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Clean Energy, Guaranteed:
Why Nuclear Energy Is Worth the Cost

by Andrew C. Klein

Last month, President Obama announced $8.33 billion in loan guarantees for the construction of two nuclear reactors in Georgia — the first to be built in the U.S. in more than 30 years. That announcement followed the president's proposal to triple nuclear loan guarantees to $54.5 billion in his latest budget. If there had been any doubt about the administration's support for nuclear power, the president's actions in recent weeks should dispel them.

Obama's pro-nuclear approach has displeased some of his allies in the environmental community. Erich Pica, president of Friends of the Earth, which endorsed Obama in the 2008 election, told the *New York Times* recently, "We were hopeful last year; he was saying all the right things. But now he has become a full-blown nuclear power proponent, a startling change over the last few months."[1]

But the president's advocacy for nuclear energy shouldn't disappoint progressives. Over the past few years the need to significantly reduce the emissions of carbon into the atmosphere has become generally accepted. This can only be accomplished if we replace large amounts of carbon-emitting electricity generated by coal with low- and non-emitting sources. While renewable sources like wind and solar power will no doubt play a greater role as we move beyond fossil fuels, we are still decades away from scaling up those sources and upgrading the grid to meet our base load electricity requirements. In light of our electricity needs, nuclear power must be a part of our energy future.

Nuclear currently makes up about 20 percent of our electricity usage and 70 percent of non-carbon-emitting electricity generation. To increase the fraction of non-emitting sources to displace fossil fuel-based power, we need to build new nuclear power plants, as the industry already is producing at more than 90

About the author

Andrew C. Klein is a professor of nuclear engineering and radiation health physics at Oregon State University.

percent capacity in the existing 104 plants in the U.S. today.

Building new nuclear plants is an expensive proposition, however. Indeed, the cost of building new plants is one of the primary criticisms leveled against nuclear power. But as this policy memo demonstrates, while cost is a problem, it is not an insurmountable one. The cost factor is certainly no more onerous for nuclear than it is for solar and wind. To their credit, proponents of clean energy have refused to let the high cost of scaling up renewables prevent them from continuing to push for such projects. Why then do so many clean energy proponents insist on crossing off nuclear from the energy mix by pointing to its costliness?

If we really are serious about creating a post-carbon future, solar and wind need to play a prominent role — but so does nuclear. Sure, nuclear plant capital costs are high, but nuclear plants have an advantage, in that their fuel costs are low, well understood and stable.

Solar and wind have the same economic and greenhouse gas-reducing characteristics as nuclear, with one very important difference: scale. Renewables come in very small unit sizes. The largest wind turbines have a capacity of no more than two to three megawatts, requiring the use of many, many individual turbines in a farm configuration. Nuclear plants come mostly in large sizes, with each plant producing up to 1,700 megawatts. A wind turbine rated at one megawatt of electrical capacity can provide enough electricity to power up to 300 homes for one year — and that's when it's generating electricity when the wind blows, which is the case about one-third of the time.[2]

Compare that with a nuclear plant, which produces electricity better than 90 percent of the time, and can produce exponentially more power than a wind farm. A single nuclear plant rated at 1,700 megawatt capacity can provide power for a year for 1,258,000 homes per year.

Why Costs Are So High

The administration's announcement of new loan guarantees for nuclear power underscores the reality that building nuclear plants is an expensive enterprise. Seventy percent of the cost of nuclear energy lies in upfront construction costs, while only 20 percent are in operations and maintenance and 10 percent goes toward fuel.[3] Compare that to coal and natural gas, whose upfront costs are lower but whose fuel costs are considerably higher, and even more so when carbon is priced under a cap-and-trade regime.

The difficulties in building new nuclear plants are driven largely by the uncertainty surrounding the costs associated with large infrastructure projects. There are four primary causes for the high cost of assembling new nuclear plants:

- **Nuclear plants are some of the largest capital construction projects that exist today.** A new nuclear power plant requires a significant amount of specialty materials and equipment that require well-established pedigrees to guarantee the highest standards of quality and safety.

- **Relatively long periods of time are needed to design, license and construct large facilities.** Schedules are also affected by uncertainties related

to delays that plague construction projects. As the U.S. hasn't built a plant in three decades, the supply chain for highly specialized materials has atrophied — a factor that also compounds the problem.

- **High interest rates on borrowed money.** Interest rates for nuclear projects typically carry an added premium to account for the uncertainty arising from missed construction deadlines and budget overruns that occurred during the construction of some nuclear projects in the late 1970's and early '80s.

- **Economies of scale have driven both reactor equipment suppliers and their potential customers to ever larger — and more exorbitantly priced — plants.**

To hear critics of nuclear energy tell it, nuclear is simply too expensive a clean energy option for the U.S. But solar and wind projects are actually more expensive on the basis of cost per unit of electricity delivered. Without significant tax incentives, loan guarantees and power purchase requirements that have been given to developers of wind and solar farms to spur their growth, it is highly unlikely that we would have seen these large land-use icons pop up around the country.

