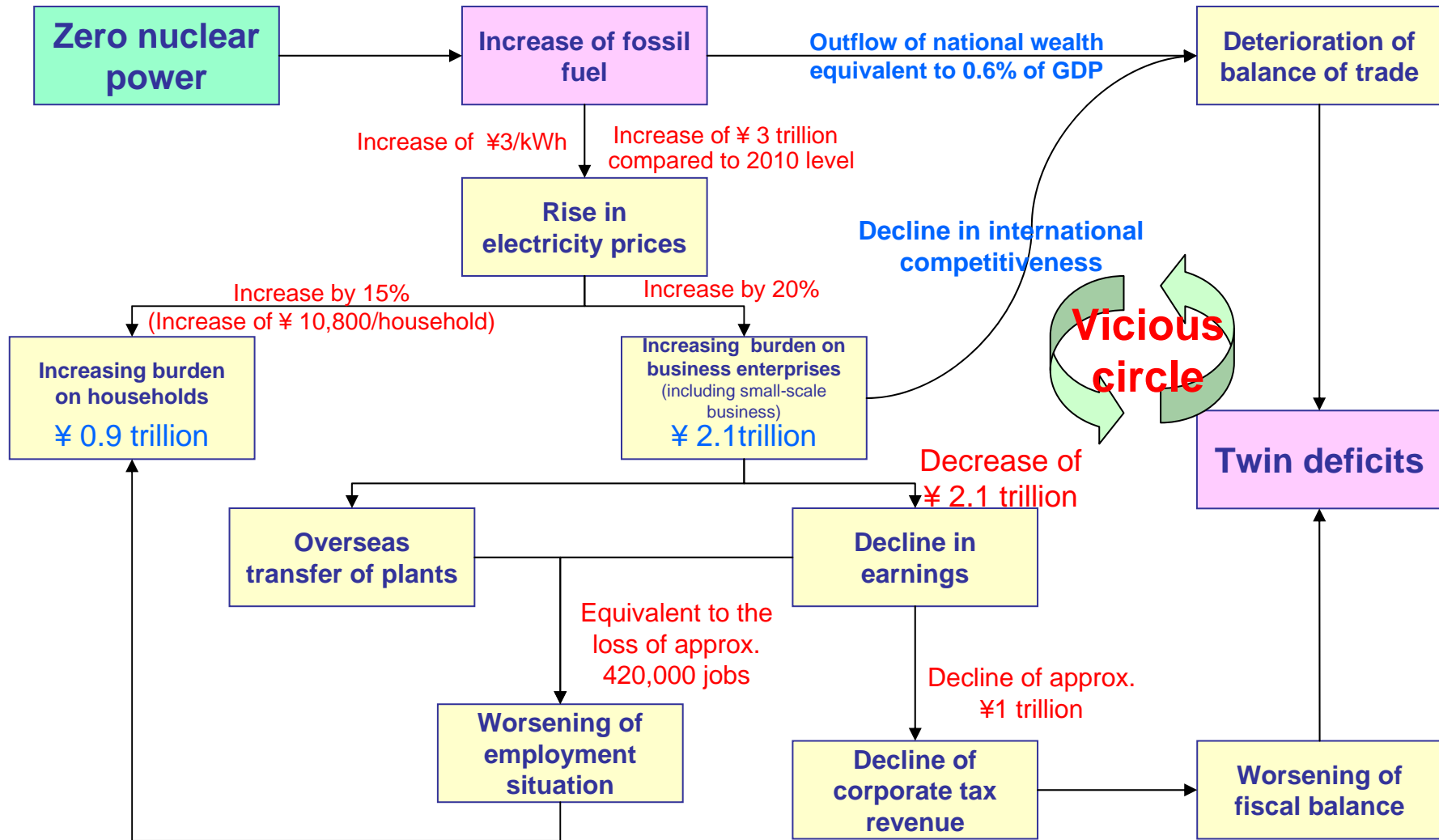
#### b. **Securing independence of the Nuclear Regulation Authority and restarting under the new safety regime**

- Enhancement of the measures to secure safety and reinforcement of both hardware and software in response to the implementation of strict regulations and inspections
- On September 19, the Nuclear Regulatory Authority was established, and Mr. Shunichi Tanaka the chairman of the Authority announced to review the above item a.

