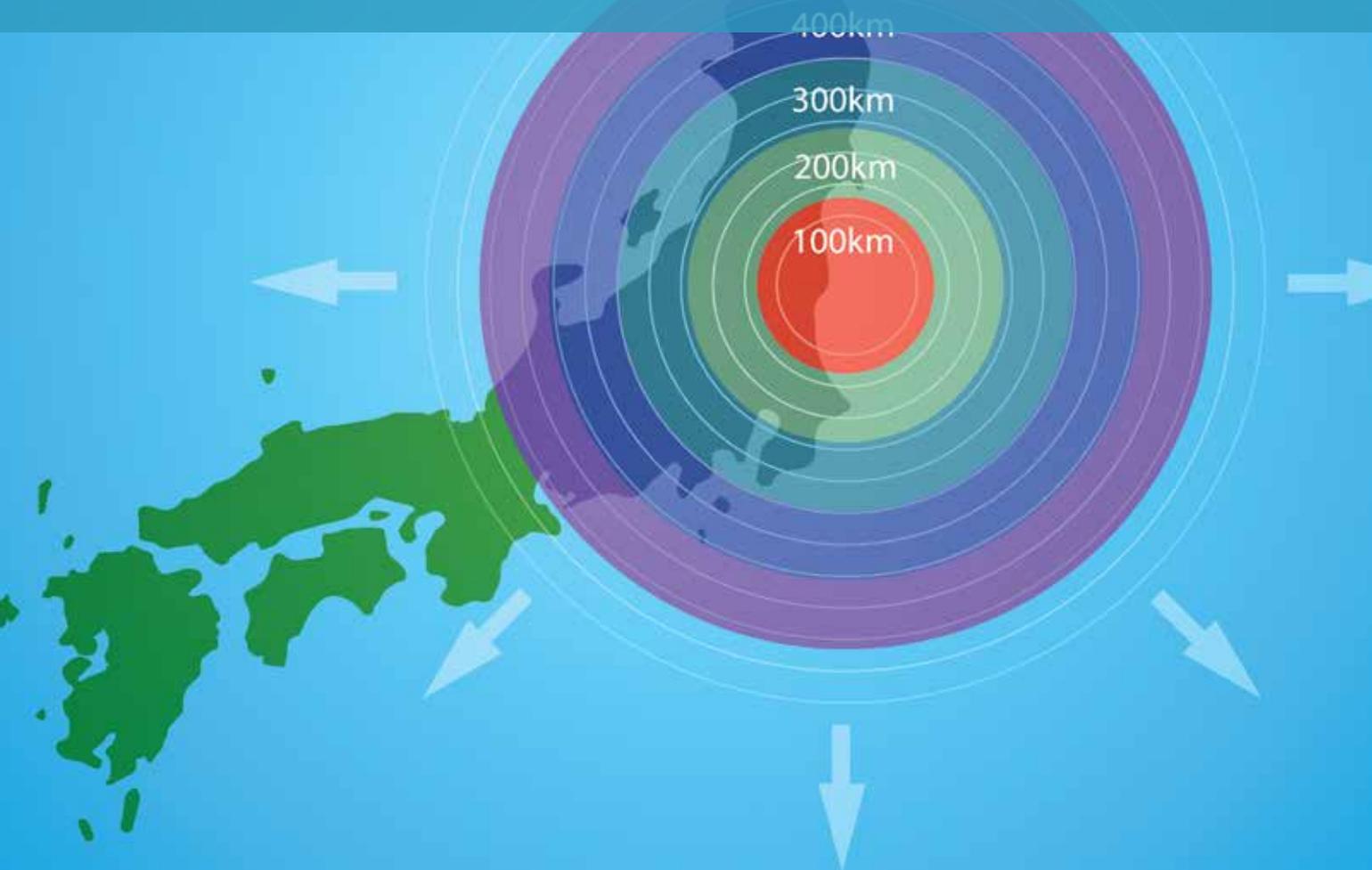


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Special Report

DISASTERS, LEADERSHIP AND REBUILDING – TOUGH LESSONS FROM JAPAN AND THE U.S.



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Disasters, Leadership and Rebuilding – Tough Lessons from Japan and the U.S.

On March 11, 2011, deep below the surface of the Pacific Ocean, enormous seismic forces reached a tipping point. At 2:46 p.m., one of the earth’s tectonic plates suddenly shifted, thrusting violently underneath another. The North American plate was pushed upward with such force that the movement generated a massive tsunami. It took the wall of moving water 51 minutes to reach the coast of Japan, some 45 miles away.

In some places, the tsunami towered more than 125 feet above the ground when it hit. Thankfully, the height of the wave was far less where it came ashore near the Fukushima Daiichi nuclear power plant — “only” 50 feet high. Still, the nuclear disaster caused by the earthquake and tsunami has been rated by the International Atomic Energy Agency as equal in severity to the 1986 accident at Chernobyl, the worst nuclear disaster on record.

The complex catastrophe — earthquake, tsunami and nuclear meltdown — killed close to 20,000 people, displaced hundreds of thousands more and contaminated a large swathe of beautiful countryside for decades or longer. More than two years later, Japan is still struggling to recover and prevent even more devastation.

On May 24, 2013, the Initiative for Global Environmental Leadership (IGEL) sponsored a panel at the Wharton Global Forum in Tokyo to consider the leadership lessons generated by the Fukushima disaster, and to look at its impact on Japan’s energy policy and the resettlement of afflicted areas.

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While the scale of the natural disaster in Japan was beyond the experience of anyone now alive, it was far from unprecedented and should have been anticipated, according to several post-Fukushima reports. Yet those in leadership positions failed to adequately prepare for the catastrophic events of March 2011. Unwilling to face up to the rare but predictable worst-case scenario, government and industry leaders were quickly overwhelmed by events. The judgments they made and the actions they took — or failed to take — often compounded problems. A close look at these mistakes offers valuable lessons for leaders facing disasters in the future.

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Since the devastating disaster of 2011 exposed Japan’s major dependence on nuclear power, the country has announced a plethora of renewable energy projects. But can Japan, with few natural energy resources of its own, easily make the transition to sustainable sources? Is such a switch practical, and does the political will exist to do so? In fact, Japan is developing robust wind and solar industries, but both face stiff challenges. And despite many misgivings, including more recent leaks of radioactive materials at the Fukushima Daiichi nuclear plant site, the Japanese government has pledged to rebuild the country’s large nuclear network.

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After major coastal storms in both Japan and the Northeastern United States, the question has to be asked: Should population-intensive development be rebuilt in areas subjected to repeated flooding and climate-related sea-level rise? There are no easy answers, especially when people have lived in those shoreline towns and cities for hundreds or even thousands of years — and emotions run high. Short-term political considerations almost always encourage rebuilding, but increasingly the case for subsidized relocation efforts is at least being made.



Lessons in Leadership from the Fukushima Nuclear Disaster

Three widely cited investigations of the Fukushima disaster — one by the Japanese government, one by an independent team of experts in Japan and a third by The Carnegie Endowment for International Peace — have now concluded that the nuclear disaster of March 2011 was not, as it first seemed, the inevitable result of events no one could have predicted.

