on board will require significant incentives and subsidies, but such investments are critical in the transition to a sustainable, low-carbon economy.

Japan's Green Revolution

Japan boasts some green technological marvels such as a train station near Tokyo that produces all its energy needs through solar panels and photovoltaic windows that lower heating and cooling needs. The government is also subsidizing household adoption of eco-friendly hydrogen fuel cells that generate electricity and heat water. They are becoming more affordable through innovation and economies of scale. Solar power generation is expanding again after the government reinstated a subsidy providing up to JPY500,000 ($5,000) to defray installation costs for households. Homebuilders are now much more conscious about energy efficiency and new electrical appliances feature large energy savings. The cool biz campaign urging workers to ditch their ties and wear lighter clothing in the summer and tackling the heat island effect by topping roofs with greenery may have only a small impact, but prod people to rethink lifestyle and design issues affecting the environment.

Under the LDP, Japan's environmental strengths were largely lost in translation. The DPJ, however, is serious about creating green-collar jobs and tapping Japan's green technology prowess. The government understands that exports of green technology and conservation know-how to China and India are potentially very lucrative. It is indicative that in his first substantive policy speech after the 2009 elections, PM Hatoyama focused on the need to cut CO_2 emissions. This means abandoning campaign promises to eliminate highway tolls and reduce gasoline tax surcharges, moves that would encourage greater use of automobiles.

The DPJ has made its pledge for CO_2 emission cuts contingent on other nations also getting on board, giving it some wiggle room that might also facilitate backsliding. PM Hatoyama gave momentum to global efforts, but clearly Japan is not going to press ahead unless other major polluters make similar commitments. The Copenhagen Summit in 2009 demonstrated that the global community remains distant from a viable action plan to reduce carbon emissions. It is unclear what Japan is prepared to do if other major polluters are not willing to cut emissions and to what extent it will rely on carbon offset schemes in lieu of actual reductions. There is also uncertainty regarding plans for carbon taxes, a domestic emissions trading scheme, and how Japan will count its assistance aimed at helping developing countries reduce their emissions towards its own reduction target.

Nippon Keidanren, Japan's leading business lobby, has criticized the targets for being overly ambitious and advocates a 4 percent decrease in emissions by 2020 from 2005 levels, meaning a 4 percent increase from 1990 levels. It describes the DPJ target as mission impossible, one that would do substantial harm to the economy, because Japan's factories are already some of the cleanest and most efficient in the world. True, but this doesn't mean that Japan cannot reduce its dependence on carbon fuels and expand reliance on renewable energy as other industrialized nations have done while promoting greater household conservation as the current eco-products subsidies are doing. Some businesses will suffer, but most will figure out how to innovate while others look to thrive by tapping the possibilities of a global green revolution. Consumer interests are often invoked to justify inaction as businesses assert that customers are unwilling to pay a premium for more eco-friendly products and do not want to shoulder the financial burden of carbon reduction despite evidence to the contrary. For example, customers purchased large numbers of Prius cars, even before eco-incentives, although they cost more than comparable non-hybrid models. There is considerable environmental awareness among Japanese and, given the sense of urgency about global warming, they are not the main obstacle to CO_2 reductions.

Nuclear Follies

The Japanese government puts a great deal of faith in, and spends massive amounts of money on, nuclear energy. This reflects policy-makers' dream of securing energy self-sufficiency and explains why two-thirds of the national energy research and development budget is devoted to nuclear power.[3] In terms of reducing carbon emissions and reducing dependence on oil imported from the Middle East, it is a sensible policy. However, there are good reasons why the majority of Japanese remain skeptical about nuclear power.

Japan has witnessed a series of nuclear accidents over the past two decades that raise serious concerns in an earthquake-prone nation with ambitious nuclear power plans. Japan is totally dependent on imported energy and has thus invested billions of dollars since the 1950s in developing its nuclear energy program. Public concerns about the safety of nuclear

power contrast sharply with official insistence that the nation's facilities are both safe and necessary. Polls consistently reveal that 70–75 percent of Japanese have misgivings about nuclear power and fear that serious accidents might happen.

