グローバルな文脈での日本

REEXAMINING JAPAN IN GLOBAL CONTEXT

Suntory Foundation Research Project

FORUM REPORT 001

Energy Security and Energy Transition: The Case of Japan and Its Global Implications

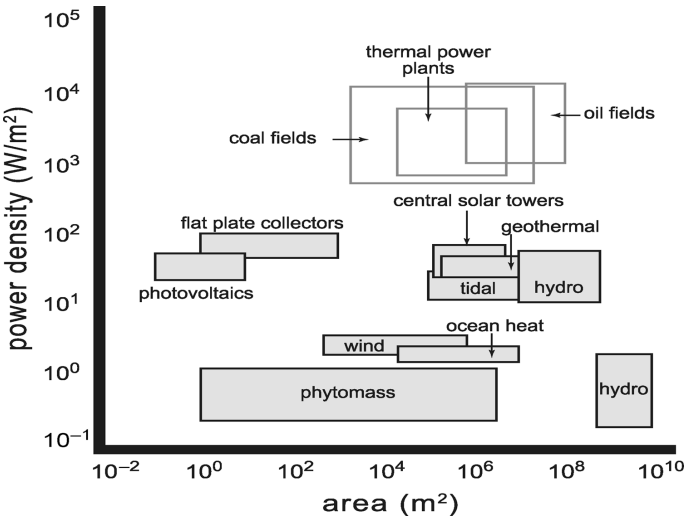
Reexaming Japan in Global Context Forum, Tokyo, Japan, December 17, 2012

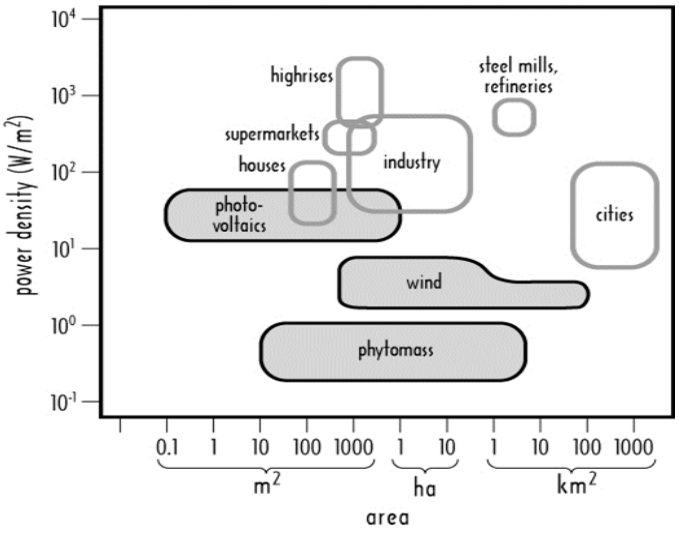
The first workshop of "Reexamining Japan in Global Context" started with Professor Masayuki Tadokoro's introduction of the project. He stated that it will be a three-year, trans-Pacific project involving scholars and professionals from Japan and North America to discuss important topics on Japan that are also relevant to the world. The topic of the project chosen for this day's discussion was energy.

The first of the two keynote speeches, by Professor Vaclav Smil of the University of Manitoba, was on energy transitions. Professor Smil succinctly summarized his main point in two Latin words: *festina lente* (make haste slowly). In terms of our energy future, we already know where we must go, but getting there will not be simple because of the enormous costs associated with shifting away from our current energy system. Nor will it be quick, and there are limits on how much the process can be sped up.

