Small nuclear reactors, funded by investors like Bill Gates, are emerging in the US as cheaper, safer alternatives to traditional nuclear power plant designs. (Cedric Joubert - AP)

THIS NEW TECHNOLOGY COULD SAVE THE TROUBLED NUCLEAR POWER INDUSTRY

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The future of the nuclear industry may happen somewhere on scenic but relatively isolated land that's about 100 miles southwest of Yellowstone National Park. Amid the 890-square-mile Idaho National Laboratory campus, a plan is in motion to build a type of nuclear reactor unlike any that's currently in use to produce electricity.

The plan belongs to Utah Associated Municipal Power Systems, a consortium of 45 municipal agencies looking to replace their aging coal-fired plants. It won approval from the US Department of Energy earlier this year to scope out a site at the lab to analyze the environmental and safety impacts of what's called the small nuclear reactor. If all goes well, the consortium plans to build a power plant there with 12 reactors totalling 600 megawatts in capacity.

The analysis is crucial for determining whether there's a strong business case for building small nuclear reactors. The emerging technology is meant

to create cheaper and safer nuclear power plants. Nuclear power plants emit no emissions, but existing designs have become too costly to be a popular solution for climate change. The new technology has gotten significant funding from investors such as Bill Gates.

The Utah group isn't alone in investing in the new technology. In May, the Tennessee Valley Authority, which supplies power to nine million people in seven southeastern states, became the first utility to apply for a permit from the Nuclear Regulatory Commission to build a small nuclear reactor.

The name of the technology gives a good clue to its distinguishing characteristics. Unlike other nuclear reactors that usually produce about 1,000 megawatts of carbon-free electricity, the small modular reactors, like the ones Utah is planning, are designed to be a fraction of the size at 50 to 300 megawatts. Rather than using electrically operated pumps and motors to circulate coolant and keep the core of the nuclear reactor at a low temperature, as happens in traditional plants, small reactors use no pumps and motors and instead rely on passive means such as gravity and conduction to cool the reactors.

The compact size and other new improvements, including the ability to assemble all the components in a factory rather than on a project site, in theory make the small modular reactors much cheaper to build than traditional nuclear power plants that cost about $10bn and take a decade to secure permits and build. At a time when many existing nuclear power plants are struggling financially from competition from low natural gas prices and subsidized wind and solar projects, the nuclear industry sees hope in this next-generation technology.

"From an investment standpoint, this makes it easier to do because you don't have to put all the money up front; you can stagger when you build them," said Gene Grecheck, a former president and the current co-chair of a policy advisory committee at the American Nuclear Society, which represents engineers and scientists. Grecheck said scientists are studying other ways to improvenuclear technology.

"There is also a lot of research going on for advanced reactor concepts to take used fuel and reprocess it to reduce [the spent fuel] even more dramatically," he said.

Startup companies working on using spent uranium fuel include the Bill Gates-backed TerraPoweras well as Transatomic and Terrestrial Energy. Another start up, Oklo, seeks to create 2-megawatt reactors that fit inside shipping containers to provide electricity for remote off-grid locations.

Many small nuclear reactor companies have yet to line up customers. One exception is Oregonbased NuScale Power, whose technology has been tapped for the project by the Utah consortium in Idaho.

NuScale plans to apply for certification from the US Nuclear Regulatory Agency later this year, a step that all nuclear engineering firms must take before their designs can be used to build power plants. The company expects the agency to approve the design by 2020 if the permit process goes smoothly, said Mike McGough, NuScale's chief commercial officer.

McGough said NuScale has currently spent "a little over" $30m on testing ahead of its NRC submission, and if the design is approved, the company expects construction costs to be less than $3bn for the first 12 modules.

Comparatively, the Southern Company's 2,200-megawatt Vogtle Power Plant, being built in Georgia, is expected to cost $8bn just for its roughly 46% share in the project.

Even if the small reactor remains within estimated costs, it will be pricey, at least initially, next to subsidized wind and solar. The US Energy Information Administration estimates the cost of constructing and operating power plants averages $50.90 per megawatt hour for wind and $58.20 per megawatt hour for solar. NuScale estimates the same type of cost for the first batch of small modules will be about $101 per megawatt hour. Like solar and wind, McGough said he expected the prices would decrease over time as more utilities build small nuclear reactors. The Utah consortium is pegging the cost at $85 per megawatt hour, a lower estimate because city governments can borrow money at cheaper rates, Webb said.

The Utah consortium, like power companies across the country, is under increasing pressure from state and federal regulations such as the Clean Power Plan to cut its emissions. Nuclear fits that need, but the size of traditional plants is too big, said LaVarr Webb, spokesman for the Utah consortium. NuScale's design is much more appealing. "That way we buy based on what our needs were, which makes a lot of sense," he said.

Plus, Webb said, the small reactor design eases the challenge of using nuclear power to complement the group's intermittent renewable energy sources, such as wind and solar. Current nuclear plants are designed to produce electricity without interruption; adjusting the levels of energy output quickly in response to any sudden increase or drop of renewable energy generation is difficult to do. Small reactors can operate independently, allowing a plant to vary its output more dynamically, McGough said.

The Utah consortium will hire Washington state-based Energy Northwest to operate and maintain its 12 reactors in Idaho if they are built. The Utah group expects the project to come online by 2024.

The initial high prices mean these tiny nuclear reactors will likely be built in the near future in states that allow utility monopolies, such as California, Utah and Washington. Utilities in those states need to win state approval for charging customers higher rates to pay for the new power plants, but they don't have to worry about competition.

Mike Pasqualetti, senior sustainability scientist at Arizona State University's School of Geographical Sciences and Urban Planning, isn't convinced the world needs this technology. These new plants may be cheaper to build in theory than conventional nuclear projects, but it delays the transition to a more sustainable future in which 100% of the US' electricity needs come from renewable sources and energy storage, he said.

"Small scale nuclear has advantages to it, but there's still waste. Are they safer? Probably. Are they cheaper to build? Probably. Do we have any experience doing it? Not really," Pasqualetti said.

While active research is in place to reduce the complexity of building and operating nuclear power plants, there's a long way to go in making this source of energy an important solution for fighting climate change, said Dan Bakal, head of the electricity power research organization Ceres, a nonprofit sustainability advocacy group.

"If we get to a breakthrough there, that could lead to [new plant construction]. Right now I wouldn't be betting a lot on that," Bakal said.