Provisional Translation

Options for Energy and the Environment

The Energy and Environment Council Decision on June 29, 2012

[Outline]

July 2012

National Policy Unit

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●Meaning of the Choice of Energy Options in Light of the TEPCO Fukushima Nuclear Power Plant Accident

－Before the Great East Japan Earthquake

- Import of fossil fuels
  Approx. ¥17 trillion a year (30% of the entire import)
- Energy consumption by households
  Approx. ¥9 trillion a year (6% of the entire consumption)
- Energy costs of the manufacturing industry
  Approx. ¥8 trillion a year (3% of the entire costs of the manufacturing industry)
- Energy-related CO2 emissions
  Approx. 1.1 billion tons a year
  (90% of Japan's greenhouse gas emissions)

“Choosing energy options is a national choice.”

March 11, 2011: The Great East Japan Earthquake and the accident at TEPCO Fukushima Daiichi Nuclear Power Plant

○A number of citizens bear a severe burden due to the TEPCO Fukushima Nuclear Power Plant accident.

- Even after more than one year since the accident, many people are forced to live away from their hometown.
  (Population in the evacuation zones: approx. 86,000 (as of the end of March 2012))
- Many communities and people are suffering from reputational damages.
- Compensation and decontamination have already imposed a heavy burden on the citizens, and such burden will increase in the future.

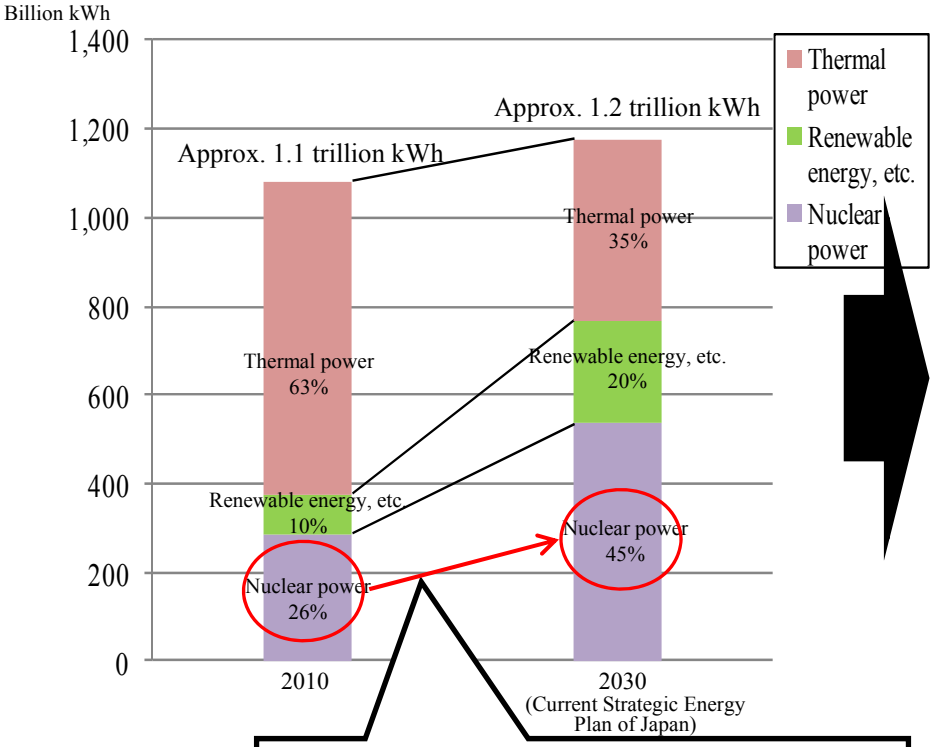
－Meaning of strategies to be questioned again

(After the Great East Japan Earthquake and the TEPCO Fukushima Nuclear Power Plant accident)

(1) A national choice to decide the affluence and shape of the country in an extremely broad sense
(2) A choice on an issue that influences future generations
(3) An international issue that affects the choice of energy options of the world

● Choice after the Disaster: Conversion of Energy/Environmental Structures towards the Reduction in Dependence on Nuclear Energy Reflecting the Examination of the Nuclear Power Plant Accident

[Composition of power sources and the Strategic Energy Plan of Japan before the Disaster]



Energy option with nuclear power as the major power source
(depending on nuclear power for nearly 50% of power sources)
- Taking the lead in the international efforts to solve the global warming issue
- Quasi-domestically produced power source that is inexpensive and contributes to ensuring energy security

[Basis of energy options toward 2030]

March 11, 2011
Occurrence of the Great East Japan Earthquake and the accident at the TEPCO Fukushima Daiichi Nuclear Power Plant
→The major premise that nuclear power is safe was undermined, and the energy option depending on nuclear power generation came under thorough fundamental review .

○Direction basically shared among the people
- Reducing dependence on nuclear energy to the extent possible in the medium-to-long terms

○Controversial issues
- Duration needed for the reduction of dependency
- Level of the reduction
- The kinds of alternative energy sources for nuclear power generation
- Costs involved (energy cost, social cost to change the people's lifestyles and industrial activities)

● Three Viewpoints to Promote Drastic Energy Structure Reforms that Need to Be Addressed Whatever Options Are Chosen

(1) Shifting to clean energy sources and securing green growth

- Shift the energy structure to renewable energy, clean energy (hydrogen and storage system, etc.), and energy conservation.
- Promote consumption and investment, and accelerate green innovation and investments in next-generation energy networks while sharing ambitious goals (increasing the share of renewable energy to over 25-30% and reducing energy consumption by 10% from the current level in 2030).
- Draw up the Framework for Green Development Policy and promote regulatory reform and support for development in an integrated manner, and use them as the basis of Japan's revival.

(2) Reforming the energy system led by demand side actors

- Convert to a new distributed energy system under which each citizen can choose their own energy sources as a consumer/producer.
- Implement energy/electric power systems reform as a priority area.

(3) Multifaceted international contribution for energy and the environmental field

- Converting structures toward clean energy development and further innovation in energy efficiency will serve as the basis for Japan to share its challenges with emerging countries and to promote multifaceted international contribution in the fields of energy/the environment. This will also offer a model for solving global warming.
- In light of the experience of the TEPCO Fukushima Nuclear Power Plant accident, Japan will fulfill its responsibility as a country using nuclear power for peaceful purposes by controlling nuclear power risks, improving nuclear safety, undertaking decontamination, and managing decommissioned reactors through securing of human resources/technological basis.
- Share our experiences in and lessons learned from the accident with other countries.

●Four Important Perspectives in Choosing Energy Options

(1) Securing nuclear safety and reducing future risks

~The current prime challenge is to secure social safety and security in a sustainable manner.