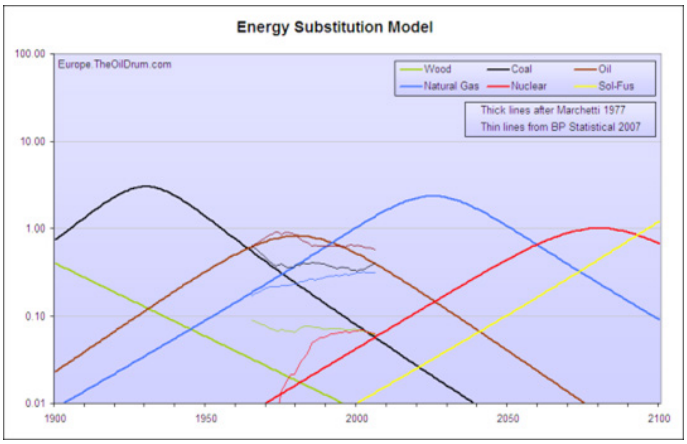
Before the Industrial Revolution, most world energy was used for food production. Afterwards, the amount of energy used in the manufacturing, transportation, and service sectors drastically increased. Modern civilization is characterized by a high level of "anthropomass"—both high levels of population and high levels of population density—requiring a concomitantly high density of power generation. Naturally, we have built our energy structure accordingly. This is the main reason why we have been relying heavily on fossil fuels (coal, oil, and natural gas): they have high energy densities and are readily sourced, transported, and converted into useful form to service the kind of civilization we have created—a civilization characterized by megacities with energy-intensive infrastructures and services such as high-rise buildings, supermarkets, steel mills, hospitals, and transportation systems. The energy infrastructure we have built around fossil fuels (and to a lesser extent, nuclear power and hydroelectricity) is effective, but was costly to create and is not easily reconfigured or substituted for more environmentally-friendly alternatives such as solar or wind.

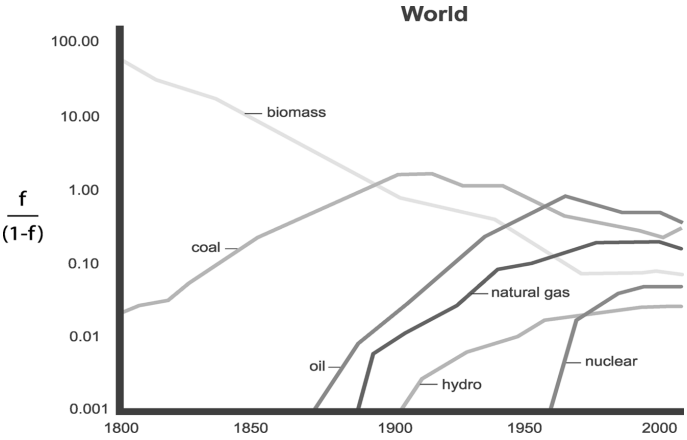
Marchetti's energy substitution model predicted periodic shifts from one energy source to another. However, we have not observed this in recent decades. Multiple sources are used concurrently, owing to the sunk costs of investment in infrastructure ("once infrastructure is there, you cannot run





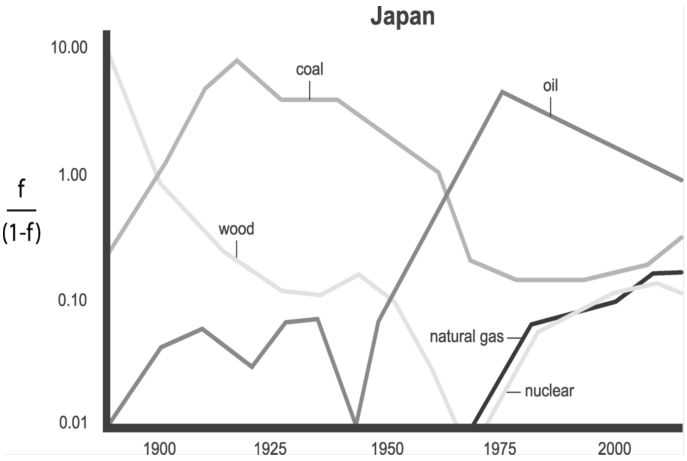
away from it"), and the fact that fossil fuels still far out-perform most alternative sources in terms of power generation density. For this reason, the combined use of oil, natural gas, and nuclear in both developed and developing countries is roughly stable at the moment.





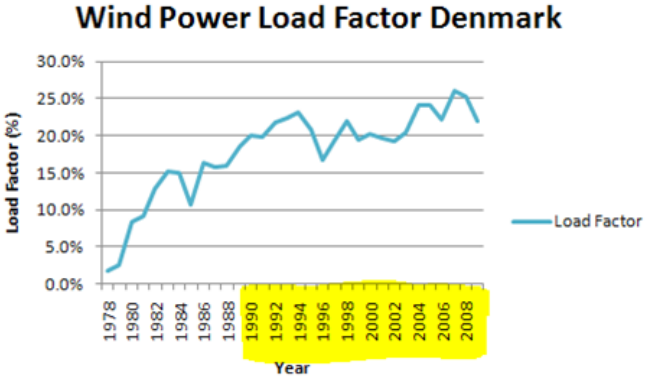
Japan has been diversifying its energy portfolio by utilizing both traditional and alternative sources, driven in part by rising social awareness of environmental considerations. Oil and wood use have experienced ups and downs during the 1930s to the 1980s, but all energy sources, including coal, are currently used in a stable fashion, with the exception of nuclear energy (post-Fukushima)—a dip that may prove to be temporary.

