The Best Energy Mix for Japan

June 4, 2015

The Institute of Energy Economics, Japan (IEEJ)

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Contents

1 . Desirable direction of energy mix formulation

(1) Policy standpoints and goals (June 1 draft)

1) Policy standpoints for long-term energy supply/demand outlook

⇒ The outlook provides a desirable future picture of energy supply and demand to be realized through measures implemented for the policy targets for energy security (stable supply), economic efficiency(energy cost), environmental friendliness and safety (**3E+S**) based on the Basic Energy Plan which was approved at Cabinet Meeting in April 2014. This time, an outlook for 2030 is being developed.

2) Policy goals on energy mix formulation

① The energy self-sufficiency rate should be higher than before the March 2011 Great East Japan Earthquake (around 25%).

② Electricity costs should be lowered from the present levels.

③ The greenhouse gas emission reduction target should be comparable to major economies , such as EU and the US levels. Japan need to take global leadership in cutting emissions.

⇒ At the same time, Japan should reduce its dependence on nuclear power generation as far as possible.

3) Regular revision

⇒ The energy mix should be revised as necessary at least to meet the Basic Energy Plan review coming every 3 years.

Japan's vulnerability in energy security

- Energy security of a country means:

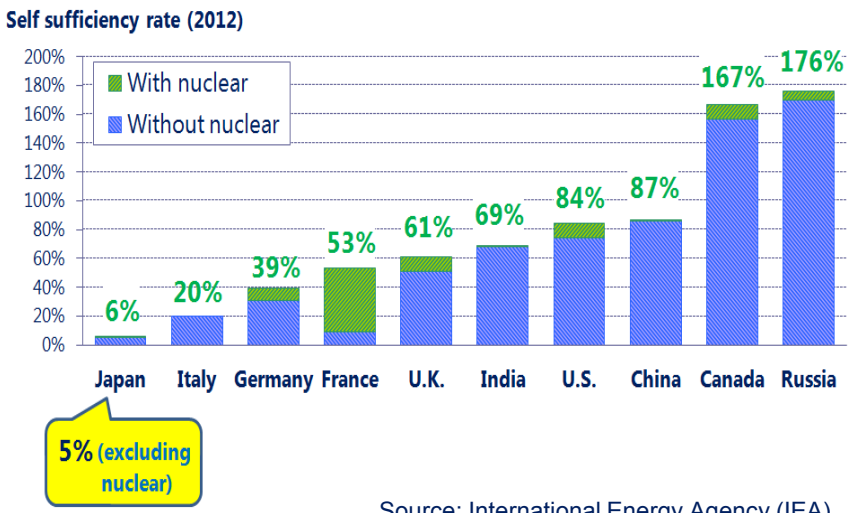
  "securing enough energy for people's living and economic and industrial activities at reasonable prices".

- Japan, however, is among the most fragile countries in terms of energy security for two reasons:

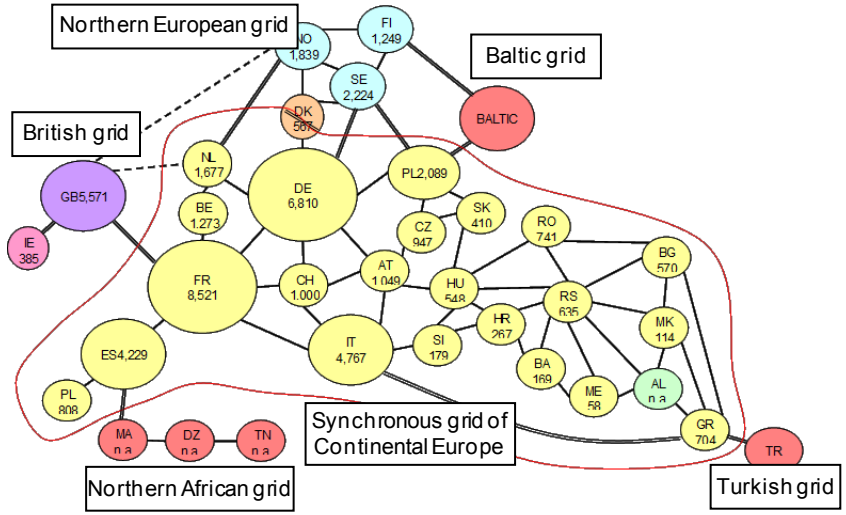
  a. The lowest level of energy self-sufficiency among the G8 countries (5%) (excluding nuclear power for 2012)

  b. Absence of a Northeast Asia network (electricity transmission network, pipelines) as shown below

Energy self-sufficiency rate of major countries (2012)

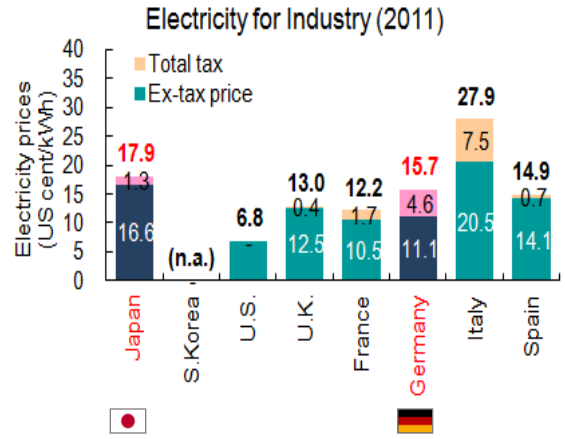


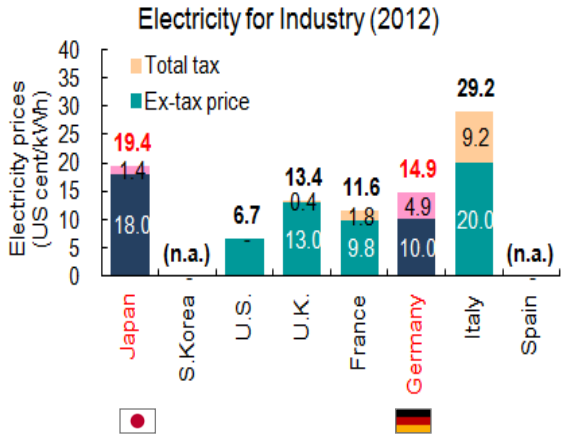
International grid connections in Europe

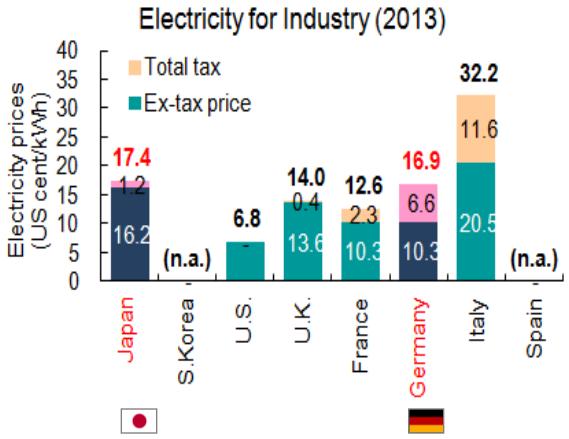


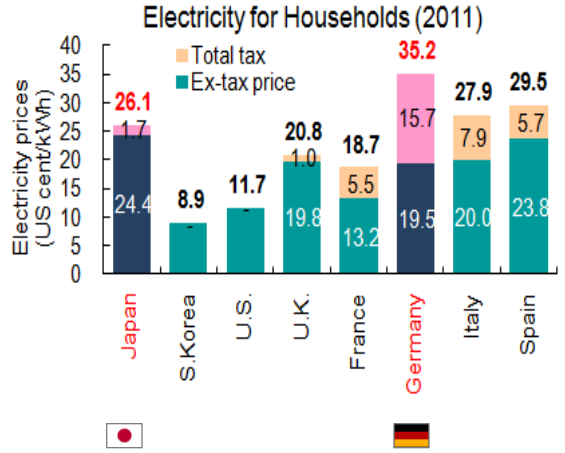
Source: International Energy Agency (IEA) "Energy Balances of OECD/Non-OECD Countries 2014"

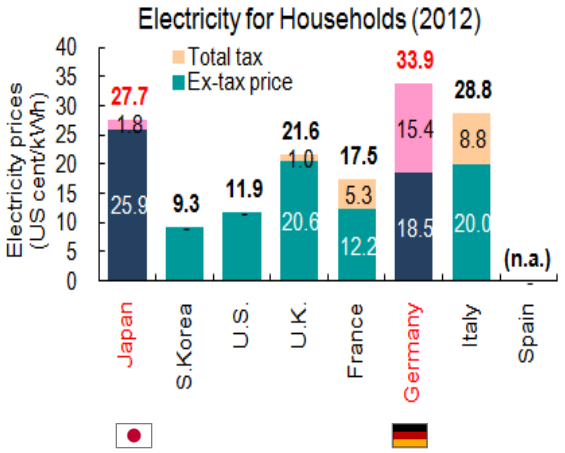
International Comparison of Electricity Tariffs (2011~13)

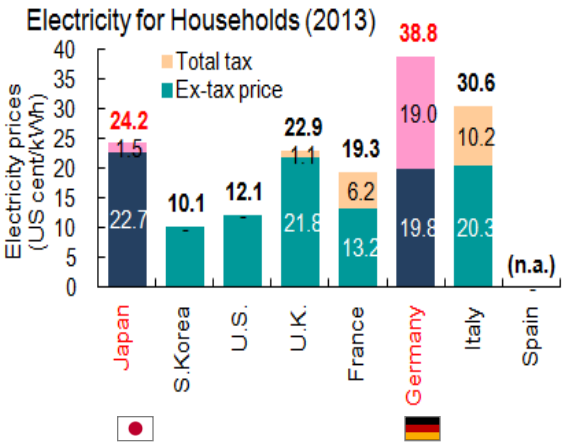












(Note 1) n.a. (no data available) for [Industrial] S. Korea for 2011-13 and Spain for 2012-13, [Residential] Spain for 2012-13
(Note 2) For S. Korea and the US, the ratio of electricity price and tax in the tariffs is not available.
(Note 3) Totals may not match due to rounding.

