EU–Japan Centre
for Industrial Cooperation

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Research Paper

The Japanese Clean Energy sector development

Report short version

Victoria VIGOT

This report aims to provide the European Commission, the Ministry of Economy, Trade and Industry (METI) and European businesses with a comprehensive analysis of clean energies in Japan. It will look at to what extent clean energies have influenced or are capable of influencing Japan's economy, notably in its relationship with Europe.

Following the Fukushima nuclear disaster, Japan appears to be at an energy crossroads. It will have to find a short-term alternative to supply the 30% of power previously generated by 52 nuclear reactors. Also, it will need to modernise its power supply network to avoid the drastic electricity shortages felt in the disaster stricken area of Tohoku in 2011.

The disaster on March 11th called for an overhaul of the energy system, the first signs of improvement are promising a bright future for the clean energy sector in Japan.

The first purpose of this report is to gather enough relevant information to help understand the transformation currently underway in the electricity market. To that end, it will highlight the challenges and the main factors that will need to be overcome to help establish a more effective and cleaner system. This study should also look at the concept of clean energy in the context of Japan to highlight possible areas of improvement that may have been neglected.

Given how rapidly things are changing in Japan (post-disaster), this report should be considered with caution. Indeed, many of the processes that will be undertaken can have long-term consequences and will depend on future developments or events. This makes it difficult to provide accurate assessments or forecasts only two years after the Fukushima disaster. It is therefore highly recommended to do some follow-up research to reassess the situation in the years to come.

It should also be noted that this report focuses on all aspects of the electricity market (which has been most affected since the Fukushima crisis). So, it will not only assess power generation and renewable energy development but also the soon-to-be-implemented deregulation reforms, energy efficiency and energy management systems and areas such as electric vehicles or the exploitation of "cleaner" fossil fuels.
Therefore, in order to accurately explain the broad and complex matter of clean energy development in Japan, the report will be divided into three parts. The first part will examine the electricity market structure, as a whole, including a description of the effects of the deregulation reform. This will provide the framework to understand clean energy development. The second part will focus on the Abe administration general energy policy, and specifically its clean energy policy with the aim of assessing what steps the government has taken. Finally, the third part of this report will analyse the clean energy market structure before 2011 and how it will evolve in the foreseeable future.

The Structure of the Japanese electricity sector

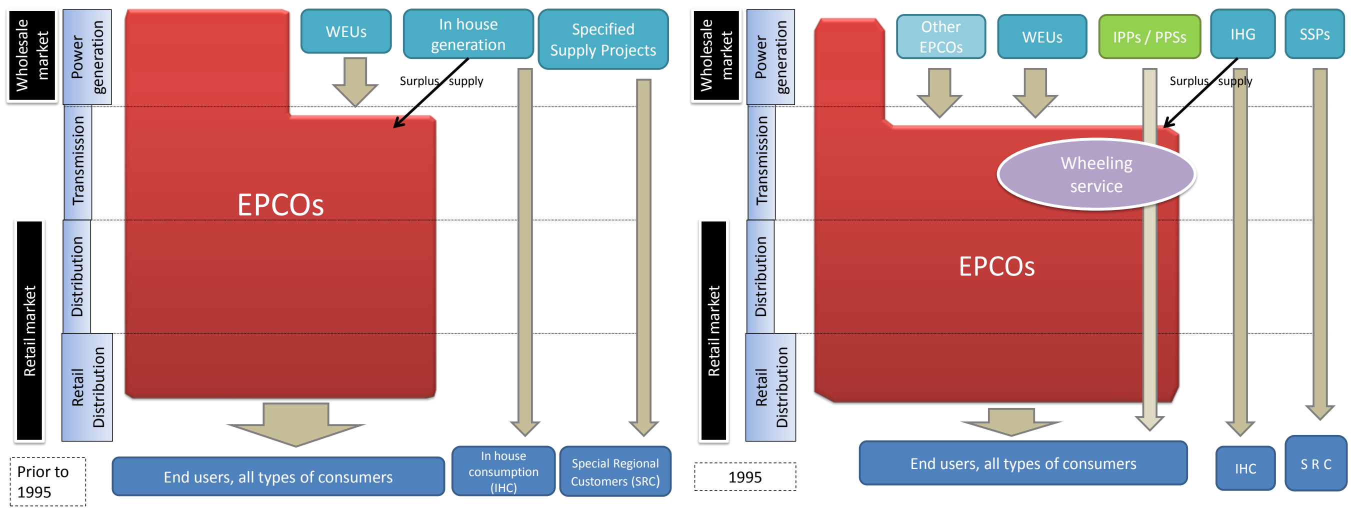
In 1951, under the Supreme Commander of the Allied Powers (SCAP), Japan adopted the American model of state regulated, privately owned and vertically integrated monopolies. The electric utility industry was sub-divided into nine regional privately owned and managed general electric utilities. Each was responsible for the supply of electricity to their region. In 1972, with the return of Okinawa to Japan, the tenth member was formed. These ten Japanese electric utilities will be referred to as "EPCOs" from now onwards. Within these monopolistic markets; transmission, distribution and retail were vertically integrated markets, with only power generation being a horizontally divided wholesale market.

During the period of double digit growth, as EPCOs lacked enough financial resources to meet the rising power generation capacity needs, the government established Wholesale Electric Utilities (WEUs). The two main ones being: Electric Power Development Co., Ltd. (fully privatised on October 6th 2004, and referred to below as J-POWER) and Japan Atomic Power Co. (JAPC).

Sometimes municipalities can also own and operate their own power generating plants; most of these are hydroelectric plants.

Several reforms to implement a more competitive system were attempted as early as 1995, but without success. A gap can be observed between their actual market presence and the progressive reduction of their theoretical role and influence (the market organisation scheme created by public authorities).

From 1995 to 2013, the transformation of the market structure has been carried out in several stages as illustrated below:

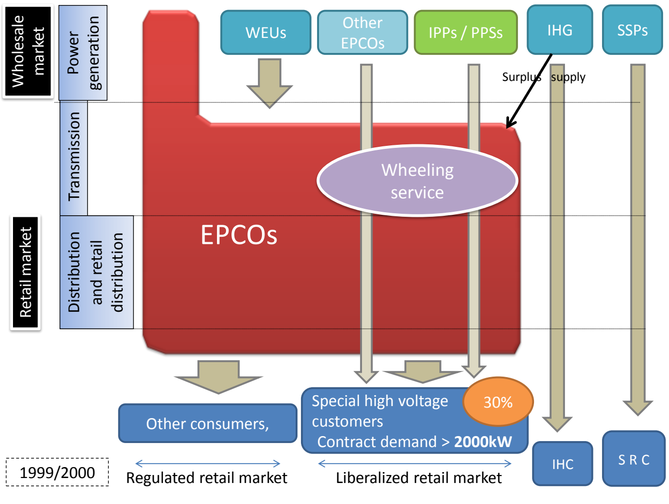


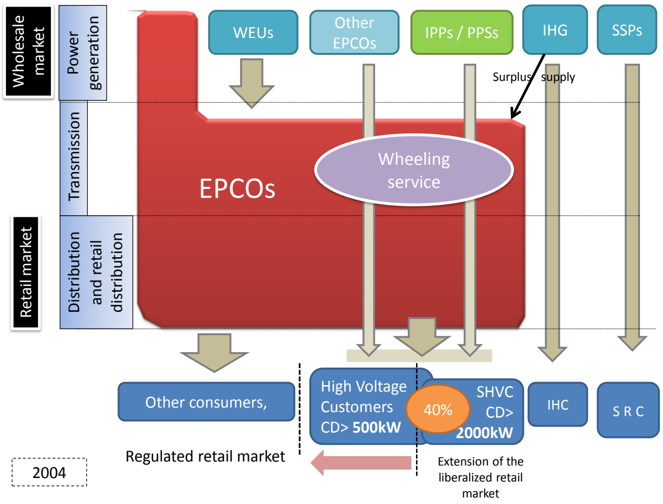
1995: Amendment of the Electricity Utilities Industry Law, effective from December 1995, standing for:

-The liberalisation of the wholesale generation market (accompanied by the introduction of IPPs or PPS: "Independent / Private Power Producers)

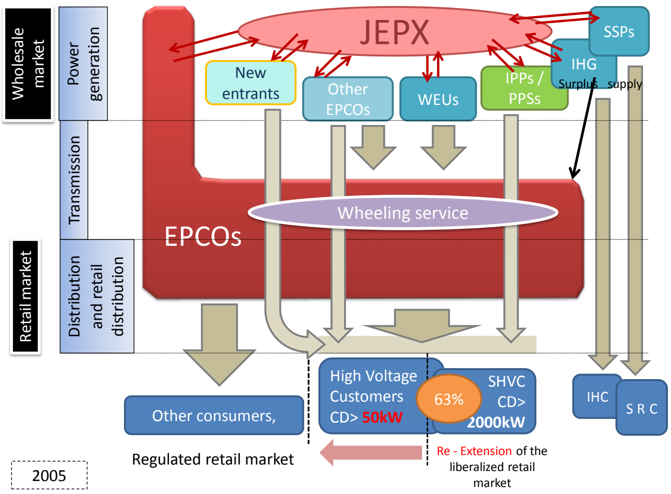
-The introduction of a wholesale power bidding system

1999: Amendment to the Electricity Business Act (EBA), effective from March 2000, implying the partial liberalisation of the retail market (for "Special High Voltage Customers"' whose consumption is above 2000kW)





2003-2004: Amendment to the Electricity Utilities Industry Law with "High Voltage Customers'" rates lowered to 500kW in April 2004.



2005:

- "High Voltage Customers'" rates were lowered once more to 50kW in April 2005

-Establishment of the JEPX (Japan Electric Power Exchange) in order to make the PPSs' collection of power easier

-Neutral Transmission System Regulation (through the clauses added to the EBA: Electricity Business Act)

-Behavioural Regulation of EPCOs (through the clauses added to the EBA: Electricity Business Act)

2008:

-Attempts to modify the law in force in order to establish a competitive environment

-Postponement of full retail deregulation

July 2012: Feed-In Tariff Law for The Renewable Electric Energy Act, making it compulsory for electric utilities to buy electricity derived from renewable energies - at a preferential rate (for accurate figures on Feed-In Tariff (FIT) rates for each renewable energy source and rates' evolution so far, please refer to the report long version).

In 2011, the deregulated market accounted for 63% of the Japanese electricity demand (METI November 2011 figure). The PPSs held only 4.17% of the special high voltage customers market (2000kW) and 3.47% of the whole market, a situation that has remained relatively unchanged until now.

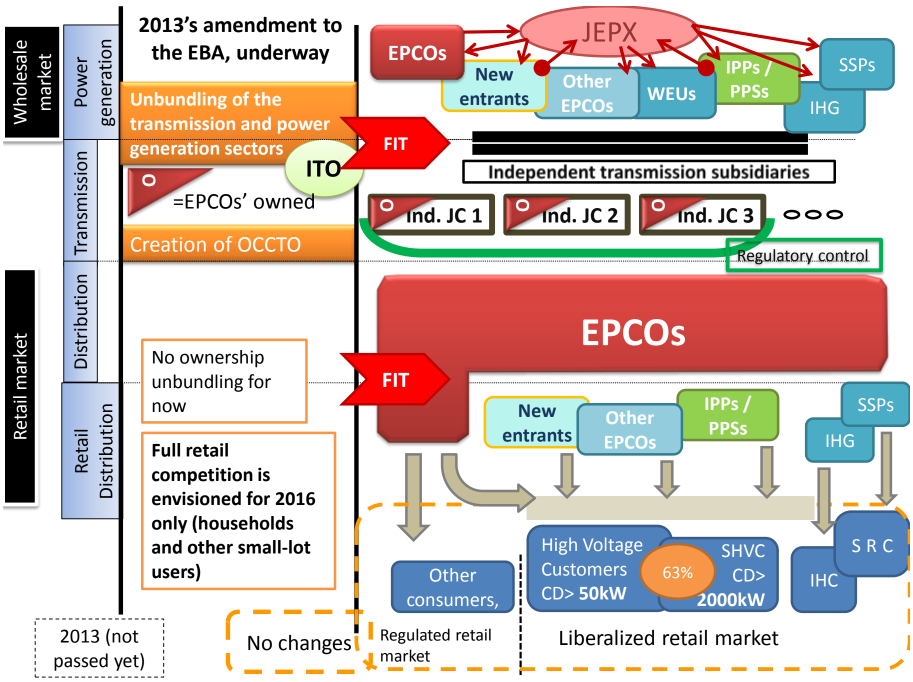
Generally speaking, big consumers tend not to switch suppliers and instead engage in the practice of so called "shadow competition". This can be described as a system of company-to-company arrangements on preferential tariffs and services to avoid confrontations between suppliers operating (or able to operate) in the same area. For example: industrial consumers large enough to influence the utilities commercial strategy (or market power), such as Toyota (in the Chubuden service area, located in Oosaka), can lead the region (Chubuden) to offer preferential prices. This is achieved through Toyota threatening to change supplier unless the prices are bought in line with the neighbours region. It is also in Chubuden's interest to accept such an agreement and to balance out these lower prices by charging higher tariffs to the mass of "captive consumers".

This situation has been made possible by the very small number of players on both sides of the market. Up to now, the Japanese electricity networks have evolved as "isolated electric islands", that is, networks that are very poorly connected to one another but within which the distribution of power is highly centralised.

Despite the high quality of the Japanese electricity service, the Fukushima crisis exposed the unacceptable and dangerous state of networks' closeness and even relative underdevelopment. Indeed, the monopoly system has most probably discouraged investment in transmission infrastructure (as it is not in the generators' interest to maintain high transmission excess capacities).

If we intend to draw a comparison between the EPCOs' transmission facilities and a benchmark European economy with the same level of development, say France - which shows similarities to the future Japanese electricity market with a legally unbundled network and the presence of a historic deregulated monopoly - we get the following results: the ratios of Japanese utilities' route length is about half or at best two thirds that of the French, except for the two regions which have more scattered populations: HEPCO and Tohokuden (please refer to the report long version for the actual calculation). The current lack of transmission capacities, and more precisely the low rate of transmission excess capacities, has been notably pointed out as the most important obstacle to the greater introduction of renewable energies. This is one of the main issues addressed in the Abe administration planned reform.

Although the first draft law of the reform was disallowed by the Diet in late summer, the Abe administration energy policy is now expected to pass in the autumn Diet session after the LDP won a majority in both houses of parliament on July 21st 2013.



End of 2013 - Legal unbundling of the transmission and distribution sectors;

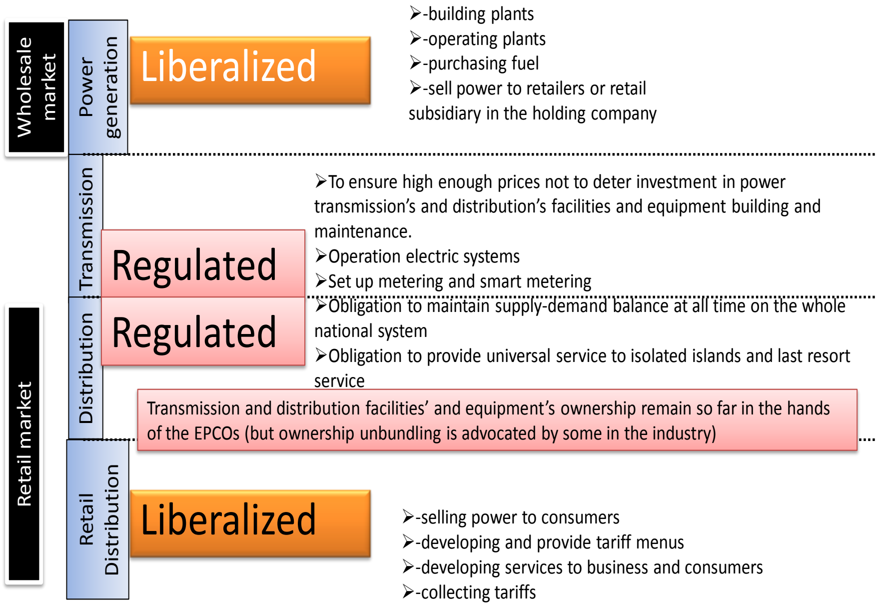
-**Abolishment of EPCOs de facto monopolies** on the wholesale market

- **Full liberalization of the retail market** (completed by 2016)

- **Creation of OCCTO** (Organization for Cross-regional Coordination of Transmission Operators)

OCCTO's mission is to unify the Japanese grid and establish the required grid related conditions for a harmonised national market. For a more detailed description of OCCTO, please refer to the report long version or to the annexes.

Unbundling the transmission and distribution sectors: reform's outlines and players 'role



Under such a framework, retail distribution and power generation, respectively in the retail and the wholesale market have been liberalised whilst distribution and transmission in the retail market was consolidated. This should allow for more consumers and suppliers to enter the market and ensure an actual level playing field, but also for a more reliable and transparent transmission service.

The clear distinction between the regulated and the deregulated parts of the market, under the legal unbundling reform, is notably seen as a way to ensure continuous investment in infrastructure maintenance and enhancement. It also helps avoid possible conflicts of interest.