Various alternative energy sources are either already being used commercially or are in the process of development. But the problem is that most alternatives do not work all of the time, are relatively inefficient, and/or are prohibitively costly:



- If we were to capture and convert a small fraction of the solar radiation that strikes Earth, we could easily provide for all of our energy needs. But solar panels do not generate energy at night or during cloudy days, are less effective in high latitudes, and even under the best conditions generate a small fraction of the energy per square meter compared to fossil fuel or nuclear power plants. Spain relies more heavily on solar power than any other country in Europe and enjoys comparatively favourable conditions, but solar panels generate electricity only about 11-16% of the time, unlike coal-fired stations that work about 70% of the time and nuclear power plants whose capacity factor often exceeds 90%. In principle, Europe could import considerable quantities of solar-generated electricity from North Africa, but this would involve enormous investments in infrastructure in politically unstable countries.

- In Denmark, the country that currently makes the most use of wind power and is relatively well suited geographically to exploit it, turbines are operational only 20-25% of the time. And while every country has wind, wind-power generation is only feasible if the winds are steady, strong enough, but not too strong. The type of wind "just right" for energy generation is comparatively rare, for example, in Asia.

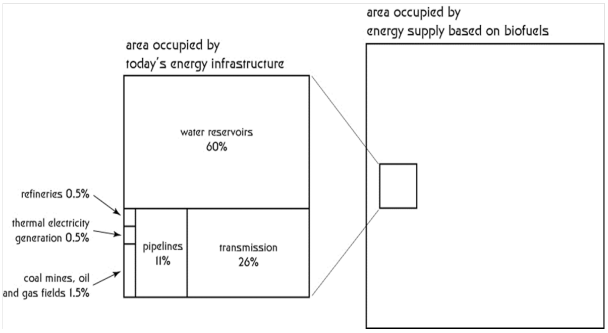


- In principle, large turbine arrays in tidal zones or strong ocean currents could generate significant amounts of energy, but sea water is highly corrosive and building durable installations and resilient transmission lines is at the moment prohibitively costly.

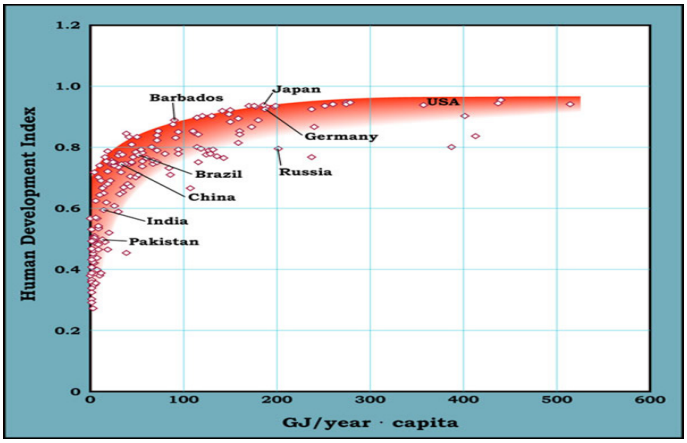
- Biofuel power generation is even less efficient than solar in terms of land use, and has a significant opportunity cost given that it is only feasible (unlike solar) on arable land.

The only exception to the low-efficiency problem is nuclear energy. Nuclear plants can operate with high capacity factors of 90% of the time or more. But as we well know, after the Fukushima disaster, most developed countries, especially in the EU, have turned away from nuclear power.

Biofuel land claims



In the end, the most important question is not how we can sustain the current level of energy generation, but whether we need all the energy that we are generating, particularly given the environmental price we are paying. The answer is no: beyond a certain threshold, increased energy consumption does not correlate with an increase in physical (objective) quality of life (infant mortality, morbidity, longevity, income) or with subjective assessment of well-being (happiness). Human Development Index that comprises indicators of subjective well-being does not rise with annual energy use beyond 120 GJ per capita.



