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Nuclear fusion

A white-hot elephant

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A costly project brings countries together, but not many nuclei

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GETTING power from nuclear fusion seems a great idea. The fuel is abundant, the process safe and the waste quite benign. Lots of power could be produced; the sun itself is powered by nuclear fusion. But getting more useful energy out of a machine than you put in has eluded the wit of man for 50 years—and a new move to throw more money at the problem marks political, not scientific, progress.

The project to build and run an International Thermonuclear Experimental Reactor (ITER) is 21 years old. It was proposed in 1985 by Mikhail Gorbachev, then the Soviet leader, who put the idea of working together on fusion to his American counterpart, Ronald Reagan. In its lofty origins the project resembles the International Space Station. There are more countries to share the costs now but the price tag is still substantial: this week, America, the European Union, Japan, Russia, China, India and South Korea signed a deal in Paris for a fusion machine that will cost $12 billion.

This collaborative effort has been dogged by politics. Russia's participation staggered on after the Soviet collapse; America quit in 1999, saying it was too expensive, before returning in 2003. Canada signed up in 2001, when it seemed a machine might be built on its soil. When this hope faded, in 2003, Canada left. Potential sites were duly found in France and Japan.

The subsequent wrangling looked like a proxy for rows over the war in Iraq. America backed the placing of the machine in Japan, which supported the invasion. Russia and China favoured France which, like them, opposed the onslaught. That the site finally chosen was Cadarache, in France, owes much to European support for a Japanese diplomat and engineer as the director-general of ITER.

That new boss, Kaname Ikeda, will oversee a fresh effort to find how feasible it is to make power with fusion—using the energy released when two light atomic nuclei are brought together to make a heavier one. The fuel, a heavy isotope of hydrogen called deuterium, is present in ordinary water; ITER plans to use seawater. Unlike nuclear fission, the concept behind today's nuclear reactors, the process generates no durable radioactive waste, though the walls of the chamber where the reactions take place stay radioactive for decades.

Yet fusion involves huge difficulties. A big volume of gas must be heated to a temperature above that found at the centre of the sun. The gas must be prevented from touching the reactor's wall by confining it, using a powerful magnetic field. The energy released in fusion is carried mostly by neutrons, a type of subatomic particle that has no electric charge and hence cannot be confined by the magnetic field. Ensuring the reactor wall can cope with being bombarded by neutrons is another problem.

The expense is huge, too. Construction of the 500-megawatt reactor is expected to cost $6 billion and take a decade. Another $6 billion will be needed to operate it for 20 years. Even then the reactor will not be used to generate power. For safety reasons, the excess thermal energy produced will be released through cooling towers rather than harnessed to make electricity. So a commercial reactor is at least 30 years away, as remote a prospect as fusion wonks said it was 50 years ago. And the problem it aims to solve—safely producing power with renewable resources—is being tackled more cheaply in other ways.

Like the International Space Station, ITER had its roots in superpower politics. As with the Space Station, the scientific benefits may not justify the price.