Source: OECD/IEA "Energy Prices & Taxes," 2nd Quarter 2014

Response to climate change, the damage of which seems to be getting serious and visible

● Japan tends to forget

(Japan's fossil fuel dependency has risen to 94% (2012))

・・・First, let's work out the energy mix!

● U.S. revved up, China cannot escape

<U.S.> reduced emissions from thermal power by 30% thanks to shale revolution)

(China: coal is a source of PM2.5 pollution)

・・・U.S.-China Summit Talks in APEC (Nov. 2014)

● Consequently, the targets for 2030:

GHG reduction target

<Japan> Not submitted.

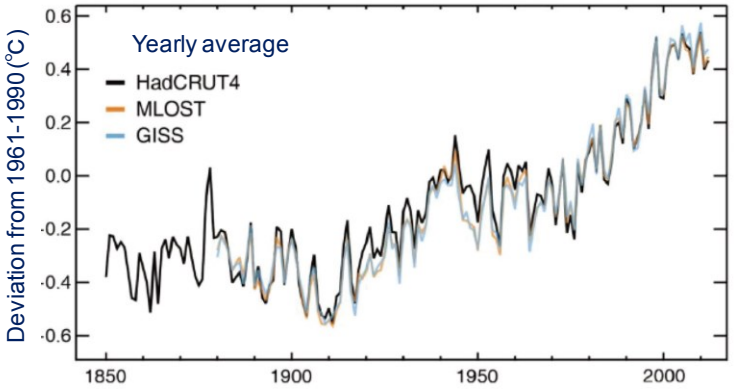
To submit at the 41st G7 summit in June 2015?

< U.S. > 26-28% reduction by 2025 (compared with 2005)

< E U > 40-45% reduction (per GDP, compared with 2005)

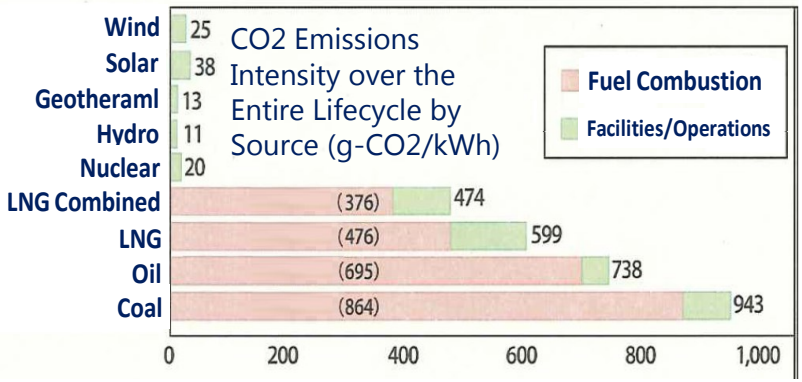
<China> CO2 emissions will peak around 2030.

Historical trend of global surface temperature



Source: Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) Overview of Summary for Policymakers (SPM) of the Working Group I (preliminary issue), released by the METI, September 27, 2013

Global warming perspective (comparison of CO2 emissions)



Source: Central Research Institute of Electric Power Industry (CRIEPI) "Evaluation of Life Cycle CO2 Emissions of Power Generation Technologies: Update for State-of-the-art Plants" July, 2010.

Securing of nuclear power safety and nuclear reactor restart

● Ready technologically

(Already has world leading technology)

⇒ Endured the earthquake.

⇒ Accident caused by "station blackout" due to tsunami

US added "station blackout" to its safety standards following 9/11

● Now ready in terms of institutional aspects (independence)

(The challenge is the speed of the reviews.)

● Safety culture is being enhanced

Two issues:

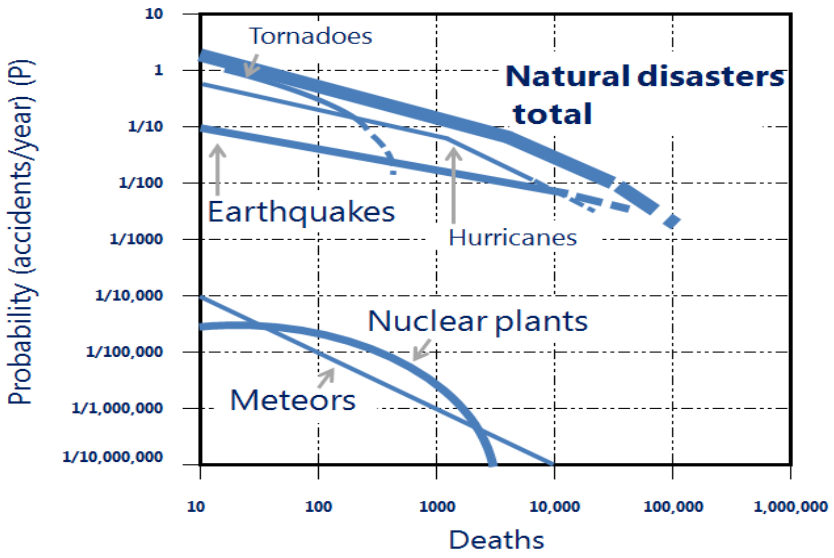
(1) Voluntary safety efforts by operators

In the US, NRC (regulators) vs. INPO (operators)※

(2) Public mindset has shifted from the safety myth to absolute risk

⇒ The ideal is to "lower risks to tolerable levels"

Risk comparison between 100 nuclear power reactors and natural disasters in WASH-1400*



Source: Nuclear Regulatory Commission (NRC) "Reactor safety study. An assessment of accident risks in U. S. commercial nuclear power plants. " 1975

***WASH-1400**

A report published in 1975 on the study of the applicability of probabilistic risk analysis to nuclear power plants. The study was conducted by the U.S. Nuclear Regulatory Commission (NRC) in the early 1970s and established the framework for probabilistically assessing the risks of accidents in nuclear power plants in a quantitative manner.

※NRC： Nuclear Regulatory Commission
INPO： Institute of Nuclear Power Operations

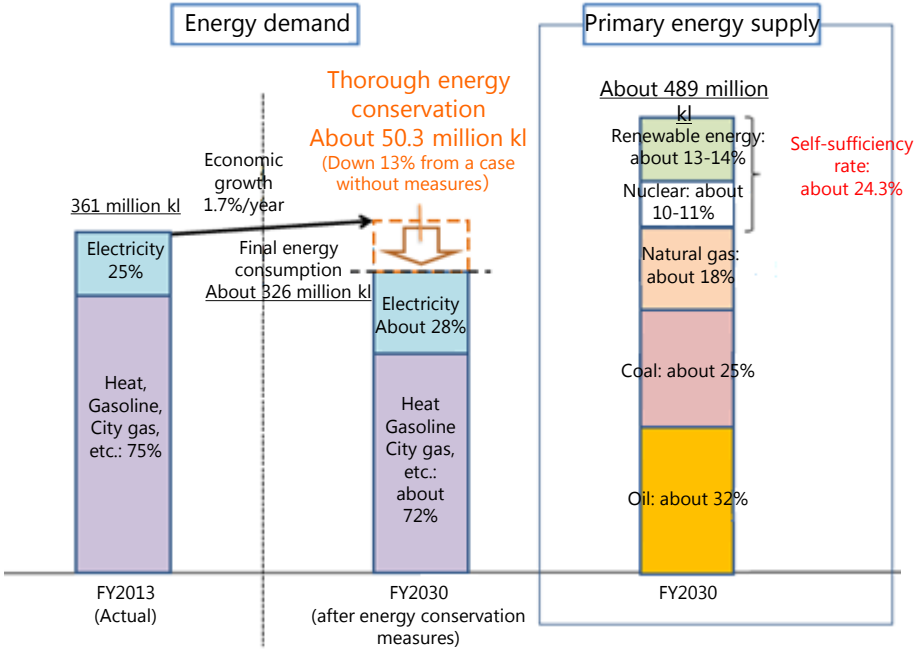
1 . Desirable direction of energy mix formulation
(2) Energy supply/demand structure in 2030
<I> Primary energy (June 1 draft)

<1> Energy demand and primary energy supply structure

○ While energy demand growth is projected in line with economic growth (**an average 1.7%**), energy efficiency is expected to improve as much as after the oil crises thorough energy conservation (**35% in 20 years**).