Energy use and subjective well-being

http://www.thehappinessshow.com/HappiestCountries.htm

Level of subjective well-being	Average annual energy use in 2010 (GJ/capita)
· 1. Puerto Rico	100
· 2. Mexico	70
· 3. Denmark	160
· 4. Colombia	35
· 10. Canada	390
· 13. Venezuela	110
· 15. USA	345
· 35. Italy	140
· 39. Japan	170

We can sustain our subjective well-being with less energy than is currently generated, and with more environmentally-friendly alternatives. The trick is to move in this direction gradually and by relying on a multitude of actions. Rushing, or relying on a single solution, is a shortcut for failure; starting with relatively low-cost measures—such as trying to internalize the costs of many environmental externalities, insisting on the best possible building codes to save energy in housing or mandating lighter and more efficient vehicles—would set us down the path toward a realistic energy transition.

During the first Q&A session, four major questions arose. The first was whether it would be possible or desirable for developed countries to fully phase out nuclear energy. Nuclear energy is no longer a purely economic issue; it has become highly politicized. Although newer power plant designs are much safer than older ones, public opinion in developed countries has turned overwhelmingly anti-nuclear. Fusion energy has been the subject of considerable research, but its technological feasibility has yet to be demonstrated, and even if it is technically feasible, it may not be economically feasible. Today's nuclear plants, which are based on nuclear fission, do require elaborate safety systems and pose challenges for the storage or disposal of nuclear waste, but they are economically feasible and have proven to be highly reliable. It is unlikely that nuclear energy will disappear, even in Japan.

The second question was whether global warming was real. The Northern Hemisphere in the past 160 years has shown 0.7^{0}C increase in temperatures. The rate of warming has slowed down since the year 2000 but a faster change can return, particularly if large-scale combustion of Asian coal will increase even more. The tricky part is to determine which aspect of any temperature increase is natural and which is anthropogenic. Also, predicting the future of global warming is extremely difficult, and there is a difference of several degrees of Celsius between the extreme forecasts for the year 2100. An especially important factor is China, but nobody can predict accurately China's future carbon emissions. International agreements, such as Kyoto Protocol, have been not effective, as countries that have decreased their emission have done so simply because of bad domestic economy or because of using less carbon-intensive sources of energy, and not necessarily because of treaty obligations.

The third question concerned the measurement of "happiness," which figured so prominently in Professor Smil's conclusion. Happiness must be measured by both objective indicators (such as the Human Development Index, which incorporates purchasing power parity, GDP, longevity, etc.) and subjective self-reports. Whether we use only one or both, the result is always the same: beyond a certain point, increased energy consumption does not correlate with happi-

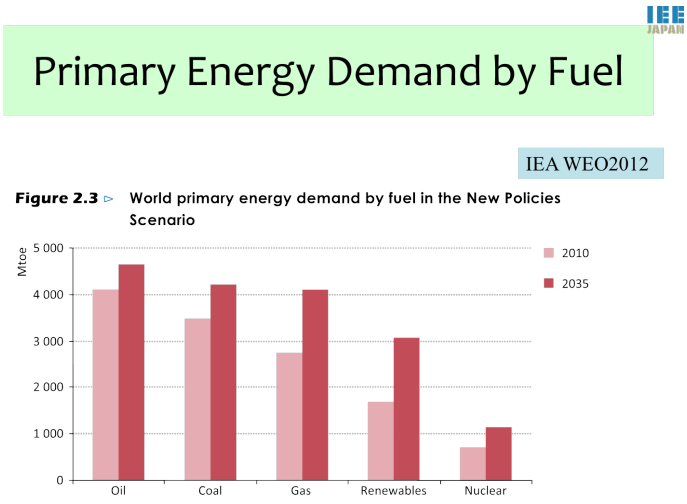
ness. Canadians use twice as much energy per capita as EU citizens, but there is no evidence that Canadians are happier. If our goal is to maximize human happiness, all we need is an annual generation capacity in the range of 100 GJ per capita.

The fourth question concerned the common practice of comparing Japan's attitude toward nuclear energy to that of Germany. Although the public and the media consider them very similar in this regard, there are important differences. Germany is able to shift from nuclear to alternative sources of energy because of high levels of cooperation between labour and corporations, the public's willingness to accept the high cost of alternative energy, and the strength of the Green Party in domestic politics. It can even be argued that Germans consider the environment to be a kind of desirable "luxury good" that they must pay for in order to feel good about themselves. None of these is characteristic of Japan.