The U.S. Energy Information Administration (EIA) recently released their estimates of average levelized capital costs of electricity for new plants entering service in 2016._The EIA's estimate took into account construction costs and time, operating and fuel expenses, and the costs of financing. The total system levelized cost for nuclear power was $119 per megawatt-hour (in 2008 dollars). That was lower than the estimate for wind ($149.3), offshore wind ($191.1), solar thermal ($256.6) and solar photovoltaic ($396.1).[4] (See table, next page.)

One edge that nuclear has over solar and wind is its reliability. Currently, solar and wind suffer from the problem of intermittency — when the clouds come out or the winds die down, power stops being generated, which requires gas-powered backups and development of more advanced storage technology. Nuclear, on the other hand, produces 24 hours a day, 365 days a year, and is largely immune to daily and seasonal weather changes.

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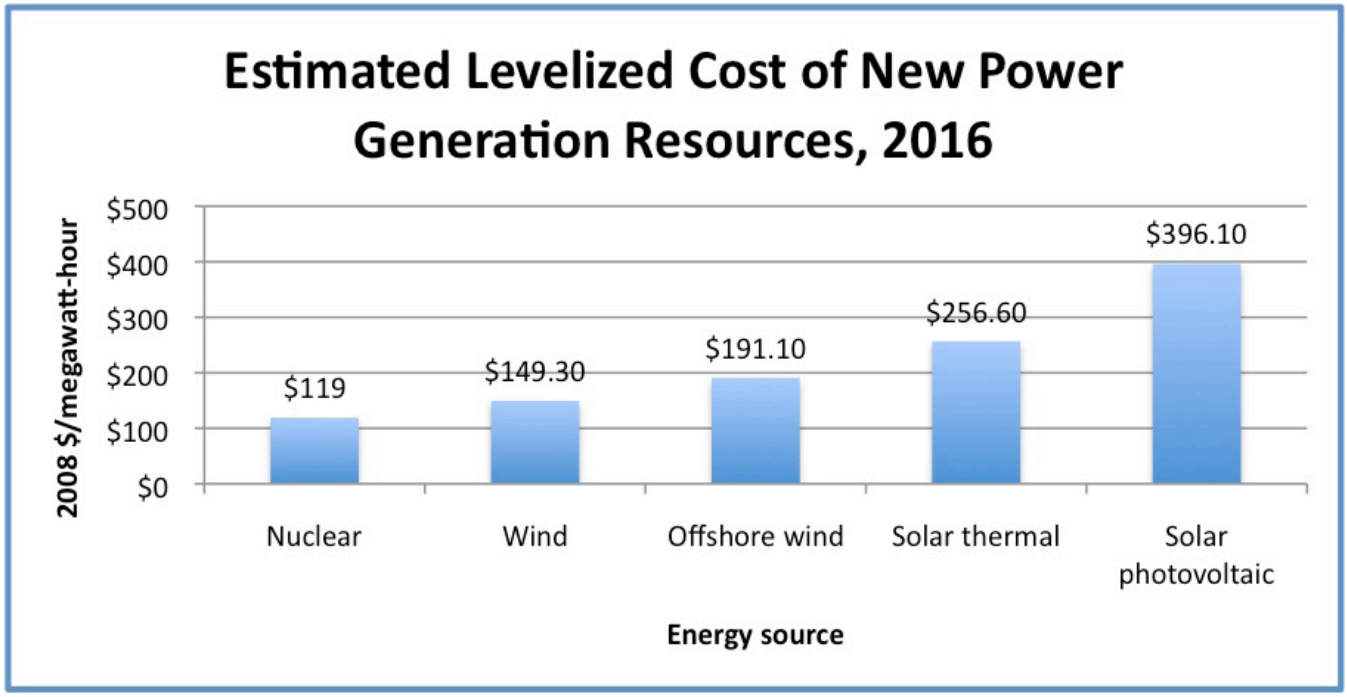
Moreover, nuclear has met the test of longevity. The upfront costs may be high, but nuclear plants stand for a long time. Nuclear reactors typically receive operating licenses of 40 years from the Nuclear Regulatory Commission. But nearly half of the country's 104 reactors have received extensions for another 20 years of operation, and there is a reasonable expectation that almost all reactors will eventually be granted 20-year extensions by the agency.[5]

What to Do About Costs

No more expensive in key cost metrics compared to solar and wind power, nuclear energy must be considered part of the energy mix if we are to move beyond fossil fuels. Solving the cost issue is central to



Source: Energy Information Administration

making nuclear a key part of our energy future.

There are several potential answers here:

- An expanded federal loan guarantee program to address the problems of long development times and cost. With the Obama administration's tripling of the loan guarantee program in its 2010 budget — to $54 billion — and the announcement of $8 billion in loan guarantees for the completion of two new plants in Georgia, it's obvious that the administration understands the importance of loan guarantees to jump-start our nuclear industry. Now Congress needs to follow the administration's lead and provide these funds.

