JAPAN'S PRE AND POST 3/11 ENERGY POLICY: DISTRESSING LESSONS AND BLURRED PROSPECTS

Elena SHADRINA[*]

ABSTRACT

The scale of the challenge Japan is faced with after the triple disaster of March 11, 2011 is enormous. This paper focuses on one sphere - energy policy, which affects the entire socio-economic and political situation at present and is to determine the country's future. The paper seeks to analyze Japan's energy policy before 2011 highlighting the aspects of risk management, asses the socio-economic costs associated with the energy crisis followed after the earthquake and tsunami, examine the options for the nation's future energy policy and discuss potential implications of Japan's changing energy policy for the international energy market.

Keywords: *Japan, Energy Policy, Earthquake, Tsunami and Nuclear Crisis.*

ÖZET

Japonya'nın 3/11 Öncesi ve Sonrası Enerji Politikası: Sıkıntı Veren Dersler ve Bulanık Olasılıklar

Japonya 11 Mart 2011 de yaşadığı üçlü felaketten sonra devasa boyutlarda bir zorlu mücadele ile karşı karşıya kalmıştır. Bu çalışmanın odak noktasını, günümüz Japonya'sında tüm sosyo-ekonomik ve siyasi durumu etkileyen ve ülkenin geleceğini belirleyecek olan enerji politikası oluşturmaktadır. Çalışma Japonya'nın 2011 öncesi enerji politikasını, risk yönetiminin çeşitli veçhelerini öne çıkararak, deprem ve tusunami sonrası enerji kriziyle birlikte ortaya çıkan sosyo-ekonomik maliyeti değerlendirerek, Japonya'nın gelecekteki enerji politikası seçeneklerini ve Japonya'nın değişen enerji politikasının uluslararası enerji pazarı için olası etkilerini analiz etmeyi amaçlamaktadır.

Anahtar Kelimeler: *Japonya, Enerji Politikası, Deprem, Tusunami ve Nükleer Kriz.*

1. Introduction

March 11, 2011 has become the saddest day in the entire post-war history of Japan. At 14:46, the Great East Japan Earthquake[1] of 9.0-magnitude hit the

[*] Doç. Dr., Meiji Üniversitesi, Yönetim Bilimleri Enstitüsü (shadrina@meiji.ac.jp)

archipelago. By seismological measures, the 3-11 Earthquake is the most powerful in Japan's history and one of the world's five strongest since the beginning of the record-keeping in 1900. However, the gigantic physical damage was caused not by the earthquake; the tsunami waves of the heights exceeding 40.5 meters in some areas struck the north-eastern coasts of Japan sweeping away the whole villages and devastating the towns.

Observable immediate consequences of the natural disaster were unbearable hardships of the tens of thousands of brave people of Tohoku region suffering low temperatures, shortages of cooked food and drinking water; demolished and severely destroyed industrial and social infrastructure; ruined manufacturing facilities; disrupted supply chains; etc. Apprehension of much more colossal damage started to appear gradually several days after the quake, when the word "meltdown" became a part of everybody's lexicon and everybody's life started stretching into a new unknown dimension.

Literally, there was no unaffected side in the post-March 11 Japan's life. Not to speak about the disaster's profoundly devastative impact on Japan's industrial sector and businesses, some unthinkable things happened. For instance, Japan's map of hot springs (*onsen*) resorts has changed, because hot springs disappeared in some places winding down the established businesses and started gushing in new locations, sometimes even from the basements of the houses. Geophysical effect of the earthquake is that portions of north-eastern Japan moved 2.4 meters closer to North America. The sport industry had been adjusting to the electricity shortage following the halts of the nuclear power plants (NPPs) in the disaster hit area through the rescheduling and shortening the baseball matches. Sacral for any Japanese *hanami* (cherry blossom festival) in the spring of 2011 has gone almost unnoticed over the people's despair as well as because of the introduced promptly after the disaster *setsuden* (energy saving) measures.

A dreadful price of the earthquake and tsunami, according to February 8, 2012 report by the National Police Agency,[2] is 15,846 dead, 3,317 missing and 6,011 injured. The material loss is enormous (and yet likely to be revised upward). There are some 128,558 units of property totally and 243,486 units half collapsed; almost 4,000 places of damage on the roads, nearly 80 cases of damage on the bridges, about 30 events of damage on the railways, etc. The

[1] Various names were given to this major disaster; among the most frequently used ones are Touhoku-chihou Taiheiyou Oki Jishin and Higashi Nihon Dai Shinsai.

[2] Accessible at: http://www.npa.go.jp/archive/keibi/biki/higaijokyo_e.pdf

disaster, commonly referred to as a triple disaster (combined earthquake, tsunami and nuclear accident), caused the total direct economic losses of 16.9 trillion yen or cost Japan an equivalent of 3.5 % of its GDP, according to the government's June 2011 report.[3]

By fatal coincidence, one of the natural disaster's victims – Tokyo Electric Power Company (TEPCO) – turned into a monstrous culprit. The earthquake and tsunami consequences for the entire country were tremendously aggravated by the situation on TEPCO's Fukushima NPP. Having lost control over its Dai-Ichi plant, TEPCO caused vast populated and industrialised area surrounding the Fukushima NPP suffer radiation and its wide-ranging appalling effects. Organized by the Cabinet Office the Investigation Committee on TEPCO's Management and Finances, concluded that the amount of compensation to be paid by TEPCO in two years from 2011 would be 4.5 trillion yen, including compensation until the normal situation is restored 1.024,6 trillion yen in 2011 and 897.2 billion later, of which evacuation expenses - 113.9 billion yen, mental distress - 127.6 billion yen, business loss - 191.5 billion yen, damage associated with invalidity and other factors - 264.9 billion yen; also temporary damages are evaluated at 2.618,4 trillion yen, of which damages such as loss of assets - 570.7 billion yen, damages in agriculture, tourism, manufacturing and other industries due to harmful rumours - 1,303.9 trillion yen.

The scale of the challenge Japan is faced with is indeed enormous. As the released in May 2011 report by the Institute for Sustainable Energy policies assesses, "March 11, 2011 is the historic 'third reset' day for Japan, following the Meiji Restoration and the defeat in the Pacific War."[4]

This paper focuses on one particular sphere, which definitely affects the entire socio-economic and political situation at present and is certainly to determine the country's future. The paper seeks to analyze Japan's energy policy before 2011 highlighting the aspects of risk management, asses the socio-economic costs associated with the energy crisis followed after the Great Tohoku Earthquake and Tsunami and examine the options for the nation's future energy

[3] Higashi Nihon Shinsai ni okeru Higaigaku no Suikei ni tsuite [Information on Estimates of the Damages Caused by the Great East Japan Earthquake]. Retrieved from: http://www.bousai.go.jp/oshirase/h23/110624-1kisya.pdf

[4] From "Unplanned Power Outages" towards a "Strategic Energy Shift". A Report on Japan's Energy Shift since March 11th. Institute for Sustainable Energy Policies, Japan. May 6, 2011, p. 22. Retrieved from http://www.isep.or.jp/images/press/ISEP_Strategy%20No1%20Revised.pdf

policy. Also, some potential implications of Japan's changing energy policy for the international community are discussed.

2. Japanese Energy Policy Before 2011

2.1. Energy Policy Review

Beginning from 1967, every two to five years the government published long-term energy supply-demand outlook *(Choki enerugii jukyu mitoshi*), which forecast the most important parameters under different policy scenarios and assumptions. The outlook however did not contain the policy itself. The latter had been informed by various measures of mainly reactive nature. Indeed, the 1970s oil shocks and the international oil market turbulences of 1990s and early 2000s were significantly changing the overall setting for energy policy at the time and the energy planners were confronting unforeseen agenda.

In 2000s, however, Japan has acquired a more systematic approach to energy governance. In June 2002, the Fundamental Law on Energy Policy Measures (*Enerugii seisaku kihon ho,* also known as the Basic Act on Energy Policy),[5] was approved. The document established three principal goals of energy policy: securing a stable supply of energy, ensuring environmental sustainability and promoting market mechanisms. It also defined the roles of the principal actors and stakeholders in energy policymaking: the central government, local governments, businesses and the general public. The Basic Act specified that the government develops a long-term supply and demand plan every three years and revises it as necessary in line with changing energy policy environment. The METI was made responsible for drafting the basic energy plan, which then had to be approved by the cabinet before reporting it to the Diet.

In October 2003, the first Basic Plan was developed. It emphasised the need for nuclear power development as an important means to ensure the security of energy supply and environmental sustainability. In accordance with Basic Act, the Plan was revised in 2006 and adopted in 2007. In 2006, however, the New National Energy Strategy (S*hin-kokka enerugii senryaku*, or NNES) was prepared by the METI.[6] The NNES became a very important document that shaped the discussions on the future national energy policy. The NNES reflected the Japanese government's growing concern about rising worldwide resource nationalism and

[5] Accessible at: http://www.asiaeec-col.eccj.or.jp/eng/pdf/e2101basic_law.pdf
[6] Accessible at: http://www.enecho.meti.go.jp/english/report/newnationalenergystrategy2006.pdf

intensifying international rivalry for the access to energy resource. The document highlighted four key areas for Japan's new energy strategy: 1) optimization of demand-supply structure through the promotion of energy conservation, new types of fuels for transport, R&D in new energy technologies and nuclear energy; 2) strengthening resource diplomacy and international cooperation on energy and environment (especially in the Asian context); 3) enhancement of emergency response via further oil stockpiling, production of indigenous gas, etc.; and 4) addressing common challenges through the advancements of energy technology, sustainable environment policy, etc.

In the following years, despite continuously growing energy prices, the Japanese government was not so much concerned about security of supply. One of the reasons, as the author of this paper used to receive as a traditional answer from the Japanese energy policy making involved officials, was that Japan was rather confident about its financial ability to afford any further rise in oil prices. What visibly started to absorb much greater attention of the policy makers at the time was the environmental sustainability. Indeed, in May 2007, the then Prime Minister Shinzo Abe announced the Cool Earth 50 initiative to reduce GHG emissions in Japan and globally. In July 2008, the cabinet adopted a detailed Action Plan for Achieving a Low-carbon Society. These efforts were continued by the new government led by the Democratic Party of Japan, which shortly after taking the office in September 2009 announced the ambitious goals of reducing GHG emissions by 25 % below the1990 level by 2020 and by 80 % below 1990 level by 2050, striving to find support of other countries towards a target of at least 50 % cut in global emissions by 2050. A detailed bill of The Basic Act on Global Warming Countermeasures was drafted in 2009, approved by the cabinet in March 2011 and submitted to the Diet.[7]

Meanwhile the economic reasoning has begun looming larger in the government energy policy making. The Japanese industry encountered the global crisis-borne effects of shrunk demand for Japanese exports, extremely unfavourable for the export-oriented business shifts in currency exchange rate and unprecedentedly strengthened competitiveness of the Japanese companies' international contenders. In 2010, burdened by deflation, soft domestic demand and pressured by the industrialised world's biggest debt, Japan lost its number two world's economy status to China. In energy industry too, in 2008, for instance, once the largest in the world solar cells exporter, Japan was surpassed by Germany and China. Furthermore, in December 2009 in a bid for a $20 billion

[7] Summary accessible at: http://www.env.go.jp/en/earth/cc/bagwc/overview_bill.pdf

contract to build four nuclear reactors in the UAE, Japanese Hitachi was outstripped by a Korean consortium, which had never had an international contract.

This was the context in which the new Basic Energy Plan was developed in 2010. METI presented a draft to the Basic Energy Planning Committee, a subcommittee of METI's Advisory Committee for Natural Resources and Energy (ACNRE), in March. After a round of deliberations and minor changes, the plan was approved by the cabinet of the then Prime Minister Yukio Hatoyama on June18, 2010.

The BEP 2010[8] lays out seven general goals of Japanese energy policy: enhancing overall energy security; strengthening policy to counter global warming; achieving economic growth with energy being a core driver; ensuring the safety of the energy supply; ensuring the efficient functioning of energy markets; restructuring the energy industry and gaining public understanding. The BEP 2010 has more ambitious targets than its predecessors did. Among those, for instance, are doubling Japan's energy independence ratio, doubling the percentage of electricity generated by renewable sources and nuclear power and 30 % reduction in CO2 emissions, all by 2030. The BEP 2010 reveals a favourable attitude to nuclear energy as a power source with 3E advantages (energy safety, environmental sustainability and economic efficiency). The post-March reality has put the reliance on nuclear power in the formerly planned manner out of the question. Consequently, the BEP 2010 is undergoing a revision.