As a final comment, Professor Smil added that for a better energy future, Japan should adopt small-step, multi-part reforms. Like any other country, Japan has sunk costs and vested interests in maintaining its current energy infrastructure, which makes sudden major changes difficult. But gradual improvements are possible and should focus on improving the efficiency of existing sources of energy, reducing consumption, and incenting investment in alternative energy (for example, by increasingly taxing carbon). If Japan decides to play a "carbon game," it should first tax coal, then oil, then natural gas.

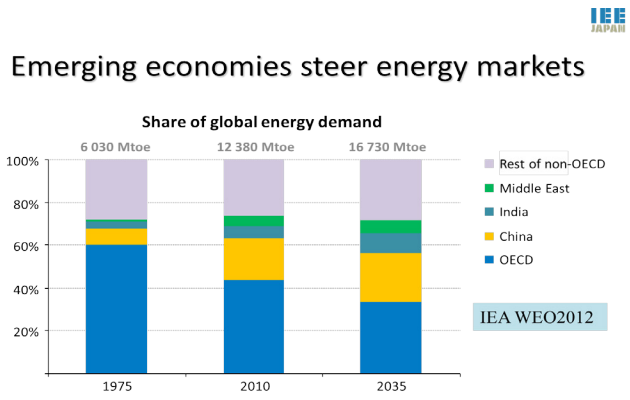
The second presentation, by Mr. Nobuo Tanaka, Global Associate for Energy Security and Sustainability at The Institute of Energy Economics, Japan, was titled "Post Fukushima Energy Strategy: Energy Security and Sustainability in Asia." We are living in an era in which the definition of energy security has expanded to incorporate strategies for achieving sustainable and stable sources of electricity beyond fossil fuels, and the share of non-OECD countries' energy demand is drastically increasing, as living standards in China, India, and the Middle East have risen.

According to the International Energy Agency's New Policies Scenario, oil, coal, and gas will continue to be major sources of energy in the decades to come, and both developed and developing countries are still heavily investing in them. Japan must take this global trend into consideration when formulating its own energy-security strategy.

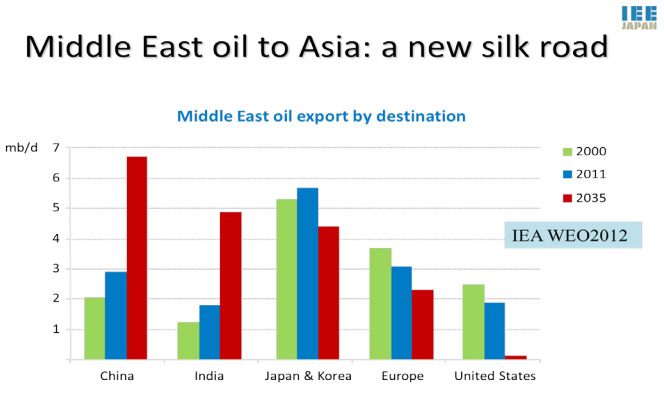


The United States will soon become "energy independent" as domestic production of unconventional oil and shale gas grows. The cheap energy available within the United States will result in domestic economy expansions (because 60 percent of the American trade deficit recently has been from energy imports), causing global economic shifts that will see jobs move back to the United States from emerging economies such as China, thanks to the new availability of cheap energy.