  Expanding the loan guarantee program to spur a larger number of projects sends a significant signal to the industry that the federal government is serious about nuclear energy. Note that a loan guarantee isn't the same as a subsidy. All that a guarantee does is put the government on the hook in case the utility is unable to repay the loans they took out for the project. The government, by guaranteeing the loans, is merely greasing the wheel for nuclear construction projects to be funded by private banks. It should also be noted that the utilities pay a premium to have this insurance — a so-called credit subsidy cost to cover the government's long-term liabilities.

  Past troubles with nuclear construction projects, most notably the bond defaults in Washington State in the early 1980s, were caused by rapid overexpansion by power companies that predicted that electricity demand would grow, as it had for decades up to that time, at seven percent per year. When actual demand rates fell far short of that historical target (more like one-to-two percent per year), many large nuclear construction projects were simply

not needed. Electricity demand continues to grow, even now, just at a slower rate. The current risk of default is considerably reduced as both construction advances and load growth are much better understood now than they were in the late 1970s and early '80s.

- The way nuclear plants are built also contribute to their enormous costs. When plants were built in the 1970s and '80s, they were constructed with designs that were specific to their locations. In other words, there was no standardization of plant design. More than two decades later, we now know we can do better — and cheaper. Design simplification, modularization and factory construction rather than onsite construction should be central to any effort to cut nuclear plant construction costs. Designing plants in a way that minimizes the need for high-cost materials — without sacrificing safety and quality, of course — would also contribute to making plants less expensive. By standardizing the way plants are built, we can make the process of construction much more efficient and less prone to mistakes and delays that have hobbled previous projects.

- Having utilities build smaller reactors could also help. Too often, utilities take on large nuclear projects that start out with an astronomical price tag. Even small budget overruns and construction deadline delays become high-cost items in their own right. Smaller reactors are viewed by lenders as lower-risk investments, which could make it easier and cheaper to finance such projects. There are a number of companies now developing and marketing designs at small capacity. If they can prove their concepts to both the Nuclear Regulatory Commission and potential utility buyers and investors, it could prove to be a game-changer in the nuclear renaissance.

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- We should also consider public ownership or majority-interest construction, similar to the large water projects of the 1920s and '30s that saw the federal government build the Tennessee Valley Authority, the Bonneville Power Authority and other entities to provide electricity for the public good. To this day, the government still manages and operates TVA and other similar projects. Indeed, this may be the only possible pathway for construction of large-scale nuclear power plants in the U.S. It already is the path that is being used in other countries.

If the Rest of the World Can Build Nuclear, Why Can't We?

As we have engaged in a political tug-of-war over whether to make nuclear energy a part of our energy future, other countries have moved ahead with construction and financing their own nuclear plants. China, France, Russia, Finland, Japan and South Korea are all building plants using domestic knowledge and resources with the intent of building more plants both domestically and globally. Many

of these countries are using government funds or incentives to achieve faster construction times and less investment risk.

Even those that are using private funds to build new large nuclear projects have a close working relationship with their governments, which makes construction times and, ultimately, costs more manageable. They undertake their projects secure in the knowledge that each new completed plant only adds to their understanding and mastery of nuclear technology.

Moving up the learning curve for nuclear financing and construction are important steps that the U.S. needs to take now. We cannot abandon the technology simply because of uncertainties in financing new construction. We have already fallen behind and ceded global leadership in this important technology — one that we pioneered — to others. Other countries have proven the capability and capacity to build nuclear projects on time and on budget. There is no reason we can't do the same.

Conclusion

Nuclear energy is simply too important a technology for the long-term health of the planet for us to ignore. The cost problem is real — but it is not without solutions. Considering how badly we need to begin reducing carbon emissions immediately, the continuing efforts by some progressives to throw nuclear out of the energy mix — even as they support less reliable and just as costly renewables — is discouraging.

At least the Obama administration is moving in the right direction. As the U.S. embarks on a revival of its nuclear industry, progressives should rethink their long-standing opposition to nuclear power. To free ourselves from coal's grip, we cannot leave any fuel behind. President Obama's push for nuclear is exactly the kind of pragmatic, progressive approach to addressing climate change and clean energy that deserves our support.

Andrew C. Klein is a professor of nuclear engineering and radiation health physics at Oregon State University, where he previously was department head and director of the OSU Radiation Center. For the past four and a half years, he was on loan from OSU to the Idaho National Laboratory as director of educational partnerships. He holds a B.S. from Pennsylvania State University and M.S. and Ph.D. from University of Wisconsin, Madison, all in nuclear engineering.

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Progressive Policy Institute
1730 Rhode Island Avenue NW
Suite 308
Washington, DC 20036

Tel 202.525.3926
Fax 202.525.3941
Email info@ppionline.org
www.progressivefix.com