IEAGHG Information Paper 2017-IP39; Fusion Power now not Ready Before 20250 at Earliest

In November 2012, the EFDA published a roadmap entitled: Fusion Electricity - A roadmap to the realisation of fusion energy, see

https://www.euro-fusion.org/wpcms/wp-content/uploads/2013/01/JG12.356-web.pdf

The EFDA sets out the solution to the worlds energy problem can come only by a portfolio of options that includes improvements in energy efficiency and (to degrees varying among countries) renewable energy, nuclear fission and carbon capture and storage.

Fusion power they propose has advantages that ensure sustainability and security of supply namely

- fuels are widely available and virtually unlimited;
- no production of greenhouse gases;
- intrinsically safe, as no chain-reaction is possible;
- environmentally responsible - with a proper choice of materials for the reaction chamber, radioactivity decays in a few tens of years and at around 100 years after the reactor shutdown and all the materials can be recycled in a new reactor.

Fusion power they predicted that fusion power could start market penetration around 2050 with up to 30% of electricity production by 2100.

However, one of the key pillars of the road map was that a demonstration fusion power plant known as DEMO could be operating in the early 2040s, in order to supply electricity to the grid by 2050. However it seems that DEMO's operations will now start sometime after 2054. The rescheduling been caused in part by delays to ITER, a 20bn-euro reactor that is currently being built in the south of France to prove that fusion energy is scientifically and technically feasible. In addition, a facility to test materials for fusion power plants has yet to be built[1].

The ITER is an international nuclear fusion research and engineering megaproject, which will be the world's largest magnetic confinement plasma physics experiment[2],[3]. ITER is an experimental tokamak[4] nuclear fusion reactor that is being built in southern France. The ITER project aims to make the transition from experimental studies of plasma physics to full-scale electricity-producing fusion power stations. The ITER fusion reactor has been designed to produce 500 megawatts of output power for around twenty minutes while needing 50 megawatts to operate. Thereby the machine aims to demonstrate the principle of producing more energy from the fusion process than is used to initiate it, something that has not yet been achieved in any fusion reactor.

The project is funded and run by seven member entities—the European Union, India, Japan, China, Russia, South Korea, and the United States. Construction of the ITER Tokamak complex started in 2013. Construction should be complete in 2021 with commissioning the same year. Plasma experiments in are scheduled to start in 2025 with full deuterium–tritium fusion experiments starting in 2035.

[1] https://www.euro-fusion.org/newsletter/new-head-of-iter-sweeps-clean-interview-with-bernard-bigot/
[2] https://www.iter.org/
[3] https://en.wikipedia.org/wiki/ITER
[4] A tokamak is a device that uses a powerful magnetic field to confine plasma in the shape of a torus. The tokamak is one of several types of magnetic confinement devices being developed to contain the hot plasma needed for producing controlled thermonuclear fusion power. For further details see: https://en.wikipedia.org/wiki/Tokamak

If ITER becomes operational, it will become the largest magnetic confinement plasma physics experiment in use with a plasma volume of 840 cubic meters surpassing the Joint European Torus by almost a factor of 10.

The first commercial demonstration fusion power station, named DEMO, is proposed to follow on from the ITER project.

An artist's impression of the ITER reactor is shown below.

Source ITER: https://www.iter.org/

Construction work underway on 42 acre site in Southern France: Source ITER, https://www.iter.org/

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