

Interactive tool lifts veil on the cost of nuclear energy

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A nuclear cost calculator developed by the Bulletin of the Atomic Scientists uses real data to provide information about the economic costs of nuclear power.

Credit: Bulletin of the Atomic Scientists

Despite the ever-changing landscape of energy economics, subject to the

influence of new technologies and geopolitics, a new tool promises to root discussions about the cost of nuclear energy in hard evidence rather than speculation. Over the last two years, the *Bulletin of the Atomic Scientists* has developed the [Nuclear Fuel Cycle Cost Calculator](#), an online interface that provides a nuanced look at the economic costs of nuclear power.

Built with significant funding from the MacArthur Foundation, and in collaboration with Prof. Robert Rosner and a team of researchers, the calculator provides a simple gateway into the physics-laden universe of nuclear economics.

A user can slide more than 60 moving scales to tweak inputs like uranium price or reactor construction time, and then watch the expected price shift. Spending time with the interface gives insight into costs in the field of [nuclear energy](#), where building a new reactor can have a greater impact on energy cost than a spike in the price of uranium. The calculator also projects the costs of recycling versus disposing of spent nuclear fuel—a subject hotly debated among energy experts—and reveals that, when all costs are added in, recycling fuel results in consumers paying more per kilowatt hour.

"It's completely transparent. You push a button, and out comes the answer," said Rosner, the William E. Wrather Distinguished Service Professor of Astronomy & Astrophysics and Physics, and a faculty member affiliated with the Chicago Harris School of Public Policy.

Less transparent are the years of rigorous scientific effort underlying the project. Rosner worked with a team of nuclear engineers to develop the mathematical model at the calculator's core when he was director of Argonne National Laboratories. The model captured the fluid relationships among variables that determine the price of nuclear energy in three different fuel cycles—that is, whether the nuclear fuel is

disposed of, partially recycled (also called "mixed oxide," or "MOX") or fully recycled—revealing that the special materials and processes needed to recycle fuel come with high prices that are ultimately borne by energy consumers.

But beyond simply breaking down costs, the model provides an economic rationale against practices that Rosner and other scientists worry could raise the risk of nuclear materials landing in the wrong hands. Their concern is with plutonium, a prime nuclear weapons material that, due to its low-level radiation, is especially susceptible to theft. In a MOX fuel cycle, plutonium left over from previous nuclear reactions is not disposed of, but instead combined with uranium. The full-recycling process requires special reactors that can be turned into what Rosner calls "plutonium factories" with slight modifications to the design.

Building the calculator

The calculator comes at a pivotal time. "As countries around the world assess their energy needs and consider reprocessing spent fuel, it is crucial that they and we understand the costs of such decisions, which can have dangerous consequences," said Rachel Bronson, executive director and publisher of the *Bulletin of the Atomic Scientists*. "The Bulletin was delighted to support Prof. Rosner's research and provide a platform for this important and unique calculator."

Two years ago Rosner mentioned the project to Lect. Kennette Benedict, senior fellow at the Energy Policy Institute at UChicago, who was serving as director of the Bulletin at the time. "She thought it would be really interesting if we could put this on the web in some way," Rosner recalls. Yet to anyone without an expert knowledge of energy economics, the model was inscrutable—a web of bizarre terminology and mathematical notation. Bringing it to a wider audience would require

designing a responsive web interface, they realized, with data presets to give users a reliable baseline.

That was when Jeremy Klavans, MPP'14, got in touch. Klavans, who was focusing on energy and environmental policy at Chicago Harris, was looking to lend his expertise to a project with a concrete impact. When Rosner offered to bring him on as the calculator's data guru, Klavans accepted.

"The idea was to first find verifiable data," Klavans recalls. "We wanted to see if, once we put those prices into our model, we got something reasonable and in line with actual energy costs." But proprietary information from [nuclear power](#) companies was difficult to come by, and finding estimates required grit on Klavans' part. "It was just a never-ending task," Rosner recalls. By reaching out to contacts at the Department of Energy and other universities, Klavans was able to piece together the necessary data, using confidence intervals to account for numbers he couldn't verify directly.

Once the team acquired the data, the next challenge was to create an interface that would work on the web. Yet within that challenge was a welcome opportunity, said Bulletin editor John Mecklin, who oversaw the calculator's digital presentation. "Nuclear [energy](#) is something that's been kept in the realm of magic for a long time," he said. "Nuclear power is no longer magic. It's 70 years old."

Computer programmer Sam Olofin, SM'08, was brought on board to craft Rosner's mathematical model into an accessible, user-friendly tool. Rosner "wanted it to appeal to experts as well as interested high school kids," Olofin recalls. Olofin rose to the occasion, said Rosner, creating an intuitive interface that wouldn't bog down a user's browser.

The calculator went live at the beginning of June. Right away, it spurred

a vibrant dialogue. "It's split between people who can't believe it—asking, 'Did you include this?'—to top experts who want to discuss details," said Mecklin.

The calculator promises to keep that dialogue rooted in hard data, as readers of all policy stripes must acknowledge the economic realities that the [calculator](#) lays bare. "It's completely consistent with the UChicago approach, which is, 'Let's do things on a fact-based basis,'" Rosner said with a smile. "Let's not make it up."

Provided by University of Chicago

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