

Japan's Crisis: Context and Outlook

By [Vaclav Smil](#) Saturday, April 16, 2011

Once, many observers thought Japan should be feared. Now, many fear that Japan should be pitied because natural disasters will accelerate its economic retreat. Perhaps the latter assessment will turn out to be as mistaken as the former.

Tohoku, the six prefectures that make up the northern part of Japan's largest island, is rarely in foreign news: it is the other Japan, with too many indicators worse than the national average. Tohoku has an older population, fewer children and young people, lower average income, a higher unemployment rate, fewer physicians, a higher rate of smoking, a higher rate of suicide (male and female), more frequent deaths in house fires, and lower life expectancy than the national average. Its people eat



less beef and grow more rice, and in some mountainous parts just about the only jobs available are cutting down trees and making charcoal in simple kilns. As in other parts of Honshu, mountains are the region's backbone, snowy and cold in winter, and both shores are beaten by waves driven by strong winds. And no other part of the world gets repeatedly struck by so many powerful tsunamis as does the region's Pacific coast.

The tsunamis are generated by the quakes whose epicenters are not that far offshore, just west of the Japan trench, and whose large magnitudes result from the massive Pacific plate sliding beneath the easternmost boundary of an even more massive Euroasian plate. In 1896, a tsunami generated by the 8.5 magnitude Meiji Sanriku earthquake rolled over more than 250 kilometers of the Pacific shores of northern Tohoku, destroying some of the same settlements that were wiped out this March: its highest crest measured 38.2 meters and it took more than 25,000 lives. Another, similarly strong (8.4 magnitude) Showa Sanriku quake hit the shores of Iwate prefecture in 1933, with a tsunami wave in Ofunato (one of the towns again devastated this March) reaching 28.7 meters. This time the crest in Ofunato was even higher, at about 30 meters, and the highest measured height of a tsunami wave channeled by a valley was 37.9 meters, close

to the 1896 record. Another grim similarity: the total number of deaths will be close to the 1896 total (it now stands at nearly 13,000, with almost 15,000 still missing).

Knowing this, my first thought on March 11 was, here goes the poor Tohoku again. But my second immediate thought was: it all could have been much worse. Not in the stricken region itself—after all, this was a magnitude 9.1 quake, the world’s fourth-greatest on the instrumental record and the largest measured in Japan, and it is hard to imagine greater coastal destruction than that seen in Rikuzentakata or Kesenuma. But imagine if the epicentre would have been some 350 kilometers southeast from its March 11 spot, near the Kanto region, where a dislodged block of the Pacific plate is jammed three ways by the Pacific, Philippine Sea, and Eurasian plates, beneath Tokyo. The last time this area shook severely was in 1855 (in the roughly 7.3 magnitude Ansei-Edo quake) and the probability of another intense shaking is as much as 40 percent before 2040. The next severe Tokyo-Yokohama-Kawasaki quake is predicted to impose damage of more than 1 trillion dollars (of which only about 10 percent may be recouped through insurance) and casualties may surpass 100,000. So, as horrible it was, March 11 was not, to use the dreaded Californian phrase, Japan’s Big One.

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But, incredibly enough, this massive tragedy unfolding across hundreds of kilometers of shoreline and reaching tens of kilometers along the valleys and into the coastal mountains was swiftly overshadowed by focusing on a single place, on serial crises unfolding at the Fukushima Dai-ichi nuclear power station owned and operated by the Tōkyō Electric Power Company (TEPCO). The station had six aging boiling water reactors (BWRs, completed between 1970 and 1979) with a total capacity of 4.80 gigawatts, but at the time the quake hit two reactors (5 and 6) were not in service and all fuel had been removed from reactor No. 4. But, once again, as I read the first alarming reports of problems with the plant’s three reactors I thought how much worse this could have been.

Just a short distance south of the No. 1 is its twin, Fukushima Dai-ni, with only four reactors but of nearly the same total capacity (4.40 gigawatts), and further north is Onagawa with three reactors (total installed power of 2.17 gigawatts) belonging to Tohoku Electric Power Company. The tsunami overtopped the defenses at the Dai-ni station and there was a temporary loss of coolant by three of its reactors, but everything was brought quickly under complete control; similarly, all Onagawa reactors were shut down without any problem and have remained in cold shutdown ever since. A somewhat higher wave at the Dai-ni plant and at the Onagawa one, more flooded back-up diesel generators, some bad decision during the first emergency response—and there could have been eight or ten reactors out of control.