“It was a profoundly man-made disaster that could and should have been foreseen and prevented,” said Kiyoshi Kurokawa, chairman of the Fukushima Nuclear Accident Independent Investigation Commission, established by the National Diet of Japan.

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In an effort to understand what went wrong and what lessons in leadership the tragedy can offer, leaders directly and indirectly involved in the disaster spoke candidly at the Tokyo panel on Fukushima sponsored by Wharton’s Initiative for Global Environmental Leadership (IGEL). Based on their presentations in Tokyo and the analyses of others in Japan and elsewhere, three areas emerge as essential to leadership in a crisis: preparation for emergencies, leadership style and communications.

Lesson 1: To prepare for the worst, leaders have to face up to what might actually occur.

Erwann Michel-Kerjan, managing director of the Risk Management and Decision Processes Center at Wharton, says that Japan spent the years following the 1995 Kobe earthquake, the nation’s last great crisis, diligently preparing for future disasters. Since many people died in train wrecks during the Kobe quake, the Japanese government re-engineered its entire railway system. As a result, just moments after the earthquake in 2011, and well before the tsunami hit, Japan’s high-speed bullet trains were successfully shut down, saving countless lives (no one died on trains on 3/11, says Michel-Kerjan).

But just as generals are sometimes faulted for “fighting the last war,” Japan’s mistake was preparing for a disaster like Kobe, which was far less severe and complex than Fukushima. The 3/11 earthquake was significantly more intense (9.0 vs. 7.2 on the logarithmic Richter Scale) and it not only badly damaged the Fukushima Daiichi nuclear plant but also crippled the area’s power grid, cutting off the nuclear facility’s access to any off-site electricity.

Back-up generators kicked in when the power grid went down, but they were obliterated when the tsunami hit. This loss of virtually all power meant that the nuclear fuel inside damaged reactors went without essential cooling. In Reactor 1, the exposed fuel soon reached 2,800 degrees Centigrade. Desperate workers tried to cool the fuel with water from fire trucks and relieve building pressure inside the reactors by venting gases and steam. The venting, subsequent explosions and leaks led to the release of radioactive material into both the atmosphere and the ground water.

This series of events — the destruction of the Fukushima Daiichi plant by a massive earthquake

and tsunami — was entirely predictable. In “Why Power Companies Build Nuclear Reactors on Fault Lines: The Case of Japan,” J. Mark Ramseyer, a professor of Japanese legal studies at Harvard Law School, notes that earthquakes of comparable magnitude have struck the northeast coast of Japan, on average, every 100 years, each one generating a devastating tsunami. In fact, the previous tsunami in 1933 was almost precisely as high as the one that struck Japan on 3/11.

Robert Meyer, co-director of the Risk Management and Decision Processes Center, points out that this pattern has been well known since ancient times. A monument from the first century still sits on a hill, high above the area destroyed by the 2011 tsunami, he says. Its inscription reads, “Beware the great tsunami; do not build below this level.”

Despite these historical warnings, “Nobody was remotely prepared,” says Akihisa Shiozaki, an attorney who was instrumental in putting together the first independent, non-governmental investigation of the Fukushima nuclear disaster, titled, “The Independent Investigation Report on the Fukushima Nuclear Crisis.” Not only were leaders unprepared for a tsunami following a major earthquake, they also failed to anticipate both the damage inflicted on the nuclear plant and the total loss of power to the cooling systems of the plant.

The failure to adequately prepare was widespread. The leaders of Tokyo Electric Power Company (TEPCO) built the reactors on a known fault line and then colluded with government regulators to avoid preparing for the inevitable. And the office of then-Prime Minister Naoto Kan (the Kantei) was totally unprepared to manage the crisis that resulted. As the report commissioned by the National Diet of Japan concluded, “The government, the regulators, TEPCO management, and the Kantei lacked the preparation and the mindset to efficiently operate an emergency response to an accident of this scope. None, therefore, were effective in preventing or limiting the consequential damage.”

Several reasons have been offered to explain why so many in leadership positions ignored the warnings of history. All are valid and offer valuable lessons to leaders in future crises.

Shiozaki looks to history itself to explain the reluctance of those in power to consider worst-case scenarios. After World War II and the destruction of Nagasaki and Hiroshima by nuclear weapons, the

Japanese population vehemently opposed all use of nuclear power in their country. So the government undertook a campaign to persuade people of “the absolute safeness” of nuclear power, says Shiozaki. “Absolute safeness meaning that there was no risk that something could go wrong, no risk that a meltdown could happen. Well, that myth of absolute safeness developed over the years into a culture where it almost became a taboo to even talk about this.... Discussing a worst-case scenario was feared because it might bring panic to the citizens. And therefore it was omitted from the regulatory discussions.”

Eric Feldman, a law professor at the University of Pennsylvania, emphasizes the political and economic forces behind this reluctance to confront worst-case scenarios. “There was, of course, a good deal of local opposition [to nuclear power] despite the government’s downplaying of the risks, which is why it took so long for the first plants to be built,” he notes. With significant political and economic forces backing nuclear power, “talking about worst-case scenarios was avoided not simply because it would scare people, but because such fear would mean that local communities would oppose the building of reactors, and without local support the reactors would not be built.”

Ramseyer views the problem from a legal perspective, pointing to the “moral hazard” that arises when the potential losses of a catastrophe far exceed the value of a company. Like any private company, TEPCO’s liability was “capped by the value of its net assets.” Beyond that amount, the company would pay nothing, leaving them with “no incentive to limit damages beyond the value of those net assets. For risks beyond that point, they capture all the returns but bear none of the costs.” The result was that “Tokyo Electric wildly underplayed the risk of a large earthquake and tsunami, but it did not underplay it carelessly or negligently. It underplayed it rationally — wildly, but rationally.”

And then there is simple human nature — there is a “threshold of concern,” says Howard Kunreuther, Wharton professor of operations and information management and co-director of the Risk Management and Decision Processes Center. “You have a lot of things to worry about, and often when you talk about what the chances are of an accident like this occurring, the general feeling is that it’s not going to happen to me,” he said. “That’s not just true in Japan, it’s true around the world.”

Despite the historical inevitability of the earthquake and tsunami, says Kunreuther, the earlier events happened so long ago that “there was a tendency to ignore them. They come out of the woodwork after an event, when everyone looks back and says, ‘Oh, we should have known this.’ But it’s not easy for people to make these decisions when there are so many things on their agenda.”

One way to combat this natural tendency, suggests Kunreuther, is to “stretch time horizons, so you don’t just think about the likelihood of this occurring next year but over a period of years.” The probability of an event, or series of events, increases considerably “when you look at the situation over the next 20 years instead of over the next year.” The geologic time scale involved in the Fukushima disaster — and the decades of radioactive contamination left in its wake—make it seem prudent to extend the planning time horizon a good deal further in some cases.