- By minimizing risks through the implementation of thorough safety measures and reducing the amounts of spent nuclear fuel and radioactive waste, the burden on future generations should be reduced. At the same time, technologies and human resources for ensuring nuclear safety need to be secured and developed.
- Based on the above, a roadmap to reduce dependence on nuclear energy needs to be framed.

(2) Strengthening energy security

~Amidst the uncertainty in the global energy situation and the prospects for securing alternative energy, strong demand for energy security remains unchanged.

- The roadmap to reduce dependence on nuclear energy needs to be framed in a form that is compatible with both energy security and the diversification of energy sources.

(3) Contributing to the solution of global warming

~Efforts to reduce domestic CO2 emissions must be continued in the course of carrying out measures to reduce dependence on nuclear energy.

- The current goal for the reduction of greenhouse gas emissions includes sinks and those gained through international contributions in addition to the reduction of domestic emissions. How should the balance between them be considered?
- Japan needs to contribute to solving the global warming issue, including reducing CO2 emissions overseas by utilizing Japan's advanced technology.

(4) Restraining costs and preventing hollowing-out of industry

~Efforts should be made to avoid the situation where industry and employment are hollowed out as a result of the energy mix conversion.

- The roadmap to reduce dependence on nuclear energy should be shaped from the perspective of avoiding the hollowing-out of industry and employment as a result of the energy mix conversion, by looking closely into the impact of the increase in energy costs on industry and economy as well as on social changes.

- **Three scenarios that can reduce dependence on nuclear energy as well as on fossil fuels and reduce CO2 emissions are prepared based on the above four perspectives. The choice of energy options must be made taking the element of economic efficiency into consideration.**

  – Premises in presenting scenarios based on the four perspectives

  Compared to now (2010), it will…

  - Reduce dependence on nuclear energy
  - Reduce dependence on fossil fuels
  - Maximize the usage of renewable energy and promote energy conservation
  - Reduce CO2 emissions

Prepare three scenarios that satisfy the aforementioned premises

(1) 0% scenario
(2) 15% scenario
(3) 20-25% scenario

Three Scenarios for 2030

•The shares mean those in the electric energy generated. Figures in parentheses indicate changes from 2010 before the Great East Japan Earthquake.

	2010	2030				
		0% scenario		15% scenario	20-25% scenario	(Reference) Current Strategic Energy Plan of Japan
		Before additional measures	After additional measures			
Share of nuclear energy	26% Note 1	0% (-25%)	0% (-25%)	15% (-10%)	20 to 25% (-5 to -1%)	45%
Share of renewable energy	10%	30% (+20%)	35% (+25%)	30% (+20%)	30 to 25% (+20 to +15%)	20%
Share of fossil fuels	63%	70% (+5%)	65% (Current level)	55% (-10%)	50% (-15%)	35%
Share of non-fossil energy resources	37%	30% (-5%)	35% (Current level)	45% (+10%)	50% (+15%)	65%
Electric energy generated	1.1 trillion kWh	Approx. 1 trillion kWh (-10%)	Approx. 1 trillion kWh (-10%)	Approx. 1 trillion kWh (-10%)	Approx. 1 trillion kWh (-10%)	Approx. 1.2 trillion kWh
Final energy consumption	390 million kl	310 million kl (-72 million kl)	300 million kl (-85 million kl)	310 million kl (-72 million kl)	310 million kl (-72 million kl)	340 million kl
Greenhouse gas emissions Note 2 (compared to 1990)	-0.3%	-16%	-23% (-21%)	-23% (-22%)	-25% (-25%)	(Around -30%)

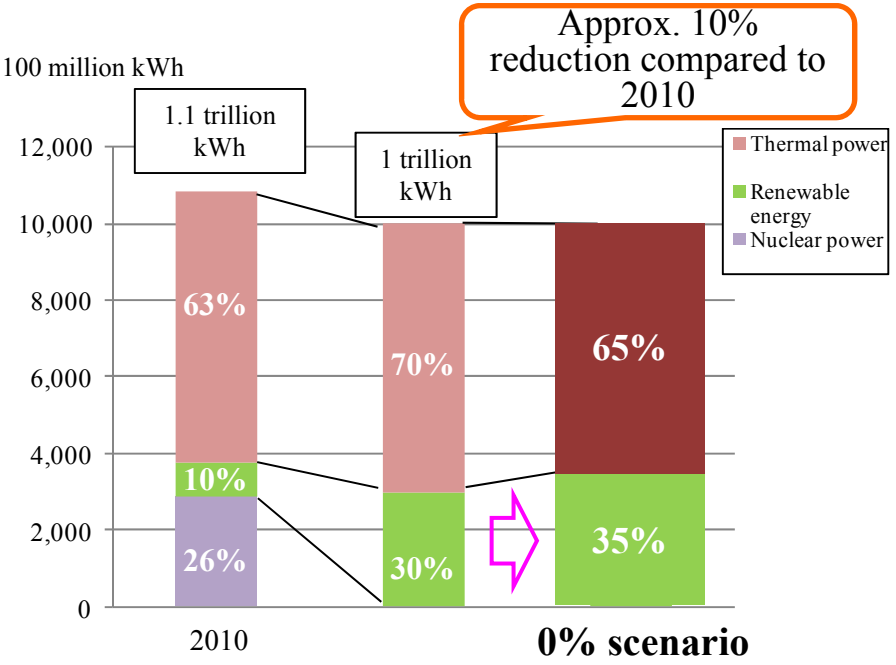
Note 1: The share of nuclear energy under the current Strategic Energy Plan of Japan (53%) is the share of large-scale power sources (excluding cogeneration and private power generation)
Note 2: Figures in parentheses indicate only energy-related CO2 emissions.

0% Scenario

- Reduce the share of nuclear energy to 0% at the earliest possible time before 2030 and adopt the nuclear fuel cycle policy of direct disposal of spent nuclear fuel.
- Convert the energy structure to one consisting of renewable energy and fossil fuels in the end.
- Impose strict regulations, including restrictions on/prohibition of sales of products with poor energy conservation performance, in broad fields, and implement a considerably drastic shift of energy sources to renewable energy, energy conservation and gas, even with a heavier economic burden, in order to reduce dependence on fossil fuels to the minimum and reduce CO2 emissions to a level comparable to other scenarios.