○ Energy supply/demand structure improvement (energy self-sufficiency rate: 6% in 2014 ⇒**24.3%** in 2030)

○ Energy-related CO_2 emissions: **down 21.9%** from 2013



(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.65 at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

1 . Desirable direction of energy mix formulation

(3) Energy supply/demand structure in 2030

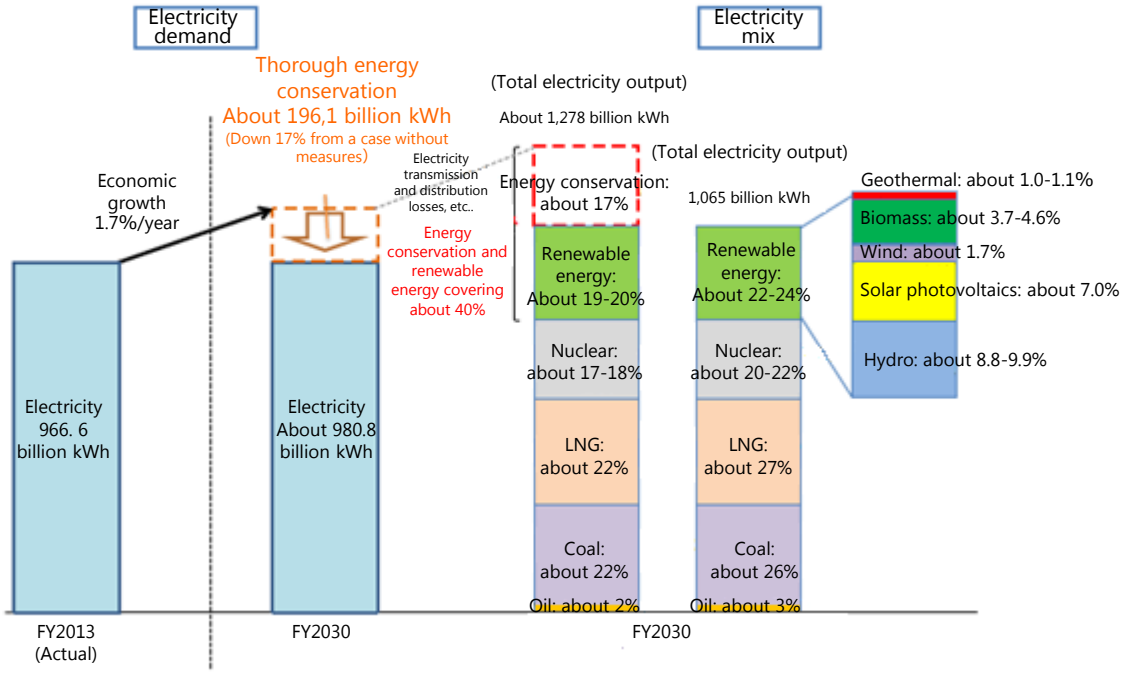
<II> Electricity mix (June 1 draft)

<2> Electricity mix

○Thorough energy conservation (electricity savings) and the maximum renewable energy diffusion will cover **about 40%** of electricity demand, reducing the dependence on nuclear power generation substantially (from **29%** before the 3/11 disaster to **20-22%**).

○ Base load share: **56%** (**63%** before the 3/11 disaster)

○ Electricity costs to **decline by 2-5%** from the present level



(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.67 at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

Impacts of electricity mix changes ①

	Coal▲1%	LNG▲1%	Nuclear▲1%	Renewables▲1%
Coal+1%		+4.4 million t-CO_2 ▲64 billion yen	+8.4 million t-CO_2 +34 billion yen	+8.4 million t-CO_2 ▲180 billion yen
LNG+1%	▲4.4 million t-CO_2 +64 billion yen		+4.0 million t-CO_2 +100 billion yen	+4.0 million t-CO_2 ▲120 billion yen
Nuclear+1%	▲8.4 million t-CO_2 ▲34 billion yen	▲4.4 million t-CO_2 ▲100 billion yen		±0 million t-CO_2 ▲220 billion yen
Renewables+1%	▲8.4 million t-CO_2 +180 billion yen	▲4.0 million t-CO_2 +120 billion yen	±0 million t-CO_2 +220 billion yen	

※Each number is an estimate.

Specification (2030)

	Coal	LNG	Nuclear	Renewables
Generation efficiency	41%	48%	-	-
Fuel prices	14,044 yen/t	79,122 yen/t	1.54 yen/kWh	-
FIT costs	-	-	-	22 yen/kWh

※1 Fossil electricity generation efficiency levels reflect declines caused by capacity utilization rate falls accompanying increases in renewable energy diffusion.
※2 Fossil fuel prices represent import prices. The nuclear fuel price represents the nuclear fuel cycle costs.
※3 Estimates for renewables are all made for wind power generation as a matter of convenience. It should be noted that renewables would actually be diffused according to substitution options based on their respective characteristics.

(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.77 at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

Impacts of electricity mix changes ②

1.Improving the energy self-sufficiency rate further

- Cutting the coal share by 1 percentage point and increasing the nuclear share by 1 point

Energy self-sufficiency rate	+0.5%
CO_2	▲8.4 million t-CO_2
Electricity costs	▲34 billion yen

2.Reducing electricity costs further

- Cutting the renewables share by 1 point and increasing the coal share by 1 point

Energy self-sufficiency rate	-0.5%
CO_2	+8.4 million t-CO_2
Electricity costs	▲180 billion yen

3. Reducing CO_2 emissions further

- Cutting the coal share by 1 point and increasing the renewables share by 1 point

Energy self-sufficiency rate	+0.5%
CO_2	▲8.4 million t-CO_2
Electricity costs	+180 billion yen

※Each number is an estimate.

(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.78 at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

1 . Desirable direction of energy mix formulation
(4) Major initiatives in various areas <I>

1) Energy conservation

- ☐**Smart energy conservation**: Enhancing energy conservation in the industry, commerce, residential and transport sectors, demand response for structural energy consumption reform, energy management promotion, etc.
- ☐**Utilizing hydrogen-related technologies** including Ene-Farm systems and fuel cell vehicles

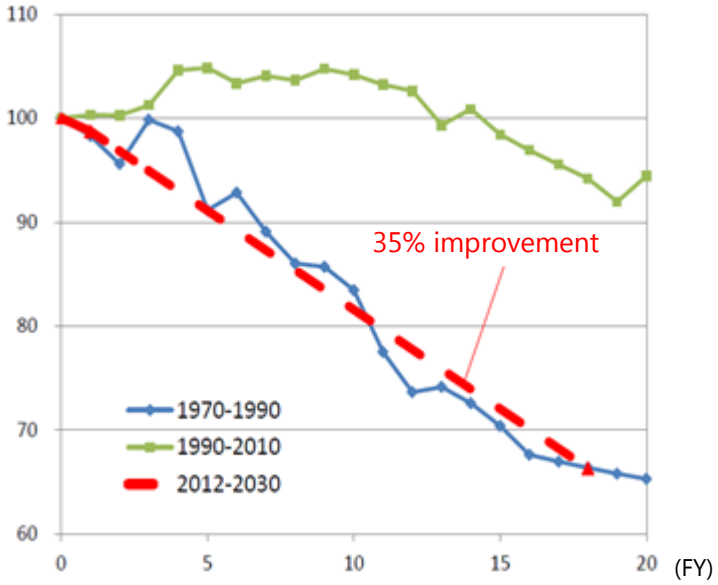
2) Renewable energy

- ☐Harmonizing **maximum diffusion** with **limited burdens on people**
- ☐**Positively diffusing geothermal heat, hydro** and **biomass** as **stable** renewable energy sources
- ☐Maximizing large-scale wind power generation to hold down burdens on people while reducing costs for **solar photovoltaics** and **wind power** as **volatile** renewable energy sources

Ambitious improvement of energy consumption efficiency

- Thorough energy conservation measures would reduce final energy consumption by 13% to 326 million kl.
- Energy conservation measures would be accumulated to improve energy efficiency as much as just after the oil crises.

