

SAFE ENERGY

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**Winkling out
MAFF's
flawed figures**

**Renewables
reports: all
about money**

**The UK's role
in proliferation**

**A future for
Britain's coal**

**Schools'
propaganda
battle**

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COMMENT

SHORT-TERMISM is the order of the day in energy policy. Michael Heseltine's present dilemma — precipitated by the intended closure of 31 coal mines — has its origins in the quick fixes which were necessary to salvage the faltering privatisation of the electricity industry. However, Heseltine's difficulties, important though they are, pale into insignificance when compared with those facing Michael Howard at the Department of the Environment (DoE): energy is at the heart of the global environmental problems of acid rain and climate change.

With the UK's desulphurisation programme having been sacrificed on the altar of electricity privatisation, the DoE is playing mathematical games to try to avoid facing up to its international commitments on sulphur reductions ("Acid comments", page 20).

In dealing with carbon dioxide, the DoE has deferred to the interests of the Department of Trade and Industry (DTI), the Department of Transport (DoT) and the Treasury. On the key issues of energy supply, transport, and funding for renewables and energy efficiency the DoE is silent.

This has led to the absurd assertion from Michael Howard that information campaigns to persuade others to save energy will be sufficient in the battle against global warming ("Climate change", page 19). But, government departments cannot even meet their own commitments ("Whitehall energy farce", *Safe Energy* 92).

From the DTI's reports on renewable energy and wave power (page 19), it seems that even the government's present limited interest in renewables is waning. The DoT remains wedded to the motor car and road building, and is planning to break-up Britain's integrated rail network.

If this government's pitiful efforts are duplicated in other industrialised countries, and if the consensus view of scientists on global warming is correct, the consequences will be much more serious than not being able to drive your favourite make of motor car.

While the present approach persists, the illusory benefits of a massive nuclear power programme are likely to gain credence. Should such a route be followed, it will starve effective options of resources, create enormous environmental problems of its own and do little to ameliorate the global environmental problems it will be meant to solve.

The first signs of this are already appearing in eastern Europe. With the eager assistance of Western governments and industry, resources are being diverted away from energy efficiency — which has tremendous potential in the region — towards nuclear power.

It is time for the DoE to wake up to reality, flex its muscles and start tackling the environmental problems the UK faces. What better first step than to stop the nuclear industry's latest folly, the Thorp reprocessing plant, save the country some money and invest it in renewables and energy efficiency.

SCRAM's *Safe Energy* journal is produced bi-monthly for the British Anti-Nuclear and Safe Energy movements by the Scottish Campaign to Resist the Atomic Menace. Views expressed in articles appearing in this journal are not necessarily those of SCRAM.

scram, skram, v.
to shut-down a nuclear
reactor in an emergency.

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Editors:
Mike Townsley
Graham Stein

Front Cover Illustration:
David Shaw.

Published by SCRAM, 11 Forth Street, Edinburgh EH1 3LE.

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SAFE ENERGY

FEATURES

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10 Renewables reports: all about money

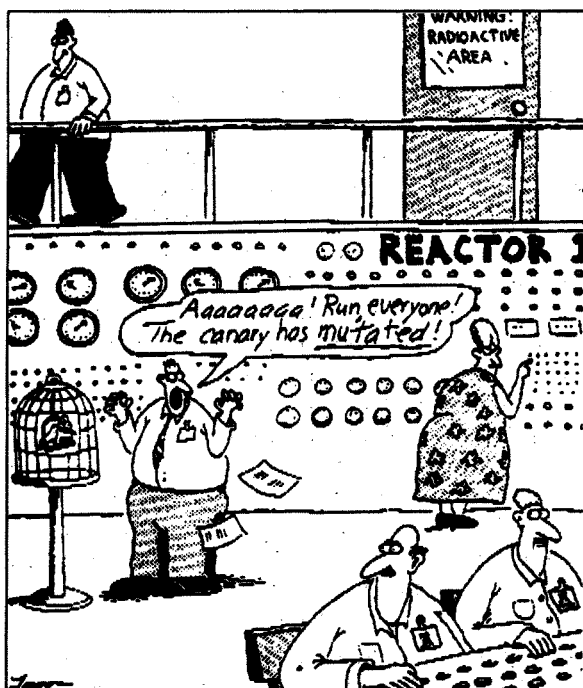
Two long awaited reports on renewables, finally published late last year, place a strong emphasis on money rather than science. David Ross, author of *Energy from the Waves*, reports on the politics and personalities behind their production, and explains the black art of 'discount rates'.