●Specifics in 2030

	2010	2030 Before additional measures	2030 After additional measures
Nuclear power	26%	0%	0% (-25%)
Renewable energy	10%	30%	35% (+25%)
Thermal power (dependence on fossil fuels)	63%	70%	65% (current level)
Share of non-fossil energy resources	37%	30%	35%(current level)
Greenhouse gas emissions	-0.3%	-16% (Reference) -30% Prospect for 2030 in the current Strategic Energy Plan of Japan. Including only energy-related CO2 emissions	-23%
Amount of import of fossil fuels	¥17 trillion	¥17 trillion	¥16 trillion



+ Further energy conservation efforts and CO2 reduction measures
  (Final energy consumption 310 million kl → 300 million kl
  Amount of energy conserved 72 million kl → 85 million kl)
+ Shift to natural gas
  (Ratio of natural gas/coal in thermal power generation: 1.3 → 1.8)

15% Scenario

- Steadily reduce dependence on nuclear energy to around 15% in 2030 and smoothly realize reduction of dependence on fossil fuels and CO2 emission reduction
- Reprocessing and/or direct disposal are possible in relation to the nuclear fuel cycle policy.
- Utilize nuclear power, renewable energy, and fossil fuels through their combination and flexibly respond to various environmental changes, including those in the energy situation, in the international situation concerning the global environment, and in technological innovation

●Specifics in 2030

	2010	2030	
Nuclear power	26%	15%	(-10%)
Renewable energy	10%	30%	(+20%)
Thermal power (dependence on fossil fuels)	63%	55%	(-10%)
Share of non-fossil energy resources	37%	45%	(+10%)
Greenhouse gas emissions	-0.3%	-23% (Reference) -30% Prospect for 2030 in the current Strategic Energy Plan of Japan. Including only energy-related CO2 emissions.	
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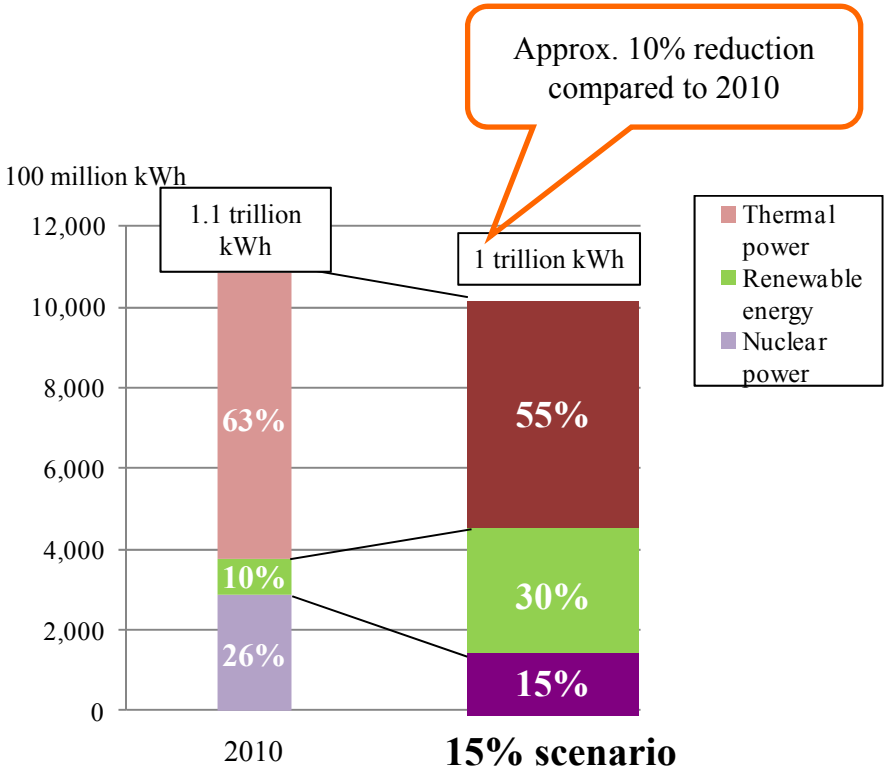
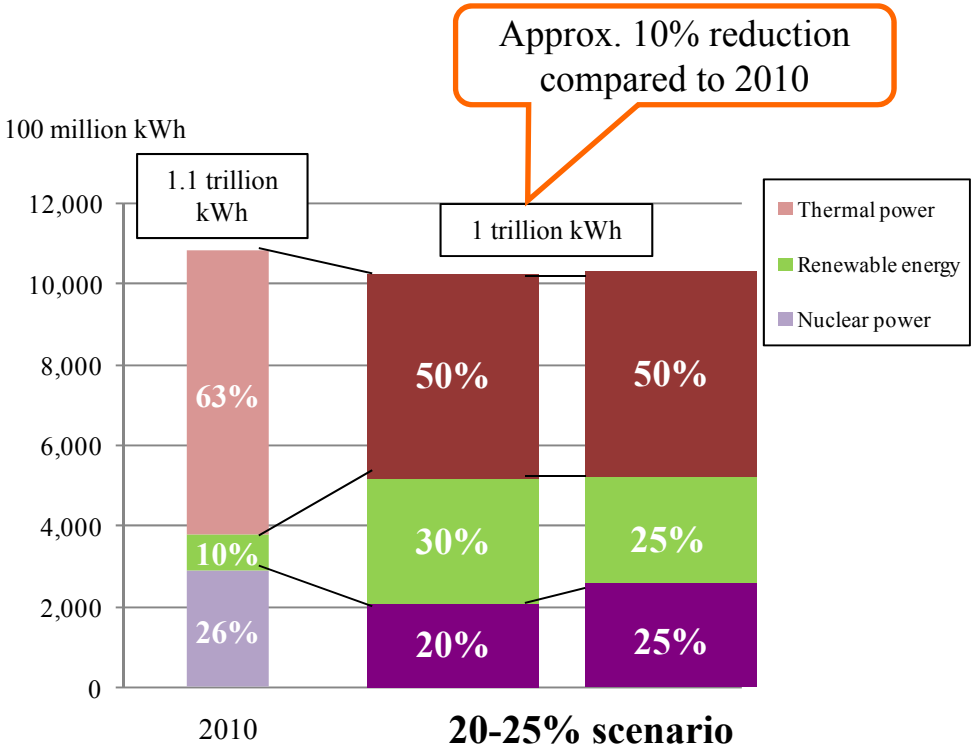