【Energy efficiency improvement】



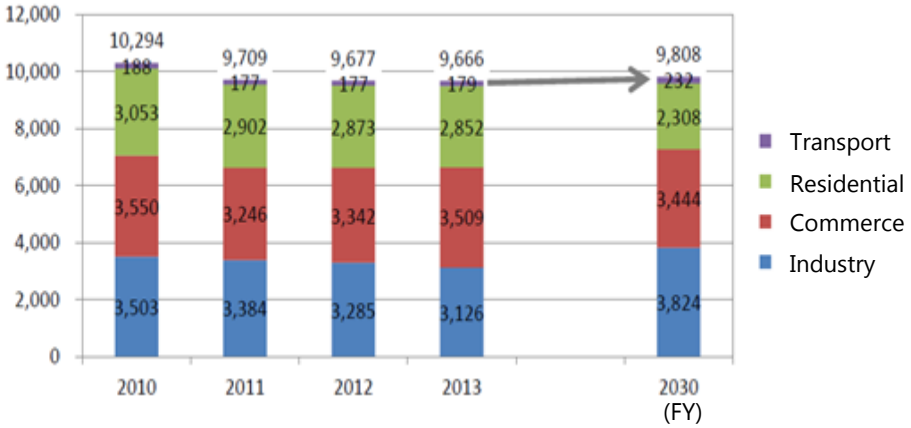
Energy efficiency=final energy consumption/real GDP

Electricity demand (100 million kWh)

	FY2013		FY2030			
			Reference		Energy conservation	
Industry	3,126	32%	4,284	36%	3,824	39%
Commerce	3,509	36%	4,387	37%	3,444	35%
Residential	2,852	30%	2,909	25%	2,308	24%
Transport	179	2%	189	2%	232	2%
Total	9,666	100%	11,769	100%	9,808	100%

※Numbers for FY2030 are estimates.

Changes in electricity demand (100 million kWh)



(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.66 (left chart) and p.69 (right chart) at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

Specific energy conservation assumptions

■Energy savings in each sector would be accumulated to save energy consumption by 50.3 million kl

<Major energy conservation measures in each sector>

Industry sector <Down about 10.42 million kl>

- **4 major industries (steel, chemicals, cement, paper-pulp)**
  ⇒ Promoting low-carbon society action plans
- **Promoting plant energy management**
  ⇒ Improving energy efficiency through visualization of manufacturing lines
- **Developing and introducing innovative technologies**
  ⇒ Introducing COURSE50 (CO_2 Ultimate Reduction in Steelmaking Process by Innovative Technology for Cool Earth 50) to cut CO_2 emissions by some 30% through hydrogen reduction of iron ore, blast furnace gas CO_2 separation, etc.)
- **Cross-industry introduction of highly efficient equipment**
  ⇒ Low-carbon industrial furnaces, high-performance boilers, etc.

Transport sector <Down about 16.07 million kl>

- **Diffusing next-generation vehicles, improving fuel efficiency**
  ⇒ One of every two vehicles would be a next-generation vehicle
  ⇒ Fuel cell vehicles: More than 100,000 units in maximum annual sales
- **Traffic flow measures**

Commerce sector <Down about 12.26 million kl>

- **Energy-saving buildings**
  ⇒ Energy conservation standard adaptation requirement for new buildings
- **Introducing LED lights and organic light emitting displays**
  ⇒ Diffusing LED and other highly efficient lights
- **BEMS building energy management system for energy management**
  ⇒ Introducing BEMS for a half of buildings
- **Promoting national movements**

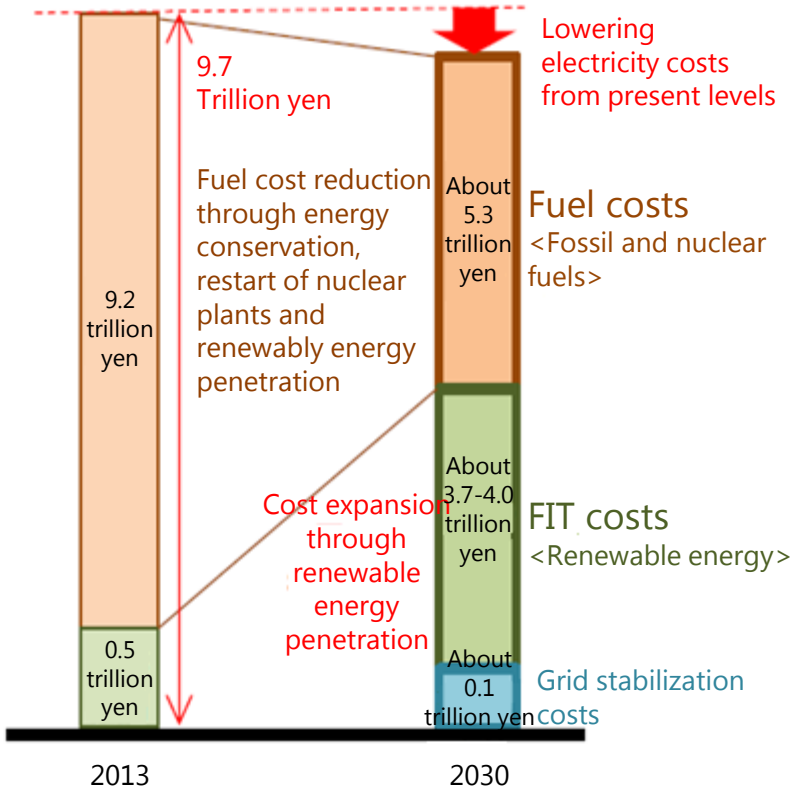
Residential sector <Down 11.6 million kl>

- **Energy-saving housing**
  ⇒ Energy conservation standard adaptation requirement for new housing
- **Introducing LED lights and organic light emitting displays**
  ⇒ Diffusing LED and other highly efficient lights
- **BEMS building energy management system for energy management**
  ⇒ Introducing BEMS for all houses
- **Promoting national movements**

(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.21 at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

Estimated renewable energy penetration in 2030

<Changes in electricity costs (image)>



(Note) Costs for renewable energy introduction include FIT costs. These costs include avoidable costs, while fuel costs are cut by an equivalent of the avoidable costs.
[Source] Fuel costs for electricity generation are estimated from electricity generation fuel input (including fuels for private generation) in comprehensive energy statistics and fuel import prices in trade statistics.

	Electricity generation	FIT costs (excluding tax)
Geothermal heat	10.2-11.3 billion kWh	0.17-0.20 trillion yen
Hydro	93.9-98.1 billion kWh	0.19-0.29 trillion yen
Biomass	39.4-49 billion kWh	0.63t-0.83 trillion yen
(Subtotal)	143.5-158.4 billion kWh	1.00-1.31 trillion yen
Wind power	18.2 billion kWh	0.42 trillion yen
Solar PV	74.9 billion kWh	2.30 trillion yen
(Subtotal)	93.1 billion kWh	2.72 trillion yen
(Total)	236.6-251.5 billion kWh	3.72-4.04 trillion yen

※Hydro power generation includes pumped storage generation (8.5 billion kWh).

※ In addition, grid stabilization costs come to 0.13 trillion yen including costs accompanying the lower electricity generation efficiency and the higher stop-start frequency for fossil power plants.

※ All numbers for 2030 are estimates.

(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.41 (left chart) and p.42 (right chart) at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

1 . Desirable direction of energy mix formulation
(5) Major initiatives in various areas <II>

3) Fossil

- ☐**The reduction of inefficient coal power generation** and other efforts to improve the electricity generation efficiency should harmonize the reduction of environmental load with the effective utilization of fossil resources.
- ☐**Oil power generation should be limited to the minimum necessary level.**
- ☐**Efforts to secure fossil fuel resources should be enhanced** for cheap, stable supply.

4) Nuclear

- ☐**Top priority should be given to securing safety.** Nuclear plants will be restarted only if they are qualified by the Nuclear Regulation Authority as meeting regulatory standards that are the toughest in the world.
- ☐Efforts should be promoted to **voluntarily improve safety in routine operations and select the site for final disposal of high-level radioactive wastes.**
- ☐The way should be paved for **developing an environment for nuclear power generation** with consideration given to reduction of the dependence on nuclear plants and conditions after the electricity system reform.

1 . Desirable direction of energy mix formulation
(6) Major initiatives in various areas <III>

5) Utilizing diverse energy sources and securing supply arrangements

- ☐Efficient utilization of energy through the promotion of **cogeneration (about 119 billion kWh) and other dispersed electricity sources** including Ene-farm systems
- ☐Efforts to secure supply arrangements, including diversification of fuels in each sector