With dwindling reserves of fossil fuels, high prices, and growing concern about greenhouse gases related to consumption of these fuels, the prospects for the nuclear power industry have brightened considerably. Advocates assert that nuclear power is the trump card in the battle to reduce emissions and curb global warming while critics suggest it is more of a wild card given the risks, high costs, and long-term waste disposal issues involved.

Japan currently operates 55 nuclear power plants, up from 32 in 1987, that supply nearly 35 percent of its electricity needs. The government plans to raise the share of energy generated by nuclear power to 41 percent by 2014. Since 1998 two nuclear power reactors have started up with six more currently slated for installation or expansion. In the following sections we examine some notorious incidents and aspects of Japan's nuclear power program that help explain why so many Japanese have considerable qualms about the potential environmental consequences.

Tokaimura

The world's most serious nuclear accident since the Chernobyl meltdown in 1986 occurred in Tokaimura in September 1999. This small village, about 70 miles from Tokyo, is known as "Nuclear Alley" because it is home to 15 nuclear-processing facilities. In 1999 workers at a uranium-processing plant accidentally triggered a runaway chain reaction that lasted for 20 hours in a facility that had no containment barriers. Mistakes in preparing nuclear fuel caused an accident that was not supposed to happen.

A stunned nation learned that the accident occurred while the workers were transferring enriched uranium in stainless steel buckets and mixing the uranium by hand and then pouring it into an open holding tank. The failsafe high-tech safety procedures lauded by nuclear industry proponents were ignored in favor of manual mixing of highly dangerous and unstable radioactive materials. The workers erred in the quantities of the solution they mixed, instead of using processing equipment at hand that had automatic controls to prevent such an accident from occurring. Investigators discovered that the workers were actually following company instructions in violating safety protocols. Since there would be no risk of an accident if workers abided by these protocols, there was no contingency plan for such an accident and no form of containment to protect area residents from the radiation.

Despite three previous nuclear mishaps at Tokaimura, public authorities were slow to react. The town authorities had no contingency plans and firefighters arrived without protective clothing because they were not informed about the nature of the accident. It took 2 days to arrange proper medical care for the three workers directly exposed to the nuclear fission and two of them died from their injuries because the hospital designated for treatment of radiation victims was not prepared to handle such cases. In 2002 the Mito District Court fined JCO, the company operating the nuclear fuel facility, JPY1 million (about $10,000) and its president an additional JPY500,000 ($5,000) while issuing suspended prison terms of two to three years for the six managers prosecuted. The cost of nuclear negligence, thus, proved rather modest.

This exposure of official bungling and the consequences of a business more concerned about profits than safety left the public even more skeptical about a nuclear program that has been plagued by safety flaws, radiation leaks, shutdowns, fires, falsification of inspections, and cover-ups.

Whistleblowing

In the summer of 2002, revelations about extensive falsification of safety records over the previous decade involving potentially dangerous problems in a number of the nation's aging nuclear power plants indicated the low priority accorded public safety. In the aftermath, 17 reactors were shut down for a year to recheck safety systems and perform necessary maintenance and repairs. Amazingly, dozens of high-level industry executives knew of the problems and participated in a well-orchestrated cover-up to falsify inspection and repair records and certify the safety of power plants where engineers had found fissures that could prove dangerous if left unattended. More stunning was the initial handling by the Ministry of Economy, Trade, and Industry (METI) of the whistleblower's report about the falsified safety records. A foreign subcontractor who participated in the inspections and found the problems later discovered that the results of his inspections were ignored and subsequently falsified. Later he reported these criminal acts to METI, the government ministry with oversight responsibilities for the nuclear power agency, and was again ignored. Moreover, ministry officials apparently alerted the power companies of the whistleblower's identity and efforts to expose their negligence. The problem

was identified as how to handle the whistleblower as opposed to responding to the allegations by investigating wrongdoing, making repairs, and ensuring public safety. The media eventually blew the lid on this case, forcing the government and power industry to do what they should have done in the first place: put safety first. Ironically, the cover-up was motivated by a desire to avoid raising public concerns about nuclear power and avoid the costs of plant shutdowns that have been the financial bane of the industry. Those concerns and costs rose substantially due to this failure to comply with existing regulations. Yet again, the public learned about the need for better oversight and the low level of corporate and government ethics that lay at the heart of this scandal. In considering how Japan is changing, it is significant that this story ever came to light. As in so many other areas of life in Japan, there is a great deal more openness about topics that were once taboo or suppressed.