20-25% Scenario

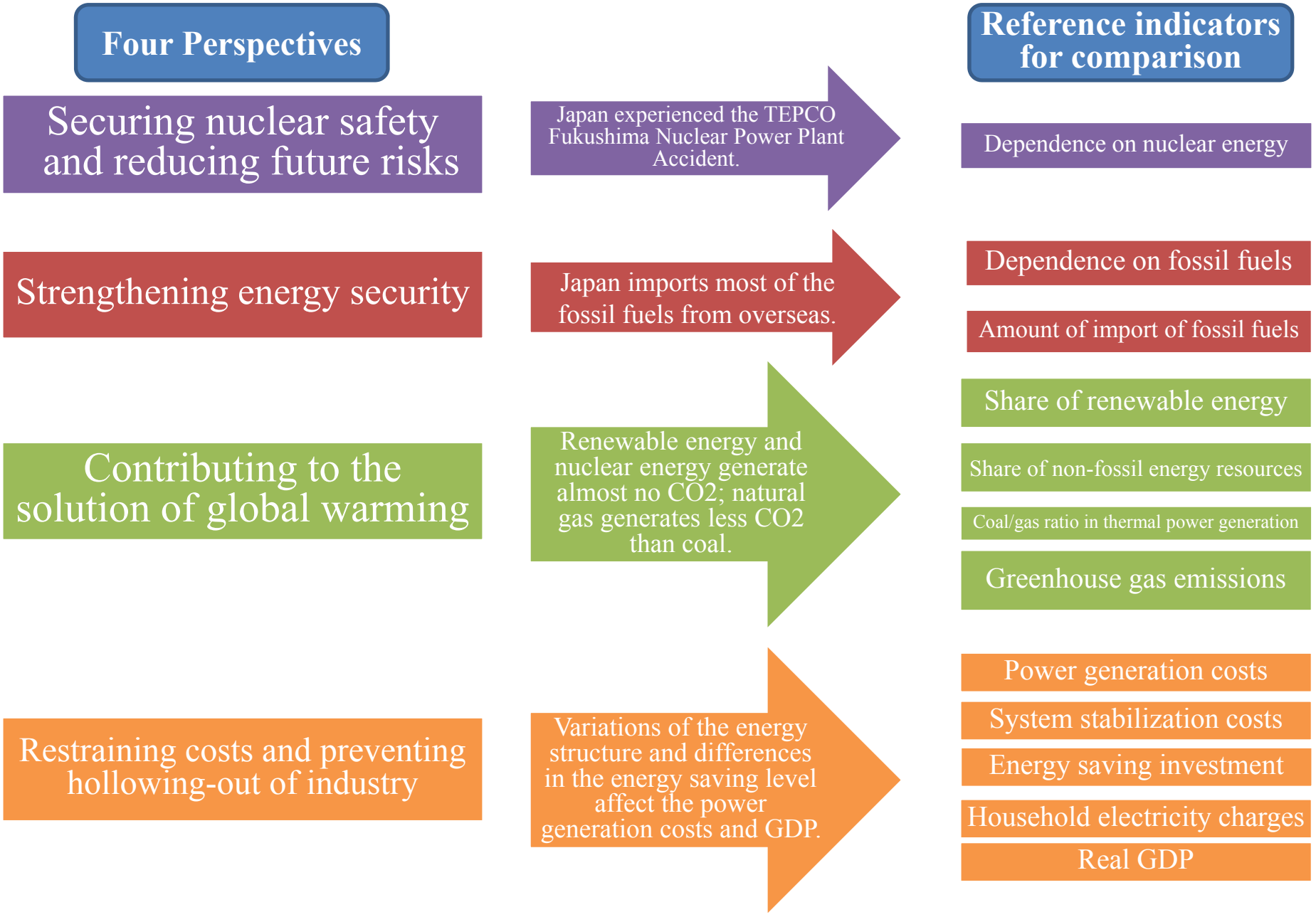
- Keep a certain level of dependence on nuclear energy while slowly reducing it and achieve a share of nuclear energy in 2030 around 20-25%. Construction of new nuclear power plants and replace of existing plants are required.
- Reprocessing and/or direct disposal are possible in relation to the nuclear fuel cycle policy.
- Promote reduction of dependence on fossil fuels and CO2 emission reduction from a more economic aspect.
- Strong public confidence in nuclear energy and administration thereof is the premise.

●Specifics in 2030

	2010	2030
Nuclear power	26%	20% to 25% (-5% to -1%)
Renewable energy	10%	30% to 25% (+20% to +15%)
Thermal power (dependence on fossil fuels)	63%	50% (-15%)
Share of non-fossil energy resources	37%	50% (+15%)
Greenhouse gas emissions	-0.3%	- 25% (Reference) -30% Prospect for 2030 in the current Strategic Energy Plan of Japan. Including only energy-related CO2 emissions.
Amount of import of fossil fuels	¥17 trillion	¥15 trillion



Reference Indicators relating to Four Important Perspectives in Choosing Energy Options



Securing Nuclear Safety and Reducing Future Risks

Facing squarely the devastating damages caused by the nuclear power plant accident and the reality of Japan as an earthquake-prone country, it is critical to reduce the burden on future generations by minimizing risks through the thorough implementation of strengthened safety measures as well as by reducing the amounts of spent nuclear fuel and radioactive waste. At the same time, it is important to secure and develop technologies and human resources for ensuring nuclear safety. Against this backdrop, the roadmap to reduce dependence on nuclear energy should be concretized.

Assessment items	2010	0% scenario	15% scenario	20-25% scenario
Dependence on nuclear energy	Approx. 26%	0% (down 25%)	15% (down 10%)	20-25% (down 5%-1%)
	—	• Reduce the share of nuclear power generation to zero at the earliest possible time before 2030	• Reduce dependence on nuclear energy steadily	• Keep a certain level of dependence on nuclear energy, while slowly reducing it. • Construction of new nuclear power plants and replace of existing plants are required • This scenario must be premised on strong public confidence in nuclear energy and administration thereof

In relation to the nuclear fuel cycle policy:

0% scenario	Adopt the policy of direct disposal of spent nuclear fuel
15% scenario	Opt for reprocessing and/or direct disposal
20-25% scenario	Opt for reprocessing and/or direct disposal

Strengthening Energy Security

Amidst the uncertainty in the global energy situation and the prospects for securing alternative energy, strong demand for energy security remains unchanged. The roadmap to reduce dependence on nuclear energy needs to be framed in a form that is compatible with both energy security and the diversification of energy sources.

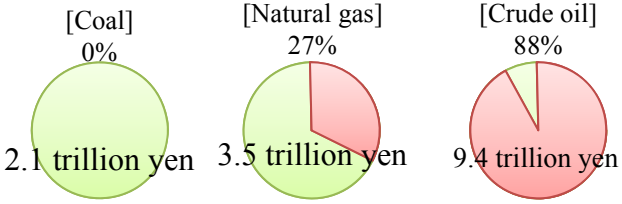
Assessment items	2010	0% scenario		15% scenario	20-25% scenario
		Before additional measures	After additional measures		
Dependence on fossil fuels (share of thermal power in the total output)	Approx. 63%	70% (+5%)	65% (current level)	55% (-10%)	50% (-15%)
Amount of import of fossil fuel (primary energy supply basis)	17 trillion yen	17 trillion yen	16 trillion yen	16 trillion yen	15 trillion yen

