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ITER chief: I won't live to see benefits of fusion, but I will help us get there

Bernard Bigot, director-general of the world's biggest nuclear fusion project, tells Science | Business the perpetually out-of-reach energy source is finally in sight – so long as Trump does not scale back US involvement

By [Éanna Kelly](#)



Bernard Bigot receives a delegation from ENGIE, the French electric utility company. Photo: ITER

The journey to fusion energy, predicted and postponed many times, is firmly “on track”, according to Bernard Bigot, director-general of the International Thermonuclear Experimental Reactor (ITER), the biggest fusion project in the world.

But this could all change – for ITER at least - if the US decides to scale back its involvement in the mammoth international project, under construction at a site in southern France.

The White House's proposal of \$75 million for ITER in 2019 falls far short of an earlier pledge of roughly \$213 million in cash and equipment.

Bigot raced around Washington last week with an appeal to lawmakers to honour their commitments. He met officials at the Energy and State departments and at the White House's Office of Science and Technology Policy, in addition to testifying before the Science Committee.

"I wanted them to see that the benefits are large relative to the costs," Bigot told Science | Business.

As Bigot was doing the rounds in Washington, in Boston the Massachusetts Institute of Technology (MIT) was announcing a new private company, Commonwealth Fusion Systems (CFS) which will work with MIT to carry out fusion research based on advances in high-temperature superconductors.

CFS, set up by former MIT scientists, has secured investment of \$50 million from the Italian energy company Eni, and is now looking for additional investors.

MIT is keen to stress that the collaboration builds on decades of federally-funded research, in particular citing recent improvements in the performance of high-temperature superconductors it says will substantially increase the performance of fusion magnets. That will lead to dramatically smaller, lower-cost fusion devices that can produce net energy up to several hundred megawatts of power.

For the first three years, the MIT/CFS collaboration will work on developing the superconducting magnets, before going on to build a prototype fusion reactor. That reactor, called Sparc, will produce a fusion power output about a fifth that of ITER, but in a device that is only about 1/65th the volume.

The CFS technology will be price competitive in the energy marketplace in less than 20 years, according to MIT.

ITER meanwhile, promises to produce net fusion power sometime after 2035, if the present schedule holds.

When completed, ITER will theoretically produce 10 times as much energy as it needs to run. It will be a “massive, safe, clean, and predictable energy source for hundreds of thousands of years,” said Bigot. “If we succeed - and we will - the breakthrough will be so large.”

But so far, scientists at ITER and other fusion experiments, including the EU's Joint European Torus, in Oxfordshire, UK, have not been able to get more energy out of a reaction than they put in.

The route to this almost too-good-to-be-true energy source is complicated and expensive. Originally foreseen to switch on in 2016 and cost around €5 billion, the price of the ITER reactor has since roughly quadrupled and its start date pushed back to 2025. If it comes together, full-scale experiments are foreseen in 2035.

Trump review of civil nuclear projects

Despite setbacks and doubt, ITER officials have always found a way to keep government money flowing to the project.

The partners in ITER – the EU, Japan, China, Russia, the US, India and South Korea – have agreed to contribute pieces of the reactor, which the central ITER organisation is responsible for coordinating construction. The EU owns 45 per cent of the project and the other partners 9 per cent each.

The fate of US funding for ITER is uncertain, however, while President Trump reviews all civil nuclear energy activities. There have been periodic calls for the US to end its participation in ITER over the years.

Without full US involvement, ITER will be delayed again.

“The US is expected to cover its share of components on time. If it cannot fulfil its commitment, it will take years to recover,” said Bigot. He expects a resolution of the matter by June.

Steadying the ship

Bigot, who was previously chairman of the French Alternative Energies and Atomic Energy Commission, and director general of research and technology at the French science ministry, came into ITER in 2015 to offer a fresh look.

At the time, the feeling was that the project was in danger of veering off course, amid ballooning costs and delays.

Now, management of the byzantine structure has improved, Bigot insists, citing 32 milestones the project has hit on time.

"I'm nearly 70, I know I won't benefit from fusion, but it's my duty to bring together some of the parts into the large chain of delivery," he said. "I'm quite confident we are on track to deliver."

It is common to hear people bemoan ITER bureaucracy, but "it's an image of the past," he said.

"We've reduced it; I came in and [set up] a project culture," said Bigot. "Since I've been in office, we have strictly complied with our schedule."

Growing competition

The idea is that the final ITER machine, like a miniaturised sun, will spin atoms very fast, and at such a high temperature that energy will be created.

Jamming hydrogen atoms together to form helium will require a temperature in the region of 100 million degrees.

Sustaining this extreme temperature in a confined space remains a daunting challenge, but if ITER can figure it out, it would be the foundation of the first fusion power plants. "It's a huge workload," Bigot said. "But it's very gratifying to know you're part of something that could change the world."

He faces competition from scientists and tech tycoons who believe they can achieve fusion faster and cheaper. In addition to the MIT/CFS collaboration, there are fusion projects run by Google and Amazon head, Jeff Bezos.

"If someone finds a better, cheaper way to do it, then that's okay," said Bigot. "[The activity] tells us that more and more people feel it is an option to be considered."

Stephen Hawking, the legendary physicist who died on Wednesday, chose fusion as the 'one idea that would transform society'. "He was a visionary," Bigot said. "He could bring the stars down here to earth."

ITER has to do the same, because there is no other choice. "We have no long-term option for energy; if we don't find an option, we'll be in big trouble."

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