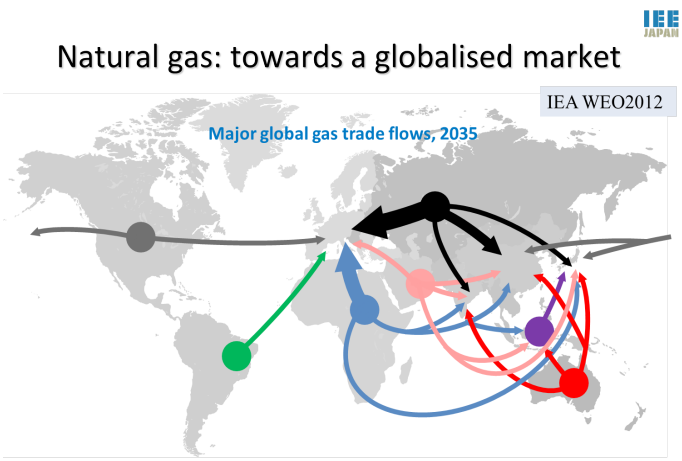
Other countries than the United States, however, will continue to rely heavily on Middle Eastern oil, and as a result the region will maintain its vital role in international energy supply. In particular, a reconstructed Iraq will become a major regional exporter and Asia's reliance on Iraqi oil, especially in China's case, is likely to rise. The United States will continue to shoulder most of the burden of reconstructing Iraq, maintaining freedom of navigation in the Persian Gulf and managing possible crises around the Strait of Hormuz even though the United States' no longer relies on Middle Eastern oil. It is accordingly likely that the United States will demand more in the way of contributions from its allies and the international community who reap the main benefits of



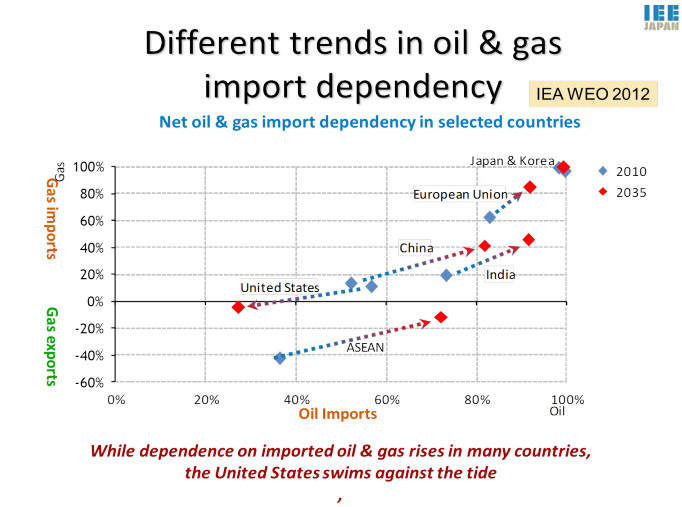
Global energy demand rises by over one-third in the period to 2035, underpinned by rising living standards in China, India & the Middle East



By 2035, almost 90% of Middle Eastern oil exports go to Asia; North America's emergence as a net exporter accelerates the eastward shift in trade



Rising supplies of unconventional gas & LNG help to diversify trade flows, putting pressure on conventional gas suppliers & oil-linked pricing mechanisms



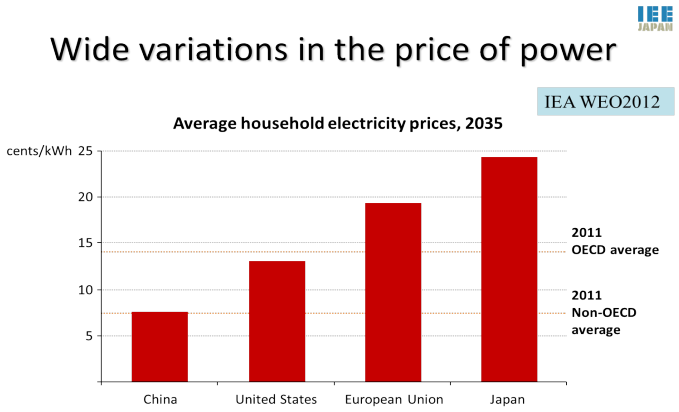
While dependence on imported oil & gas rises in many countries, the United States swims against the tide

a stable Middle East. It would be prudent for Japan to diversify its energy supplies and minimize its over-dependence on oil, which makes it extremely vulnerable to such potential future crises. Unfortunately, the Japanese government is ill-prepared for such a scenario at present.

Another characteristic of the current world energy market is the rise of natural and unconventional gas supplies. In addition to Russia, the United States has come to the fore as a major exporter of gas, and Australian and African export have also diversified the world gas market structure.

