International Thermonuclear Experimental Reactor (ITER)

Prelims - *Current events of national and international importance | General Science.*

Why in news?

Recently scientists completed the main magnet system of the world's largest nuclear fusion project with India's significant contributions.

- **About ITER** – It is a collaborative effort involving 35 countries to build the world's largest tokamak.
- Tokamak is a magnetic fusion device that has been designed to prove the feasibility of *fusion as a large-scale and carbon-free source* ***of energy*** based on the same principle (Nuclear Fusion) that powers our Sun and stars.

  Nuclear fusion is a reaction in which two or more atomic nuclei combine to form a larger nuclei, nuclei/neutron by-products.

  The difference in mass between the reactants and products is manifested as either the release or absorption of energy.

- **Location –** Southern France.
- **Goals –** To demonstrate the feasibility of using fusion energy for power generation.
- At full power, ITER is expected to produce 500 megawatts of energy from just 50 megawatts of input.
- **Burning Plasma -** To achieve a state of "burning plasma," where the fusion *reactions themselves generate enough heat to sustain the plasma* without needing external energy input.
  - Nuclear fusion needs surrounding temperature of over 150 million degrees Celsius.
- **India's contributions –** India designed and manufactured the massive cryostat chamber and other critical components for this international clean energy initiative.

  The cryostat's chamber maintains extremely low temperatures, typically below -150°C.

- **Main member countries** – India, China, US, Russia, Japan, South Korea, European Union members.
- **Cost sharing –** Europe (host) pays 45%, other six main members contribute about 9% each.

- **Patent rights** - All members get full access to research results and patents.
- ITER will not produce electricity itself but will serve as a large research facility to test the fusion process at scale.
- The data generated helps to build future commercial fusion power plants.

About Fusion Energy

- Fusion is the energy source of the sun and stars.
- Unlike nuclear fission, fusion doesn't produce radioactive waste.
- Process involves heating hydrogen gas until atoms fuse, releasing energy.
- If successful, could provide nearly limitless, clean energy without long-lived waste or carbon emissions.

Reference

The Hindu| World's Largest Fusion Project