The lesson is clear: To adequately prepare for worst-case situations, those in power need to look past cultural prejudices, shortsighted financial reasoning and their own limited experience. Whether the leaders of private companies worried about quarterly earnings or governments struggling to meet pressing needs can, or will take this lesson to heart, is an open question.

Lesson 2: In the midst of chaos, leaders should stop looking for control and start looking for answers.

Asked what experience he found most challenging during 3/11, Kenichi Shimomura, former deputy director general for public relations and chief spokesman for the Japan’s prime minister during the crisis, replied, “Being a leader without information.” It is easy, he said, to make decisions when a leader has all the necessary facts, “but information about the nuclear crisis was a luxury we did not have in the prime minister’s office at the time.”

The National Diet’s report explains that “as the situation deteriorated and the planned government accident response systems failed to function, control of the emergency response was taken by the Kantei, with Prime Minister Kan at the center of an ad hoc group of politicians, advisors and the chairman of the Nuclear and Industrial Safety Agency (NISA).”

While the government report states that this group did not include any experts, Shimomura told those attending the IGEL panel that there were in fact three top-ranked nuclear experts on hand. However, these experts were incapable of contributing to the decision-making, because of what Shimomura called not just a blackout of energy, but a “blackout of experts,” who seemed incapable of providing any useful guidance.

“With each new report from the site, the prime minister would ask [the experts] what he should do ... and each time they averted their eyes.... Once the prime minister asked one of the scientific experts a question directly, but the expert was at a complete loss for words.” Even when asked to consult with his company, this expert was frozen in place until Shimomura literally walked up to him, and whispered into his ear that he should take out his cell phone and call his company for answers in the moment. “I was shocked,” said Shimomura. “He had lost his ability to make any decisions on his own.”

The prime minister also contributed to the confusion. Instead of helping to orchestrate the vast multitude of problems contributing to the disaster, Prime Minister Kan immersed himself in the minutiae of the nuclear plant. Shiozaki reports that Kan and his closest advisors brought a white board into his office and started “counting the number of trucks that were trying to arrive at the Fukushima nuclear plant, trying to check what types of electricity codes could be connected to the power plants.” In a vain attempt to gain direct knowledge of what was going on, Kan himself visited the Fukushima Daiichi plant, which “disrupted the chain of command and brought disorder to an already dire situation at the site,” according to the National Diet’s report.

The prime minister also refused to delegate decision-making. Kan “allowed the reporting line to stretch out in a very multi-layered hierarchy up to the final decision maker, which was him,” impeding what was already poor communications with TEPCO, noted Shiozaki. It was not until “five days after the crisis that he delegated the decision-making power to a lower-level joint team,” which included both his advisors and TEPCO management.

The problem was not just that Prime Minister Kan made these mistakes, but that no one in his inner circle questioned his decisions, offered other options or acted independently of the Kantei. In his

introduction to the National Diet's report, Kurokawa attributes this failing to Japanese culture. "What must be admitted, very painfully, is that this was a disaster 'Made in Japan,'" Kurokawa writes. "Its fundamental causes are to be found in the ingrained conventions of Japanese culture: Our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our group-ism; and our insularity." It was this "mindset of obedience to authority" that hindered the free flow of ideas and information, according to the parliamentary report.

Japanese culture and authoritarian leadership, which have endured for centuries, clearly offer important advantages. But those benefits are much more evident when information and time are plentiful. "Hierarchical culture works well when you have lots of time to make a decision; it helps you make a good decision," notes Michel-Kerjan. "But by definition, crisis management is about making very quick decisions with very limited information."

Feldman believes that "stereotypes such as 'reflexive obedience' and 'reluctance to question authority' are not terribly illuminating, and seem an odd juxtaposition with the public anti-nuclear demonstrations post-Fukushima." He agrees with those who suggest that Prime Minister Kan's personal leadership style is just as likely as Japanese culture to have discouraged dissent.

It is never easy to distinguish the personal from the cultural. Was Kan's failure to delegate the result of a personality trait or of Japanese culture? Did the nuclear experts in his office and at the site fail to speak up because of a cultural mindset or because, as some of them later told interviewers, they were intimidated by Kan, who berated them publicly?

Whatever the mix of culture and personal qualities were in the Fukushima case, the lesson for leaders struggling to manage a crisis is as simple to state as it is difficult to implement: Rise above the fog of details; encourage fresh thinking and frank communication; and delegate decision-making to those best able to make decisions on the ground.

Lesson 3: In a crisis, leaders have to prevent panic and maintain credibility. Rehearsals help.

At each stage of the crisis, experts offered Kan varying estimates of the area that should be

evacuated, and each time, Kan took the safest option. But the estimates kept changing, so Kan kept changing what he told the public. Paradoxically, this emphasis on safety and truthfulness led to growing fear and mistrust.

"When the safest option was 10 kilometers, the prime minister went with 10 kilometers. When it was 20 kilometers, he chose 20 kilometers," Shimomura said. "But each time the radius of the evacuation zone increased, so did the people's mistrust of the government. People accused the government of underestimating and playing down the gravity of the situation. It was far from the case. The public thought we were lying or hiding something." Yet, "we didn't have the luxury of any certain information to hide."

"What would you do in a situation like that?" asked Shiozaki. "If you said on the first day, 'Twenty kilometers should evacuate,' you're likely to cause a panic. Roads would be filled. Elderly people would be left behind in their homes. People in hospitals might lose their lives because of the confusion." And in fact, when Kan first announced an evacuation zone of just three kilometers, he had been told that was the safest distance.

Shimomura, who was in charge of communication with the public, noted: "If your leader is a liar, you can solve the problem by kicking out your leader. But if the leader is honest, but still causes these problems, what should you do? This was my most challenging leadership experience."

Shimomura told those at the IGEL panel that "for two years, I have asked myself the question, was there a better way to handle the crisis communication?" His answer: "Try to share information about the whole iceberg, not only the tip of the iceberg."

In particular, Shimomura believes that while Kan was personally announcing the official evacuation zone, others in his office — but not the prime minister himself — should have provided the public with the information leading up to the decision, including other possibilities or scenarios that were considered during various meetings. This would allow Kan to maintain his position of authority but also make it clear that his announcement was not likely to be the last word, that what was being released was provisional. "The PM could have shown the tip and his office could have shown the rest of the iceberg."

A more direct version of this approach, reminiscent of the way Mayor Rudolph Giuliani communicated with the public during the 9/11 crisis in New York City, has proven effective in other crises. The prime minister, suggests Michel-Kerjan, could have told people that he would report to them on a regular basis, say twice a day, and share what he knew at that point. This approach would allow him to maintain a reassuring position of authority, but also admit the truth about what he did and did not know. And by telling people that ‘we are all in this together, all struggling to get the right information,’ he could also help build a sense of trust and community.

What many people don’t realize about Giuliani’s mastery of this approach was that he had rehearsed it numerous times. Michel-Kerjan points out that New York City had large-scale crisis management rehearsals on a quarterly basis before 9/11, and Giuliani participated in every one.