2.2. Nuclear Energy Policy Throughout 2011

By 2011, Japan had one of the most advanced commercial nuclear power programs in the world. The nuclear power industry consist of 54 reactors with the total installed generating capacity of around 49 GW, which makes Japan the third largest (after the U.S. and France) nuclear power generator. Before the 3-11, Japan had two reactors under the construction and 12 others at different planning stages.

Japan started its nuclear research program in 1954. The Atomic Energy Basic Law Strictly limiting the use of nuclear technology to peaceful purposes was introduced in 1955. Three principles –democratic methods, independent

[8] "The Basic Energy Plan". June 2010. [Enerugii Kihon Keikaku] Retrieved from*:* http://www.meti.go.jp/committee/summary/0004657/energy.pdf

management and transparency- established the basis of nuclear research activities in Japan and the country's international co-operation. In 1956, the Atomic Energy Commission was established. Key governmental agencies and industry began to develop a closed nuclear fuel cycle through reprocessing and recycling the used nuclear fuel from the light water reactors (LWR). In doing so, Japan hoped to decrease dependency on foreign sources. Japan's commitment to closing the nuclear fuel cycle necessitated the development of certain technologies –fast breeder reactor (FBR) and reprocessing to produce the fuel for use in these reactors. The adherence to reprocessing subsequently locked Japan in the need for FBR in order to prevent the stockpiling of the reprocessed material –plutonium– a material usable for nuclear weapons production and therefore subject to stringent safeguards. This strategy, as the history of Japanese nuclear industry illustrates, has engaged the country in a technological path with dubious economic and safety benefits.

The first reactor to produce electricity in Japan was a prototype boiling water reactor (BWR): the Japan Power Demonstration Reactor (JPDR). The JPDR was run during 1963-1976 and produced data valuable for further development of the commercial reactors. Later it also provided the test facilities for reactor decommissioning. Japan imported its first commercial nuclear power reactor from the UK (operated from 1966 to 1998). By the end of the 1970s, however, Japanese Hitachi Co Ltd, Toshiba Co Ltd and Mitsubishi Heavy Industry Co. Ltd. (in cooperation with U.S. companies) had established the domestic nuclear power production capacity. Nowadays, the Japanese companies export the NPP equipment and technologies to East Asia as well as are involved in the development of new reactor designs likely to be used in Europe.

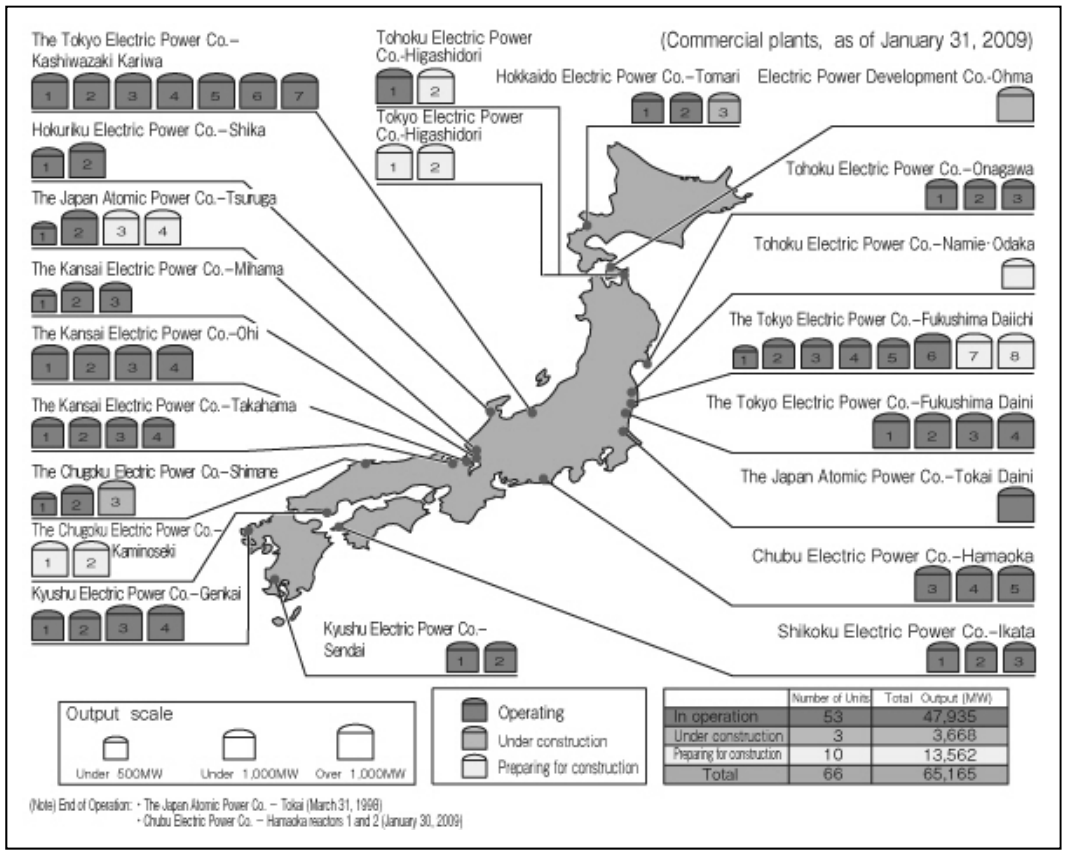
As noted earlier, Japan's recent energy policy has had a clear focus on nuclear power. The main elements of the Japan contemporary nuclear energy policy were to: increase nuclear power capacity as a major element of electricity production; further advance domestic recycling and reprocessing; develop the reactors designs in order to improve the utilization of fuel and promote nuclear energy to the public emphasizing its safety.

In March 2002, the Japanese government announced that it would increase its reliance on nuclear energy to achieve GHG emission reduction goals set by the Kyoto Protocol. In 2008, in Cool Earth 50 energy innovative technology plan, the Japan Atomic Energy Agency (JAEA) has planned a 54 % reduction in CO2 emissions (from 2000 levels) by 2050 targeting a 90 % reduction by 2100. This

envisioned that nuclear energy would contribute about 60 % of primary energy in 2100 (compared with 10 % at the time).

Before March 2011, Japan had about 32 % of electricity generated by nuclear power plants (NPP) and planned to increase this share to some 50 % by 2030 through the construction of 14 new reactors (Figure 1). [9]

Figure 1: Nuclear Power Plants in Japan



Source:http://nuclearstreet.com/nuclear_power_industry_news/b/nuclear_power_news/archive/2010/04/22/japan-intends-to-build-over-14-new-nuclear-power-plants-by-2030-04225.aspx

[9] *White Paper on Nuclear Energy. 2009.* Japan Atomic Energy Commission [Genshiryoku Hakusho. Genshiryoku iinkai. 2009] Retrieved from: http://www.aec.go.jp/jicst/NC/about/hakusho/hakusho2009/index.htm.

Three main arguments traditionally set forth to advocate nuclear energy use relate to three aspects. The first is what can generally be explained through the notion of energy security. Two other principal considerations for the nuclear power promotion in Japan fall within the areas of economics and environment.

Japan is known for having a very limited stock of domestically available natural resources. As one of the most developed economies, Japan consumes all types of energy resources in great volumes. As a result, the country is the world's third largest importer of oil (after the U.S. and China) and the largest importer of LNG and coal. Meanwhile, self sufficiency ratio for energy resources stands at some 18 % (indigenous sources and nuclear energy) and only at around 4 % when nuclear energy is excluded. Logically, the nuclear energy option has been pursued as one of effective means to diversify Japan's energy resources and fortify the national energy security. Over the years, Japan was gradually establishing the sector.

Speaking on economic account, the cost of unit of electricity generated by NPP has traditionally been estimated as the lowest compared with the costs of electricity produced using all other traditional and renewable sources of energy. Reasonably, for the economy striving to maintain its international competiveness, the production costs is by far a considerable issue. Although the number of proponents of the nuclear energy cost-efficiency argument has definitely declined after a more precise price of the Fukushima accident became known, there is still some support based upon this very economic reasoning. Less controversial point is that the nuclear energy helps Japan to reduce the financial burden of fossil fuels imports. It is estimated, for instance, that because of the nuclear power, Japan's oil imports is lower by some 440 Mb/y, which means less of the financial resources vitally needed domestically is spent to pay for the increasingly costly resource. This aspect gains an additional importance in the light of Japan's posted in 2011 first trade balance deficit in over three decades. Among various factors (strong yen, shrinking external demand, etc.), larger physical volumes of fuels coupled with their higher prices attributed to Japan's negative balance.

On the environmental front, as a prominent advocate of the climate change policy, Japan has even higher responsibility to abide by the earlier set targets. Meanwhile, for the economy with already advanced level of energy-efficiency and low energy-intensity, it is extremely hard to sustain the economic growth while continuing to toughen the climate change policy parameters. From this angle, the reliance on (relatively) ecologically clean nuclear power is one of the most

practicable solutions. The Federation of Electric Power Companies assesses, for instance, that nuclear power helps Japan to lessen its annual CO2 emissions by some 14 %.

2.2. 1. Nuclear Energy Safety and Regulation

Public support for nuclear power in Japan has been eroding since the 1990s due to a series of accidents and scandals. The accidents were at the Monju FBR in 1995, at the waste bituminisation facility connected with its reprocessing plant at Tokai-mura in 1997, and the 1999 criticality accident at a private fuel processing company Japan Nuclear Fuel Conversion Co. (JCO) in Tokai-mura.

In 2002, a major scandal erupted over the documentation of equipment inspections at TEPCO's reactors. While the issues were not safety-related (inspection, which was the responsibility of TEPCO, had been contracted out), the industry's reputation was seriously damaged. In May 2002, questions emerged about data falsification and the significance of cracks in reactor shrouds and whether faults were reported to senior management. On August 29, 2002, the government revealed that TEPCO was guilty of false reporting in routine governmental inspection of its nuclear plants and systematic concealment of plant safety incidents. All seventeen of its boiling-water reactors (BWR) were shut down for inspection as a result. TEPCO's chairman, vice-president as well as two advisers stepped-down by September 30, 2002. The utility eventually admitted two hundred occasions over more than two decades between 1977 and 2002 involving the submission of false technical data to authorities. TEPCO's new president issued a public commitment that the company would take all the countermeasures necessary to prevent fraud and restore the nation's confidence. By the end of 2004, TEPCO eventually had all its reactors back on line, but the total cost of this debacle was about 2 billion yen.

In 2004, an eruption of heated steam from a burst pipe at a reactor run by Kansai Electric killed five workers. A government investigation showed this pipe section was omitted from safety checklists and therefore has not been inspected for all the 28 years the plant had been in operation.

In 2007, in pursuit of the safety, the Nuclear and Industrial Safety Agency (NISA) ordered the reactor owners to check their records and uncover the incidents which should have been reported at the time but were not. This revealed other TEPCO's accidents that were not reported in 2002. TEPCO reported about its

Fukishima I-3 BWR's criticality incident that lasted over seven hours during an outage in 1978, when control rods slipped out of position, and at least six emergency stoppages at Dai-Ichi. Kansai Electric, Chubu Electric Power Co., Tohoku Electric Power Co. and Hokuriku Electric Power Co. have also admitted they faked safety records.

Public bewildered and frustration enlarged even further when various falsifications committed not only by the utilities, but their contractors and companies involved, were disclosed. It has been revealed, for instance, about a cover-up of a damage in a production process of a $250 million steel pressure vessel for TEPCO in 1975. Scrapping the damaged vessel (today it holds the fuel rods in the core of the No. 4 reactor at Fukushima's Dai-Ichi plant), as the law required, would mean Hitachi's bankruptcy. The vessel was eventually reshaped to cover the damage. Mitsuhiko Tanaka, who supervised the work at the time, filed a report on the case years after Chernobyl. However, summoned to clarify the case Hitachi denied any misdoings and the government did not initiate further investigations.

The series of scandals over the electric companies' systematic false reporting and their failures to comply with the safety regulation have increased public criticism, undermined citizens' trust and turned public opinion against the industry.

While the above are examples of negligent safety mismanagement, because of Japan's proneness to various natural disasters, additional and a very close attention is required to risk management. One of the major natural hazards facing Japan is earthquakes. High seismicity demands a particular attention to design and construction of NPP. In May 2007, the revised seismic criteria were announced ordering some reinforcement of older plants. In July 2007, the Niigata Chuetsu Oki earthquake occurred on a fault close to the Kashiwazaki-Kariwa NPP. The earthquake was stronger than the plant was designed for. Although there was no damage to the main parts of the plant, some leakage of the radioactive water has occurred. The 20-member Chuetsu Investigation and Countermeasures Committee acknowledged that the government was responsible for approving construction of the first units in the 1970s in a dangerous proximity to a geological fault line. In October 2008, the NISA presented to the Nuclear Safety Commission (NSC) its evaluation of TEPCO's report on Kashiwazaki Kariwa. It contained the results of TEPCO's inspections and assessments of equipment, buildings and other structures at the plant following the July 2007 earthquake. In 2009, the NSC endorsed NISA's recommendation for the units 6 and 7 to be restarted.