#### c. **In addition implementing mutual verification of safety under the international cooperation ... Ensuring compliance with the international standards**

- Further contribution to the enhancement of the IAEA safety standards and taking initiative in performing peer reviews
- Performing mutual surveillance and sharing information on the best practice with the US and France

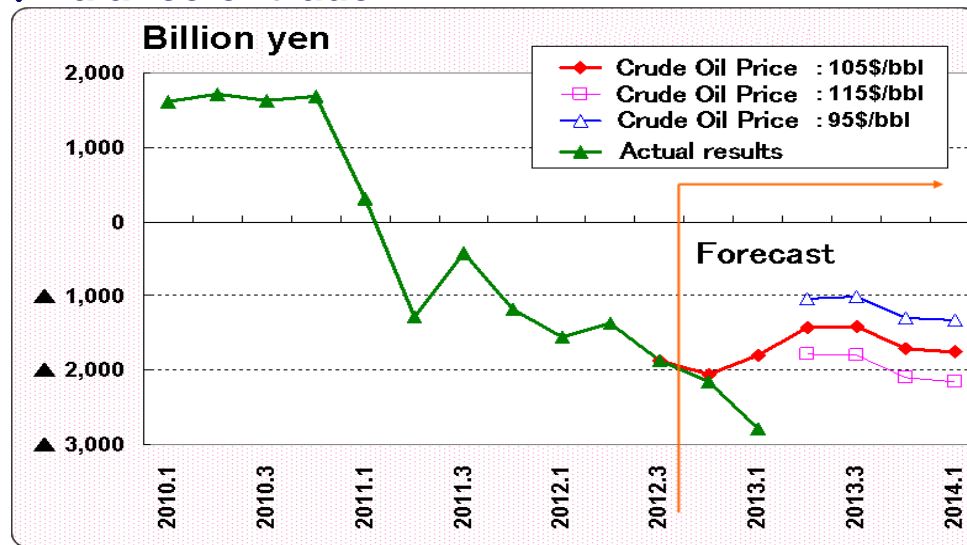
## 2-2) e. Macro Economic Impact (1) : Vicious Circle due to Hollowing-out (The case for 2012)



## 2-2) e. Macro Economic Impact (2) : Increasing Import of Fossil Fuel and Worsening of Trade Deficit

- In **FY2012**, economies in other countries decelerated and trade between China and Japan slowed down, before signs of recovery emerged. Thanks to “**Abenomics**”, the rapid depreciation of the yen boosted export values. However, imports of fossil fuels, etc. expanded even faster, causing **a large deficit balance of 8.2 trillion yen**.
- In **FY2013**, recovery of overseas demand will increase Japanese exports. On the other hand, fossil fuel import value will remain high and the trade deficit will also remain high at **6.3 trillion yen**.

### ◆ Balance of trade



### ◆ Export and Import

(Trillion yen)	Actual			Forecast
	FY2010	FY2011	FY2012	FY2013
Export	67.8	65.3	63.9	63.6
Import	62.4	69.7	72.1	69.9
Fossil Fuels	18.1	23.1	24.7	23.4
Balance of Trade	5.4	▲ 4.4	▲ 8.2	▲ 6.3