This last point is key. When Michel-Kerjan works with corporations on similar rehearsals, he always insists that the CEOs participate, because they are the ones who will be on the front lines. “When you look at companies that have handled crises well,” says Michel-Kerjan, “every one of them has had conventional and unconventional rehearsal exercises quite a few times, typically with the CEO present.”

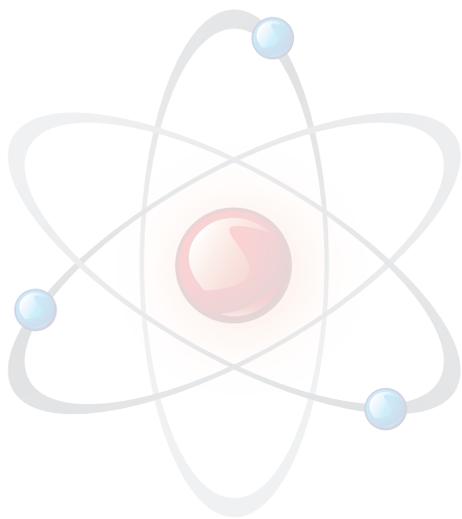
The performance of the JX Nippon Oil and Energy Corporation offers compelling evidence of how useful rehearsals can be. For the past 20 years, ever since the Kobe earthquake, the company

has conducted annual disaster drills that included the formation and training of teams charged with specific duties: employee safety, the gathering of information from within the company and from outside sources, identifying and securing emergency supplies, information technology and engineering and construction.

Hiroshi Hosoi, executive officer and senior vice president of the company, told the IGEL attendees that this preparation helped explain how JX Nippon was able to overcome the devastation of its Sendai refinery and the loss of all its trucks and railroad tankers, and find ways to deliver badly needed fuel for cars, home heating and emergency vehicles.

The company also worked with competitors and the government to “enable fuel supplies to flow smoothly to where they were most needed, like evacuation centers, hospitals, power plants, etc.,” said Hosoi. And throughout the crisis, JX Nippon communicated on a regular basis with the public, updating which service stations were open and discussing the supply situation on their website.

While Hosoi pointed out that “March 11 was different,” it is clear that the yearly disaster drills prepared the company to rise to the same challenges all leaders confront in a crisis — facing up to a worst-case situation, quickly gathering information, encouraging fresh thinking, delegating decision-making and communicating openly and regularly with a community desperate for answers.





Renewable Energy for Japan: A Post-Fukushima Quest

Since the Japanese earthquake and tsunami in 2011, the country has understandably seen an explosion of interest in renewable energy. A plethora of wind and solar projects were announced, especially in the early days after the Fukushima nuclear plants were shut down. Goldman Sachs said recently that it will invest as much as \$487 million in Japanese fuel cell, solar, wind and biomass efforts. The Japanese government, meanwhile, has set renewable targets of between 25% and 35% of total power generation by 2030, by which time some \$700 billion would be invested in new, renewable energy.

Despite those developments, the Japanese government still backs nuclear power as a key energy provider. Prime Minister Shinzo Abe, breaking from the previous Liberal Democratic Party (LDP) government that had committed to phasing out of nuclear power by 2030, said in early 2013 that the country would begin restarting its plants as soon as new safety guidelines are in place. It's likely to be a slow process: In the summer of 2013, Japan had just two of its 50 reactors operational, and may have only four providing power by 2015, according to Japan's Institute of Energy Economics.

What's more, serious new challenges affected the plant in the spring and summer of 2013, which could impact Japanese views on nuclear power going forward. Radiation readings on the ground at the crisis-ridden Fukushima Daiichi nuclear plant by September had spiked to levels that would be deadly within hours to an unprotected person, according to news reports. Tokyo Electric Power Company (TEPCO), Japan's largest utility, which runs the Fukushima plant, has also been increasingly under fire to stem serious leaks of contaminated water into the Pacific Ocean. The Japanese government has pledged to spend some

\$500 million to correct the problems at the plant, but the recent setbacks could derail Prime Minister Abe's efforts to restart some of Japan's 48 atomic plants now in mothballs.

Japan, the only country to experience nuclear bomb attacks (on Hiroshima and Nagasaki in 1945), remains deeply conflicted about nuclear power. As the *The New York Times* reported, "The question of when, and whether, to restart the plants has dogged the country for two years, as politicians and ordinary Japanese try to balance their fears of a moribund economy when oil and gas costs have already hurt the balance of trade and worries over another environmental crisis, especially if the industry is not well regulated."

“Japan is a country that is not rich in natural resources on its own, so you would always have to secure an alternative energy source before you phase out something.”

— Akihisa Shiozaki, Attorney, who helped create the first independent, non-governmental investigation of the Fukushima nuclear disaster

Akihisa Shiozaki, an attorney who helped organize the first independent investigation of the Fukushima nuclear disaster, said that giving up the plants is not an easy decision, but the consensus for it is increasing. “Japan is a country that is not rich in natural resources on its own,” he said at the May 2013 Wharton Global Forum in Tokyo, in a session

organized by the school's Initiative for Global Environmental Leadership (IGEL). "So you would always have to secure an alternative energy source before you phase out something"

Shiozaki added, "I think there is definitely a greater interest in renewable energy now. And nuclear energy will be facing higher security standards and therefore higher costs. There also will be efforts to import energy, like shale gas, from the U.S., and others."

Erwann Michel-Kerjan, managing director of the Risk Management and Decision Processes Center at Wharton, agrees with Shiozaki about the critical issues ahead. "The challenge in Japan is that the energy choices are rather limited," he said. "It's a small country without large natural resources, and it's technically hard for them to abandon nuclear power — which has been a multi-decade national investment. Japan can substitute renewable for some nuclear, and that's what they're looking at now. But the country's capital investment in nuclear power is considerable."

Hard Choices for Japan

The reaction to the Fukushima Daiichi disaster has varied from nation to nation. In the U.S., the government has called for greater safety precautions, but made no serious political effort to reverse American commitment to nuclear power.

In Germany, however, the effect on policy was dramatic. As Lincoln Davies wrote in a 2011 article for the Brigham Young University Law Review titled, "Beyond Fukushima: Disasters, Nuclear Energy and Energy Law," the disaster happened soon after German Chancellor Angela Merkel had forged a deal to keep the country's 17 plants open for an additional 12 years.

"How much can change in a day," Davies wrote. "In Fukushima's wake, anti-nuclear sentiment in Germany surged to all-time highs, and Chancellor Merkel swiftly caved to the pressure. Not weeks or months but mere days after the tsunami struck Japan, Merkel announced that the government would order the shutdown of Germany's seven nuclear plants built before 1980." A later announcement added the 10 newer plants as well, meaning that Germany would have no nuclear power after 2022.

But Germany had always been a reluctant partner with nuclear power, and the Japanese — after

some initial hesitation — had fully embraced it. Indeed, before 2011, Japan was on a course to double its nuclear commitment. As *Nature* reported, the country was laying the groundwork for nine additional plants in the next decade and 14 by 2030, complementing the 54 it already had. By 2030, nuclear power was intended to provide half of Japan's energy needs (double its pre-Fukushima contribution).

