Japan's Path to Sustainable Electricity Supply

A Review of Current Japanese Energy Policies

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SUMMARY

Following the East Japan earthquake and the nuclear incident at Fukushima, all reactors in Japan were required to pass newly revised safety standards to confirm their continued ability to operate safely in the event of a natural disaster and remain closed until Japanese authorities reviewed and accepted the results. As a result, nuclear generation by electric utilities dropped from average of 30% of Japan's total generation to 2%. The contribution of fossil-fueled generation of electricity rose to 90% of Japan's total electricity output during 2012[1]. Japan's use of fossil-fueled generation was up 21% in 2012, compared to the level in 2011. Most of this increase is in the consumption of liquefied natural gas (LNG) petroleum, with a smaller increase in the consumption of coal.

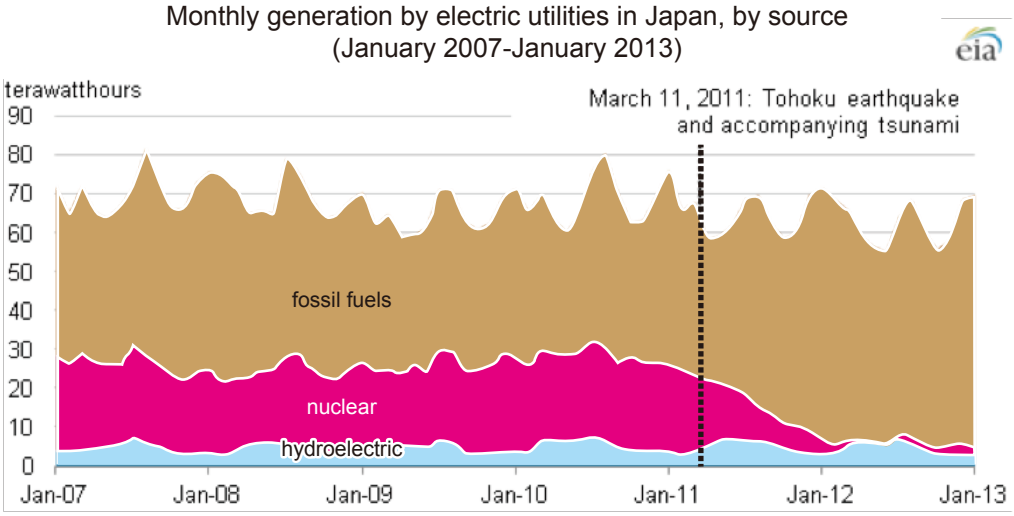


Figure 1. Monthly generation by electric utilities in Japan, by sources. Source: EIA[2]

The increased use of expensive imported fossil fuels and a dramatic decline in the value of the yen has raised prices within Japan and contributed to sustained multi-billion dollar monthly trade deficits. In April, 2014, the Government of Japan (GOJ) adopted the Fourth Strategic Energy Plan (SEP) that revised Japan's approach to energy development and use in Japan. The SEP is intended to meet Japan's "3E+S" energy goals: Energy Security, Economic Efficiency, Environment and Safety. Under the revised plan, coal-fired generation of electricity and reopening some number of idled nuclear powered electric generating units (EGUs) would be relied on to provide baseload electric power as research and gradual introduction of renewable energy would occur on a longer time frame. In addition, the SEP promotes additional sales of high-efficiency coal-fired EGUs world-wide as a means of reducing global CO_2 emission.

1. The remaining generation was provided by pre-existing hydropower.
2. Source: U.S. Energy Information Administration, based on Bloomberg LP.
http://www.eia.gov/todayinenergy/detail.cfm?id=10391

Several months earlier, the U.S. Government had adopted a Climate Action Plan[3] that disfavored the continued use of coal-fired generation and promoted the prompt adoption of renewable energy, with natural gas fired Combined Cycle Gas Generation as a "bridge" fuel to a low carbon intensity future. As part of the U.S. Climate Action Plan, the U.S. Environmental Protection Agency (USEPA) has proposed several new rules that, when finalized, will dramatically alter energy development and use in the U.S., but in a manner that is substantially different from the most recent SEP. In January of 2014, USEPA proposed rules limiting CO_2 emissions from new fossil fuel-fired power plants. Notably, the proposed limits would effectively prohibit the construction of new coal-fired power plants[4]. In June of 2014, USEPA proposed limits on existing fossil-fuel fired power plants that would force the closure of a number of existing coal-fired EGUs, require efficiency upgrades at remaining coal-fired EGUs and promote the use of existing natural gas fired EGUs and development of renewable energy and energy efficiency. Final action on these proposals is scheduled for June, 2015.

Kiko Network has requested a review of the potential energy options and issues, focusing on electricity, that may not be fully considered in the SEP and potential policy revisions for consideration within Japan. The SEP relies on several factual assertions that are demonstrably incorrect and fails to take into account other factors that are relevant to the consideration of Japan's 3E+S goals. This report identifies and discusses a number of those incorrect assertions and overlooked issues. The SEP underestimates the potential for a rapid scale up of renewable energy in Japan. While recognizing current problems of FIT structure and developer's side, the current backlog of certified projects waiting to commence construction still demonstrates a ready supply of RE that can be available before the planned fleet of new coal-fired EGUs could be constructed, once the FIT is revised realistically and transmission constraints are eliminated - for less cost than new coal-fired EGUs. The SEP also underestimates the price volatility demonstrated over the past two decades for both coal and nuclear fuel, fails to establish a risk premium to compensate for that volatility and fails to consider the likely increase in maintenance costs, over and above increased safety costs, associated with continued use of older coal-fired and nuclear powered EGUs.

This report also addresses the lack of transparency concerning the operation of Japan's energy sector and suggests that the release of far more data concerning existing and planned EGUs than is current practice will lead to better policy development in this critical area. Among the elements of the Climate Action Plan being implemented in the United States is a requirement for heat rate improvements at existing fossil fuel- fired electric generating units (EGUs). A technical review of this alternative was attempted, but could not be completed because data needed to evaluate the potential for improving the efficiency of existing fossil fuel-fired EGUs is not publicly available in Japan. Importantly, the SEP does not indicate that this option was even considered in developing the plan.

3. http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf

4. The proposed CO_2 emission limit is 1000 lb/MWh (gross) for above 100MW and 0.33 capacity factor and 1100 lb/MWh for smaller plants between 25 and 100 MW and 0.33 capacity factor. Therefore, only plants that were equipped with partial carbon capture and sequestration (CCS) would be permitted.

SOLAR ENERGY

The SEP acknowledges that renewable energy is a promising energy source and proposes to encourage its use through regulatory reform and additional research and development. However, the SEP concludes that renewable energy has "various challenges in terms of stable supply and cost at this moment." While conceding a future role for small scale solar generation in distributed generation settings, the SEP concludes that

> "the power generation cost of solar power is high, and power output is unstable. Therefore, further technological innovation is necessary. In the mid-to-long-term, cost reduction is expected to promote the introduction of solar power based on its position as an energy source which complements peaking demand in daytime hours in the distributed energy system and which contributes to the implementation of energy management involving the participation of consumers."

While further technical development will further reduce its cost, solar energy, particularly utility scale solar energy is commercially available. Based on cost trends in the United States, Europe and elsewhere utility scale solar energy should be competitive with fossil fuel fired generation in Japan by the time a new fleet of coal-fired power plants could be constructed. Several years ago the United States Department of Energy (DOE) established the SunShot program to reduce the cost of solar energy by 75 percent between 2010 and 2020. In its most recent report on the project's progress, the Lawrence Berkeley National Laboratory, which manages the program for the U.S. DOE, provides hard data - actual costs of completed projects – that documents the very dramatic decline in solar photovoltaic (PV) costs in just three years[5] . While the data show a significant decrease in the cost of systems of all sizes, of most relevance to Japanese energy policy is the very large decrease in recent years in the cost of utility scale solar PV. At an installed cost of 11.2 U.S. cents/kWh utility scale solar is now cost competitive with natural gas peaking and load following generation and, when fuel price volatility is properly considered, with new coal-fired generation. The most recent compilation of cost of generation from different sources reports an even lower cost of USD 72-86/MWh for utility scale solar[6].

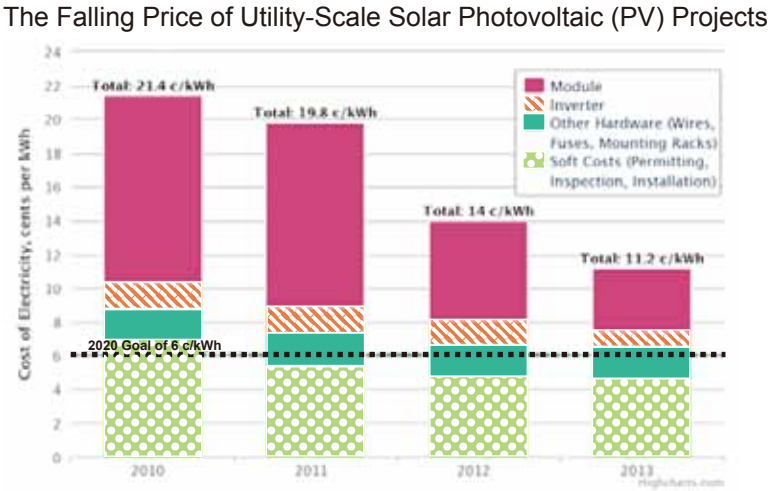


Figure 2. The falling price of Utility-Scale Solar Photovoltaic (PV) projects
Source: U.S. Department of Energy[7]

5. This report and the underlying data can be accessed at http://eetd.lbl.gov/sites/all/files/lbnl-6350e.pdf.
6. http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf?utm_source=Video+of+Sept.+18+event+with+Lazard&utm_campaign=GCC+-+Lazard+Event&utm_medium=email
7. http://energy.gov/eere/sunshot/photovoltaics

The DOE study, cited above, reports that residential/commercial PV panel prices in Japan are slightly less expensive than in the U.S. The study also reports that Chinese PV panels are slightly less expensive than U.S. panels[8]. Japans' solar resources are among the very best in the world, far better than Germany or several U.S. states with fast growing solar penetration.