Alas, inadequate maintenance and inspections carries real consequences, claiming the lives of five workers in 2004 at the Mihama nuclear plant. They were scalded to death when exposed to steam leaking from a corroded pipe that had not been inspected since it was installed in 1976. Tests on the pipe after the incident showed it had lost 85 percent of its thickness, something that could have been discovered in an inspection. Nine months before the accident, a subcontractor had informed the operators about the urgent need for such inspections, but his warning was ignored. Regulations did not require regular inspections of secondary cooling cycle steam pipes so they weren't inspected. This in a country where every car more than 3 years old is required to undergo extensive and expensive safety checks every other year. The culture of safety that should be intrinsic to nuclear power operations appears lax in far too many instances in Japan – an institutionalized complacency in industry and government that raises legitimate environmental concerns.

Kashiwazaki

In Japan, Kashiwazaki has come to mean "close call." On July 16, 2007 a 6.8 magnitude trembler jolted beneath the world's largest nuclear power complex located in Niigata Prefecture in a place that was not supposed to have a tectonic fault. This earthquake serves as a vivid reminder of the risks generated by nuclear power, especially in zones of seismic risk.

The good news is that a mega-disaster did not occur and, thanks to design safety margins, the seven reactors with a capacity of 8,000 MW were not damaged by an earthquake that exceeded all assumptions in the design

specifications. The three reactors in operation and a fourth in start-up mode did shut down automatically as designed. Kashiwazaki had been shut down previously in 2002 because of falsifying safety data.

Tokyo Electric Power Company (TEPCO) reassurances about the negligible risk associated with this incident rang hollow in a nation accustomed to the nuclear utility industry's lack of transparency, tardy notifications, cover-ups, and mishaps. TEPCO informed local government authorities about the radioactive leakage nearly 9 hours after the earthquake. Industry advocates emphasize the effective functioning of nuclear-related safety equipment and the absence of damage to the reactor buildings. Critics have called on the government to shut down some one-third of the nation's 55 nuclear reactors for more robust inspections to investigate and reassess seismic risks in light of the lessons drawn from Kashiwazaki; the tremors were more than double the design benchmark. Nobody knows how many reactors may have been built on similarly flawed assumptions. The discovery of a fault beneath Kashiwazaki's nuclear reactors has also raised concerns about relying on power companies to select and assess site suitability.

NHK aired an investigation featuring interviews with the staff that were at the plant when the quake hit. The supervisor explained that the crisis control room door jammed because of the earthquake, meaning that he and his staff were unable to enter and monitor the situation. Instead they set up a whiteboard in the parking lot and used their private mobile phones to maintain communications and monitor the seven reactors spread over the complex. The supervisor admitted that the absence of effective centralized crisis control and poor communications with local authorities could have turned a dangerous event into a more serious disaster. Sometimes it is good to be lucky.

There are grave concerns about seismic science and the government's credibility on safety. In 2005 a judge ruled in favor of TEPCO in a case filed by local residents of Kashiwazaki to revoke the license to build a nuclear reactor at the site. The judge ruled that the scientific evidence overwhelmingly proved that the plaintiffs' assertion – that the plant was vulnerable to an earthquake due to a hitherto undetected fault – was baseless. Proof is in the eye of the beholder, but clearly this faulty judicial ruling has been a black eye for seismic evaluations conducted by the nuclear power industry.

