

of technology and public policy at Harvard, and Edward Ginzton, chairman of Varian Associates.

A tantalising preview of some of the conclusions likely to emerge from the study surfaced last week when the steering committee issued an interim report, essentially suggesting that energy use in the United States will grow at a slower pace than most other studies have anticipated. The committee suggests, moreover, that the country can adjust to a slower rate of energy growth without sacrificing economic or social goals.

If the Academy does indeed come up with such a conclusion, it would add considerable weight to the view put forward a couple of years ago by the Ford Foundation's Energy Policy Project, namely that energy growth can be gradually reduced over a decade or so to a very low rate, without either causing economic stagnation or radically altering people's lifestyles. The practical consequence of such a development—if true—would be that there may be much more flexibility in long term energy supplies than is generally realised; Mr Carter could, for example, carry out his campaign pledge to slow down the present breakneck pace of the breeder reactor programme, without running a large risk of causing massive economic disruptions toward the end of the century.

Further evidence of the growing acceptance of the view that energy growth is likely to slow markedly is

also to be found in a meticulous study of the possible consequences of a nuclear moratorium, produced recently by the Institute for Energy Analysis (IEA), headed by Alvin Weinberg. The study predicts that total energy use in the year 2010 will lie between a low of about 118 quads and a high of about 159 quads, compared with 71 quads in 1975. It notes that "even our 'high' estimate . . . is much lower than most previously published estimates. If our estimates are valid, they could imply considerable rethinking of those elements of energy policy and energy R&D policy that are premised on higher overall projections."

Because of those lowered energy growth rates, the study estimates that the economic and environmental impacts of a nuclear moratorium (which would prohibit the construction of new reactors after 1980 but allow continued operation of reactors on line by 1985), though severe, would be smaller than is generally believed. It is assumed that most of the energy shortfall would be taken up by a switch to coal in the short term, with growing input from alternative sources such as solar energy, which would tend to increase the cost of energy by a total of between \$31,400 and \$42,000 million by the year 2010, the study estimates. That would amount to less than 1% of the gross national product each year. As for employment, the study predicts that a moratorium would result in the loss of about 50,000 jobs in the nuclear and

related industries, but "the displacement caused by the moratorium would be temporary".

The environmental implications of a switch from nuclear to coal could be relatively severe. If the moratorium is coupled with limitations on oil imports, which would be likely, between 100 and 300 million more tons of coal would have to be mined each year in the period between 2000 and 2010 than would be the case without a moratorium. That would probably despoil larger areas of land for strip mines, increase atmospheric levels of carbon dioxide, and possibly increase pollution from sulphur dioxide, oxides of nitrogen, hydrocarbons, particulates and carbon monoxide. Increased use of pollution control technologies would, however, take care of some of the increases.

Though such impacts are relatively large, they certainly do not add up to the level of economic and social disruption predicted by the nuclear industry last year during the referendum in seven states on nuclear power.

The expectation that energy growth in the United States will slow down over the long term without precipitating economic stagnation, which drew sharp criticism when the Ford Foundation published its study, is therefore growing in acceptance. It means that President Carter may have more flexibility when he chooses his long range energy plans, but it won't help much over the next few years. Only some warmer weather would do that. □

## AUSTRALIA

# SCORE scores

*Peter Pockley reports from Sydney on Australia's data collecting project for research expenditure*

INACTIVITY on questions of priority and level of financial support for science in Australia has regularly been justified on grounds of a lack of reliable data on expenditure and manpower. In the early 1970s, the then Department of Education and Science started the first national data collecting operation and graced it with the acronym of Project SCORE (Survey and Comparison of Research Expenditures).

The project, however, was for some years plagued by problems of definition, management and staffing. But it did manage to grind out in 1973 a detailed set of figures for the financial year 1968–69 (the Australian financial year runs from July 1 to June 30, with the exception of the universities whose accounts run from January 1 to December 31—just one of the problems faced

by the number crunchers). These figures came out just as inflation began to canter up towards the gallop of 1975 and 1976, and this, coupled with the long delay between year of study and year of publication, greatly diminished their value.

The Department of Science has now begun publishing the second set of Project SCORE data. These refer to the financial year 1973–74; being more recent, the project scores more useful points for the student and politician of science alike. However, the criteria used in collecting and processing the data are not entirely consistent with the 1968–69 figures because the project changed to following OECD prescriptions very closely. This makes international comparisons valid, but has negated any reliable and precise statements on national trends in expenditure and manpower which are so urgently needed for drumming complacency out of politicians. This will have to await the next publication planned for the financial year of 1975–76 (the Depart-

ment now hopes to collect data at two-yearly intervals).

Project SCORE reveals that in 1973–74 the Gross Expenditure on Research and Development (GERD) amounted to 651 million Australian dollars (£1=\$1.58). This represents 1.3% of the Gross Domestic Product (GDP) of \$50,557 million for the year under study. The manpower involved in GERD was equivalent to 53,300 man-years, representing 0.9% of the Australian work-force of 5,867,700; 48% of the manpower effort was attributed to professional persons. There are, however, no figures for the supply and demand of professionals, nor are these available from other sources to confirm or deny the now popular belief in Australia of an oversupply of scientists and technologists at a time when overall unemployment is nudging 5% of the workforce.

Using OECD's definitions, 91% of GERD was spent in the natural sciences, and 9% in the social sciences and humanities, assuming all business enterprise expenditure to be in the former. Basic research took 28% (\$184 million) of GERD, applied research

37% (\$238 million) and experimental development 35% (\$229 million).