Tsunami is another feature of Japan. Since 1498, there have been 16 tsunamis with the waves' height exceeding 10 metres; these were happening on average once every 30 years. As the Fukushima accident showed, although a new inspection system of nuclear facilities came into effect in 2009 (following deliberations on the matter since November 2005), the tsunami risk was not evaluated appropriately and no preventive measures were undertaken. TEPCO's Fukushima NPP operated on the assumption about the maximum height of tsunami of 5.7 meters (only a few days before the tsunami TEPCO submitted a report where it admitted a possibility of tsunami of up to 10.2 meters). Interestingly, that at the time of construction TEPCO lowered the cliff level by 25 meters to make it easier to deliver the construction materials by the sea. While TEPCO called the 13.1 meter tsunami that hit Dai- Ichi "unforeseeable," geological surveys in the last decades suggest otherwise. From the 1980, a geologist Koji Minoura at Tohoku University has been disseminating the results of his research evidencing that the area had been hit by three giant tsunamis over 3,000 years.[10]

Overall, the industry neglected the warnings based on advances in seismology since the 1960s and 1970s when many of Japan's NPPs were built. Katsuhiko Ishibashi, a seismologist and former professor in the Research Centre for Urban Safety and Security at Kobe University, argued that Japan's nuclear accidents origin in overconfidence in plant engineering. As a member of a 2006 Japanese government subcommittee charged with revision of the national guidelines on the NPPs' earthquake-resistance, Ishibashi proposed the amendment of the standards for surveying active faults. His proposed was rejected and Ishibashi resigned claiming that the review process was unscientific and the outcome rigged to suit the interests of the Japan Electric Association, which had 11 out of 19 members in the government subcommittee. Ishibashi pointed that the subcommittee's guide was seriously flawed because it underestimated the earthquake.[11]

Critically vital elsewhere, in Japan, given the magnitude of natural hazards here, the system of safety regulation of nuclear power sector has an absolute

---

[10] See Minoura, Koji, Nakaya, Shuyu (1991). "Traces of Tsunami Preserved in Inter-tidal Lacustrine and Marsh Deposits: Some Examples from Northeast Japan". *Journal of Geology.* Vol. 99. No. 2. Retrieved from: http://www.jstor.org/pss/30081120; Minoura, Koji (2001). Tsunami saigai wa kurikaesu [Tsunami Disaster Repeats]. Retrieved from*:* http://web.bureau.tohoku.ac.jp/manabi/manabi16/mm16-45.html

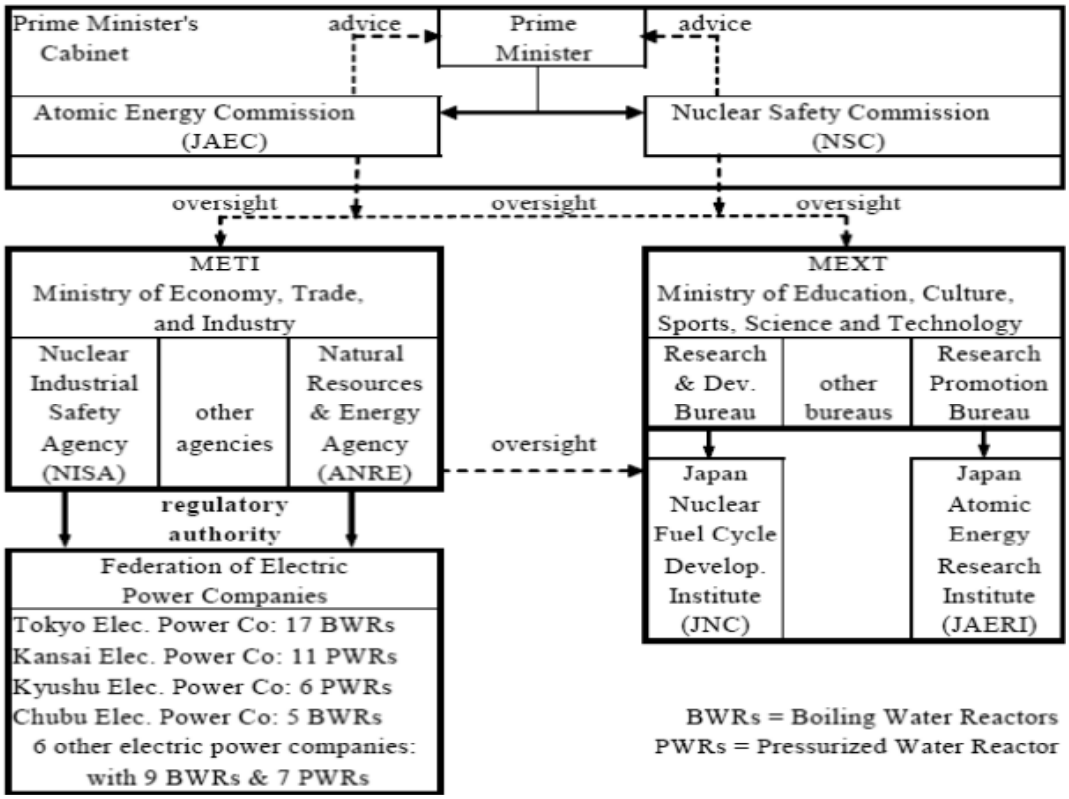
[11] Ishibashi Katsuhiko (2007). "Why Worry? Japan's Nuclear Plants at Grave Risk from Quake Damage". *The Asia-Pacific Journal: Japan Focus*. August 11.

significance. Having briefly reviewed the records of safety incidents in the Japanese nuclear power sector, it is worth taking a closer look at organization of safety regulation. The latter, as admitted, suffers numerous deficiencies.

Examination of nuclear policy-making in Japan demands a three-level analysis: intentional, national and regional. In more detail, national and regional aspects are addressed below, while only a few points involved with the international facet of nuclear policy-making in Japan will be touched upon in the latter part.

Before the organizational changes have been undertaken following the March 11, Japan's nuclear policy-making was executed by the agencies within the following structure (Figure 2).

Figure 2: Organization of Nuclear Energy Policy Making (before 2011)



Source: Aoki, Masahiko and Rothwell, Geoffrey (2011). "Organizations under Large Uncertainty: An Analysis of the Fukushima Catastrophe". National Energy Policy Institute. Institute. NEPI Working Papers. October 7. p. 5.

Since its establishment, the nuclear policy in Japan was generated by three key agencies and implemented by industry and a number of public-private corporations with special status.

The Japan Atomic Energy Commission (JAEC, 1956), under the authority of the Prime Minister's Office, sets national nuclear policy (The Long-Term Program for the development and utilization of nuclear energy, LTP), promotes the research, development and implementation of nuclear energy. The Nuclear Safety Commission (NSC) is a more senior government body set up in 1978 under the Atomic Energy Basic Law and is responsible for formulating policy alongside the Atomic Energy Commission. After the 2001 reform, JAEC and NSC are part of the Cabinet Office. The NISA within the METI is responsible for nuclear power regulation, licensing and safety; it conducts regular inspections of safety-related aspects of all power plants.

The METI prepares the long-term vision on energy (*Choki enerugii mitoshi*) and works with the industry to facilitate the implementation of JAEC's LTP. METI is focused on the promotion of industrial policy, including nuclear policy. The Ministry of Culture, Sports, Science and Technology (MEXT), the Ministry of Foreign Affairs (MOFA) and the Ministry of Finance (MoF) also play their respective part in the development of the nuclear power in Japan. As the result of 2001 reform under which the Science and Technology Agency was abolished, the MEXT is tasked with science and technology aspects of the nuclear industry. The MOFA, given the U.S. and other countries involvement in Japan's nuclear sector development, often negotiates critical agreements to ensure the progress of the Japanese nuclear industry. Meanwhile, the MoF is crucial in funding the new projects.

2.2.2. Making Nuclear Energy Policy in Japan: Nemawashi, Nigen Taisei and Other Practices

Numerous agencies, organizations and corporations make up a network that promotes nuclear power; the camp is coined "nuclear village"[12] or *genshiryoku mura*, in Japanese.

[12] "Nuclear Crisis: How it Happened. 'Nuclear Power Village' A Cozy, Closed Community." *Yomiuri Shimbun.* June 16, 2011. Retrieved from: http://www.yomiuri.co.jp/dy/national/T110615005652.htm.

The post-March reality is that Japanese civil society, local communities, NGOs, NPOs and even individuals from the nominal actors of nuclear policy making process turned into real ones. This paper does not focus on the analysis of this transition, the addresses the most notorious practices employed in the Japanese energy policy making.

Among the notorious, the most known in the west is *amakudari* (literally "descended from the heavens"), a practice of former bureaucrats taking advisory posts in industries they previously regulated. Common for the entire system of policy making in Japan, the practice is hard to die despite all the severe criticism from within and outside of the government and the government's regular programmatic pledges to weed it out. Among many examples,[13] a couple is presented here to pin the point about the government – utilities, in particular, TEPCO connection. According to Yomiuri Shimbun of June 16 2011, since 2000, power companies have sent at least 100 employees to central government bodies for on-loan postings, according to the government. These government bodies include the NSC and other offices involved in safety at NPPs. TEPCO, which has sent 32 workers to the government, had reserved seats at several posts. Meanwhile, 68 former industry ministry officials have moved to postretirement jobs as executive board members or advisers at 12 of the power companies over the past five decades. As of May 2, 2011, there were still 13 former industry ministry officials working at TEPCO and 10 other power companies.

Tokio Kano is credited to be one of the best examples of the system. He joined TEPCO in 1957 and became its executive vice president in 1989. In 1998, Tokio was elected to the parliament backed by Keidanren, where he has been ardently working towards re-formulation of Japan's national energy policy favouring nuclear energy. After being involved within the political system two times for six-year period, Tokio returned to TEPCO in 2010.

Toru Ishida became an adviser at TEPCO in January 2011, just four months after retiring as the head of the Natural Resources and Energy Agency, the METI organization that promotes the nuclear industry. He was seen as likely to become a TEPCO vice president. After becoming a post-tsunami symbol for amakudari, Ishida resigned.

[13] Pritchard, Justin (2011). "Realistic Safety Debate Not Nuke Sector, Regulator Forte". *The Japan Times,* May 5, 2011. Retrieved from: http://www.japantimes.co.jp/text/nn20110505f1.html.

Traditionally, the Japanese nuclear policy-makers and industry heavily relied on the domestic relations and internal framework for decision-making. An implicit process of subtle negotiations and discussions that occur between key players prior to the official meeting has its Japanese name – *nemawashi* (literally, "digging around the roots of a tree" (before transplanting). The overall (intended) result of such practice is indispensable and invariable consensus despite any underlying conflicts and differing objectives. While for the agencies assigned with one task it could probably be a commendable practice, in case of nuclear policy-making it caused great damage in a form of wasteful financial backing, for instance. The resources were allotted by the MoF for the domestic development of the technologies readily available abroad. The JAEC's and STA's safety considerations could be downplayed as the result of intensive consultations with the METI. The rotation of staff between the different agencies, as well as, between the industries, further reinforced the positions of nuclear power. That is, the METI's *Enerugii choki mitoshi* traditionally coincided with the JAEC's LTP for nuclear energy development in the principal objectives and targets for energy policy.

Much like the process of intra-government negotiations, there is a pattern of close relationship between the government and industry. The METI is largely credited with creating and maintaining the practice of *nigen taisei*, a complex relationship where the government has no choice but rely on industry for the implementation of its plan. In turn, having no autonomy, the industry abides by the government's plan. When the conflicts of interests arise, they are resolved within the policy-making system. Under this practice, for instance, the METI has implemented the development of the FBR in Japan. The Monju FBR in Tsuruga and Rokkasho-mura reprocessing plant can also be referred as the examples to the point.

Recently, the continuation of *nigen taisei* has been increasingly difficult because of its sheer contradiction to the government's and METI's own declarations about the need for the electric power market deregulation. Moreover, growing costs of reprocessing and overall deteriorating economics of nuclear power in Japan affected the sector's attractiveness. It became much more a challenge for the government to get the industry engaged in the implementation of the plans it charts.