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Breaching the Nuclear Non-Proliferation Treaty is only one of the accusations being laid against the UK government by individuals and governments worldwide. Pete Roche of Greenpeace catalogues the actions of the UK government and companies marketing the spread of military nuclear technology.

13 A future for British coal

The dash to gas, one of the factors in the UK electricity industry's present chaos, uses combined cycle gas turbine technology (CCGT). Cllr Steve Martin, press officer for Calder Valley Mineworkers Support Group, puts the case for the use of this new generating technology with our indigenous coal reserves.



Gary Larson

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16 The science of climate change

With the terms "greenhouse effect" & "global warming" now in common use, Paul Gill, a graduate in environmental technology, looks at some of the science behind climate change and makes some recommendations for the future.

Japan's plutonium

WHILE the Japanese ship, the Akatsuki Maru, finally arrived home on 5 January with its cargo of over one tonne of plutonium ("Plutonium shipments", *Safe Energy* 92), the country's plans to exploit fast breeder reactor (FBR) technology are beginning to look less like plain sailing.

The start up of Monjo, Japan's 280MW prototype fast breeder reactor, has been delayed for a third time. Originally due to be started up in March 1991, the reactor is not now scheduled to go critical until October.

Fabricating fuel for the reactor, for which the tonne of plutonium has been shipped from France, is proving more difficult than Japan's Power Reactor & Nuclear Fuel Development Corp (PNC) originally thought. PNC first admitted that it was behind schedule over a year ago but maintained that the plant would go critical on target in October 1992. Later, it conceded that there were design problems in manufacturing secondary components and in fabricating the fuel, saying criticality would occur at the end of March 1993. At that time they reiterated the claim that the plutonium, from reprocessed Japanese spent fuel in France, was needed by the end of the year so

fabrication for Monju's second core could begin in the spring.

This later delay means that the plutonium for the second core will be stockpiled until 1994, contrary to PNC's promise that it would not maintain a stockpile of plutonium. The Tokyo based Citizens Nuclear Information Center has always maintained that the plutonium shipments were being made with too much haste and inadequate planning. A position borne out by statements made by PNC's President, Takao Ishiwatari: "For this voyage we decided as a general rule not to enter any other country's territorial waters and, consequently, we thought we didn't need to seek understanding [agreement] of these countries. That was bad."

A number of countries told the Japanese government to keep the ship out of their territorial waters. They included South Africa, Australia, New Zealand, Chile, the Philippines and Indonesia. Last October the Asia Pacific Forum called upon the Japanese to "halt" the plutonium shipments. Nations which could have been along the route — which is still a closely guarded secret — were concerned that although they could be called upon to provide an emergency port in the event of an accident they were neither consulted nor informed about the route

or nature of the vessel.

However, now that the plutonium is safely in Japan, concerns are being expressed about the longer-term effects it might have on global security. Because Japan is a highly technically advanced nation and now possesses a considerable amount of plutonium it is a de facto 'nuclear power'. A situation which is not lost upon its Asian neighbours, many of whom, such as North Korea, are believed to be developing their own weapons programmes.

Further exacerbating Japan's nuclear problems, the French government has asked that the Japanese take back high-level radioactive waste generated as a result of reprocessing sometime in 1994. However, Japan's storage facilities will not be complete until 1995. The French state owned nuclear fuel company has received over 2,900 tonnes of Japanese spent nuclear fuel, which it will turn into 30 tonnes of plutonium and vast quantities of radioactive waste. Over 30,000 waste containers will eventually have to be returned.