#### FY2013

Oil price  
-10\$  
-4.6 trillion yen

Oil price  
+10\$  
-7.8 trillion yen

**trade deficit**  
**(3 years in a row)**

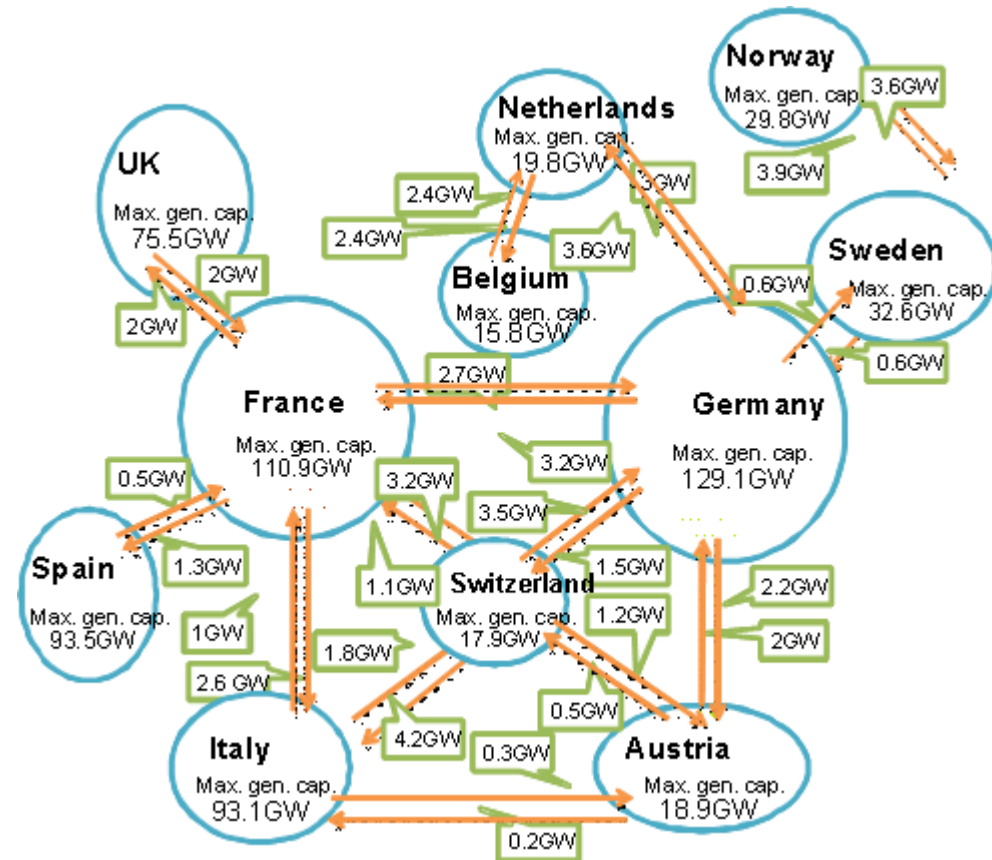
## 2-3) Differences between Germany and Japan (1) : Significance of Networking with Other Countries

- EU countries are connected by international networks for energy supply (power grids and pipelines).  
Note: The power supply capacity of the entire network is 10 times larger than the capacity of the German grid alone.
- To optimize energy utilization in the entire Northeast Asian economic zone, Japan may consider power line interconnections with South Korea (and possibly also with China and Russia) as one of the options.

**Energy security**  
**Cost**  
**Best mix**

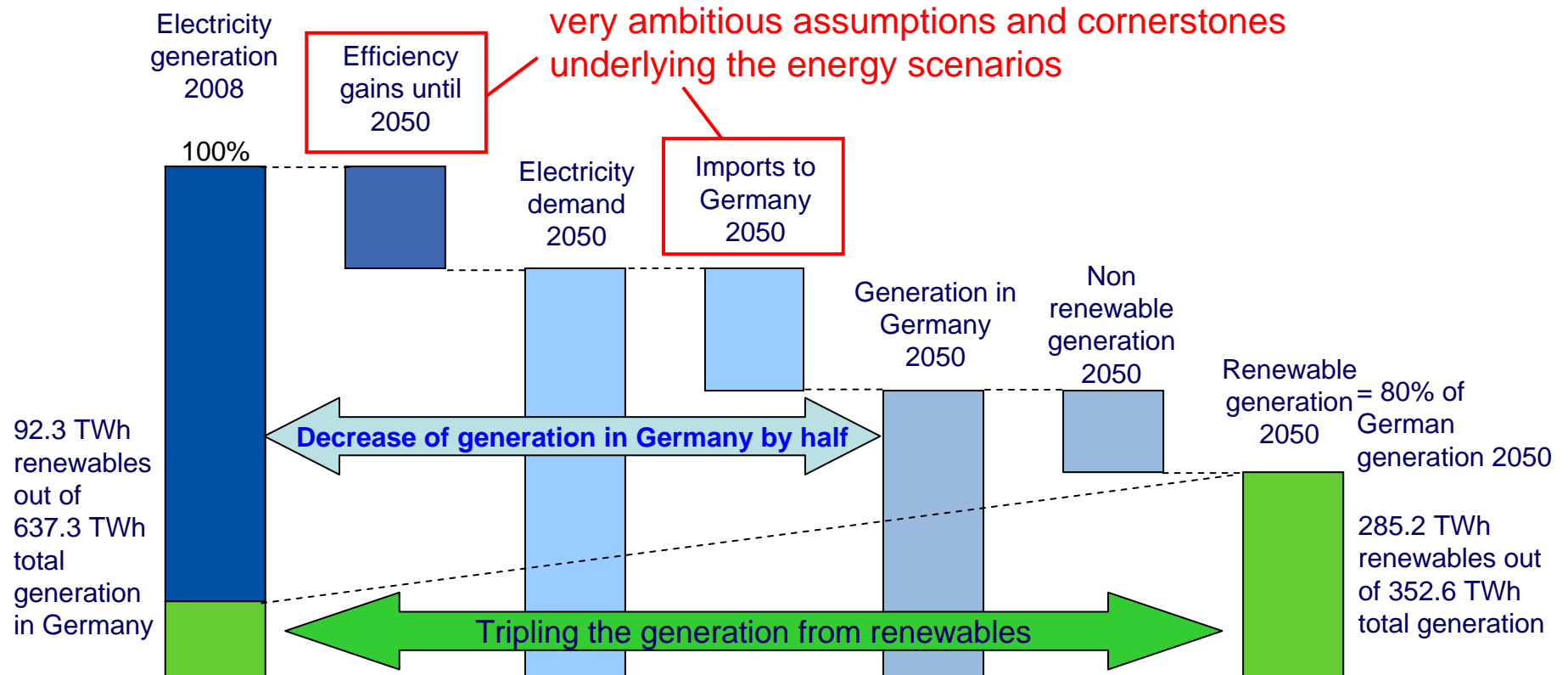
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### Power System Interconnections in Europe