The GOJ has undertaken several efforts to provide a startup impetus for renewable energy, including net metering, portfolio standards and, most recently, a Feed In Tariff (FIT). The Japanese FIT specifies a tariff that has been more than sufficient to spur the development of a truly significant amount of solar PV, but contains features that sharply diminish the program's effectiveness.

A Power Purchase Agreement (PPA) is a contract between the developer/owner of the generating asset (here, the owner of the solar park) and the utility that then resells the electricity to the consumer. A long term PPA that provides a predictable revenue stream provides the basis for financing solar and other renewable energy projects. While the Japanese FIT system does provide for a 20 year term, unlike successful European and U.S. FIT programs, it does not provide for clear "take or pay" priority provisions that assure that the utility will purchase the electricity that is generated. In the Japanese FIT legislation there are conditions under which Japanese utilities can decline to accept the electricity produced by renewables, including a lack of transmission capacity.

The most recent data demonstrates that there continues to be a steady investment by individuals in solar PV. Those data also demonstrate that something is preventing the large number of projects that have registered for the tariff from commencing construction. In the period from April, 2012 to December, 2014 solar projects with a capacity of 70,880 MW had registered and been certified, but projects totaling only 15,410 MW had commenced construction. Some portion of the unbuilt projects has been attributed to speculators who submitted registrations to obtain high tariff to get larger profits at its premature stage of development. The GOJ has withdrawal of the registration for a number of these projects. The GOJ has expressed a concern that the large capacity of registered projects would cause transmission system deficiencies in certain locations.

Hokkaido is a popular location for renewables and the Hokkaido Electric Power Company has reportedly been authorized to curtail purchases of renewables, without limitation or compensation, once 700 MW of renewables are online in its system. On September 24, 2014, the Kyushu Electric Power Company announced that it would temporarily suspend processing applications for grid connection of new renewables. The company noted that in March of 2014 alone it had received 70,000 applications for grid connection and that the total capacity of all wind and solar connection applications currently filed was 12,600 MW. Prior to adoption of the FIT policy, Kyushu Electric had predicted that its 2020 renewable generation would be 3,000 MW. Shortly thereafter Hokkaido, Tohoku, Shikoku and Okinawa announced similar restrictions on renewable generation.

8. http://eetd.lbl.gov/sites/all/files/tracking_the_sun_vii_report.pdf

In January, 2015, the GOJ revised the FIT provisions to lower the amount of the feed-in-tariff and to prevent speculative registration of proposed projects where there was no concrete business plan to proceed with a project. The GOJ also adopted a revision[9] on the right of utilities to curtail purchases from utility scale renewable generators, and introduced the notion of "real time" control of the amount of renewable generation ("output control") by the Agency for Natural Resources and Energy (ANRE). Under these rules, The utilities may limit renewable generation (including small scale renewable generation), without compensation to the operator, based on the "grid access capacity" where nuclear and fossil fuel-fired plants, including newly constructed power plants, would have a priority right to grid capacity.

The reduced FIT and cancellation of speculative registrations will not likely pose a significant barrier to the development of renewable energy in Japan, but the prospect that utilities can constrain output from renewable sources without compensation will continue to generate uncertainty about the ability of investors to make loan payments and chill investment in renewable energy projects. The large utilities are in the best position to ensure efficient integration of renewables, but lack a financial incentive to do so. Applying the "take or pay" principles discussed herein provides that financial incentive and will likely be more efficient than ANRE regulation.

A long-term PPA, where the utility agrees to take all of the generation from the solar park, provides a guaranteed stream of revenue. The PPA, not the solar panels, is the important security for the loan needed to build the solar park. The developer assigns rights under the PPA to the lending institution. Renewable "take or pay" provisions provide a priority for renewable generation, with very low operating costs, over generation from expensive imported fossil fuels. Japan's vertically integrated monopoly utilities would be required to accept all technically valid applications and ensure that sufficiently flexible transmission resources are available. If the grid is not able to accept the renewable generation at certain points in time, the system operator can curtail renewable generation to maintain grid stability, but the utilities are still required to pay for the curtailed generation. These provisions are common in the U.S. and elsewhere in the world. They discourage delays by utilities (whose profits may be reduced by competition from renewables) in upgrading the grid and provide assurance to lenders that the loan for the renewable project will be serviced. Interest on the loan is one of the major components of the cost of new renewables. PPA terms that increase the risk of default by the developer, such as those described above, will prevent some projects from going forward; other projects may move forward, but with higher interest rates that reflect the increased risk – and, for that reason, higher generating costs.

9. The revision shifted the scheme for limiting renewable electricity output without compensation for the operators of renewable energy power generation facilities (so-called "30-day rule") from a daily basis to an hourly basis

Distributed PV has many advantages and the SEP encourages the continued development of this technology. Less visible is any indication of support for utility scale PV that is far less expensive than distributed PV and would normally be expected to play a significant role in development of low cost power options for Japan.

The International Energy Agency (IEA) reports that the cost of solar PV has already reached grid parity with other forms of energy, including new coal-fired generation, in many countries[10]. As a result, the IEA projects that solar PV in Japan will grow at a rate of 3-4,000 MW per year, reaching 50,000 MW by 2020. After accounting for the differences in capacity factor, *this is more capacity than is needed to offset the proposed new coal-fired power plants.* In Germany, where the solar resources are less valuable than in Japan, the FIT for new solar projects has been reduced to 13.01€c/kWh (18 ¥/kWh) for new small roof mounted systems and 9.01€c/kWh (12¥/kWh) for land-based systems. This step was taken to manage costs and implementation issues at far higher levels of penetration than are contemplated in Japan over the next few years. The FIT is now less than the end user electricity price paid by some of the major industrial enterprises, less than half of the gross electricity price paid by households and less than the estimated full costs for electricity from fossil and nuclear plants[11]. The reduced FIT has reduced the number of new PV projects. 1,000 MW of projects were added in the first half of the year, new projects of 2,000 MW of new solar can be expected to be added to the 32,500 MW of already installed capacity.

Local PV developers in Japan claim that their costs are much higher than those reported in the U.S., Europe or China, even though PV panel prices in the U.S. and Japan are comparable. It is not unusual for "first of a kind" projects to have higher prices than later projects, but there is enough experience worldwide and in Japan that there should not be a large difference between Japanese projects and others (especially in light of Japan's relatively high levels of solar insolation). It may be that there is an unusually high cost to construct new transmission capacity to connect individual projects to the grid. These claims may also be based on prices reported several years ago, before the price cuts in recent years. Or it may simply be the fact that landowners have anticipated the FIT and adjusted their land rents based on the level of the FIT. The large number of registrations for large scale PV suggests that many potential developers, including some who may simply be speculators looking to sell the development rights to others, found the current FITs to be attractive. This issue is extremely important, as a FIT that is too high can be as much a barrier to the long-term implementation of renewables in Japan as a FIT that is too low.

10. http://www.iea.org/media/freepublications/technologyroadmaps/solar/TechnologyRoadmapSolarPhotovoltaicEnergy_2014edition.pdf
11. http://www.ise.fraunhofer.de/en/publications/veroeffentlichungen-pdf-dateien-en/studien-und-konzeptpapiere/recent-facts-about-photovoltaics-in-germany.pdf

WIND ENERGY

The GOJ estimates that Tohoku, Hokkaido and Kyushu have over 1,000,000 MW of potential wind energy.

Japan's wind resources were developing at a very modest, but steady rate of approximately 250 MW/year from 2001 to 2011. Thereafter, wind power development dropped to approximately 50 MW/yr, even as wind power costs continued their steady decline. This decline coincided with the 2011 revision of Japan's Environmental Impact Assessment (EIA) law. Under this law a developer can build a 149.9 MW coal-fired power plant, with the attendant stack emissions, fugitive emissions and water quality issues associated with coal and ash piles, and noise - all without conducting an EIA[12]. However, if a developer wants to construct a 10 MW wind or geothermal site, a full EIA is required. At the current FIT a 10 MW project that (just four 2.5 MW wind turbines) would generate a gross revenue of less than USD 6 million per year and net profits of several hundred thousand dollars per year. The obligation to conduct an expensive and time consuming EIA for such relatively small projects is a much larger obstacle than an EIA for a 1200 MW thermal project or for a large concentrated wind farm that would generate much, much larger revenues. This requirement discriminates against wind projects in general and discourages the development of smaller, disbursed wind projects that may be less objectionable from an aesthetic perspective and that would reduce the intermittency of wind power by disbursing the wind turbines over a wider area.

This is not to suggest that environmental concerns with wind power should be ignored or minimized. Wind farms are without doubt industrial facilities and concerns over noise, shadow flicker and bird strikes are legitimate. Other countries have adopted strategies that address these issues in sensible and effective ways. In the U.S. the requirement for site specific studies is often limited to wind farms of 70MW or larger. Low frequency noise and shadow flicker issues can be addressed by establishing set back requirements through zoning laws that govern how far from the property line units of a given height may be installed, rather than expensive site specific studies. Various state governments and/or the Federal government have sponsored flyway studies and delineated areas that are not of concern for bird strikes and industry groups have consulted with government agencies and environmental organizations and published best practice requirements. These obligations can be incorporated in generic permitting documents that can be used to fast track projects employing best practices and that do not raise site specific issues.