6) Initiatives for 2030 and later years

- ☐Utilizing **hydrogen and other new technologies**

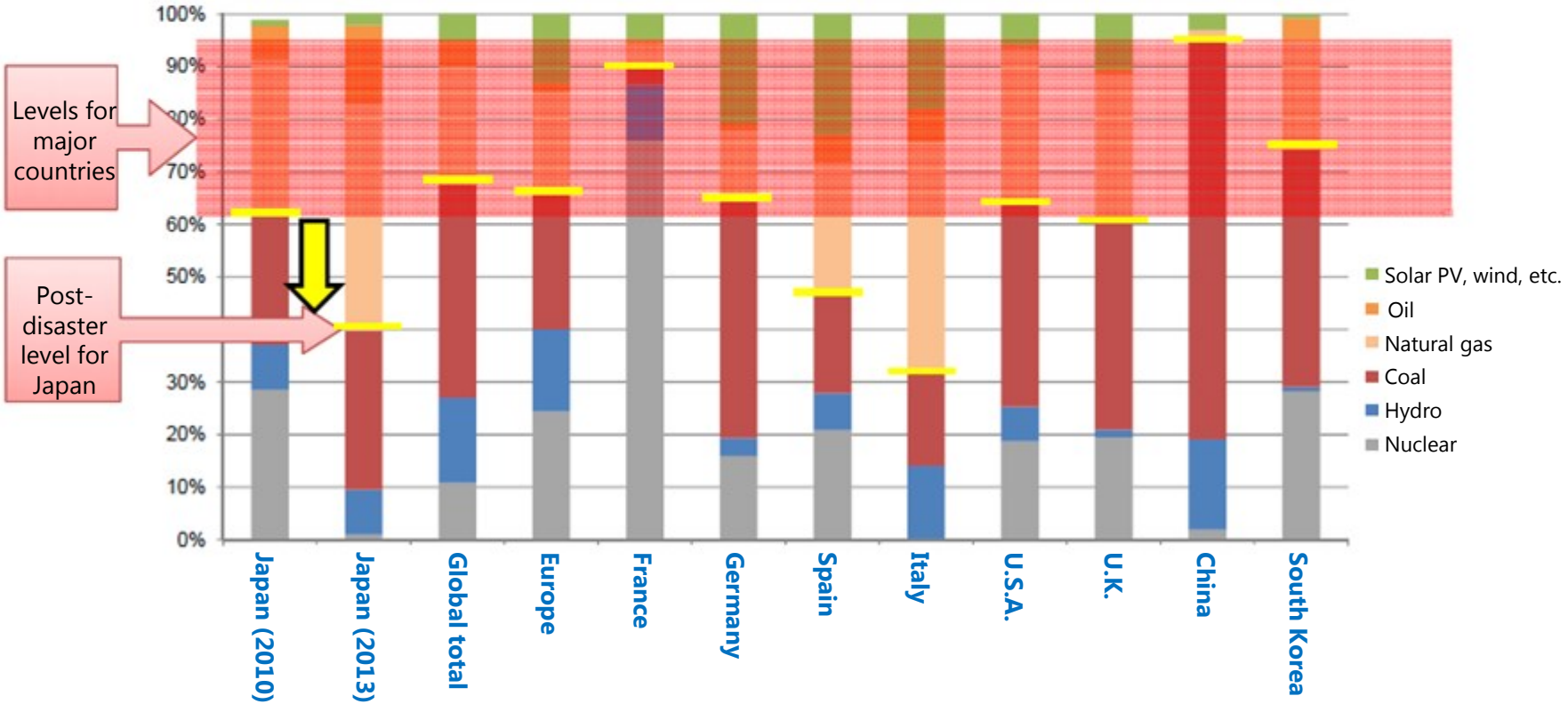
There is no perfect energy source

	Coal	LNG	Oil	Nuclear	Renewables
Energy security (Stable supply)	Among fossil fuels, coal features the lowest geopolitical risk (dependence on the Middle East at zero). Storing is easy (domestic inventories equivalent to about 30 days' consumption)	LNG features a lower geopolitical risk than oil (dependence on the Middle East at 30%). Storing is difficult (domestic inventories equivalent to about 14 days' consumption)	Oil features great geopolitical risk (dependence on the Middle East at 83%). Oil is highly transportable and oil reserves are abundant (domestic inventories equivalent to about 170 days' consumption).	Quasi-domestically produced energy	Domestically produced energy
Economic efficiency	Coal features the lowest price per calorie among fossil fuels. (Generation cost: 9.5 yen/kWh including 4.3 yen/kWh in fuel cost and 1.4 yen/kWh in fixed cost)	Liquefaction and transportation costs account for a large share of the LNG price. (Generation cost: 10.7 yen/kWh including 8.2 yen/kWh in fuel cost and 0.7 yen/kWh in fixed cost)	The price is high. (Generation cost: 22.1 yen/kWh including 16.6 yen/kWh in fuel cost and 1.9 yen/kWh in fixed cost)	The operation cost is low. (Generation cost: 8.9 yen/kWh including 1.4 yen/kWh in fuel cost and 3.2 yen/kWh in fixed cost)	Economic efficiency differs depending on renewable energy sources. Some renewables feature wide fluctuations in generation depending on natural conditions, while others keep stable generation. (Generation cost: 30.1-45.8 yen/kWh for solar PV 9.9-17.3 yen/kWh for wind power)
Environmental friendliness	Coal features massive GHG emissions (Emission coefficient: 0.82 kg-CO_2)	LNG features the least GHG emissions among fossil fuels. (Emission coefficient: 0.40 kg-CO_2)	Oil features the second largest GHG emissions after coal. (Emission coefficient: 0.66 kg-CO_2)	Zero-emission electricity source	Zero-emission electricity source
Safety	-	-	-	There is concern about safety	-

(Source) Prepared from Document 1 "Each Electricity Source's Characteristics and Viewpoints for Considering Electricity Mix" p.4 at 5th meeting (March 30, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

International comparison of base-load electricity sources

■ In major foreign countries where base-load electricity sources are not necessarily defined in the same way as in Japan's basic energy plan, nuclear, hydro and coal defined as base-load sources in Japan account for roughly 60-90% of total electricity generation. The share for Japan had remained within the range before the March 2011 disaster and declined substantially after the disaster to an internationally low level.



(Source) Document 1 "Each Electricity Source's Characteristics and Viewpoints for Considering Electricity Mix" p.7 at 5th meeting (March 30, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

Nuclear issues

Key points of interim report by Nuclear Energy Subcommittee (December 26,2014)

(1) Challenges to reduce dependence on nuclear power generation

- As for radioactive wastes emerging from the decommissioning of nuclear plants, plant operators' efforts to secure disposal sites are required along with the urgent formulation of regulatory standards.
- Measures are required to level nuclear reactor decommissioning costs to avoid any delay in decommissioning and prevent safe decommissioning from being impeded.
- While government financial resources are limited, the government should consider economic, employment, financial and other measures for municipalities that host nuclear plants subject to decommissioning.
- An opinion stated that municipalities hosting nuclear plants cannot make decisions unless the government clarifies the future picture of nuclear energy including how to make up for electricity supply capacity losses on the decommissioning of nuclear plants.

(2) Voluntary improvement of nuclear safety and maintenance/development of technologies and human resources

- Technologies and human resources should be secured within Japan. Some nuclear supply chains should be secured to develop an environment where on-the-job training can be conducted.
- (1) An autonomous framework for the continuous improvement of safety and (2) infrastructure for high-quality technologies and human resources for securing safety should be developed.

(3) Nuclear industry in competitive environment

- The government should take appropriate policy measures for each energy source to achieve the best energy mix while deregulating the electricity market.
- Specifically, the government should (1) take measures to limit nuclear plant operators' financial and accounting risks to a reasonable range and (2) consider and implement measures to finance a nuclear fuel cycle project in a competitive environment.
- Relevant organizations should cooperate in resolving problems regarding the revision of the nuclear damage compensation system and of the timing for applying for extending nuclear plant operation.

(4) Initiatives to resolve spent nuclear fuel problems and promotion of nuclear fuel cycle policy

- The government should consider realistic arrangements, role sharing between public and private sectors, necessary policy measures and schedules to steadily proceed with the nuclear fuel cycle project.
- As for the final disposal of radioactive wastes, the government should discuss (1) requirements and standards for selecting scientifically promising sites and (2) how local support should be.

(Source) Document 4 "Nuclear Power Generation Issues" p.23 at 5th meeting (March 30, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

Cost comparison in power source

Overview of 2030 model plant estimation results and sensitivity analyses (draft)