Deregulation

Deregulation of the utility industry is putting pressures on operators to boost profits at the expense of safety. So just as Japan's aging nuclear power

plants, many entering their fourth decade of operation, are in more need of inspections, maintenance, and repairs, bottom-line concerns are forcing cutbacks in safety measures. Given various mishaps, cover-ups, and a culture of deceit in the nuclear power industry, there is considerable public unease with this turn of events.[4] The government mandates that every nuclear power plant shut down once a year for an inspection, and in the pre-deregulation era this typically lasted 3 to 4 months. Cost-cutting measures, however, have drastically shortened inspection times to as little as 6 weeks and operators seek further reductions in costly downtime. They are also seeking to extend the shelf life of their plants to 60 years, double what experts thought prudent when they built the plants. In the context of fewer and shorter inspections, and a record of falsifying safety reports, the implications are unsettling in light of the potential harm of an accident.

Rokkasho

In northern Japan the government has established a complex for nuclear enrichment, reprocessing, and waste storage facilities. There were high hopes that the International Thermonuclear Experimental Reactor might be built there, but in 2005 this project was awarded to France.

In 2007, Rokkasho commenced reprocessing of spent reactor waste to reuse as fuel. The reprocessing yields weapons-grade plutonium, raising questions about the growing size of Japan's nuclear-weapons-usable plutonium stockpile, currently estimated at 45 tons, about 20 percent of the global total. There are also environmental concerns about the toxic release of carcinogenic tritium associated with reprocessing nuclear waste. The plant operators have been given permission to release into the ocean 2,800 times the allowed tritium release for conventional reactors.

Even operating at full capacity, Rokkasho will only be able to reprocess about 800 tons of spent fuel per year, less than the 900 tons of nuclear waste currently produced by the nation's 55 nuclear power reactors. Given that it already has 12,600 tons of nuclear waste as of 2006, and new reactors will boost annual waste production to at least 1,200 tons per annum, the reprocessing capacity of Rokkasho is insufficient for the task at hand.

The long-term concern associated with Rokkasho is its nuclear waste storage facility. The projected total capacity for low-level nuclear waste is 3 million 200 liter drums that will be buried under mountains of soil. In addition, canisters of vitrified high-level radioactive waste are also stored there in above-ground facilities for three to five decades, after which they will be placed in an underground storage facility that will require monitoring and safekeeping for several generations. Even if safety assurances are reliable, the huge cost of handling and disposal of nuclear waste underscores just how high the stakes are in pursuing expansion of nuclear power. It is also important to factor in the cost of decommissioning older plants as their shelf life expires, involving dismantling of reactors, disposing of waste, and site clean-up operations. The nation already knows, to its regret, the high cost of improper waste management.

Closure on Minamata

Japan has overcome the toxic legacy of its rapid post-WWII development, symbolized perhaps most viscerally by Minamata disease. For decades beginning in the 1930s a chemical company dumped mercury waste into the bay off this small Kyushu fishing village. It is a long and sordid story involving a corporate cover-up aided and abetted by government officials that prolonged the dumping while the number of victims piled up.[5] Belatedly, Chisso Corporation and government officials acknowledged their negligence for failing to stop the dumping that led to a nightmare of human toxic poisoning, causing serious nervous system damage. Children born to affected women absorbed the mercury, to some extent detoxifying the mothers, but as a result suffered terrible deformities and shortened lives. Lawsuits filed by victims have percolated slowly through the court system since the 1970s and eventually brought incrementally and begrudgingly some measure of justice in the form of financial compensation.

Finally in 2009, the government passed legislation aimed at extending redress and medical benefits to many previously unrecognized victims. Victims, however, are not all pleased with the modality of the settlement and complain that this plan provides inadequate compensation and amounts to a reprieve for Chisso by blurring the company's responsibility. Controversially, the new legislation requires those who receive compensation to give up ongoing litigation and waive any further claims. A court-brokered settlement in 2010 provides benefits to most of the unrecognized victims.

There is no settlement that can truly compensate the victims for what they have endured and it is understandable that many refuse to end their