Will ITER make more energy than it consumes?

ITER will produce about 500 MW of fusion power in nominal operation, for pulses of 400 seconds and longer. Typical plasma heating levels duriung the pulse are expected to be about 50 MW, so power amplification (Q) is 10. Thus during the pulse the ITER plasma will create more energy than it consumes.

The efficiency of the heating systems is ~40%. Other site power requirements lead to a total steady power consumption af about 200 MW during the pulse. Now the fusion power of ITER is enhanced by about 20% due to exothermic nuclear reactions in the surrounding materials. If this total thermal power were then converted to electricity at 33% (well within reach of commercial steam turbines), about 200 MW of electrical power would be generated.

Thus ITER is about equivalent to a zero (net) power reactor, when the plasma is burning. Not very useful, but the minimum required for a convincing proof of principle. In ITER the conversion to electricity will not be made: the production of fusion power by the ITER experiment is too spasmodic for commercial use, and the ITER reactor can be designed with low temperature coolants which ease safety and licensing conditions with today's nuclear-licensed austenitic steels, and money can be saved on relatively well-known engineering.

This also explains ITER's interest in extending pulses to steady state. A reactor operating for only 7 minutes every 30 minutes is not attractive, since little electricity can be produced during much of the "dwell" time, but some plant power is nevertheless consumed then.

ITER will carry out tests of electricity production from fusion on a small scale. Some test blanket modules being used to develop power reactor blankets will include a complete steam-raising cycle and turbine in the port cell, allowing the generation of some electrical power even on ITER. The electric power delivered from such a small section of the ITER blanket will be ~ 1 MW.