

# NEWS IN FOCUS

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LEE JIN-MAN/AP



With nuclear power stations out of action, can Japan find a way to reduce carbon emissions and still avoid the blackouts?

## ENERGY

# Japan faces power struggle

*Climate goals in doubt as fossil fuels come to the fore in fight to meet electricity demand.*

BY JEFF TOLLEFSON

The disaster at Japan's Fukushima nuclear power plant is putting the nation's ambitious plans to reduce carbon emissions under serious pressure. With few natural resources, Japan has long been forced to rely on imports of oil, coal and natural gas to provide about 80% of the energy needed to sustain its economy. Nuclear energy was supposed to help Japan limit these energy imports and cut its carbon emissions at the same time — but that was before Fukushima.

The government has committed to reduce carbon emissions by 25% from 1990 levels by 2020, and by roughly 80% from 1990 levels by 2050. The short-term target is particularly ambitious, because Japan's streamlined

economy is already among the most energy-efficient in the world. To achieve its goals, Japan had planned to build nine nuclear power plants over the coming decade and a total of 14 plants by 2030, all while squeezing as much power as possible out of the current 54 plants. By 2030, nuclear power was to have provided half of Japan's electricity, doubling its current contribution (see 'Nuclear power in Japan').

A big question mark now hangs over those plans. Nearly a month after the magnitude-9.0 earthquake and the tsunami that followed, workers are still struggling to control the reactors at Fukushima. Four

of the six reactors there have been destroyed; the other two will probably never run again; and plans for two new reactors have been abandoned (see page 146). Another eight reactors in the northwest of the country were automatically shut down after the 11 March earthquake. The Tokyo Electric Power Company (TEPCO), Japan's largest private utility, which operates Fukushima Daiichi and three other nuclear plants with multiple reactors, is struggling to meet electricity demand in Tokyo. Japan's vulnerability was highlighted again on 7 April, when a magnitude-7.1 earthquake temporarily shut down several conventional power stations and left millions without electricity.

No one knows when the situation will stabilize, nor what Japan's nuclear industry will look like when it does. Although several power



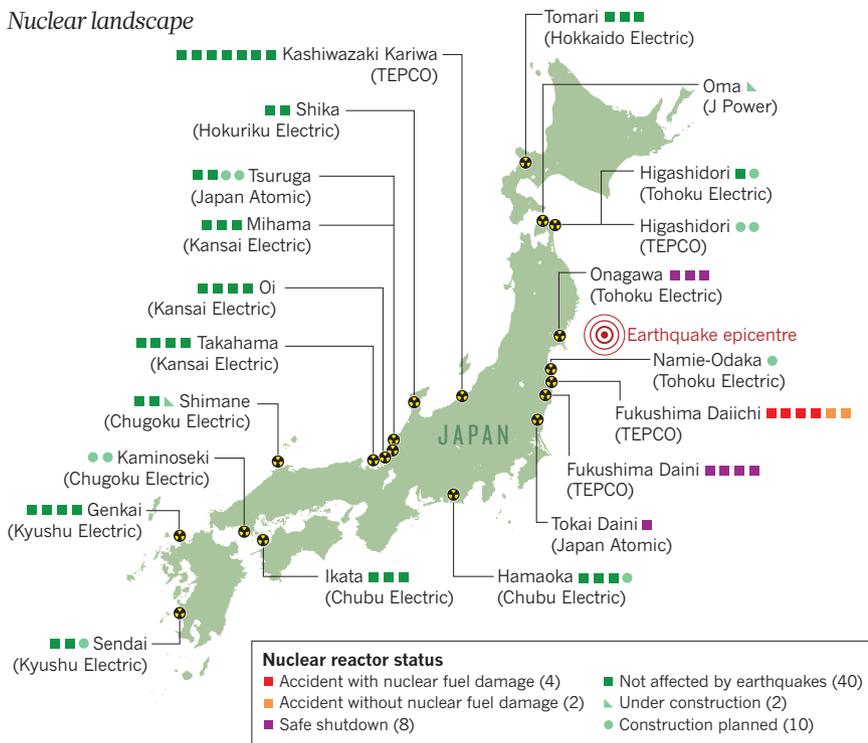
**FUKUSHIMA CRISIS**  
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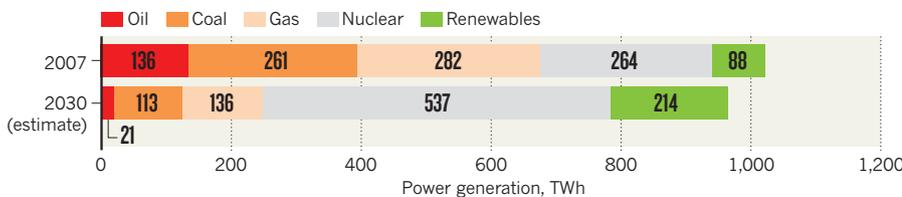
# NUCLEAR POWER IN JAPAN