The recently released International Energy Agency (IEA) Wind power Report[13] forecasts that new wind power installations in Japan may return to 200MW/yr levels as EIA studies underway are completed and projects go forward. However, understanding that wind projects typically have capacity factors of 30 percent or less, 200 MW/yr of new wind is equivalent to 60 MW of fossil fuel capacity. This rate of increase in actual generation is far too slow a pace to address Japan's needs. By way of comparison, the U.S. state of Texas, which has a population one-fifth of Japan's, has added an average of 1,600 MW/yr in the period from 2006 to 2015. If Japan were to add 1,600 MW/yr of wind over the next ten years, the generation from wind power alone would be sufficient to offset the generation from the proposed new coal-fired generation[14]. *And so, Japan would not need to add new coal generation and could reduce imports of high priced fossil fuels.*

12. A simplified EIA may be required for 112.5-149.9MW power plants.
13. http://www.ieawind.org/annual_reports_PDF/2013/Japan.pdf
14. Or 3,200 MW/yr for the next 5 years. The total capacity needed is approximately 0.016 percent (16/10,000) of the estimated wind capacity of Hokkaido and Kyushu Islands.

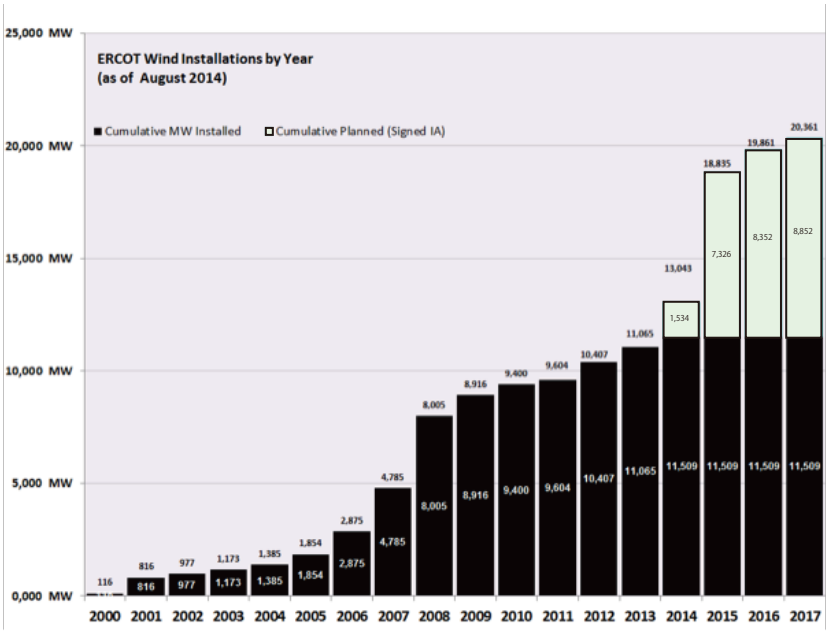


Figure 3. ERCOT Wind Installation by Year[15]

The SEP correctly notes that in Japan, as in many other parts of the world, the most valuable wind resources are not adjacent to the large cities that need the power.

> "Wind power is an energy source which has a potential to be capable of securing economic efficiency, since the power generation cost is close to that of thermal power generation when developed on a large scale. However, while there is sufficient load following capacity to adapt to changes in supply volume in a service area where demand is large, that is not necessary the case in areas suited to wind power, such as Hokkaido and the northern part of Tohoku. Therefore, it is necessary to develop transmission lines, to secure sufficient load following capacity through broad-area operation of power grids and to utilize storage batteries. GOJ needs to promote the utilization of wind power while taking economic efficiency into consideration."

This is certainly true in Texas, South Dakota and other U.S. states that have experienced a rapid growth in RE development. The history of the wind power development in Texas is illustrative of the nature of governmental support needed to develop new energy resources. Several years ago the Texas legislature passed a law requiring the electricity system operator to develop a grid system capable of supporting Texas' wind resources. That law provided a funding mechanism where the ratepayers throughout the state supported the necessary projects in remote, but windy areas of the state known as "Competitive Renewable Energy Zones" (CREZ). Now completed at a cost of nearly USD 7 billion, the CREZ projects involved 186 separate projects, including 345 kV transmission lines and network upgrades spanning 3,600 miles. It has the capacity to transmit approximately 18.5 GW of wind energy from remote windy areas to Texas' large cities. With knowledge that the electricity can be transmitted to markets at reasonable cost, developers have added generating capacity. *Again, the added wind power in Texas in the past few years alone, made possible by an act of the Texas legislature, is nearly at a scale needed to replace the proposed new coal-fired power plants in Japan.*

15. ERCOT Monthly Operational Overview (April 2014)
http://www.ercot.com/content/committees/board/keydocs/2014/ERCOT_Monthly_Operational_Overview_201404.pdf, page 17

In considering the Texas experience it is important to understand that Texas is not California. The Texas legislature, like that in South Dakota, Kansas and a number of other states that are rapidly expanding wind and solar power generation, is a conservative body. The Texas legislature did not enable the CREZ zones to limit emissions of greenhouse gases. It did so to create wealth for its residents and lower based on valuable wind resources that would not likely be developed without legislative action. Texas' electricity rates are less than the U.S. national average and the same or less than nearby U.S. states that rely more heavily on coal-fired generation. The new renewable generation in Texas has proven to be price competitive with natural gas-fired generation, even though Texas has significant non-conventional (fracked) natural gas that is priced far lower than LNG imported in Japan. In its discussion of wind power the SEP correctly notes that integration of wind power is easier where there is a large integrated system and suggests that this factor makes integration of wind power more difficult in Japan than in the U.S. However, most of Texas is not interconnected with the rest of the United States. The major load centers and the major wind power generating facilities in Texas are isolated from the rest of the U.S. grid and so the Texas example provides a good demonstration of what can be accomplished in Japan.

The SEP incorrectly asserts that wind power is somewhat more expensive than new coal-fired generation and states that "[t]here is also the problem of a wind blade falling". Occasional turbine blade failures were experienced earlier in the development of the technology, but that problem was solved more than a decade ago. Wind power is generally recognized as having a lower cost than new conventional pulverized (PC) coal plants and a substantially lower cost than the new Integrated Gasification Combined Cycle (IGCC) coal plants that Japan is promoting[16].

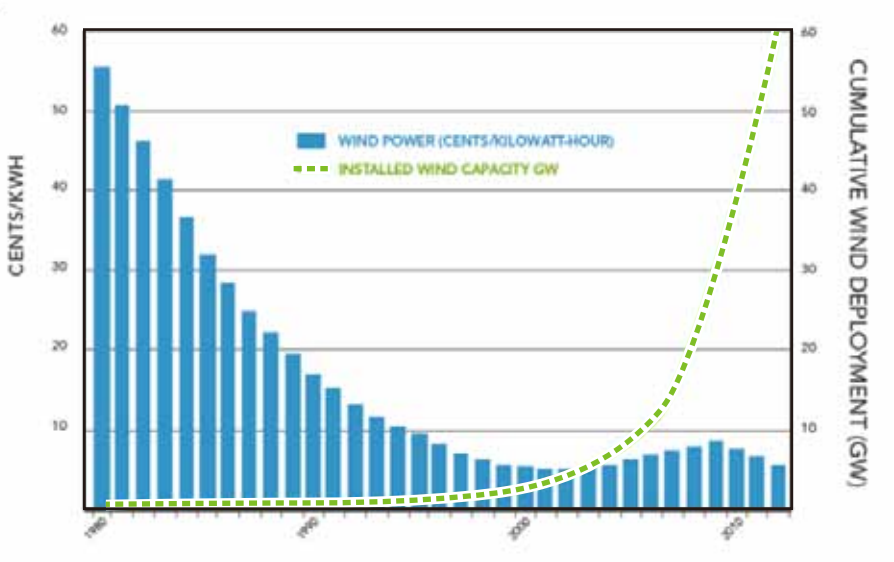


Figure 4. Declined cost of wind energy in US
Source: American Wind Energy Association[17]

16. http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf
17. http://www.awea.org/Resources/Content.aspx?ItemNumber=5547

The SEP provides little specific support for land based wind power, but provides greater policy support for offshore wind power. Most notably, the SEP leaves development of the transmission resources needed to fully develop land-based wind power to a hoped for agreement between wind power developers and Japan's vertically integrated power generators. A tradeoff is between land and offshore wind power is unnecessary as both resources can be developed. On the other hand, the SEP sees promotion of offshore wind power is inevitable for mid and long term. However, promotion of offshore wind power in lieu of land based wind power is also generally viewed skeptically within the environmental community, as is carbon capture and sequestration (CCS). Advocates for the continued use of coal have in recent years feigned support for each of these technologies, but only for so long as actual implementation remained in the distant future. As CCS and offshore wind projects reached the point of commercial implementation, industry support in the U.S. and elsewhere evaporated because of the high intrinsic costs of these technologies. Some governments, notably the German government, appear to be serious about actual implementation of offshore wind power, notwithstanding today's costs. There is no reason why development of offshore technology should not proceed so that in the future it will prove to be useful and affordable. But the potential for offshore wind power at some undefined point in the future should not be used as an excuse to defer development of the technologies that are available today. Development of land based wind power and utility scale solar power can and should continue, both as a bridge to the time when offshore wind implementation is feasible and cost effective and as a complementary power generation option.