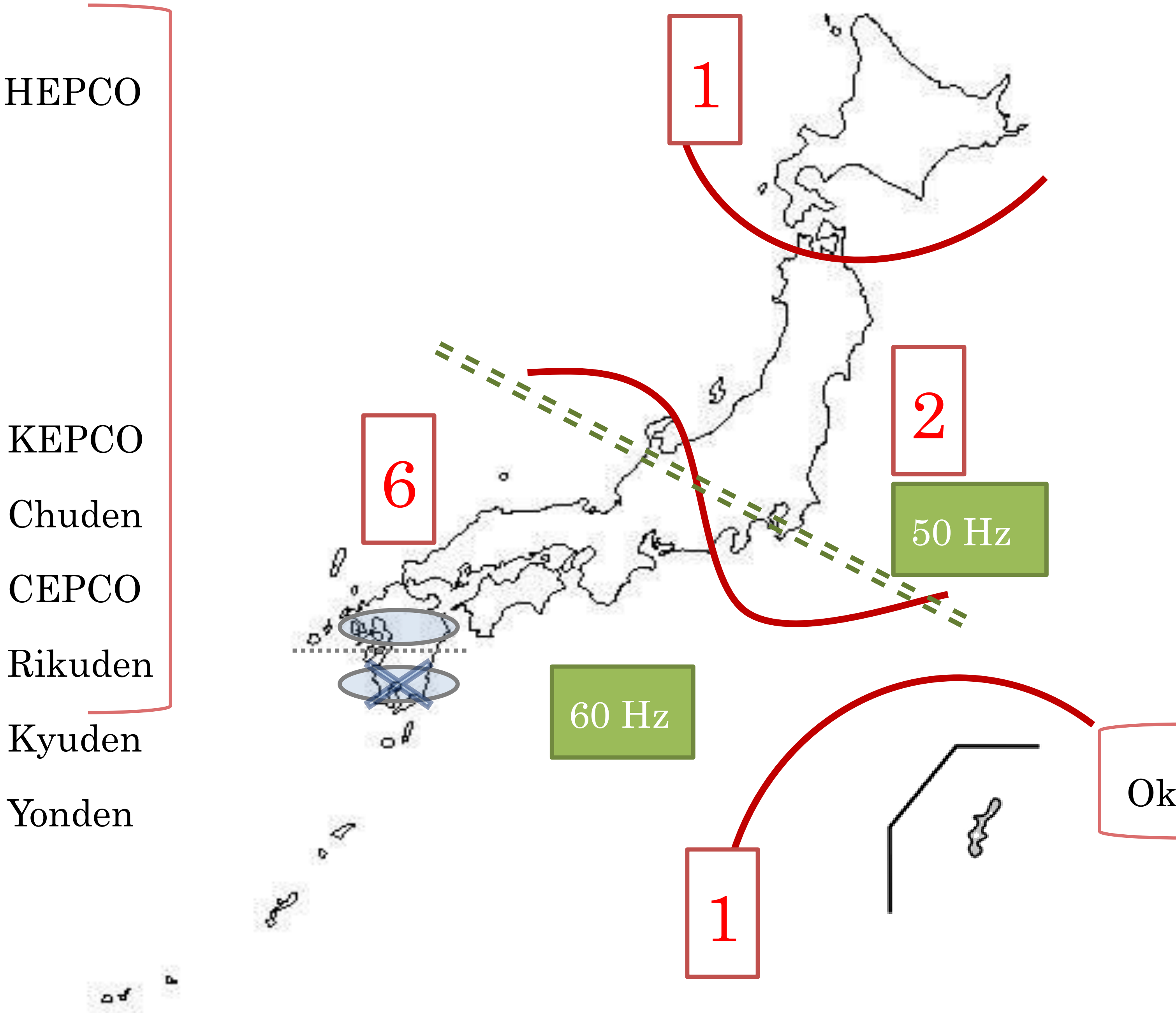
Yet, there are sufficient grounds to already reconsider the effects of the planned reform on the Japanese market.

Competition in Japan may be naturally limited in some respects:

-Hokkaidô and Okinawa, two isolated markets in terms of demand or natural characteristics, are typical "natural monopoly" markets. Therefore, the likelihood of competition taking hold is relatively low.

-Competition would be respectively very complicated between companies from the 50Hz and the 60Hz frequency zone.

Competition is actually possible and adapted to the "6 companies area" in the 60 Hz frequency zone, as presented below.



HEPCO
KEPCO
Chuden
CEPCO
Rikuden
Kyuden
Yonden
1
2
6
50 Hz
60 Hz
1
Ok

According to Takeo Kikkawa, Professor at Hitotsubashi University and expert in the business history of the Japanese energy sector, the most probable outcome at first will be a multiplication of new players in the "6 area" followed by a natural market selection phenomenon (a "winner takes it all" process).
The benchmark example for today's Japan is the 1980s German power sector. The large number of Electric Power Producers that had emerged from market unbundling rapidly decreased to four, leading to a renewed concentration and vertical integration of the market, yet still under competition regulation. Only a small number of more efficient companies will remain, and possibly EPCOs, depending on how affected they have been by the nuclear crisis (please refer to the annexes for a complete overview of current state the nuclear industry and an assessment of each EPCOs' financial situation). In the 50 Hz markets of Kantô and Tohokku, no major upheaval should be expected.

Dismantling the electric utilities or further weakening them is unlikely to be on the government's agenda as it would send a negative message at a time when efforts need to be made to strengthen them in anticipation of the network modernisation. Indeed, the EPCOs possess a valuable know-how in how to transmit power, as demonstrated by Japan's very low frequency rates and low intensity of blackouts or brownouts and its high quality service. Indeed, there has been no restriction of consumption or power outage since 2011, despite the complete shutdown of the country's 52 nuclear reactors (up to December 2013). What they lack however is; the expertise to manage networks with a higher intermittency rate, to manage more frequent and more important power exchanges with neighbouring grids, knowledge on how to put in place the rights mechanisms for large scale renewable energy integration, and finally, they lack experience in "smart" network development (see more information on smart networks further ahead). Thus, the Japanese utilities seem to be particularly interested in the German network's operators' expertise. Certain Japanese utilities as well as would-be power providers, such as large industrial consumers, have already established contact with some of Germany's four network operators.
Along with the deregulation reform, the government is considering opening up the utilities' shareholding. This would make the transfer of know-how possible through joint ventures for instance, or direct participation. The government would notably promote investment in grid development projects, that consists in buying "parts of network to be developed", rather than asset specific investment in the EPCOs, according to Elia, one of the German network's four operators, whose contribution to the report's findings was much appreciated.
Thus, the EPCOs seem to be already bracing themselves for the greater integration of renewable energies, which can be interpreted as a positive market signal. Nevertheless, this is far from representing the only strategic approach for the utilities, as well as for decision makers or private corporations. To understand its actual scope, renewable energy development has to be set within the context of the broader Japanese energy policy.

The Abe administration new energy policy

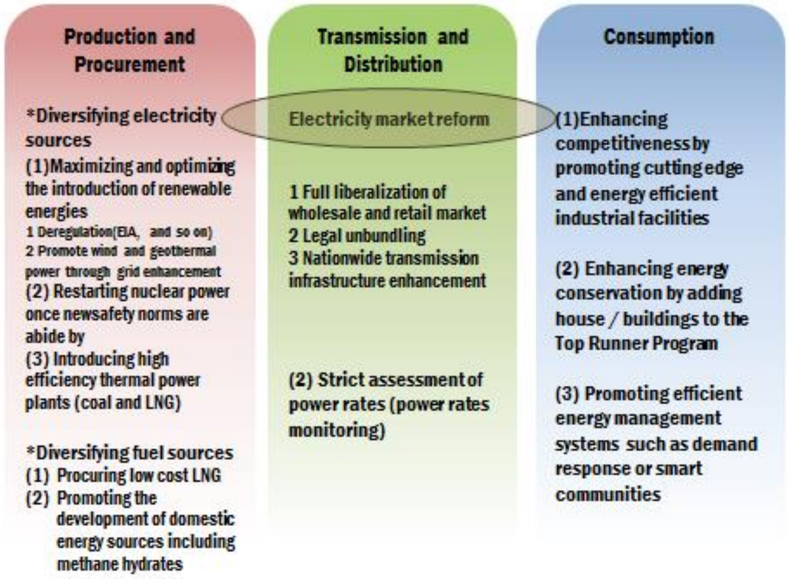
Overview Japan's general energy policy

The new energy policy measures are divided threefold according to the section of the energy market they apply to and according to which objective they contribute to, that is to say, in order of priority:

-The security of the supply

-Competitiveness of the energy sector and of the Japanese economy

-Sustainability of the energy system (a low carbon energy system and a safe nuclear energy supply)



Renewable energies are, in a very short term perspective, part of the government's line for electricity cost alleviation. Yet, the two most likely effective moves were clearly identified as:

-The continued safe utilisation and further development of nuclear energy on condition that new safety norms are adhered to

-A drastic and proactive strategy on the part of the government, as well as corporate players (such as Sôgô Shôsha), for securing gas supply in sufficient volumes and reducing its purchase price (through the establishment of long term contracts with producing countries, or in the medium term by considering to buy shale gas directly from the United States).

The purchase conditions for LNG and LPG are indeed the most important cost reduction factors regarding power generation (Horizon 2015 and 2020). It is also worth mentioning that, according to Professor Kikkawa's estimates, 50% of the price at which Japan can obtain liquefied gas may depend on the Panama Canal Expansion project to double its current capacity by 2015. The development of the American shale gas industry and the prospect of seeing the United States becoming mass exporters by 2017-2020 (according to the 2012 IEA World Energy Outlook regarding shale gas and shale oil) would also be of great importance.

So far, the government is yet to reveal precise figures for its projected energy mix in the mid to long term. Yet, an examination of the figures presented in the METI energy specific draft budget for fiscal year 2014 can provide a reliable comparison of the financial effort put into each of the above mentioned strategies.

Therefore, the Japanese clean energy policy measures will be presented in detail before comparing their corresponding budget with other clean energy measures and general measures' budgets.

Overview of Japan's clean energy policy

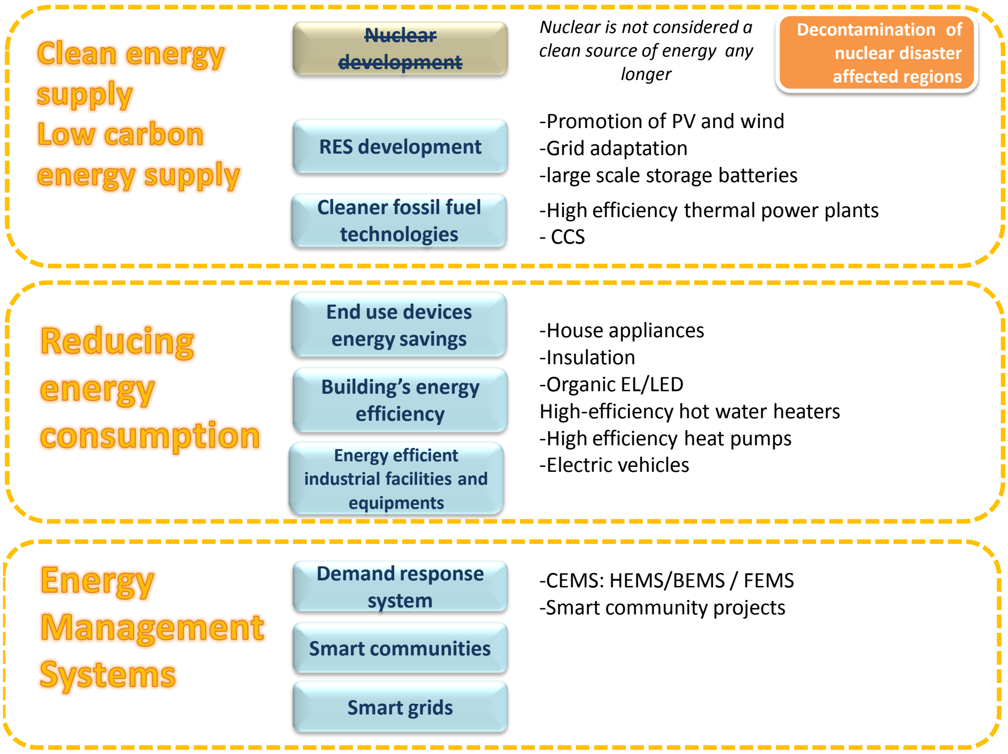
The Japanese clean energy policy targets three areas, namely: clean energy supply, consumption reduction and energy management systems, as presented below:

CEMS : Community Energy Management System

HEMS : Home Energy Management System

BEMS: Building Energy Management System

FEMS: Factory Energy Management System



The Fukushima disaster's effect on the Japanese green policy is complex and varied, it includes:

-The upscaling of all the already existing policies, such as accelerating research on low carbon technologies (please refer to the table for the 2014 energy related draft budget)

-The discard of nuclear energy as a "clean source of energy" even if nuclear abandonment is not envisioned

-The FIT implementation, but along with the following;

-A reduction of the CO2 emission targets announced in the November 2013 Warsaw Climate Conference

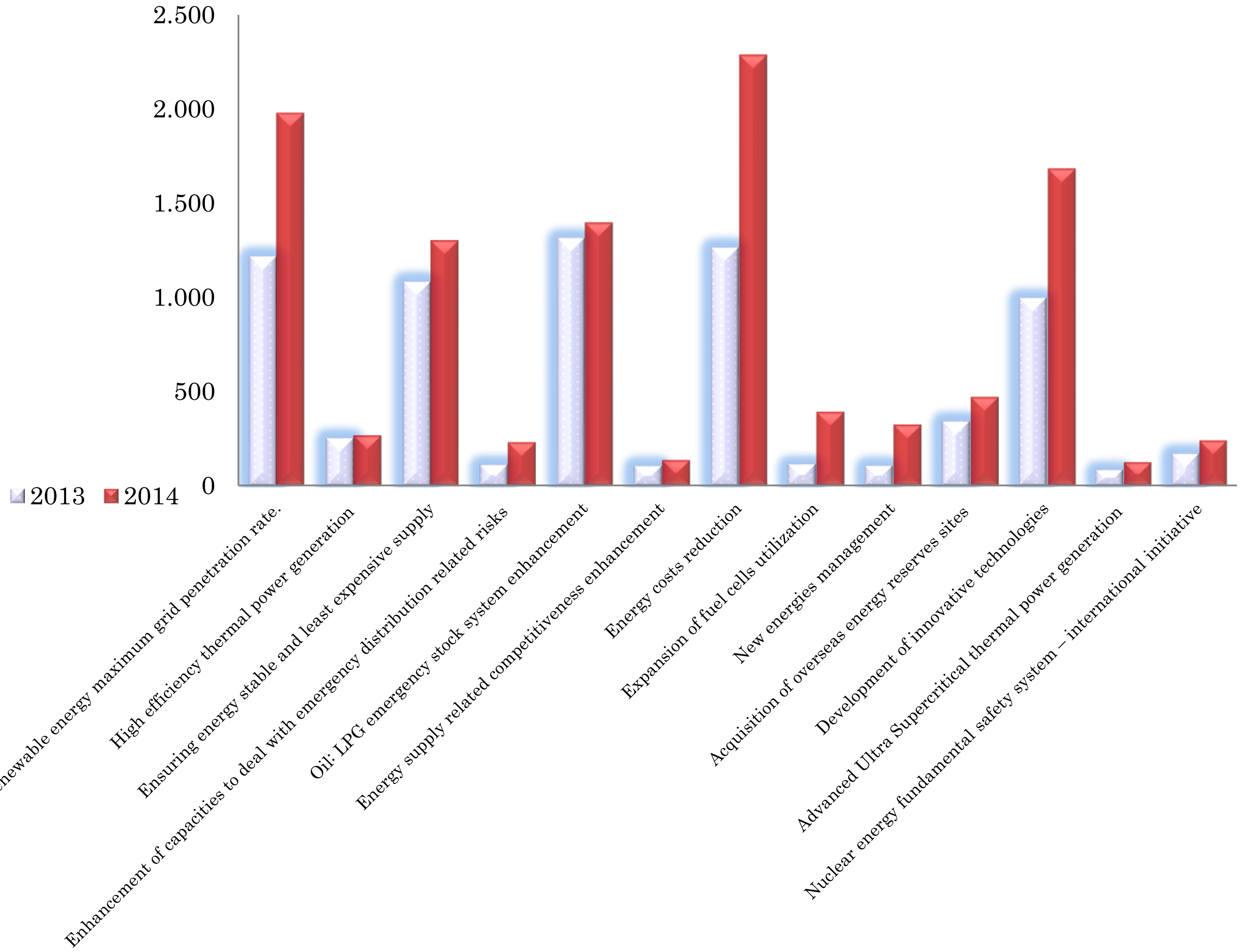
-A "go forward strategy" on gas procurement and, consequently, on high efficiency thermal power plants and clean coal related research and development

- A vast METI nationwide campaign to create a "Japan specific" smart grid model. Given the high reliability and quality of the service provided and the large number of innovations that have "smartened the network" throughout the years, the electricity industry used to consider the Japanese network as "already smart" and actual smart grid equipment to be redundant. However, the Japanese transmission industry lacked the organisation and a plan to coordinate these "smartening initiatives" nationwide to create a better result

- A questioning of power distribution's centralised organisation as part of the smart grid enhancement program

- The launch of several demonstration projects under the name of "smart communities" (please refer to the report long version for further details about the Smart Communities projects implemented in Japan)

The distribution of funds in the 2014 energy draft budget compared to the 2013 figure is presented in the graph below: (For a more precise depiction of the 2014 draft budget, please refer to the report long version and the annexes)



Japan's clean energy market structure

Japan, driven by the oil crisis in the 1970's, became a pioneer in the field of clean energy technologies. By 2005, it was producing half of the world's solar panels. However, despite being at the forefront of clean energy technologies, little was done to encourage the development of clean power generation systems at home (notwithstanding nuclear, which can no longer be considered as a clean energy in Japan). Energy efficiency in the building sector is another important neglected area that has been, to this point, left out of the national clean energy effort.

The Japanese economy has to this point shown a mixed picture to whether the concept of environmentally friendly energy has been an unmitigated success. On the one hand, Japan has a high degree of technical competence and concern regarding energy sustainability and energy conservation but, on the other hand, it has very conservative markets and practices responsible for other areas of high inefficiency. The development of clean energy systems encompasses situations so different from one another that providing overall assessments or forecasts would have no relevance in this regard.

Thus, the first part of this section will focus on energy efficiency, and more precisely on electric devices, heat generation and finally building's envelope energy efficiency. The second part of this section will be devoted to clean power generation and an overview of the current state of development in each renewable energy source.

Energy efficiency

➢ Energy efficiency for end use devices

The Japanese market of end use devices is considered to be one of the world's most competitive in terms of energy efficiency rates. The electric appliances and transportation equipment manufacturing industries have been steadily carrying out major improvements since the late 1990s, notably under the framework of the Top Runner public regulatory program, introduced in 1998 under the Act concerning the Rational Use of Energy amendment. It encourages competition under a system of energy efficiency compulsory targets to meet within periods of 3 to 10 years and set according to the previous period's best performance on the market. The Top Runner program is the core tool of the Energy Conservation law used to prescribe energy efficiency standards. As of December 2013, 28 product categories are being regulated. This program has proven to be a real success since its inception as, according to METI's statistics, 70% of households' energy consumption is covered by the programme and significant improvements have been achieved (as presented in the table in the report long version).
Ambitious targets are to be fixed within the framework of the coming Smart City initiative focusing on low energy urban development, and notably on:
-Electric vehicles along with the placing on the market of several big car manufacturers' new models such as the Toyota FCV, equipped with a fuel cell engine or the 100% electric Blade Glider created by Nissan.
-Network' smartening and "smart houses" with cutting edge economical house appliances and equipment

Yet, the notion of energy efficiency of the building itself is conspicuously absent from the smart houses project.

Smart appliances seem to be a drop in the ocean compared to the considerable amounts of electricity lost and heat escaping buildings with a dramatically poor, if existent, insulation and ill-adapted heating systems.
More precisely, the matter relates to buildings with a surface inferior to 300 m2 (mainly residential and commercial buildings). Due to tougher climatic conditions, the island of Hokkaido is also subject to actual insulation standards, known as the 1999 norm (see below).