<Import prices for fossil fuels>

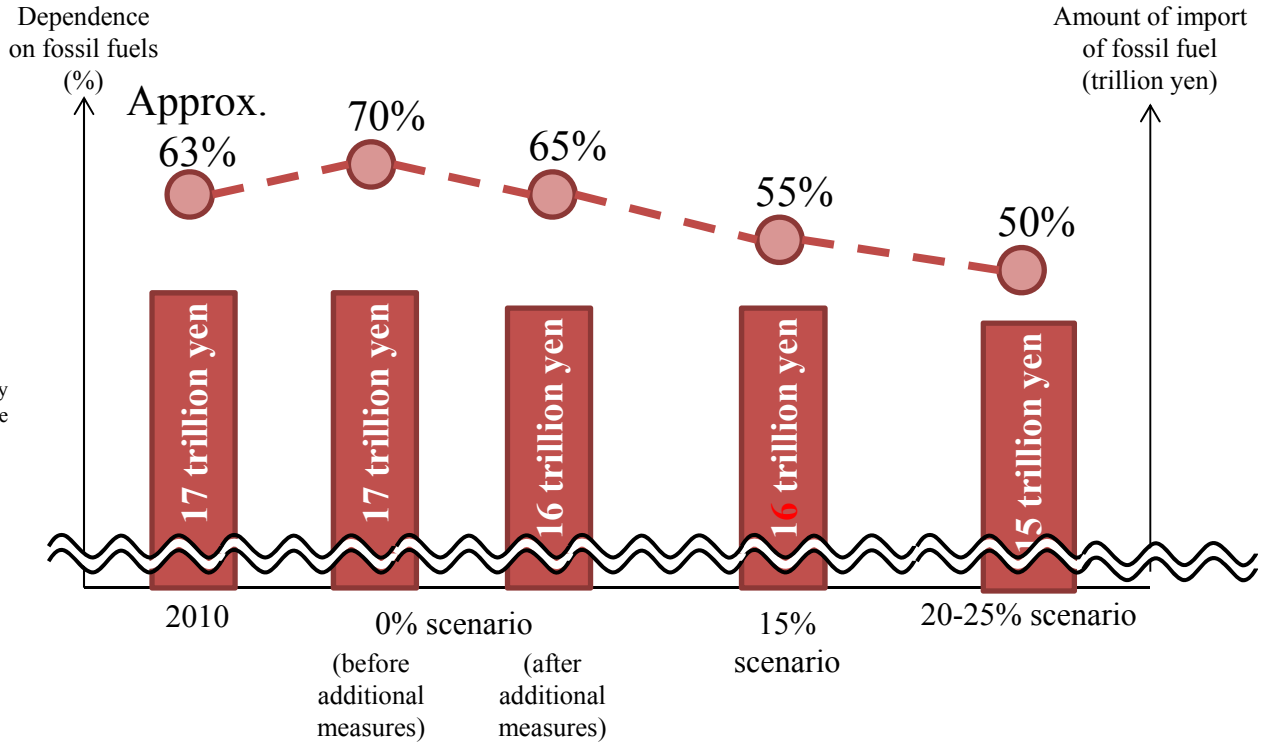
Fuel	Unit	2010	2020	2030
Coal	$/ kl (crude oil equivalent)	172	183	187
	$/t	114	121	124
Natural gas	$/ kl (crude oil equivalent)	415	485	521
	$/t	584	683	734
Crude oil	$/ kl	538	733	790
	$/bbl	84	115	123

* $/ crude oil equivalent: Price per calorie
* Based on the outlook for the new policy scenarios in World Energy Outlook 2011 (IEA), as amended by means of the purchase price (CFI price in 2010 (by the Cost Review Committee)).

<Dependence of fossil fuels imports on the Middle East>



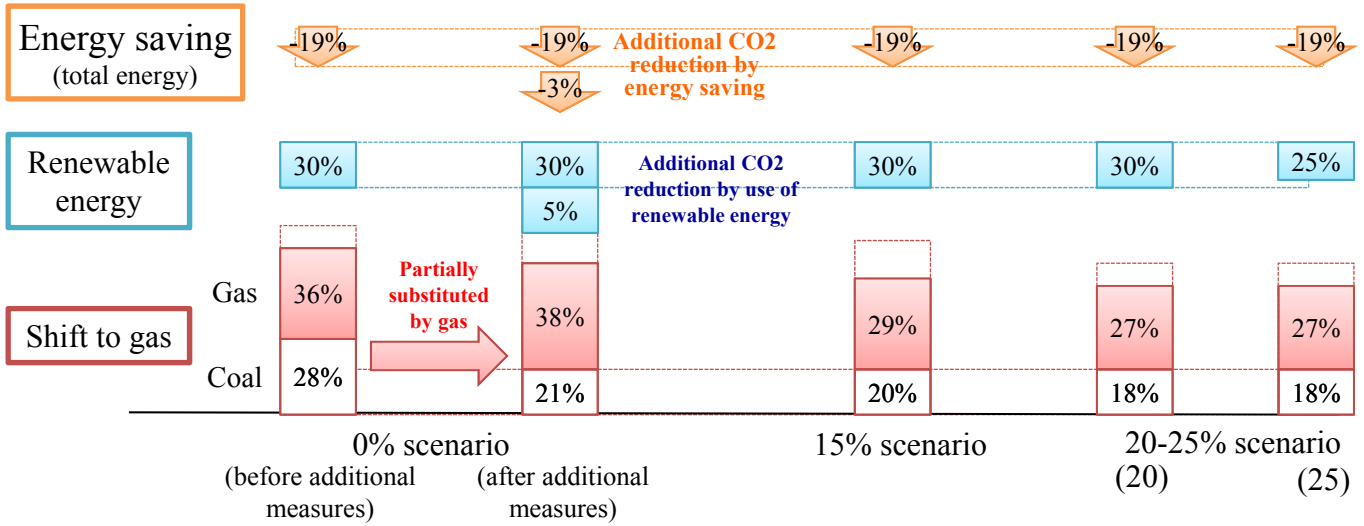
Source: 2011 Trade Statistics of Japan



Contributing to the Solution of Global Warming

Efforts to reduce domestic CO2 emissions must be continued in the course of carrying out measures to reduce dependence on nuclear energy. Japan will contribute to solving the global warming issue, including reducing CO2 emissions overseas by utilizing Japan's advanced technology.

Assessment items		2010	0% scenario				15% scenario	20-25% scenario
			Before additional measures		After additional measures			
Share of renewable energy		Approx. 10%	30% (+20%)		35% (+25%)		30% (+20%)	30-25% (+20-15%)
Share of non-fossil energy resources		Approx. 37%	30% (-5%)		35% (current level)		45% (+10%)	50% (+15%)
Coal/gas ratio in thermal power generation (including cogeneration)		1:1.2	1:1.3		1:1.8		1:1.5	1:1.5
Greenhouse gas emission (1990-level basis)	2030	-	-16%		-23%		-23%	-25%
	2020*	-	+0% (nuclear energy: 0%)	-5% (nuclear energy; 14%)	-0% (nuclear energy: 0%)	-7% (nuclear energy: 14%)	-9% (nuclear energy: 21%)	-10-11% (nuclear energy: 23-26%)



* The level of dependence on nuclear energy in 2020 is projected as a middle point on a line that runs between the 2010 point and the 2030 point.