COAL FIRED GENERATION

The SEP promotes the construction of new coal-fired generation asserting that (1) coal has the lowest geopolitical risk and (2) the lowest price per unit of heat energy - among fossil fuels. It also promotes the use of new technologies, such as integrated gasification and combined cycle facilities (IGCC), that it claims "drastically" reduce greenhouse gas emissions per unit of generated power. The SEP further claims that it is, in fact, "necessary" to use coal domestically, but to promote the use of Japanese coal combustion products internationally. Japan has in the past few years aggressively marketed Japanese supercritical pulverized coal (SCPC[18]) generating systems throughout the world.

First, it should be understood that neither coal gasification nor supercritical combustion technology is a new technology. Coal gasification was first discovered in the 1600s and was widely used throughout the U.S. and Europe for lighting, heating and cooking. Prior to World War II, 20,000 coal gasifiers were operating in the United States. After World War II, petroleum replaced coal gas throughout most of the world, with the notable exception of South Africa, whose apartheid policies required the continued reliance on gasified coal. With the first oil shocks in the 1970s, interest in coal gasification revived and the first IGCC plant was constructed in the U.S. As oil prices receded, so did interest in IGCC plants, but with the increase in oil prices in the 1990s several new IGCCs were constructed in the U.S. and Europe. As of 2010 there were 144 IGCC plants, with 427 gasifiers operating in 27 countries[19].

Supercritical combustion technology involves operation at the elevated temperature and pressure conditions. This technology was first developed in the U.S. in the 1950s. It was adopted in Japan in the 1960s and has evolved with incremental improvements throughout the world since that time. There are over four hundred coal or lignite-fired SCPC/USCPC/AUSCPC steam electric generating units in service around the world today.

Further, these technologies do not "drastically" reduce greenhouse gas emissions per unit of generated power. These technologies reduce CO_2 emission rates by 10-15 percent compared to modern subcritical units, not a trivial amount, but by no means a "drastic" reduction. Replacing existing LNG-fired units with even the most efficient IGCC technology effectively doubles the rate of emissions. And replacing an existing coal-fired unit, even a unit with a relatively poor emission rate effectively increases the lifetime emission rate of than unit by a factor of two to ten, depending on the remaining useful life of the unit. If the older, low efficiency unit is assumed to operate for 5 to 10 more years, it can be reasonable assumed that at that time the replacement generation will be from renewables or geothermal power. But if that unit is replaced by an IGCC in the near term, the operator of that unit will be locked into generating using coal for as long as society will permit. Most importantly, the level of reduction from implementation of higher efficiency coal-fired units is not sufficient to qualify this resource as part of a meaningful solution to the problem of climate change. It should be noted that, while SCPC/USCPC/AUSCPC generating costs are roughly equivalent to SCPC costs, IGCC generating costs are substantially higher.

Lastly, the SEP offers no factual support, or even rational argument for the claim that the increased use of SCPC or IGCC generation, both domestically and internationally, is somehow "necessary," given the available alternatives. No fact-based argument has been presented to show that Japan must have new coal-fired generation. Further, no facts have been put forward to show that new coal units are "necessary" in Viet Nam, Myanmar or any of the other countries that are targets of the GOJ/JBIC aggressive coal unit marketing and lending policies or that the Japanese economy will suffer if the country were to decide to export highly advanced renewable technologies rather than coal burning technology.

18. As temperature and pressure increase, so does efficiency. Following the trend towards higher operating temperatures and pressures, these units are now being described as 'Ultra-supercritical" (USCPC) or "Advanced Ultra-supercritical" (AUSCPC), but there is no additional thermodynamic phase change involved as there is in the transition from subcritical to supercritical operating conditions.
19. http://www.netl.doe.gov/research/coal/energy-systems/gasification/gasifipedia/history-renewed

Japanese utilities and wholesale power utilities operate approximately 442,000 MW of coal fired capacity, which provides 28percent of Japan's electricity. The reports in 2014[20] indicated that Japan's regional generating monopolies are planning to add 11,000 MW of new fossil fuel generation over the next 14 years, including 1,800 MW of new gas generation, 3,500 MW of new coal generation and 7,000 MW of undetermined fossil fuel generation. Encouraging such development, the SEP boldly asserts that:

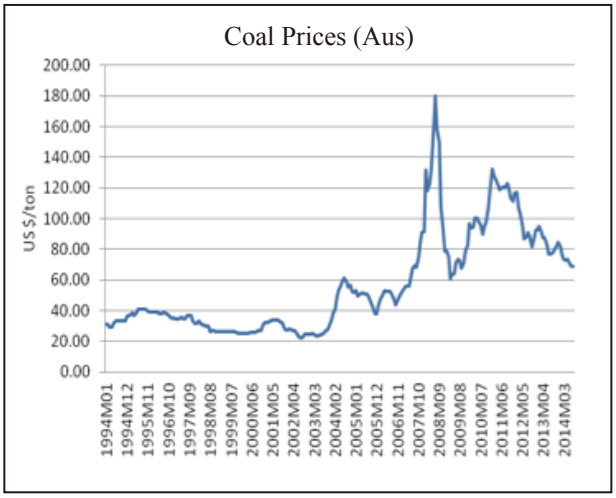
> "crude oil and natural gas prices will keep tendency of rise. The prices seem to be kept at today's level or further rise due to robust demands in emerging countries. On the other hand, the coal price will be relatively stable."

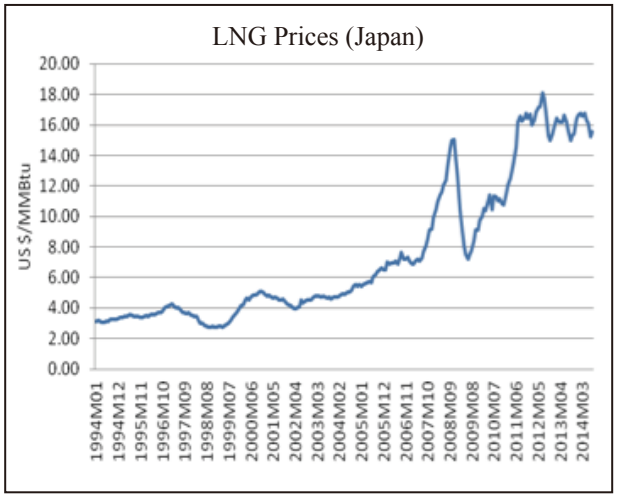
Once a multi-billion dollar investment in new fossil-fuel fired generating capacity is made, the owner is locked into that fuel for 40 to 60 years. It is impossible to forecast with any level of accuracy the price of any fuel more than a few years into the future. A review of recent forecasts of the price of natural gas shows that the U.S. estimates of prices just four years into the future were wrong by 100 percent. The actual price of natural gas in 2013 was half of that predicted for 2013 in 2009, even though the government was fully aware of the development of non-conventional shale gas. Contrary to the assertion in the SEP, long term volatility in coal prices is similar to oil and gas. The charts below set out the prices for various fossil fuels over the past twenty years. Here we see that the peak coal price in that period is approximately six times the average of the early period. This is roughly the same as the ratio of peak to early average shown for the other fossil-fuels – and, as shown later, for nuclear fuel. History has demonstrated that specific events that cannot be predicted, such as flooding in Australia or Indonesian coal export policy decisions, can have significant impact on the price of coal.

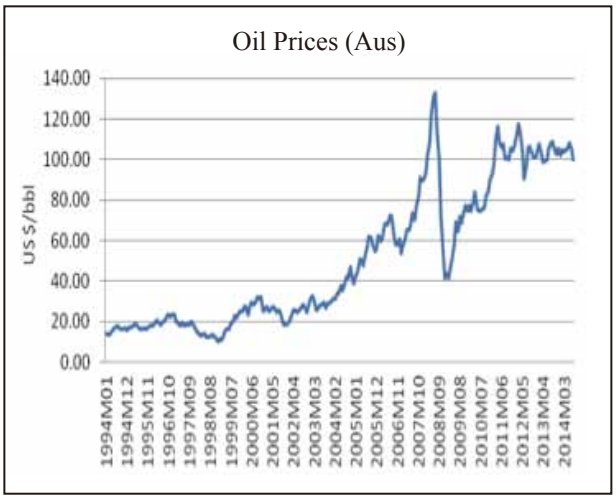
The difference between coal and LNG prices is not the degree of potential volatility, but the fact that coal prices are lower than LNG prices at this moment. But there is no basis to predict that this will remain the case over the next 40-60 years. It takes several years to add coal production capacity. As coal prices rose and predictions of huge demand increases were made, producers expanded supply significantly in recent years. But the anticipated demand did not appear and there is currently an oversupply of coal. A number of producers have declared bankruptcy while others have closed mines and fired thousands of workers to scale back production and rebalance prices. Coal analysts report that coal producers are now selling below cost, so that there is no real probability that prices will be significantly lower for any sustained period of time. As supply is rebalanced to more closely match demand, it is reasonable to anticipate that prices will rise, the price and forward volatility will depend on the ability of producers to anticipate demand and their appetite for risk of additional losses from oversupply.

As the European/US Natural Gas Chart below demonstrates, there is a potential for lower gas prices (and presumably lower LNG prices over the next several decades) if U.S. technology to develop nonconventional natural gas reserves proves to be applicable in Asia and elsewhere.