Other important dimension of nuclear energy policy making in Japan involves local communities. These relationships certainly contributed to the

progress of nuclear power in Japan. Back in 1950s, the government was utterly concerned about the means to revive the devastated by the WWII areas and bring the growth and development to the rural Japan. Development of nuclear energy meant the erection of state-of-the-art infrastructure and creating jobs, all almost missing and all so needed in *inaka* Japan at the time. Also, the locals could enjoy sport and cultural facilities and many more other luxuries, which otherwise could never appear there as unaffordable by the local budgets. Siting a nuclear facility in a certain area has always been exchanged to (or bought by) the flows of government financial packages, subsidies and special programs and private incentives. This boosted the development of the adjacent areas; the phenomena coined a "donut" effect.

The negotiation involves a triad composed of the government, representatives of local communities (more often governors, but also local government officials, fishing and agricultural associations) and industry (utilities). This practice heavily relies on a gentleman's type of agreements. A crucial stage of negotiation is over the decision on the nuclear facility's siting. The governor, as the evidences prove, have the ultimate power and can veto any project regardless of the progress already achieved through the negotiation with all other parties concerned. There were only a few cases when the local community called for a referendum and could influence the decision.

Taking case of Fukushima prefecture, it is nicknamed Nuclear Ginza for the highest concentration of the nuclear reactors (ironically, thirteen). Before the natural disaster triggered the human catastrophe with almost 20,000 lives lost and almost 200,000 people evacuated from highly radioactive area, local residents enjoyed higher than average incomes and bigger than average housing. Now, almost one year on, the former residents of the deserted by tsunami and radiation area endure poor housing conditions, high unemployment, serious health complications, etc. It is a dreadful price the local communities and the whole nation have paid and yet to pay for many years to come for the flawed policy making.

3. Problems Revealed by 3-11

3.1. Information, its Price and Cost

Perhaps, one of the most serious issues revealed by the disaster of March 2011 is information or, more precisely, collection of accurate and adequate

information, its dissemination and accessibility. The highest price was paid by those who in their attempts to save their lives were fleeing destroyed houses only to get into radioactive clouds, as nobody guided thousands of people through the area. The disruption of communication in the very first days following the earthquake and tsunami has been felt sharply even at the government agencies level. The government seemed genuinely to be very poorly informed about the post-tsunami situation at Fukushima Dai-Ichi, but TEPCO was purposely withholding the horrible true and playing down the danger spreading over the north-eastern part of Japan. Most of all, commercially-minded TEPCO was concerned about its material losses, willing to safe as much as only possible. That is why, for example, TEPCO postponed pumping the seawater for cooling the reactors despite the government's ordinance to do so.

Going far back prior to this major crisis, an unpleasant picture of nuclear industry is appearing from numerous cases of concealed accidents at the NPPs and ill practices widely employed in nuclear policy making. Often, the information the Japanese society has been given, was carefully filtrated or even counterfeited. There was no, for instance, an impartial examination of the costs of electricity generated by different sources of energy. The approved by the government reports emphasized nuclear energy's by far outstanding cost-efficiency, but they contained no adequate consideration for the associated with nuclear energy safety costs, reprocessing and storage costs, ecological hazards, etc. It is only natural then that the disaster revived and expanded further the camp of anti-nuclear researchers and activists making them more vocal in expressing their professional and civil opinions and bolder in their initiatives.

One of the most seriously debated issues involves earlier addressed question of nuclear energy cost efficiency. The results of previous studies were revisited and the new enquiries have been undertaken. Kenichi Oshima, a professor of environmental economics and policy at Ritsumeikan University, for instance, examined the cost of nuclear energy using the utilities' financial reports. Along with his supported by calculations argument about dubious cost-efficiency of the nuclear energy, the professor's findings disclose an extreme unfeasibility of the spent fuel reprocessing.[14] Why do Oshima's results differ from the official data? The professor took into consideration large government subsidies, estimating that some 70 % of the total amount of subsidies provided by the national government has gone to nuclear; used actual data on operating levels, which are closer to 70 %, not 80 % assumed in government costing; looked at the

[14] Oshima, Kenichi (2010). *Political Economics of Recyclable Energy,* Toyo Keizai Inc.

plant construction and operating costs, which due to the delays in construction and overruns were higher in actuality than in the pro-forma examples often cited; included the costs of nuclear waste management, which were overlooked in the government's estimates; etc.

According to Professor Oshima's calculations between fiscal 1970 and fiscal 2007, the cost for a kilowatt-hour of nuclear-generated power was the most expensive (Table 1).

Table 1: Unit Power Generation Cost by Types of Generating Facilities (based on Oshima, 2010), yen/ kWh

		Nuclear	Fossil	Hydro	Conventional hydro	Pumping-up hydro	Nuclear + pumping-up hydro
1970s	Unit power generation cost	8.85	7.11	3.56	2.72	40.83	11.55
	Unit development cost	4.19	0.00	0.00	0.00	0.00	4.31
	Unit siting cost	0.53	0.03	0.02	0.01	0.36	0.54
	Total unit cost	13.57	7.14	3.58	2.74	41.20	16.40
2000s	Unit power generation cost	7.29	8.90	7.31	3.47	41.81	8.44
	Unit development cost	1.18	0.01	0.10	0.05	0.60	1.21
	Unit siting cost	0.46	0.11	0.10	0.07	0.38	0.47
	Total unit cost	8.93	9.02	7.52	3.59	42.79	10.11
FY 2007	Unit power generation cost	8.05	10.73	7.58	3.58	45.34	9.19
FY 1970-2007	Unit power generation cost	8.64	9.80	7.08	3.88	51.87	10.13
average	Unit development cost	1.64	0.02	0.12	0.06	0.94	1.68
	Unit siting cost	0.41	0.08	0.06	0.04	0.34	0.42
	Total unit cost	10.68	9.90	7.26	3.98	53.14	12.23

Source: Yuji Matsuo, Yu Nagatomi and Tomoko Murakami, "Thermal and Nuclear Generations Cost Estimates Using Corporate Financial Statements". *IEEJ.* October 2011. p. 4. Retrieved from: http://eneken.ieej.or.jp/data/4103.pdf

These results have even been discussed at a meeting of the Atomic Energy Commission in September 2011. Professor Oshima and others' findings[15] pose a question Why is that possible that despite all the economic inefficiency and enormous ecological hazard, nuclear energy has been bestowed such a favourable treatment. In the following, some lines of analysis are offered. Here, it is tempting to assume that it may largely be because so many resources and efforts were funnelled into nuclear sector and so strong forces were involved with the industry

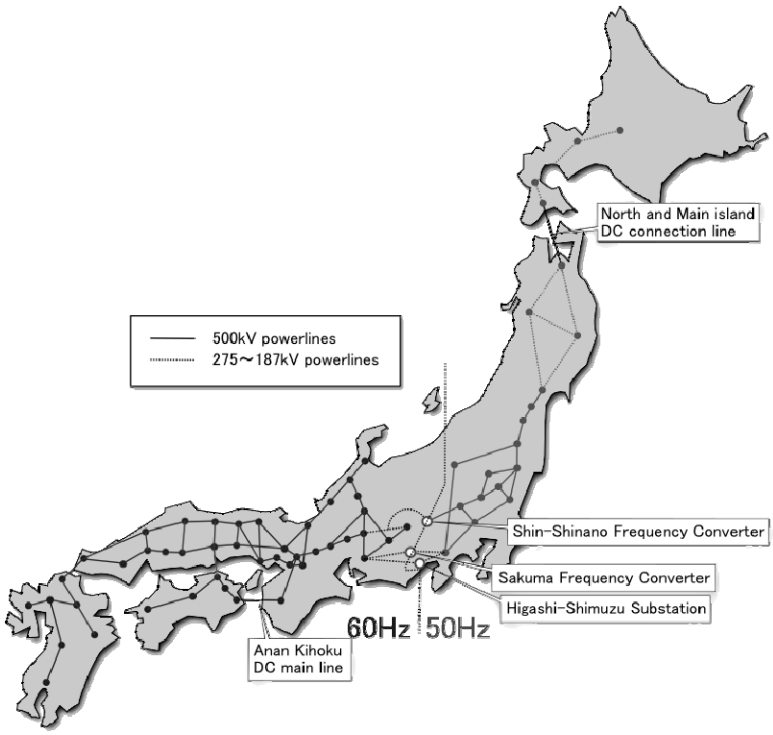
[15] Japan Rode over Summer with Nationwide Power Saving. *Japan Energy Brief.* IEEJ. No. 15, September 2011. Retrieved from: http://eneken.ieej.or.jp/en/jeb/1109.pdf. Yuji Matsuo, Yu Nagatomi and Tomoko Murakami, "Thermal and Nuclear Generations Cost Estimates Using Corporate Financial Statements". IEEJ. October 2011. Retrieved from: http://eneken.ieej.or.jp/data/4103.pdf

that others, first and foremost, renewable energy has been if not altogether neglected then left on its own.

3.2. Connected Along... or Split Across

When following the power failure of TEPCO-run NPPs in Fukushima some 4.9 million people in Tohoku regions and several thousands of users in the regions of Tokyo lost power supply and other densely populated and industrialized areas of Japan faced with the electricity shortage, for many it came as a big surprise that the country's electric grid is not harmonized (Figure 3).

Figure 3: Power Grid in Japan.



Source:http://ja.wikipedia.org/wiki/%E3%83%95%E3%82%A1%E3%82%A4%E3%83%AB:Power_Grid_of_Japan.PNG

Although some electricity generating capacity of the quake-intact regions could have been utilized to ease the power deficit of Tokyo, it turned out to be technically difficult. A peculiarity is that three electric companies in eastern Japan

- Hokkaido Electric Power, Tohoku Electric Power, and Tokyo Electric Power – operate 50 Hz, whereas seven electric companies in western Japan - Chubu Electric Power, Hokuriku Electric Power, Kansai Electric Power, Chugoku Electric Power, Shikoku Electric Power, Kyushu Electric Power, and Okinawa Electric Power - adopt 60 Hz. For power exchange between eastern and western Japan, three frequency converters of total capacity of about 1 GW have been set up by three utilities: J-Power, Tokyo Electric Power, and Chubu Electric Power.

This, by all accounts, paradoxical situation has a long history. The Japanese electricity business started with the foundation of Tokyo Electric Lamp Company in 1883. Later, electric light companies were founded throughout Japan and the pioneering Tokyo Electric Lamp had been installing power generators imported from Germany for other electric lamp companies. Osaka Electric Light Company, which was founded in 1888, took an independent path importing 60 Hz alternating-current generators from the U.S.

Apparently, preserving domestic electrical grid setting as it was initially established by the business rivals adversely impacts Japanese economy, not to speak about all-inclusive issue of national security. It took this major disaster to start serious deliberation of the situation in the national electric power. Along with the discussion about the grid unification, debate about the need for the nation's gas pipeline system has revived. Developments in both directions are likely to be seen before long.

3.3. Forgotten and Abandoned

A peculiarity of Japan is still not so much solidified civil society coupled with strong culture for and rich traditions within the local communities. Before the 3-11, the utilities could relatively easily foster their plans through the provisions of some financial support to the communities in the rural greying areas, where rather limited jobs were mainly in agriculture or fishery. For the places that used to have jobs and enjoy additional financial flows and public facilities comparable to those in the big cities (cultural halls, swimming pools and the like), all brought in by the utilities, it is a hard choice even now to outlaw the NPPs.[16] For the Japanese government faced with rapidly deteriorating budget deficit it seems nearly impossible to take a comparable to former scale care of the areas where the utilities used to reign. The problem of the future development in the

[16] Japanese town's dependence on nuclear plant hushes criticism. *Asahi Shimbun.* January 27, 2012. Retrieved from: http://ajw.asahi.com/article/behind_news/social_affairs/AJ201201270014

areas hosting the NPPs is certainly discussed by the government, but comprehensive policy is yet to be formulated.