Restraining Costs and Preventing Hollowing-out of Industry (1)

The roadmap to reduce dependence on nuclear energy should be shaped from the perspective of avoiding the hollowing-out of industry and employment as a result of the energy mix conversion, by looking closely into the impact of the increase in energy costs on industry and economy as well as on social changes.

Assessment items	2010	0% scenario		15% scenario	20-25% scenario
		Before additional measures	After additional measures		
Power generation costs	8.6 yen/kWh	-	15.1 yen/kWh (+6.5yen)	14.1 yen/kWh (+5.5yen)	14.1 yen/kWh (+5.5yen)
Power line costs (accumulated until 2030)*1	—	3.4 trillion yen	5.2 trillion yen	3.4 trillion yen	3.4-2.7 trillion yen
Energy saving investment (accumulated until 2030)	—	Approx. 80 trillion yen (Saved cost: approx. 60 trillion yen)*2	Approx. 100 trillion yen (Saved cost: approx. 70 trillion yen)	Approx. 80 trillion yen (Saved cost: approx. 60 trillion yen)	Approx. 80 trillion yen (Saved cost: approx. 60 trillion yen)

*1: Excludes costs for the handling of surplus energy.
*2: Energy costs (e.g. electricity costs, fuel costs) expected to be saved by energy saving investment (i.e. energy saving benefit).

<List of power generation costs>*3

	Nuclear power (70%) *4 *5	Coal-fired thermal power (80%) *4	LNG thermal power (80%) *4	Oil-fired thermal power (10%~50%) *4 *5	General hydroelectric power	Small-scale hydroelectric power	Solar power (mega solor)	Solar power (residential)	Wind power, onshore	Wind power, offshore	Biomass-fired power	Gas cogeneration	Oil cogeneration	Fuel cells
Existing plants *6	6.4～	8.1	10.0	26.6～20.2	2.3	13.5	10.5	7.4	3.6	-	22.4	9.6	15.7	23.4
New plants														
2010	9.0～	9.5	10.7	36.0～22.1	10.6	20.6	38.0	35.9	13.6	-	24.8	10.6	17.1	101.9
2020	9.0～	10.2	10.4	36.4～22.5	10.6	20.6	19.1	15.4	13.3	16.2	24.8	11.1	18.6	20.4
2030	9.0～	10.3	10.9	34.9～21.0	10.6	20.6	16.0	12.0	13.1	15.9	24.8	11.5	19.6	11.5

*3: The costs are estimated based on the power generation cost estimation sheet of the Cost Review Committee. The data used are the lowest figure for nuclear power, the figure in the new policy scenario for thermal power, the mean value estimated in the accelerated scenario for solar power, and the mean value between the upper limit and the lower limit for other types that have some value ranges.
*4: The list describes the typical case of facility utilization ratios, which are inconsistent with the data actually used for the estimation because of the difference in the facility utilization ratios by respective scenarios.
*5: In the calculation of nuclear power generation costs, the accident risk cost is revised from 0.5 yen/kWh to 0.6 yen/kWh. The power generation efficiency for oil thermal power is revised based on the result of the call for evidence.
*6: The figures exclude the capital cost from the costs for the 2010 model plant; however, the cost for the existing plants above is estimated by deducting the depreciation expenses from the costs for the 2010 model plant.

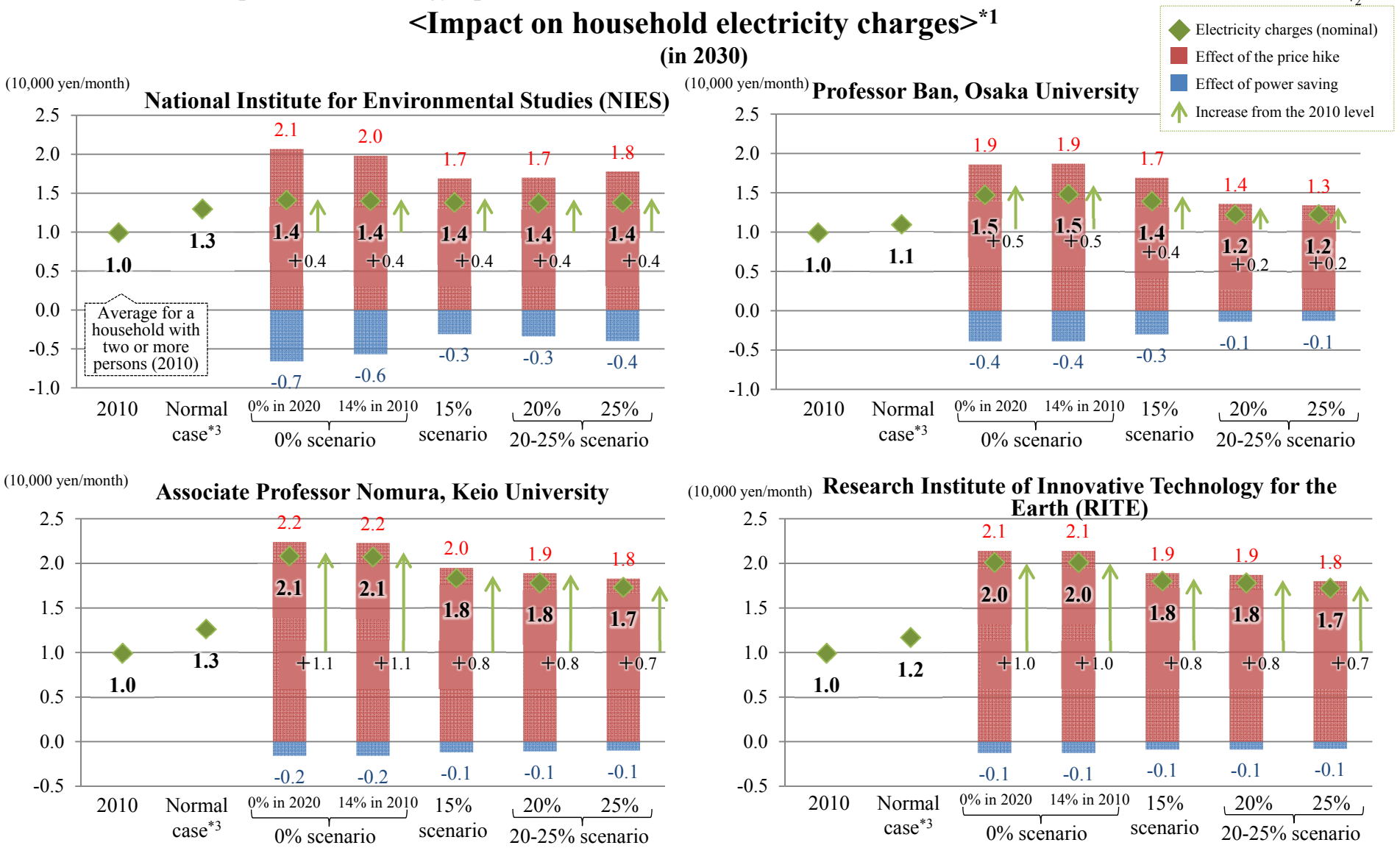
Restraining Costs and Preventing Hollowing-out of Industry (2)

The following four institutes that have great expertise on economic model analysis have analyzed the economic impact of each energy option.