Source: Material prepared by Secretary General Tanaka of IEA for an IEEJ meeting

## 2-3) Differences between Germany and Japan (2) : Germany is planning to import electricity from neighbouring countries



Bruttostromerzeugung gemäß Tabelle A I-7, Szenario II A, Energieszenarien EWI, GWS, Prognos

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1. Energy Policy before Fukushima

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## **3. Desirable Energy mix**

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## 3-1) Options under Discussion (1) : 3 options

Four options under discussion (Advisory Committee for Natural Resources and Energy, as of June 7):

	<b>Nuclear power</b>	<b>Renewable energy</b>	<b>Fossil-fired generation</b>	<b>Cogeneration</b>	<b>Energy conservation (power conservation)</b>	<b>CO<sub>2</sub> emissions (change from the 1990 level)</b>
<b>Option (1)</b>	0%	35%	50%	15%	-20% (-10%)	-16%
<b>Option (2)</b>	15%	30%	40%	15%	-20% (-10%)	-20%
<b>Option (3)</b>	20-25%	25-30%	35%	15%	-20% (-10%)	-23%
<b>(Addition)</b>	35%	25%	25%	15%	-20% (-10%)	-28%

**Option (4)** Achieving the most desirable generation mix for society by the choice of power consumers in the market after setting up a framework for sharing the social cost (of generation) by utilities (and power consumers)

## 3-1) Options under Discussion (2) : Economic Impact Analysis

(Interim outputs from the Advisory Committee for Natural Resources and Energy as of June 7)

	<b>Real GDP</b>	<b>Impact on household budget (substantial)</b>	<b>Electricity charge (nominal)</b> (In FY2010: about 9,900 yen/month, or 118,800 yen per year)
<b>Option (1)</b>	<b>-5.0 to -2.0%</b> [-31 to -12 trillion yen]	-6.0% to -5.6% [-19 to -18 trillion yen]	<b>99% to 102%</b> [19,700 to 20,000 yen/month] (236,400 to 240,000 yen/year)]
<b>Option (2)</b>	-4.1 to -1.5% [-25 to -9 trillion yen]	-4.6% to -4.4% [-15 to -14 trillion yen]	71% [16,900 yen/month] (202,800 yen/year)]
<b>Option (3)</b>	<b>-3.6 to -1.2%</b> [-22 to -7 trillion yen]	-4.2% to -3.8% [-14 to -12 trillion yen]	<b>54% to 64%</b> [15,200 to 16,200 yen/month] (182,400 to 194,400 yen/year)]
<b>(Additional scenario)</b>	-2.5 to -0.9% [-15 to -6 trillion yen]	-3.4% to -2.9% [-11 to -9 trillion yen]	38% to 39% [13,700 to 13,800 yen/month] (164,400 to 165,600 yen/year)]

These are the results of estimations made at research institutions (the Research Institute of Innovative Technology for the Earth and Associate Professor Nomura of Keio University) using generation cost data provided by the Cost Investigation Committee.



