

Physics, systems analyses and economics of fusion power plants

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Abstract

Fusion power is being developed primarily because of its large resource base, low environmental impact and high levels of intrinsic safety. However it is important to investigate the economics of a future fusion power plant to check that the electricity produced will, in fact, have a market.

The internal cost of electricity from a fusion power plant is calculated by means of self-consistent systems analyses that incorporate plasma physics and engineering relationships and constraints, and are benchmarked against the ITER costings and international comparisons. The key dependencies on the plasma physics and technology assumptions, are elucidated. In particular, first-generation commercial power plants are investigated, based on the plasma physics of the ITER design-basis and on modest extrapolations therefrom, together with the technology and materials of the blankets developing within the European fusion programme. If based on ITER design-basis plasma physics, the plant would have a cost advantage over PV and would be comparable to wind power with storage. If based on modestly extrapolated plasma physics, the plant would be competitive with a range of environmentally responsible alternative sources of electricity.

The other important aspect of costs, the external costs which can arise from effects such as pollution, accidents and waste are also given. These are always very low.

Thus, fusion is found to offer the prospect of a new energy source with acceptable internal costs and very low external costs. This places fusion in a strong position in a future energy market, especially one in which environmental constraints become increasingly important.