20. http://www.reuters.com/article/2014/03/28/japan-utilities-plant-idUSL4N0MN1X520140328







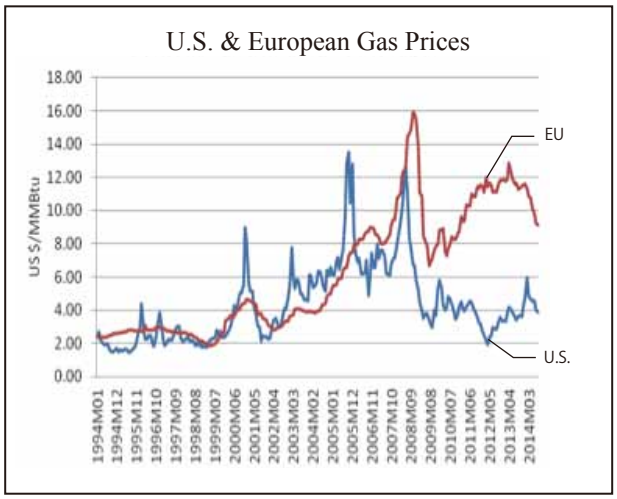


Figure5 Fossil Fuel price

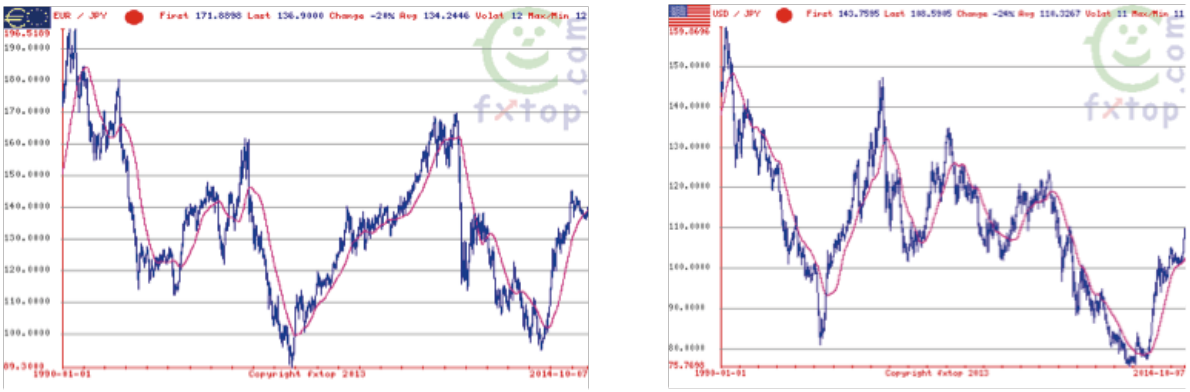


Figure 6. Exchange rates: Japanese Yen vs. Euro and U.S. Dollar, 1990-2014

Indeed, the recent natural gas prices for the U.S. are much closer to 1994 levels than are coal prices. The fundamental point is that no one can predict what will happen to prices of these commodities decades into the future. No one anticipated either the sharp run up in fossil fuel prices prior to the oil shocks of the 1970s or the Iran and Iraq hostilities of recent years, or the steep drop in U.S. gas prices associated with horizontal drilling and fracturing. Historically, incorporating the risk of fuel price volatility in energy decisions was not as important as it is today. In the past coal and gas prices were linked to the price of oil, so that as oil prices rose or fell, so did the price of coal and gas. The theory was that the operator was simply purchasing the heat content of the fuel and the prices of the different forms of providing that heat content should simply reflect the heat content of the fuel. In recent years, the linkage between oil and other fuels has been severed, with by U.S. natural gas prices no longer linked to oil prices, but also to a lesser degree with coal[21] prices. Generating efficiencies with fired CCGT are substantially higher than coal units (including IGCC), so that the cost per unit of electricity generated are closer than they appear in the charts of the cost per unit of heat input published by METI.

More importantly, fossil fuel-fired generation now must compete with energy resources, such as wind and solar power, where the fuel cost is known to be zero and known to be non-volatile. Japanese policy does not appear to recognize the price premium that should be incorporated to account for the fact that fossil fuel fired-generation necessarily bears a risk of price volatility and exchange rate volatility over time. Even without this consideration wind power is priced lower than new gas or coal power and solar power is competitive with peak power prices during daylight hours. If Japan's policy makers include a reasonable premium to account for these risks, renewables will clearly be shown to be less expensive than either new coal or LNG-fired generation going forward.

21. A portion of the cost of internationally traded steam coal is the cost of transportation which is still linked to the price of oil.

GEOTHERMAL ENERGY

Japan is also blessed with the third most abundant geothermal energy resources in the world. Estimates place the developable resources about 33,000 MW. This form of energy generation can be dispatched as base load energy and can be developed as a mix of small and larger projects. Unlike solar or wind power, which are intermittent generating technologies, geothermal energy production has a capacity factor similar to base load coal and nuclear power. In the thirty year period from 1966 to 1996, 520 MW of geothermal generation was installed in Japan, but then development ceased until very recently. Barriers to development include the fact that many of the developable sites are in national parks. In addition, operators of onsen have raised concerns that geothermal power generation will drain the hot springs and ruin a cherished form of relaxation and source of tourism income. In addition, the hiatus in development of this resource in Japan has stalled technical development that can reduce cost.

As with solar power, the SEP offers kind words and research for the mid to long-term development of the resource, but no specific policies to aggressively promote this resource:

> "[c]onsidering such merits, based on mid-to long-term perspective, GOJ studies arrangements for site location in order to continue promoting sustainable development with regions".

A FIT of 40¥/kWh for smaller projects and 26¥/kWh for projects greater than 15 MW is provided. There are very few capacities registered for the FIT. In April of 2014, the first new geothermal plant in 15 years opened in Kumamoto prefecture in Kyushu. Some additional projects are planned throughout Japan, but the initial development process is slow, in part because any geothermal project greater than 10 MW must undergo a full EIA. In addition, as with wind and solar power, the utilities need not take all of the power that the source generates and can refuse interconnection based on lack of transmission capacity. Advocates of this technology express hope that, as the first few projects are developed, public acceptance of this form of power generation will improve. "Take or pay" PPA's that are commercially acceptable to lenders and an upgraded transmission system can help dramatically expand the use of this valuable resource.

With regards to safety, the SEP candidly acknowledges that

> "[t]he TEPCO's Fukushima nuclear accident exposed the fact that countermeasures against severe accidents were lacking. The Japanese government and nuclear operators must continue to reflection the fact that they fell into the trap of the so-called "safety myth" and brought about a situation in which disaster victims and other people are suffering significant hardships.

The SEP asserts that new, post Fukushima accident, "which are of the most stringent level in the world" can guarantee a level of safety that may allow reopening an unspecified number of units that are currently closed. The adopted SEP asserts that the operational cost of nuclear power is low and stable and proposes to allow restarting nuclear units once the Nuclear Regulation Authority (NRA) confirms that the units are in compliance with the new regulations. As we have seen above, the SEP rejects or delays implementation of renewable energy technologies and continued reliance on LNG, on the basis that these technologies are too expensive, but the policy asserts that Japan should move forward with restarting its nuclear plants.

However, in order to evaluate whether alternate options are too expensive than those adopted in the SEP, one needs to know the cost of the favored options. Until Japanese authorities have publicly discussed the extent and cost of their proposed upgrades to nuclear plants they cannot conclude that nuclear power is cheaper than renewables.

Standard reliability theory posits what is known as the Weibull bathtub curve, where failures occur early in a unit's life, then stabilize at a low rate of random failures for a period of time, and then escalate as the unit reaches the end of its economic life. In the U.S. and elsewhere a number of nuclear units have closed (or are scheduled to close) because the cost of ongoing maintenance needs has rendered these units unprofitable. A proper evaluation of the cost of restarting some or all of Japan's nuclear units should include a public discussion, based on plant operating records, of the past and projected maintenance costs as well as the cost of upgrading the plant to meet new requirements and a determination of the remaining useful life of those units and a determination of the Levelized Cost of Electricity (LCOE) for the generation from those units in comparison with the alternatives. Several U.S. nuclear generation units are facing closure because of the inability of the unit to compete with lower cost options, including gas-fired CCGTs and wind power.

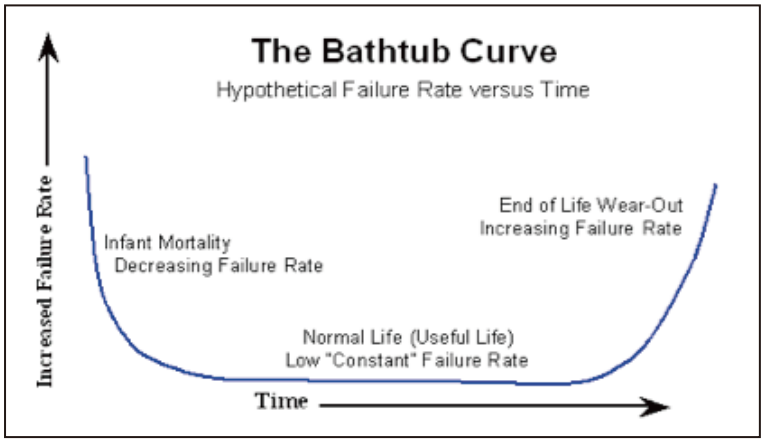


Figure 7. The Bathtub Curve

Any evaluation of the cost of restarting Japan's nuclear fleet should also include a public discussion, based on prior date the cost of storing and reprocessing nuclear waste. In Japan, as in the U.S., this issue has eluded policymakers for over half a century. Given the long time frame for final storage, the need to monitor and potential need for remedial activities at various points over the next 100,000 years, these costs may be material to any cost comparison with renewables.