After the Fukushima reactors were scrambled successfully (that is, after control rods were automatically inserted into their cores when the quake hit, to stop fission nearly instantly) their only need was for sensibly uninterrupted cooling in order to remove their afterheat. This residual heat production in a shutdown reactor continually declines with the passage of time after reactor shutdown, but without adequate cooling the heat production rate will remain high enough to potentially do severe damage to fuel rods for months after reactor shutdown. But, obviously, a

prompt resumption of cooling of the three Fukushima Dai-ichi station reactor cores did not take place—and you can spend days retracing what happened next.

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The Web already contains many millions of pages devoted to the catastrophe. You can read archived updates of TEPCO's vague briefings, hardly changing from day to day, or detailed daily summaries prepared by the International Atomic Energy Agency experts, or relatively somber public statements and congressional testimony by U.S. officials, or a quite detailed technical estimation of what is believed to have actually happened inside the failed reactors by Areva, the big French nuclear power company. You can try to make sense of wildly fluctuating announcements about the radiation emitted by water contaminated by core fuel element components inside and outside the plant (at least some of which grossly contradict some others) or you can follow maximum radiation readings from stations around Japan—except for the two worst affected prefectures, Fukushima and Miyagi, where, even one month after the disaster, the values are still “under survey” (read: censored). Or you can replay videos of the series of spectacular hydrogen explosions that badly damaged the buildings housing Dai-ichi reactors 1 and 4 and nearly wrecked that of reactor 3, or you may review high-resolution imagery of these wrecked buildings taken by a small fixed-wing drone brought in from the United States. Or you can read the assessments by expert European groups which estimate that the total release of radioactivity into the environment has been far in excess of that from the Three Mile Island accident—and is within a factor of ten of that of the Chernobyl disaster (the reduced consequences in Japan are due to the movement of most of the Fukushima radiological release out over the Pacific, where most of it “rained out” harmlessly before reaching North America, let alone Europe).

The Japanese government had already promised a full inquiry into the genesis of the Fukushima Dai-ichi power station disaster and eventually we may know just what mistakes were made during the first minutes and hours of the emergency response, and what were the inappropriate later steps that compounded these early errors. This much we already know: a better response should have prevented the hydrogen explosions that mangled the station's reactor buildings, one after another with large interspersed time intervals, and directly or indirectly released much of the radioactivity. Uninterrupted cooling of the reactor cores—cooling which was within even the tsunami-impacted capabilities of the station but which wasn't executed—would have precluded much, and possibly all, of the ensuing problems. Or, as the deputy director general of the International Atomic Energy Agency put it, “Such an accident should not have happened. Something was not done from the very beginning.” What was done too often seemed not just disorganized and poorly thought out, but outright inept and irresponsible—attempts to avoid present small risks and costs while incurring far larger future ones.

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To those who knew about TEPCO's less-than-sterling past with respect to reactor safety (skipping mandatory checks, falsifying reports, and, perhaps most notably, fudging results of a safety test of a containment vessel in 2002) this did not come as a complete surprise. But what came afterwards was surprising. For many days after the tsunami, the company released little beyond minimal statements. The government was manifestly reluctant to step in and demand more—and—better information. The country famed for its obsession with robots, in an age of highly maneuverable mini-helicopter drones able to fly into windows of buildings and take high-quality, close-up photos, was reduced for days to guessing what was taking place in the spent-fuel pools inside the reactor buildings—although these pools contained much more long-term radioactivity than did the distressed reactor cores themselves. The Japanese people were left to form their own assessments of the situation with essentially all reasonably specific—and—timely information being provided by Americans and Europeans.

Some circumstances were truly inexplicable, perhaps most shockingly the persistently inadequate number of individual dosimeters (radiation-sensitive gadgets worn by workers to measure their cumulative exposure to nuclear radiations). Because hundreds of dosimeters were apparently destroyed by the tsunami, Dai-ichi station personnel sent into high-radiation areas of the stricken plant did not have enough individual units and were forced to “share” the devices, by staying close together and hoping that the single dosimeter carried by one group member somehow would more or less indicate the dose being received by all others. This was revealed by Japan's Nuclear Industrial Safety Agency only on March 31, with no explanation of why dosimeters were not immediately brought in from nearby nuclear power stations. Not much less bizarre was the fact that, even three weeks after the crisis began, the emergency workers at the Dai-ichi station were still subsisting on only two meals a day, including a breakfast of vegetable juice and crackers; when the available rations went from two to three meals a day in early April, the TEPCO spokesman admitted that the workers' diet still had very little variety. Not surprisingly, even a population prone to be forbearing and tolerant in crises hardened its collective mind: about 60 percent of Japanese polled disapproved of the government's handling of the nuclear crisis.

