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Wind Power Versus Plutonium: An Examination of Wind Energy Potential and a Comparison of Offshore Wind Energy to Plutonium Use in Japan

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Foreword

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This report is part of IEER's global outreach program on reducing nuclear dangers, and on achieving complete and enduring nuclear disarmament. The energy choices we make will likely shape the environment of the Earth for generations to come. They will also profoundly affect the prospects of reducing proliferation risks, and of achieving stable and enduring nuclear disarmament. No energy-related question is more pressing and more important for non-proliferation and disarmament purposes than the future of plutonium use in the commercial economy.

For over half a century, the nuclear establishment has promised the world energy from plutonium. It was to be plentiful in supply, lasting into the indefinite future and, in the 1950s, even "too cheap to meter." After tens of billions of dollars in research and development expenditures and little to show for it, programs for the use of plutonium must be viewed as failures.

Plutonium is now widely recognized as an uneconomic fuel. It is not even competitive with uranium and is unlikely to be in the foreseeable future. However, its proponents point out, as they have done from the start of the nuclear power era, that once-through uranium fueled reactors use a very small portion of the uranium resource base because they rely mainly on uranium-235, which is only 0.7 percent of natural uranium. The most abundant isotope, uranium-238, which is almost 99.3 percent of natural uranium is almost completely wasted (though a small portion is converted to plutonium and fissioned in the course of reactor operation). Since economically extractable uranium resources are unlikely to be a fuel source for the millennia to come, the

advocates of plutonium point out that the conversion of uranium-238 to fissile plutonium fuel in breeder reactors is necessary for a long-term nuclear future.[1]

The key technology, the breeder reactor, converts uranium-238 (which is not a nuclear reactor fuel) into plutonium (which is). However, breeder reactors have a dismal record, especially given the amounts of resources that have been poured into them. Of the 2,600 megawatts of breeder reactor capacity in the mid-1990s, almost half was in a single reactor in France, Superphénix, which has since been shut. Moreover, the technology needed to separate plutonium from irradiated reactor fuel is in many ways the dirtiest part of the nuclear fuel cycle. It has been responsible for extensive pollution of the seas, rivers, and soil. It has resulted in highly radioactive liquid waste, which must be stored in tanks. Among the problems posed by these tanks is the risk of catastrophic explosions, such as that which occurred in a military high-level waste tank in the Soviet Union in 1957, and there was an electrical power failure at the French reprocessing plant at La Hague in 1980 that could have resulted in disaster but fortunately did not. Moreover, plutonium fuel use puts weapons-usable plutonium into circulation in the commercial economy, increasing proliferation dangers.

Plutonium is not the only fuel that can provide energy for the indefinite future. Wind and solar energy are two obvious alternatives to it. Even advocates of nuclear power admit their environmental and security advantages. However, advocates of nuclear energy have long argued that these are not economical. This is a specious and misleading argument on several counts. Plutonium is not economical - in fact, costs have gone up over time. Moreover, improvements in technology have made wind energy economical in some circumstances already. In addition, breeder reactors are not even a sound energy strategy for energy independence, as our analysis shows.

The relevant question for the long-term energy future is not whether wind, solar, or plutonium are economical now, but how we can arrive at an energy future that is environmentally sound, economically viable, and addresses the problems of greenhouse gas build-up and proliferation concerns all at the same time. This study does not address the whole complex of the issues involved, but rather one component - is it sensible at all to invest in plutonium as a long-term energy resource given that wind power is commercial in some circumstances and can be made widely commercial in the foreseeable future?

In comparison to plutonium, renewable energy sources have received a far smaller share of public resources for technological development despite the evident superiority on environmental and non-proliferation grounds. Wind power has no routine emissions and no long-lived radioactive wastes, for instance. One result has been that the development of renewable energy sources has been slow and halting. However, the total amount of wind power is still very small both in relation to its potential and as a fraction of total electricity generation. Nonetheless, in the last two decades, significant improvements have been made. In the 1980s, the first major wind farms were built in California, and in the 1990s, wind power developments have been significant in Denmark and Germany. Denmark has made a major difference to the development of wind power technology through its ambitious and long-range commitment to it. The industry is evolving and improving rapidly, especially since the early 1990s. One of the major constraints on wind power development, the large amount of land required, is now being loosened by the

development of offshore wind power plants. Sweden, Denmark, and Holland have been trying them out since 1990, with good results. Again, Denmark has the best-developed plans for expansion.

