ITER, THE LATIN WORD FOR "THE WAY", MARKS THE CULMINATION OF MORE THAN **SEVEN DECADES** OF FUSION RESEARCH.

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ITER
ENERGY FOR OUR FUTURE

Nested amidst the hills of Haute-Provence, in southern France, the ITER installation covers 42 hectares and comprises close to 50 scientific and industrial buildings.

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The ITER tokamak is the most complex machine ever designed. It will open the way to the industrial exploitation of fusion energy.

FUSION POWERS **THE SUN AND STARS**

Hydrogen fusion is the process that occurs in the core of the Sun and stars. What we see as light and feel as warmth is the result of fusion reactions: hydrogen nuclei collide, fuse into heavier helium atoms, and release considerable amounts of energy.

Hydrogen fusion is the source of life in the Universe.

In the Sun and stars, gravitational forces create the necessary conditions for fusion. On Earth, fusion can be achieved through "magnetic confinement" – a technique that involves high-temperature plasmas and intense magnetic fields.

ITER is a large-scale scientific experiment that aims to demonstrate the scientific, technological and industrial feasibility of hydrogen fusion. It is the culmination of seventy years of research, carried out on hundreds of devices throughout the world.

Experiments run on ITER – the largest fusion device ever built – will provide the data necessary for the design and subsequent operation of the first electricity-producing fusion power plants.

CLIMATE AND **ENVIRONMENT**

By the end of this century, world electricity demand will have tripled under the combined pressure of population growth, increased urbanization and the improvement of living conditions in emerging countries.

In the context of climate change, a new large-scale, sustainable and carbon-free form of energy is urgently needed.

Complementing renewable energies as well as nuclear fission for countries that choose to use it, hydrogen fusion has the potential to provide the baseload energy source needed to supply electricity to cities and industries.

The worldwide scientific community is now convinced that harnessing hydrogen fusion is within reach.

Components as tall as a five-storey building and as heavy as a fully-loaded Airbus A380.. machine assembly operations began in May 2020.

THE **ITER TOKAMAK**

The ITER device is a tokamak – a Russian acronym meaning "toroidal chamber with magnetic coils." Tokamaks are torus-shaped fusion devices that were developed in the late 1950s and 1960s in the Soviet Union and quickly adopted by most fusion laboratories throughout the world.

In the past 70 years, progress in tokamaks' performance has been steady and spectacular. Key fusion parameters have increased by a factor of 10 million.

In the ITER Tokamak, a 50/50 gaseous mixture of hydrogen isotopes deuterium and tritium will be heated to temperatures in excess of 150 million °C to form a hot plasma.

The fusion reactions will release four million times more energy than the chemical reactions obtained through the burning of oil or gas.

Magnetic fields created by an array of giant superconducting coils and a strong electrical current will shape and confine the plasma, keeping it away from the vessel walls.

The 23,000-tonne ITER Tokamak will be the largest and most powerful fusion device ever built, capable of generating at least 10 times more energy than required to heat the plasma (Q≥10).

ITER will integrate key technologies for future fusion power plants at reactor scale.

A UNIQUE **INTERNATIONAL COLLABORATION**

ITER is a unique international collaboration that brings together China, the European Union, India, Japan, Korea, Russia and the United States – seven Members (33 nations) that represent 80% of the world's GDP and half the planet's population.

The ITER Members are sharing the responsibility for designing, building and operating the ITER installation. By unanimous decision in 2005, the ITER Members chose to build ITER on the site proposed by the European Union in southern France, some 40 kilometers north of Aix-en-Provence.

The ITER project brings together seven members representing more than half the world's population and 85% of the planet's GDP.

CONSTRUCTION AND **ASSEMBLY**

The seven Members' contribution to ITER is done largely in-kind by manufacturing the components and systems required by the installation.

As host-Member, Europe is also responsible for the construction of the installation's buildings.

Construction began in earnest in the summer of 2010 and nearly all the buildings and support infrastructure needed for the facility are in place.

The installation's main buildings are fully equipped and operational, and the commissioning of industrial systems is progressing.

Machine assembly operations were launched in May 2020. Massive components, some as tall as a five-storey building and as heavy as an Airbus A380, are being positioned with millimetric precision in the 30-metre-deep tokamak assembly pit. Despite setbacks with some large components requiring repairs to meet ITER's stringent requirements, the project is progressing steadily.