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One month after the tsunami, the Fukushima Dai-ichi power station looks like a heavily bombed industrial plant, with exploded buildings, twisted steel beams in profusion, and debris strewn everywhere. More problematic were tens of thousands of tons of radioactive water in the station's basements—some of it highly radioactive—and continuing expression of doubts by outside experts about TEPCO's ability to regain real control of the situation anytime soon. However, radiation scares in Tokyo (not to speak of the U.S. West Coast) were grossly overblown and the world's greatest megalopolis will not have to be afraid to breathe its air or to drink its tap water. On the other hand, with completely inadequate information regarding the isotopic compositions and concentrations of radioactive materials still being dribbled into the ocean at the station's edge, it is too early to judge the long-term impacts on the coastal Pacific fisheries.

Nor can we cite any solid figures for the total earthquake and tsunami damage. Some early comments indicated that Japan's economy—the world's third-largest, with per capita GDP in

excess of \$30,000 a year, a high level of technical prowess, and arguably unexceeded historical experience in dealing with both natural and manmade catastrophes—should not have a hard time coping with the disaster’s aftermath. They pointed out that the Kobe (Great Hanshin) earthquake in January 1995 hit the area that accounted for some 12 percent of the country’s GDP, including what was at the time the world’s sixth-largest container port—but the volume of goods handled by the port was back to normal in less than a year, and Japan’s economy posted a nearly 1.5 percent GDP gain for 1995. In comparison, the region hit by the Tohoku quake contributes only about 8 percent of national GDP and so commentators concluded that the economic impact could be easier to handle. Other economists go as far as to extol creative destruction aspects of natural catastrophes that stimulate economic growth through new investment and more modern and efficient capital plant.

However, both the simplistic accounting of damage and GDP and theoretical expectations of benefits through restoration of destruction ignore the specifics of the actual event as well as its broader setting. The Kobe quake was highly concentrated in spatial terms, the total economic damage it imposed was equal to about 2.5 percent of Japan’s annual GDP and its death toll was less than 7,000. Severe shaking during the Tohoku quake affected more than 10,000 square kilometers, its total costs are yet to be tallied but will most likely amount to \$400 billion (close to 8 percent of Japan’s GDP this year) even without counting the Fukushima Dai-ichi cleanup, and the death toll is roughly four times higher.

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Moreover, the Tohoku quake led to a considerable loss of electricity generation capacity, forcing the country’s largest utility (and the capital’s supplier) to resort to rotating supply cuts that are likely to last for months. Indeed, formal electricity rationing has been imposed through summer’s end, including 25 percent reductions for businesses. Incredibly, the capital and the stricken region cannot import electricity from the western part of Honshu because Japan’s main island has two incompatible electric grids: the Tohoku-Tokyo grid operates on 50 hertz, the rest of the island is on 60 hertz.

And the wider setting of that still unfolding catastrophe is even more important. When the Kobe quake hit in January 1995 the country was just five years into its economic retreat, which began in early 1990. In 1989 its GDP grew by nearly 5 percent and in December of that year the Nikkei stock index reached its record high at 38,900; by 1994 GDP managed to grow by just 0.6 percent and the Nikkei stock index fell below 20,000, but economists were still hoping for an early turnaround. But it did not come during the late 1990s and, so far, nothing has been easy for Japan in the 21st century. The lost decade of the 1990s was followed by an even worse performance during the first decade of the new century. Between 2000 and 2010 the country’s GDP grew annually by just 0.8 percent, by the end of 2010 the Nikkei index fell to just 10,000, while the average household savings rate (at nearly 13 percent in 1995) of the aging population declined from 8.7 percent in 2000 to just 2.4 percent by 2010.

Recently even the greatest icons of manufacturing, bearing some of the world’s most recognizable brand names have been humbled: Toyota had to recall millions of faulty vehicles

and in 2010 saw its quality ratings surpassed by Ford; Sony has lost much of its brand appeal, had to cut its labor force, had to sell its famed gaming console at a large loss, and its stock has been trading down and sideways for a decade. And, as the long-awaited economic renaissance failed to materialize, the government kept borrowing, turning Japan into the world's most indebted affluent economy with a government debt-to-GDP ratio at 225 percent in 2010 (in the United States, the ratio rose from 64 percent in 2007 to 93 percent by 2010, while in Germany it is at 80 percent), with 2011 being the third fiscal year in a row when taxes will bring less to the national treasury than does government borrowing.