The French request is believed to have been inspired by the growing public concern, prompted by the negative publicity surrounding the plutonium shipment, that the country is being used as a dump for foreign nuclear waste. □

Thorp uncertainty

GROWING uncertainty over the stability of contracts signed for the first ten years of the operation of British Nuclear Fuel's (BNFL) Thermal Oxide Reprocessing Plant (Thorp) and escalating decommissioning costs could lead to the plant draining £1 billion from the public purse according to a new Greenpeace report.*

The report, by Dr Frans Berkhout of Princeton University's Centre for Economic and Environmental Studies, is an update of an earlier Greenpeace report on the economics of the plant. That earlier report eventually led to the current economic reassessment of Thorp which is being conducted by a Cabinet deputy secretary.

Berkhout argues that "at the most optimistic, it is possible that Thorp may complete the baseload contracts and a few beyond it. In the process it could make a small profit (less than anticipated by BNFL) and therefore make no claim on public finances." However, he points out that there is great

uncertainty surrounding those contracts and the "chances of post-2002 business are small, and if such business is secured it is unlikely to make a contribution to the present value of profits."

Yet if Thorp were not to open, admits Berkhout, some costs could still be incurred by the public purse, but these are in areas of low technological uncertainty and under some degree of political control; "the risk of them being very high is therefore minimal."

It is impossible to say whether or not opening the now complete £2.8bn plant would cost the public more, yet "the political costs of a start-up, especially in the longer term, is almost certainly higher than that of abandonment. Further, and looming over all in public expenditure terms, there is the fact that once Thorp starts up, there will be a residual public liability for decommissioning, minimally estimated by BNFL at £900 million."

BNFL has rejected the report: "We believe Thorp is an economic success. We have secured £9bn worth of orders stretching over 15 years even before the

plant opens. This report merely rehashes old arguments which we refuted 2 years ago. Since then we have had our own conclusions verified independently by Touche Ross."

However BNFL is refusing to make the contents of that report public.

■ BNFL has admitted making a fundamental mistake in calculating the radioactive discharges from Sellafield once the Thorp plant opens.

As a result it has applied to vary its discharge licence — which has been the subject of an 11-week public consultation — and a two-week extension to the consultation has been made to allow the objectors to comment on the new application.

While the error does not affect the overall proposed discharge limits in the draft authorisation, "what it does show," says Dr Patrick Green of Friends of the Earth, "is that they have not got clue what has come out of their chimney stacks in the past." □

* "Fuel reprocessing at Thorp: Profitability and Public Liabilities" by Frans Berkhout. Greenpeace, 1993.

EC radiation ruling

A ruling from the European Court, made at the beginning of December, allowing Belgium to adopt stricter radiation protection standards than those laid down in a European Commission directive have opened the door for a similar move by the UK's National Radiation Protection Board (NRPB).

The Board has been seeking stricter standards for the UK's nuclear industry for some years, however, it has been constrained by the need to conform to the Commission's directive. While the directive dictates that the maximum tolerable risk from radiation is such that no one should receive a dose of

more than 1mSv in a year, the NRPB believe that the limit should be three times lower at 0.3mSv.

The Court's ruling, on the eve of the single European market, has angered many in the Commission. Some officials have condemned the decision as incomprehensible and as an unacceptable political judgement.

In 1987 Belgium set a new protection standard for apprentices and students between the ages of 16 and 18 exposed to radiation in the course of their studies. It was decided that such people should receive no more than one-tenth the limit which applies to occupationally exposed nuclear workers.

The Commission decided to take the Belgian government to court, hoping to force them to relax their standards. The

court, however, rejected the Commission's action.

The NRPB said: "The situation in general terms is that no one quite knows what the ruling means. We will continue to develop our own advice to government which is independent of the EC."