➢ Heat generation

Inside Japanese houses or offices, most of the heat is produced by electrical equipment, sometimes complemented by portable heaters. In Japan, the notion of building integrated heating systems using, for instance, heat pumps or thermal solar panels connected to the building's central water heater or under floor heating is nowhere to be found. Instead, they have cooling and heating units distributed individually in each room. This has had a disastrous effect in several regards:

-Steep variations in temperature, dampness and the lack of integrated ventilation systems provoke condensation and create mould that can affect the durability of the building. The average lifespan of a Japanese house is around 30 years, whereas a "passive" European house is 100 years.

-Switching alternatively from heating to cooling implies frequent power pulses, the additional consumption of which can reach over ten times its normal load

-The negative effect of these conditions on indoor comfort, leading to an under-utilisation of the space in the house (e.g. near doors or windows) and their negative effect on mental health

-A changing indoor environment is also harmful to the inhabitant's health (for example, moving back and forth between a warm living room to a cool and damp bathroom)

Japan is the only developed country without any regulation on building quality, apart from seismic norms and anti-fire standards for buildings over 300 m2 (no regulation on thermal, acoustics, or even air sanitary quality) and, in this regard, it is even outperformed by China. Experience has shown in Japan that, until there is actual public commitment, there can't be market structuring, as is argued later.

- Insulation:

Japanese buildings are, roughly speaking, 30 years behind European insulation and energy efficiency standards, a situation that has arisen due to a strong building companies lobby supported by the government, and also the lack of regulatory constraints.

There are four types of houses (or commercial buildings) in Japan when it comes to insulation:

-Houses with no insulation at all

-Houses that comply with the 1980 standard that sets out a few insulation requirements on a voluntary basis

-Houses that comply with the 1992 norm that promotes a relatively small number of "better" insulation practices but is still a voluntary based standard

-Houses that are built in accordance to the 1999 standard that have been implemented as a voluntary base standard but which is intended to become compulsory only in 2020

The 1999 norm will set a building energy efficiency limit of 127 kW/m2/year, which roughly corresponds to the 1980s insulation standards in France (the current norm underway in the RT2012 is about 50 kW/m2/year and a passive house objective has been decided at Horizon 2020). The decision for the 1999 norm to become mandatory in 2020 was made in 2012. For a more complete overview of the insulation standards' implementation agenda, please refer to the report long version.

Thus, if it is not being completely ignored, the buildings energy efficiency issue is potentially being put on the back burner once again and the 1999 norm is to burden the building industry with a 20 years lag for the coming decade.

Energy efficiency has never been a competitive advantage argument on the residential or tertiary real estate market. There are no incentives in place for builders or house lenders, to invest in better insulation, with house owners seeking to compensate the relative high land prices by saving on insulation. The underlying reasons for this economic incoherence include: lobbying, lack of information to consumers, and lack of coordination between government's actions.

On the government side, there are three ministries involved in the buildings' energy efficiency issues: METI, the MLIT, and more recently, the Ministry of the Environment. On the other side, 80% of Japanese house building companies are small to very small and usually inefficient, their activity is usually restricted to less than 10 houses a year. Yet, these small companies together account for an important source of employment, which the MLIT is keen to preserve. In addition, the poorer quality of construction ensures a higher house replacement rate, hence additional support for employment. The METI, on the other hand, has pushed on several occasions for the implementation of tougher regulation for the common economic benefit and in the interest of the residents. The two ministries have different positions and interests and interaction between them has not always proved productive.

According to the French company Saint Gobain, a glass and building materials manufacturing specialists established in Japan (under the name of its affiliated company, Mag Isover KK), the underlying factors for the sector's inertia on the demand side are deeply ingrained in the mind-set and utter lack of knowledge about insulation.

Traditional Japanese houses' architecture is based on a century old construction code designed for summer climate control. Thus, priority is given to ventilation in order to avoid the proliferation of mildew in wooden houses and to keep them cooler during the summer, although this is at the detriment of heat conservation in winter. The traditional response to this state of things can be summed up in the so called "我慢" (がまん) attitude (the literal meaning of which would be roughly patience; endurance; perseverance and self-control). Due to modern day life however, few people tend to stick to this type of behaviour. It is common, in their own houses or in private offices, to see electric devices functioning full-time and at maximum power for unsatisfactory levels of temperature control.

There has been poor demand for better quality buildings due too the lack of available information on possible improvements that could be made to the indoor environment and possible energy savings. In Japan, there is a lack of communication between the government and State agencies, as well as amongst local private corporations on the quality of buildings.

To give a few examples, there are no (or at least no widely disseminated) comparisons of building materials' characteristics, no studies or simulations made on energy savings, no buildings' air tightness test during construction, let alone labels such as "bioclimatic house", "low energy house" or "passive house" that exist in Europe. Furthermore, public communication usually calls for a direct reduction of consumption (campaigns such as "cool biz and warm biz") and associate energy savings inside buildings with a loss of comfort. Instead of very simple solutions, such as double-glazing or steel whole (which are still presented as innovations in Japan), the Japanese government, so far, has been promoting "a pointless sacrifice".

Renewable energies

Currently, the Japanese renewable energy sector is one of the least developed amongst OECD countries (please refer to IEA's and the Agency for Natural Resources and Energy's statistics in the report long version).

For some observers, this renewable energy "disillusion" is linked with the Japanese energy policy making tradition, where short sighted, temporary objectives prevailed over more consistent long-term energy policy. From energy diversification and nuclear energy development to energy efficiency and alternative energy development in recent times, Japanese authorities have preferred regulatory frameworks adapting to each crisis and growth phase. Thus, without being completely neglected, renewable energy development has been pursued according to the vagaries of changes in the global energy market.

It is also more likely that the combination of nuclear energy for a massive and relatively cheap base load production and monopolistic markets have had a negative effect in that respect (for a relevant example, Japan can be compared with the French power generation market, which has the same above mentioned characteristics and displays one of the lowest rates of renewable energy introduction in Europe).

Then again, experience has shown so far that, amongst countries with the same level of development, renewable energy relied on three main factors: electricity price, dependence on foreign import and government involvement. On this subject, it can be noted that since 2011 in Japan:

-Key features have been changed to improve price competitiveness

-A costly and politically undesirable reliance on fossil fuels imports is again looming on the horizon

-Interest in renewable energy technologies from the government as well as public opinion has been regained

Although progress in this field cannot be taken for granted, as many market barriers remain, a window of opportunity has clearly been opened for renewable energies in the aftermath of the March 11th earthquake, as shown in the Japan Renewable Energy Foundation's figure below:

type of resources	installed capacity (started operation)				certified capacity
	before FiT	after FiT			after FiT
	cumulative installation by the end of June 2012	FY 2012 July - March	FY2013 April - June	cumulative installation by the end of June 2013	by the end of June 2013
residential PV	approximately 4,700MW	969MW	410MW	1,379MW	1,633MW (+91MW to the end of May 2013)
non-residential PV (above 10kW)	approximately 900MW	704MW	1,416MW	2,120MW	19,755MW (+385MW to the end of May 2013)
Wind	approximately 2,600MW	63MW	3MW	66MW	805MW (+9MW to the end of May 2013)
Large & Medium scale Hydro (above 1MW)	approximately 9,400MW	0MW	0MW	0MW	65MW (+0MW to the end of May 2013)
Small & Medium scale Hydro (below 1MW)	approximately 200MW	2MW	0MW	2MW	14MW (+0MW to the end of May 2013)
Biomass	approximately 2,300MW	30MW	68MW	98MW	639MW (+58MW to the end of May 2013)
Geothermal	approximately 500MW	1MW	0MW	1MW	4MW (+0MW to the end of May 2013)
Total	approximately 20,600MW	1,769MW	1,897MW	3,666MW	22,915MW※2

Due to very different prospects in relation to the energy source, each renewable market has to be the subject of a separate overview

Geothermal energy

Though Japan was estimated to be the world's third largest country in terms of geothermal resources up to 2011 (23,470 MW, according to the latest data from Japan's National Institute of Advanced Industrial Science and Technology-AIST), it has only ranked 7th in geothermal power production. There are currently twenty-one electric power units in Japan at eighteen geothermal sites, mainly in Northern Honshu and Kyushu Islands, accounting for only 0.3% of the total national electricity output. Only 5 of these 18 plants are considered as large-scale, at a capacity of 50 MW or more (for precise information about market players, please refer to the report longer version).

The low level of investment in geothermal energy (no geothermal projects of more than 10 MW have been developed in Japan over the past 16 years) has resulted in:

-A deterioration of the geothermal installed base, as shown by a reduction in absolute terms of the installed capacity (revealing infrastructure's ageing and non replacement of existing capacities, potential shortages in maintenance and operation)

-A probable shortage in skills and experience in developing geothermal electricity projects

-An under utilisation of this installed geothermal capacity as showed by the reduction in absolute terms of the geothermal electricity produced over the last decades

This relative neglect of geothermal energy can be explained by two closely related bottlenecks:

-National parks regulations that greatly restrict the areas where geothermal power plants can be built (see the chart for the exploited potential in the report long version)

-Industry opposition

Moreover, high upfront investment costs and time consuming processes (such as Environmental Impact Assessments that can take up to four years to be completed) have also deterred investors in this sector. An initial investment is required for research, drilling (estimated at 5 to 10 billion yen) and testing. Then, large capital is necessary for plant construction and plant operation over a long period of time.

All of the Japanese high temperature geothermal systems have their heat source from late quaternary magma chambers (young volcanic heat sources), creating hot springs on the surface and causing the overlap between national park and geothermal spots. As a result, 81.9% of the high temperature geothermal resources are located in special protection zones and special zones of natural parks (please refer to the report long version for clear explanation of the different protection regime).

There are no geothermal-specific laws in Japan, but geothermal developers have been required to go through cumbersome permission processes to abide by a number of environment protection laws. Applicable laws include: the Nature Park Law, the Hot-spring Law, the Forest Law and national Forest Laws.

After the Great Eastern Japan Earthquake, the government resumed its support for geothermal energy and related regulations are being revised:

-The Japanese Cabinet, directed by the Ministry of Environment, set up a one year re-examination of the regulation regarding exploration and development in national parks. It has also made a new notice regarding geothermal development within National and Quasi-National parks in March 2012 (the development of small scale facilities will be admitted in low priority zones and survey will be accepted in Special Protection Zones)

- METI has increased the FY 2012 budget to about 18,745 billion Yen to promote geothermal energy R&D (surveys and loans guarantees for well drilling)

-METI furthermore plans to strengthen geothermal development support from survey to construction by using the network and know-how of the Japan Oil, Gas and Metals Corporation (JOCMEG)

Biomass

Biomass exploitation stands out compared to other renewable energy sources in two main regards:

-Biomass exploitation is a thermal generation process the same as coal or gas fired power generation

-Biomass exploitation implies both heat and power generation

In 2011, biomass made up a third of the Japanese renewable energy derived electricity and 1% of the energy consumption. There is a general concensus that biomass projects have not been fully or adequately developed despite an availability of rich forest resources. Indeed, even though most of Japan's forests were felled after the Second World War, the subsequent reforestation of 66% of Japan's total area resulted in the re-establishment of 250,000 km2 of forest.

For a long time, biomass appeared to be a promising source of energy and received 6500 billion Yen worth of allowances. However, the combined effect of economic inefficiency and policy inadequacy rendered these investment ineffective.

Making the most of Japanese biomass resources requires resolving three main key issues:

-Providing fuel efficiently

-Considering the potential of biomass heat generation and co-generation

-Improving the resource profitability and reducing the induced environmental effects through better resource management and more intensive exploitation

As biomass requires the transformation of primary resources, its feasibility also depends on the cost competitiveness of the upstream industry's products. In Japan, most biomass projects have been unprofitable due to upstream industries' inefficiency or their inability to provide an exploitable input. This is notably the case for both the forestry and agriculutre sector.

When it comes to woody biomass, the amounts necessary for large scale biomass power generation could be provided. However, very little suitable fuel can actually be supplied due to; a lack of experience in modern forestry, the relative "underdevelopment" (or undercapitalisation) of this sector, as well as the difficulty of collecting raw materials due to inappropriate forest management. Moreover, despite the fact that Japanese forestry has long been specialised in the timber industry, the price of raw timber is relatively high when compared to other countries due to inefficient timber extraction. This in turn, gave rise to an influx of cheap foreign timber into Japan, thus further reducing the domestic biomass potential.

Insufficient information diffusion about the energy potential of crop residues or transformation of farm residues

is more acute in Japan since the agricultural sector typically consists of family exploitations, with an average size of 1.5 hectares, run by farmers in their sixties (on average).
Therefore, due to the upstream sectors economic inefficiency and the lack of availability of biomass exploitable fuel, the development of the biomass industry has been curtailed. At the same time, size has also affected biomass profitability resulting in higher prices.
The biogas industry is also affected by the same combination of lack of knowledge and high costs.
The total capital expenditure (CAPEX) of building a plant attached to an agricultural exploitation is about five time higher than in Germany (a 300kW biogas facility costs 500 million Yen, equivalent to 4 million euros); and the operation and maintenance Expenditure (OPEX), which decreases proportionately to the increase of the scale of the operation, is estimated to be two or three times the price of municipal mixed gas.

If woody biomass is only used for power generation, it gives an energy use efficiency rating of around 20%. If wood biomass is used in co-generation (producing heat and electricity simultaneously), the total energy efficiency to be expected is between 65 to 85%. However, in the feed-in tariff scheme, only electric power is purchased at a preferential rate. There is no heat production from biomass in Japan which accounts for a considerable energy waste.
The way the Japanese FIT has been set for power generation is also deemed too generalistic to take into account the very heterogenic nature of biomass sources.
A too rigid or simplified classification of the fuels can as such exclude many biomass projects, meaning that the owners risk seeing their resource undervalued especially if it falls outside the above mentioned categories (see the report long version for further details).

Besides, it is also worth bearing in mind that the future of biomass use is a system of integrated provision (plants integrated to industrial compounds, co-generation and so on).
Thus, the main factor for cost reduction and better resource management is the so called "cascade utilisation of biomass", meaning optimising on a case by case basis the use of biomass as a raw material and as an energy carrier in an integrated manner.

Solar

The Fukushima nuclear disaster helped revive Japan's interest in renewable sources of energies, and in the solar photovoltaic industry in particular. In 2005, Japan was producing half of the world's solar panels and was one the first countries to install its own solar capacity. It has since dropped to 5^{th} place in 2011 and has now lost its leading role in the photovoltaic industry. One of the reasons behind this, despite cutting edge companies such as Sharp or Kyocera, is the abandonment of public support policies.
In 2013, a total of around 1.5 GW of photovoltaic (PV) capacities were installed, which translates into a 270% growth compared to the first quarter of 2012 first.

The 2013 IMS photovoltaic market report predicted that Japan was set to be the world's largest photovoltaic market in terms of revenue (IMS research, 2013 Edition). According to the "Photovoltaic Roadmap Toward 2030 (PV2030+)" report compiled by NEDO in June 2009, the potential of photovoltaic power generation for building and unused sites is estimated to be 7.98 billion kW in total (please refer to the report longer version to have a precise description of solar energy resources).

The government target for solar capacity building relies mainly on mega solar projects (for information on the market for residential PV, please refer to the report long version). The tariff established for solar PV installations above 10kW in 2012 was twice the German purchase price, which was already considered as one of the highest fixed rates in Europe (please refer to the report longer version for the precise figures on the Japanese and German Feed-In-Tariffs).

The promised success of solar PV raised two questions: the sustainability of the FIT as it is currently fixed and the possible bottleneck coming from the amount of renewable energy derived electricity to be poured into the grid.

The FIT regime will also have to be sophisticated in order to adapt to its success. METI is now facing the major issue of PV labelling. The high FIT has attracted far too many speculative would-be PV developers and the Japanese government is now facing a critical time (there is no certainty, as things stand currently, on whether 50 % or 80% of the applications received by METI will ever be constructed because of land unsuitability issues).

A high FIT has most probably been set in order to give solar development a strong impetus to meet objectives to increase capacity as quickly as possible. The government has to this end already offered a 20% reduction in the FIT rate for non-residential solar since 2012. Companies involved in the mega solar business expect the FIT to be spread over no more than three to four years before its actual retraction. On top of that, suitable and available land can expect to be fully occupied within the next three or four years. The build up of incentives behind solar power generation is intended to fill the gap between the 2011 nuclear crisis and the rebuilding of the energy systems. The government's focus on solar energy is due to its relative advantage compared to wind development, as solar energy can be easily connected to the main supply grid, its relative technical simplicity and the volume that can be produced contrary to biomass or hydroelectric power whose production's potential is already saturated.

Local companies involved in the PV farm development business, such as Soyeads or Sumitomo Corporation, usually do not carry out construction and maintenance themselves but rather rely on subcontractors. In this regard, Japanese PV developers have often sought the contribution of foreign companies, in particular European ones, which can provide innovative designs and competitive engineering. Because PV technology can be learned relatively quickly, establishing contracts with local companies and acquiring funds from local banks (long term debt) has been fairly easy. Whereas one year ago, Japanese banks had no interest in these technologies, they now have hired technical advisers with specialist knowledge on photovoltaic power that have learned how to mitigate mega solar projects' financial risks. Now, Japanese banks feel more comfortable to provide funds for solar projects, even though the process remains slow.

The vertical integration of the market is also responsible for lengthening the development procedure but has not caused specific obstacles.

By and large, the solar energy market seems to have few market barriers, except the obstacles of language and business culture. Therefore, the Japanese solar PV market may be very accessible for companies that have already acquired experience in working with Japanese companies or have had contact with Japanese authorities (through Embassies' network in particular). The market for mega solar procurement also appears to be quite open (Japanese developers tend to choose the most competitive panels regardless of the selling company or the manufacturing place).

Then again, this relative degree of "openness" needs to be considered along with some important factors:

-The Japanese market still offers lower returns on investment due to tougher exploitation conditions

-Many European companies have been discouraged so far by the unfavourable evolution of the euro/yen exchange rate (the yen depreciated from EUR_{JPN} = 95 mid 2012 to EUR_{JPN} =145 at the end of 2013)

-The presence of other promising markets for solar PV among developing countries (especially in South America). These are equally open to European companies and do not have the same language and business culture barriers.

The attractiveness of the Japanese market for European companies needs to be increased accordingly.