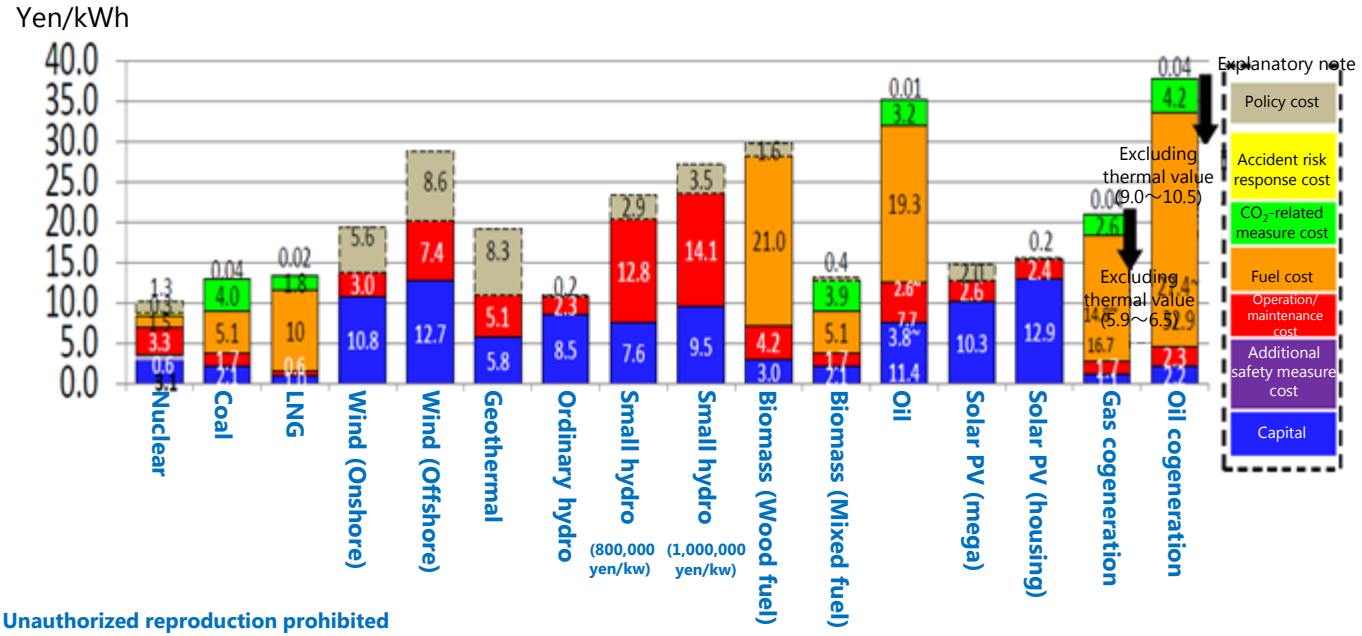
Power sources	Nuclear	Coal	LNG	Wind (Onshore)	Wind (Offshore)	Geothermal	Ordinary hydro	Small hydro 800,000 yen/kW	Small hydro 1 million yen/kW	Biomass (Wood fuel)	Biomass (Mixed fuel)	Oil	Solar PV (Mega)	Solar PV (Housing)	Gas cogeneration	Oil cogeneration
Operating rate Service life	70% 40 years	70% 40 years	70% 40 years	20~23% 20 years	30% 20 years	83% 40 years	45% 40 years	60% 40 years	60% 40 years	87% 40 years	70% 40 years	30・10% 40 years	14% 30 years	12% 30 years	70% 30 years	40% 30 years
Generation cost yen/kWh	10.1~ (8.8~)	12.9 (12.9)	13.4 (13.4)	13.9 ~21.9 (9.8 ~15.6)	28.7 ~33.1 (20.2 ~23.2)	19.2 (10.9)	11.0 (10.8)	23.3 (20.4)	27.1 (23.6)	29.7 (28.1)	13.3 (12.9)	28.9 ~41.6 (28.9~ 41.6)	12.7 ~15.5 (11.0~ 13.4)	12.5 ~16.4 (12.3~ 16.2)	14.4 ~15.6 (14.4~ 15.6)	27.2 ~31.1 (27.1~ 31.1)
2011 Cost Review Committee report	8.9~	10.3	10.9	8.8~ 17.3	8.6~ 23.1	9.2~ 11.6	10.6	19.1 ~22.0	19.1 ~22.0	17.4 ~32.2	9.5 ~9.8	25.1~ 38.9	12.1~ 26.4	9.9~ 20.0	11.5	19.6

※1 Fossil fuel prices could drop depending on future policy efforts. Sensitivity analysis results follow:

Sensitivity analysis for fossil fuel power generation			
Impact of a 10% fuel price change (yen/kWh)	Coal About ±0.4	LNG About ±0.9	Oil About ±1.5

※2 The operating rate in 2011 stood at 80% for coal and LNG and 50%/10% for oil.

※3 Figures in parentheses represent costs excluding the policy cost.



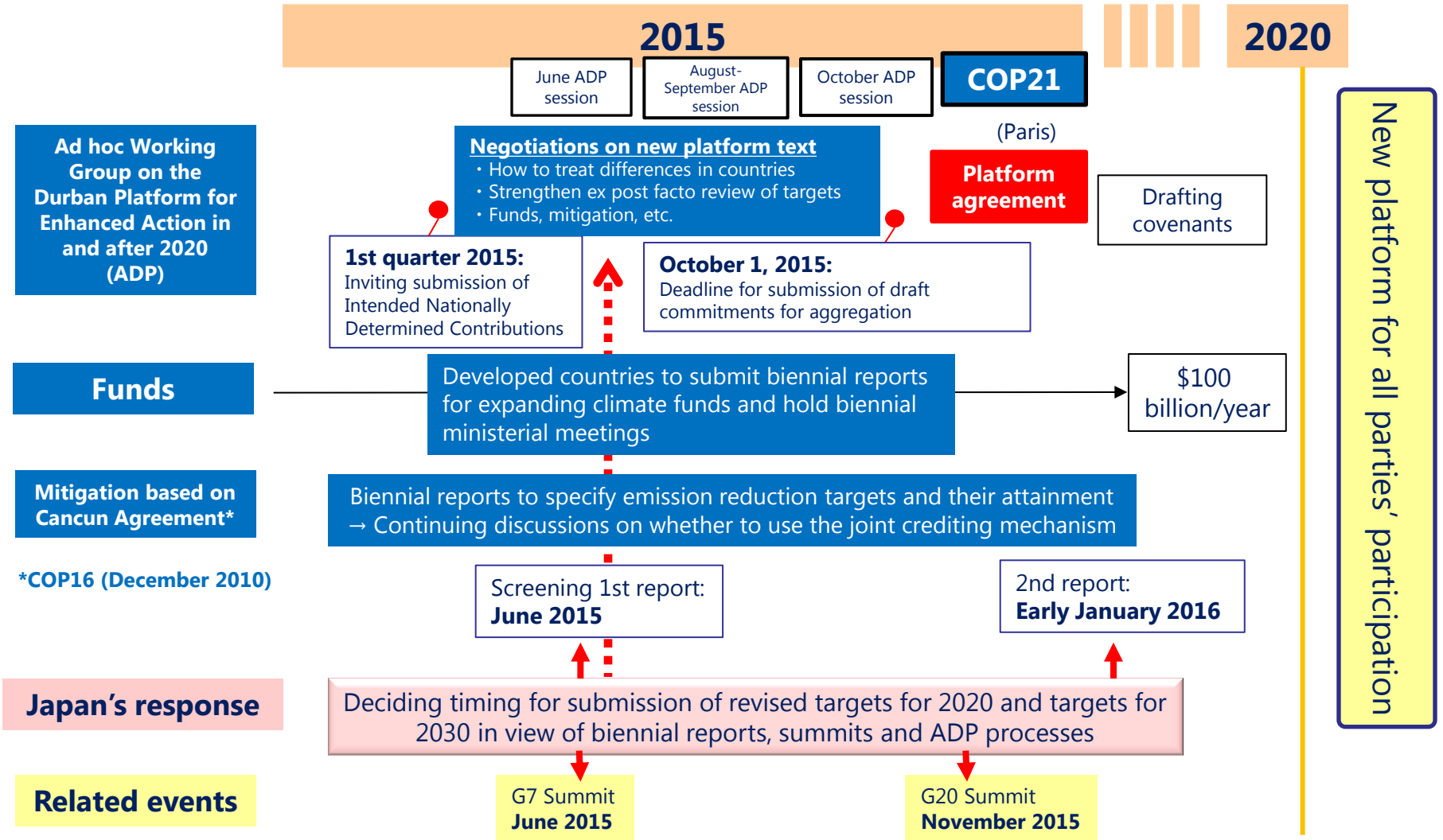
<Adjustment costs accompanying penetration of naturally volatile power sources (solar PV and wind)>

Penetration rate for naturally volatile power sources	Penetration rate for renewables	Survey cost
About 80 billion kWh (8%)	About 21%	About 400 billion yen/year
About 90 billion kWh (9%)	About 22%	About 500 billion yen/year
About 120 billion kWh (12%)	About 25%	About 700 billion yen/year

※Penetration rates are based on total power generation at 1 trillion kWh.

(Source) Document 2 "Long-term Energy Supply/Demand Outlook Outline (draft) Related Documents" p.83 at 10th meeting (June 1, 2015) of the Long-term Energy Supply and Demand Outlook Subcommittee, Strategic Policy Committee, Advisory Committee for Natural Resources and Energy

2. COP21 and greenhouse gas emission reduction draft target
(1) Schedule of global warming negotiations



MEF: Major Economies Forum on Energy and Climate

2. COP21 and greenhouse gas emission reduction draft target
(2) Elements and issues of Paris Agreement

Mitigation (Reduction)	Setting targets (bottom-up approach)	Almost all countries have broadly agreed to take a bottom-up approach based on their submitted draft contributions. But some countries have asserted that some top-down measures should be introduced to raise targets to narrow their gap with the 2°C goal. Many countries have supported the prior review to assess target levels in the next efforts to set targets. But India and some others have opposed the review.
	Reviewing compliance with and attainment of targets	Some countries have called for establishing a compliance mechanism. But discussions on the matter have just begun. If a compliance mechanism has legally binding power, the United States may fail to participate in the platform. Details of an ex-post factor review of whether targets are attained are left for future discussions.
	Japan's joint crediting mechanism	International negotiations are underway on the international recognition of Japan's joint crediting mechanism and other proposals. The Ad hoc Working Group on the Durban Platform for Enhanced Action in and after 2020 has started discussions on market mechanisms and is considering the JCM.
Adaptation, funds, etc.	Developing countries are concerned that the Paris agreement could end up as a decision only on mitigation (reduction) and are calling for expanding support for adaptation and funds.	
	Funds	At the COP15 meeting in Copenhagen in 2009, developed countries agreed to provide $30 billion in new or additional funds between 2010 and 2012 and mobilize $100 billion a year until 2020. **Japan provided $13.3 billion of the $30 billion planned for the 2010-2012 (three-year) period.** **Japan pledged (in 2013) to provide $16 billion in additional funds in three years from 2013.** Developing countries have demanded an increase in climate funds.
	Adaptation	Discussions are underway on global adaptation targets, how to expand responses to climate change-related losses and damage in developing countries vulnerable to adverse effects of climate change, etc.
Separation between developed and developing countries	Developed countries (Annex I countries) were defined as OECD members and transitional economy countries when the United Nations Framework Convention on Climate Change was concluded in 1992. But China, India and other emerging economies have come out later. At the Lima meeting in 2014, UNFCC parties decided to reflect common but differentiated responsibilities for developed and developing countries in the 2015 Paris agreement, indicating that China, India and some others could assume some responsibilities that are different from those for ordinary developing countries.	