Even after Fukushima, the nuclear momentum in Japan remains formidable. Renewable energy is not yet the path not taken, but it could become that. David Suzuki, the leading Canadian environmentalist, told Bloomberg News that the nuclear meltdown was "a huge opportunity" to build a national wind and solar network, but the opening is "being squandered in the drive to get the reactors up and running again." Suzuki, a member of the Japan Renewable Energy Foundation, decried the tight bonds between the government and the private energy sector, which he said has made Japan's Parliament reluctant to consider alternatives.

Before the earthquake and tsunami, carbon-free energy — mostly hydroelectric — accounted for just 11% of Japanese power generation. That percentage is growing, but slowly. In general, with the nuclear plants out of action, the biggest beneficiary in the short term has been fossil fuels, use of which was up 21% in 2012. Much of the growth comes from imported natural gas, a rising force to produce electricity in Japan.

Strong Renewable Incentives, But with Barriers

At the same time the Japanese government is supporting the re-start of its nuclear industry, it's also very visibly financially supporting renewable energy. Shiozaki says the largest initiative so far has been the introduction of a feed-in tariff for renewables. Introduced a few months after the meltdown, the tariff "provides the assurance that the government will purchase for a fixed price any energy that is produced from renewable energy sources.... Companies can enjoy a large subsidy as a result of the fixed price."

The feed-in tariff covers purchases over 10 to 20 years, depending on the type and amount of energy produced. Among the renewable forms covered are wind, solar, geothermal, biomass and hydropower. Solar producers, for instance, will receive, over 20

years, a very generous 37.8 yen, or 38 cents, per kilowatt hour generated.

But despite clean energy subsidies that are as much as three times more lucrative than those offered by renewable leaders Sweden and Germany, development has been slow. Although the feed-in tariffs made Japan the largest solar market (by annual installations) in 2013, the high cost of photovoltaic (PV) panels and wind turbines there remains a deterrent, reports Bloomberg. According to the International Energy Agency, installed solar PV prices in Japan are more than double those in Germany as of 2011. Some of the reasons for the price differences include higher land and labor costs and tougher regulations. In addition, the Japanese market tends to demand more advanced PV technologies given space limitations.

Japanese officials are also mindful of the intermittent nature of wind and solar — a big barrier to making either a primary source of electric power. Uninterrupted renewable power (except from geothermal, biomass and hydro-electric sources) often requires a backup form of energy storage, including large battery banks.

Bernard David, a partner in Energy Management International, and a senior fellow at Wharton's IGEL, points out that intermittency is the biggest obstacle to a renewable-based energy economy. And it's a challenge everywhere in the world, not just Japan. "We truly need great battery storage in order to use either wind or solar for baseload energy demands," he said. "Also, depending on where you are in the world, you need to have high-voltage transmission lines from utility-scale projects to move the electricity to places where it will most probably be used."

There are developing solutions to that problem. Mark Schiller, vice president for business development at Proton Onsite, a Connecticut-based company that manufactures energy-storage solutions based on PEM electrolysis hydrogen generators, says his firm is developing a hydrogen storage solution that can store energy on a megawatt-scale, with the ability to start and stop very quickly. Fast response is a key attribute for power plant energy-storage solutions.

Japan's *Asahi Shinbun* newspaper reports that bureaucratic hurdles are another impediment to the country's development of wind power, despite an abundant supply (especially along the extensive

coastline). Holding installation back, the newspaper reports, "is a requirement that they [the developers] first carry out a lengthy and complex environmental impact assessment"

One company, Green Power Investment Corporation, is planning a wind project on Japan's main Honshu Island, but remains unsure how long it will take to complete the lengthy environmental assessment. Green Power also announced a 55-turbine project in a windswept district of Tokyo, but despite popular support, that 120-megawatt effort (the largest in Japan) has stalled as it attempts to meet the requirements of "dozens" of environmental studies.

Japan: A Nation of Efficiency Experts

Almost by necessity, Japan has become a very efficient user of energy. "Japan has had to import nearly all of its energy and that led to their becoming careful stewards of resources, and to a position of leadership on energy efficiency," says Eric W. Orts, director of IGEL and a professor of legal studies and business ethics at Wharton, (as well as leader of the Wharton Global Alumni Forum Tokyo panel on "Lessons Learned from 3/11"). "They are very good at that, and continue to improve. And that's led to greater opportunities for decentralizing energy resources."

An example of the latter is the Japanese government's successful subsidy of home fuel cells, thousands of which (aided by their compact size) now provide distributed electric power in homes throughout the country. In the first three years of a subsidy program launched in 2005, more than 2,000 one-kilowatt fuel cells were installed. One factor that makes the program work is lower per-capita electricity consumption in Japanese households (especially when compared to profligate American homes).

Japan has been an enthusiastic supporter of zero-emission hydrogen, which drew \$240 million in research funding in 2012, according to the Hydrogen and Fuel Cell Promotion Office at Japan's Ministry of Economy, Trade and Industry. The country is also a leading supporter of fuel-cell vehicles, and both Honda and Toyota plan to commercially launch hydrogen-based cars around 2015. By that year, *Japan Times* reported, 13 companies will have banded together to establish 100 hydrogen fueling stations, mainly in large cities.

Under the National Energy Strategy adopted in 2006, the goal is to improve Japan's overall energy efficiency by 30% in 2030. The country has started toward that goal, one project at a time. Here are some key announcements:

- Honda said this year it would build a 10-megawatt solar installation at a property that also includes a test track in the city of Tochigi prefecture city of Sakura. The company said it would be in a position to sell electricity by 2015.
- Mitsubishi and C-Tech Corporation are currently building a very large 77-megawatt solar complex in Tahara City.
- Japanese trader Mitsui announced plans in 2011 to build solar plants able to supply 30,000 households in the region most affected by the earthquake and tsunami.
- Habitat for Humanity has also installed solar panels in storm-damaged regions of Japan as part of its Solar Home Recovery Project. Thirteen families are to benefit from the first phase of the program, with three-kilowatt systems. According to Hisato Harako, whose Higashinihon Sorana is installing the solar arrays, "The need for renewable energy is now higher than before the disaster. I hope this project will help bring about a positive change for the future of disaster-hit areas."
- Soon after the earthquake, a mega-solar project involving 38,000 panels was opened on an industrial waste site in the Tokyo suburb of Kawasaki City.
- Japan has 2.3-gigawatts of installed wind power, with regulations requiring any tower over approximately 100 feet to have earthquake proof technology. Some 80% of the Japanese wind power infrastructure survived the natural disaster, including the Kamisu offshore farm, located only 180 miles from the epicenter. In early 2013, a 143-turbine, one-gigawatt offshore wind farm was announced for a location just nine miles from Fukushima. If completed by 2020 as planned, it would be the world's largest.