Wind energy

The Fukushima disaster has also heightened a new interest in wind energy, a long-neglected resource in Japan considered arduous to access. It has a vast potential estimated at about 132 GW for onshore wind and 157 GW for offshore wind (in the report of investigation for renewable energy published by the Ministry of Environment in 2011). However, with far less flat land than in the United States or Europe, Japan's wind development is limited by its topography and by a high population density. The natural characteristics of the Japanese territory have also been a major cause of concern. While land-based development is limited by Japan's mountainous terrain, offshore wind, still greatly underdeveloped, could be a more promising market. Yet, the most suitable regions for offshore large-scale wind energy development are Hokkaidô and Northern Tohoku, rural areas weakly connected to the rest of the country where energy demand is low and networks are sparse. As a consequence, installation costs in these regions are high (see below for further details about grid connection issues).

In addition, the country is subject to extreme weather conditions, such as typhoons, lightning strikes and high atmospheric turbulence, not to mention earthquakes and tsunamis. Japan is surrounded by extremely deep water, which also makes offshore wind farms a costly option.

Given its unique meteorological and geographic conditions, Japan's safety standards differ from the International Electro Technical Commission (IEC) standards. For this reason, integration of the Japanese Industrial Standards (JIS) and IEC standards is important.

Yet, there is a fine line between the alleged wind energy related "natural mismatch" and a lobbying strategy from the part of traditional energy industries and different groups of interests from fishery associations to environment protection organisations.

Specific effort in research and development has been required to tackle issues such as periodic extreme humidity and resistance to typhoons, in cooperation with European companies. In addition, given the limited amount of shallow waters available, Japan has been exploring the feasibility of floating wind farms which are, however, significantly more expensive to install and present considerable engineering challenges. Finally, in order to tackle the increased intermittency issue implied by mega wind farms, large-scale storage batteries would need to be integrated into the process. Such conditions imply more thorough and more cautious estimations of exploitable resources and risks, hence more complex and solid (meaning equity funded or self-funded) business plans.
Yet, as the FIT established in July 2012 does not differentiate between onshore and offshore wind and does not take into account these added costs, a crucial recommendation would be to create a large-scale offshore wind specific FIT.

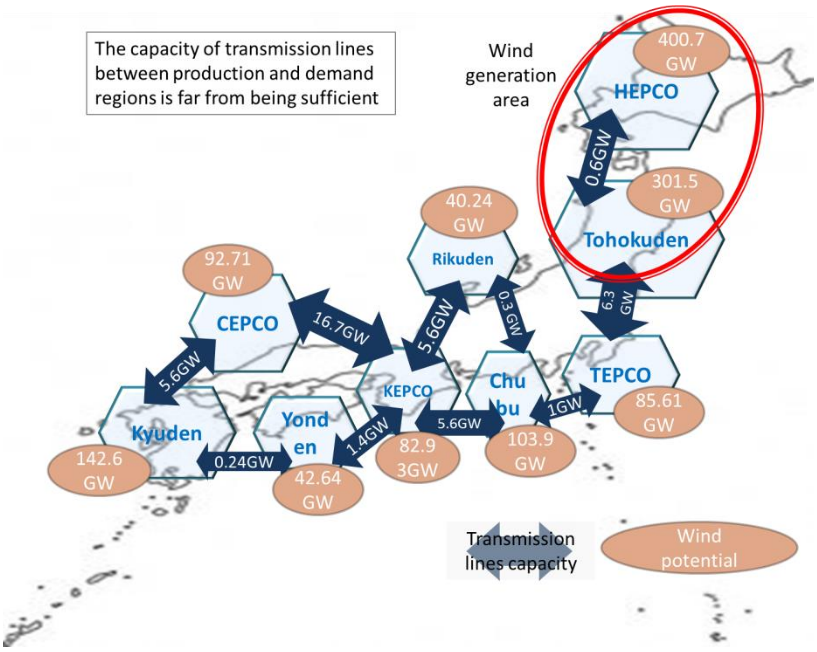
By the same token, inadequate regulations have also very much restricted growth up to now (for offshore and onshore wind alike). The Japanese Wind Power Association has listed six pieces of regulation responsible for thwarting wind development, the most important of which being the Environment Impact Assessment (EIA) and its proceedings (please refer to the report long version for a precise description of the regulation related to wind development). The EIA law was introduced in 1999, but wind farms were not originally included. Following a public campaign opposed to wind turbine noise, the environmental law has been extended to include wind farms in October 2012. The obligatory EIA is complex, expensive and lengthy (it could take up to four years, please see process stages in the annexes) and obtaining local public support is an essential requirement for wind farm development (including cooperation with local fisheries).
In response, METI has been trying to shorten the EIA for wind development by:
-Restricting potential harm to bird populations to some species of rare birds only
-Establishing a regional general EIA and a partial supplementary assessment on a case by case basis for each site (which would theoretically represent a two years cut in the project's duration)
Test projects under this simplified EIA will be launched, but not before 2015.
While a project cannot currently apply for the FIT under the EIA (3.5 GW under EIA), the developing company must be able to cope with the implied gap in revenues (the amount of money invested being immobilized for several years). This is one of the reasons why a company whose sole activity was wind power development would have little chances of success under this framework. In Japan, the operating and the developing company is usually the same and wind tends to be the company's side activities (for more information, Japan's leading wind farm developer is Eurus Energy, jointly owned by Toyota Tsusho (60%) and Tokyo Electric Power Company (40%)). European wind companies wanting to expand in Japan will need to keep up to date with progressions made regarding the EIA's duration and organisation.

Nevertheless, the main obstacle to wind development in Japan does not lie with the wind industry itself but is a structural issue caused by the inadequacy of the resource and consumption location.
According to Professor Takeo Kikkawa, the organisation of the grid and the wind resources location are the main factors undermining the greater introduction of wind energy in Japan. The government has unlocked a special budget to tackle the issue of insufficient network density and dedicated special funds to the integration of wind energy comprising of smart grid technologies, investment in storage battery technologies, and so on. (Please

refer to the report long version for detailed graphs on resource and consumption locations).

Data from the Ministry of the Environment	Hokkaido	Tohoku	Tokyo	Hokuriku	Chubu	Kansai	Chugoku	Shikoku	Kyushu	Total
Offshore wind potential (GW) for wind intensity above 5.5 m/s	400.7	301.5	85.61	40.24	103.9	82.93	92.71	49.64	142.60	1300
Maximum demand (GW)	5.6	15	64	28	5.6	33	5.9	12	17	186.1
Electric power companies' installations' capacity (GW)	7.42	16.55	64.49	7.96	32.63	34.32	11.99	6.67	20.03	203.9

Okinawa is excluded from the total figures



Then again, the Japanese network not only lacks sufficient transmission capacities to cope with the new amount of electricity to be poured into the grid, but also lacks sufficient economic incentives to cover the costs required for the full development of networks in the Northern Tohoku and Hokkaido's regions. (Please refer to the report long version for further details on transmission capacities issues).

Despite the higher profitability and resistance that can be achieved with the turbines, many challenges still need to be overcome to make Japan's network profitable for wind rather than making wind profitable for Japan. To that end, in addition to incentives such as FIT, a long-term government strategy will be needed, as with nuclear development in the 1970s. So far, the development of offshore large-scale wind has been limited to government funded holding companies projects (such as the Fukushima floating wind project, the first turbine already in operation off the Fukushima prefecture's shores). This explains why wind projects developed since March 11th have been exclusively undertaken by Japanese companies, whereas European firms used to have a market share close to 70% before 2011. The main way for foreign companies to enter the large-scale wind energy market will be via subcontractor's partnerships, supply and maintenance contracts (with transfer of technology) or niche opportunities for specific technological designs. Innovative SMEs are particularly recommended to adopt this business model to enter the Japanese wind market.

The Japanese government is also contemplating a different option to enable wind development: "hydrogen transportation" (meaning power storage and transport by means of hydrogen bottles) to avoid white elephant infrastructure projects. Japan is not the only country engaged in research on this topic but may make great and rapid progress out of necessity.

To conclude, the development of offshore wind in Japan, due to its higher technological complexity and a still relatively unfavourable regulatory framework, is not expected to get running properly for the next five to eight years, unless a considerable government effort is made in the near future. As things stand at present, wind energy can only succeed when viewed long-term. By the time these mega projects are developed to full capacity, the vast majority of nuclear power plants respecting the new safety norms will have been restarted.

Recommendations

Recommendations to METI

General recommendation

-Giving figures in the New Basic Energy Plan would give market players and particularly European would-be-investors and project developers a much welcomed view of relevant information such as the percentage of nuclear in the new energy mix, the size of the market for renewable energy development, a reference point for expected electricity prices, and so on.

Energy costs alleviation related recommendations

-The main factor for electricity costs reduction appears to be the purchase conditions for LNG and LGP. Therefore, as awkward such a move could be given current circumstances, it would be in Japan's interest to collaborate with North Korea on this issue, given that Japan and North Korea together account for more than 50% of the global market for imported LNG. This high percentage would ensure market power for this "consumer lobby", whereas blind competition on liquid gas resources would be highly detrimental to both players.

-It is recommended also to enhance the policy further to secure LNG resources abroad, through JETRO notably.

Deregulation reform related recommendations

-In conjunction with the previous recommendation, as gas is expected to represent a much more important share of the Japanese energy supply in the coming decades, the Japanese government should look to immediately provide the basis for a competition regulation framework for the gas market. Taking this precautionary step would spare a time consuming and delicate deregulation process over the next 15 years (the European experience on gas supply organisation can be held as a relevant example in this regard).

Building efficiency related recommendations

- A crucial measure is to implement a consistent set of compulsory norms and standards for building energy efficiency and heating systems at least equivalent to 2000 European levels.

To save time, cooperation with the European Commission dedicated departments would prove very useful. It should be also noted that a cost free and radical solution is a change of law.

-This must be accompanied with a circulation of relevant information on the building efficiency issue in Japan (public communication campaigns, and so on).
-Clarification of market rules particularly for foreign companies.

Electric utilities related recommendations

-Establishing a common framework for carrying out transmission services. For instance, on ways to appraise wheeling charges, maximum rates of safe introduction of renewable energies, or a framework for efficient and harmonised balancing services (demand and offer adjustment). This move by the utilities would greatly ease OCCTO's task
- Creating, in the future, a more concrete and detailed framework for nuclear decommissioning. This would be modelled on the previous life cycle assessment method seen in accounting regarding the obligations and standards for asset retirement (please refer to the section dedicated to the nuclear industry prospects in the annexes). This simple and cost effective move would also be very welcomed by the international community and help to relieve some of the pressure felt by the government.

Renewable energy related recommendations

Wind energy

-Given its unique meteorological and geographic conditions, Japan's safety standards differ from the International Electro Technical Commission (IEC) standards. For this reason, integration of the Japanese Industrial Standards (JIS) and IEC standards is important.
-Setting a differentiated FIT for onshore and offshore wind
-Making rapid progress when it comes to adapting and shortening the Environmental Impact Assessment or by providing a framework for securing subsidies for developers of wind technologies.

Biomass

-Fostering the reorganisation and modernisation of the forestry and agricultural industries to encourage industrial clustering and, provide financial support for capital-intensive equipment and help with the education of modern practices
-Prioritising co-generation in the definition of the FIT tariff for biomass
-Providing precisely distinguished tariffs for each fuel type
-Designing tariffs based on the cascading use of biomass in order to avoid competition between material and energetic biomass use

Geothermal power

-Establishing a clear study into the potential of geothermal power for base load generation and ensuring that information regarding its results is broadly circulated amongst the general public.

Other clean technologies related recommendations

Electric vehicles

-To accompany the induction of electric vehicles into the marketplace, METI should encourage mass adoption by developing standards, policies and interoperable systems comparable to Europe's €42m EU

Green eMotion program. The project should notably aim to develop a user-friendly framework enabling "electromobility" (for instance to ensure charger compatibility of different car models, and constant availability of charging points).

Recommendations to the European Commission

Building efficiency related recommendations

-Active cooperation from the part of Europe is highly recommended, in particular on standards and market mechanisms (house certificates and so on) and regulation designs.

Renewable energy related recommendations

Wind energy

-As floating offshore is a promising technology for Europe as well, and as the Japanese FIT system has turned out to be less attractive than expected for offshore wind, the European Commission should provide a type of special financial support for European companies involved in floating offshore development projects in Japan.

Research and development related recommendations

-Particular attention should be paid to hydrogen research within the Horizon 2020 fund allocation framework. Advances made by Japanese companies could greatly benefit European research.

Carbon policy related recommendations

- To enlarge the scope of both the European and Japanese schemes, it should be considered to link the EU ETS and Japanese Carbon market together (that is, to allow exchanges of carbon credits between European and Japanese companies on harmonised standards). In addition, such a measure may enable companies to compete on a level playing field regarding environment policies in the light of completion of the EU-Japan Free Trade Agreement.

Recommendations to European companies

General recommendations

These recommendations can be applied to all sectors in Japan, therefore it is worth keeping in mind that:

-There is no chance of success in Japan without establishing strong links with local companies (partnerships on specific projects, including common projects overseas, joint ventures, subcontractor agreements, etc.) and hiring Japanese staff to tackle the two significant hindrances of language and business culture (paperwork, regulatory obligations and so on). It is even recommended, if a company were to establish a branch in Japan, they would need to operate using a majority of Japanese staff.

Renewable energy related recommendations

Solar energy

-Very careful and thorough land suitability and cost assessments should be carried out before engaging in mega solar development to account for the particularities of the Japanese territories.

-The evolution of the Japanese Yen should also be taken into consideration as a matter of priority in the business model (investing in the Yen through Japan based companies could be a solution to help get around this issue).

-The relatively rapid reduction of the FIT (no more support to purchase within 3 or 4 years) should also be kept in mind. The FIT for solar PV may represent profits in the very short-term

Biomass

-Opportunities for European technologies and equipment transfer exist if marketed correctly to Japanese companies (by precisely understanding the state of the market, business models and practices).

Recommendations to the EU-Japan Center for Industrial Cooperation

-The EU-Japan Centre should envision the organisation of what could be called a "productivity mission" for Japanese small-scale construction companies, involving the cooperation of European business organisations. The recruitment of adequately qualified people could, for example, be carried out through the European Member States' specialised agencies' network (ADEME, "l'Agence de l'environnement et de la maîtrise de l'énergie"; EnerAgen, Asociación de Agencias Españolas de Gestión de la Energía, to name but a few).

-For sector specific questions (in particular with regard to the state of competition on a given market or regulatory issues), the Centre should take measures to enable companies to have recourse to a network of energy experts; this is in accordance to requests made from European companies. This service could be reassigned like an externalised consulting service on a case-by-case basis (several "missions").

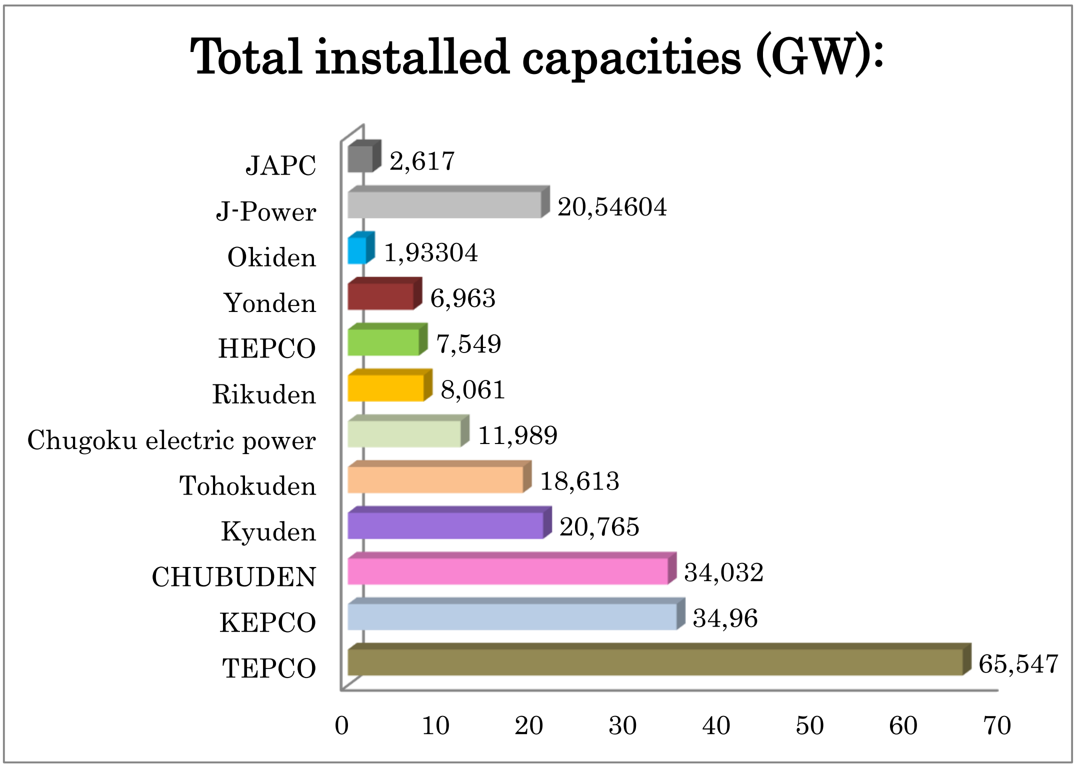
ANNEXES

Overview of Japanese Power Generators

When it comes to power generation, the 10 EPCOs and the two major Wholesale Electric Utility (J-Power and JAPC) account for **81,38% of the country's total installed capacity** (and even 96,12% if the disaster induced diminution from 287.027 MW (IEA data 2012) to 243 MW in absolute capacity between 2012 and 2013 is taken into account).