* For the features of each analysis model, see the footnote on the next page.

<Impact on household electricity charges>*1

(in 2030)



*1: The data are estimated by the National Policy Unit on the basis of the growth rates between 2010 and 2030 in the normal case for each model and the rates of change from the normal case level in each scenario.
*2: The data takes into account both the effect on the price hike without power saving efforts and the effect of power saving.
*3: The normal (intact) case is based on the assumption that the economic growth and other macroeconomic conditions are in line with the prudent scenario (the real GDP growth will be 1.1% between 2010 and 2019 and 0.8% between 2020 and 2029).

Restraining Costs and Preventing Hollowing-out of Industry (3)

Four institutes that have great expertise on economic model analysis have analyzed the economic impact of each energy option.*1

<Impact on the real GDP>

(in 2030; the 2010 level=511 trillion yen)

(trillion yen)

Analysis institution	Items	Normal case*2	0% scenario		15% scenario	20-25% scenario	
			0% in 2020	14% in 2020		20%	25%
NIES (AIM/CGE Model)	Real GDP	636	627	628	634	634	633
	Against the 2010 level	+125	+116	+117	+123	+123	+122
	Against the normal case	—	-9	-8	-2	-2	-3
Professor Ban, Osaka University (Ban Model)	Real GDP	624	605	608	611	614	615
	Against the 2010 level	+113	+94	+97	+100	+103	+104
	Against the normal case	—	-18	-15	-13	-10	-9
Associate Professor Nomura, Keio University (KEO Model)	Real GDP	625	609	609	616	617	617
	Against the 2010 level	+124	+98	+98	+105	+106	+106
	Against the normal case	—	-16	-17	-10	-9	-8
RITE (DEARS Model)	Real GDP	609	563	564	579	581	583
	Against the 2010 level	+98	+52	+53	+68	+70	+72
	Against the normal case	—	-46	-45	-30	-28	-27

*1: As the estimates by economic models analysis could change significantly depending on the assumptions and conditions used in each model, too much emphasis must not be placed on the estimate values. It is important to roughly grasp the impact of the differences among the scenarios on economy and the general direction of the effects, rather than focusing on the scale of the respective values estimated by each institute. The data are estimated by the National Policy Unit on the basis of the growth rates between 2010 and 2030 in the normal case for each model and the rates of change from the normal case in each scenario.

The features of the model used by each institute for the analysis are summarized as follows. For details of each model, see the reference documents issued by the Basic Issue Subcommittee of the Advisory Committee on Energy and Natural Resources (http://www.enecho.meti.go.jp/info/committee/kihonmondai/) and the Global Environmental Division of the Central Environment Council (http://www.env.go.jp/council/06earth/yoshi06.html).

(1) Price elasticity

・The degree of progress in energy saving in the case of raising the energy price (price elasticity) differs greatly depending on the model (the price elasticity of electricity is the highest in Osaka University's model, followed by NIES, RITE and Keio University, whereas the marginal cost for CO2 reduction is the highest in RITE's model, followed by Keio University, NIES, and Osaka University). When the elasticity is higher, further progress will be made in taking measures even in response to a small price hike (because the measures cost less), the price hike in the scenario will become smaller, and the impact on economy will become smaller accordingly.

(2) The economic impact estimated by RITE is larger than those estimated by other institutes because the model applied by RITE estimates lower price elasticity and higher cost for CO2 reduction as compared to other models, and also because that is an international model which expressly deals with an increase in overseas production arising due to an energy price hike in Japan (leakage). NIES estimates a smaller economic impact because it assumes that progress will be made in energy saving and CO2 reduction at low costs, giving higher evaluation to the effect of energy saving investment (by taking into account the future effect of energy saving).

*2: The normal case is based on the assumption that the economic growth and other macroeconomic conditions are in line with the prudent scenario (the real GDP growth will be 1.1% between 2010 and 2019 and 0.8% between 2020 and 2029).

Image of Clean Energy Policy (1)