Challenges and Opportunities

The projects are encouraging, but are not yet sufficient to wean Japan from its dependency on nuclear power. Hiroaki Fujii, executive deputy president and director of SB Energy Corporation in Tokyo, said at the Wharton forum, "we have been highly dependent on nuclear power, and I have no intention of denying its importance now,

but renewable energy is also something that the Japanese people are now thinking about.... If we had distributed power, and a disaster of this magnitude reoccurs, we would have that system in place to respond. The government needs new policies to further promote renewable energy, and they should be positioned to encourage private investment."

Wharton management professor Marshall W. Meyer, who specializes in Asia, said in an interview at the Tokyo Forum that Japanese leaders need to play a major role in encouraging renewable investment if it is to succeed. "The government is going to have to guarantee the investments — not just jump-start it, but stay in," he said. "Because if that doesn't happen, the investors will end up going to China or somewhere else." Meyer pointed out that Chinese over-capacity in solar panel production has affected markets elsewhere, including the U.S. (where it was a factor in the celebrated Solyndra collapse) and Europe.

But in one sense, the Fukushima meltdown inadvertently led to a possible opening for locating renewables in a country where land is at a premium. Interviewed after the IGEL panel session, Satoshi Kitahama, representative director of the Kizuna Foundation, said that post-tsunami, land unsuitable for resettlement — or any other kind of development — could become sites for solar and wind installations. "Suddenly there is a large amount of land along the coast in a no-build zone," he said. "It has abundant sunlight, and is in the largest populated prefecture after Hokkaido. The region is connected to the main electric lines, and thus to a large part of Japan."

It's more than a concept. "[The foundation is] working with locals to give them some value back to their land," Kitahama said. "If it is shoreline land, we can put panels on it — and there will be no need to go near them. The owners can get paid a royalty or an equity stake in the business, which would give them the means to move on and get their lives started again."

A Strong Start

In some ways, Japan is well-positioned for a renewable renaissance. Masayuki Kamimoto, vice chairman of the North Japan Research Institute for Sustainable Energy at Hirosaki University, reports that the disaster area "is well known for abundant renewable energy resources, such as wind, biomass and geothermal heat. Aomori Prefecture in the northern end of this area, for instance, has

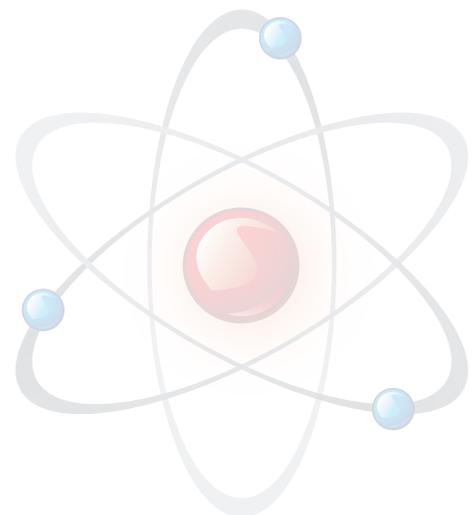
more renewable energy potential than its energy demand.” He cautioned that to effectively distribute renewable resources across different regions of the country will “require reinforcement of the national power grid.”

Effectively, if Japan is to at least supplement its nuclear-dominated energy supply, it needs a robust renewable network, connected to a smart grid that can move the power where needed. That would be a worthy goal, notes Robert Giegengack, professor of earth and environmental science at the University of Pennsylvania. “Nuclear power is inherently enormously complicated, and that by itself is the strongest argument for getting our energy from somewhere else. As we saw in Japan,

the consequences of mistakes with nuclear power are very great.”

Bernard David, an entrepreneur and senior fellow at IGEL, endorses feed-in tariffs — already in place in Japan — and other incentives that need to be “in place long-term, and with certainty” — to transcend what might otherwise be a risky investment in renewable energy.

By setting national goals, passing lucrative incentives, announcing large-scale projects and exploring innovative ideas — such as unmanned green energy parks in irradiated zones — the country is making a start. But Japan is unlikely to say, as the Germans have, “Atomkraft? Nein, danke.”





A Tale of Two Storms: Rebuilding after the U.S. and Japanese Disasters

The earthquake and tsunami that struck the East Coast of Japan in 2011 killed nearly 20,000 people, displaced 500,000, caused \$360 billion in economic damage and destroyed 138,000 buildings. It also created a large, coastal uninhabitable zone and left many shoreline residents unsure about rebuilding their residences and their lives.

Two-and-a-half years later, these issues still resonate. As the Brookings Institute reported, “The reconstruction challenges remain daunting for Japan. Hundreds of thousands of people are still displaced, the quality of the nuclear cleanup continues to raise concerns and the financial cost of rebuilding the Tohoku region is staggering.”

“When people’s houses are destroyed, they say, ‘I will rebuild again right here.’”

— Erwann Michel-Kerjan, managing director of the Risk Management and Decision Processes Center at Wharton

The Japanese government has pledged a massive, long-term reconstruction budget of \$262 billion. But the question has to be asked: Given the frequency of devastating natural disasters in earthquake-prone regions of Japan, as well as the likelihood of a sea-level rise as a result of climate change, *should* population-intensive human settlements be rebuilt just as they were?

Scientists and other experts are questioning the wisdom of such policies. It was a topic at the May 2013 Wharton Global Forum in Tokyo, organized by the Initiative for Global Environmental Leadership (IGEL) at Wharton, in a session titled “Risk, Challenges and Opportunities: Lessons Learned from 3/11.”

The issue is also relevant in the wake of Hurricane Sandy in the U.S., where federal insurance until recently has been greatly subsidized, enabling some residents to repeatedly rebuild coastal property more easily. As is often the case, financial and political considerations — including the high valuation of shoreline homes and businesses continue to influence policy decisions.

Relocation Challenges

National Geographic, in a 2013 article titled “Rising Seas,” predicts that coastal storm damage is set to rise dramatically. Shoreline cities, it said, “face a twofold threat: Inexorably rising oceans will gradually inundate low-lying areas, and higher seas will extend the ruinous reach of storm surges. The threat will never go away; it will only worsen. By the end of the century a 100-year storm surge like Sandy’s might occur every decade or less.... By the next century, if not sooner, large numbers of people will have to abandon coastal areas in Florida and other parts of the world.” In 2070, according to the Organisation for Economic Co-operation and Development, the at-risk population in large port cities could reach 150 million, with \$35 trillion worth of property under threat.

Abandoning coastal property, no matter how it may be threatened by future natural disasters, is difficult for people worldwide. In Japan, the post-Fukushima

challenge is complicated by both the nature of the destruction and the limited options available in such a small island nation. Japan, says Robert Giegengack, professor of earth and environmental science at Penn, “is almost all coast. It’s coast and Mount Fuji.”

Yet people affected by the nuclear disaster have to relocate. The tragedy in Japan was not just “the thousands of people who were killed, and the people who were made sick by radiation sickness and will die within decades, but also that you have this beautiful region of the country that’s been decimated for many hundreds of years,” said Eric W. Orts, a Wharton professor of legal studies and business ethics who chaired the Wharton Forum panel in Tokyo and who also heads IGEL. Erwann Michel-Kerjan, managing director of the Risk Management and Decision Processes Center at Wharton, adds that people in Japan “want to stay where they are — they don’t want to move — but nuclear contamination means that hundreds of miles of coastline may be lost.”

