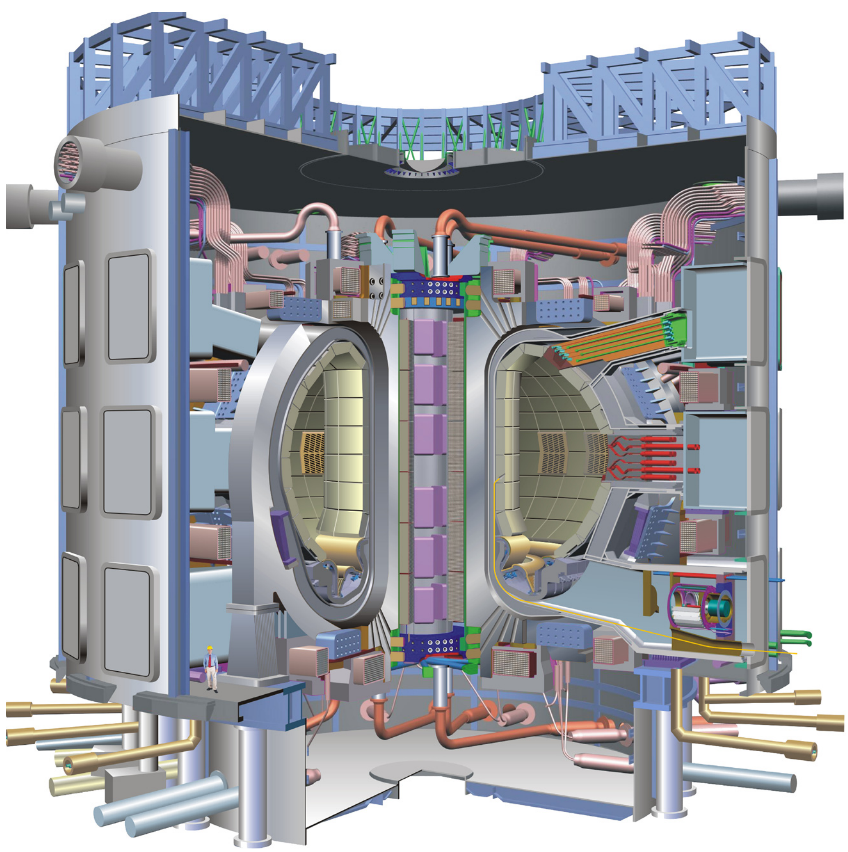
What is ITER?

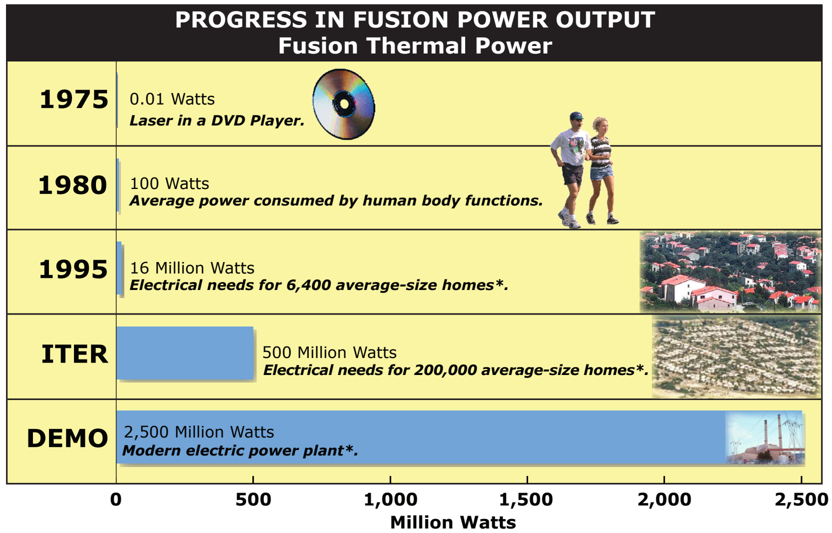
ITER is a large international fusion experiment aimed at demonstrating the scientific and technological feasibility of fusion energy. ITER (Latin for "the way") will play a critical role advancing the worldwide availability of energy from fusion — the power source of the sun and the stars.

To produce practical amounts of fusion power on earth, heavy forms of hydrogen are joined together at high temperature with an accompanying production of heat energy. The fuel must be held at a temperature of over 100 million degrees Celsius. At these high temperatures, the electrons are detached from the nuclei of the atoms, in a state of matter called plasma. In magnetic fusion energy, such as will be studied in ITER, magnetic fields are used to confine the high-temperature plasma with a density typically one millionth that of air at sea level.



For decades, scientists around the world have been replicating the fusion process and studying the underlying physics of plasma through experiments at universities and national laboratories. ITER is a critical step between today's studies of plasma physics and tomorrow's fusion power plants producing electricity and hydrogen. An unprecedented international collaboration of scientists and engineers led to the design of this advanced physics experiment. Project partners are the U.S., China, Europe, Japan, South Korea, and Russia. India has asked to join. ITER is technically ready to start construction, with experimental operations planned to begin in 2016. The site selected for the project is Cadarache, in southeastern France. The experiment is expected to operate for 20 years.

What scientific capabilities will ITER provide?



* Assumes 40% efficiency in the conversion of heat to electricity.

Scientific and technological advances in fusion research provide high confidence that the international ITER fusion experiment will be able to produce a burning plasma. A burning plasma is predominantly sustained at high temperature by the power of its own fusion reactions. ITER will produce 500 million watts of fusion power for a period of at least 400 seconds. The fusion power produced by ITER will be at least 10 times greater than the external power provided to heat the fusion fuel — a "gain" of 10. Although ITER will not produce electricity, only heat, the experiment will be of the same size as a power plant. Consequently ITER will provide an essential bridge from previous physics experiments, which produced up to 16 million watts of fusion heat for time periods approaching one second, to a Demonstration Power Plant (Demo) producing 2,500 million watts of fusion heat (1000 million watts of electricity) continuously with a gain of over 25.

How will the costs for ITER be shared?

America's decision to join the ITER project allows us to share the experience and knowledge resulting from the design, construction, and eventual operation of this essential experiment at greatly reduced cost, compared to a national venture of the same scale. As the host party, Europe will contribute 50% of the construction cost, with the five other partners, including the U.S., each providing 10%. Components for which the U.S. is responsible will be built under subcontracts with industry. The U.S. contribution to the construction of ITER will be approximately $1.1 billion.

What else needs to be done?

Research is needed to leverage the expected results from ITER in order to attain continuous operation at high power and high gain in Demo. Some experiments use the same overall magnetic configuration as ITER, while others in operation and under construction employ modifications of the magnetic fields with particular promise for increased power level at a given magnetic field, and/or for continuous high-gain operation. The larger U.S. facilities are supported by a nationwide program of smaller experiments, theoretical and computational efforts, and technology development. In the longer term, emphasis will transition to facilities to test the materials and components for Demo.

Advantages of Fusion Energy

- Worldwide long-term availability of low-cost fuel.
- No chemical combustion products and therefore no contribution to acid rain or global warming.
- No possibility of a runaway reaction or meltdown.
- Low risk of nuclear proliferation.
- Short-lived radioactive waste.
- Steady energy source, without need for large land use, large energy storage, or very long distance transmission.
- Estimated cost of electricity comparable to other long-term energy options.

With these advantages, fusion complements other nearer-term energy sources to address the world's long-range energy needs.

The Princeton Plasma Physics Laboratory is operated by Princeton University under contract to the U.S. Department of Energy. For additional information, please contact:

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