2. COP21 and greenhouse gas emission reduction draft target
(3) National emission reduction targets

Japan	**26% in FY2030 from FY2013** (draft, will be submitted soon)
EU	**40% in 2030 from 1990** (Submitted)
Russia	**25-30% in 2030 from 1990** (Submitted)
U.S.	**26-28% in 2025 from 2005** (Submitted)
Brazil	<Target under consideration>
China	**Peaking out in 2030**
India	<Target under consideration>
Indonesia	<Target under consideration>
Switzerland	**50% in 2030 from 1990** (Submitted)
Norway	**40% in 2030 from 1990** (Submitted)
Mexico	**22% in 2030 from BAU** (Submitted)
Gabon	**50% in 2025 from BAU** (Submitted)
Lichtenstein	**40% in 2030 from1990** (Submitted)
Andorra	**37% in 2030 from BAU** (excluding sinks) (only CO_2, CH_4, N_2O and SF_6 from energy and waste sectors) (Submitted)

2. COP21 and greenhouse gas emission reduction draft target
(4) Outline of Japan's Intended Nationally Determined Contributions and emission reduction target <1>

1) Greenhouse gas emission reduction target (draft)

☐An emission reduction target that can be attained with a combination of measures and technologies consistent with and backed in the energy mix

☐Cutting GHG emissions in FY2030 by **26.0% from FY2013 (25.4% from FY2005)** (to about 1,042 million t-CO_2)

☐ **"Energy-related CO_2 emissions** (90% of GHG emissions) **down (21.9%) from FY2013 " +**
"GHG emissions other than energy-related CO_2 (down 1.5%)" +
"Securing sinks (equivalent to a 2.6% cut)"

☐ **The joint crediting mechanism (JCM) will be developed and implemented** to quantitatively assess Japan's contributions to GHG emission reduction and absorption through the diffusion of GHG emission reduction technologies, products, systems, services and infrastructure and the implementation of relevant measures in developing countries. The cumulative emission reduction through the JCM under Japanese government projects covered by annual budgets is estimated at between 50 million and 100 million t-CO_2.

Breakdown of GHG emission reduction rate

	From FY2013 GHG emissions (%)
Total GHG emissions	-26.0
Energy-related CO_2	-21.9
GHG emissions other than energy-related CO_2	-1.5
Non-energy-related CO_2	-0.4
Methane	-0.3
Dinitrogen monoxide	-0.1
4 gases including HFC	-0.7
GHG sinks	-2.6

Comparison of major countries' Intended Nationally Determined Contributions

	From 1990	From 2005	From 2013	GHG emissions per GDP (kg/dollar GDP)	
				2012 Actual	2025/2030 Estimated
Japan (Advisory panel draft) (2030)	-18.0%	-25.4%	-26.0%	0.28	0.1 6
U.S. (2025)	-14-16%	-26-28%	-18-21%	0.45	0.27-0.28
EU (2030)	-40%	-35%	-24%	0.31	0.17

◆The U.S. submitted a reduction target compared with 2005 and the EU a target compared with 1990.

(Source) Reference Document 1 "Draft Commitment-related Materials" p.3-4 at 7th joint meeting (April 30, 2015) of the subcommittee on post-2020 global warming measures, Global Environment Subcommittee, Central Environment Council, and the working group on intended nationally determined contributions, Global Environment Subcommittee, Committee on Industrial Science and Technology Policy and Environment, Industrial Structure Council

2. COP21 and greenhouse gas emission reduction draft target
(4) Outline of Japan's Intended Nationally Determined Contributions and emission reduction target <1>

2) Matters to be specified in Intended Nationally Determined Contributions

①**Standard year**: Registering both **FY2013** and FY2005. Explanations focus on FY2013.

②**Target year**: **FY2030** (Implementation period: April 1, 2021-March 31, 2031)

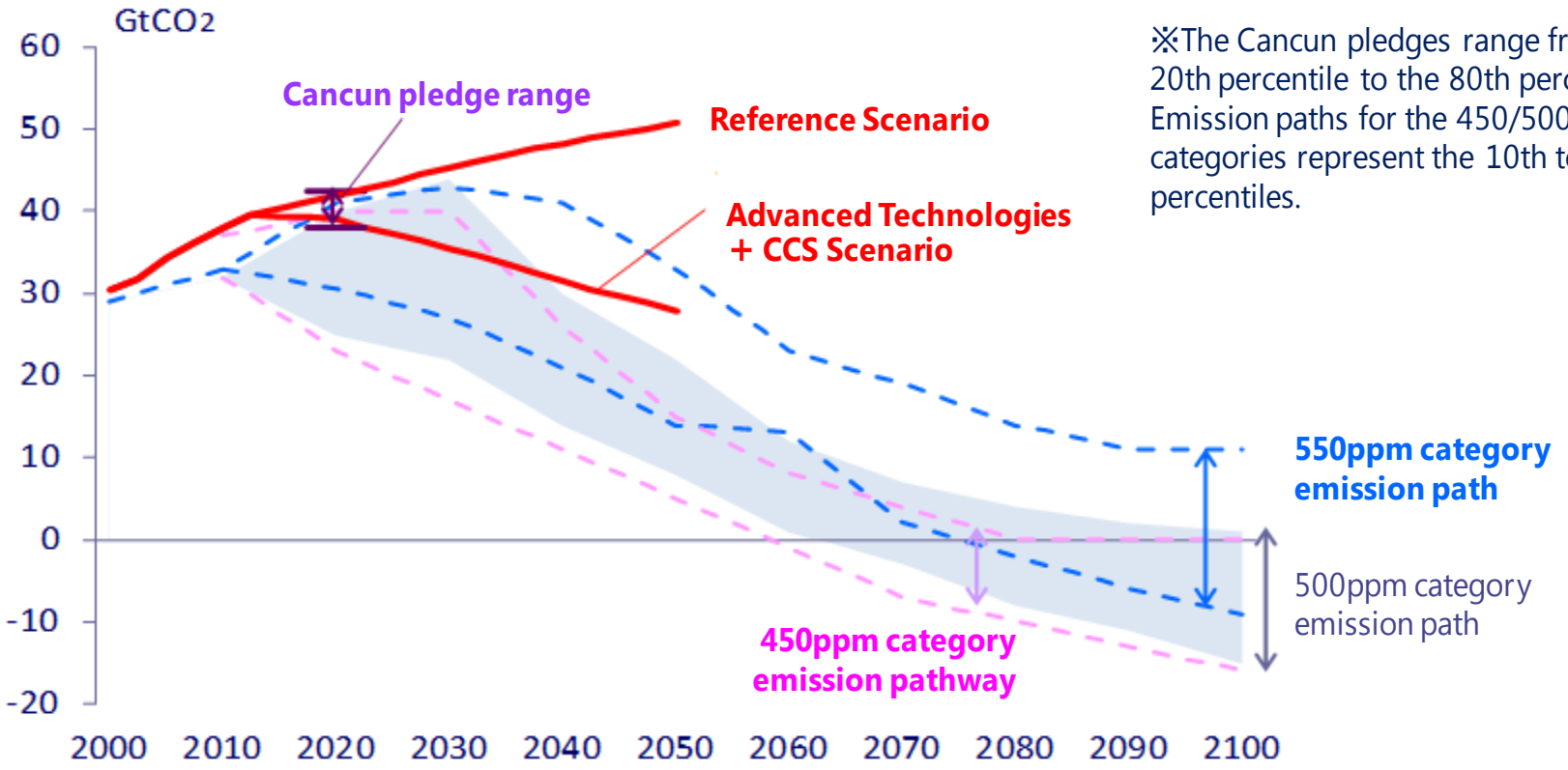
③**Coverage**: Target-covered gases (CO_2, CH_4, N_2O, HFC, PFC, SF_5, NF_3)

Coverage rate is 100%

④**Planned process**: Based on **domestic energy mix discussions.** Discussions are opened to the public through joint meetings of the Central Environment Council and the Industrial Structure Council. A global warming action plan based on law is planned to be drafted.