Many believe that the ruling will lead to a delay in publication of a new radiation protection directive which was due in 1994, and allow UK regulators "to set what limits we think are right for the UK."

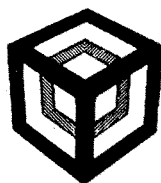
If the NRPB is successful in establishing standards three times lower than those currently in place, then many parts of the UK's nuclear industry may have to close, as meeting stricter limits would be prohibitively expensive. □

Nirex site doubts

SELLAFIELD is a "poor site" for a nuclear waste repository which could lead to radioactively contaminated water returning to the surface within 300 years, according to a report prepared for Cumbria County Council by Environmental Resources Ltd (ERL).

Nirex has reacted angrily to the report arguing that ERL's calculations are "simplistic" and "off beam". The company instructed its consultants to review ERL's calculations and concludes that the suggestion of contaminated water returning to the surface in 300 years is "not consistent with published information for site characterisation programme."

Nirex believes the site continues to "show promise as a repository location" and is "absolutely committed to careful step by step investigation of the geology over the months ahead, only with extra



UK Nirex Ltd

information from continuing investigations can any meaningful judgements be made."

According to newspaper reports the Minister for Energy, Tim Eggar, was warned of the contents of the report just before Christmas. "Regrettably quotes such as this are likely to be publicly reported," reads a Department of Trade and Industry internal memorandum. Eggar, however, was assured that the industry was taking steps "aimed at minimising any adverse impact of reporting of the ERL work."

A pro-active stance is to be taken by

the industry, informs the memorandum: "This will involve strong public support for the Nirex position being expressed by ... experts, including the British Geological Survey, Sir Alexander Gibb and Partners and the AEA [Atomic Energy Authority]." All three are contractors to Nirex.

The company intends to submit a planning application later this year for a £120 million rock laboratory, to conduct site characterisation work, and to seek planning permission for the £3 billion deep repository by early 1997 and to have it operational by 2007. ERL believes this timetable is far too ambitious and will not allow adequate time for a full review, by both the public and experts, of the results obtained from the rock laboratory.

In addition ERL believes the area may contain a geological fault running from the level of the proposed repository, 750m underground, to the surface, which could carry water even faster. □

Cancer risk confirmed

LEUKAEMIA and blood cancers in young people living in the village of Seascale near Sellafield are in excess of the national average, a situation which is unlikely to have occurred by chance, according to a new study.

The excess of leukaemias and Hodgkin's lymphomas in Seascale were first identified by the Black report in 1984. At that time some critics said it was a chance occurrence. However, the new study by the Child Cancer Research Group at Oxford University,

the Leukaemia Research Fund Centre for Clinical Epidemiology at Leeds University and The Royal Victoria Infirmary, Newcastle, will further add to the controversy surrounding the opening of British Nuclear Fuels' Thermal Oxide Reprocessing Plant.

In addition to confirming Black's findings, the study, using data up to 1990, has shown that the incidence of the diseases has remained above the national average in the 0-24 age group.

■ A re-analysis of the health records of 36,235 workers at the

Hanford military nuclear establishment in the USA, by radiation pioneer Dr Alice Stewart, has confirmed the results of an earlier investigation, showing that even small doses of radiation are four to eight times more likely to cause cancer than is currently accepted by Government scientists.

Stewart and statistician Dr George Kneale have also found that those exposed to radiation in later life are more vulnerable to radiation induced cancer and that radiation delivered in small doses may carry a greater risk than that delivered in a single large dose. □

Russian roulette

WHILE anti-nuclear feeling in the former Soviet Union is still running high, following the 1986 Chernobyl disaster, the Russian government has approved plans to almost double the country's nuclear capacity by 2010, without carrying out any public consultation.

The decision taken by Cabinet, behind closed doors, on 24 December and passed by the Parliament four days later has been condemned by President Yeltsin's environment advisor Alexi Yablokov as "unacceptable from the legal, ecological, economic and political points of view."