Unlike Japan, says Michel-Kerjan, “the U.S. is huge. We really could relocate entire cities elsewhere.” But in the absence of an immediate and lethal threat, such as nuclear contamination, it’s much harder to declare property off-limits. “When people’s houses are destroyed, they say, ‘I will rebuild again right here,’” he notes. “And politicians, mayors or governors, how many of them will say, ‘You guys are out.’ They know they wouldn’t be re-elected if they said that. In any case, these aren’t easy questions to answer, because some of the people affected have been living in those locations for generations.”

The Catastrophe Paradox

Given that large-scale earthquakes and tsunamis regularly assault the Japanese coast (though not usually of such magnitude and usually not together), why were reactors like Fukushima Daiichi built along fault lines?

According to J. Mark Ramseyer, a professor of Japanese legal studies at Harvard Law School, it’s because owners such as the Tokyo Electric Power Company (TEPCO) faced limited liability. In a 2011 journal article for *Theoretical Inquiries in Law*, he argues that TEPCO “would not pay the full cost of a meltdown anyway.... It could externalize the cost of running reactors. In most industries, firms rarely risk tort damages so enormous they cannot pay them. In nuclear power, ‘unpayable’ potential

liability is routine. Privately owned companies bear the cost of an accident only up to the fire-sale value of their net assets. Beyond that, they pay nothing — and the damages from a nuclear disaster easily soar past that point.”

Total claims against Tokyo Electric have been estimated by Bank of America/Merrill Lynch to reach \$31 billion to \$49 billion, well beyond the pre-storm market capitalization of the company. Beyond that amount, Ramseyer says, “any losses fell on its victims — or if the government so chose, on taxpayers.”

Ramseyer’s point also applies to homeowners living on the coast in both Japan and the U.S. for whom routine rebuilding, often at public expense, has been a given. But the catastrophic nature of the recent Japanese and American coastal disasters has led to some rethinking of those assumptions.

The World Bank estimated the cost of the Japanese catastrophe at \$235 billion, plus \$125 billion related to shutdowns and delays in business recovery. The Japanese government has pledged huge long-term aid, but so far has offered a fraction of this amount for rebuilding efforts. It faces its own budget issues — Japan has the highest level of public debt in the world.

Questions are arising about spending many billions on rebuilding, only to face another devastating event, but that is indeed what has been proposed in the Tohoku area. Satoshi Kitahama, representative director of the Kizuna Foundation in Tokyo (a non-profit created to aid the survivors of the March 11, 2011 twin disasters), asks if that effort — though it may be emotionally satisfying — is economically viable. Given a small and aging population of just 20,000 people, with a limited number of those in the workforce, he says that paying residents to relocate might be a more viable option.

“I have suggested to many of the mayors — just pay them,” he says. “You can’t hold [residents] hostage for the nostalgia of what this used to be, because it is never coming back to that.” He suggests that efforts to raise low-lying areas or replant ancient forests are poor public policy. “Instead of dispersing those funds and letting the individual decide what to do with them, they put it into projects like this, spending billions of dollars for a population of 20,000,” he said. “Instead, give people a couple of hundred thousand dollars per resident and let them make the decision. Let people move to higher ground, to other parts of Japan.”

Major Commitments, But Talk of Retreat

As in Japan, the U.S. has made a major federal commitment to rebuilding the Northeast after Hurricane Sandy, committing \$50 billion, much of which has not yet been spent. New York Mayor Michael Bloomberg, warning of more storms ahead and a predicted sea-level rise of as much as 31 inches by 2050, has asked for \$20 billion to erect flood barriers, including dunes and bulkheads, to protect low-lying areas.

It's easy to see how, in a litigious society, rebuilding, rather than relocating became the priority. A small coastal town in New Jersey, Harvey Cedars, had the prescience to work with the federal government's Army Corps of Engineers on a \$26 million plan to protect itself against the storms that have repeatedly caused major damage and wiped out both beach and beachfront property.

Some homeowners held out against signing on to the project, which required the building of sand dunes on their property — and in some cases destroyed their view. Harvey and Phyllis Karan took opposition to their dune further than most — to court — and as reported in a 2013 article for *The New Yorker*, won a \$375,000 judgment in March of 2012.

Seven months later, in October, Hurricane Sandy hit the Northeast, taking 159 lives, causing \$69 billion in damages, and carrying away 37 million cubic yards of sand. But most of dune-sheltered Harvey Cedars was spared, including the Karans' house. Despite that, their lawsuit continued, though their financial verdict was overturned last July. "All we wanted was our view," said Phyllis Karan.

But simply rebuilding the Northeastern shore and moving on won't be simple, especially in the wake of expensive new building requirements (some homes will have to go up on pilings) and escalating federal flood insurance premiums that can reach \$30,000 annually. The National Flood Insurance Program (NFIP), managed by the Federal Emergency Management Agency (FEMA), has long provided subsidized coverage to property owners, but since early 2013 it has been phasing out subsidies for second homes and vacation residences, with premiums rising 25% annually until they reach actual market rates.

Until recently, the default position was that property would routinely be rebuilt at federal expense. As Justin Gillis and Felicity Barringer write in *The*

New York Times in late 2012, "Across the nation, tens of billions of tax dollars have been spent on subsidizing coastal reconstruction in the aftermath of storms, usually with little consideration of whether it actually makes sense to keep rebuilding in disaster-prone areas."

Marshall W. Meyer, a Wharton professor of management with a specialty in Asia, said of the FEMA insurance program, a lot of people think they over-insure — "the government shouldn't be putting public funds at risk to insure homes on the New Jersey shore."

The *Times* cites the example of 1,300-resident Dauphin Island on the Gulf Coast, which has been repeatedly battered by a dozen hurricanes and storms — and rebuilt each time.

According to Kitahama, speaking at Wharton's Tokyo forum, "When thinking about how to rebuild, it's very difficult. There will be another quake on the coast of Japan, and communities exist there in areas that have been inundated in the past. Also, some areas that were devastated this time, like Tohoku, had never had a quake or a tsunami." One city that saw widespread damage "was in a safe zone."

Reconstruction — in Japan and New York

Kitahama noted that there has been "a lot of focus on reconstruction, because that is the easy way to demonstrate action by the government — but it's not really what's needed." He pointed to action by New York City Mayor Michael Bloomberg to buy heavily damaged coastal property and put it into no-build zones.

"This is not happening on Tohoku," Kitahama said, "so some are sitting on properties deemed to be in non-build areas, but they haven't been given any kind of offer for their land." Kitahama said that one of the best uses for the land in no-build zones would be as locations for renewable energy farms (see the separate report on alternative energy prospects for Japan).