## 3-2) Status of “Innovative Energy and Environmental Strategies” (1) : Major points of the strategies announced in Mid Sept. under the previous Adm.



(Three pillars)

### 1) Earliest possible realization of a nuclear independent society

- \* Devote all types of political resources to realize zero nuclear power in the 2030's
- \* NPSs of which safety is confirmed in the above process will be used as important power source

### 2) Implementation of green energy revolution

- \* Emergence of a newly growing economic sector

### 3) Stable energy supply

- \* Ensuring fossil fuel supplies, thermal use, research and development of next generation energy technology

As a result,

OGHG emissions in 2020 are expected to be cut by 5-9% (compared to 1990 level).  
In 2030, emissions are expected to be cut by almost 20% (compared to 1990 level).

(Note) According to the current plan, the emissions in 2020 and 2030 are expected to be cut by 25% and 30%, respectively.

However, this strategy itself was not approved by Cabinet meeting

## 3-2) Status of “Innovative Energy and Environmental Strategies” (2) : Serious concerns expressed by industries etc.



(Concerns expressed for the goal to achieve zero NPP in the 2030's)

- 1) Decline of economic power of Japan, **hollowing-out, outflow of national wealth**
- 2) **Weakening of the energy security system**
- 3) **Escape from international responsibility to combat global warming**
- 4) **Absence of specific supporting evidence for the expansion of renewable energy**
- 5) Increasing **difficulty in maintaining nuclear technology and human resources; Difficulty in contributing to ensuring nuclear safety in Asia**
- 6) **Adverse effects are expected in the relationship between the US and Japan** which have been intertwined by each other in the field of nuclear technology. Japan's cooperative relationship with the UK and France may also be affected
- 7) Making it difficult for the national government to **fulfill the state responsibility for the local communities hosting nuclear facilities**
- 8) Others
  - **Decline of negotiating power** for securing fossil fuel
  - **Confusion** in the world crude oil/natural gas market

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## 4-1) The outcome of the general election on Dec.16, 2012

< The outcome of the Election in the Lower House >

**LDP** (The Liberal Democratic Party of Japan.) **won in a overwhelming manner while the voting rate was relatively low.**

	Before	After
- <b>LDP</b> +New Komeito (LDP)	<b>139</b> (118)	<b>325</b> (294)
- <b>DPJ</b> +Peoples' New Party	<b>233</b>	<b>58</b>
- Japan Restoration Party	<b>11</b>	<b>54</b>
- Others	<b>96</b>	<b>43</b>
- <b>Total</b>	<b>479</b>	<b>480</b>

## 4-2) The messages from the new administration



### < The policy of LDP (The Liberal Democratic Party of Japan.) >

#### a. Short term

\*Existing **nuclear reactors should be restarted** as the **Nuclear Regulatory Commission**, which was established in mid-September in 2012, **confirms their safety** within three years.

#### b. Long term

\***The best energy mix should be determined within ten years**, by evaluating the performance of renewable energy, which is being increasingly introduced after “ Feed in tariff system ” set in last July.

### < The policy of LDP/New Komeito coalition government >

\*The reactors could be restarted after the NRA's safety judgement through the new regulation in line with international standards.

## 4-3) Preferable Energy Mix

### ・ ・ ・ My personal recommendation

My personal view on the theme (energy mix <power generation mix>: option (3)

#### 1) Comprehensive viewpoints

##### ● S+3E Safety + Energy Security

+ Efficiency (energy efficiency and costs)

+ Environment (environmental conservation and measures against global warming measures)

● “There is no perfect energy” for a resource-poor country like Japan.

● In addition to “energy conservation”, four types of energy, that is, “nuclear energy,” “renewable energy,” “fossil energy” and “cogeneration” should be combined in a well-balanced and diverse way to assure energy security.

#### — — — — Preferable Energy Mix

● “Nuclear” : “Renewable” : “Thermal” : “Cogeneration” = 25 : 25 : 35 : 15%

#### 2) International viewpoint

● Germany can import electricity from the EU-wide network (which has the supply capacity equivalent to 10 times as much as the electricity demand in Germany)

● Nuclear power generation output is expected to sharply rise in the countries such as China and India: 4 – 7 times as much as the present status within the next 2 decades (160-260 units).