The expansion, from 20 million kilowatts to 37 million, will be carried out in three stages. First, nuclear stations left unfinished following the Chernobyl disaster and the economic collapse of the former Soviet Union will be completed. This will involve three units — at the Balakovo, Kalinin and Kursk nuclear power stations — which will be brought into operation by 1995. Then, if local authorities agree, new stations will be built: on the Kola peninsula above the Arctic circle; near

St Petersburg; near Kostroma in central Russia; and near Khabarovsk in the Far East. Kursk is also expected to get a new RBMK, Chernobyl-type, reactor. Playing down any criticism of the decision to build a new RBMK, the Atomic Energy Ministry argues that extensive modifications have been made to the design, bringing it in line with recommendations made by the International Atomic Energy Agency. However, officials from the European Commission's programme for nuclear safety in Eastern Europe say there is "no such thing as a safe RBMK."

Finally, remote areas with no indigenous energy sources will play host to a series of small — 500-600MW — reactors of an unspecified design. They will, according to Deputy Minister for Atomic Energy Yevgeny Reshetnikov, be "small nuclear power units which do not require numerous staff or a great deal of servicing. These units would be designed for small villages."

The plan also envisages the construction of three fast breeder reactors, including the completion of one where construction was halted following massive local protest in 1989. Two of the three will be at Kyshtym in

the Urals. The Ministry of Atomic Energy also plans to build new reprocessing facilities, adding to Russia's stockpile of plutonium.

Although Russia as a whole derives only 11% of its energy from nuclear power, in arguing for the expansion Reshetnikov said some areas such as the north-west and the central 'black earth' region were almost entirely dependent upon it. Environmentalists may oppose the plan, he continued, but the public expect to have light and heat. Dismissing Western concern, he added that despite many promises of aid "not a kopeck" had been received, saying Russia must rely on itself.

Yablokov believes that small gas turbines "would be at least three times more economical than nuclear plants," and would take only 5 years to build. He believes the new plan is the result of lobbying by the "enormous nuclear lobby," which includes the military. He also thinks the European Energy Charter, signed in 1991, encourages Russia to sell its oil and gas to western Europe, "so we must develop nuclear power."

However, so far nobody has said where the enormous amounts of money required to carry out the plan will come from. □

East nuke concern

DESPITE massive publicity to the contrary, Western aid programmes aimed at helping the Commonwealth of Independent States (CIS) deal with the Soviet Union's legacy of decrepit, unsafe nuclear power stations are pitifully inadequate, according to Friends of the Earth (FoE).

In a new report,* FoE argues that the western nuclear industry is lobbying governments hard to provide finance for projects in central and eastern Europe (CEE) for three main reasons:

- to provide new contracts for their barren order books;
- to help reduce the risk of a further nuclear power plant disaster which could deal yet another body blow to the global nuclear industry; and
- to delay the decommissioning of any reactors in order to prolong the time before the industry has to face up to the technical and economic problems of doing so.

FoE observes that "almost every 'discussion', 'negotiation', 'co-operation agreement' and 'memorandum of understanding' has been heavily publicised," but

comments that: "In fact very little of substance has actually happened." The total sum of money provided to date to the CEE nuclear sector is \$800 million which pales into insignificance compared to the \$12 billion which Germany's engineering multinational Siemens believes is required to improve both reactor safety and develop more environmentally acceptable and economically efficient energy systems.

Of the money already spent or promised "nearly three times as much" is being focused upon completing partly-built reactors rather than is being spent upon making existing reactors safer. Arguably, "since backfitting will not completely suspend the risk of accident, it may be that Western firms are avoiding involvement in such activity to ensure that they are sufficiently distanced from any nuclear accident that does occur. In addition the report shows that more than twice as much "government-backed money" has been directed at expanding nuclear power in the region than has been spent on making existing reactors any safer.

