

Why (or why not) nuclear energy?

By Elizabeth Landau, CNN

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The North Anna nuclear plant operates near Richmond, Virginia. Problems in Japan have raised nuclear concerns elsewhere.

STORY HIGHLIGHTS

- Nuclear power plants are attractive for countries like Japan lacking natural resources
- Some say nuclear power should be a last resort
- Energy diversity and energy security are important considerations, experts say
- It's unclear if taxpayers would pay for large subsidies for solar and wind, expert says

(CNN) -- Since Japan's Fukushima Daiichi nuclear power plant suffered damage from a massive earthquake and tsunami March 11, you might be a little more aware of the nuclear power plant nearest you. Does it really need to be there? Is it safe?

And on a global scale, several countries including Germany, Israel and Italy are also expressing worry about the safety of their existing or planned nuclear projects. The disaster at Fukushima Daiichi has prompted many governments to begin reassessing their own nuclear power plants in hopes of ensuring that a similar accident would not happen in their territories.

"The (nuclear) option will be shoved aside until the dust settles and we know what happened there in Japan, and what kind of changes are necessary to compensate for deficiencies that will be discovered later," said Chaim Braun, consulting professor at the Center for International Security and Cooperation at Stanford University.

[See the problems the reactors face at the Fukushima Daiichi plant](#)

How much nuclear power is too much, or too little? That's a complex question, experts say. Each country must balance its particular energy needs with the domestic availability of natural resources, consideration for greenhouse gas emissions and cost-effectiveness measures, not to mention safety and foreign policy concerns.

As you form your own opinions about nuclear power, here are some things to think about:

Reliance on nuclear power



U.S. nuclear plants in damage control

There are 104 operating commercial nuclear reactors in the United States and 54 in Japan before the recent earthquake and tsunami. The U.S. relies on nuclear power for 20% of electricity; for Japan, it accounts for about 27%, according to the U.S. Energy Information Administration.



Utility CEO: New nuclear plants to be built

For countries such as Japan that don't have natural resources like oil and gas, nuclear power plants are attractive options. The cost of construction of nuclear power plants is high, but the cost of fuel is low, it would be hard for Japan to back out now, experts said.

"Will they go back and look at what they need to change? Of course, they will do that. But is this going to be

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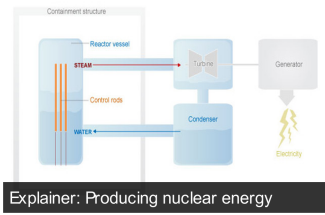
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Explainer: Producing nuclear energy

ing the overall portion of how much power they make by nuclear? I don't necessarily think that's the case," said Peter Hosemann, assistant professor of nuclear engineering at the University of California, Berkeley.

So why not get all electricity from nuclear power? It's not because of safety concerns, but rather because of the importance of energy diversity and energy security, said Najmedin Meshkati, nuclear safety expert at the University of Southern California.

Just as you shouldn't invest all your money into one stock, it's wise for a country to have a diverse portfolio of energy sources to ensure constant coverage, experts said.

"You need a healthy mix of power supply and power sources in order to guarantee a stable grid," Hosemann

said.

There can also be all sorts of beneficial but nonenergy-related results of nuclear power generation, which economists call positive externalities. In a country that boosts its nuclear plant development, the heavy-machine building and metallurgy industries might greatly benefit as they would be employed to work on the technology.

Plus, it's a good idea to have some form of domestic power generation, and not to rely entirely on buying from other countries. For instance, relying on foreign oil can be a problem if the source country decides to hike prices or, for diplomatic reasons, cuts off supply entirely.

"Nuclear power provides that energy security," Meshkati said. "It's very secure and very reliable. It's there for you. Nobody else can control it."

But there's another security issue raised by nuclear technology that is a big concern: the proliferation of nuclear weapons. Plutonium from used fuel in nuclear reactors can be used for weapons; in 1974, India tested a bomb that incorporated plutonium from a research reactor.

That's why nuclear physicist and Princeton University professor Frank N. von Hippel said he thinks nuclear power should be a "last resort."

Countries should look at energy efficiency -- ways to reduce everyday electricity usage -- as well as renewable sources and carbon sequestration, a technology that could capture and bury the carbon dioxide emitted from coal plants. Nuclear energy is not the be-all and end-all, even for Japan, he said.