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A new study on sovereign fiscal responsibility (published by the Stanford Institute for Economic Policy Research) defined the fiscal space and fiscal path of 34 major economies—and put Japan in 31st place, just behind Ireland and ahead of Iceland, Portugal, and Greece. Japan—until recently the world's second-largest economy, admired for its high-tech innovative drive and product quality and, in some views, even a presumptive heir to the U.S. global economic primacy—thus finds itself with a perilously diminished fiscal space on par with Portugal, with just five years left before it hits its maximum-feasible debt ceiling (for the United States, this point presently appears to be in 2027). Sovereign debt downgrading has already begun—in May 2009, Moody's cut Japan's rating from AAA to Aa2, and in January 2011 S&P posted an AA-rating (while the United States and Germany retain their AAA ratings). And the governor of Japan's central bank keeps repeating the mantra of no country being able to run deficits forever. But, to put it bluntly, Japan for years has not had any government able to make significant decisions.

The country now resembles postwar Italy, with five prime ministers coming and going during the last five years, and, ironically, the tenure of the latest premier (in power since June 2010) was prolonged by the quake: Prime Minister Kan's pre-quake favorability rating was only about 20 percent, he was under pressure (including from critics from his own party) to resign in the wake of illegal campaign donations, and the opposition was demanding an early new election—and it subsequently refused his invitation to join a new post-quake cabinet of national unity. Add to this frequent firings and resignations of key government ministers, and it is clear that the historic shift in September 2009 from more than a half-century of nearly-uninterrupted Liberal Democratic Party rule to control by the Democratic Party has brought neither improvements in policy clarity nor more resolute management of nation's affairs.

What is ahead is a long and costly slog. Just to clear the seemingly endless fields of coastal debris in the two worst affected prefectures will take three to five years. New housing will have to be found or built for 150,000 people who now live scattered across 18 prefectures in more than 2,000 temporary shelters, and it is clear that some coastal settlements will not be rebuilt. It will take months to achieve stable cold shutdown at all Fukushima Dai-ichi station reactors and spent-fuel storage pools, to clear all radioactive debris from failed reactor cores and ruined storage pools, and to remove all radioactive water, while the complete unwinding of the disaster will take decades: the account books have yet to close on the Three Mile Island accident of far lesser magnitude-and-severity, 32 years later.

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The aggregate long-term costs of coping with Fukushima station's shutdown and (now inevitable) decommissioning remain highly uncertain, with a displaced population that has been removed from the roughly 1,000 square-kilometer formal exclusion zone around the plant, with radiological complications in international relations, and with reduced food production (Japan already imports two-thirds of its food, more than any other rich nation) from the contaminated area. Current estimates are that half of the 13,000 small farmers in the area may be at least temporarily excluded from the marketplace due to the combined impacts of farmland inundation and contamination of their produce. And what will Japan decide to do about its nuclear electricity generation capability? Before the quake it supplied about 30 percent of Japan's electricity and was expected to grow to 50 percent within two decades, fractions so large that they cannot be replaced either rapidly or cheaply by any other available option, making a substantial retreat from nuclear power almost impossible to contemplate and a failure to continue with planned nuclear growth one fraught with major challenges.

The Japanese government has no choice with respect to taking on more public debt: it has already announced that it will nationalize all land abandoned by disaster victims, finance the region's redevelopment (including construction of as many as 100,000 new residences), take a large stake in the financially troubled TEPCO (whose present market capitalization is barely 10 percent of its short-term-maturing debt, to say nothing of its possible liabilities), and indemnify farmers for their losses due to their contaminated rice fields, and fishermen for their similarly forgone catches. All this will obviously further constrict Japan's fiscal space and truncate its already-short fiscal trajectory toward de facto shut-out from global capital markets.

A single generation ago, it appeared to many sober observers that Japan should be feared as it moved on a seemingly unstoppable track toward global economic domination. Today, many fear that Japan should be pitied as the greatest measured earthquake in the country's history, compounded by an extraordinary tsunami and potentiated by a serious nuclear catastrophe, will accelerate the nation's two-decade old economic retreat. My modest hope is that the latter assessment will turn out to be as mistaken as was the former.

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