Installed capacities

	Company	Total installed capacities (GW):		
EPCOs	KEPCO	34.96		
	HEPCO	7.549		
	TEPCO	66		
	CHUBUDEN	34.032		
	Tohokuden	18.613		
	Chugoku electric power	11.989		
	Kyuden	20.765		
	Yonden	6.963		
	Rikuden	8.061		
	Okiden	1.93304		
WEUs (main)	J-Power (Electric power development)	20.54604		
	JAPC	2.617		
	Total	233.57508	81.38%	96.12%
	Total stat, IEA 2010	287.027	100%	243
	In-house consumption		18.62%	3.88%
	Specified supply projects			



2013 KEPCO	Installed capacity (GW)	Number of facilities
Thermal power	16.97	12
Large scale hydro power	8.21	151
Nuclear power	9.77	3
New energies	0.01	1
Total	34.96	167

	2013 HEPCO	Installed capacity (GW)	Number of facilities
	Hydroelectric power plants	1.239	54
Thermal power	Total thermal	4.214	12
	Steam power	3.9	6
	Gas turbine	0.148	1
	Internal combustion	0.166	5
	Nuclear power	2.07	1
	Geothermal power plant	0.025	1
	Photovoltaic power plant	0.001	1
	Total	7.549	69

2013 TEPCO	Installed capacity (GW)	Number of facilities
Hydroelectric power plants	9.453	7
Thermal power	41.598	15
Nuclear power	14.496	3
Total	66	25

2013 CHUBUDEN	Installed capacity (GW)	Number of facilities
Thermal	25.159	12
Hydroelectric	5.225	183
Nuclear	3.617	1
Renewable energy	31	3
Total generated	34.032	199

2013 Tohokuden	Installed capacity (GW)	Number of facilities
Hydroelectric	2.543	227
Thermal	11.415	9
Nuclear	3.274	2
Internal combustion power	1.116	8
Renewable	0.265	8
Total	18.613	254

2013	Chugoku electric power	Installed capacity (GW)	Number of facilities
	Thermal	7.801	12
	Hydroelectric	2.906	97
	Nuclear	1.28	1
	New energy sources	0.003	1
	Total generated	11.989	111

2013	Kyuden	Installed capacity (GW)	Number of facilities
	Nuclear	5.268	2
	Thermal	10.68	9
	Hydroelectric power	3.582	142
	Geothermal	0.212	6
	Internal combustion power	0.398	34
	Wind	0.325	2
	Solar	0.3	1
	Total generated	20.765	196

2013	Yonden	Installed capacity (GW)	Number of facilities
	Hydroelectric Power	1.142	58
	Thermal Power	3.797	4
	Nuclear Power	2.022	1
	Photovoltaic Power	0.002	1
	Wind Power	0.0003	1
	Total Renewable	0.0023	2
	Total	6.963	65

2012	Rikuden	Installed capacity (GW)	Number of facilities
	Hydroelectric power	1.906	
	Thermal	4.4	
	Nuclear	1.746	
	Renewable	9	
	Total generated	8.061	

2012	Okiden	Installed capacity (GW)	Number of facilities
	Thermal	1.758	19
	Internal combustion power	0.17455	69
	Renewable	0.00049	2
	Total generated	1.93304	90

2013 J-Power	Installed capacity (GW)	Number of facilities
Hydroelectric power plants MW	8.556	58
Thermal power plants (including 1 geothermal plant)	8.427	8
Total	16.983	66
Other electric business generation capacity		
Wind powerMW	0.353	18
IPPs, wholesale power for PPSs	0.844	6
Total other electric business generation capacity	1.197	24
Total	18.18	90

2013 JAPC	Installed capacity (GW)	Number of facilities
Nuclear	2.617	3

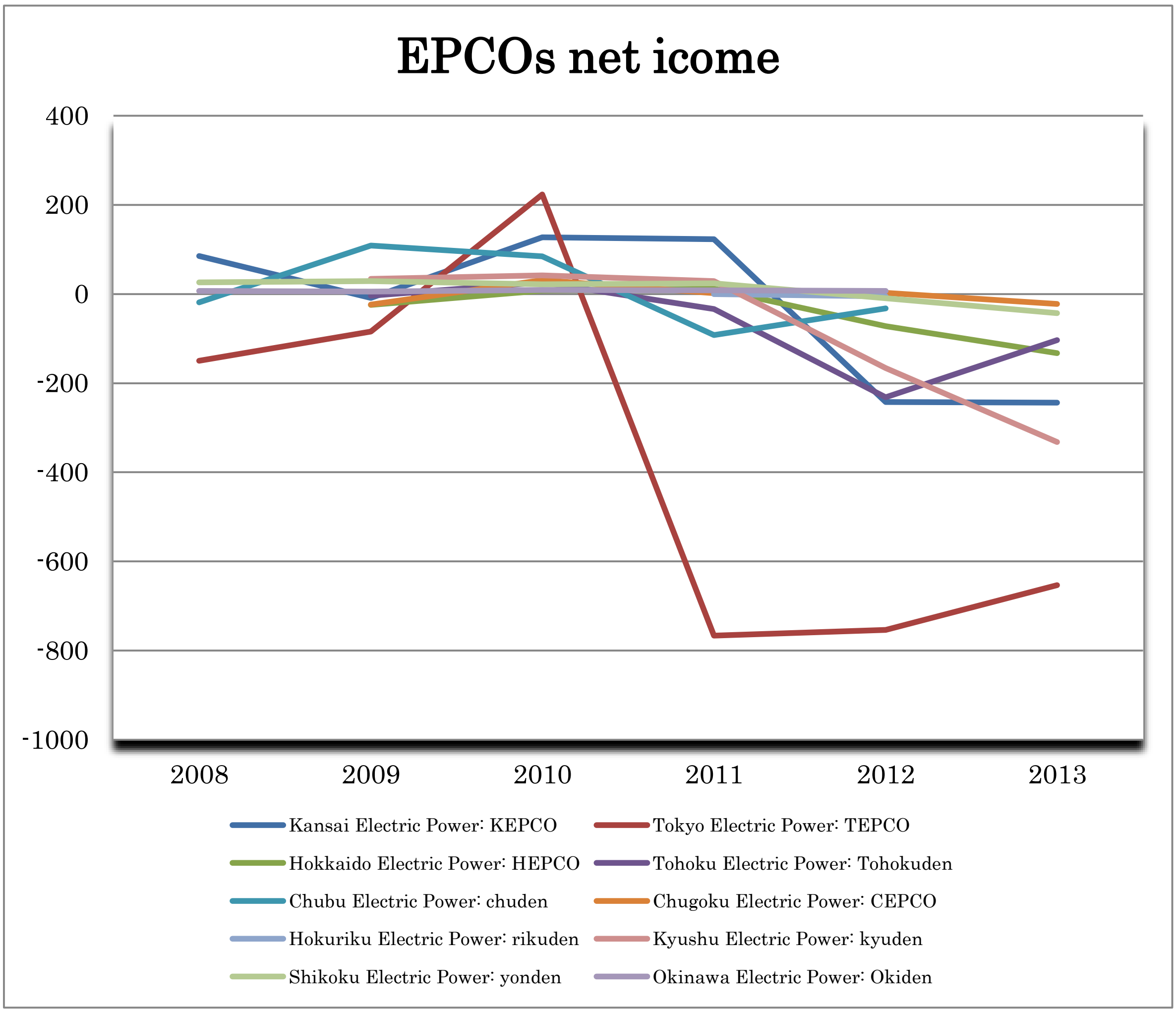
Overview of the Japanese nuclear industry

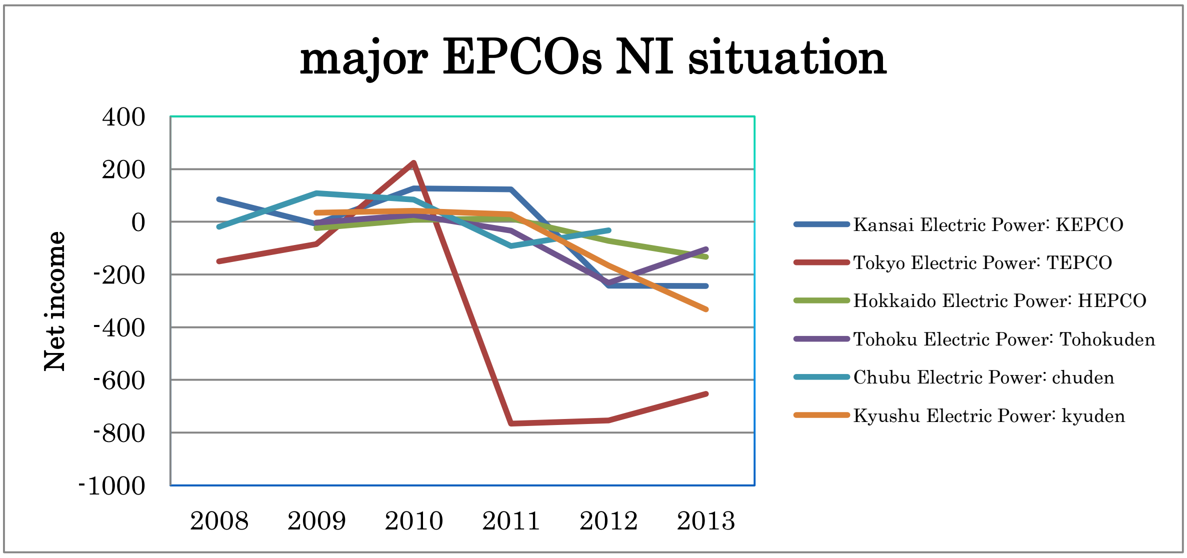
The EPCOs financial situation as for December 2013

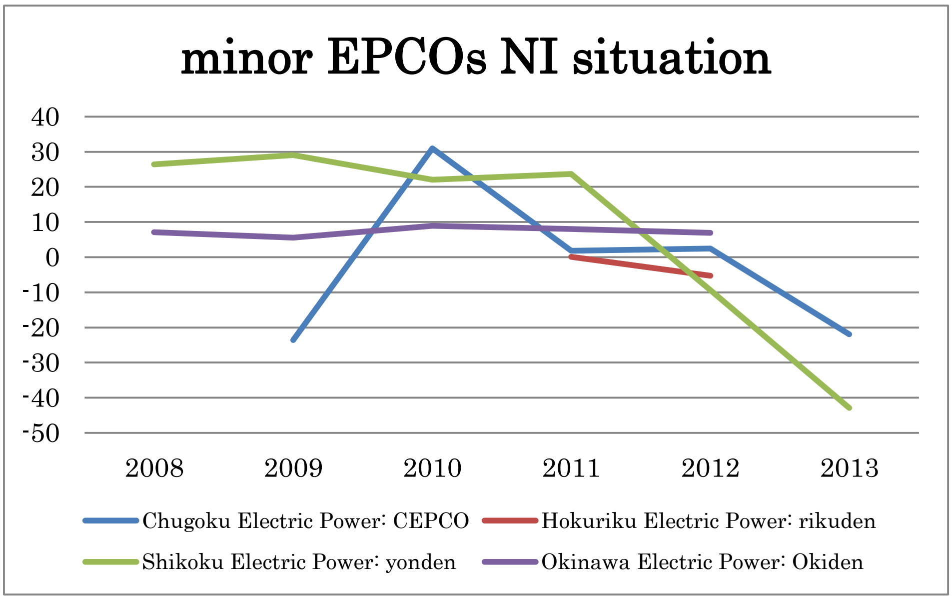
Apart from TEPCO, which has been virtually nationalised and whose future remains uncertain, the EPCOs, as corporate entities, are not likely to disappear from the Japanese power sector playing field. With ownership on the majority of power generation, transmission and distribution facilities, and given their excellent know-how on "traditional" grid management (low rate of blackouts and brownouts), they account for the best placed players to positively respond to the system projected overhaul in the long run.
Considering EPCO's role in the nuclear industry, the Abe administration has been working on ways to reduce the financial burden of the nuclear disaster and to alleviate some of the potential cost overruns that could weaken them short term by:
-Allowing a certain number of them to raise their tariffs throughout 2013
-Agreeing on the restart of the nuclear power plants after safety inspections and promoting Japanese nuclear industry abroad
-In the case of anticipated nuclear power plant decommissioning, allowing for the extension of nuclear a life cycle provision constitution (so as not to burden their balance sheet to a critical level).
Although it seems to be a necessity to reform the current system and the distribution of roles and responsibilities, the government's view is that the dismantling of the utility does not appear to be in anyone's interest.
Though some utilities will certainly not leave the Nuclear Regulation Authority unscathed (in particular JAPC which only possesses nuclear power generation assets), the majority of them will need to be temporarily supported, in the government's view, not to further jeopardise the reliability of the electricity supply.

Then again, it can be assumed that with the current tight financial situation faced by EPCOs they will probably lack the needed investment capacities to tackle all of the power generation infrastructure extension efforts in the medium term. This will create opportunities for new entrants whilst allowing EPCOs to iron out any problems before the market becomes more competitive.

Indeed, from mid 2011 onwards, only the Okinawa Electric Power Company has had a positive net income. This cannot exclusively be explained by an increase in costs due to replacement of nuclear power with imported fossil fuels.







An interesting point to note is that with the exception of TEPCO, (although there have been a few variations in operating revenues, and a relatively slight drop in operating income), their net income has plummeted, and, in most cases, only from 2012 (and not 2011 when the first wave of the suspension of nuclear power plants took place).

	Operating revenue and income (billions of yens)					
	2008	2009	2010	2011	2012	2013
Kansai Electric Power: KEPCO		2789.5	2606.5	2769.7	2811.4	2.859.0
		31	227.6	273.8	−229	−314
	85.2	−8.7	127.1	123.1	−242.2	−243.4
Tokyo Electric Power: TEPCO	5479.38	5887.576	5016.257	5368.536	5349.445	5976.239
	136.404	66.935	284.443	399.624	−272.513	−221.988
	−150.108	−84.518	223.482	−766.134	−753.761	−653.022
Hokkaido Electric Power: HEPCO		594.559	549.305	566.272	634.439	582.99
		−17.155	31.694	43.198	2.482	−115.493
		−31.482	17.788	29.287	−9.669	−128.184
		−24.106	7.658	11.982	−72.066	−132.819
Tohoku Electric Power: Tohokuden		1843.2	1663.3	1708.7	1684.9	1792.6
		−1.5	89.2	114.6	−142	−55.9
		−3.7	25.8	−33.7	−231.9	−103.6
Chubu Electric Power: chuden	2509.982	2238.551	2330.891	2449.283	2648.994	
	182.234	200.032	174.237	−37.667	−14.483	
	−18.968	108.558	84.598	−92.195	−32.161	
Chugoku Electric Power: CEPCO		1173.727	1038.443	1094.3	1181.35	1199.728
		15.525	81.515	48.481	55.063	−4.006
		−23.576	31.002	1.793	2.498	−21.951
Hokuriku Electric Power: rikuden				495.118	492.487	
				11.661	11.758	
				0.098	−5288	
Kyushu Electric Power: kyuden		1524.1	1444.9	1486	1508	1545.9
		84.7	99.7	98.9	−184.8	−299.4
		33.9	41.8	28.7	−166.3	−332.4
Shikoku Electric Power: yonden	618.106	635.132	545.393	592.123	592.142	561.783
	54.275	54.282	42.424	60.022	5.789	−50.337
	26.431	29.104	22.079	23.646	−9.357	−42.886
Okinawa Electric Power: Okiden		173.136	162.501	158.494	166.075	
		14.086	17.397	14.376	12.769	
	7.072	5.604	8.950	8.047	6.956	

Operating revenue
Operating income
Net income

Note: all the EPCOs' financial data are taken from the utilities 2013 or 2012 annual report respectively.

The costs of more expensive fossil fuels can be observed in the losses from operating revenues to operating incomes (when costs are accounted for). As for the losses from operating income to net income, they are mostly due to the implementation of new accounting rules for nuclear decommissioning costs (as part of the national nuclear safety enhancement plan), thus not directly linked with the shutdown of nuclear power plants.

A closer look at the utilities' management of their nuclear activity revealed a rather disorganised and lax asset amortisation and nuclear decommissioning related accounting practices.

Since the end of 2011, Japanese utilities adopted a standardised life cycle cost assessment method and their provisions for nuclear assets were recalculated, hence the sharp drop in their net income, with the exception of Okiden that, with its lack of nuclear facilities, has remained positive.

		2010	2011	2012	2013
KEPCO	Ammortization and depreciation	403.107	423.564	401.813	380.025
	Decommissioning costs of nuclear power units		12.225	6.665	7.863
	Effect of the application of the accounting standards for asset retirement obligations		37.105		
	Total:	403.107	472.894	408.478	387.888
TEPCO	Ammortization and depreciation	759.391	702.185	686.555	621.08
	Provision for decommissioning of nuclear power units	18.594			
	Decommissioning costs of nuclear power units	-	20.889	6.911	7.103
	Effect of the application of the accounting standards for asset retirement obligations		57.189		
	Reserves for loss on disaster (*for 2011: actual loss on disaster)		1020.496	285.128	28.5
	Grants-in-aid from nuclear damage liability facilitytation fund			-2426.27	-696.808
	Compensations for nuclear damages			2524.93	1161.97
	Payments or nuclear damage compensation			-566.264	-1476.38
	Total:	777.985	1800.759	510.989	-354.536
HEPCO	Ammortization and depreciation	114.484	107.676	104.59	97.572
	Decommissioning costs of nuclear power units	-	4.058	2.425	0.964
	Effect of the application of the accounting standards for asset retirement obligations		4.923		
Tohokuden	Ammortization and depreciation	250.825	252.916	237.197	233.085
	Decommissioning costs of nuclear power units	-	5.293	0.068	0.845
	Effect of the application of the accounting standards for asset retirement obligations		6.554		
Chuden	Ammortization and depreciation	284.046	289.451	276.544	
	Decommissioning costs of nuclear power units	3.709	0.738	1.792	
	Effect of the application of the accounting standards for asset retirement obligations		8.686		

CEPCO	Ammortization and depreciation	131.641	128.167	123.058	112.842
	Decommissioning costs of nuclear power units	-	836	1.737	0.881
	Effect of the application of the accounting standards for asset retirement obligations		6.816		
Rikuden	Ammortization and depreciation	27.948	30.846	81.936	74.929
	Decommissioning costs of nuclear power units	-	3.211	0.029	0.309
	Effect of the application of the accounting standards for asset retirement obligations		2.397		
Kyuden	Ammortization and depreciation	256.7	259.078	244.47	212.735
	Decommissioning costs of nuclear power units	-	7.524	3.106	2.627
	Effect of the application of the accounting standards for asset retirement obligations		18.429		
Yonden	Ammortization and depreciation	82.561	96.074	78.572	69.463
	Decommissioning costs of nuclear power units		3.845	1.73	1.333
	Effect of the application of the accounting standards for asset retirement obligations		8.812		
Okiden	Ammortization and depreciation	22.342	21.439	22.519	
	Decommissioning costs of nuclear power units	No nuclear asset			
	Effect of the application of the accounting standards for asset retirement obligations				

Endangered utilities

Please see below for a precise description of the state of the country's nuclear power installations:

