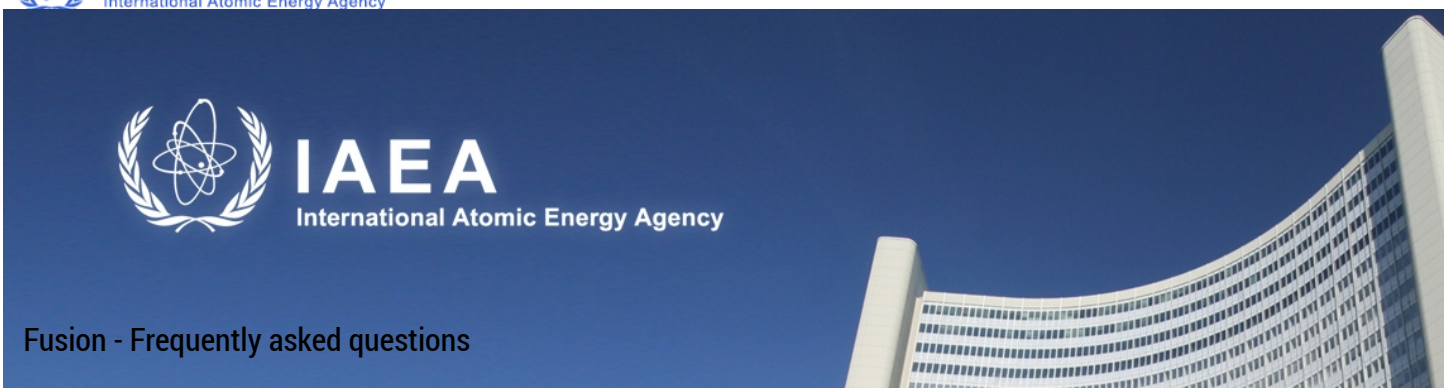
IAEA International Atomic Energy Agency (/)



Fusion

- Basic fusion physics (/topics/energy/fusion/background)
- Fusion FAQs (/topics/energy/fusion/faqs)
- News (/news?topics=2938)
- Events (/events?topics=2938)
- Publications (/publications?topics=2938)

What are the effects of fusion on the environment?

Fusion is among the most environmentally friendly sources of energy. There are no CO^2 or other harmful atmospheric emissions from the fusion process, which means that fusion does not contribute to greenhouse gas emissions or global warming. Its two sources of fuel, hydrogen and lithium, are widely available in many parts of the Earth.

What's the difference between nuclear fission and nuclear fusion?

Both are nuclear processes, in that they involve nuclear forces to change the nucleus of atoms. Chemical processes on the other hand involve mainly electromagnetic force to change only the electronic structure of atoms. Fission splits a heavy element (with a high atomic mass number) into fragments; while fusion joins two light elements (with a low atomic mass number), forming a heavier element. In both cases, energy is freed because the mass of the remaining nucleus is smaller than the mass of the reacting nuclei. The reason why opposite processes release energy can be understood by examining the binding energy per nucleon curve. Both fusion and fission reactions shift the size of the reactant nuclei towards higher bounded nuclei.

Does Fusion produce radioactive nuclear waste the same way fission does?

Nuclear fission power plants have the disadvantage of generating unstable nuclei; some of these are radioactive for millions of years. Fusion on the other hand does not create any long-lived radioactive nuclear waste. A fusion reactor produces helium, which is an inert gas. It also produces and consumes tritium within the plant in a closed circuit. Tritium is radioactive (a beta emitter) but its half life is short. It is only used in low amounts so, unlike long-lived radioactive nuclei, it cannot produce any serious danger. The activation of the reactor's structural material by intense neutron fluxes is another issue. This strongly depends on what solution for blanket and other structures has been adopted, and its reduction is an important challenge for future fusion experiments.

Can fusion cause a nuclear accident?

No, because fusion energy production is not based on a chain reaction, as is fission. Plasma must be kept at very high temperatures with the support of external heating systems and confined by an external magnetic field. Every shift or change of the working configuration in the reactor causes the cooling of plasma or the loss of its containment; in such a case, the reactor would automatically come to a halt within a few seconds, since the process of energy production is arrested, with no effects taking place on the outside. For this reason fusion reactors are considered to be inherently safe.

Can fusion reactors be used to produce weapons?

No. Although hydrogen bombs do use fusion reactions, they require an additional fission bomb to detonate. Working conditions of a magnetically-confined fusion reactor require a limited amount of fuel in the reactor. This fuel is continuously injected and consumed; therefore there is never a sufficient amount of fuel to produce the instantaneous power required for a weapon.

When is electricity generated through fusion expected to be available?

At present, fusion devices produce more than ten megawatts of fusion power. ITER will be capable of producing 500 megawatts of fusion power. Although this will be on the scale needed for a power station, there are still some technological issues to address before a commercial power plant can operate. A prototype of a fusion reactor (DEMO) is expected to be built by 2040. Electricity generation and exploitation is also expected to take place in the second half of the century, depending on funding and technical advancement.

Related resources

- Basic fusion physics (/topics/energy/fusion/background)
- Nuclear Fusion Journal (http://www-pub.iaea.org/books/IAEABooks/Nuclear_Fusion)

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