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Nuclear fusion group calls for building a pilot plant by the 2040s

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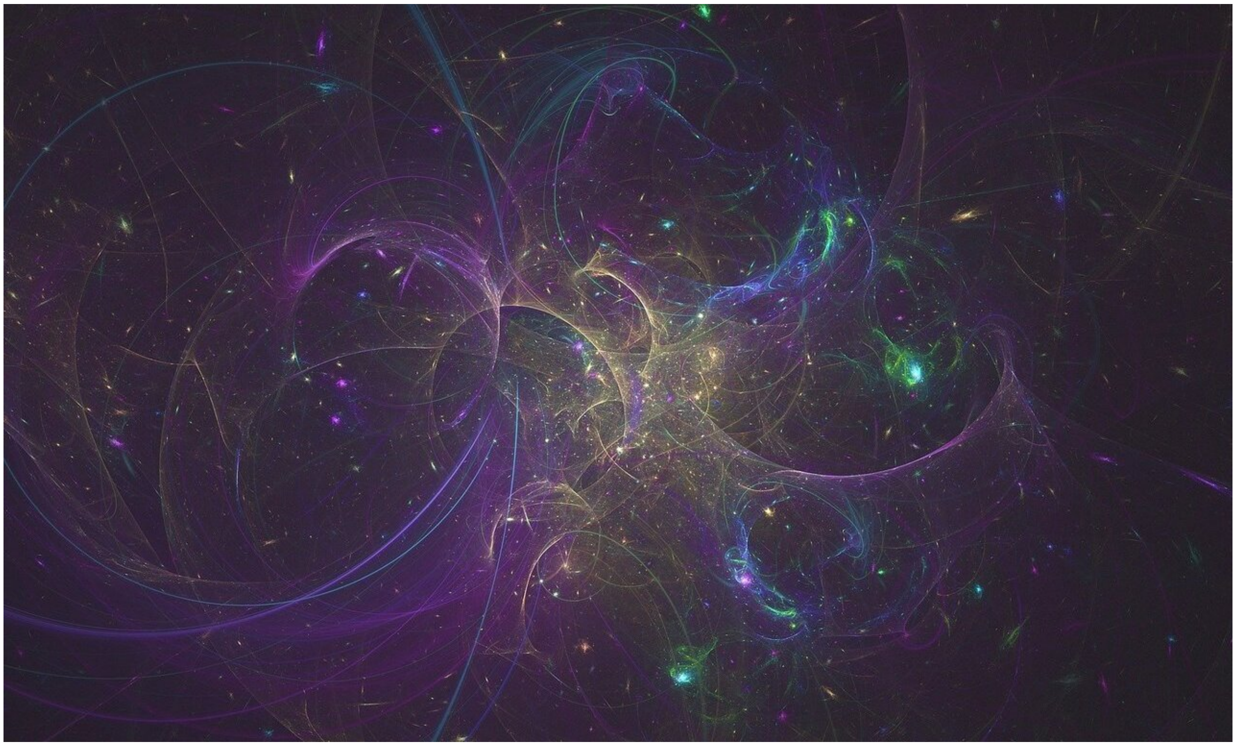

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The main criticism about nuclear fusion has been that its vast potential as a commercial source of energy has always been just out of reach.

But a group of the nation's top fusion scientists and researchers just issued a report to the Department of Energy that calls for the U.S. to build a fusion pilot plant by the 2040s. The 80-page report, written by the Fusion Energy Sciences Advisory Committee, was two years in the making.

"What really emerged strongly from this is a real sense that the fusion energy science portfolio should really pivot towards an energy mission and the realization of that mission is the development and operation of a fusion pilot plant in the 2040s," said Wayne Solomon, who served as a committee co-chair. "That (target date) is a line-in-the-sand type of thing."

The report charts a strategic path for the U.S. as it seeks to develop nuclear fusion as a virtually limitless source of carbon-free energy.