Starved of hard currency, CEE nations are also being encouraged by western utilities to export electricity,

further encouraging the completion of partly-built plant and the operation of reactors which should be shut on safety grounds. Therefore, in order to meet domestic demand throughout the winter and to maximise the amount of foreign currency which can be earned, "It is likely that existing reactors will be run flat out in coming months. Rather than developing energy policies for their own needs, governments in the region are being directed by western interests."

The FoE report also highlights the growing problems of decommissioning and waste management. As neither activity produces any income, the former Soviets will require aid in the form of grants and not loans. However, "to begin the process of seeking funds for decommissioning ... the nuclear industry would need to face up to the full costs of decommissioning nuclear plants, no matter where they are, Russia, the UK, Lithuania or the USA. These costs, once assessed, would then be on the nuclear industry's balance sheet." □

* "Dangerous liaisons: Western involvement in the nuclear power industry of central and eastern Europe", researched by Tim Jenkins & edited by Simon Roberts. FoE, 27pp, £7.

Significant errors in the way the Ministry of Agriculture, Fisheries and Food (MAFF) assesses the radiation dose received by people exposed to Sellafield's marine discharges has been revealed by Friends of the Earth (FoE). Dr PATRICK GREEN and NICK CASSIDY of FoE outline their findings.

Winkling out MAFF's flawed figures

THE main body of Friends of the Earth's (FoE) objection to the granting of a new discharge authorisation for the Sellafield site, submitted to Her Majesty's Inspectorate of Pollution (HMIP), is a 165 page report, *Sellafield: the contaminated legacy*.

The group of people who receive the largest radiation dose as a result of Sellafield's marine discharges are consumers of fish and shellfish, particularly molluscs, from the local Sellafield area. Each year, as part of its annual monitoring programme, MAFF publishes an estimate of the dose received by this critical group which is used to claim that the discharges are "safe" because the doses are within the dose limits recommended by the International Commission on Radiological Protection (ICRP).

Since 1980, the dose received by members of this critical group has been dominated by plutonium and americium contamination in molluscs such as winkles. MAFF's dose estimates are based on measurements of contamination in seafood and on surveys of how much seafood is consumed by members of the critical group. MAFF does not stress the uncertainties in this approach; dose estimation is not a precise science. Average consumption rates are used for the dose calculations, which MAFF argues will tend to overestimate the actual dose received by members of the group.

MAFF does not publish any information on the observed peak consumption rates in its annual monitoring reports. However, it did supply limited information when FoE's objection was being prepared. According to MAFF, the peak consumption rate of molluscs was a factor of 2.1 times the "representative" average rate during 1990 [the last year for which MAFF has published data]. A variation of about a factor of three was found between the maximum and minimum observed consumption rates.

Logically, this would imply that some members of the group would receive a bigger dose than the figure MAFF publishes in its annual reports. However, MAFF advised FoE that this information should be interpreted with care and that one is "not entitled" to consider one individual and make the simple deduction that: "his consumption rate is

x therefore by applying the ICRP dose coefficients his dose must be y."

MAFF argued that this simple relationship does not stand because of the wide range of metabolic differences between individuals which would affect the actual dose received. A particularly important parameter is how much of the ingested plutonium or americium is absorbed through the human gut into the bloodstream. Although only small amounts of these radionuclides are believed to pass through the gut wall, they are highly radiotoxic once in the bloodstream.

Gut Uptake Factors

The proportion of a given radionuclide which is absorbed through the gut lining is accounted for in dose calculations by a gut uptake factor (GUF). These are based largely on animal experiment data, they are poorly defined and currently the subject of considerable conjecture. It is of paramount importance for dose estimation purposes that the GUF is not underestimated, otherwise calculated critical group doses will underestimate the dose received.

Until 1980, the ICRP assumed that only 0.01 per cent of ingested plutonium was absorbed (i.e. a GUF of 0.0001 was used). However, in 1982, the National Radiological Protection Board (NRPB) recommended that the GUF be increased five-fold to 0.0005. The adoption of this value led to a dramatic increase in MAFF's estimated doses. For instance, its 1981 dose was increased from 2.3mSv to 3.45mSv.