Socio-economic objectives groups accounted for intramural expenditure as follows, assuming all expenditure in the business enterprise sector to be in the economic development group: economic development 59%, advancement of knowledge 26%, national security 9%, and community welfare 6%. These and other broad figures quoted are broken down into fine detail in Project SCORE's publications.

As a percentage of GDP, Australia's GERD (natural sciences only) was in the middle rank of OECD's 18 member countries for the calendar year 1973. Australia's figure, adjusted to that year, was 1.2%, compared with the USA

2.3%, UK 2.1%, Germany 2.0%, Netherlands 1.8%, Japan and France 1.7%, Sweden 1.6%, Belgium 1.3%, Canada and Norway 1.1%, Austria 1.0%, and New Zealand 0.9%.

Changes in Australian R&D expenditure in the five years from 1968-69 to 1973-74 are difficult to quantify because of the changed criteria. Project SCORE's published figures for 1968-69 put total GERD at \$334 million, approximately half the 1973-74 figure of \$651 million without taking inflation into account. If compared at constant prices, GERD has increased about 35%, but when measured as a percentage of GDP, the GERD figures are closely comparable.

The relative financial support of

Australian R&D has remained fairly static over the five-year period between comprehensive data collections and analyses. The figures thus support the general contention from more superficial indicators that neither the Liberal nor Labor governments of recent times gave significantly more or less attention to science than to other areas of government finance. Using the superficial indicators for the period since 1973-74, it is at least certain that the relative standstill position has been maintained, and quite likely that there has been a significant slippage. For example, it is believed that the number of staff engaged on industrial R&D has dropped by as much as 40% over the two years from 1973-74. □

## IN BRIEF

### Gloomy energy report

In a sombre analysis released last week of projected global energy supply and demand to 1985, an OECD publication, *World Energy Outlook*, warns of a likely shortfall in oil supply that will mean either higher prices or shortages or both. The report, calling for a "transformation" and "revitalisation" of energy policies in industrial countries, urges them to increase indigenous energy production and improve conservation through a combination of financial measures, including investment incentives and use of the price mechanism, and regulations, embracing direct and indirect conservation measures and relaxed environmental requirements.

### Brazilian deal developments

Reports in Brazilian papers suggest that Brazil is determined to resist pressure from the United States to change the terms of its controversial nuclear deal with West Germany. There are also signs that Argentina, which has its own nuclear ambitions, is proffering support for the stand. The reports follow others in the Brazilian press indicating a possibility that the US might consider supplying Brazil with nuclear fuel if it gave up that part of the German deal which includes both enrichment and reprocessing facilities.

The US Vice-President, Walter Mondale, apparently urged West Germany to restrain sales of nuclear technology when he visited Bonn last week as part of his diplomatic tour of key western capitals, and the possibility has emerged of including tighter curbs on trade in sensitive technology. Nothing specific was disclosed regarding the Brazilian deal, however.

Brazil has not signed the nuclear Non-Proliferation Treaty, and although the deal is permissible under the treaty,

it is hardly in keeping with President Carter's intentions in the field of international trade in nuclear technology.

### Safety bodies established

The UK Health and Safety Commission has announced the establishment of two more bodies which are to be part of the advisory committee structure that will help it discharge its obligations under the Health and Safety at Work Act. One is the Advisory Committee on Toxic Substances, and will be chaired by the Director of the Health and Safety Executive's Hazardous Substances Division; committee members include four with relevant expertise and the CBI and TUC have each nominated four. Attention will focus on new chemicals, but not nuclear materials, which a new committee to replace the Nuclear Safety Advisory Committee will examine.

The other committee is the Advisory Committee on Dangerous Substances, to be chaired by the Executive's Deputy Director. This will concern itself with flammable and explosive substances, and includes three expert members as well as three each from the CBI and TUC.

A third committee, the Medical Advisory Committee, is already functioning, and one of the approximately 18 industry-based bodies, for agriculture, is also in operation.

### Finland nuclear report

Finland should put a sharp brake on its nuclear energy plans, says the report of an energy committee under the leadership of the Finnish Minister for Trade and Industry, Arne Berner. Finland's shaky economic situation demands that investments should be confined to projects which will increase employment and the development of exports, rather than to nuclear power;

instead of the string of reactors which the government had thought of building around Finland's coast, the committee suggests that no new reactors should be built before 1985. If more energy is needed before then, it should come from non-nuclear sources and problems connected with nuclear energy should meanwhile be studied more closely.

Finland has four reactors under construction, at Lovisa and Olkiluoto, and the first is due to be loaded in a few months' time. By 1985 it is expected that they will be producing about 14% of the country's total energy consumption. Water power will supply about 23% (30% last year), with most energy continuing to come from oil, coal and peat.

There has been no general public debate about nuclear energy in Finland as there has been in Sweden, although groups living near the reactors have protested. The committee's report offers them no comfort. If Finland does build more nuclear power stations, it says, they will probably be sited near the existing ones.

### Budgets announced

The 30-member Executive Board of the World Health Organisation last week recommended a budget for WHO activities in 1978 of \$165 million. The World Health Assembly will consider the proposal at its 30th session in Geneva in May.

The Council of the European Space Agency, meeting in Paris, approved programme budgets for 1977 last week of 481.1 million units of account, some 3 million down on those proposed. The programmes include Aerosat, Ariane, Marots, Meteostat, OTS and Spacelab. The Ministerial Council holds its first meeting later this month and will discuss the level of resources for 1978-80.