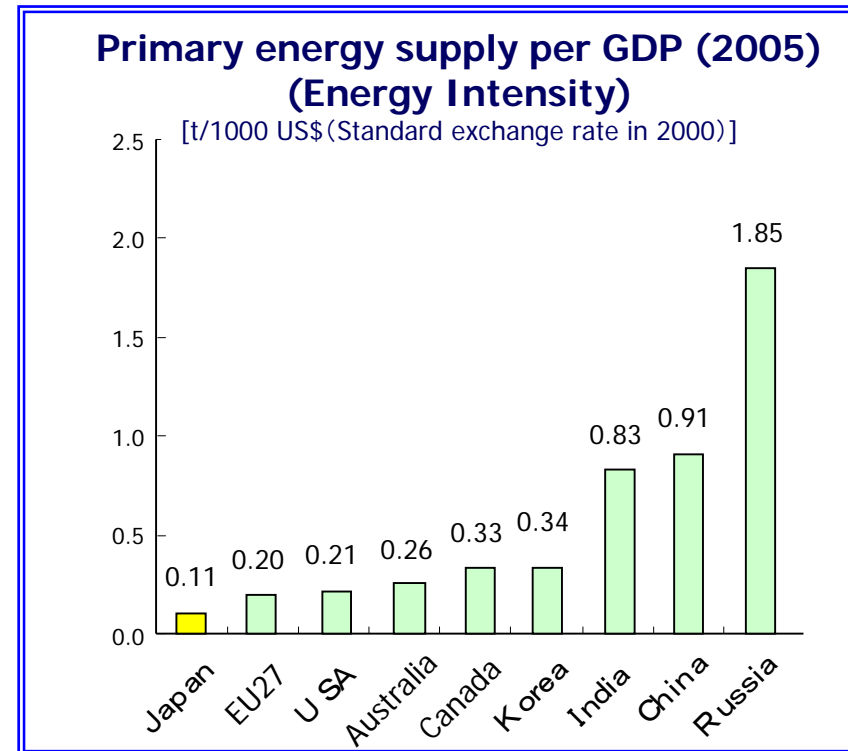
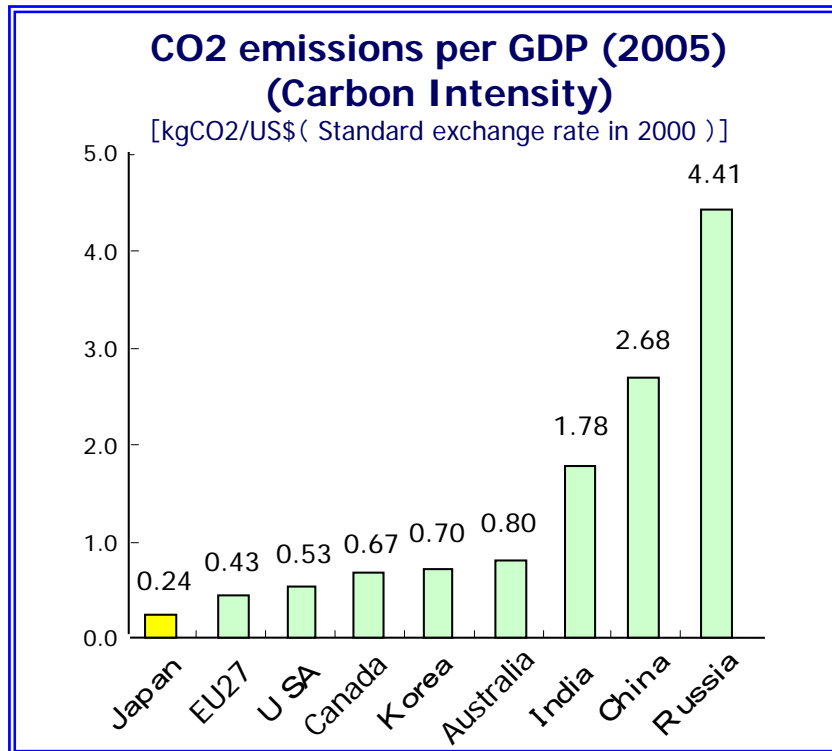
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# 5-1) Energy conservation vs Climate Change