"If nuclear power had not been invented or were not possible, Japan would have figured out how to do it some other way," he said.

[What are some energy alternatives for Japan?](#)

Environmentally friendly energy

Nuclear and hydropower sources have 50 to 100 times lower greenhouse gas emissions than coal, according to the International Atomic Energy Agency. But analyses showing nuclear energy's environmental friendliness don't take into account the emissions from the mining and transport of nuclear fuel, said Mark Jacobson of the Department of Civil and Environmental Engineering at Stanford University.

In his view, a combination of renewable sources such as wind and tidal power should be the standard, and investment in nuclear power, or using a combination of nuclear and other sources, is merely funneling resources to something with potential dangers.

But with renewable energy, it's hard to generate continuous power, known as the baseload demand, said the University of Southern

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California's Meshkati.

Nuclear power plants deliver large amounts of power for long periods of time. Solar and wind energy technologies, on the other hand, rely on natural phenomena that aren't available all the time -- the sun, which doesn't shine in the same place all day, and the wind, which doesn't blow around the clock. For that reason they are "intermittent." But Jacobson and colleagues have shown that, by putting different renewables together, it's possible to fill in the gaps and get steady power.

Energy storage systems can be devised that would store energy when the sun shines, and then release it to the grid when needed after the sun goes down, said Braun, the consulting professor at Stanford. Still, this technology isn't commercialized on a large scale and is currently too expensive to be practical to power large cities. It's unclear whether taxpayers would be willing to pay for large subsidies for solar and wind, Braun said.

The United States spends about 2% of its gross domestic product on electricity, and if the country were willing to raise that to 3%, it could probably afford using renewables instead of nuclear power, Princeton's von Hippel said.

"There is a social choice. If people want very much to go away from nuclear power, and are willing to pay for it, which is two different things, then we could," von Hippel said.

The costs

So how cost-effective is nuclear power? Like many issues, it depends on who you ask. Advocates say that, per kilowatt-hour produced, nuclear power is cheaper than other sources. But detractors will point out it's expensive to construct a power plant.

An analysis by J.L. Conca of New Mexico State University and J. Wright of UFA Ventures Inc., a soil and rock testing company, found that hydro, nuclear and wind are the most cost-effective sources over the next 50 years, with almost identical costs per kilowatt-hour of electricity produced. They trump coal, natural gas and solar power in cost-effectiveness, the report found.

But what about adding more capacity? With the next generation of nuclear power technologies, it might not be cost-effective unless the U.S. imposes a price-based constraint on carbon-dioxide emissions.

Under the Energy Policy Act of 2005, newly built, advanced-technology nuclear power plants are eligible for incentives such as loan guarantees and tax credits. A 2008 report from the U.S. Congressional Budget Office found that without these incentives, and in the absence of a universal charge for carbon-dioxide emissions, "utilities would probably continue to build power plants relying on conventional fossil-fuel technologies to meet increases in base-load electricity demand."

Stanford's Braun predicts that the immediate impact of the Fukushima Daiichi disaster will be that natural gas will become the fuel of choice, sold at higher prices as demand increases.

Yet while nuclear development in smaller countries may be delayed or canceled, China and India likely will continue with their nuclear programs. These are the countries where the most nuclear power plants will be built in the coming years, Braun said. Those countries need nuclear energy to meet their burgeoning electricity needs and to reduce their large emissions of pollutants from other sources, he said.

Toward a better nuclear reactor

A downside of nuclear power plants is that the reactors need constant attention, and so do the spent fuel pools. The University of Southern California's Meshkati compared them to babies that sleep at different times of the day, always requiring care.

The reactors at Japan's Fukushima Daiichi are boiling water reactors, which is one of the oldest designs, he said.

But there's a whole category of reactors in development with "inherently safe" features that use the laws of physics to prevent meltdown.

For instance, China has planned prototypes of pebble-bed nuclear reactors. These use heat gas instead of the conventional choice of water, and balls made of graphite and uranium instead of uranium fuel rods. These reactors can theoretically cool themselves in case of emergency.

"Because of life's necessities and the bitter realities of energy availability, they (Japan) may choose to embrace this new generation of reactors," Meshkati said.

After many decades, if the site of Fukushima could be cleaned up, a new generation of "inherently safe" reactors may one day operate in the same place, he said, but don't hold your breath.

"It's not going to be in my lifetime," Meshkati said.

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