Nuclear fusion differs from fission, which is the process used in commercial nuclear power plants, such as the now-shuttered San Onofre Nuclear Generating Station. Fission splits the nuclei of atoms to create power while fusion causes hydrogen nuclei to collide and fuse into helium atoms that release tremendous amounts of energy—essentially releasing the same amount of energy that powers stars.

Fusion technology was critical in the development of the hydrogen bomb in the 1950s but a peaceful, commercial application for fusion as a source of energy has attracted scientists for decades.

While operators of fission plants have to cope with radioactive spent fuel, or waste, that is left behind, the half-life of most radioisotopes contained in fusion is lower than ten years and the components activated in a fusion reactor are low enough to be recycled or reused within 100 years.

When any disturbance occurs during the fusion process, the plasma cools within seconds and the reaction stops, thereby preventing the risk of a meltdown or accident like the one at Fukushima.

"It really has a lot of potential to address humankind's energy needs, now and into the future, at a level that probably nothing else can actually do," said Solomon, who is also the director of Science and Technology for Magnetic Fusion Energy at General Atomics, the San Diego company long associated with fusion research.

But no commercial fusion reactors exist. In fact, fusion power has been generated only for very short periods in the laboratory, leading to a wry observation made over the years by skeptics that fusion as an electricity source is always 30 years away.

In 2018, the Department of Energy called on the Fusion Energy Sciences Advisory Committee to come up with a long-range strategy for fusion as an energy source. The committee reached out to wide swaths of the fusion community and the report that came out in mid-December has received broad-based support.

In addition to the call for a pilot plant in the 2040s, the committee recommends experimental facilities to better understand plasma science and technology.

What's plasma? At the extreme temperatures needed for nuclear fusion, electrons are separated from nuclei and a gas becomes a plasma—an ionized state of matter. Fusion energy and plasmas are inextricably linked, with a fusion reactor requiring a "burning plasma" that is confined and controlled at its core.

Advancements in plasma science have been made at the DIII-D National Fusion Facility that General Atomics operates as a contractor for the Department of Energy. At DIII-D, a doughnut-shaped metal vacuum chamber called a tokamak is surrounded by incredibly powerful magnets. Fuel consisting of hydrogen isotopes can be converted into plasma by heating the fuel to more than 150 million degrees Fahrenheit.

A great deal more progress in fusion is expected at ITER, a multi-billion dollar international project under construction in France. The U.S. is one of the global partners in the experiment—in fact, General Atomics is supplying one of the project's key pieces—that is expected to begin operations in December 2025.

But ITER will not capture the energy it will produce as electricity. Rather, it hopes to pave the way for the development of future fusion power plants.

The Fusion Energy Sciences Advisory Committee report calls for building on what will be learned at ITER.

"Now is the time to move aggressively toward the deployment of fusion energy," said the report, which was unanimously endorsed by the committee's 22 members, which included two members from San Diego—Solomon and Christopher Holland at UC San Diego.

The committee's report warned the U.S. risks falling behind other countries in fusion research, development and operations. But it did not give an estimate for the cost of a pilot fusion plant or make suggestions for potential sites.

At this early stage, Solomon said the committee did not want to hazard a guess.

"There are very wide ranges of opinions about how much a particular facility might need to cost or what its particular mission should actually entail," Solomon said, "so we decided not to go down that path."

The report now goes to the Department of Energy's Fusion Energy Sciences office, which will weigh the recommendations and consider what should be implemented and what funding requests to make to Congress.

Solomon said the report has received "positive feedback" from staffers on Capitol Hill. There will be a change at the top of the Department of Energy, with President-elect Joe Biden nominating former Michigan Gov. Jennifer Granholm as secretary.

"Fusion has generally had strong bi-partisan support," Solomon said. "And given that the new administration has indicated an interest in addressing climate change and the like, I would hope and expect that this should receive continued support."