TEPCO (3 facilities)	Location	Reactor	Reactor type	Operation duration	Capacity (MW)	Suspended as for 12/01/2013	Status (as for 12/2013)
福島第一原子力発電所 Fukushima I Nuclear Power Plant	Futaba, Fukushima	Fukushima I-1	BWR		439	YES	DECOMMISSIONING
		Fukushima I-2	BWR		760	YES	DECOMMISSIONING
		Fukushima I-3	BWR		760	YES	DECOMMISSIONING
		Fukushima I-4	BWR		760	YES	DECOMMISSIONING
		Fukushima I-5	BWR	35	760	YES	PROBABLE DECOMMISSIONING
		Fukushima I-6	BWR	34	1067	YES	PROBABLE DECOMMISSIONING
福島第二原子力発電所 Fukushima II Nuclear Power Plant	Naraha, Fukushima	Fukushima II-1	BWR	31	1067	YES	
		Fukushima II-2	BWR	29	1067	YES	
		Fukushima II-3	BWR	28	1067	YES	
		Fukushima II-4	BWR	26	1067	YES	
柏崎刈羽原子力発電所 Kashiwazaki-Kariwa Nuclear Power Plant	Kashiwazaki, Niigata	Kashiwazaki-Kariwa-1	BWR	28	1067	YES	UNDER INSPECTION
		Kashiwazaki-Kariwa-2	BWR	23	1067	YES	UNDER INSPECTION
		Kashiwazaki-Kariwa-3	BWR	20	1067	YES	UNDER INSPECTION
		Kashiwazaki-Kariwa-4	BWR	19	1067	YES	UNDER INSPECTION
		Kashiwazaki-Kariwa-5	BWR	23	1067	YES	UNDER INSPECTION
		Kashiwazaki-Kariwa-6	ABWR	17	1315	YES	UNDER INSPECTION
		Kashiwazaki-Kariwa-7	ABWR	16	1315	YES	UNDER INSPECTION
東通原子力発電所 Higashidōri Nuclear Power Plant	Higashidōri, Aomori	Higashidōri-1	ABWR			YES	
		Higashidōri-2	ABWR			YES	

KEPCO (3 facilities)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
美浜発電所Mihama Nuclear Power Plant	Mihama, Fukui	Mihama-1	PWR	43	320	YES	DECOMMISSIONING
		Mihama-2	PWR	41	470	YES	DECOMMISSIONING
		Mihama-3	PWR	37	780	YES	PROBABLE DECOMMISSIONING
大飯発電所 Ōi Nuclear Power Plant	Ōi, Fukui	Ōi-1	PWR	34	1120	YES	UNDER INSPECTION
		Ōi-2	PWR	34	1120	YES	UNDER INSPECTION
		Ōi-3	PWR	22	1127	YES	UNDER INSPECTION
		Ōi-4	PWR	20	1127	YES	UNDER INSPECTION
高浜原子力発電所 Takahama Nuclear Power Plant	Takahama, Fukui	Takahama-1	PWR	39	780	YES	UNDER INSPECTION
		Takahama-2	PWR	38	780	YES	UNDER INSPECTION
		Takahama-3	PWR	28	830	YES	UNDER INSPECTION
		Takahama-4	PWR	28	830	YES	UNDER INSPECTION

Kyuden (2 facilities)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
川内原子力発電所Sendai Nuclear Power Plant	Satsumasendai, Kagoshima	Sendai-1	PWR	29	846	YES	UNDER INSPECTION
		Sendai-2	PWR	28	846	YES	UNDER INSPECTION
玄海原子力発電所 Genkai Nuclear Power Plant	Genkai, Saga	Genkai-1	PWR	38	529	YES	UNDER INSPECTION
		Genkai-2	PWR	32	529	YES	UNDER INSPECTION
		Genkai-3	PWR	19	1127	YES	UNDER INSPECTION
		Genkai-4	PWR	16	1127	YES	UNDER INSPECTION

Chubuden (1 facility)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
浜岡原子力発電所 Hamaoka Nuclear Power Plant	Omaezaki, Shizuoka	Hamaoka-1	BWR	37	515	YES	DECOMMISSIONING
		Hamaoka-2	BWR	35	806	YES	DECOMMISSIONING
		Hamaoka-3	BWR	26	1056	YES	UNDER INSPECTION
		Hamaoka-4	BWR	20	1092	YES	UNDER INSPECTION
		Hamaoka-5	ABWR	8	1380	YES	UNDER INSPECTION

Tohokuden (2 facilities	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
東通原子力発電所 Higashidōri Nuclear Power Plant	Higashidōri, Aomori	Higashidōri-2	ABWR			YES	
		Higashidōri-1	BWR	8	1067	YES	
女川原子力発電所 Onagawa Nuclear Power Plant	Onagawa, Miyagi	Onagawa-1	BWR	29	498	YES	
		Onagawa-2	BWR	18	796	YES	
		Onagawa-3	BWR	11	798	YES	

JAPC (2 facilities)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
東海原子力発電所 Tōkai Nuclear Power Plant	Tōkai, Ibaraki	Tōkai-1	Magnox	15	169	YES	DECOMMISSIONING
		Tōkai-2	BWR	35	1056	YES	UNDER INSPECTION
敦賀発電所 Tsuruga Nuclear Power Plant	Tsuruga, Fukui	Tsuruga-1	BWR	43	341	YES	PROBABLE DECOMMISSIONING
		Tsuruga-2	PWR	26	1115	YES	UNDER INSPECTION

HEPCO (1 facility)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
泊発電所 Tomari Nuclear Power Plant	Tomari, Hokkaidō	Tomari-1	PWR	24	550	YES	UNDER INSPECTION
		Tomari-2	PWR	22	550	YES	UNDER INSPECTION
		Tomari-3	PWR	4	912	YES	UNDER INSPECTION

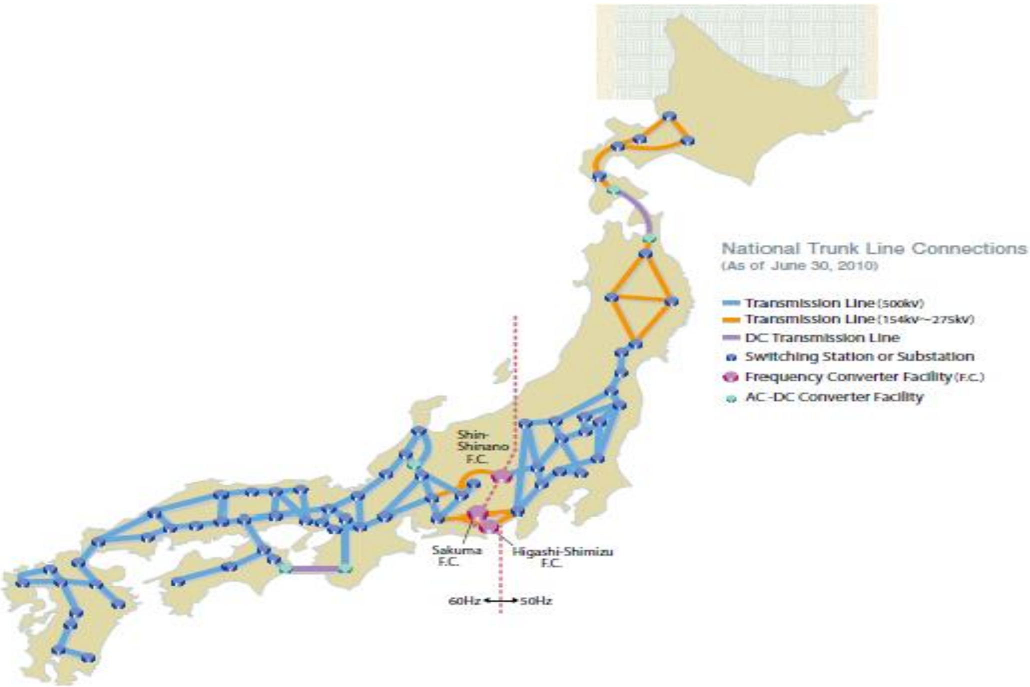
Yonden (1 facility)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
伊方発電所 Ikata Nuclear Power Plant	Ikata, Ehime	Ikata-1	PWR	36	538	YES	UNDER INSPECTION
		Ikata-2	PWR	31	838	YES	UNDER INSPECTION
		Ikata-3	PWR	19	846	YES	UNDER INSPECTION

Rikuden (1 facility)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
志賀原子力発電所 Shika Nuclear Power Plant	Shika, Ishikawa	Shika-1	BWR	20	505	YES	UNDER INSPECTION
		Shika-2	ABWR	7	1358	YES	UNDER INSPECTION

Chugokuden (1 facility	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
島根原子力発電所 Shimane Nuclear Power Plant	Matsue, Shimane	Shimane-1	BWR	39	439	YES	UNDER INSPECTION
		Shimane-2	BWR	24	789	YES	UNDER INSPECTION
		Shimane-3	ABWR	2	1373	YES	

JAEA (1 facility)	Location	Reactor	Reactor type	Operation duration	Capacity	YES	Status (as for 12/2013)
もんじゅ Monju Nuclear Power Plant	Tsuruga, Fukui	Monju	FBR	19	320	YES	

The Japanese transmission grid lack of excess capacity



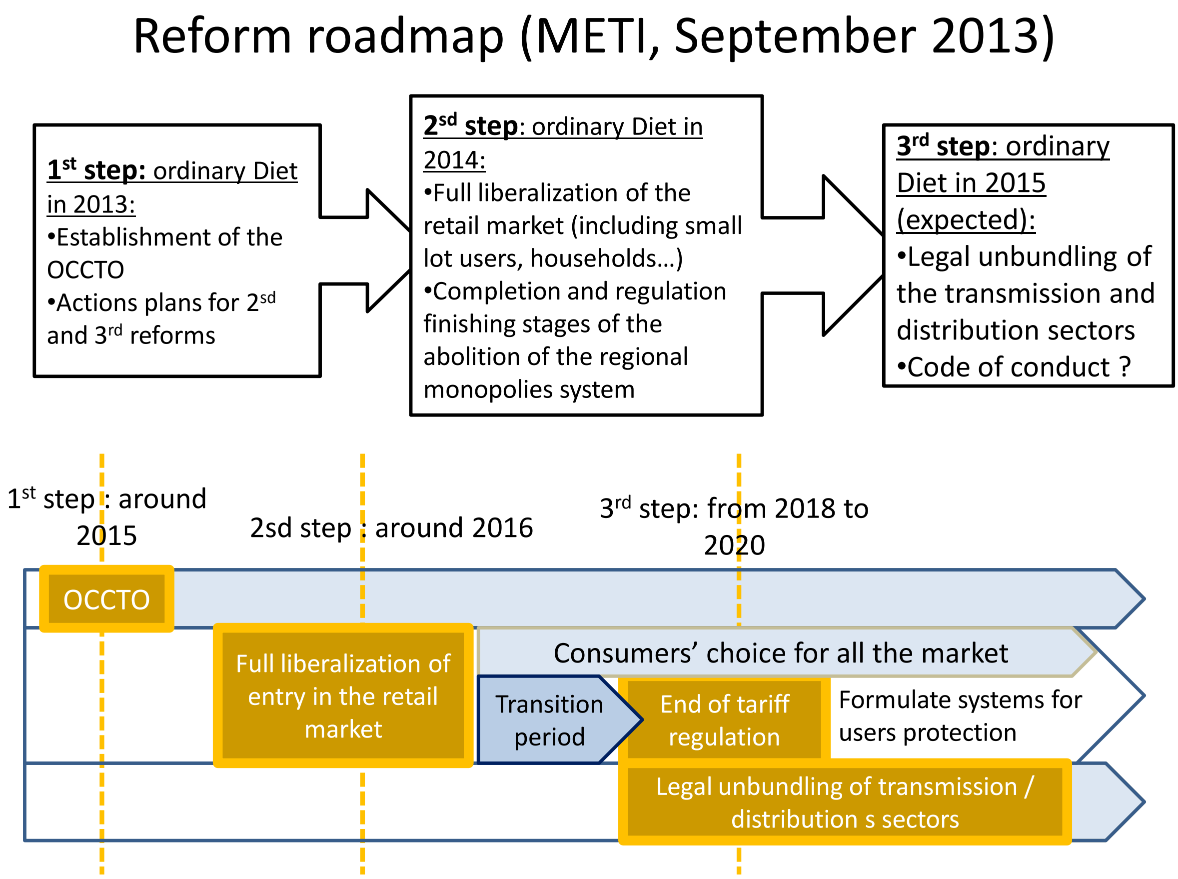
Source: The Federation of Electric Power Companies of Japan, ELECTRICITY REVIEW JAPAN, 2011.

	Route length (km)		Population	Electricity
	Transmission line	Distribution line	(million)	sales (TWh)
Chubuden	12258	131978	16	126.6
Tohokuden	15094	144816	9.63	77.833
TEPCO	21115		44.78	271.388
KEPCO	18469	129641	21.692	146
HEPCO	8,317	68,060	5.444307	31.183905
FRANCE				
RTE	100000			
ERDF		1300000	65.8	489.5

	Ratio to population		Ratio to consumption	
	Transmission line	Distribution line	Transmission line	Distribution line
Chubuden	766.13	8248.63	96.82	1042.48
Tohokuden	1567.39	15038.01	193.93	1860.60
TEPCO	471.53		77.80	
KEPCO	851.42	5976.44	126.50	887.95
HEPCO	1527.65	12501.13	266.71	2182.54
FRANCE				
RTE	1519.76		204.29	
ERDF		19756.84		2655.77

Note: route length data, electricity sales data and population of areas served are all taken from EPCOs' and RTE's and EDF's 2013 (or 2012) annual reports.

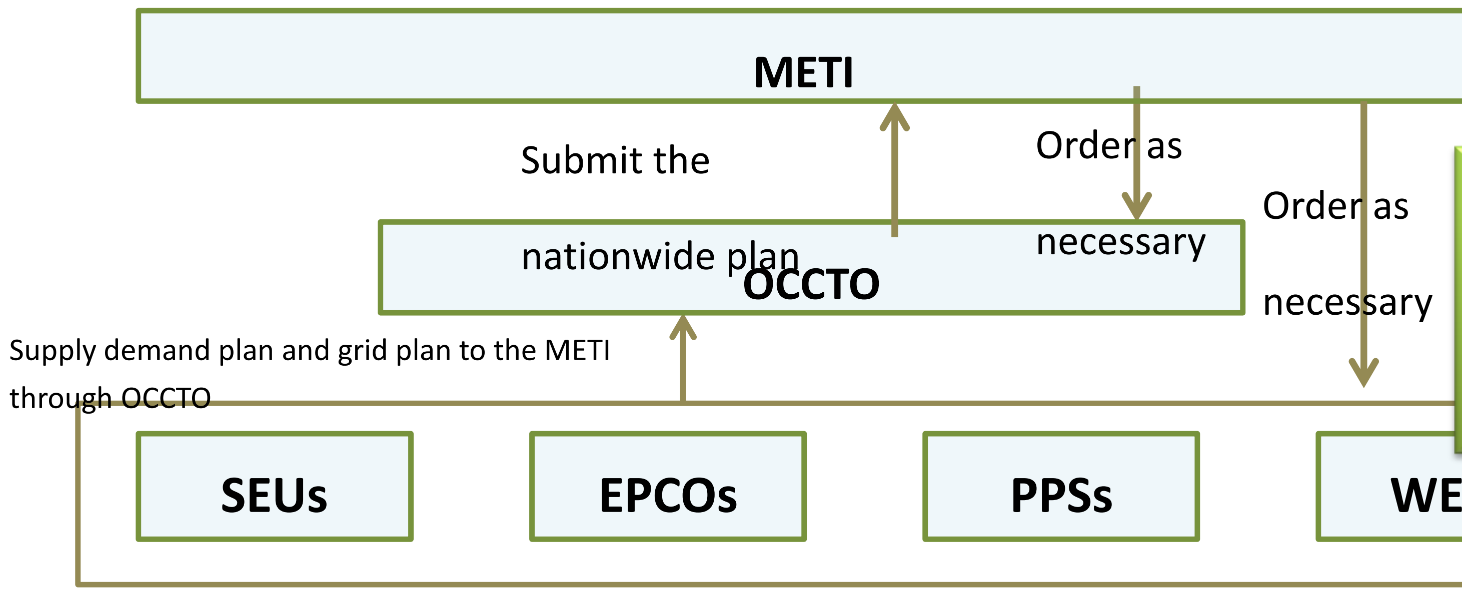
The Deregulation reform roadmap



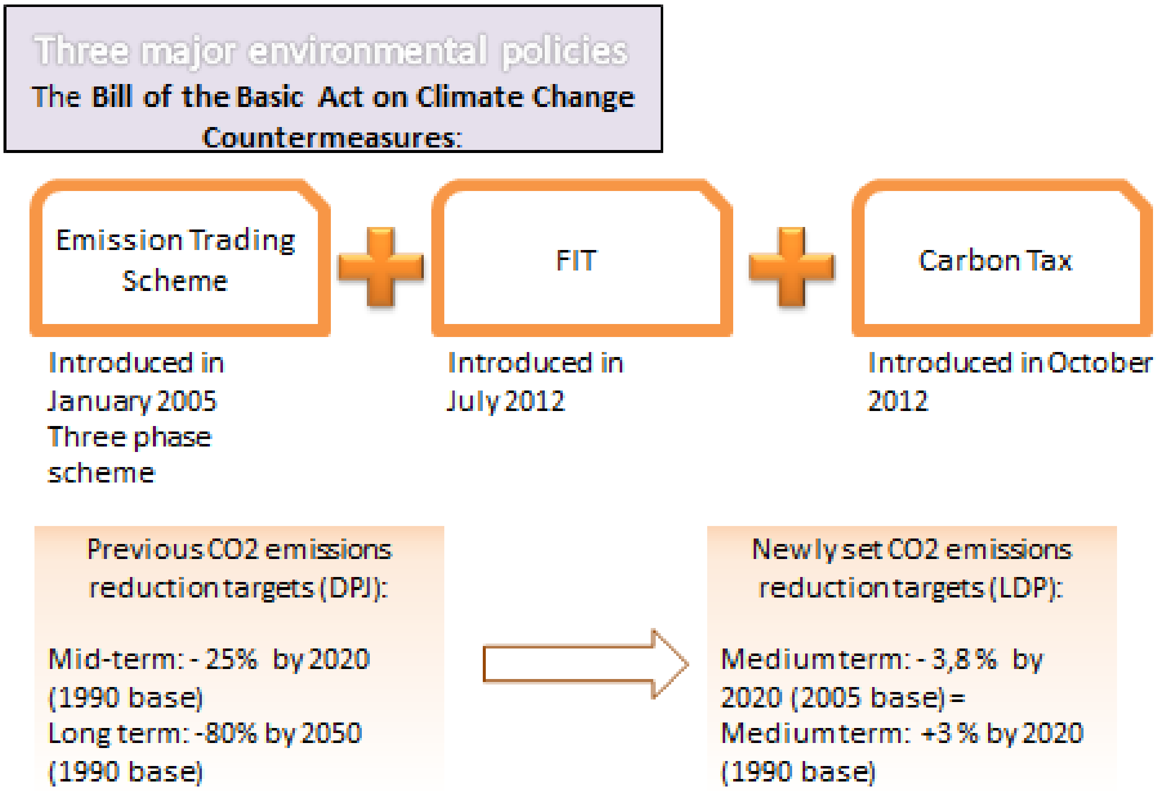
Function of the OCCTO

OCCTO is intended to:

