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The Atom Option

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Nuclear power is at a curious crossroads. Ever since the accidents at Three Mile Island in 1979 and Chernobyl in 1986, most people have come to see this technology as far too dangerous to contemplate making it a foundation of our civilization. The more practical-minded have bemoaned its high costs. As a result, nuclear power is in decline. Few countries are building new plants these days--Sweden, a pioneer in the move away from nuclear power, is even committed by law to phasing out its existing plants entirely by the end of the decade.

In recent years, scientists have converged on a consensus that the Earth is warming due in no small degree to the emission of carbon dioxide from electrical power plants that burn coal, oil and natural gas. The events of September 11 have added political reasons for reducing dependence on oil. Discussions of the alternatives to fossil fuels generally include windmills, photovoltaics and even hydrogen fuel. Although these technologies hold a great deal of promise for the long term, none provides a way out of our present fix any time soon. And even if they turn out to fulfill their potential in 10, 20 or 50 years (a big if), there's no telling whether they will meet the demand for carbon-free energy that the world is likely to see this century. Nuclear power, that old devil, has become an attractive alternative--and yet it is being written out of most plans for our energy future. Before taking another step down this rejectionist path, it would be wise to stop and consider just what it is we're about to abandon, and whether our reasons for doing so are sound.

The benefits of nuclear power are fairly clear. For one, it does not depend on the weather. And since it is concentrated, it meets a specific need for supplying cities and factories, for which wind and solar are inappropriate. Nuclear plants emit no carbon into the atmosphere and can be built in inaccessible locations. And unlike the infant technology of hydrogen-powered fuel cells, we have 10,000 reactor-years of operating experience, not to mention the lessons of many failures, to learn from. But what about those troublesome drawbacks--catastrophic accidents, nuclear-waste disposal, terrorism and proliferation?

The risk of catastrophe is not as great as most people believe. Even the Three Mile Island disaster released only a small amount of radiation--statistically speaking, resulting in less than one death. Some people may argue that even a tiny amount of radiation is too much. Radiation is indeed harmful, and one ought to take cost-effective measures to reduce all radiation exposure. The death of even one person is too much, but compared with what?

More than a thousand people die each year worldwide from exposure to the radioactive materials liberated in the current style of mining the uranium for the world's nuclear power plants. By contrast, coal-fired power plants kill about the same number of people from the radioactive materials in coal ash used for building concrete, and many times that number from the chemical pollution and fine particulates emitted from the burning of coal. Radiation from medical X-rays kills about 4,000 Americans each year. When you have something beneficial, like nuclear power, that involves the occasional release of tiny amounts of radiation, it simply doesn't follow that an enormous sacrifice is required to reduce that risk to zero.

The Chernobyl explosion was indeed a catastrophe. Fundamental design flaws and incompetent operation allowed the reactor power to surge to thousands of times normal levels, bursting pipes and sending plumes of radioactive steam and burning fuel into the air. All told, about 24,000 people will die from exposure to radiation from the accident. No such violent explosion can happen in a U.S. reactor like Three Mile Island, but even a slight risk of such a disaster is unacceptable. In case of a core meltdown, conventional nuclear reactors depend on the integrity of the containment dome that isolates the nuclear reactor vessel from the environment. To avoid a meltdown, most reactors rely on engineered safeguards--alarms and coolant systems, procedures, blinking red lights and so forth. Some new reactors, however, would rely instead on something much more dependable: the laws of physics. While conventional reactors are so big they can overheat even after they are shut down (just as coals in a fireplace can flare up long after the fire it out), smaller reactors now being developed by South Africa and a consortium of U.S., Russian, Japanese and French firms shut down gracefully. Had such inherent safety features been in place in Chernobyl or Three Mile Island, the loss of coolant would have shut the reactors down harmlessly.

The problem of nuclear-waste disposal is not so much technical as one of mismanagement. Each country is required to dispose of its own waste, which means that countries like Sweden or Switzerland, which have only a few plants, still have to do the research and development and find a local site for disposal. This makes no economic or environmental sense at all. A better solution would be to have competitive, commercial geologic repositories--in stable underground sites like the one in Yucca Mountain, Nevada--that take waste from other countries for a fee. Plutonium does not move significantly in ground water, and if some did ultimately escape it would be readily detected, and measures could then be taken to avoid contamination. A geologic repository would work effectively for at least 100,000 years, after which the fuel would be little more radioactive than the natural uranium from which it was made.

Nuclear-weapons proliferation is a grave risk, but in significant ways it is separate from the risk of nuclear power. A single, moderately sized nuclear power reactor can be used to turn uranium into enough plutonium to make three or four dozen bombs a year. To recognize this possibility is to understand how to solve it. Agreements are in place with the United Nations' International Atomic Energy Agency to ensure that so-called civil plutonium is not diverted to military purposes. It will require constant vigilance and support to make this a reality. Having hundreds or thousands of reactors supplying a large portion of the world's electrical power would not necessarily increase the weapons-proliferation risk.

As for terrorism, one threat to homeland security may now very well be the risk of nuclear plants' being struck by heavy airplanes. Clearly there are near-term solutions--some as simple as strengthened cockpit doors. In the longer term, it may be cheaper to provide security by building the plants underground. With the enormous tunneling machines we have nowadays, this would entail a minor expense.

Embracing nuclear power would be a relatively inexpensive way to reduce carbon emissions. The cost of injecting carbon dioxide from coal plants into underground wells has been estimated at about $100 for each ton of coal. A one-gigawatt coal plant burns about 3 million tons of coal per year, releasing about 11 million tons of carbon dioxide into the air. A tax recovering the cost of disposing of these emissions would imply an emissions "cost" of about 4 cents per kilowatt-hour--largely making up for the greater expense of generating electricity with a current-design nuclear power plant. Given the chance, nuclear power could be a safe and economical alternative source of energy. And we're going to need all the alternatives we can get.