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Perspectives

Can Nuclear Power Be Part of the Solution?

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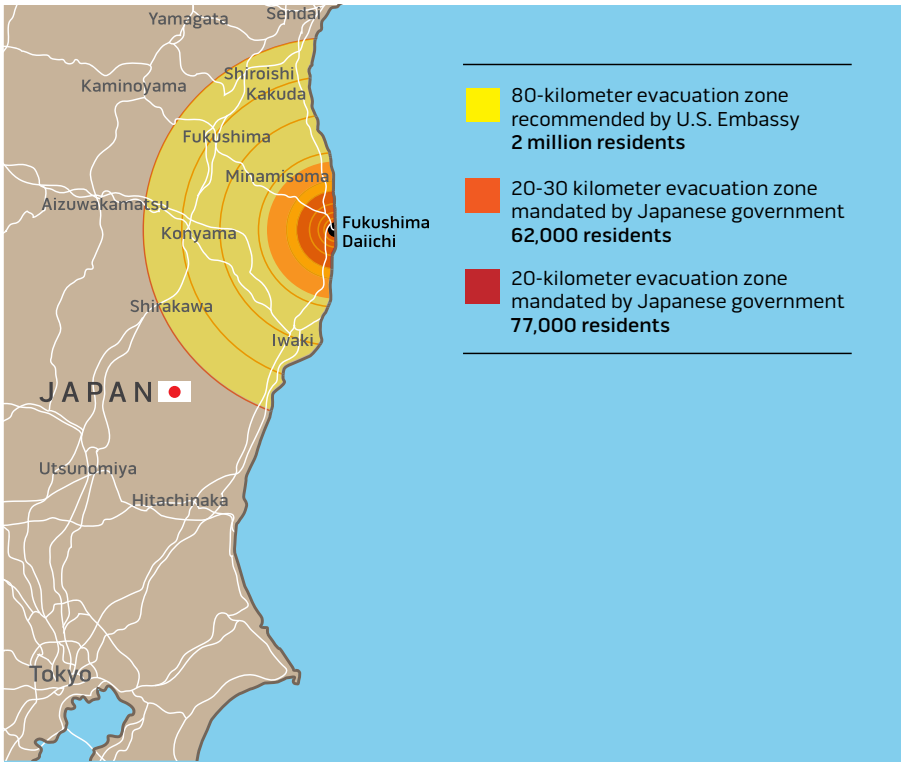
As the unfolding nuclear disaster in Japan has shown, the costs of cleanup after a nuclear meltdown are borne in large part by national governments and taxpayers rather than the industry. Paying for cleanup is just one of many hidden costs of nuclear energy that make judging the value of nuclear power difficult. Many countries, including the United States, are rushing to build a new generation of nuclear power plants to reduce carbon emissions. However, the disaster in Japan should force us to take into account the full costs of nuclear power (and other energy sources). Here we propose that all forms of energy incorporate their full costs (including climate impacts, the risk of accidents, and the safe disposal of waste) so that their true value to society can be revealed and better decisions made.

Taken as a whole, the safety record of nuclear energy has been relatively good.[1] In addition, new plant designs, so-called generation III reactors, have enhanced safety features compared to the 1970s-era generation II designs like those at the Fukushima Daiichi facility in Japan. And even the Fukushima reactors did not completely melt down after a magnitude 9.0 earthquake and a relatively direct hit from a massive tsunami. The number of people killed or injured globally from the nuclear energy system is far smaller than the number killed or injured, for example, producing energy from coal or even hydropower. France generates about 75 percent of its electricity from nuclear power and has been running nuclear power plants for decades with no major incidents.[2]



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This map shows the evacuation zones around the Fukushima Daiichi nuclear power plant in Japan. As of March 25th, the Japanese government has urged people living 20-30 kilometers from the plant to voluntarily evacuate.

On the other hand, the Fukushima Daiichi plant disaster demonstrates that even with all the precautions taken and multiple redundancies to guard against disaster, major unforeseen problems can occur and can have huge, long-term economic and ecological consequences. For example, the Chernobyl nuclear power plant is now encased in a huge sarcophagus that will have to be maintained for hundreds of years to prevent radiation leakage, and a 2,800-square-kilometer area around the plant will be completely off-limits for a similar amount of time.[3] The economic and social hurdles of locating and constructing new power plants have encouraged the relicensing of existing nuclear plants beyond their design lifetimes, increasing vulnerability and risk. Also, as more nuclear reactors come online—60 are currently being constructed in 15 countries—and those that were built before the 1990s begin to show their age, the chances for another disaster grow.