Fifty-four nuclear reactors supply about a quarter of Japan's electrical energy needs (1). Before the Fukushima disaster struck, new reactors and energy conservation were set to double that proportion by 2030 (2).

## 1 Nuclear landscape



## 2 Energy mix



► firms say they will stick to construction schedules to meet the nuclear capacity goals, the Japanese government has ordered a review of its energy policy. “They obviously have a predicament in that they have put a lot of eggs in the nuclear-power basket,” says Ed Lyman, a nuclear expert with the Union of Concerned Scientists in Washington DC. “It’s hard to imagine that Fukushima isn’t going to disrupt those plans.”

The most immediate challenge is to meet the nation’s electricity needs. The rolling blackouts introduced after the crisis began have stopped,

thanks to reduced demand and energy conservation measures. But supplying enough power is difficult because Japan maintains two essentially incompatible electricity grids, a decision dating back more than a century. These grids carry alternating current at different frequencies, preventing large-scale diversion of electricity from power plants outside the affected region. There are no plans to unify the systems.

In the short term, most experts agree that the crisis will force Japan to rely much more heavily on its natural-gas power stations,

and potentially also its coal-fired plants. But increasing fossil-fuel use probably won’t stop Japan from meeting its short-term carbon-emissions commitment under the Kyoto Protocol — a reduction of 6% below 1990 levels by 2012 — says Lisa Zelljadt, a senior analyst with the energy consultancy Thompson Reuters Point Carbon in Washington DC.

Japan’s emissions have increased significantly since 1990, so the country has been working to offset much of its emissions by paying for reductions in other countries. “The only way that they were going to make their Kyoto commitments was by buying carbon credits,” says Robert Stavins, an economist at Harvard University in Cambridge, Massachusetts. Japan also moved a little closer towards its climate targets during the global economic crisis, when plunging economic output reduced emissions by 7% from 2007 to 2008. The earthquake, tsunami and nuclear crisis will also help curb carbon output.

All these factors should put Japan in a position to meet its Kyoto commitments, says Zelljadt. “The nuclear disaster will thus affect more how Japan stands towards a longer-term target in the international negotiations,” she says.

In a move towards not just carbon-free energy but also energy self-sufficiency, Japan had outlined ambitious plans to develop an advanced nuclear-energy programme that would not only recycle spent nuclear fuel but also deploy fast-breeder reactors that produce more fuel than they burn (see *Nature* 464, 661; 2010).

These efforts are a cornerstone of Japan’s climate strategy, but they were under pressure even before the earthquake. Japan’s Rokkasho reprocessing plant has suffered from numerous problems and will be some 15 years behind schedule if it opens as currently planned in 2012. The plant stores thousands of tonnes of spent nuclear fuel, and had to rely on backup diesel generators to cool the fuel after the plant lost power following last week’s big aftershock.

Meanwhile, a prototype fast-breeder reactor — dubbed Monju — has been plagued with problems (see *Nature* 434, 6; 2005). Fifteen years after a sodium coolant leak and a related fire led to its closure, Monju was briefly started up in 2010 only to be shut down once again after a non-nuclear accident.

“It’s a pretty grim story anywhere you look in Japan,” says Lyman. “You have to wonder how many nuclear failures they can put up with before throwing in the towel.” ■

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