In 1986, the ICRP recommended a further increase in the GUF used for dose calculations. Its new value of 0.001 was intended as a "cautious" estimate taking account of uncertainties in the chemical form of environmental plutonium and americium and a wide range of physiological and dietary factors which may influence the gut absorption.

In its correspondence with FoE, MAFF argued that since the ICRP recommended a "cautious" value for the GUF, its calculated doses could be considered as "upper estimates" of the doses received by individual members of the critical group. In other words, MAFF considers that the use of average consumption rates together with a "cautious" GUF will not lead to an underestimation of doses.

In conclusion, MAFF stated that: "no significance in dose terms should be interpreted from the fact that anyone in the group is eating more, or less than anyone else in the group."

MAFF's argument has a fundamental flaw; it currently use a GUF five times lower than the ICRP's. In fact, neither the NRPB nor MAFF is willing to endorse the ICRP's value for the GUF even though it has been approved by an Expert Group of the Nuclear Energy Agency of the Organisation for Economic Cooperation and Development (NEA/OECD).

Using its own value for GUF, MAFF claims that the critical group has always received a radiation dose well within ICRP dose limits. However, if MAFF had adopted the ICRP's GUF, average doses for the Sellafield critical group would have exceeded the ICRP's 1mSv dose limit up to 1985. Since then, doses would have exceeded the NRPB's 0.3mSv tolerable maximum. Approximately 80% of the dose currently received by the group is due to contamination that has accumulated as a result of 40 years of reprocessing. Furthermore, the dose from existing contamination alone exceeds the NRPB's tolerable maximum. This means that the risk is unacceptable by NRPB criteria and no further discharges should be authorised.

Both MAFF and NRPB have attempted to justify their refusal to follow ICRP recommendations by reference to a statement in the 1986 ICRP gut uptake report, stating that if "a different value more suitable to the specific situation can be justified, it should be employed."

MAFF subsequently conducted two experiments in an attempt to derive a gut uptake factor that would specifically apply to the ingestion of Cumbrian winkles. It is not known whether these were conducted following a request from BNFL or whether MAFF undertook them on its own initiative. The first experiment, published in 1986, was based on eight volunteers who consumed contaminated winkles collected from the Cumbrian coast. MAFF concluded from this experiment that the GUF, which was estimated from measured excretion rates, was ten times lower than the new ICRP value.

The NRPB was initially sceptical of MAFF's experimental findings. It suggested that many of MAFF's conclusions were "open

to question" and that the data could actually support the use of a GUF that was as high as or even exceeded the ICRP's 1986 value. Inexplicably, the NRPB concluded that it would be prudent to continue to use its lower GUF recommended previously in 1982.

There is, however, a further inconsistency in the NRPB's approach. In 1987, the NRPB published a report on Generalised Derived Limits (GDLs) for environmental contamination. These limits were established as a benchmark against which the significance of environmental contamination could be assessed. The calculations used to derive GDLs involve the use of GUFs. The NRPB did use the ICRP's 1986 GUF for these calculations and moreover commented at the time that it actually "endorsed" this value. Curiously, this endorsement was not given wider application and the NRPB continued to use its earlier recommended value of 0.0005 until 1990 when MAFF published results of a further experiment also using eight volunteers. It concluded that the two experiments together supported a gut uptake factor five times lower than that recommended by the ICRP. Its new GUF of 0.0002 is intended to be used in "realistic assessments of dose" from consumption of winkles near Sellafield.

The NRPB has endorsed MAFF's conclusions and has stated that the two experiments constitute "sufficient" information to support the use of MAFF's lower GUF specifically for the Sellafield critical group. Neither MAFF nor the NRPB has recommended that this lower gut uptake factor be used for other foodstuffs, including winkles, from outside the local Sellafield area. In these instances, the NRPB's "best estimate" for the GUF remains at 0.0005.

