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Statement of Marc Fioravanti on Wind Energy Versus Plutonium
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Renewable energy sources have been pointed to as a solution to society's energy needs for decades. The Paley Commission of President Truman called attention to the need to invest in renewable energy back in 1952. Decades later, however, solar energy resources provide a tiny fraction of commercial energy use.

The situation for wind energy has begun to change dramatically in just the last few years. Advances in electronics and design of wind turbines have brought costs down steadily since the first "wind farms" were constructed in California in the 1980s. Worldwide, some 2,100 megawatts of new wind capacity was installed in 1998, increasing total world capacity by more than 25 percent compared to 1997. In Denmark, eight percent of the annual electricity needs are met by wind power, and the Danish government has announced ambitious plans for wind energy to supply 25 percent of total energy demands by the year 2030, as part of a program to reduce carbon dioxide emissions by 50 percent relative to 1988. Denmark has become a leader in wind technology as a result of its farsighted plans, but other countries are taking significant action as well. Wind energy could play an important role in the energy supply of many countries, including those that have large greenhouse gas emissions - namely western European countries, the United States, China and Russia.

Importantly, it is now possible to economically tap large offshore wind energy resources. Offshore wind turbines have been operating in Europe since 1991, with good results. Extra costs for larger and more reliable turbines are offset by stronger, less turbulent winds over the seas. Offshore wind potential is also substantial and in some countries, such as Japan, could play a role in wind energy supplies.

We completed a case study of Japan, which is pursuing a long-term energy strategy based on energy from plutonium. It does not have significant plans to develop its wind resources. In the near-term, Japan plans to use plutonium in mixed-oxide fuel in current light water reactors, and in the long-term, Japan plans to use plutonium in breeder reactors. The situation for plutonium in Japan relative to wind power is about as favorable as it can be since Japan has a limited land area on which wind power development is possible. But our study concludes that even today, given

developments in offshore wind technology, wind energy is much more economical than the use of plutonium as a fuel in Japan's nuclear reactors

In the near-term, we propose an aggressive strategy to replace the use of plutonium in mixed oxide (MOX) fuel with wind energy - most of which will likely be installed offshore. The current plutonium program calls for initiating MOX use in 2 reactors in 1999 and 16 to 18 reactors in the year 2010. Specifically, we found that a little more than 12,000 megawatts of wind capacity installed over the next ten years could generate as much electricity as Japanese power companies expect to generate by using MOX fuel. Moreover, we found that wind electricity can replace MOX fuel use and save money - on the order of hundreds of millions to a couple of billion dollars. The wind targets are ambitious for Japan, which does not have a mature wind industry comparable to Europe's, but they are nonetheless achievable. Our proposal for wind power in Japan in the year 2010 are one-third to one-fourth of the proposed level of wind energy development by American and European Wind Energy Associations for the same year.

Wind energy is also more favorable than plutonium as a fuel for the long-term. Breeder reactor technologies, on which long-term plutonium scenarios rest, have been the subject of billions of dollars of development - around $10 billion in the Superphénix reactor alone - but have little to show for it. Our estimates of the electricity cost for breeder reactors is 11 ¢ per kilowatt-hour, possibly more. In comparison, offshore wind energy costs are projected to be less than 6 ¢ per kWh based on optimizing current technology for offshore conditions. Furthermore, there has been a clear trend toward downward costs for wind energy, while no such trend exists for breeder reactor technology. Even with added costs that may be necessary to accommodate the intermittent nature of the wind, such as energy storage or use of hydrogen as a fuel, the wind energy option is economically more attractive.

Wind energy development does need to proceed carefully. Wind turbines may affect marine or bird life. The environmental impacts of wind power should be carefully addressed during planning stages, and during operation, monitoring of environmental systems should take place as a matter of course. Environmental impacts of wind power, however, are clearly far lower than those of plutonium fuel use. Not only have radioactive discharges from plutonium processing facilities in the United Kingdom and France contaminated marine life and endangered human health, but the residual high-level waste will be a burden for generations to come.

The worldwide potential of wind energy and recent advances in technology, such as larger, more reliable turbines and offshore wind power platforms, have made electricity from wind far more economical in the near-term and much more promising in the long-term than plutonium. In both time frames, not only is wind energy more economical, but it also does not present environmental or nuclear proliferation problems that are inescapable with plutonium processing and use. Wind energy should now be considered as a practical long-term energy resource.

As such, public policies need to be geared to promoting wind energy to realize its potential and decrease the cost. We have evaluated a number of policies and proposals for introduction of wind energy. In view of United States commitments to the Kyoto Protocol and the need to move in the direction of a sustainable energy supply, we recommend that the government initiate a program to purchase 1,000 megawatts a year of wind capacity at least until the year 2010. These bids

should require guaranteed performance over a specified period of time, at least 15 to 20 years. The competitive nature of this program would systematically reduce the cost of wind electricity. We also recommend that similar programs should be put in place for other renewable energy technologies; taken together, they would form a substantial part of a comprehensive approach to decreasing the costs and increasing the use of renewable energy.

We make several specific recommendations in the report.

1. Japan should end its program for generating electricity from separated plutonium, including its MOX program for light water reactors and its breeder reactor program.
2. Japan should immediately begin serious evaluation of offshore wind energy resources and start programs in favorable locations. It should aim to generate enough electricity from wind to replace the projected energy generation from plutonium fuel through the year 2010.
3. The International Energy Agency and the United Nations Environment Programme, in collaboration with other agencies such as the World Meteorological Organization, and national governments should undertake a comprehensive survey of global offshore wind potential.
4. Government policies should be aimed at creating a predictable and significant market for wind energy, including offshore wind energy, given the need to reduce greenhouse gas emissions.
5. Offshore wind energy projects that are undertaken should have significant components that would evaluate their environmental impact on marine ecosystems.