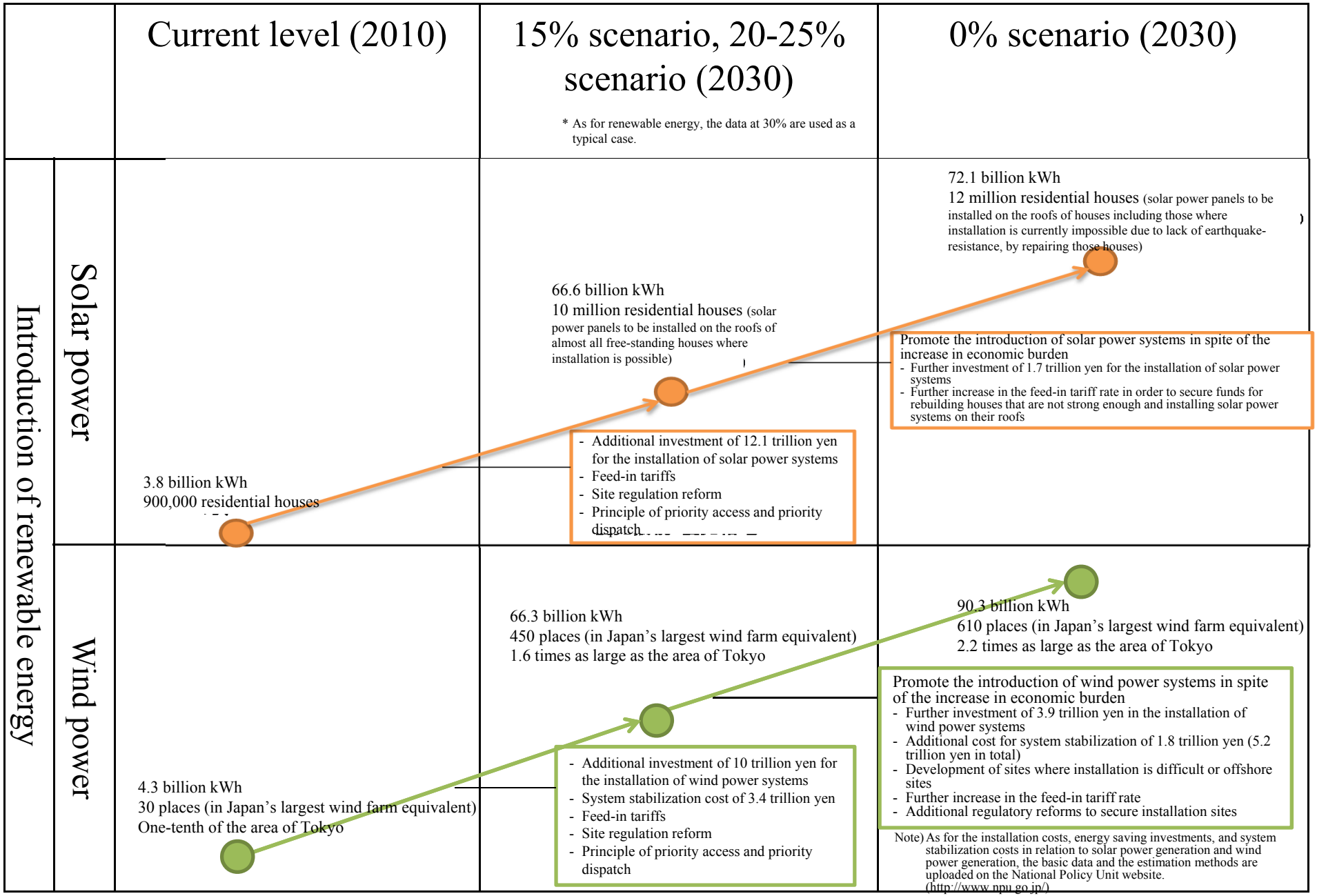
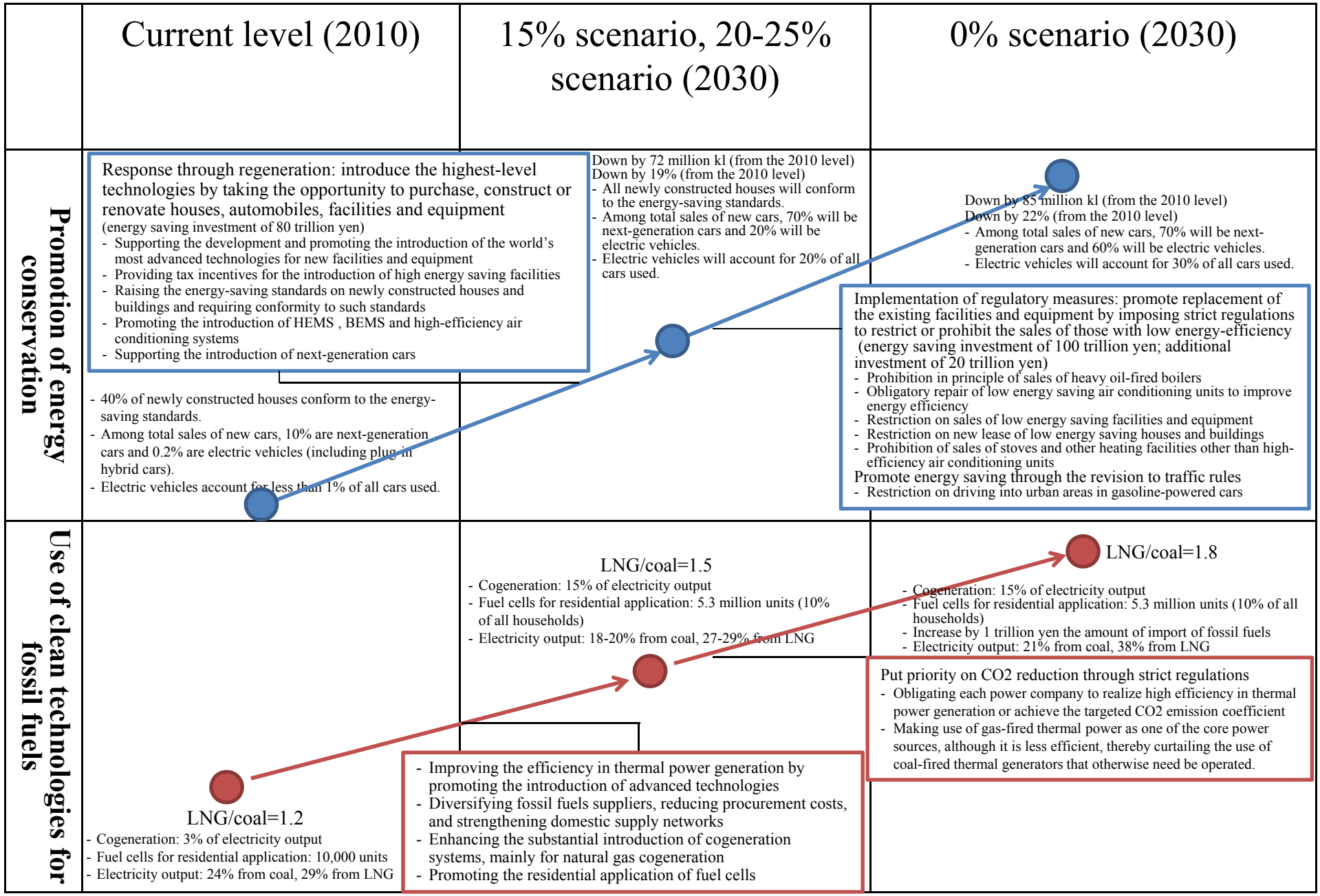


Image of Clean Energy Policy (2)



Future Schedule

July

National disucussions

- Development of the information database (early July)
- Public hearing sessions (at 11 places nationwide, on every weekend from July 14 to mid-August)
- Solicitation of public comments (from July 2 to the end of July)
- Deliberative Polling (early August)

August

Decide on Innovative Strategy for Energy and the Environment

Promptly

Formulate a New Strategic Energy Plan of Japan

By the end of 2012

Formulate Framework for Nuclear Energy Policy, Global Warming Countermeasures, and Framework for Green Development Policy

Thereafter

●**Continuous review**

: Provide the relevant information to the public, while grasping international energy situations and other international circumstances relating to the global environment, trends in technological innovation, and public confidence in the government's energy policy.

●**Verification to be made by 2030**

: Verify the general direction of the policy by 2030, whichever scenario is chosen.

Closing

- The energy issue is the most critical and challenging task to tackle in any age and in any country.

- In particular, the choice that Japan will make in relation to energy and the environment after experiencing the TEPCO Fukushima Nuclear Power Plant Accident will be:

  • a choice that concerns all citizens
  • a choice that affects future generations
  • a choice that draws attention from the international community

- It is expected that all citizens will take part in the national discussions on the choice of energy and environmental options. The government will make the best choice based on the voices expressed in the national discussions.