Our case study was on plutonium fuel use in nuclear reactors for Japan, which has among the most ambitious plutonium programs in the world. Moreover, the land constraints in Japan are severe and the land-based wind power potential is relatively low.

We decided to compare the costs and electricity generation potential of using plutonium as a fuel with those of offshore wind development in Japan. The basic purpose of the comparison is to explore a long-term energy source for Japan and to discuss a short- and medium-term investment strategy that derives from that analysis. For the long-term analysis we compare the use of breeder reactors with plutonium recovery to wind energy, based on costs that are roughly comparable to those that currently prevail. While the costs of breeder reactor technology and associated reprocessing may decline, this is not at all assured; nor can such a trend be discerned from past development of this technology. On the other hand, there is a clear trend toward lower costs of wind energy. Thus, a comparison based on approximate current costs yields results that are biased against investment in wind. Despite this, our analysis clearly shows the desirability of long-term investment in wind energy.

The short- and medium-term analysis that is needed in such a situation is to compare the benefits that can be derived from the development of wind power compared to plutonium programs over the same period. These involve the use of plutonium fuel as a fuel in current light water reactors, which is the transitional plutonium use strategy that has been adopted by France, Japan, and others. [2] The fuel consists of a mixture of a few percent of plutonium dioxide mixed with uranium dioxide, called MOX fuel . Were the short- and medium-term economic benefits of MOX fuel use relative to wind overwhelmingly great, an economic argument could be made for the development of wind and plutonium technologies in parallel. But this is not the case. MOX fuel carries high costs as well and environmental and proliferation liabilities that are not shared by wind technology.

The results of our research point clearly in the direction of offshore wind energy development for Japan. Based on preliminary survey of the literature on the subject, offshore wind potential could also be similarly developed in many other countries, including those that now have large plutonium programs: Britain, France, and Russia. Of course, due to their large land area, land-based wind energy may be a better choice for Russia and several other countries that were formerly part of the Soviet Union.

In 1952, the Paley Commission, appointed by President Truman, judged the promise of renewable energy sources to be greater than that of nuclear power for meeting energy needs and preventing economic dislocations due to disruptions in foreign oil supply. But shortly thereafter, the US government chose to ignore that recommendation in favor of pursuing nuclear power, largely as part of its Cold War propaganda campaign. [3]

It is well past the time when Cold War dreams of plutonium as a "magical" energy source should have been abandoned in favor of renewable energy sources. I hope that this study will spur Japan

as well as other countries to vigorously pursue wind energy. The same level of resources as have been expended on plutonium energy are not likely to be required, since wind energy is already commercial relative to plutonium in many locations. But the same determination will be needed. It will also require some political courage to put aside the pork-barrel claims of the plutonium establishment, which has had an unduly large claim on the public purse for over fifty years and still exercises a high level of bureaucratic influence in several countries.

A word is warranted here about recent developments in Germany. The new German coalition government of the Social Democratic and Green parties has decided to phase out nuclear power. In conjunction with this decision, they will terminate reprocessing as a method of waste management and the use of separated plutonium as a fuel source. Germany's decisions regarding reprocessing may well be the harbinger for a thorough reassessment of the plutonium commitments by other countries. Following on the heels of the German decision, Switzerland, another country that uses MOX fuel, also announced a decision to phase-out nuclear power and use of plutonium for energy. Neither country has settled on a timetable as yet

As a result of the German decision to stop reprocessing, Japan will become by far the largest foreign customer for French and British reprocessing services. A decision by Japan to develop wind energy instead of plutonium could play a big role in convincing the British and French to end their own uneconomical commitment to this fuel.

The rapid developments in favor of wind energy and against plutonium as an energy source come at a time of an urgent need for new electrical generating capacity designed to reduce carbon dioxide emissions. Our analysis shows that one essential component of investment in long-term energy sources should be wind energy and specifically development of offshore wind resources. It is time to leave plutonium behind in the century in which it was created and stop throwing good money after the enormous amount of public resources have already been wasted on it.

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ENDNOTES

1. The argument for the conversion of non-fissile thorium-232 into fissile uranium-233 is about the same as that for converting uranium-238 into plutonium, with the difference that the practical utilization of thorium-232 has faced even greater obstacles than plutonium.
2. MOX fuel use in light water reactors is not a suitable strategy for using most of the uranium resource base. This is because repeated recycling of plutonium in these reactors degrades the isotopic composition of the plutonium. Isotopically-degraded plutonium eventually becomes unsuitable for use as a fuel.
3. Paley Commission as cited in Makhijani and Saleska 1996.