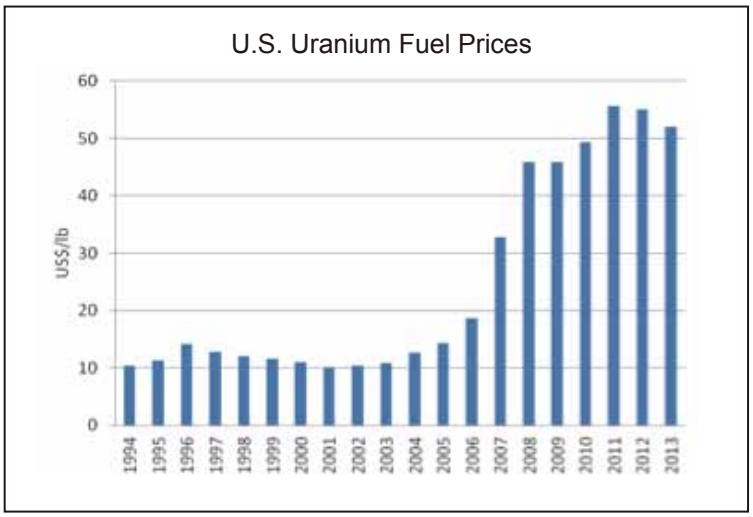


Figure 8. US Uranium Fuel Prices
Source: USEIA

Further, any cost comparison should include a discussion and evaluation of the cost, and cost volatility of fuel reprocessing and virgin nuclear fuel purchases. In the U.S. uranium fuel prices have increased by roughly the same percentage as fossil fuels in recent years.

In addition to a risk premium for future fuel price, reprocessing and storage volatility any evaluation of the cost of restarting nuclear plants compared with reasonable alternatives should include a risk premium for catastrophic accidents. It may be difficult to quantify this premium, since commercial catastrophic risk insurance is not available. However, as events in Fukushima have shown, there is a cost to these uninsured events that is some non-zero amount per kWh of electricity. Best efforts should be made to arrive at a consensus figure (or range of estimates) that is then applied to the projected cost of future nuclear generation.

New nuclear generation is among the highest cost electricity options in the U.S. When and if the cost of upgrades to meet new safety requirements is considered, along with the increase in maintenance costs that is associated with older units, and appropriate fuel price volatility and catastrophic risk premiums, *it is highly likely that renewable energy will be found to be more cost effective than restarting nuclear units.*

ENERGY EFFICIENCY (EE)

As with other technologies the SEP mentions EE, and concludes that EE is a good thing. But the SEP fails to discuss the relative cost of EE to other options. This is highly significant in Japan, since much of the shortfall from the idling of nuclear units has been made up by EE efforts. Further, EE is widely recognized as the lowest cost option for satisfying energy demand. The SEP also fails to set out specific policy, in terms of actions to be taken by the GOJ, or of a national goal for EE that the GOJ will work towards.

HEAT RATE IMPROVEMENTS, BETTER PLANT O&M AND RETIREMENT OF LEAST EFFICIENT UNITS

The SEP claims that coal thermal power is "superior in terms of stable supply and economic efficiency", but acknowledges a problem in that "it emits a large amount of greenhouse gases." To "resolve this problem" the SEP proposes to shorten the EIA review period from three years to one to encourage the development of SCPC/IGCC technology. The SEP also incorporates the long-standing promise of the coal industry to conduct "research" on CCS. Finally, the policy incorporates a highly controversial policy decision to promote new coal-fired generation throughout the world.

Within Japan, however, many of the existing coal-fired units have reasonably high design efficiencies. Some in Japan assert that Japan's fleet of coal-fired EGUs has the highest average operating efficiency in the world. The SEP does not propose to scrap the existing fleet and replace it with new IGCCs. The utilities have identified plans to add new coal capacity that is a relatively small percentage of the existing coal capacity. While this level of new capacity additions will extend Japan's dependency on foreign sources of coal, it will not significantly reduce the cost of generation of electricity or reduce the trade deficit associated with importing coal. However, there are measures available that can improve the fuel efficiency of Japan's coal oil and gas-fired generating units and reduce CO_2 emissions without locking Japan into a long term need to purchase fossil fuels. Nowhere does the SEP discuss the potential for reduced emissions and import of fossil fuel associated with Heat Rate Improvements (HRI)[22] at existing units.

The literature[23] points to recently developed technologies that can improve the operating efficiencies of existing units, particularly units that are more than 10 or 15 years old. These technologies include neural nets[24] to optimize combustion, advanced seal designs, intelligent sootblowing[25], and advanced steam turbine designs. These technologies each improve the efficiency of existing units by small percentages that range from 0.1 percent to 3 percent. In combination, they can provide a substantial improvement of up to four percent in the performance of existing coal units and a smaller improvement in other thermal units.

22. The "heat rate" of a unit is the engineering term used to describe the efficiency of the unit. For thermal power plants it is the amount of heat energy needed to produce a unit of electricity and is often described in terms of heat input in British Thermal Units consumed by the unit to produce a thousand watts of electricity for an hour or Btu/kWh. Metric terms are also commonly substituted for the British units described here. The heat rate is comparable to the fuel economy of a car, expressed in liters/kilometer – lower is better.
23. http://www.iea.org/publications/freepublications/publication/PartnerCountrySeriesEmissionsReductionthroughUpgradeofCoalFiredPowerPlants.pdf
24. A "neural net" is a system of sensors placed throughout the combustion process and computer algorithms to manage and optimize combustion on a real time basis.
25. "Sootblowing" refers to the process of cleaning internal components to improve heat transfer and unit efficiency

Larger improvements may also be available by increased attention to the operation and maintenance of existing units. Japanese utilities, like their American counterparts are likely to claim that they are already operating their units at the highest levels of efficiency throughout their lifetime. However, the operating records of U.S. utilities show that this is not the case. Large variations, that at times exceed 10%, have been observed in the *annual* efficiency and CO_2 emission rates of existing units (Figure 6)[26]. These differences vary substantially between plants and are believed to be associated with differences in operating and maintenance practices at these plants. Given the stress of the post-Fukushima period, Japanese coal-fired plants have been operated at higher capacity factors than previously and may have deferred maintenance necessary to ensure the highest efficiency and lowest CO_2 emission rates. The potential for low-cost GHG emission reduction and fuel cost savings is not mentioned in the SEP and apparently has not been investigated.

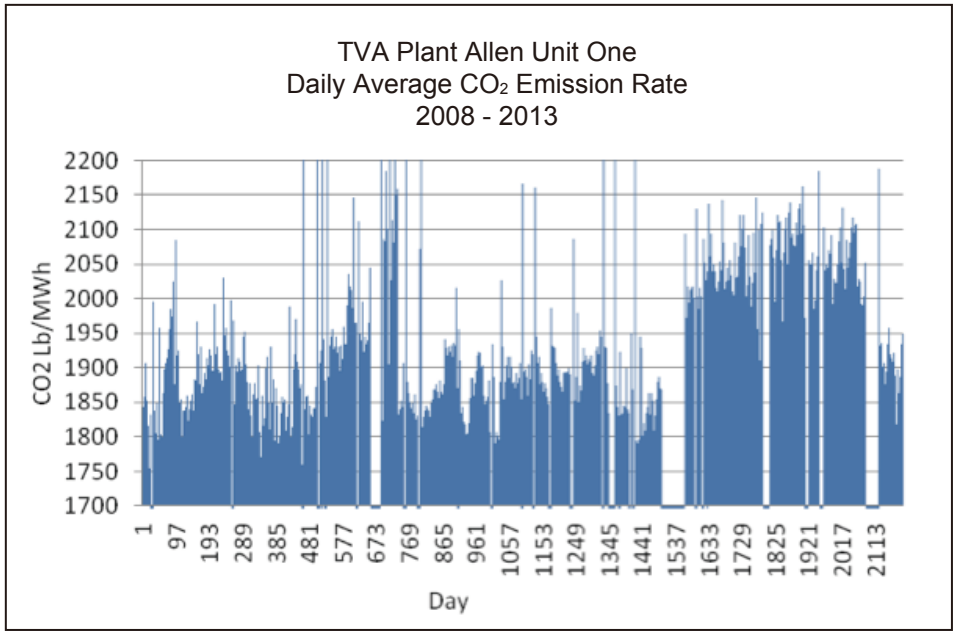


Figure 9. TVA Plant Allen Unit One, Day Average CO_2 Emission Rate 2008-2013
Source: EPA Air Markets program Data

26. See, www.regulations.gov, Docket Number EPA-HQ-OAR-2013-0602-25475. Exhibit A to comments of the SierraClub and Earth Justice, Daily Average CO_2 emission rates for representative U.S. coal fired power plants.