4. Energy Policy after March 11

4.1. Whether a Paradigm Shift?

Certainly, the constrained energy supply endangers Japan's economic recovery. According to the Institute of Energy Economics, Japan (IEEJ), in case the nuclear energy is abolished, Japan's GDP growth for 2012 is projected at 0.1 %; if nuclear energy is allowed, the national economy may see some 1.9 % increase in GDP.[17]

Japan is forced to formulate a new energy policy, because it simply needs to make-up for that 30 % chunk of electricity previously generated by the NPPs. As of February 2012, only two reactors (at Kashiwazaki-Kariwa and Tomari NPPs) are on-line with a perspective of all 54 reactors being shut down by the end of April 2012.[18]

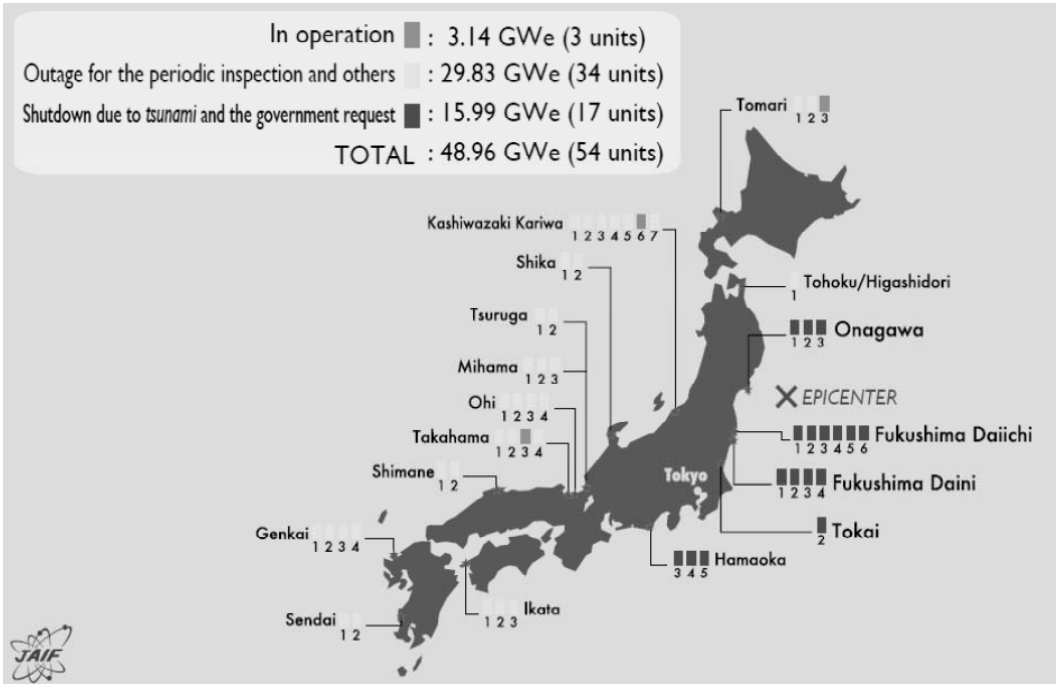
The reactors are being stopped for a periodic check, but it is yet very far from being decided when, if at all, the NPPs can resume operation. One conclusion can be drawn quite definitely: nuclear power's heyday is over in Japan.

---

[17] *Japan Energy Brief*. No. 17. January 2012. Retrieved from: http://eneken.ieej.or.jp/en/jeb/1201.pdf

[18] *The Mainichi Daily News*. February 10, 2012. Retrieved from: http://mdn.mainichi.jp/mdnnews/news/20120210p2g00m0dm024000c.html

Figure 4: Japan's NPPs Current Status.



Source: Japan Atomic Industrial Forum, Inc. Retrieved from: http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS02_1327975531P.pdf

Since March 11, 2011, the Japanese government has been making tremendous efforts to solve numerous contingencies, handling which it has never experienced neither practically nor theoretically. March 11, 2011 became a watershed in many aspects for the policy making in Japan. Energy policy stands to be the area undergoing the most profound transition. The changes involve diverse aspects, but their essence can be summarised as centred on enforcement of safety of energy, improvement of economics of energy and protection of environment.

The most principal decision to be made is certainly about the future of nuclear energy in Japan. Whether it must be phased out absolutely or a form of compromise can be achieved. This decision requires a very careful examination of public opinion. Overall, the system of energy policy making needs to be reformed from the policy serving the demands of certain interest groups towards a policy which is transparent and socially fair.

Meanwhile, Japan is living under the three-year Action Plan for Energy Supply-Demand Stabilization. The prime concern of the government is to develop

and implement the policies in order to avoid the electricity shortage and prevent a steep rise in energy tariffs. The government articulates its readiness to activate diverse policy instruments.

In October 2011 the government published the White Paper on Energy Policy[19] confirming that in the medium- to long-range future Japan's dependency on nuclear energy will be reduced as much as possible. The document emphasizes the existing weaknesses of the domestic energy system and analyses some of the relevant issues outside of Japan (such as renewables policy in the EU and U.S. and growing energy demand of China, India, etc.). The document stipulates that a new energy policy will be introduced in 2012.

The Basic Principles of energy policy set forth by the Energy and Environment Council inform the platform for a new energy policy, where considerations of safety (reduction of nuclear power use), efficiency (cost-efficient energy mix) and environment (commitment to climate change policy) are given top priority. Based on these principles, also by spring of 2012 the Japan Atomic Energy Commission in coordination with other concerned entities is expected to present a new nuclear energy policy.[20] The Energy and Environment Council is tasked with the development of the Innovative Strategy for Energy and the Environment by spring of 2012.

The ongoing changes in the area of Japan's nuclear policy are characterised in a separate section. Here, other important developments are summarised.

4.1.1. Energy Economics and Climate Change Policy. Focus on Renewables

Economics of energy dictates cost efficiency. As has been discussed earlier, a new wave of research to verify the actual costs of various types of energy is observed. To support policy making with objective analysis, the government established a special body - the Cost Verification Committee within the Energy and Environment Council a subcommittee under the Council on National Strategy and Policy. The Committee has been tasked to examine the cost of unit of electricity generated by different sources. The Committee's findings

[19] *Enerugii hakusho*. 2011. Retrieved from: http://www.enecho.meti.go.jp/topics/hakusho/2011/index.htm

[20] "Strategy for Rebirth of Japan". National Policy Unit. December 24, 2011. Retrieved from: http://www.npu.go.jp/policy/pdf/20120127/20120127_en1.pdf

proved that electricity generated at the nuclear plants is no longer the cheapest option.[21] The nuclear power generation cost, which was previously estimated at 5.9 yen/ kWh, is revised to 8.9 yen/ kWh reflecting inflated construction costs, additional safety costs, subsidies extended to the communities hosting the atomic facilities and damages identified by the Fukushima Dai-Ichi nuclear accident. With some other costs added (such as in case of accident, compensation to residents, interim storage and permanent disposal costs for contaminated materials, etc.), the cost of electricity generated at a nuclear plant may even exceed 10 yen/kWh. Costs of electricity produced at coal-, LNG- and oil-fired power plants are also revised upward. CO2 emissions and rising price of the fuels are main drivers. On the other hand, cost of renewable sources is estimated to decline on path with the technological advancements and liberalization of electric power market.

This is a very significant step which may signify the beginning of green energy era in Japan.

Japan has always been a frontrunner in proposing the climate change policy initiatives; it however started to lag behind many developed (and not only) economies in its pursuit of actual implementation of the climate policy tools. Among the dominant reasons of sluggish development were strong anti-renewables lobby in the government, structurally and regionally monopolised electric power industry, etc. The Fukushima accident irreversibly destroyed the image of nuclear power as a safe option and the government had to intensify its efforts to put into action an adequate policy allowing substitution of atomic energy with authentically safe, but yet economically feasible and clean sources of energy. Apparently, the moment for diverse alternatives is about to come.

As it is known, at September 22, 2009 UN Summit on Climate Change in New York the then Prime Minister Hatoyama pledged to introduce a domestic emission trading mechanism and a feed-in tariff for renewable energy, as well as to consider a global warming tax.[22] The pledges to reduce GHG emissions by 25 % below the 1990 levels by 2020 were reiterated in Copenhagen Accord. This,

[21] Report on Cost Verification by the Cost Verification Committee of the Energy and Environment Council [Kosuto-tō kenshō iin kaihōkokusho. Enerugī kankyō kaigi. Kosuto-tō kenshō iinkai] December 19, 2011. Retrieved from: http://www.aec.go.jp/jicst/NC/tyoki/sakutei/siryo/sakutei10/siryo2-2-3.pdf

[22] Retrieved from: http://www.kantei.go.jp/foreign/hatoyama/statement/200909/ehat_0922_e.html

along with a number of targets set forth in recent energy policy documents, urges the government to introduce appropriate policy mechanisms.

In 2010, renewable energy accounted for 10 % of generated electricity, according to Japan's Agency for Natural Resources and Energy, but new assessments by the METI reveal huge potential for growth.

Recently, there were particularly visible advancements in implementing some of the instruments provided in the bill on the Basic Act on Global Warming Countermeasures.[23] In particular, the carbon tax materialised in the form of 1 yen per litre of petrol introduced in October 2011. As regards emissions trading scheme (ETS), although the respective bill was submitted in 2010 to the Diet is yet to be adopted, there is certain experience gain in the past years. The voluntary ETS, for instance, started in 2005. And in 2008, the experimental introduction of an integrated domestic market of emissions trading was launched.

Especially robust developments are happening with the feed-in-tariff (FIT) for renewable energies. In fact, in 2009 the METI revived subsidies for photovoltaic (PV) power generation and announced the introduction of a PV electricity buyback program that was applied to surplus electricity generated and could reduce the period of initial investment recovery to about 10 years. At first, this program was scheduled to begin in 2010, but it began ahead of schedule on November 1, 2009. This scheme, however, applied solely to PV power generation and did not help promote other renewable energy sources.

On April 1, 2011, the government raised feed-in tariffs for solar power to promote non-residential use of solar from 24 Yen/kWh to 40 yen/kWh. However, as solar power generated from solar panels is relatively expensive, a significant increase in solar power capacity would require a high feed-in tariff, which in turn might entail an increase in higher government expenditure.

In August 2011, the Japanese Diet adopted The Act on Special Measures Concerning the Procurement of Renewable Electric Energy by Operators of Electric Utilities. Under the Act,[24] the Japanese electric utility operators are obligated to purchase solar, wind, hydro, geothermal and biomass generated electricity for contractual terms and at prices to be fixed by the FIT price-setting

[23] Summary accessible at: http://www.env.go.jp/en/earth/cc/bagwc/overview_bill.pdf

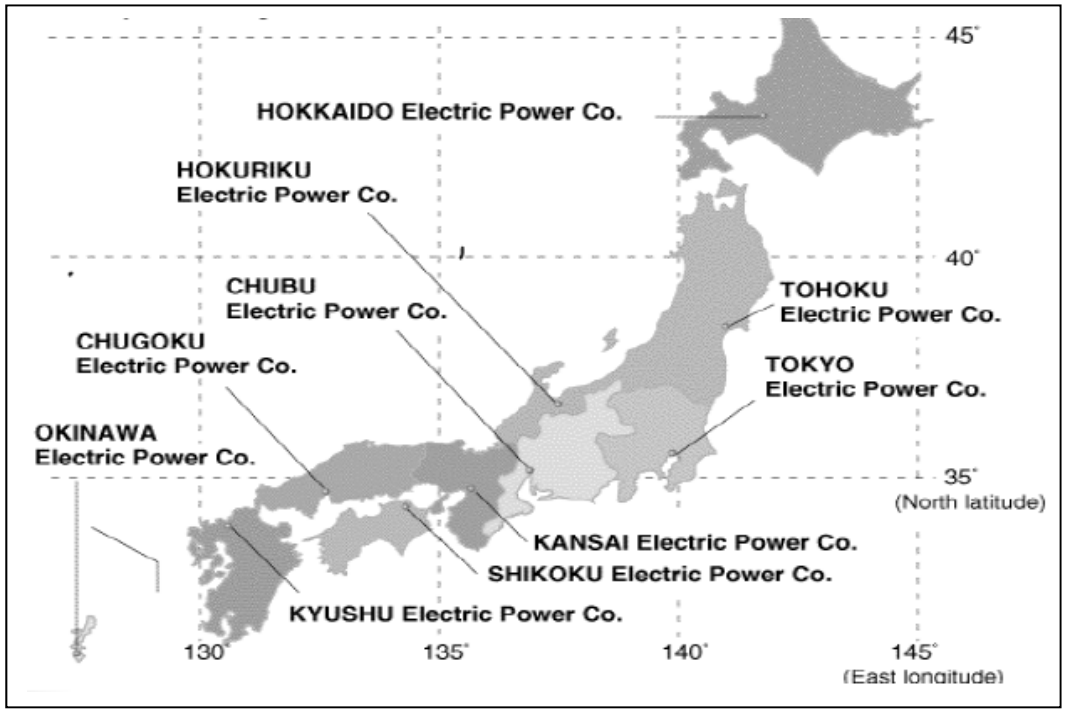
[24] Summary accessible at: http://www.meti.go.jp/english/policy/energy_environment/renewable/pdf/summary201109.pdf

council under the METI. Like the existing surplus electricity purchase system, costs required for purchasing will be added to electricity charges in the form of surcharges, which will be borne by the electricity users. The Act takes effect from July 2012 and is to be conducted no longer than through March 31, 2021. The document is stipulated to be revised every three years and in case either of the Basic Act or BEP 2010 undergoes any relevant changes.

