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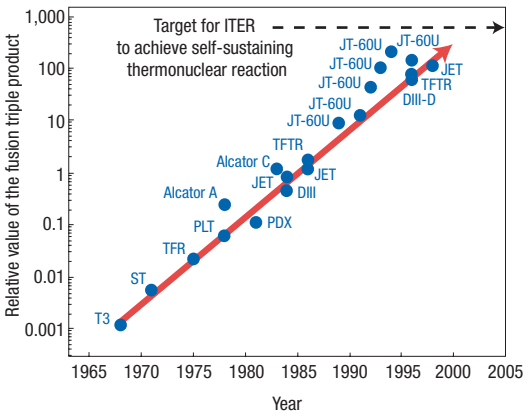
To dream the possible dream

For 50 years it has been said that commercial fusion power is just a few short decades away. It still is. Is it then an unreachable goal? Certainly the challenges facing the development of a working fusion reactor are great. But given the substantial and continuing progress that has been made, to suggest that they are intractable is premature. Moreover, in the near future the greatest challenge is likely to be not scientific, but political.

It is widely reported that ITER — the international experimental reactor that represents the next step in the development of fusion power — will be one of the most expensive scientific experiments ever built. But it is important to put this into perspective. ITER's estimated construction budget of around US$5.5 billion is less than a quarter of the cost of the Manhattan Project, a tenth of the cost of the International Space Station, one twenty-fifth of the cost of the Apollo programme, and a fraction of a percent of what the world spends annually on electricity. Or, in more everyday terms, it is equivalent to the cost of one small beer per European per year over the ten-year period it will take to build ITER[1].



IN FOUR DECADES OF PROGRESS TOWARDS ACHIEVING A SELF-SUSTAINING THERMONUCLEAR REACTION IN A MAGNETICALLY CONFINED PLASMA, THE KEY FIGURE OF MERIT — THE FUSION TRIPLE PRODUCT — HAS DOUBLED APPROXIMATELY EVERY 1.8 YEARS. ADAPTED WITH PERMISSION FROM REF. 1.

The greatest technical challenge is the development of the materials necessary to withstand the extreme conditions inside a commercial reactor, and research here is still at an early stage. It is also fair to say that a healthy dose of faith in human ingenuity is a prerequisite for those working in the field. Such faith is not, however, unfounded. The last four decades have seen exponential progress towards achieving a self-sustaining thermonuclear reaction, with the key figure of merit, the so-called fusion triple product (of plasma density, temperature and confinement time) doubling every 1.8 years (pictured). And, as the latest breakthrough reported on page 419 of this issue attests, the history of innovation in this field gives ample reason to remain optimistic.

Yet overall the picture is far from rosy. Since its inception, ITER has been plagued by political difficulties in securing the multinational agreements needed to fund such a large undertaking. Not only has this delayed its construction by almost a decade — it's now due to begin later this year — but it has pared ITER's budget down to the bare minimum, leaving little margin for error. If magnetically confined fusion research is to have any future, ITER must be a success. This has forced the fusion community to put most of its eggs into this one basket, and has created the false impression that little progress has been made since the tremendous successes and record-breaking fusion yields demonstrated in the late 1990s. It is therefore crucial that politicians, and the broader public, do not lose sight of the bigger picture.

The development of fusion as a sustainable energy source, even if successful, will not alleviate the threat of environmental and economic catastrophe arising from global warming and the energy crisis. Arguably, we already have the tools to address such problems. But the world's unwillingness to make the sacrifices necessary to do so — either in terms of substantial investment in alternative and fission-based energy sources, or through substantial lifestyle changes — has nothing to do with whether or not fusion research is undertaken. Moreover, to suggest that we need to focus solely on immediate solutions is short-sighted.

Nuclear energy, be it fusion or fission, is the only likely means of powering the rate of growth to which the industrialized world has become accustomed, and which the developing world increasingly sees as its right. ITER member states China and India are already acutely aware of this fact. Those in the west need to understand that the issue is not just of sustainability but also of global social justice. Yet only fusion offers the hope of solving such problems without contributing to the danger of further nuclear-weapons proliferation.

The merits of any challenging endeavour can be called into question. Such questions ultimately boil down to whether the rewards are worth the costs. In the quest for fusion power, surely the answer is, still, yes.

REFERENCE

1. Lister, J. & Weisen, H. *Europhys. News* **2**, 47–48 (2005).