- Analyse the EPCOs' supply demand plans and grid plans (comprising statistics on demand, price fixing mechanisms, calculation of electricity rates and wheeling charges and so on.) in order to help modify and harmonised them
- Coordinate the balance of supply-demand and the frequency adjustment managed by transmission and distribution operators in each region
- Compel EPCOs' to reinforce generations and power exchanges under a tight supply-demand situation (in order to be able to carry out massive readjustments and reverse the trend). EPCOs are to publish plans and directives to deal with peak loads and other big supply-demand gap risks



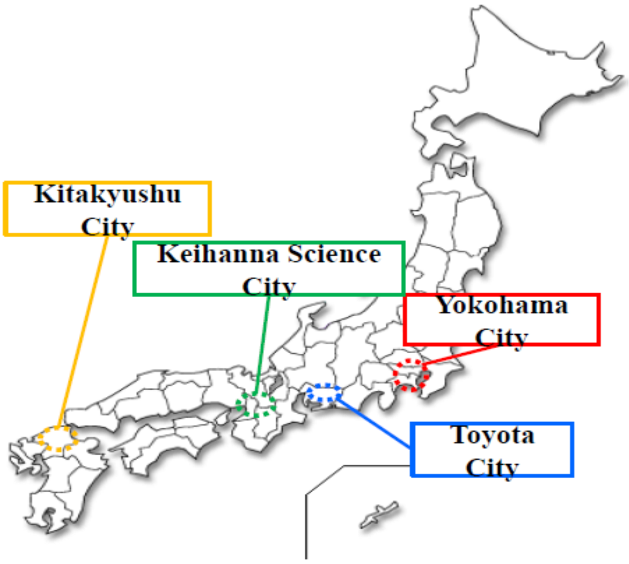
The Japanese Carbon Policy mechanisms:



Smart community initiatives

Yokohama City	Wide-area metropolis Introduction of an energy management system for an existing wide-area metropolis. As the sample number is high (4000 households)

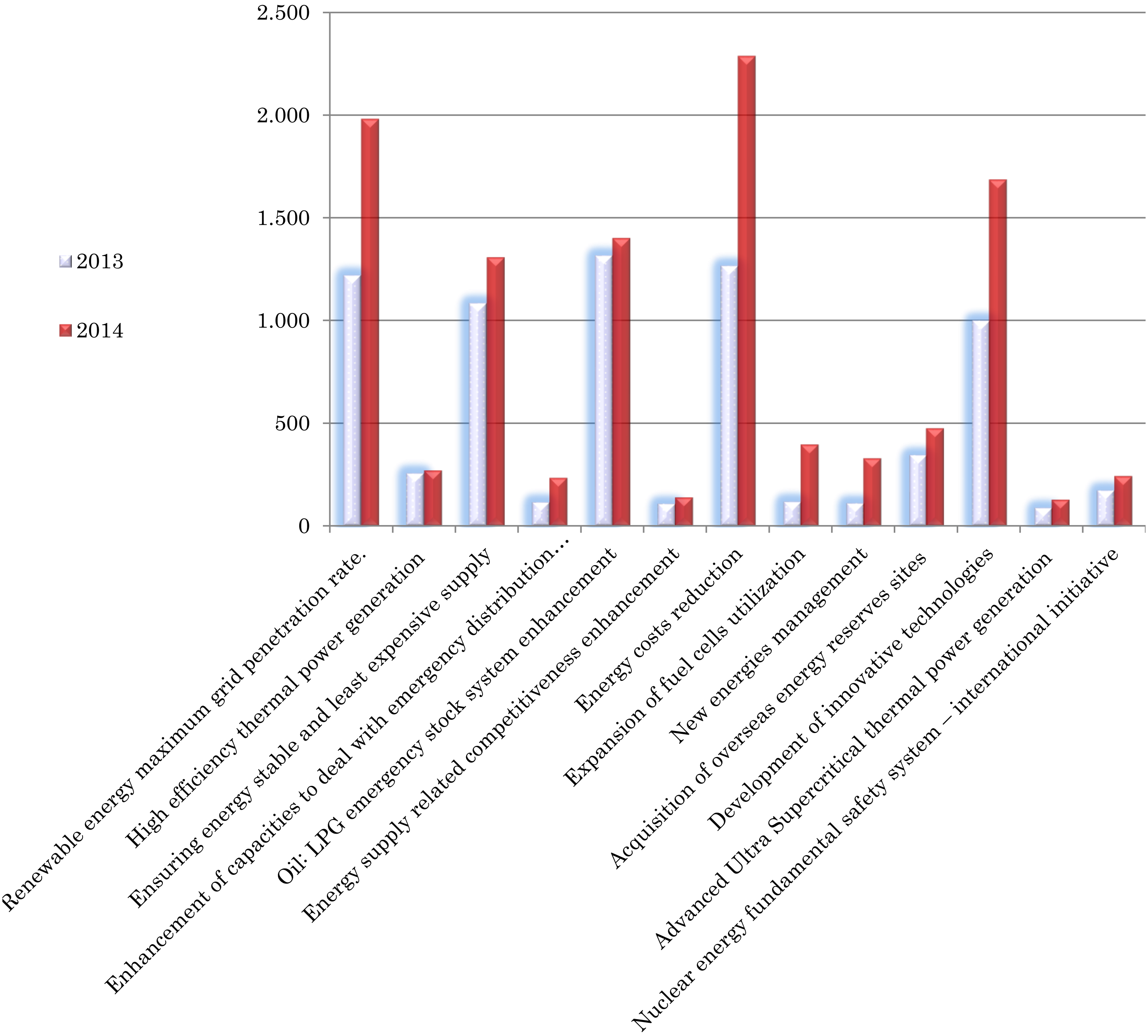
Toyota City	Separated housing Automatic control of home appliances in 67 homes. Secondary cells equipped in vehicles are used to supply energy to households. Measures for drivers to be informed of the state of the traffic and alleviate congestion.
Keihanna	Housing development Demand response demonstration based on a point system is being implemented for general households (approximately 700 households where PV or HEMS automatic control has not been introduced.
Kitakyushu City	Designated supply area In an area where power is supplied by Nippon Steel Corporation (big energy consumers), a pricing system where the power price fluctuates for 2 hours afterwards in accordance with the state of supply and demand of energy for the day. Applicable to 50 business establishments and 230 households.



<u>26th fiscal year (Heidei period) request for budgetary appropriations for energy resources summary</u>

			億円	
		Measures	2013 dedicated budget	2014 forecast budget
ルギー最先進国」の実現 Establishing Japan at the	☐Production (supply) related	Renewable energy maximum grid penetration rate.	1 221	1 981

fore front of the energy sector	**progressive effort / initiative (1)**	High efficiency thermal power generation	257	271
		Ensuring energy stable and least expensive supply	1 086	1 308
	□Building a solid energy procurement system	Enhancement of capacities to deal with emergency distribution related risks	116	235
		Oil: LPG emergency stock system enhancement	1 317	1 401
		Energy supply related competitiveness enhancement	109	140
	☐Effort related to electricity spending levels	Energy costs reduction	1 267	2 288
		Expansion of fuel cells utilization	118	397
		New energies management	111	329
ギー・環境産業の競争力の維持・強化 Energy-environment industry's competitiveness improvement		Acquisition of overseas energy reserves sites	346	476
		Development of innovative technologies	1 001	1 687
一原子力発電所の廃炉に向けた取組 Plan for the Fukushima daiichi nuclear power plant decommissioning		Advanced Ultra Supercritical thermal power generation	88	128
		Nuclear energy fundamental safety system – international initiative	174	244



For Information:

(1) Measures to increase the renewable energy maximum grid penetration rate include:

-Power grid maintenance's demonstration projects for wind power generation

-Distributed energy model demonstration projects

-Measures for ensuring electric power surplus such as storage batteries

-Demonstration projects of technologies dealing with electric power system output fluctuation

-Environmental assessment examination

-Subsidies to support projects to promote a better understanding of geothermal energy development

-Independent renewable energy power generation systems

-Research for sea wind farms' demonstration projects

-High efficiency technology development for solar (PV) new generation power generation system

-Research projects for geothermal power generation technologies

-Research projects for sea energy technologies' development

(2) Research for high efficiency thermal power generation includes:
-Development of the engineering skills for Advanced Ultra Supercritical thermal power generation
-Coal gasification fuel cells combined power generation demonstration projects
-Highly efficient gas turbine technologies demonstration projects
-CO2 reduction technologies demonstration project
-Carbon sequestration potential examination projects

(3) Measures to ensure energy stable and least expensive supply include:
-Mineral exploration: investment in companies' capital for example acquisition of assets
-Overseas coal development support project
-Asia Pacific Energy Centre financial contribution
-Development of methane hydrates
-Examination of the potential for domestic natural petroleum gas (LPG)
-Promotion of energy use rationalization for rare metal resources exploitation
-Examination of the potential for deep-sea bed resources

(4) Enhancement of capacities to deal with emergency distribution related risks includes:
-Oil products shipping functional enhancement
-Maintenance of the local supply of energy
-Oil products utilisation promotion measures

(5) Oil: LPG emergency stock system enhancement includes:
-National oil emergency stocks' management
-Oil emergency stock operations
-Enhancing the oil products storage facilities

(6) Energy supply related industry competitiveness enhancement includes:
-Improvement of the organisation of the oil production industry
-Oil products: transport network's maintenance enhancement projects
-Petroleum gas retail industry's structure improvement

(7) Energy costs reduction related investment includes:
-Assistance of companies that implement measures such as energy use rationalisation
-Energy use rationalisation specific installation introduction
-Innovative new structural building materials engineering
-Environment harmonic iron industrial process technology's development
-Strategic energy efficient technologies innovation program
-Projects for the strategic insertion of multi uses clean devices

(8) Expansion of fuel cells utilisation includes:
-Housing – buildings' innovative energy efficient technologies' introduction promotion programme
-Fixed use lithium ion storage batteries introduction support projects

-Assistance programme for SMEs' innovative energy efficiency licensing using the cloud
-Promotion of the introduction of clean vehicles

(9) New energies' management measures include:
-Support for companies that implement next generation energy management business model
-Next generation energy – "society system"
-Project for smart grid introduction

(10) Acquisition of overseas energy reserves sites includes:
-International energy consumption optimisation
-International energy efficiency standardisation –base diffusion of standards
-Promotion program for the diffusion of measures against the earth global warming
-Human resources support program for the promotion of the low carbon technologies exports

(11) Promotion of the development of innovative technologies includes:
-Next generation power electronic technologies
-Energy- environmentally friendly technologies leadership

(12) Development of engineering skills for Advanced Ultra Supercritical thermal power generation includes:
-Nuclear reactor decommissioning – environmental safety technology fundamental maintenance programme
-International Atomic Energy Agency donation
-Elimination of the contaminated waters issue

(13) Nuclear energy fundamental safety system – international initiative includes:
-Nuclear reactor safety improvement measures
-Bettering of nuclear safety related human resources
-Overseas nuclear construction human resources

	Measure / set of measures	億円 2013 budget	2014 budget	Variation percentage		
Ⅰ.「エネルギー最先進国」の実現 Establishing Japan at the forefront of the energy sector	**☐Production related progressive initiative**	**2,726**	**3,805**	139.58%	39.58%	
	(1) Amount allocated for increasing the renewable energy maximum grid penetration rate.	**1,221**	**1,981**	162.24%	62.24%	
	Improving the system's base regarding bottle necks	357	462	129.41%	29.41%	
	Power grid maintenance's demonstration projects for wind power generation:	250	250	100.00%	0.00%	
	Next generation distributed energy model: grid structure	0	54			new measure
	Measures for ensuring electric power surplus such as storage batteries' demonstration project	104	111	106.73%	6.73%	
	Demonstration projects of technologies dealing with electric power system output fluctuation	0	44			new measure
	System's base transformation regarding renewable energy's introduction maximum threshold	216	356	164.81%	64.81%	
	Environmental assessment examination	0	34			new measure
	Subsidies to support projects that promote a better understanding of geothermal energy development	28	30	107.14%	7.14%	
	Independent renewable energy power generation systems:	30	30	100.00%	0.00%	
	Development of technologies to accelerate the introduction of renewable energies demonstration projects	447	854	191.05%	91.05%	
	Research for sea wind farms' demonstration project	95	310	326.32%	226.32%	
	Solar (PV) power generation system new generation high efficiency technology development	71	67	94.37%	-5.63%	
	Research projects for geothermal power generation technologies	10	30	300.00%	200.00%	
	Research projects for sea energy technologies' development	25	30	120.00%	20.00%	
	(2) Nuclear energy fundamental / basic safety system	**174**	**244**	140.23%	40.23%	
	See below					new measure
	(3) Research for high efficiency thermal power generation	**257**	**271**	105.45%	5.45%	
	Development of technologies for coal fired thermal power generation efficiency improvement	130	147	113.08%	13.08%	
	Development of the engineering skills for Advanced Ultra Supercritical thermal power generation	15	26	173.33%	73.33%	
	Coal gasification fuel cells combined power generation demonstration project	70	65	92.86%	-7.14%	

	Highly efficient gas turbine technologies demonstration projects	23	39	169.57%	69.57%	
	Initiatives regarding the implementation of CCS	126	124	98.41%	-1.59%	
	CO2 reduction technologies demonstration project	115	96	83.48%	-16.52%	
	Carbon sequestration potential examination projects	0	10			new measure
	(4) Resources: ensuring energy stable and least expensive supply	1,086	1,308	120.44%	20.44%	
	Oil, natural gas, coal's interest preservation and international energy related cooperation promotion	632	816	129.11%	29.11%	
	Mineral exploration: investment in companies' capital for example acquisition of assets	465	620	133.33%	33.33%	
	Overseas coal development support project	10	17	170.00%	70.00%	
	Asia Pacific Energy Center financial contribution	4	5	125.00%	25.00%	
	Promotion of the development of domestic energy resources, such as methane hydrates	259	282	108.88%	8.88%	
	Development of methane hydrates	87	127	145.98%	45.98%	
	Examination of the potential for domestic natural petroleum gas (LPG)	170	153	90.00%	-10.00%	
	Securing foreign and domestic mineral resources	105	129	122.86%	22.86%	
	Promotion of energy use rationalization for rare metal resources exploitation	8	11	137.50%	37.50%	
	Examination of the potential of deep sea bed resources	37	50	135.14%	35.14%	
	☐Building a solid energy procurement system	1762	2035	115.49%	15.49%	
	Enhancement of capacities to deal with emergency distribution related risks	116	235	202.59%	102.59%	
	Oil products shipping functional enhancement	51	151	296.08%	196.08%	
	Maintenance of the local supply of energy	42	48	114.29%	14.29%	
	Oil products utilisation promotion measures	0	6			new measure
	Oil: LPG emergency stock system enhancement	**1,317**	**1,401**	106.38%	6.38%	
	National oil emergency stocks' management:	538	571	106.13%	6.13%	
	Oil emergency stock operations	311	316	101.61%	1.61%	
	Enhancing the oil products storage facilities	0	16			new measure
	Energy supply related industry competitiveness enhancement _ assistance for the enhancement of the management base	**109**	**140**	128.44%	28.44%	
	Improvement of the organization of the oil production industry	0	35			new measure
	Oil products: transport network's maintenance enhancement projects	5	24	480.00%	380.00%	
	Petroleum gas retail industry's structure improvement	7	8	114.29%	14.29%	

	☐Effort related to electricity spending levels	**1,767**	**3,044**	172.27%	72.27%	
	(1) Energy costs reduction related investment	**1,267**	**2,288**	180.58%	80.58%	
	Industries specific economical use of energy	376	814	216.49%	116.49%	
	Assistance of companies which implement measures such as energy use rationalisation	310	700	225.81%	125.81%	
	Energy use rationalisation specific installation introduction	17	40	235.29%	135.29%	
	Households, offices and transportation specific economical use of energy measures	435	744	171.03%	71.03%	
	Innovative new structural building materials engineering	41	61	148.78%	48.78%	
	Environment harmonic iron industrial process technology's development	27	55	203.70%	103.70%	
	Strategic energy efficient technologies innovation programme	90	108	120.00%	20.00%	
	Projects for the strategic insertion of multi uses clean devices	0	20			new measure
	(2) Expansion of fuel cells utilisation	**118**	**397**	336.44%	236.44%	
	Housing – buildings' innovative energy efficient technologies' introduction promotion program	110	152	138.18%	38.18%	
	Fixed use lithium ion storage batteries introduction support projects	0	130			new measure
	Assistance programme for SMEs' innovative energy efficiency licensing using the cloud	0	91			new measure
	Promotion of the introduction of clean vehicles	300	300	100.00%	0.00%	
	(3) New energies' management business' establishment	**111**	**329**	296.40%	196.40%	
	Support for companies that implement next generation energy management business model	0	138			new measure
	Next generation energy – "society system"	86	90	104.65%	4.65%	
	Project for smart grid introduction	0	83			new measure

new measure

Ⅱ．エネルギー・環境産業の競争力の維持・強化 Energy-environment: industry's competitiveness improvement	(1) Acquisition of overseas energy reserves sites	**346**	**476**	137.57%	37.57%	
	International energy consumption optimisation	205	273	133.17%	33.17%	
	International energy efficiency standardisation –base diffusion of standards	0	40			new measure
	Promotion programme for the diffusion of measures against global warming	35	77	220.00%	120.00%	
	Human resources support programme for the promotion of low carbon technologies exports	0	15			new measure
	(2) Promotion of the development of innovative technologies	**1,001**	**1,687**	168.53%	68.53%	
	Next generation power electronic technologies	20	60	300.00%	200.00%	
	Energy- environmentally friendly technologies leadership	0	40			new

					measure

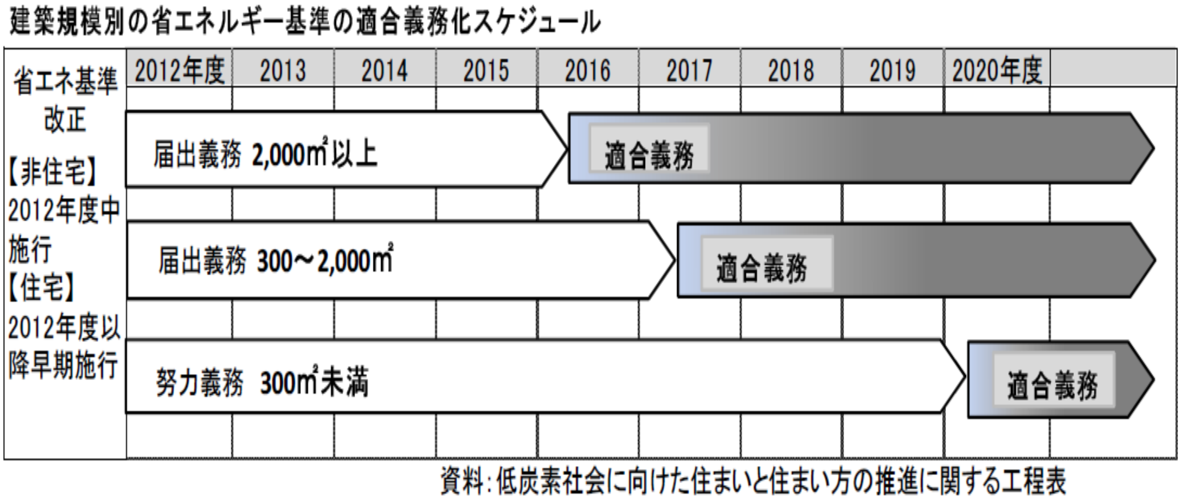
Ⅲ. 福島第一原子力発電所の廃炉に向けた取組 Plan for the Fukushima daiichi nuclear power plant decommissioning	Development of engineering skills for Advanced Ultra Supercritical thermal power generation	**88**	**128**	145.45%	45.45%
	Nuclear reactor decommissioning – environmental safety technology fundamental maintenance programme	87	125	143.68%	43.68%
	International Atomic Energy Agency donation	1	2	200.00%	100.00%
	Elimination of the contaminated waters issue –	not defined yet			
	(2) Nuclear energy fundamental safety system – international initiative	**174**	**244**	140.23%	40.23%
	Nuclear reactor safety improvement measures	54	85	157.41%	57.41%
	Bettering of nuclear safety related human resources	1	2	200.00%	100.00%
	Overseas nuclear construction human resources	12	15	125.00%	25.00%

