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ENERGY SUPPLY FOR THE NEXT 50 YEARS

There is clearly a need for a new strategic policy for energy in the UK. The dwindling supply of fossil fuel and the problems of global warming and air pollution mean that alternative sources are essential, though energy conserving schemes might ameliorate the problem a little.

There is of course nuclear fission power which is well developed and proven. Indeed newer, intrinsically safe reactors have been designed, and this clearly is a bottom line option. France is already committed to this in the near term. Four problems arise from this route however; the proper disposal of radioactive waste (not an unsolvable problem), the development of a commercial breeder reactor (France had trouble with liquid metal coolant and closed Phoenix), and the difficulty of proliferation (more a world-wide issue but within the remit of IAEA inspection) and last but not least the safety of reactor operation.

There is however a sense of irreversibility in going to a fully plutonium energy economy, and alternatives should be thoroughly explored and evaluated before embarking on a breeder based programme.

The strongest alternative candidate is controlled nuclear fusion. Euratom currently spends some ECU 500M per annum on magnetic fusion energy research. The UK is making a big contribution to this, notably in hosting the JET project. Because of political considerations of some smaller EU states the pursuit of inertial confinement energy is rather limited in Europe, but, because it is suitable as part of the Stockpile Stewardship programme the US is spending more on this approach with largely unclassified research than on magnetic fusion. On magnetic fusion it also a few years ago adopted a policy of returning to a study of the basic physics issues with the intention of trying to find a more economic approach than that defined by the then proposed ITER project, which is based on the tokamak concept. Currently a smaller international project, ITER-FEAT, is being considered by many governments as a less ambitious next-step for magnetic fusion. I would strongly support this, provided it is not the only approach to fusion that is being pursued. Even if the plasma physics (especially stability to disruptions and transport) is solved the problems of scale of the reactor the lifetime of components (especially the diverter plates and first wall), and the resulting effect on cost of electricity (COE) require close and intensive study. New problems may arise when a thermonuclear burning plasma, the object of ITER-FEAT, is formed. There is a case for a cheaper, non-superconducting, experiment to study this; similarly there is a case for building a large-scale spherical tokamak (pioneered by Culham) or one of several magnetic fusion alternatives.

A thermonuclear burning plasma and at least ignition might more easily be achieved in inertial confinement schemes. Single shot laser experiments in this regime are the objectives of the National Ignition Facility (NIF) being built at Lawrence Livermore National Laboratory, to which UK universities and AWE will have access and also of Megajoule in France. The 1.8 MJ laser, though more than ten times the size of any other laser, is nevertheless on the borderline of reaching ignition. The indirect irradiation using the laser to produce soft X-rays is their preferred approach, though direct irradiation of the fuel capsule by lasers is also being studied. An alternative being pursued at Sandia National Laboratory is the use of pulsed power driven Z-pinch to produce the soft X-rays for the indirect drive approach. This is already proven to be an energy-rich source of soft X-rays, and 1.8 MJ of soft X-rays in a 5 ns pulse has been produced with a wall-plug efficiency of nearly 20%. Whilst at an earlier stage of physics understanding it is clearly an approach to be followed up. The engineering development of a repetitive pulse driver for inertial confinement, and the overall reactor design are still at an early stage, but the separation of the various engineering components in inertial confinement give it an advantage over magnetic fusion.

Mention should be made of renewable energy, especially solar power. There are very interesting developments in this area, and important questions that arise are energy storage and the cost of electricity. Conventional hydroelectric schemes including the Severn barriage, can provide some of the UK's requirements. Further research into wind power and wave power should be done, but with a realistic view of the environmental consequences. There will be specialist requirements that can use such technologies.

All of these programmes involve many years of research. There is no cheap answer. But I believe that the right strategy is to develop all of these approaches up to prototype systems, unless proved to be clearly unsuitable as a power supply unit. Furthermore, bearing in mind the need to replace fossil fuel within about a 50 year period, a strategic policy should be formulated to enable a proper, unbiased assessment of the above approaches by a common deadline, say 2030, before any decision is made towards a fission-based breeder economy. This does not preclude some earlier expansion of fission reactors and indeed development of safer, new fission systems, so that there is a genuine level-playing field for making a very responsible decision based on internationally acquired and verified information on the future energy supply