Note that the CO_2 emission rate for this unit in the US over the most recent two years is approximately 10% higher than the prior three years (Figure 7). And so, the fuel economy of this unit has degraded by 10% without correction. The author and the Sierra Club anticipate publishing the results of a comprehensive evaluation of this issue over a representative sample of the U.S. coal-fired EGUs in the next few months. Though less frequent, similar decreases in efficiency that can be corrected have been observed in the operation of U.S. combined cycle gas turbines:

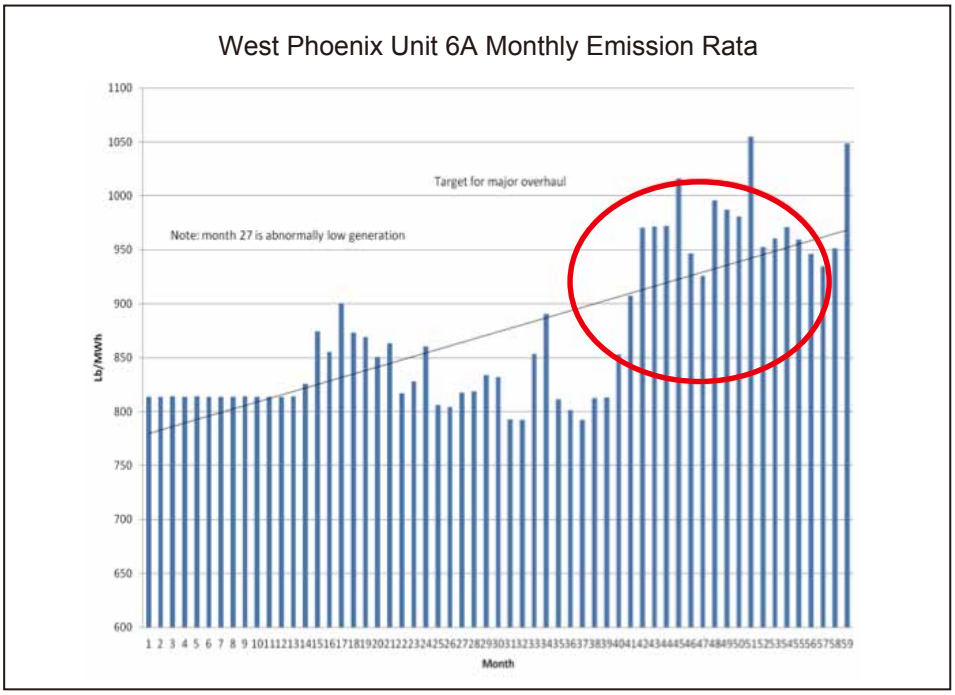


Figure 10. West Phoenix Unit 6A Monthly Emission Rate, Source USEPA Air Markets Program Data

In contrast to the SEP proposals, the actions needed to secure CO_2 emission reductions – and reduced fuel costs – for Japanese consumers need not involve large capital expenditures that then lock investors and consumers into additional decades of reliance on expensive imported fuels. Japan's current natural gas fleet is has sufficient capacity to provide intermittent support for widely dispersed renewable generation.

U.S. CARBON ACTION PLAN AND PROPOSED REGULATIONS

Under President George W. Bush, the U.S. provided little or no climate policy development or leadership. President Obama, on the other hand, has expressed his understanding of the need to address this critical issue. Conservatives in the U.S. Congress have sufficient power to block any broad-based legislation and so the Obama Administration has undertaken a number of administrative actions that, while not ideal, will result in a significant reduction in U.S. carbon emissions and provide a demonstration of U.S. leadership that may help secure broader global agreements. The Administration's actions commenced with a modest increase in some motor vehicle fuel economy standards in 2011. In April, 2012, the U.S. EPA issued a determination that CO_2 is a pollutant under the U.S. Clean Air Act and promulgated of a fuel economy standard for passenger motor vehicles of 54.5 miles per gallon by model year 2025. Rules that will require similar dramatic reductions in CO_2 emissions from larger vehicles are proceeding.

Then, the Obama Administration has proposed a series of regulatory and administrative actions that will dramatically change the course of electricity production and use in the U.S.

- Limits on carbon emissions from new fossil-fuel fired plants. The proposed limits are set at levels that prohibit the construction of new coal-fired plants that do not employ partial carbon capture and sequestration (CCS) and limit the use of gas-fired combustion turbines (CTs) to peaking applications. A final rule is scheduled to be issued by June, 2015.
- Limits on carbon emissions from existing coal-fired power plants. As proposed, the limits, to be implemented by states on a state-wide average basis, would achieve emission reductions equivalent to a formula that includes:
  - o heat rate improvement at fossil fuel power plants;
  - o shifting dispatch from coal-, oil-, and natural gas-fired steam generation to less carbon intensive combined cycle natural gas generation;
  - o increasing renewable generation; and
  - o increasing demand-side energy efficiency.

The low-cost compliance option for complying with the proposed limits is retiring up to 100 GW of existing coal-fired capacity and replacing that capacity with renewables. Overall emissions from this sector are predicted to be 30 percent or more below 2005 U.S. CO_2 emission rates. A final rule is scheduled to be issued by June, 2015. Compliance with the different components of the rule occurs in the period between 2020 and 2030. However, as proposed, 80 percent of the emission reductions will occur by 2020.

- U.S. generation from wind, solar and geothermal sources doubled from 2008 to 2012. The Administration has adopted a goal to redouble it by 2020. To achieve that goal the Administration is taking the following specific steps:
  - o In 2012 the President set a goal to issue permits for 10 gigawatts of renewables on public lands by the end of the year. The Department of the Interior achieved this goal ahead of schedule and the President has directed it to permit an additional 10 gigawatts by 2020.
  - o The Administration has committed to develop and demonstrate improved permitting procedures for hydroelectric power at existing dams, the Administration has designated the Red Rock Hydroelectric Plant on the Des Moines River in Iowa to participate in its Infrastructure Permitting Dashboard for high-priority projects.
  - o The U.S. Department of Defense – the single largest consumer of energy in the United States – is committed to deploying 3 GW of renewable energy on military installations by 2025.
  - o Federal agencies have been directed to streamline the siting, permitting and review process for transmission projects across federal, state, and tribal governments to facilitate the integration of renewable energy.
  - o Federal agencies have been assigned a goal of reaching 100 megawatts of installed renewable capacity across the federally subsidized housing stock by 2020. This effort will include conducting a survey of current projects in order to track progress and facilitate the sharing of best practices.
  - o The Federal budget increases funding for clean energy technology across all agencies by 30 percent, to approximately $7.9 billion.
- The Administration also committed to a range of new steps geared towards achieving President Obama's goal of doubling energy productivity by 2030 relative to 2010 levels:
  - o The U.S. Department of Energy will establish efficiency standards for appliances and federal buildings set in the first and second terms combined will reduce carbon pollution by at least 3 billion metric tons cumulatively by 2030.
  - o The Department of Agriculture's Rural Utilities Service will finalize a proposed update to its Energy Efficiency and Conservation Loan Program to provide up to $250 million for rural utilities to finance efficiency investments by businesses and homeowners across rural America.
  - o The Administration established a business/government partnership to achieve a 2020 goal of cutting energy use by an average 2.5 percent annually from U.S. commercial and industrial buildings and multifamily housing.
- In addition to reducing emissions of CO_2, the Administration's Clean Power Plan includes commitments to reduce emissions other greenhouse gases.
  - o The Administration has incorporated an incentive in its fuel economy and carbon pollution standards for cars and trucks to encourage automakers to reduce hydroflourocarbon (HFC) leakage and transition away from the most potent HFCs in vehicle air conditioning systems.
  - o The U.S. EPA has committed to use its authority through the Significant New Alternatives Policy Program to encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives.
  - o The Administration has commenced an effort to develop a comprehensive, interagency methane strategy. The group will focus on assessing current emissions data, addressing data gaps, identifying technologies and best practices for reducing emissions, and identifying existing authorities and incentive-based opportunities to reduce methane emissions.

- o Across the economy, there are multiple sectors in which methane emissions are to be reduced, from coal mines and landfills to agriculture and oil and gas development. For example, in the agricultural sector, over the last three years, the Environmental Protection Agency and the Department of Agriculture have worked with the dairy industry to increase the adoption of methane digesters through loans, incentives, and other assistance.
- o Across the economy, there are multiple sectors in which methane emissions are to be reduced, from coal mines and landfills to agriculture and oil and gas development. For example, in the agricultural sector, over the last three years, the Environmental Protection Agency and the Department of Agriculture have worked with the dairy industry to increase the adoption of methane digesters through loans, incentives, and other assistance.
- o In the oil and gas sector, investments to build and upgrade gas pipelines will reduce emissions and enhance economic productivity, while EPA develops Federal standards governing release of methane during development of nonconventional natural gas (fracking) and processing and distribution of natural gas.
- o The Administration is working to identify new approaches to protect and restore U.S. forests, as well as other critical landscapes including grasslands and wetlands, in the face of a changing climate.

• The Climate Action Plan calls for the Federal Government to exhibit leadership in its purchases and facility operations:

- o Under the Obama Administration, federal agencies have reduced greenhouse gas emissions by more than 15 percent and have established a new goal: The federal government will consume 20 percent of its electricity from renewable sources by 2020 – more than double the current goal of 7.5 percent.
- o On December 2, 2011, President Obama signed a memorandum entitled “Implementation of Energy Savings Projects and Performance-Based Contracting for Energy Savings,” challenging federal agencies, in support of the Better Buildings Challenge, to enter into $2 billion worth of performance-based contracts within two years. Performance contracts drive economic development, utilize private sector innovation, and increase efficiency at minimum costs to the taxpayer, while also providing long- term savings in energy costs. Federal agencies have committed to a pipeline of nearly $2.3billion from over 300 reported projects.
- o In order to increase access to capital markets for investments in energy efficiency, the Administration has committed to develop a standardized contract to finance federal investments in energy efficiency.

The U.S. environmental community continues to pressure the Obama Administration to make more vigorous effort and the U.S. Congress to finally recognize the seriousness of the challenge posed by climate change. However, the lengthy and specific list of actions and commitments undertaken in the past 6 years by the U.S. government stands in sharp contrast to the nonspecific and unfulfilled commitments set out in the SEP.