Total variation of budget from 2013 to 2014	7,864	11,419	145%	45.21%

Top Runner programme's achievements

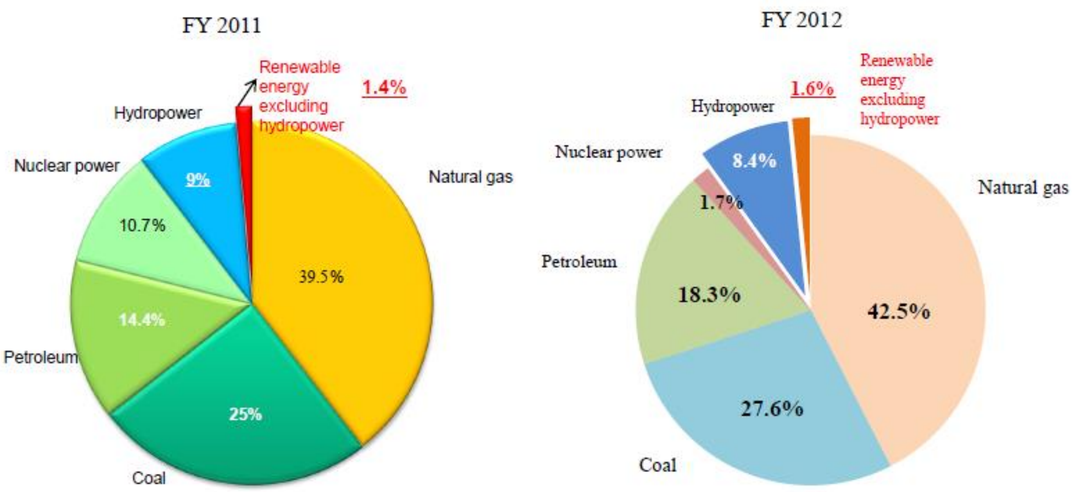
Product name	Improvement in energy efficiency (performance data)	Breakdown
Air conditioning units (room air conditioners)	67.8% (FY1997→2004 (industry fiscal year))	COP (3.01→5.05)
Electric refrigerators	55.2% (FY1998→2004)	Annual power consumption (647.3kWh/year →290.3kWh/year)
Electric freezers	29.6% (FY1998→2004)	Annual power consumption (523.8kWh/year →369.7kWh/year)
Gasoline-engine passenger cars	22.8% (FY1995→2005)	Fuel efficiency (12.3km/l→15.1km/l)
Diesel-engine freight vehicles	21.7% (FY1995→2005)	Fuel efficiency (13.8km/l→16.8km/l)
Vending machines	37.3% (FY2000→2005)	Annual power consumption (2617kWh/year →1642kWh/year)
Fluorescent lighting	35.7% (FY1997→2005)	Lumen/watt (63.1lm/W→85.6lm/W)
Computers	99.1% (FY1997→2005)	Watt/mega calculation (0.17→0.0015)
Magnetic disc devices	98.2% (FY1997→2005)	Watt/gigabyte (1.4→0.0255)
Copiers	72.5% (FY1997→2006)	Electric power consumption (155Wh→42.7Wh)
Electric toilet seats	14.6% (FY2000→2006)	Annual power consumption (281kWh/year →240kWh/year)
Gas water heaters (gas boilers & gas bath water heaters)	5.5% (FY2000→2006)	Thermal efficiency (77.7%→82.0%)
Gas cooking appliances (cooktop burners)	15.7% (FY2000→2006)	Thermal efficiency (48.3%→55.9%)
Gas heaters	1.9% (FY2000→2006)	Thermal efficiency (80.9%→82.4%)
Oil heaters	5.4% (FY2000→2006)	Thermal efficiency (78.5%→82.7%)
Television sets (LCD & plasma TV)	29.6% (FY2004→2008)	Annual power consumption (179.7kWh/year →126.5kWh/year)
DVD recorders (noncompliant with terrestrial digital broadcasting)	40.9% (FY2004→2008)	Annual power consumption (66.0kWh/year →39.0kWh/year)
Microwave ovens	10.5% (FY2004→2008)	Annual power consumption (77.2kWh/year →69.1kWh/year)
Electric rice cookers	16.7% (FY2003→2008)	Annual power consumption (119.2kWh/year →99.3kWh/year)

<u>Insulation standards' implementation agenda</u>



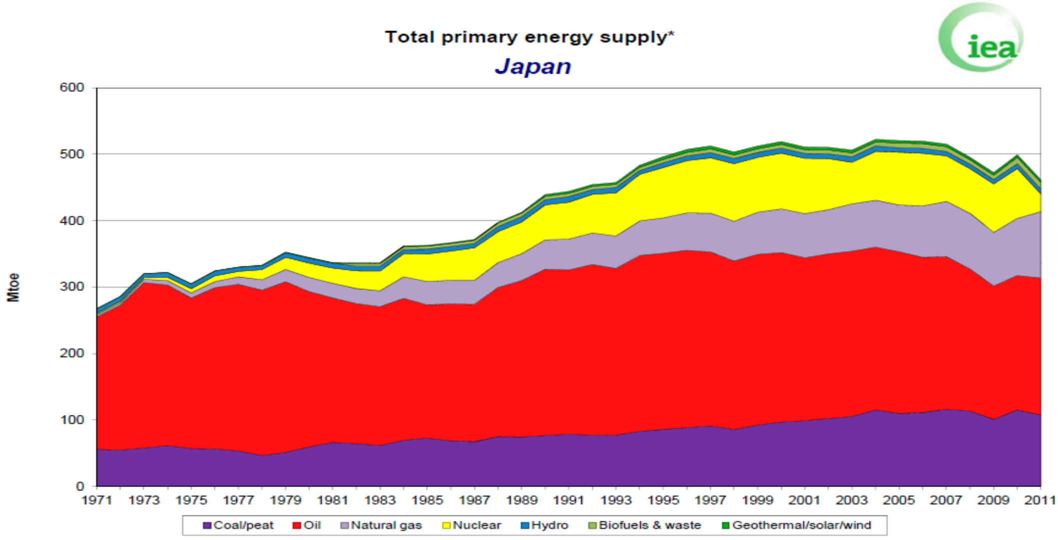
建物断熱 1999 2020

<u>Renewable energies in the Japanese energy mix</u>



Source: Agency for Natural Resources and Energy's "Outline of electric power development for FY2010"

<u>IEA statistics on the evolution of the Japanese energy and electricity mix</u>



* Excluding electricity trade.

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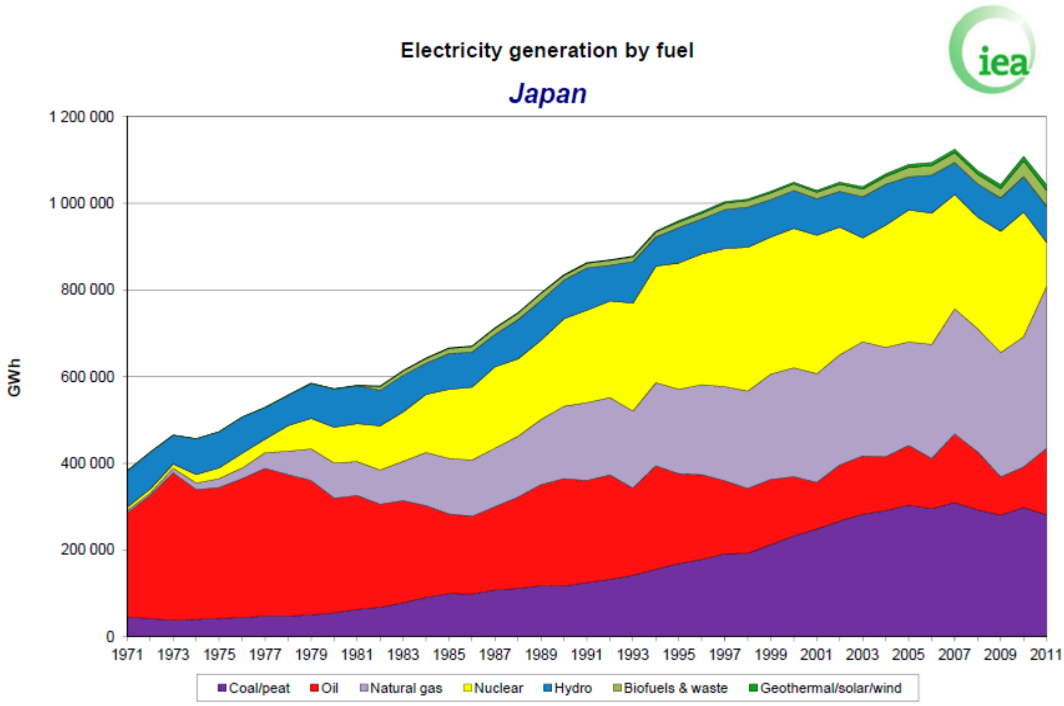
For more detailed data, please consult our on-line data service at http://data.iea.org.

IEA Energy Statistics

Statistics on the web: http://www.iea.org/stats/index.asp



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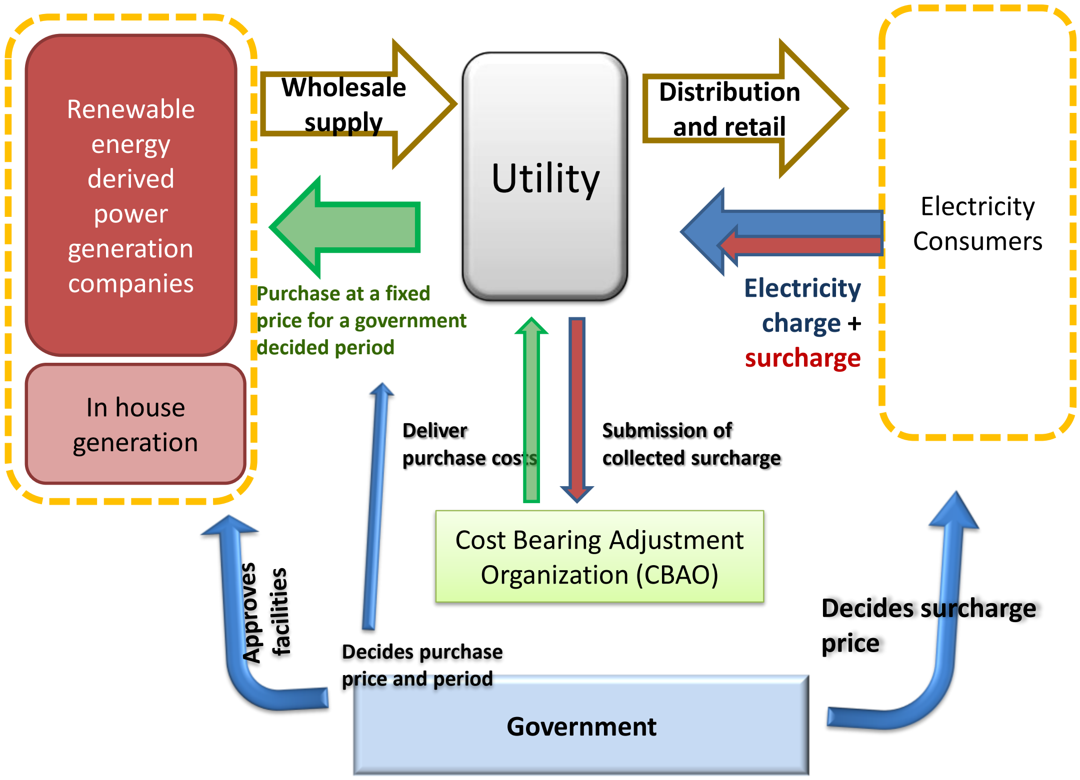
Description of FIT



Purchase rates, Japanese FIT, yen, all RES except biomass

Energy source	Procurement category	Estimated costs		Pre tax IRR	Tariff (per kWh)		Contract duration
		CAPEX (\/kW)	OPEX (\/kW)		Tax inclusive	Tax exclusive	
Solar	10kW or more	325,000	10,000	6 %	42 ¥	40 ¥	20 years
	Less than 10kW (purchase of excess electricity)	466,000	4,700	3,2 %	42 ¥	42 ¥	10 years
Wind	20 kW or more	300,000	6,000	8 %	23,10 ¥	22 ¥	20 years
	Less than 20kW	1,250,000	-	1,8	57,75 ¥	55 ¥	20 years
Geothermal	15MW or more	790,000	33,000	13%	27,30 ¥	26 ¥	15 years
	Less than 15MW	1,230,000	48,000		42 ¥	40 ¥	15 years
Small and medium size hydro	Between 1MW-3MW	850,000	9,500	7%	25,20 ¥	24 ¥	20 years
	Between 200 kW-1MW	800,000	69,000		30,45 ¥	29 ¥	
	Less than 200kW	1,000,000	75,000		35,70 ¥	34 ¥	

Purchase rates, Japanese FIT, euros, all RES except biomass

Energy source	Procurement category	Estimated costs: CAPEX (euros/kW)	Estimated costs: OPEX (euros/kW)	Pre tax IRR	Tariff (per kWh): Tax inclusive (ct euros)	Tariff (per kWh): Tax exclusive (ct euros)	Contract duration
Solar	10kW or more	€ 2,421.70	€ 74.51	6%	€ 31.29575	€ 29.80548	20 years
	Less than 10kW (purchase of excess electricity)	€ 3,472.34	€ 35.02	3,2 %	€ 31.29575	€ 31.29575	10 years
Wind	20 kW or more	€ 2,235.41	€ 44.71	8%	€ 17.21266	€ 16.39301	20 years
	Less than 20kW	€ 9,314.21	-	1,8	€ 43.03166	€ 40.98254	20 years
Geothermal	15MW or more	€ 5,886.58	€ 245.90	13%	€ 20.34224	€ 19.37356	15 years
	Less than 15MW	€ 9,165.19	€ 357.67		€ 31.29575	€ 29.80548	15 years
Small and medium size hydro	Between 1MW-3MW	€ 6,333.66	€ 70.79	7%	€ 18.77745	€ 17.88329	20 years
	Between 200 kW-1MW	€ 5,961.10	€ 514.14		€ 22.68942	€ 21.60897	
	Less than 200kW	€ 7,451.37	€ 558.85		€ 26.60139	€ 25.33466	

Purchase rates, German FIT for solar

Solar	FiT from 1 February 2013	FiT from 1 March 2013	FiT from 1 April 2013
≤ 10 kW:	16,64 €/kWh	16,28 €/kWh	15,92 €/kWh
≤ 40 kW:	15,79 €/kWh	15,44 €/kWh	15,10 €/kWh
≤ 1 MW:	14,08 €/kWh	13,77 €/kWh	13,47 €/kWh
Other systems ≤ 10 MW:	11,52 €/kWh	11,27 €/kWh	11,02 €/kWh

Purchase rates, Japanese FIT, yen, all RES except biomass

Energy source	Procurement category	Estimated costs		Pre tax IRR	Tariff (per kWh)		Contract duration
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	Less than 15MW	1,230,000	48,000		42 ¥	40 ¥	15 years
Small and medium size hydro	Between 1MW-3MW	850,000	9,500	7%	25,20 ¥	24 ¥	20 years
	Between 200 kW-1MW	800,000	69,000		30,45 ¥	29 ¥	
	Less than 200kW	1,000,000	75,000		35,70 ¥	34 ¥	

Purchase rates, Japanese FIT, euros, all RES except biomass

Energy source	Procurement category	Estimated costs		Pre tax IRR	Tariff (per kWh)		Contract duration
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Purchase rates, German FIT for solar

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≤ 40 kW:	15,79 €/kWh	15,44 €/kWh	15,10 €/kWh
≤ 1 MW:	14,08 €/kWh	13,77 €/kWh	13,47 €/kWh
Other systems ≤ 10 MW:	11,52 €/kWh	11,27 €/kWh	11,02 €/kWh

Tariffs and Durations (Biomass)

METI Agency for Natural Resources and Energy

Energy source		Biomass				
Biomass type		Biogas	Wood fired power plant (Timber from forest thinning)	Wood fired power plant (Other woody materials)	Wastes (excluding woody wastes)	Wood fired power plant (Recycled wood)
Cost	Installation cost	3,920,000 yen/kW	410,000 yen/kW	410,000 yen/kW	310,000 yen/kW	350,000 yen/kW
	Operating and maintenance costs (per year)	184,000 yen/kW	27,000 yen/kW	27,000 yen/kW	22,000 yen/kW	27,000 yen/kW
Pre-tax IRR (Internal Rate of Return)		1%	8%	4%	4%	4%
Tariff (per kWh)	Tax inclusive	40.95 yen	33.60 yen	25.20 yen	17.85 yen	13.65 yen
	Tax exclusive	39 yen	32 yen	24 yen	17 yen	13 yen
Duration		20 years				