In reality, New York's efforts have been far from decisive, reflecting the high stakes involving any valuable coastal property. Governor Andrew Cuomo launched a \$400 million homeowner buyout, and the Bloomberg administration followed up last spring with a \$1.8 billion effort using federal Community Development Block Grant funding.

Cuomo's plan, which also leverages federal funds, is unambiguous about what should be done with the abandoned property. "There are some parcels that Mother Nature owns," Cuomo stated.

But Brad Gair, director of New York City's housing recovery office, said its own funding is not oriented toward turning stricken property into open space — instead, it will be offered for redevelopment by new buyers. "If there is one element that we have not yet come to full alignment on," he noted, "it's whether properties acquired should be made permanently open space or whether some of those would be suitable for redevelopment — preferably for the home owners in the area. These are valuable properties. There is a limited amount of coastline properties."

In announcing the \$1.8 billion in grants, deputy mayor for operations Caswell Holloway said in early 2013 that the money would go to "restore neighborhoods, re-open businesses, and better protect our coast and coastal communities from the dangers of climate change."

In the New York area alone, more than 300,000 housing units were damaged or destroyed by Hurricane Sandy (with repair costs estimated at \$9.6 billion), but city officials predict that only 10% to 15% will agree to city or state buyout offers. The storm has totally transformed the real estate market in some Northeastern shoreline communities. Although most homeowners are rebuilding, new buyers are asking questions about flood map zones, federal insurance and building elevations — and if they don't like the answers, they're looking for property elsewhere.

President Obama's Hurricane Sandy Rebuilding Task Force issued a report in August 2013 that documents \$110 billion in damages from 11 U.S. climate-related natural disasters in just the last year (\$69 billion of that from Hurricane Sandy). The report, which embraces resilience as the new planning paradigm for disaster relief, makes sobering reading. It recognizes the elevated risk to shorelines from climate change, and suggests that such recognition be incorporated into all future relief planning. And it says that there may be limits to rebuilding efforts — despite new, stronger building codes that require elevating buildings above the high-water mark.

"Over time," the report noted, "the ability to incrementally increase the height of flood control

structures may be limited. Some communities are already facing limits to their ability to adapt to risk, presenting challenging questions for policy makers about managing consequences.... Understanding the limits of tolerable risk is an active area of research and public debate."

Taxpayers, opined the *Times* in an editorial on the federal report, "should not be paying to rebuild and then re-build as the sea level rises. Even those politicians who say they still don't believe in climate change must see that the system needs fixing."

Insurance and Catastrophe Planning

The shock of responding to such a severe and fast-moving event as the Japanese earthquake and tsunami has heightened emotions and complicated rebuilding plans. Howard Kunreuther, a Wharton professor and co-director of the Wharton Risk Management and Decision Processes Center, argues that people "aren't prepared for low-probability, high-consequence events — the likelihood is very small, so it's below a threshold level of concern. The general feeling that an earthquake of that magnitude coupled with a tsunami was not going to happen."

For companies, including those in Japan, Kunreuther adds, "The event is seen as so catastrophic, there's no reason to prepare for it. Small companies may not take protective measures because they can't afford it — if a major event occurs, they'll just go under."

Kunreuther argues that short-term insurance is part of the problem. "The industry has traditionally looked at annual policies," he says. "But there is very little concern over climate change or other long-term effects in setting rates with one-year policies. We have been arguing for five-year policies so the costs can be spread over multiple years — but there's not a lot of movement on that."

Robert Meyer, a Wharton marketing professor who also is co-director of the school's Risk Management and Decision Processes Center, says that simply having flood insurance available, even at federally subsidized rates, is no guarantee that people will buy it — only 13% of American homeowners have such policies, for instance. New Jersey Manufacturer's Insurance, which has 280,000 homeowner policies (and paid out \$241 million in Sandy-related claims), said only 11,000 (or 4%) of them include flood coverage. That percentage didn't change after Hurricane Sandy, said spokesman Pat Breslin.

Chile Sets an Example

According to Meyer, “If you give people discretion on whether to buy flood insurance, they won’t make the right decision. Even people who have been through hurricanes forget pretty quickly if they weren’t badly affected. You need strong leadership at the very top, and you need very strong building codes. If new nuclear plants are built in Japan, it will have to be to very high standards.”

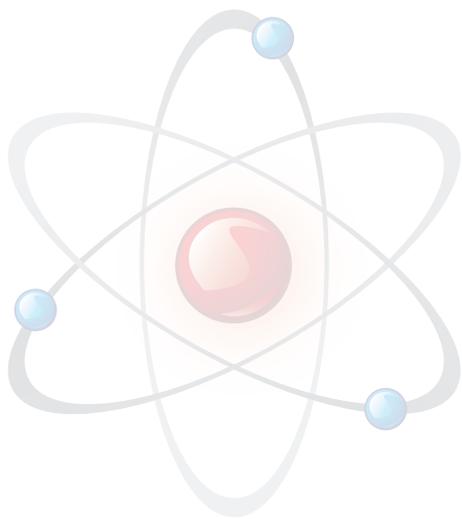
Meyer cites the positive example of Chile, most recently hit with an 8.8-magnitude quake in 2010. According to Bloomberg.com, “Since 1960, when the country suffered a 9.5 magnitude quake, the largest ever recorded, Chile has steadily improved building codes to protect lives and property. In 2010’s temblor, only five commercial buildings designed with the help of structural engineers were destroyed, according to a report by the U.S. Geological Survey.” One building, the \$200 million Titanium Tower, incorporated the latest earthquake technology (including shock-absorbing steel dampers) and survived with no structural damage.

Nonetheless, Meyer says it’s impossible to build infrastructure to survive severe, 1,000-year natural disasters, even if the political will existed. “New York City is a great example. It’s sitting right on the water, one hurricane away from a \$100 billion disaster. But

with the probability of such a storm at 1.0, it’s very difficult to get people to take action. After Sandy, an unused airport was used to store 15,000 storm-damaged cars, and yet people with vehicles or fleets of them took no action to prevent them from getting flooded.”

According to Meyer, the risk management center has responded to that problem by building online simulations that “can realistically give a sense of what it would be like to experience a serious hurricane. It helps people develop options for protective action.” That’s in line with the federal Sandy report, which found that many residents of storm-prone regions are unaware of the risks they face, or how severe the consequences might be.

Looking forward, the case against reoccupying some hard-hit coastal regions of both the U.S. and Japan — despite their high value on many levels — can be compelling. As adopted policy, however, it is fraught with political consequences and strong emotions. Rebuilding efforts will go forward, in both countries, but with greater awareness of risk, and with limits on insurance coverage and the location and design of rebuilt buildings. In some cases, federal safety nets will be gone. Given that, the marketplace is likely to play a major role in determining the future of shoreline communities.



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Eric Orts

Faculty Director

Initiative for Global Environmental Leadership (IGEL)

The Wharton School, University of Pennsylvania

ortse@wharton.upenn.edu

Joanne Spigonardo

Senior Associate Director of Business Development

Initiative for Global Environmental Leadership (IGEL)

The Wharton School, University of Pennsylvania

spigonaj@wharton.upenn.edu