## Energy conservation can address the issue of CC

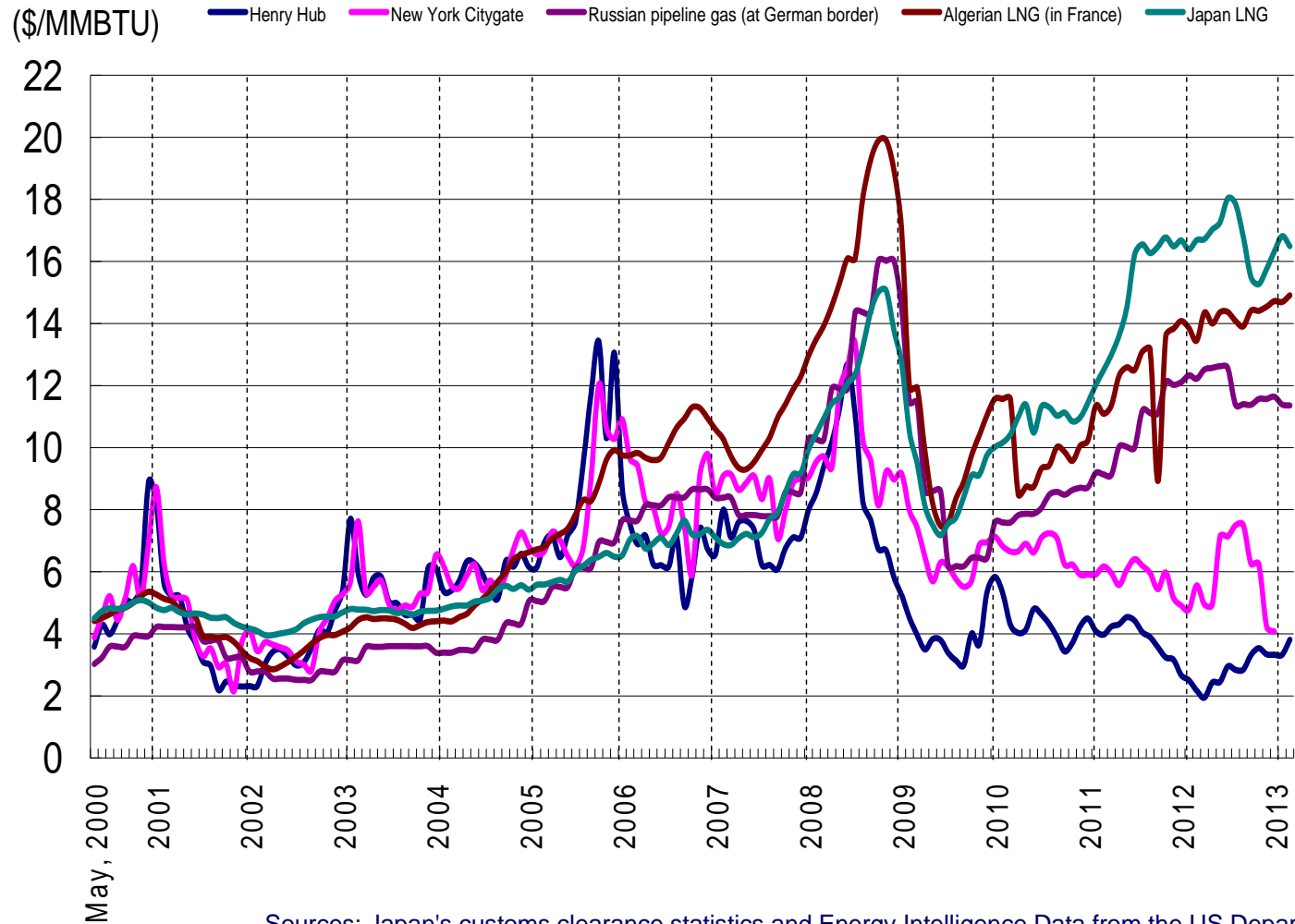
- Domestic mitigation efforts could be based on intensity improvement efforts.
- Japan's mid-term target aims at improving its carbon intensity, which is already the lowest among major countries.



