



Nuclear Fusion and the Future of Energy

Bottling the power of the Sun

Fusion vs fission

Fission (today's reactors)

- Splits heavy atoms like uranium
- Proven: decades of commercial power
- Long-lived radioactive waste

Fusion (the goal)

- Joins light atoms like hydrogen
- Fuel from seawater and lithium
- Much less long-lived waste

The challenge

**100+ million
°C**

needed to fuse
hydrogen on Earth

**~600
million**

tons of hydrogen the
Sun fuses each second

2022

first experiment to get
more energy out than
the laser put in

Not yet

commercial fusion
electricity

The 2022 result came from the National Ignition Facility in California.

Two main approaches



Magnetic (tokamak)

Magnets hold a ring of super-hot plasma



Laser (inertial)

Lasers crush a tiny fuel pellet



ITER

A giant international tokamak being built in France



Private companies

Many startups racing to build pilot plants

Sources: U.S. Department of Energy; Lawrence Livermore National Laboratory; ITER

Remember

Fusion has been shown to work in the lab; making it steady, affordable electricity is the remaining challenge.