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A Nuclear Option for Energy

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In the wake of the 2011 accident at the Fukushima Daiichi nuclear plant, it may sound odd to say so, but here goes: The prospects for nuclear energy have never been brighter.

Reactor technology is improving fast, the nuclear sector is getting significant private-sector investment, and mainstream environmentalists are embracing nuclear like never before. To be clear, nuclear faces many challenges -- it's too expensive and there are too many old plants -- but with the right policies in place, nuclear should become more affordable and safer over the coming decades.

Nuclear is green because it has such a small footprint. Inside the core of an average reactor, the power density is about 338 megawatts per square meter. This explains how just two reactors at the Indian Point Energy Center in Westchester County, New York, can provide as much as 30 percent of New York City's electricity.

To equal the generation capacity at Indian Point with wind energy, which has a paltry power density of 1 watt per square meter, you'd need about 772 square miles of wind turbines, an area three-quarters the size of Rhode Island.

Add in nuclear's minimal carbon-dioxide emissions, and it's clear that nuclear can, and will, provide a significant chunk of the world's electricity for many years to come.

But costs remain too high. While nuclear plants can produce electricity at relatively low cost once they're built, the up-front price tag is daunting. The Vogtle 3 and 4 reactors under construction near Augusta, Georgia, will cost about $14 billion, or roughly $6.3 million per megawatt -- six times as much as a natural-gas-fired power plant.

Some opponents still claim nuclear energy is also too dangerous. Debunking that argument requires only a quick look at the facts about Fukushima.

From a nuclear safety standpoint, it's difficult to imagine a scarier scenario than what happened on March 11, 2011. An earthquake measuring 9.0 on the Richter scale -- powerful enough to shift the position of Earth's axis by about 6.5 inches -- hit 80 miles off the Japanese coast. Within minutes, a series of seven tsunamis, some as high as 50 feet, slammed into the Fukushima Daiichi nuclear plant. Backup diesel generators, designed to keep the reactors' cooling water pumps operating, quickly failed. A day later, a hydrogen explosion blew the roof off the Unit 1 reactor building. Over the next few days, similar explosions hit Units 2 and 3. Three reactors melted down.

It was the worst nuclear accident since the Chernobyl accident in 1986. But here's the reality: It led directly to exactly two deaths -- two workers who drowned at the plant.

It was feared that radioactive materials from the plant would contaminate large areas of Japan and even reach the U.S. That didn't happen. In early 2013, the World Health Organization reported that radiation exposure due to Fukushima was low and concluded: "Outside the geographical areas most affected by radiation, even in locations within Fukushima prefecture, the predicted risks remain low and no observable increases in cancer above natural variation in baseline rates are anticipated."

I am not minimizing the seriousness of what happened at Fukushima. The reactors used at the site were of an older design that lacked passive cooling systems. Nor am I forgetting about the staggering costs of decommissioning and cleaning up the Fukushima site and compensating all the people who were displaced.

Nevertheless, this wasn't Chernobyl.

About 10 days after the disaster struck, George Monbiot, a British journalist and environmentalist who had long described himself as "nuclear-neutral," announced he had changed his mind. "Atomic energy has just been subjected to one of the harshest of possible tests, and the impact on people and the planet has been small." He continued, "The crisis at Fukushima has converted me to the cause of nuclear power."

Fukushima has helped catalyze the push for safer reactors. Several companies are already deploying what are known as Generation III+ reactors, which have stronger containment systems and passive safety mechanisms that can cool and stabilize a reactor core for at least three days, even if there is no electricity. Here are some of the most interesting technologies:

Small modular reactors. Generally defined as having a capacity of 300 megawatts or less, small modular reactors cost a fraction of what larger reactors cost. In addition to their lower up-front costs, they can be deployed as single or multiple units, and they're designed to be buried in the ground, which makes them more resistant to natural disasters, terrorism and mishaps. The hope is that if enough are ordered, the reactor assemblies can be fabricated in a central location, which should mean lower costs and a faster learning curve.

Molten salt reactors. This design mixes the nuclear fuel into a salt mixture that can be used in place of fuel rods. A drain plug made of cooled, solid salt at the bottom of the reactor serves as a fail-safe mechanism: If the plug's cooler gets turned off, or the system's pumps lose power, the plug melts and the molten salt-fuel mix flows into a storage tank where it cools on its own, removing the possibility of a meltdown. The U.S. Department of Energy successfully tested the molten-salt design in the 1960s at Oak Ridge National Laboratory.

Integral fast reactors. This design uses metal cooling instead of water. Tests on an Idaho prototype that operated for three decades showed that if the reactor's cooling pumps were shut off, the reactor would simply shut down on its own. In addition, the integral fast reactor can burn radioactive waste from other reactors and produce its own fuel. General Electric Co. and the Japanese firm Hitachi Ltd. have proposed building a Power Reactor Innovative Small Modular, which would produce about 600 megawatts of power.

Thorium-fueled reactors. Some nuclear advocates believe thorium is a better reactor fuel than uranium. It's far more abundant in the Earth's crust, it doesn't need to be enriched, and when used in the reactor, it doesn't produce as many radioactive by-products, such as plutonium. Also, the waste produced by thorium-fueled reactors is far less radioactive. However, no commercial reactors operate with thorium today.

Traveling wave reactors. The traveling wave reactor has passive safety features that prevent it from melting down. It uses sodium as a coolant and, for fuel, depleted uranium (U-238), which is produced as a by-product during the enrichment process for U-235, the primary fuel for conventional reactors. This design is being pursued by TerraPower LLC, a private company bankrolled, in part, by Bill Gates.

In mid-2013, the Oakland, California-based Breakthrough Institute published a report called "How to Make Nuclear Cheap," which should be required reading for anyone interested in nuclear technology. What's needed, the report says, is sustained investment in technology, focused on making reactors safer and more modular, so that their components can be manufactured at lower cost. It makes a critical point about the need for more governmental involvement -- to streamline the licensing process for new reactor technologies and to enable innovation in materials science. Government is also needed to provide proper licensing and oversight, as well as insurance.

Jerry Taylor of the Cato Institute has frequently condemned governmental involvement, calling nuclear "solar power for conservatives." It's a funny line. But Taylor ignores the benefits that nuclear energy can bring.

Our future prosperity depends on cheap, abundant, reliable electricity. We should be making a long-term commitment to nuclear because the physics are so favorable. Its power-density advantage cannot be denied.

(This is the last of three excerpts from "Smaller Faster Lighter Denser Cheaper: How Innovation Keeps Proving the Catastrophists Wrong," which will be published May 13 by PublicAffairs.)