⑤**Preconditions**: Calculation is made in accordance with IPCC-drafted guidelines. The Joint Crediting Mechanism (**JCM**) is taken into account appropriately, while refraining from being used as a base for accumulating targets.

Comparison of GHG emission paths
(Advanced Technologies Scenario) (IEEJ estimates)



※The Cancun pledges range from the 20th percentile to the 80th percentile. Emission paths for the 450/500/550ppm categories represent the 10th to 90th percentiles.

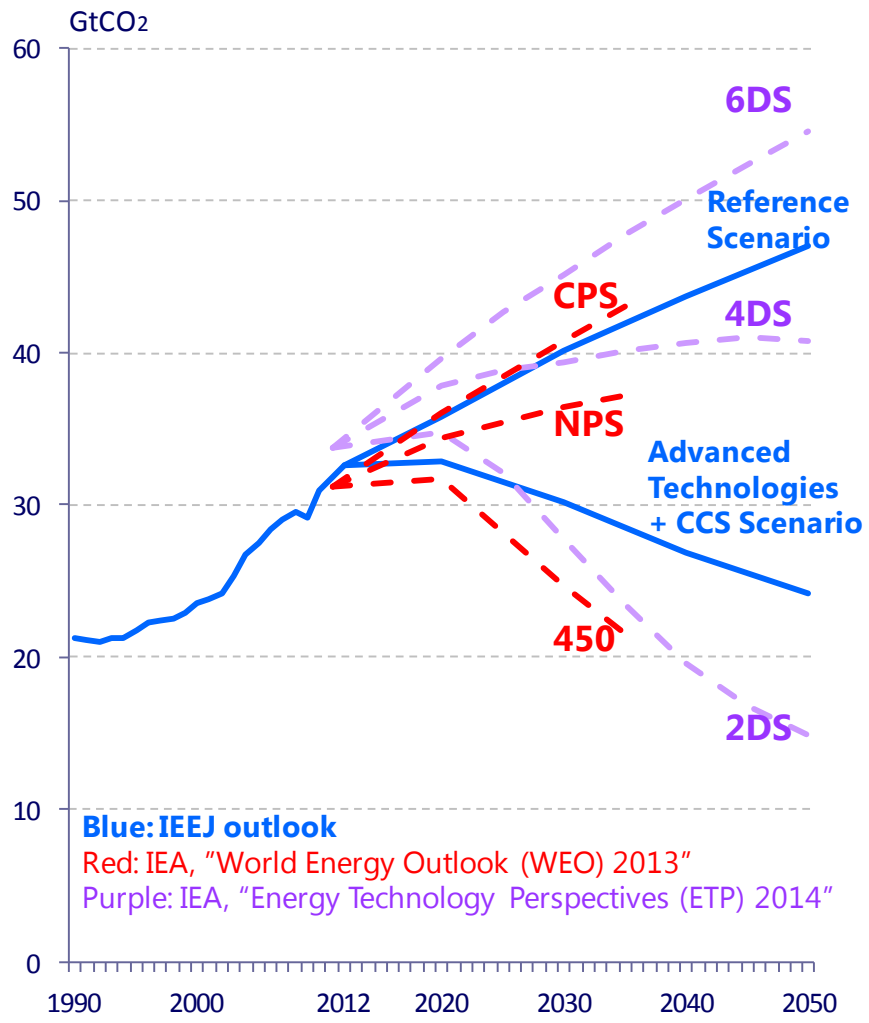
(Sources) Prepared from IPCC, UNEP, The Emissions Gap Report 2013, etc.

- The CO_2 emission path amounts to the lower limit of the Cancun pledges. But the path through 2050 exceeds the upper limit of the 500ppm category emission path, roughly amounting to the 550ppm category.

(Source) IEEJ, Asia/World Energy Outlook 2014, October 2014

Image of Advance Technologies Scenario

(IEEJ estimates)



- The International Energy Agency (IEA) has the "World Energy Outlook" through 2035 and the "Energy Technology Perspectives" through 2050.
- The scenario in which the GHG emission reduction would make the biggest progress is called the "450" or "2DS" scenario. In the "2DS" scenario, CO_2 emissions in 2050 would be halved from 2011 (to 15 $GtCO_2$).
- These scenarios assume the introduction of very ambitious technologies to halve CO_2 emissions. For example, the WEO2013 assumes the Japanese building sector as follows:

CPS (Current Policies Scenario)
Continuation of the top runner system, etc.

NPS (New Policies Scenario)
Expanding the top runner system
Making all new buildings net-zero-energy buildings by 2030
Making all lights highly efficient lights by 2030

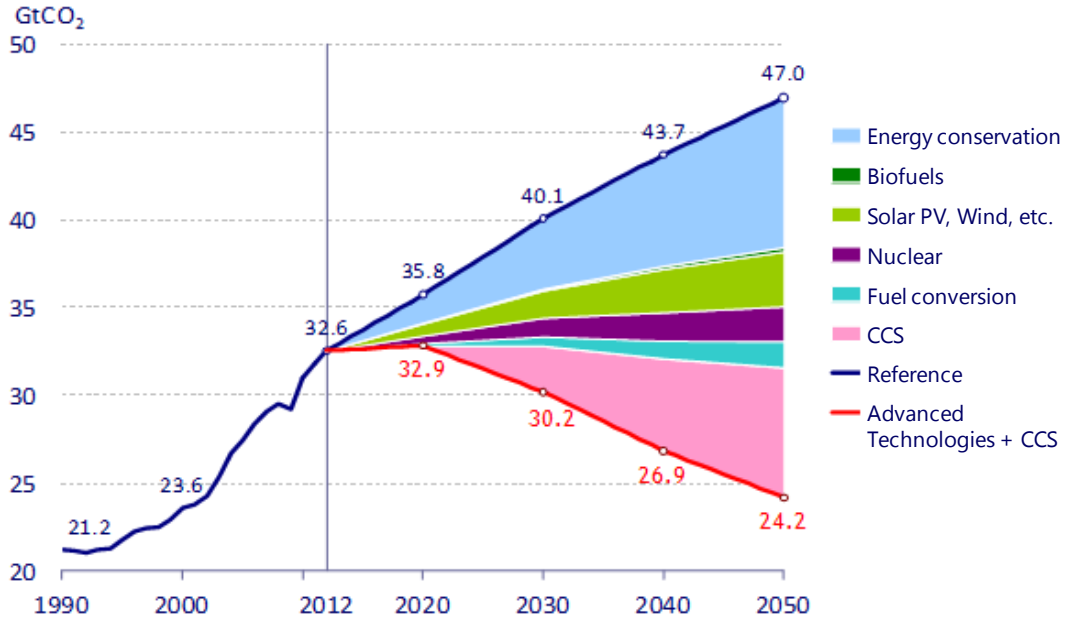
450 Scenario
Applying compulsory, tough energy-saving standards to all buildings (new and existing ones)
Making all new buildings net-zero-energy buildings by 2025

(Reference) The **6DS** (6 Degree Scenario), **4DS** (4 Degree Scenario) and **2DS** (2 Degree Scenario) are the scenarios to limit the temperature rise to these numbers in the ETP 2014.

CO2 emissions (World: Breakdown by measure)

(IEEJ estimates)

Reference Scenario
Advanced Technologies + CCS Scenario



Breakdown of CO_2 emission cuts through 2050

Energy conservation	$GtCO_2$	Share
Biofuels	8.6	38%
Solar PV, Wind, etc.	0.2	1%
Nuclear	3.1	13%
Fuel conversion	2.0	9%
CCS	1.5	7%
Total	7.4	33%
	22.8	100%

- Among technology categories, energy conservation promotion has the largest CO_2 emission reduction potential (8.6 billion tons accounting for 38% of cuts through 2050 and amounting to about 30% of present emissions), followed by CCS (7.4 billion tons). The expansion of renewable energy consumption and fuel switching (from coal and oil consumption to natural gas) will also play a key role.
- Additional measures will be required for halving global CO_2 emissions from the present level, including such long-term programs as innovative technology development and eco-friendly city development.

(Source) IEEJ, Asia/World Energy Outlook 2014, October 2014

3. Conclusion

1) Desirable direction of energy mix formulation

- The draft energy mix announced by the Subcommittee on Long-term Energy Supply-Demand Outlook held on June 1 seems to be generally well-balanced from the viewpoint of **"3E + S"**, suggesting a share of **22-24% for renewables**, **20-22% for nuclear energy** and **56% for fossil fuel**.

- The draft may be approved by the Cabinet by **the end of June** after going through the process of public comments and reaching agreement within the ruling party.

2) COP21 and greenhouse gas emission reduction draft target

- **The reduction of GHG emissions by 26.0% from 2013FY levels in 2030FY** (down 25.4% from 2005FY) **is comparable** to the targets of the EU and USA. The figures will be announced on June 6-7 at the 41st G7 summit meeting as Japan's Intended Nationally Determined Contribution (INDC) and may be finalized **within the month**.

- Japan is expected to take the initiative toward COP21.

Thank you for your attention.

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