4.1.2. Electric Power Market Deregulation

Japan has never had an authentically integrated electricity power market; it instead has all along been divided by the monopolized privately-owned regional electric power companies into ten fifes (Figure 5).

Figure 5: Japan's 10 Electricity Generating Utilities.



Source: http://www.tepco.co.jp/en/news/presen/pdf-1/0406-e.pdf

Whether there are signs of a more than decade ago proclaimed deregulation? A total of 60 companies have entered the power producers and suppliers (PPS) business since 2000, when sales of electricity for large-lot users was liberalized in 1999 by the Amendment of the Electricity Business Law

(1995). Currently, 50 companies registered with the Natural Resources and energy Agency as PPS, or businesses entitled to sell electricity to large-lot users. However, according to The Yomiuri Shimbun, 24 firms are not operating.[25] Many PPS companies are facing difficulties in procuring electricity to sell to large-lot customer. The pace of new entry into the PPS business has slowed: 11 companies in 2009 and 13 in 2010 to seven in 2011. Additionally, according to Fuji Keizai Co., if 2010 saw a three-fold increase in the volume of electricity supplied by PPS firms (19.96 billion kWh), 2011 has revealed no (20.06 billion kWh). Currently, the PPS supplied volume of electricity accounts for about 2 % of the total electricity demand.

Following the announcement of TEPCO's plan to raise the electricity charges to large-lot users by an average of 17 %, many companies and more than half of 49 major local governments, including nine prefectures within TEPCO's jurisdiction and central government ordinance-designated cities, are considering switching to PPS firms instead of conventional electric power companies. The main hindrance, however, is limited electricity supply to PPS by the major electric power companies. Having only two NPPs in operation, the utilities are forced to limit their wholesale sales activity. This leads to an increase in electricity procurement costs for PPS firms. After the March 11 disaster, electricity prices on the electric power exchange, in fact, soared more than threefold to 32.59 yen/kWh on January 31, 2012. In an effort to encourage electricity supply to PPS firms, the government is considering obliging local governments to engage into the open competitive bidding system for public-sector electric power projects, such as hydroelectric power generators owned by local governments.

4.2. Nuclear Power after March 11

4.2.1. Government Response

One of the key concerns – safety management at the NPPs across the country – has been addressed in the immediate aftermath of the disaster. In July 2011, the NISA issued the Comprehensive Assessments for the Safety of Existing Power Reactor Facilities.[26] Also in July, the Chief Cabinet Secretary, the METI and the Minister for the Restoration from and Prevention of Nuclear Accident issued a Confirmation of the Safety of Nuclear Power Stations in Japan. This

[25] Half of PPS electricity providers no longer in operation. *Yomiuri Shimbun,* February 21, 2012. Retrieved from: http://www.yomiuri.co.jp/dy/national/T120223007082.htm

[26] Retrieved from*:* http://www.nisa.meti.go.jp/english/press/2011/08/en20110831-2-1.pdf

document explains the procedure of Comprehensive Safety Assessments utilizing the stress tests. The results of the assessments will be confirmed by NISA and their validity will be further confirmed by the NSC. For the technical review of the assessments NISA receives support from the Japanese Nuclear Energy Safety Organization (JNES). In January 2012, the IAEA mission to Japan found the safety measures developed after the March 2011 earthquake satisfactory.[27]

Also, the government has eventually started to tackle the paradoxical status of METI within the national system of nuclear policy making. Confusion often occurred over the METI's authentic role in nuclear energy policy: is it a promoter or a regulator of the nuclear sector? Most of the analysts argued that it is hard to expect the agency whose mandate is to promote the industry to act as an impartial safety watchdog. The observers noted that a renowned heavyweight who crafted Japan's industrial might METI (MITI, formerly) is directly involved with the nuclear sector regulation for the purpose of utilising technical, technological, etc. advancements of the nuclear sector to trigger the development of other Japanese economy's segments. In other words, safety regulation has become a secondary agenda for METI.

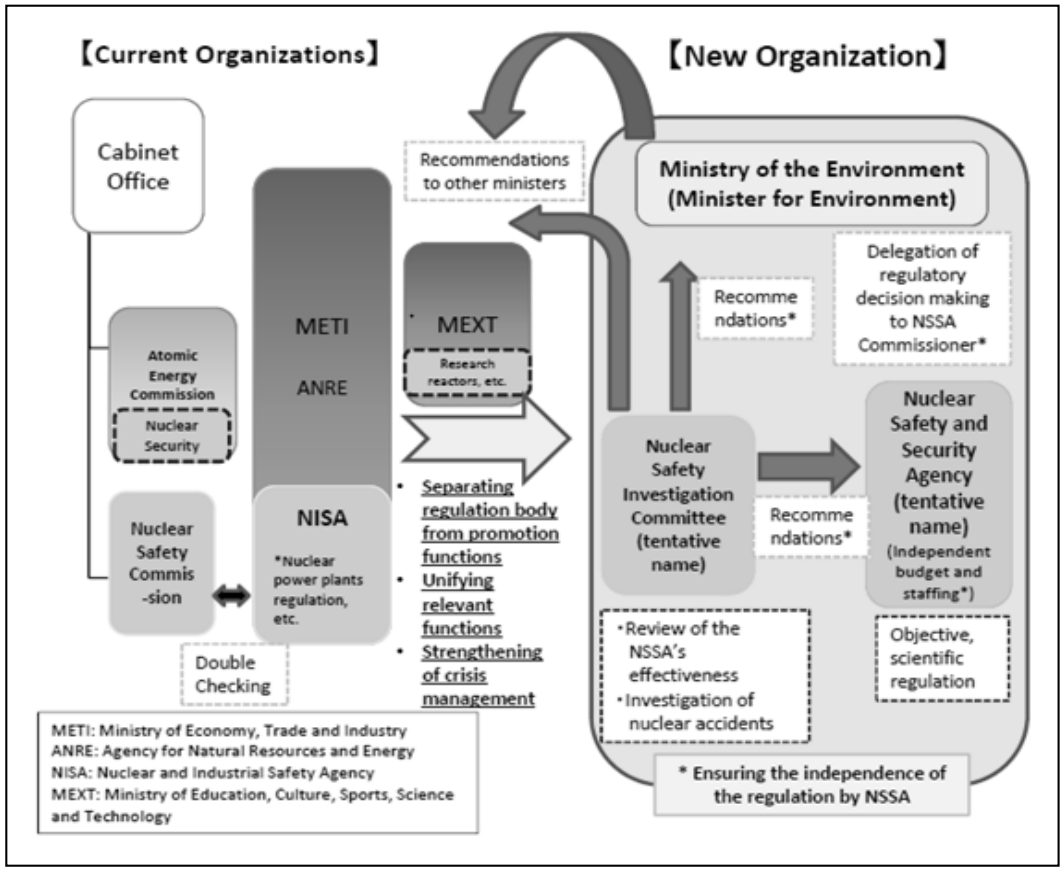
Public belief that had the government been more capable of crisis management, the post-disaster situation could have been coped with more efficiently is strong in Japan. The government admitted that the handling of the nuclear crisis has been poor and strengthened focus on safety and crisis management.

It has been pointed long ago that significant harm is being caused by placing the NISA, an administrative body tasked to regulate nuclear power safety, under the umbrella of the METI, a major promoter of nuclear power. That is why the ongoing structural reform aims to separate nuclear regulation from nuclear promotion and centralize regulatory duties into one agency. On January 31, 2012, the Cabinet adopted a bill envisaging several steps in the direction of safety regulation re-organization. The document reads that NSSA will be established as an agency, an external organ of the Ministry of Environment (MOE) by separating the nuclear safety regulation section of NISA from METI and unifying relevant functions of other ministries. The Nuclear Safety Investigation Committee (NSIC), a council□type third party to be created with NSSA, will review the

[27] IAEA mission to review NISA's approach to the "Comprehensive assessments for the safety of existing power reactor facilities" Preliminary summary. Tokyo and Ohi, Japan. 23-31 January 2012. Retrieved from: http://www.iaea.org/newscnter/focus/fukushima/pre_report310112.pdf

effectiveness of regulatory actions taken by NSSA, investigate causes of nuclear accidents and make recommendations to monitor the regulatory independence of NSSA. Crisis management will be one of the most important roles of NSSA, and NSSA will lead the entire government (Figure 6).[28]

Figure 6: Organization of Nuclear Energy Regulation (before 2011 and in-the making)



Source: Reform of Japan's Nuclear Safety Regulation. METI. January 2012. Retrieved from: http://www.cas.go.jp/jp/genpatsujiko/info/kokusaiws/siryo/reform_of_regulation.pdf

There are nonetheless certain concerns being expressed whether the new agency is not a mere nameplate change and re-dressing. Such concerns are not groundless, because many of the new agencies staff members are likely to be

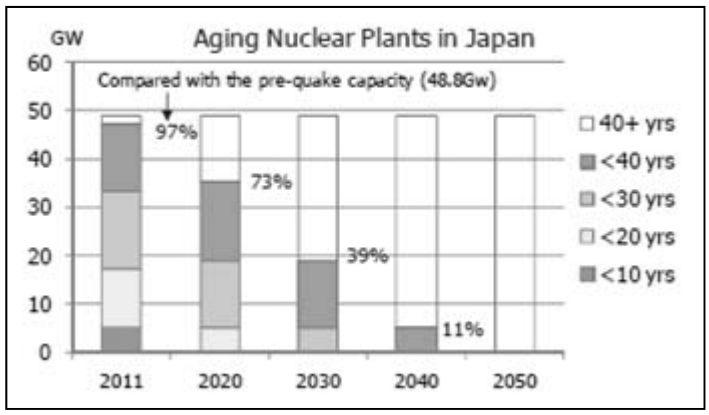
[28] "Reform of Japan's Nuclear Safety Regulation". METI. January 2012. Retrieved from: http://www.cas.go.jp/jp/genpatsujiko/info/kokusaiws/siryo/reform_of_regulation.pdf

transferred from the NISA and the NSC. It is important that the newly established bodies were free from the formerly exploited techniques and patterns. Without a doubt, the new system is challenged to re-gain peoples' faith and demonstrate independence from the nuclear village in the matters of nuclear safety and security.

Meanwhile, there are some reasons to question whether the ongoing reform is indeed comprehensive. It appears that some of the important functions have altogether elapsed from the centralization of regulatory responsibilities. That is to say, safety research (formerly, prerogative of the JAEC) and the inspections and other safeguards to prevent the diversion of nuclear material toward the production of nuclear weapons (previously, duties of MEXT) have not been assigned to the jurisdiction of the new regulatory agencies.

A number of other concerns arises from the content of the latest amendments to the Atomic Energy Basic Act and the Nuclear Reactor Regulation Law. Despite all the heated debates continuing for almost one year and very intense discussions held over the last decades about nuclear energy safety, the drafted after 3-11 bills designate a 40-year lifespan for the nuclear reactors and the implementation of "back-fit" measures that would help maintain the existing reactors up to the latest technological standards. Moreover, the bills contain a staggering clause on "special exemptions", under which the reactors may be allowed to operate for up to 60 years. A mere glance at the graph below explains why such propositions have been generated and why they are being deliberated (Figure 7).

Figure 7: Structure of Japanese Nuclear Facilities by Age



Source: Japan Energy Brief. No. 17. January 2012. Japan Energy Economics Institute. Retrieved from: http://eneken.ieej.or.jp/en/jeb/1201.pdf

Out of 54 nuclear reactors Japan has, four are being run for 40 or over years, 21 units including four mentioned above are exceeding 30-year period of operation in 2012, which in terms of their generating capacity is equivalent to 32 % of total 48,847 MW capacity of all 54 reactors. By 2030, 18 units 39 % of generating capacity (18,913MW) and by 2050 all nuclear facilities will be older than 40 years. It is, nonetheless, hard, if not altogether impossible to relate these newly drafted provisions to "new energy policy".