TRANSPARENCY ISSUES

The SEP acknowledges that a lack of transparency in certain areas has led to reduced public confidence in Japan's institutions, including both the plant operators and the GOJ itself.

> "Since before the TEPCO's Fukushima nuclear accident, public distrust of energy-related administrative organizations and business operators have grown due to many troubles and scheduling delays related to nuclear energy policy, including cover-up of accident information, problems related to the Monju fast reactor, repeated delays in the start of operation at Rokkasho Reprocessing Plant, and delays in selecting a final disposal site for high-level radioactive waste."

> "In addition, while handling the TEPCO's Fukushima nuclear accident and its aftermath, the government and business operators came under heavy criticism for their inadequate information sharing and lack of awareness about the need for communications with the local communities concerned, resulting in a significant decline in public trust in them."

Unfortunately, the SEP merely repeats earlier assertions that "all is well" and does not propose any specific response to rebuild public confidence in the ongoing development of energy policy.
Information about specific plans for energy development, about the status of proposed new plants and about the performance of existing units is not made available to the general public. Based on meetings with various organizations and individuals in Japan, this information is not generally available to legislators, agency staff or nongovernmental organizations with specific interest in the subject. This situation stands in stark contrast to the U.S. situation where detailed information about the status of proposed projects, costs and, importantly, the performance of each unit that provides electricity to the grid is readily available[27].

The broad access to detailed, hourly production and emission data that is available in the U.S. and the public process of developing and refining proposals for energy policy allows all parties – businesses, local governments, academics and NGOs – full access to the relevant information. This, in turn, provides for a more robust and informed discussion of the issues and promotes better policy development. Recognizing that providing this level of access is not customary in Japan, it still must be observed that the lack of access to basic information and transparency in the decision making process necessarily imposes a cost to Japan as it increases the likelihood that the final policy will be less than optimal. Accordingly, and recognizing that this will be a long term process, it is recommended that the GOJ take steps to liberalizing the publication of all relevant data concerning the cost and performance of existing generating facilities and proposed energy options.

27. See, for example, www.ampd.epa.gov, http://www.eia.gov/todayinenergy/detail.cfm?id=15491, www.eia.gov/electricity/data/eia861/index.html, 2012 Coal Unit Characteristics, National Electric Energy Data System (NEEDS v4.10MATS) frame (EPA, December 2011) with additional information EPA, 2013 as but a few of the dozen or more separate data sources for U.S. energy production.

EVALATION OF ALTERNATIVES USING JAPAN' S 3E+S FACTORS

Japanese energy policy is based on the interplay of energy security, economic efficiency, environmental impact and safety (3E+S). Disclosure of detailed facts relevant to the assessment of these factors is needed before a final, informed evaluation can be made. Based on information available in Japan today, and a greater pool of information available concerning costs and environmental issues, the following represents the author's best assessment of these issues. Assessment of energy security and safety are necessarily somewhat subjective. The assessment of these issues that follows is based largely on consideration of the reasonable worst case scenario for each technology. The reader is invited to incorporate his or her own assessment of these risks in evaluating options.

Table 1 : 3E +S Factor Assessment

Technology	Energy Security	Economic Efficiency	Environment	Safety
Transmission System Upgrade	High	High	High	High
Energy Efficiency	High	High	High	High
Distributed (roof top) Solar Power	High	Medium	High	High
Utility Scale Solar Power	High	High	Good	High
Onshore Wind Power	High	High	Good	High
Offshore Wind Power	Medium[28]	Medium	High	High
Small Scale Hydropower	High	Low	Good	High
Large Scale Hydropower	High	High	Medium[29]	Medium[30]
Small Scale Geothermal	High	Medium	High	High
Utility Scale Geothermal	High	High	Good	High
Coal (SCPC)	Poor[31]	Medium	Low[32]	Medium[33]
Coal (IGCC)	Poor	Medium	Low	Medium
Coal (CCS)	Poor	Low	Poor	Medium
Natural Gas (CCGT)	Poor	Low	Medium[34]	Good
Nuclear	Poor[35]	Low	Unknown	Unknown
Oil	Poor	Poor	Medium/Low	Medium
Existing Unit Efficiency Upgrade	Poor[36]	High	Medium[37]	Good[38]

28. Offshore wind farms may face competing claims of national jurisdiction and interference with operation in times of international disagreements.
29. Large areas of habitat may be destroyed to create reservoirs.
30. Based on the low risk of dam failure.
31. Subject to international events that may increase prices and seaborne trade interference.
32. Based on environmental harm from mining operations, coal and ash storage, CO_2, mercury and other emissions.
33. Based on the risk of mining accidents and deaths and failure of coal ash storage areas.
34. Based of CO_2 and methane emissions and environmental damage from extraction activities.
35. Based on the price volatility of uranium fuel and the potential attractiveness of uranium fuel and waste as a terrorist target.
36. Based on the energy security of the underlying fuel.
37. Mitigates, but does not eliminate, the environmental impact of the underlying fuel.
38. Reduces the safety concerns of the underlying fuel.

CONCLUSION:

There are no technical or economic barriers that would preclude a rate of implementation of new renewable energy of 2 percent of sales per year for a period of 10 years. This level of growth in renewable energy would be sufficient to offset the increased use of fossil fuels that currently are used in lieu of nuclear generation. Given (1) the rapidly falling prices of renewable e energy, (2) the current high price for imported LNG, (3) the potential for price and currency exchange volatility for nuclear and fossil fuels and (4) the likelihood of increased maintenance costs associated with aging nuclear and fossil fuel-fired units, an aggressive program of support for infrastructure needed to implement high levels of penetration of renewable energy would likely be the low cost solution to Japan's energy needs.

The SEP references a projection that renewables will provide 13.5 percent of Japan's generation in 2020 and 20 percent in 2030. However, this outcome would be far too carbon intensive to slow the rate of damage from climate change. Importantly, the SEP does not establish any policy determination as to the amount or timing of renewable generation that is to be achieved. Nor does the SEP provide any specific guidance to Japanese program administrators, the legislature or the public as to what government measures, if any, will be taken to ensure that this amount of renewable generation will occur.

There are no barriers to the economic development of large scale renewable energy in Japan, but there are steps that must be taken if this is to occur. Kiko Network reports that over 15 GW of new coal generation is planned over the next 6-12 years , while METI and JBIC actively promote the construction of new coal-fired EGUs throughout Southeast Asia. At the same time, the GOJ is not moving with sufficient urgency to solve the FIT, PPA and transmission problems that must be addressed to meet Japan's need for clean, affordable and reliable energy. The reasons for delays in resolving these issues should be explained and resolved.
While the detailed design of a program to move forward would necessarily involve much more detailed analysis than presented here, it seems that the key elements of the program would most likely include the following:

(1) a realistic and ambitious renewable energy target and a comprehensive program that addresses generation, storage and transmission needs as a whole;
(2) a revised FIT, coupled with "take or pay" requirements under narrowly proscribed PPA terms;
(3) to ensure the appropriate lower cost FIT that will support RE development targets, the GOJ might consider a bidding process in which developers would bid a FIT price for up to the amount of RE scheduled for a given year, with the requirement that the project be completed within a set time frame; Under this approach, the government might establish a FIT of not more than 15¥/kWh[39] for up to 5,000 MW of capacity (for example) to be brought online no later than 2018. That FIT would be coupled with a PPA as described above that provided a secure revenue stream for 15 years. The amount of capacity and the maximum price for capacity to be brought online by 2019 would be determined based on the results of the bidding process in the first year. Presumably, as Japanese developers and utilities gain experience the capacity would increase while the maximum allowed FIT would decrease.
(4) a manageable implementation schedule, nominally an increase in renewable energy generation of 2% of total electricity sales per year;
(5) substantial transmission system upgrades, funded by the ratepayers generally rather than individual project developers;

39. As an example for solar power only. The PPA would be awarded to the lowest bidders.

(6) removal of artificial barriers to the development of RE, including revision of EIA project limits, development of model setback and noise requirements;
(7) mandatory continuous emission monitoring, submission and public dissemination of hourly emission data (SO_2, NOx, $PM_{2.5}$, Hg and CO_2), gross and net electric output;
(8) mandatory fuel efficiency improvements for existing fossil fuel-fired generation (without extending the useful life of those units) and retirement of inefficient units as additional RE comes online;
(9) CO_2 emission limitations for new and existing coal-fired, gas-fired and oil-fired EGUs that force heat rate improvements at existing units, environmental dispatch of those units (cleanest units first), retirement of existing fossil-fuel fired units in a prompt and orderly manner.

Such a program would likely prove to be a better solution to Japan's 3E+S energy policy needs than continued investment in nuclear and new fossil fuel-fired generation.

The current SEP is lacking in objective, technical support and in transparency. There are many ways in which detailed cost, environmental and performance information can be acquired and assessed. One potential path for a more transparent and inclusive policy development might be for the GOJ to establish a high level panel comprised of members of the executive and legislative branches, industry and the environmental community, supported by an independent unbiased technical consulting firm to develop and evaluate options. The merits of each of these options for going forward might then be the subject of public discussion, with all parties having full access to the relevant facts, before final decision by the GOJ.

Perhaps the most important promise of the SEP, and what appears to be its greatest missed opportunity is the following:

" Dependency on nuclear power is to be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation."

As revealed above, the SEP does not attempt to develop renewable energy and energy efficiency "to the extent possible" and, focusing only on new plants, makes no effort to improve the efficiency of the existing thermal power generation fleet.

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