United States and global energy policy.

One of the first priorities in a preventive strategy would be to decide "what level of atmospheric carbon dioxide should be considered a prudent upper bound". Should we allow an atmospheric build-up of, say, 50 or 100 per cent over pre-industrial levels? The upper bound would carry with it implications for both developed and developing countries and would raise questions about the sharing of the fossil fuels whose use would be allowed.

Speth was not particularly optimistic about the chances of getting these things done. It is very hard to provoke an international response to an intangible problem whose consequences are not yet even predictable. Dr Thomas B. Johansson of the University of Lund could offer a little encouragement in that the sorts of energy policies desirable from a carbon dioxide point of view were also becoming increasingly necessary, in Sweden at least, for economic reasons. **Wendy Barnaby**

Plasma research

German setback

The Max-Planck-Institute for Plasma Physics at Garching has been forced to make a major reappraisal of its future. Because of government financial restraints (*Nature* 5 February), the institute's next major project, the "Zephyr" tokamak, has been cancelled. The institute, one of the three leading fusion laboratories in Europe, is now planning that its next project should be financed by a redistribution of resources within its total budget of about DM100 million a year.

Zephyr had been planned to leapfrog the joint European tokamak machine called JET, now being built at Culham in the United Kingdom, and would have experimented with ignited plasma. The hope now is that a redistribution of the budget will yield between DM20 million and DM100 million over the next seven years to build a less ambitious machine.

The reassessment at the institute will be carried out under new management. Last week, Professor Klaus Pinkau was appointed director of the laboratory. Although not a plasma physicist but a cosmic ray physicist, he has considerable experience of international collaboration, the politics of big science and the management of scientific institutions. He has been the director of the Max-Planck-Institute for Extraterrestrial Physics, next door at Garching, and is chairman of a committee reporting to the federal government on the merits of ten big science projects which, curiously, did not include Zephyr.

Pinkau said last week that it was dangerous to make scientific institutions too dependent on "annual changes" in the financial position of governments but, also, that budgets should not grow too fast. Certainly this year's changes at the Institute for Plasma Physics will give him pause: not only has Zephyr been deleted but the proposed budget for 1981 has been cut by 15 per cent. This trimming of sails may give the laboratory a sense of realism, persuading it that it cannot alone compete with JET, but a tough internal struggle seems inevitable between the advocates of an upgraded stellarator and a mirror machine. The edge might be taken off this battle if the new project were adopted by Euratom as a "preferred project", in which case between 10 and 20 per cent of the cost could come from Brussels. The advocates of an improved stellarator point to their success last year when the existing machine at Garching, Wendelstein VIIA, was used to show that a stellarator plasma could be held stable in conditions only previously obtained in tokamak machines. The same series of experiments created conditions of plasma density and confinement time more stringent than those reached by tokamaks of similar size, apparently putting stellarators back in business.

Tokamaks are in fact beginning to lose favour because of the various difficulties (fatigue and maintenance, for example) expected to arise in power reactors. Diversification is therefore considered prudent, whence current interest in stellarators and mirror machines. The Lawrence Livermore Laboratory in California is in fact building a mirror machine (the Mirror Fusion Test Facility) in which a large long solenoid is plugged at the ends with magnetic quadrupole mirrors. Garching cannot hope to compete with Livermore in money terms but, some argue, could attack the principles of such a device. This, broadly, is the second proposal being considered at Garching. A decision is expected in the middle of the year. **Robert Walgate**

Tokamaks and stellarators

In both tokamak and stellarator, plasma is confined to a torus by two superposed magnetic fields. One field runs around the torus, along its long circumference; the other winds round and round the small circumference of the plasma ring.

The first field is created in both tokamak and stellarator by a coil wrapped round the small circumference of the torus. The second is created differently in tokamak and stellarator.

In the tokamak, it is the result of a current carried in the plasma itself; in the stellarator it is the result of a component of current in the outer coils along the major circumference of the torus. As the plasma ring is electrically isolated, the tokamak must create the longitudinal current in the plasma by a transformer effect, and so must be pulsed.

The stellarator, on the other hand, can in principle be run statically. Early tokamaks — which were invented in the Soviet Union — were successful principally because of their large "aspect ratio" (major torus radius over minor), it is now believed, rather than because of any intrinsic merit of the tokamak design; and the need for pulsed operation is seen as a disadvantage in the construction of a true reactor, where the variation of thermal, neutron, and magnetic stresses could increase material fatigue.

Princeton perplexities

There are slippery hands and red faces at the Princeton Plasma Physics Laboratory, where a gaggle of lawyers is trying to decide who was responsible for dropping a 350-ton generator component during the construction of the Tokamak Fusion Test Reactor (TFTR).

The accident happened in December, when the outside stator of the vertical axis generator was being lowered into position. A crane bearing broke and the stator fell 15 feet, damaging both itself and the central rotor.

The incident is not expected to have a significant impact on the construction schedule for the TFTR, which will be used to achieve energy breakeven for the first time and to investigate the engineering features of large fusion systems. A second generator, already in place, will be able to supply sufficient energy for the test reactor, at least in the early phases of operation. However, a detailed study will now be necessary to determine whether the generator can be repaired — or whether a replacement is needed, which could cost up to $2 million, and take some time to deliver.

Present construction schedules anticipate that the TFTR will come into full operation in July or August 1982. This is about seven months later than the original completion date of December 1981, due largely to delivery delays on some of the major components — in particular the toroidal and ohmic field coils used to contain the plasma — which have presented more technical difficulties than expected.

Officials at Princeton say that they do not foresee any insuperable problems, as most of the technology is "state of the art". However, the delays will inevitably add to the construction costs, which are expected to exceed the predicted $284 million by about 10 per cent.

More than five subcontractors may be involved in the heated debate over the responsibility for December's accident. A report is expected shortly from the Department of Energy, which is expected to identify errors of judgement responsible for the crane overload. However, with large insurance sums at stake, any such conclusion is likely to be contested — and will almost inevitably end up in the courts.

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