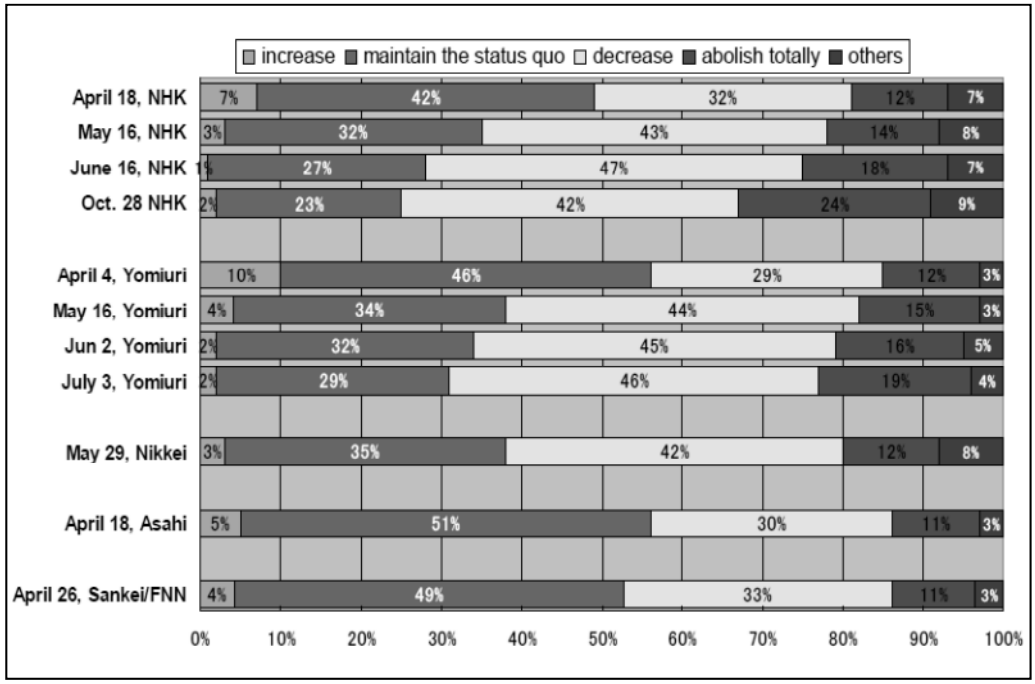
4.2.2. Public Opinion about Nuclear Energy and Anti-Nuclear Initiatives

It would certainly be a mistake to assess even the pre-March 2011 situation in the nuclear energy sector as fully supported by the public. However, in the aftermath of the March 2011 triple disaster, social and political landscape for nuclear energy policy in Japan has dramatically altered. The crisis that revealed the health and environmental hazards of the nuclear power, strengthened scepticism about the government energy policy, cast doubt on the appropriateness of government-business coordination and questioned the corporate ethics. Japanese civil society that has traditionally been seen as nonparticipatory and weak, showed an unprecedented unity and reacted strongly further accelerating the momentum for the energy policy transition and amplifying its magnitude.

Over the last decades, numerous safety failures and safety records' falsification scandals have contributed to a corrosion of public trust in the nuclear industry. If in late 1980s, for instance, only about 10 % of the respondents opposed the promotion of nuclear power, by the end of 1990s this number more than doubled.[29] Undoubtedly, there is much stronger public aversion to nuclear power in the post 3-11 Japan. According to figure below, about 70 % of respondents surveyed by the Japanese media answered that Japan must abandon nuclear energy or decrease reliance on it.

[29] Retrieved from: http://cnic.jp/english/newsletter/pdffiles/nit73.pdf

Figure 8: Public Opinion about Nuclear Energy Future; Results of Japanese Media Surveys in 2011



Source: Japan Atomic Industrial Forum, Inc. Retrieved from: http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS02_1320397876P.pdf

Along with unprecedented objection to nuclear power, there is a considerable support by Japanese businesses and civil society for renewable energy promotion. Japanese society became totally intolerant to the relapses of safety measures violations and stands unlikely to grant nuclear power another chance to recover its reputation (as it actually was in 2002). To the contrary, Japanese civil society is increasingly vocal in the pursuit of the rights for clean and safe environment. Importantly, the anti-nuclear protests became better coordinated and organised. For instance, the citizens group called Let's Decide Together/Citizen-initiated National Referendum on Nuclear Power is pushing Tokyo governor Shintaro Ishihara to issue an ordinance to hold a referendum to vote on whether the NPP should be restarted.

Dozens of initiatives on ecologically aware life style, environmentally-friendly local development, environmentally-concerned business practices, etc. are launched across the country. On this wave, the Japan Renewable Energy

Foundation (JREF) was established in September 2011 by SoftBank's CEO Mr. Masayoshi Son.

Ardent anti-nuclear activist Son argues that Japan's renewables ratio can to be tripled by 2020. By Son, solar plants installed on 20 % of unused agricultural land in Japan can create the generation capacity of about 50 GW, or almost matching that of TEPCO (who generates 1/3 of the electricity in Japan). Addressing a common argument about Japan's limited land, Son proposes the Solar Belt plan envisaging development of solar farms in Tohoku areas, where the agricultural activity cannot be resumed earlier than in 10 years because of the tsunami-caused salinization of soil.

Son claims that Japan can shift up to 60 % of its power production to renewable over the next two decades with a help of a 2 trillion yen national onshore and offshore transmission network. Son's idea about the 2,000 km of Japanese interconnections (*Japan Super Grid*) being expanded across the entire Asian region (*East Asia Super Grid*, interconnecting Japan, China, Korea and Russia) and further to form a vast network of some 36,000 km linking Japan with China, Korea, Malaysia, Singapore, Philippines, India, Russia etc., coined *Asia Super Grid*,[30] not only attracted public attention but a found a certain support. Son admits that the project may take up to 30 years, but he is prepared to invest 1 billion yen of his own capital and pledges investments by SoftBank of 10 to 20 billion yen. With backing of at least 33 of Japan's 47 prefectures, Son seeks the access to transmission networks owned by the 10 utilities and an agreement that they buy electricity generated by renewable sources. The JREF founder ardently promotes wide-ranging initiatives essential to a new energy policy and robustly resists the nuclear village's attempts to preserve the existing policy and policy making system through the implementation of some minor changes. Son advocates a "paradigm shift in energy policy" through "wide deployment of renewables, vitalization of electricity market and enhancement of transmission infrastructure".[31]

5. Conclusion: Scenarios and Implications

One of the most important, though rather generic, lessons any country can learn from Japan's experience is that the government needs a policy-making

[30] Accessible at: http://jref.or.jp/images/pdf/20110912_presentation_e.pdf

[31] Masayoshi son's presentation at the JREF launch: http://jref.or.jp/images/pdf/ 20110912_ presentation_e.pdf

mechanism that is flexible and robust to instantaneously incorporate emerging as well as emergent perspectives and develop appropriate tactics and strategies in the event of drastically divergent from the planned scenario.

More concrete and direct lesson was learnt by a number of nations, such as Germany, Switzerland, Italy and Belgium, who promptly turned to revisiting their nuclear energy programs toward phasing-out the existing facilities and banning the construction of new NPPs. Certainly, many others, France, Russia, South Korea, China and India are among them, made no move to change previously programmed direction. There was a third group composed of those who even activated their efforts to develop the commercial nuclear facilities; these are some Middle Eastern and ASEAN countries. It is yet too early to claim that these decisions are rock solid. The U.S., for instance, has paused for almost one year, but in February 2012 the Nuclear Regulatory Commission approved a construction of the first new U.S. nuclear power plant since 1978.[32] Every country faces a specific set of challenges and has a certain vision about and criteria of appropriate and efficient solutions.

While deliberating the fate of its nuclear energy, Japan needs to incorporate various perspectives into the future scenario for nuclear energy. In the following, let us speculate about possible implications of two opposing scenarios.

Suppose, the decision made is to continue nuclear power use. This scenario will require times more generous spending on safety and security and times more scrupulous safety management. Now, how the sector with its ever dubious cost-efficiency, which is now additionally bogged down by tremendous losses and damages caused by the 2011 disaster, can afford all those extras to establish a proper safety management? Whether the Japanese government, which is increasingly busy with finding the sources to solve the deteriorating public finance, will continue its generous support through the diversified means and channels? For an ordinary Japanese citizen the "yes" scenario will certainly mean higher energy bills, heavier tax burden and unending anxiety about the next nuclear disaster. The latter, in a firm belief of many, is only a matter of time, as regular forecasts repeat - the probability of powerful earthquakes in Japan remains high. Moreover, it needs to be understood that even in the "yes" case scenario, Japan's nuclear power will not be the same – the number of NPPs reaching their 40-year limit will increase. Keeping generating capacity at some stable level will require new enormous investment. A reasonable question here rises: If the already

[32] Retrieved on February 9, 2012 from: http://www.eenews.net

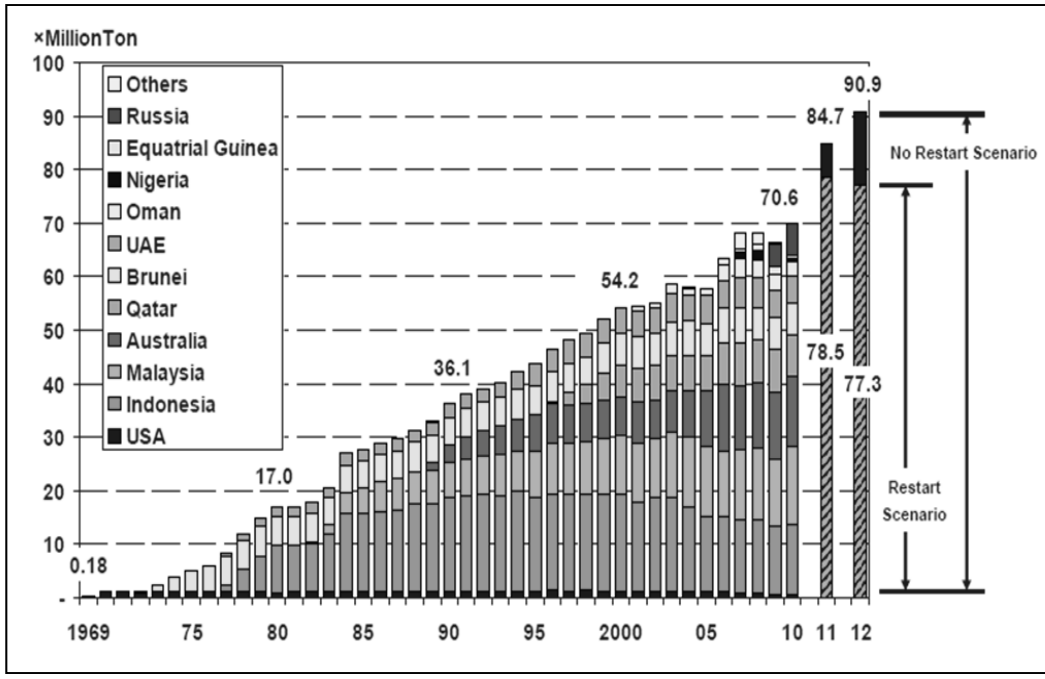
about to end their life NPPs could not demonstrate solid economic benefits for the entire economy (not the utilities' stakeholders), why an ordinary Japanese citizen may yet again be asked to pay for the "yes" scenario continuation.

Looking at the prospects of the future power demand, in over the next 20 years, as projected, Japan may not need as much energy as it needs today. Japan faces shrinking productive-age population, which is forecast to be declining at an annual rate of 0.9 %. Also, Japan's GDP per capita trend growth is assumed at around 1%, while the growth rate for the economy as a whole is predicted to be in the vicinity of zero. Moreover, the increase of net capital stock has already stopped in Japan. Considering these trends together, it seems to be inappropriate to envision excessive power demand in the long-run.

One more important argument against the nuclear future lies with the environmental aspect. The nuclear energy itself might be one of the cleanest options, but this holds true for 100 % risk free nuclear facilities, which is simply impossible. In case of Japan, as has been discussed, safety regulation violations have been nearly a norm in nuclear power industry. Taking into consideration the regularity and extent of the natural hazards Japan is prone to, "yes" option appears a highly irresponsible option. After Fukushima, even a minor probability of a disastrous event to occur must be persuasive enough to dismiss the nuclear scenario.

Now, suppose the decision to phase out all the NPPs and end the era of nuclear power in Japan is made. At what cost this "no" scenario is attainable? The most immediate consequence is an increased fossil fuels import. What are the volumes in question? Are they readily available? As the Institute of Energy Economics, Japan (IEEJ), assesses, with no nuclear power in place, Japan's LNG demand may grow by up to 20.3 million tonne in 2012 over 2010 (Figure 9).

Figure 9: Japan's LNG Import, Million Tonne



Source: http://www.pecj.or.jp/japanese/overseas/conference/pdf/conference08-07.pdf

Already in 2011, resulting from the significantly reduced number of operating NPPs, a record 78.5 million tonne (increment of 7 million tonne or 17 %) of LNG and 21.3 % greater in cost terms of crude oil and petroleum were imported to Japan.

