

NY Times: November 19, 2013



# Unavoidable Answer for the Problem of Climate Change



Workers removing fuel rods from one of the reactors at the Daiichi plant in Fukushima, Japan, site of a nuclear accident in 2011.

By [EDUARDO PORTER](#)

Japan's [announcement last week](#) that it would not meet its promise to sharply reduce its carbon emissions met a chorus of disapproval from around the world.

Delegates at the international climate talks in Warsaw, which end Friday, lamented Japan's move as a blow to worldwide efforts to slow global warming. In the Philippines, which is still collecting the dead from Typhoon Hayan, it served as yet another example of the indifference of the rich world to the plight of the world's poorest nations on the front lines of climate change.

But Japan's about-face on its climate promises — which followed the government's decision to shut down its nuclear power generators after the meltdown at the Daiichi nuclear plant in Fukushima — is also an opportunity for a reality check in the debate over how to slow the accumulation of greenhouse gases warming the atmosphere.

It brings into sharp focus the most urgent challenge: How will the world replace fossil fuels? Can it be done fast enough, cheaply enough and on a sufficient scale without nuclear energy? For all the optimism about the prospects of wind, sun and tides to power our future, the evidence suggests the answer is no.

Scrambling to find an alternative fuel to generate some 30 percent of its power, Japan had no choice but to turn to coal and gas. A few years ago, it promised that in 2020 it would produce 25 percent less greenhouse gas emissions than in 1990; last week it said it would, instead, produce 3 percent more.

Japan is unlikely to be the only country to miss its targets. In response to the Fukushima disaster, Germany shut down eight nuclear reactors and said it would close the remaining nine by 2022.

Everybody is promising to fill the gap with renewables. So far, however, coal and natural gas have won out. [CO2 emissions in Germany actually increased 1 percent last year](#), even as they declined in the United States and most of Western Europe.

Between 2010 and 2012, worldwide consumption of nuclear energy shrank 7 percent. Over the same period, the consumption of coal, the dirtiest fuel and the worst global warming offender, rose 4.5 percent. [Data released on Tuesday by the Global Carbon Project](#) confirmed that coal accounted for over half the growth in fossil fuel emissions in 2012.

With energy consumption expected to [grow by more than half over the next 30 years](#), the odds seem low that the world can avoid catastrophic warming without carbon-free nuclear power.

Opponents of nuclear energy say the case for nuclear power underestimates its costs and unique risks, including the fact that no other energy source can produce the sudden devastation of a nuclear meltdown. And they say that nuclear proponents overstate the challenge that renewable energy faces in replacing fossil fuels.

But while investment in renewable sources is crucially important to meet new energy needs, nuclear power remains the cheapest and most readily scalable of the alternative energy sources. Difficult as it may be to reduce dependence on coal, nuclear power is probably the world's best shot.

Take the [Energy Information Agency's estimate](#) of the cost of generating power. The agency's number-crunchers include everything from the initial investment to the cost of fuel and the expense to operate, maintain and decommission old plants. Its latest estimate, published earlier this year, suggests that power generated by a new-generation nuclear plant that entered service in 2018 would be \$108.40 per megawatt-hour. (A megawatt-hour is enough to supply an hour's worth of electricity to about 1,000 American homes.)

This is not cheap. Even if the government were to impose a carbon tax of \$15 per metric ton of CO<sub>2</sub>, a coal-fired plant would generate power at \$100.10 to \$135.50 per MWh, depending on the technology. Plants using natural gas could produce electricity for as little as \$65.60 per MWh, even after paying the carbon tax.



Still, nuclear power is likely to be cheaper than most power made with renewables. Land-based wind farms could generate power at a relatively low cost of \$86.60 per MWh, but acceptable locations are growing increasingly scarce. Solar costs \$144.30 per MWh, the agency estimates. A megawatt-hour of power fueled by an offshore wind farm costs a whopping \$221.50.

Even these comparisons underestimate the challenges faced in developing wind and solar power on a large scale. They might be clean and plentiful sources, but they require expensive transmission lines from where the sun shines and the wind blows to where the power is needed. Moreover, the sun doesn't shine at least half the time. The wind doesn't always blow. And we don't yet know how to store electricity generated on hot summer days to use on cold winter nights.

The sun has provided half of Germany's power on some days. On others it has provided next to nothing. It's not easy to build a power network, let alone an economy, on the basis of such an unreliable energy source.

Perhaps the most levelheaded estimate of the relative cost of alternative fuels comes from the British government, which earlier this year published the price it was prepared to guarantee power generators as an incentive to develop [renewable sources](#).

The exercise underscored just how uncompetitive alternative sources of energy are, compared with coal and gas. It also revealed that nuclear power generated at a new plant in Somerset was expected to be [significantly cheaper](#).

The British government offered to guarantee a price of £92.50 per MWh of power generated at the Somerset plant. For offshore wind, the guarantees ranged from £155 per MWh at plants starting next year to £135 per MWh for those starting in 2018.



What about the danger of nuclear power? What about the fish swimming in cesium-laced waters off the coast of Japan or the tens of thousands of evacuees fleeing radioactive fallout?

In 2007 The Lancet medical journal published a study comparing deaths and illnesses associated with different sources of electricity — both from environmental pollution and accidents. [Nuclear energy, it found, was about the safest around](#). Nuclear energy was responsible for 0.003 accidental deaths per terawatt-hour generated. Coal-fired electricity accounted for 15 times as many.

“More than 10 years of operations would be needed before a single occupational death could be attributed to the plant” at a new French reactor, wrote the authors, Anil Markandya from the University of Bath and Paul Wilkinson from the London School of Hygiene and Tropical Medicine.



Chernobyl, the worst nuclear accident in history, produced 50 additional deaths from cancer in 20 years, [according to a study by 100 scientists from eight United Nations agencies](#). Of 800,000 people exposed to its radiation, a maximum of 4,000 may eventually die from cancer, according to the World Health Organization.

Any such deaths are tragic, but there are downsides to all energy sources. The strongest evidence that nuclear energy is much safer than the public believes comes, of all places, from Japan.

In 1945, the United States dropped nuclear bombs on Hiroshima and Nagasaki. Since then, [500 of the 100,000 or so survivors — 0.5 percent — have died prematurely because of radiation exposure. Six decades worth of analysis of this population suggests the risks from radiation are unexpectedly low.](#)

The climate change scientist James Hansen, former head of NASA's Goddard Institute for Space Studies, argues that nuclear energy will save lives. In fact, [it has prevented some 1.8 million air pollution-related deaths](#) already.

The good news is that the sun and the wind are not the world's only alternative to fossil fuels. There are risks associated with nuclear power, but it looks a lot better than the energy we've got.

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This article has been revised to reflect the following correction:

**Correction: November 19, 2013**

An earlier version of this column misstated the number of survivors of the bombing of Hiroshima and Nagasaki who died prematurely because of radiation exposure. It was 500, not 5,000.