Since gas and oil export chains have become more complex—giving more choices to importing countries—one reasonable option for Japan in diversifying its energy portfolio is to further tap into Russian natural gas. Currently Russia cannot export more to Europe than it already does, and it is thus expanding its gas exports to a number of Asian countries to stake out a strategically advantageous position in the world energy market. But Japan pays a premium for natural gas imports owing to the long-term contracts with oil price indexation and to a paucity of alternatives in the wake of the post-Fukushima shutdown of nuclear power. For this reason, at least some nuclear plants must be reopened to demonstrate the existence of alternatives during negotiations. Concurrently, Japan must also reform its domestic energy marketplace. The existence of regional monopolies encourages inefficiency, discourages innovation, and provides insufficient incentives to negotiate hard for better gas import prices. The fact that Japan has two incompatible power grids (one operating at 50 Hz, one at 60 Hz) compounds the problem. The power companies are resisting integration, not only because of the costs of adjustment but because of the increased likelihood of intense competition. The obstacle to integrating power grids is less technical than financial and political.

Having an alternative energy source available in the form of nuclear power while attempting to further diversify its energy portfolio can strengthen Japan's negotiation position and provide the country with cost-effective electricity, while Japan and other developed countries continue to build new infrastructures for renewable energies. The cost of energy is cheap in developing countries—especially in China—because they still rely heavily on coal with already-existing infrastructures. In developed countries, however, the cost is expensive because they are in the process of additionally investing in new infrastructures for the environmentally-friendly energy demanded by the public.



Electricity prices are set to increase with the highest prices persisting in the European Union & Japan, well above those in China & the United States

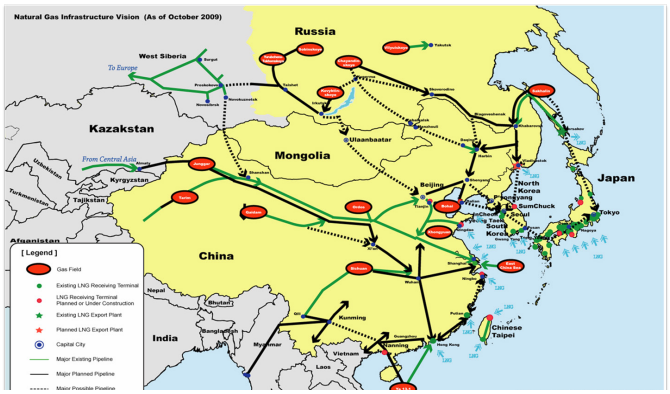
There is potential for greater reliance on renewable and clean energy sources, though these will require very high levels of investment in new infrastructure and grid interconnection. In the short to medium term, without nuclear power Japan's current level of energy cost is simply not sustainable, and it is even likely to rise further as the Germany case in Europe. The Japanese government's 2012 "Innovative Energy & Environment Strategy" calling for a phasing-out of nuclear power generation by 2040 is, from a global context, problematic and unrealistic.

If we are to assume that nuclear will remain an important source of power generation in the coming years despite its negative image, we must put more effort in improving existing atomic technology. There have been proposals for new types of reactor and pyroprocessing, such as the integral fast reactor design by Dr. Yoon Il Chang at the Argonne National

Laboratory. Although actual adaptation of the technology will be geopolitically complicated, South Korea is already showing interest. In 2014, the United States and South Korea are scheduled to renew their bilateral nuclear agreement, and the reprocessing issue is already on the top of agenda, as this type of fast reactor will require reprocessing facilities that South Korea currently lacks. Japan, on the other hand, already has reprocessing facilities. If Japan decides to phase out nuclear energy completely, it could risk giving up "tier one nation" status as Nye & Armitage reported in August 2012. Japan must take such regional changes into account. A more reasonable choice for Japan would be to form a new nonproliferation regime in the region that involves the United States, Japan, and South Korea.

IEE JAPAN

New concepts for North East Asia Gas & Pipeline Infrastructure



In the end, Japan must share the lessons learned from the Fukushima incident and formulate viable, realistic energy security schemes for its future. The most important lesson from Fukushima concerning energy security is that we must always "think about the unthinkable." Japan should learn from the EU model of "collective energy security," in which European countries are interconnected with regional power grids and diversified gas pipelines. As in the EU, Japan must seek to diversify its energy supply and demand portfolio, and actively support the development of a regional gas infrastructure that incorporates Russia, which has multiple pipelines to Europe, but none to East Asia.