Russia was one of the suppliers who provided larger than was initially contracted volumes. In fact, Japan considers Russia as a more significant LNG and oil supplier in the future. In April 2011, the two countries agreed on a second LNG plant (in addition to currently operated under Sakhalin II project) to be built in Vladivostok.

In case of "no" scenario, Japan will also demand more oil. Currently, Russia is the sixth largest oil supplier to Japan following Iran, who provided 9.8 % of Japan's imported oil in 2011. This year, the ranking is likely to change, as amidst the sanctions against Iran, Japan was forced to define its position too and it did so by pledging up to 20 % cuts in imports from Iran. Again, these volumes are easy to make up as the East Siberia Pacific Ocean pipeline oil is readily available in the Russian Far East. Even more to Japan's benefit, it is in direct proximity to Japan (consequently, price competitive) and, compared to the route from Iran, involves no transport

security risks. In short, one of the feasible options for Japan in case nuclear power is decreased or totally abandoned and larger volumes of oil and LNG are required, is closer cooperation with Russia. Increased Japan's imports, especially that of LNG, make the supply situation tighter and additionally contribute to higher prices in the international market.

Less optimistic is the perspective of nuclear security. If Japan chooses to abandon nuclear energy, except the tremendous costs Japan will incur domestically in order to appropriately store spent nuclear fuels and handle the radioactive materials, there will be a higher risk of proliferation. Once Japan opt for stepping down, a very sensitive nuclear business may become easier to enter. Once the established framework of deterrence of nuclear proliferation weakened, the dissemination of dual-use technologies, materials and equipment become easier, which in turn multiplies a proliferation risk. As a number of unstable regimes in Africa and the Middle East are already demonstrating an increasing interest in nuclear, they are most likely to try to seize this opening opportunity. From the point of balance of power in Asia and beyond, China stands to benefit the most from Japan's "no nuclear" move, provided it plans to build 200 nuclear reactors by 2030. South Korea too, will come out a stronger regional power. Apparently, it is the issues of traditional security, including balance of power and non-proliferation, that are the most complicated to solve if abiding by a system of law and international agreements Japan decides to leave a club of nuclear energy countries. It is important to bear in mind, however, that in these matters Japan does not act independently. There certainly will be the bilateral consultations with an attempt to persuade Japan to stay in "business". It is tempting to speculate that the U.S.'s decision to build a new NPP may have been made to demonstrate its international responsibility in an expectation to find the ally's support.

At the same time, having abandoned nuclear energy, Japan, as discussed, would have to activate simultaneously diverse options, including those of international reach. If implemented, expansion of grids in East Asia and greater Asia would improve peace and security environment in the entire region and facilitate cooperation among the economies.

Turning to the climate change policy goals, would "no nuclear" enable Japan to comply with its commitments? A more precise examination of this rather complex theme, though is certainly needed, exceeds the scope of this paper. Having said that, it needs to be pointed that nuclear-free scenario automatically involves drastic development of renewable energy in Japan. While Japan's reality is that the renewables are yet to become cost competitive as compared to traditional sources of

energy, it is only a matter of several years. The studies prove that the most expensive is the initial stage when the renewables are introduced. Once the investment made, technologies accumulated, process scaled up, etc. the cost of unit of energy generated by renewable source decreases by times. Importantly, the development of renewable energy opens ample opportunities for the IT businesses expansion, research and development advancements, small and medium size companies' involvement, etc.

While sketching "yes" and "no" scenarios, the author tends to think that the actual short- to mid-run scenario is most likely to consist of half "yes" and half "no". This scenario appears to be the most realistic and cost-efficient. It is however important not to dwell on it too long, because in this case the two halves will never add up to the whole.

Meanwhile, there is a need for a sober discussion about advantages and disadvantages of various sources of energy. What is currently observed in traumatized by nuclear crisis Japan, however, is almost unanimous opinion that anything else except for nuclear energy is a panacea for solving Japan's energy future. In advocating, in particular, the renewables' benefits their proponents are being deluded by some countries' extraordinary success in this area. Most of the time, Germany is referred to as a country already succeeded in renewables' revolution and therefore must become a model for Japan. Meanwhile, German situation is rather far from being described as the renewables' triumph.[33] This sort of objectivity and precision is essential for Japan, who reached a critical juncture and needs to define a long-term direction.

This paper attempted to reflect the diverse shifts ongoing in Japan's energy policy. Objectively, the progress made within less than one year (as of the time of writing) along each of Japan's energy policy key 3E dimensions is impressive. Despite the need for energy policy reform has been ripe since long ago and some initial steps in that direction have been undertaken, the critical impulse for changes was generated by an external force – natural catastrophe in March 11, 2011. It is important now that the Japanese government keeps the transition momentum so that all feasible undertakings could combine and reinforce each other informing genuinely comprehensive, genuinely coherent, genuinely efficient - new energy policy.

[33]"German's Energy Supply Transformation Has Already Failed". Retrieved from: http://arabenergyclub.com/site/wp-content/uploads/2012/02/Renewables-in-Germany.pdf

BIBLIOGRAPHY

"Eastern Japan Paralyzed by Unprecedented Earthquake". *Japan Energy Brief.* IEEJ. No. 12. March 2011. Retrieved from: http://eneken.ieej. or.jp/en/jeb/1103.pdf

"Energy News in Japan and Asia". *Japan Energy Brief.* IEEJ. No. 13, May, 2011.

From "Unplanned Power Outages" towards a "Strategic Energy Shift". A Report on Japan's Energy Shift since March 11th. Institute for Sustainable Energy Policies, Japan. May 6, 2011, p. 22. Retrieved from http://www.isep.or.jp/images/press/ISEP_Strategy%20No1%20Revised.pdf

Fukao, Mitsuhiro (2011). "The Great East Japan Earthquake and Japan's Financial Consolidation". *Japan Economic Currents*. *A Commentary on Economic and Business Trends*. Keizai Koho Center. Retrieved from: http://www.kkc.or.jp/english/activities/publications/economic-currents79.pdf

"Higashi Nihon Shinsai ni okeru Higaigaku no Suikei ni tsuite [Information on Estimates of the Damages Caused by the Great East Japan Earthquake]". Retrieved from: http://www.bousai.go.jp/oshirase/h23/110624-1kisya.pdf

IAEA mission to review NISA's approach to the "Comprehensive assessments for the safety of existing power reactor facilities" preliminary summary. Tokyo and Ohi, Japan. 23-31 January 2012. Retrieved from: http://www.iaea.org/newscenter/focus/fukushima/pre_report310112.pdf

Ishibashi Katsuhiko (2007). "Why Worry? Japan's Nuclear Plants at Grave Risk from Quake Damage". *The Asia-Pacific Journal: Japan Focus*. August 11.

Japan Energy Brief. No. 17. January 2012. Retrieved from: http://eneken.ieej.or.jp/en/jeb/1201.pdf

"Japan Rode over Summer with Nationwide Power Saving". *Japan Energy Brief.* IEEJ. No. 15, September 2011. Retrieved from: http://eneken.ieej.or.jp/en/jeb/1109.pdf

Japanese town's dependence on nuclear plant hushes criticism. *Asahi Shimbun.* January 27, 2012. Retrieved from: http://ajw.asahi.com/article/behind_news/social_affairs/AJ201201270014

Johnson, Chalmers (1982). *MITI and Japanese Miracle: The Growth of Industrial Policy*. Stanford: Stanford University Press.

Kaneko, Shuichi (2012). "Nuclear Safety Regulation Reform in Japan". Retrieved from: http://www.oecd-nea.org/nsd/fukushima/documents/workshop_Japan_TaskForcePresentation.pdf

Kono, Ryutaro (2011). "Future Economic Scenarios for Quake-Hit Japan". *Japan Economic Currents*. *A Commentary on Economic and Business Trends*. Keizai Koho Center. Retrieved from: http://www.kkc.or.jp/english/activities/publications/economic-currents78.pdf

Maeda, Risa (2012). "Insight: Japan's Nuclear Crisis Goes Much Further than Fukushima". *Reuters*. February 23. Retrieved from: http://www.reuters.com/article/2012/02/24/us-japan-nuclear-waste-idUSTRE81N08P20120224

Son, Masayoshi (2011). Presentation at the JREF launch. Retrieved from: http://jref.or.jp/images/pdf/20110912_presentation_e.pdf

Minoura, Koji and Nakaya, Shuyu (1991). "Traces of Tsunami Preserved in Inter-tidal Lacustrine and Marsh Deposits: Some examples from Northeast Japan". *Journal of Geology*. Vol. 99. No. 2 Retrieved from: http://www.jstor.org/pss/30081120

Morita, Yuji (2011). "Japan's Issues and Concerns on Energy Supply and Demand after the Great East Japan Earthquake". The Institute of Energy Economics, Japan (IEEJ). Retrieved from: http://www.pecj.or.jp/japanese/overseas/conference/pdf/conference08-07.pdf

"Nuclear Crisis: How it Happened. 'Nuclear Power Village' A Cozy, Closed Community. *Yomiuri Shimbun.* June 16, 2011. Retrieved from: http://www.yomiuri.co.jp/dy/national/T110615005652.htm

"Nuclear Power in Japan". World Nuclear Organization. Retrieved from: http://www.world-nuclear.org/info/inf79.html

Oshima, Kenichi (2010). *Political Economics of Recyclable Energy,* Toyo Keizai Inc.

Pickett, Susan E. (2002). "Japan's Nuclear Energy Policy: From Firm Commitment to Difficult Dilemma Addressing Growing Stocks of Plutonium, Program Delays, Domestic Opposition and International Pressure". *Energy Policy.* 30: 1337-1355.

Pritchard, Justin (2011). Realistic Safety Debate Not Nuke Sector, Regulator Forte. *The Japan Times*. May 5, 2011. Retrieved from: http://www.japantimes.co.jp/text/nn20110505f1.html

Report on Cost Verification by the Cost Verification Committee of the Energy and Environment Council [Kosuto-tō kenshō iin kaihōkokusho. Enerugī kankyō kaigi. Kosuto-tō kenshō iinkai] December 19, 2011. Retrieved from: http://www.aec.go.jp/jicst/NC/tyoki/sakutei/siryo/sakutei10/siryo2-2-3.pdf

Samuels, Richard J. (1987). *The Business of Japanese State: Energy Markets in Comparative and Historical Perspectives*. Ithaca, NY: Cornel University Press.

Schneider, Mycle, Froggatt, Antony and Thomas, Steve (2011). *Nuclear Power in a Post-Fukushima World. 25 Years after the Chernobyl Accident.* Worldwatch Institute. Mycle Schneider Consulting. Retrieved from: http://download.www.arte.tv/permanent/u1/tchernobyl/report2011.pdf

Strategy for Rebirth of Japan. National Policy Unit. December 24, 2011. Retrieved from: http://www.npu.go.jp/policy/pdf/20120127/20120127_en1.pdf

Takase, Kae and Suzuki, Tatsujiro (2011). "The Japanese Energy Sector: Current Situation and Future Paths". *Energy Policy*. 39: 6731-6744.

The Advanced Energy Revolution. A Sustainable Energy Outlook for Japan. European Renewable Energy Council. 2011. Retrieved from: http://www.greenpeace.org/japan/Global/japan/pdf/er_report.pdf

The Basic Energy Plan. June 2010. [Enerugi Kihon Keikaku] Retrieved from: http://www.meti.go.jp/committee/summary/0004657/energy.pdf

The Mainichi Daily News. February 10, 2012. Retrieved from: http://mdn.mainichi.jp/mdnnews/news/20120210p2g00m0dm024000c.html

Toyoda, Masakazu (2011). "Energy Policy Agenda after the Great Japan Earthquake". The Institute of Energy Economics, Japan (IEEJ). Retrieved from: http://eneken.ieej.or.jp/data/3897.pdf

Waldenberger, Franz (2011). "The Japanese Economy after the Tohoku Earthquake". ISPI Analysis. Retrieved from: http://www.ispionline.it/it/documents/Analysis_82_2011.pdf

White Paper on Energy [*Enerugii hakusho*]. 2011. METI. Retrieved from: http://www.enecho.meti.go.jp/topics/hakusho/2011/index.htm

White Paper on Nuclear Energy. 2009. Japan Atomic Energy Commission [Genshiryoku Hakusho. Genshiryoku iinkai . 2009] Retrieved from: http://www.aec.go.jp/jicst/NC/about/hakusho/hakusho2009/index.htm

Yuji Matsuo, Yu Nagatomi and Tomoko Murakami (2011). "Thermal and Nuclear Generations Cost Estimates Using Corporate Financial Statements". Institute of Energy Economics, Japan. October. Retrieved from: http://eneken.ieej.or.jp/data/4103.pdf