In addition, the long-term waste disposal problem has yet to be solved for nuclear power, and decommissioning costs are still highly uncertain. In the United States, after decades of trying, a long-term waste storage plan still does not exist. The

GeoEye/Google

Satellite images taken before (left) and after the Fukushima Daiichi nuclear power plant in Japan was damaged by a 9.0 earthquake and subsequent tsunami in March 2011. The image on the right shows severe damage to three of the four cube-shaped nuclear reactor containment buildings. Cracks in the reactors themselves were also later discovered at the plant.

proposed storage facility at Yucca Mountain, Nevada, was recently rejected by President Obama, partly on the grounds that it could only guarantee that radioactive material wouldn't leak after 10,000 years of storage, while the minimum safety requirement established by the US Environmental Protection Agency is 1 million years. President Obama has set up a commission to examine these issues—revealing the stark reality that no one has yet found a safe way to store radioactive waste for the very long time period required. Even if the Yucca Mountain facility is approved, the current proposal would not have the capacity to handle the country's existing radioactive waste, let alone what a new generation of power plants will produce.

Government subsidies have made nuclear energy appear to be a relatively cheap option. Legacy subsidies lowered capital and operating costs through the 1980s. Ongoing subsidies offset the costs of uranium, insurance and liability, plant security, cooling water, waste disposal, and plant decommissioning.

A suite of new subsidies in the last decade has extended government support to new reactors and upstream fuel cycle facilities. The effect of these new subsidies is simple: they externalize the cost of building nuclear reactors, thus distorting the price of electricity generated by nuclear energy. For example, the US government requires that a nuclear facility be insured only up to $12.6 billion. Although this seems like a large amount, consider that damage from the 2010 Gulf of Mexico oil spill was estimated at $34 billion to $670 billion,[4] and the US government called for an initial $20 billion fund for restoration. The cleanup costs from the Fukushima disaster could far exceed these numbers. Large government subsidies for nuclear energy lead to suboptimal decisions by consumers, investors, and society in general.

Faced with these grave issues, it is time to change our approach to evaluating nuclear power. It is time to make sure the full costs and benefits are clear and that enough information is available for society to make informed decisions. To do this we propose a few straightforward steps:

1. Eliminate subsidies for nuclear power, especially those that shift long-term risk. Government subsidies directly reduce the private cost of capital for new nuclear reactors and shift the long-term, often multigenerational risks of the nuclear fuel cycle away from investors to the general public.[5]
2. Require nuclear power plant owners to buy full-coverage insurance against accidents. This can be accomplished by repealing the Price-Anderson Act, which limits liability for nuclear accidents to $12.6 billion, and similar subsidies in the United States and also eliminating limits on liability in other countries. Insurance companies are in the business of assessing and monetizing risks. Since new power plant designs are, according to their supporters, inherently safer, the insurance premiums should be lower. If the insurance companies are unwilling or unable to insure these nuclear power plants, plant operators should be required to maintain an assurance bond (i.e., self-insurance) adequate to cover a worst-case-scenario accident or

to create new models of nuclear industry risk sharing.[4] This would ensure that, if an accident did occur, costs would not be borne by the public but by the plant owners. It would also make the cost of that risk apparent in the short term and thus part of the price of electricity from nuclear plants.

3. Require plant owners to also maintain an assurance bond adequate to cover decommissioning and waste disposal costs. This approach is often used for mining operations to ensure that the mines are properly reclaimed. In most countries there are already some funds set aside for nuclear plant decommissioning and waste disposal, but it is almost certainly not enough to cover the real costs. The size of the bond would reflect the worst-case scenario for decommissioning and waste disposal and could be lowered (or raised) as more information is accumulated about the real costs involved.

Taking these steps would internalize many of the costs associated with nuclear power and would create a system in which the price of electricity from nuclear plants more accurately reflects the full costs and benefits of the technology to society. How much this would raise the price of electricity from nuclear plants would depend on the design of the plant, its location, how it is operated, how old it is, and other factors. This would give society a better (and more discriminating) picture of the true costs of nuclear power and would make comparing nuclear energy with other energy sources more direct and rational.

We should do the same for other sources of energy as well, many of which also receive huge subsidies. For example, what consumers pay for electricity produced from fossil fuel sources does not reflect environmental and health externalities. A recent study by Paul Epstein of the Harvard Medical School and his colleagues estimated that if the health and environmental externalities from coal's life cycle were included in its price, the US public would pay an additional $0.3 to $0.5 trillion per year, which is triple the current price of electricity per kilowatt-hour from coal.[6] This would make wind, solar, and other renewable sources of energy, which have much smaller subsidies and external costs, economically more competitive.

How would nuclear power fare if the subsidies were removed and the full costs internalized? It is hard to predict, but the answer to whether nuclear power can be part of the energy solution lies in how the full costs of nuclear compare with the full costs of fossil fuel, hydro, and renewable energy. For example, most people believe that nuclear energy is either completely free of greenhouse gases or contributes negligible amounts. However, this is not true when one considers the entire life cycle of the nuclear power complex. A 2008 study showed that if the price of nuclear energy included the cost of greenhouse gases, nuclear power would cost more than not only fossil fuel technologies but also wind energy.[7] Including the cost of the risk of accidents and waste disposal, as discussed above, would raise the price significantly further.

So let's remove the subsidies, require nuclear power plants to be fully insured, and put aside adequate funds for decommissioning and long-term radioactive waste disposal. Let's do the same for all energy sources. Then we can use the market mechanism to find out whether nuclear power plants should be part of the energy solution.

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