Source: IEA (2007), "CO<sub>2</sub> emissions from fuel combustion 1971-2005"



# 5-2) Asian Premium in LNG trade needs to be resolved



**Japan LNG**  
**France LNG**  
 from Algeria  
**German border:**  
 Pipeline gas from  
 Russia  
**US: NY City Gate**  
 (Pipeline gas)  
**US:**  
**Henry hub**  
 (Pipeline gas)

Sources: Japan's customs clearance statistics and Energy Intelligence Data from the US Department of Energy

# 5-3) Nuclear Power Development in Asia v.s. Safety

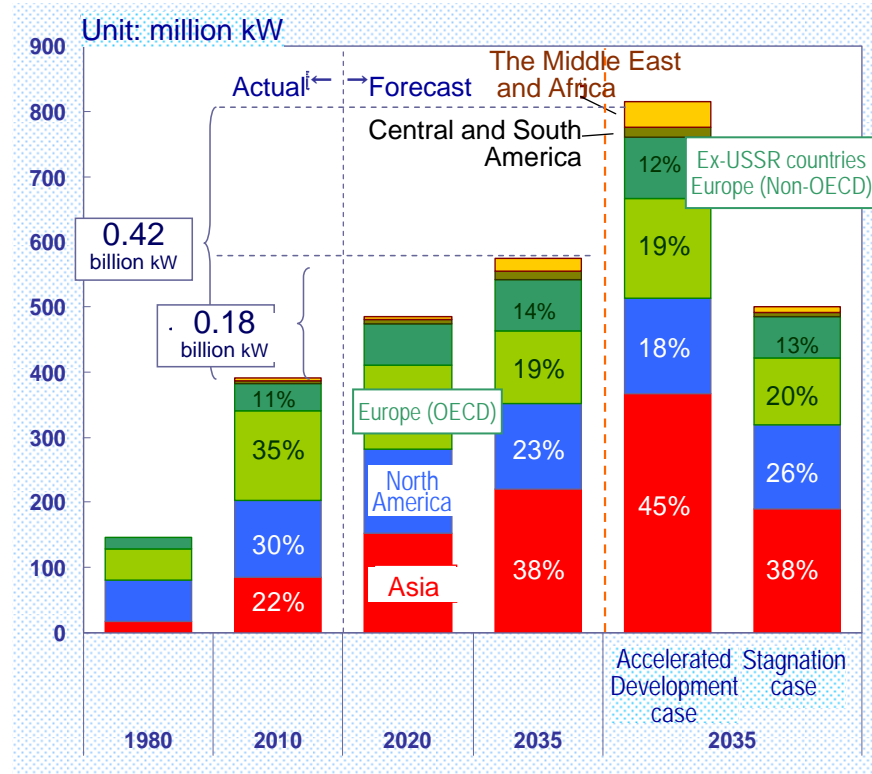
- The rapid expansion of nuclear power generation in Asia is based on its advantages of **energy security** and **global warming prevention**, and the vital need for nuclear power as **an economically efficient generation option**, for economic growth.
- The total installed capacity of nuclear power generation in Asia is expected to increase by at least a factor of two to four from the present level by 2035.

**Outlook for Installed Capacities in Asia for Nuclear Power Generation**

(Unit: million kW)

	2010	2020			2035		
		Reference case	Accelerated development case	Stagnation case	Reference case	Accelerated development case	Stagnation case
China	9	60	70	60	104	158	104
Taiwan	5	8	8	5	6	8	4
S·Korea	18	24	32	24	34	48	34
ASEAN	0	0	0	0	9	26	3
India	4	18	26	18	35	72	35
All Asia	85	153	179	139	220	366	190

**Outlook for Installed Capacities in the World for Nuclear Power Generation**



## 6) Conclusion

1. **3E** was key elements for energy policy in Japan before the Fukushima accident.
2. After Fukushima, **3E + S + M** has become important.
3. Although **a new and desirable energy mix** had been discussed at the Advisory Council to METI (Ministry of Economy, Trade and Industry) Minister for more than one year, **no conclusion was made yet.**
4. **The new administration led by LDP has been taking a cautious approach** to determine a new energy mix.
5. In the meantime, it is important for Japan to contribute to resolve the following challenges in Asia.
  - to promote **energy conservation**
  - to resolve **Asian premium** in LNG trade
  - to make **nuclear reactors safer**
6. International Organization such as **IAEA will play a key role.**



**Thank you very much for  
your attention**