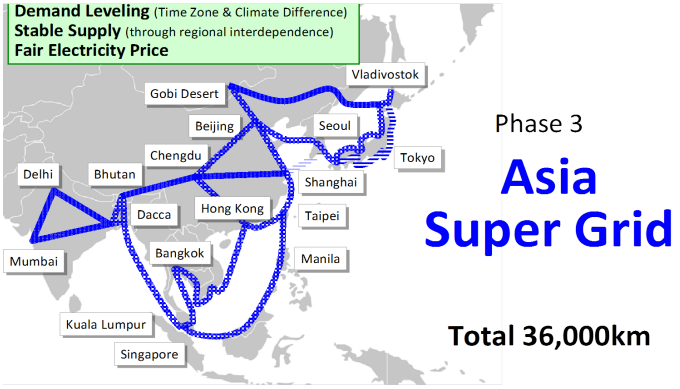
At the end of the day, nuclear power must continue to be in Japan's energy mix. Simply phasing out nuclear power for domestic political reasons without considering the reality of Japan's long-term energy security would be a serious mistake.

In the second Q&A session, the panel asked Mr. Tanaka a number of detailed technical questions concerning various energy sources, then discussed the role that nuclear issue played during the Japanese general election in December 2012. While it is possible to argue that LDP's victory reflected the Japanese public's realistic acceptance of the LDP's "anti-zero-nuclear" stance of the party, it is more likely that Japanese voters were simply punishing the DPJ for poor performance in government. Opinion polls still indicate that the Japanese public is strongly anti-nuclear. Since the December election was fought by the two parties with "packages of policies," the final outcome cannot be directly interpreted as an endorsement of any one particular policy position. In Japan, the most serious obstacle to a serious analysis and discussion of energy is policymakers' reluctance to support nuclear power openly, even if most bureaucrats and experts concede the necessity of this. For example, before and after the Fukushima incident, there had been discussions about the Fukushima Daiichi plant and engineers knew that additional safety measures would have resulted in a different outcome. But nobody has officially and openly stated that if the plant had been given same preparations for total plant blackout like in the United States, it would in fact have demonstrated the safety of nuclear energy.

The discussion then turned to Japan's negotiations with Russia over natural gas. Negotiating with Russia is difficult at the best of times. To make Japan's position stronger, it could buy cheap shale gas from the United States for leverage. However, shale gas is not sufficient to convince the Russian side that Japan has alternatives, which is why domestic nuclear generation must be continued. In addition, Japan should only sign short-term contracts, like Germany, to maintain a stronger negotiating position.

Finally, discussion turned to Japan's neighbours and the possibility of establishing a new regional nonproliferation scheme, particularly with South Korea. South Korea is more open to the nuclear fuel cycle option and is seeking to build new nuclear facilities; but it could face opposition from the United States because of the reprocessing issue. South Korea is in a relatively strong position on this issue, however, since its capacity to store spent fuels will be exhausted by 2020. Although this bilateral negotiation will be a difficult political process, Japan can actively take part for the creation of a new regional nonproliferation scheme that will ensure a stable supply of safe nuclear energy for allies in the region.

Energy for Peace in Asia. A New Asian Vision? IEE JAPAN



Presentation by Mr. Masayoshi SON

Reexamining Japan in Global Context

Energy Security and Energy Transition: The Case of Japan and Its Global Implications

Monday, December 17, 2012

International House of Japan

Keynote Speakers

- Professor Vaclav SMIL, *Distinguished Professor, Faculty of Environment, University of Manitoba*
- Mr. Nobuo TANAKA, *Global Associate for Energy Security and Sustainability, The Institute of Energy Economics, Japan*

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Professor Vaclav Smil is currently Distinguished Professor Emeritus in the Faculty of Environment at the University of Manitoba in Winnipeg, and a Fellow of the Royal Society of Canada. Born in the former Czechoslovakia in 1943, he obtained his Ph.D. from the Pennsylvania State University. He has a wide arrange of academic interest and continues to research in energy systems, environmental change, energy and technology innovation, food, population, economics, and public policy.

Mr. Nobuo Tanaka is currently Global Associate for Energy Security and Sustainability at The Institute of Energy Economics, Japan. Born in 1950, he has a degree in Economics from the University of Tokyo. During his career at the Ministry of Economy, Trade and Industry (METI) in Tokyo, he was awarded an MBA from Case Western Reserve University, Cleveland, Ohio. He also formerly served as Director-General of the Multilateral Trading System Department at the Trade Policy Bureau, and as Executive Director of the International Energy Agency (IEA).

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