The use of MAFF's new GUF has obvious implications for assessments of the dose received by the local critical group. Doses calculated using this new value are a fraction of the 1mSv limit and are within the NRPB's 0.3mSv tolerable maximum. However, there are good scientific reasons to question MAFF's experimental conclusions and the NRPB's decision to endorse them.

Intuitively, it is unlikely that there is any difference between absorption of plutonium and americium from winkles collected from the local Sellafield area compared with winkles collected elsewhere. Yet, the NRPB's endorsement of MAFF's GUF only for locally collected winkles clearly suggests that these are unique in some respect, though neither MAFF nor the NRPB has published any data to support such a conclusion.

MAFF's experiments were conducted on eight volunteers who consumed Cumbrian winkles in Lowestoft. From a

scientific point of view, two experiments each with eight observations cannot be considered as an adequate data set to derive a GUF which is applicable to the local population around Sellafield.

The data derived from MAFF's experiments has recently been reanalysed in research commissioned by FoE. This work, carried out by scientists in the Radiobiology Department at St Bartholomew's Hospital Medical College in London, concluded that MAFF's experimental data does not provide sufficient justification to warrant the use of a GUF lower than that recommended by ICRP. Indeed, the authors of this work reanalysed MAFF's data and concluded, from MAFF's data and a review of the available animal data, that a "best estimate" for both plutonium and americium absorption would be in the range of 0.0005-0.0008. The lower end of this range is the "best estimate" currently recommended by the NRPB for use in all dose calculations except those involving Cumbrian winkles.

The St Bartholomew's scientists also stated that factors such as fasting could lead to increased uptake of both plutonium and americium. Animal experiments have indicated a substantially increased (5-15 times) gut uptake after 24 hours of fasting. They drew attention to a scientific paper which suggested that: "persons who skipped breakfast and were orally exposed to plutonium before their first meal might absorb considerably more plutonium than their nonfasting counterparts."

Underestimate

They concluded that the NRPB's current "best estimate", of 0.0005, would "certainly under-protect certain members of the critical group". Consequently, a GUF equal to the ICRP's 1986 value, of 0.001, was recommended. It was felt that even this value; "may well underestimate the dose to some [members of the critical group] especially if, for instance, there are seasonal variations in the availability of actinides."

MAFF's experimental data is clearly open to challenge. What is surprising, and of concern, is that the NRPB has not come to a similar conclusion. If use of the ICRP's GUF was likely to lead to a significant overestimation of critical group doses, there would be some scientific justification for using a lower value. However, as described above, this is not likely to be the case. Indeed, the NRPB has even commented that the ICRP's GUF tends: "to incline on the side of conservatism without being unduly cautious."

It is difficult to reconcile this statement with the NRPB's endorsement of MAFF's GUF. Furthermore, the reanalysis of MAFF's

data by scientists at St Bartholomew's concluded that even the ICRP's GUF may underestimate the dose received by some members of the critical group. This being the case, it is difficult to understand how MAFF and the NRPB can claim that use of MAFF's GUF can possibly lead to realistic estimates of dose.

From a regulatory context, MAFF's GUF is of paramount importance to BNFL since it results in significantly lower dose estimates for the critical group. If MAFF's GUF is used, current doses are well within the ICRP's 1mSv dose limit and are less than the NRPB's 0.3mSv tolerable maximum.

Does the NRPB really consider that MAFF's experiments are good science? The NRPB should answer this question at the earliest opportunity.

MAFF's claim, to FoE, that its calculated doses are likely to be "upper estimates" of the dose received by members of the critical group, would also appear to be misleading. Far from being upper estimates, its calculated doses are likely to significantly underestimate the average dose received by the group. Members of the group with higher than average consumption rates will receive a larger dose. Average doses, from historical contamination alone, exceed the NRPB's 0.3mSv tolerable maximum. On this basis, the risk is unacceptable and further discharges must not be authorised. □

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Two long awaited reports on renewable energy were finally published just before Christmas. DAVID ROSS, a freelance journalist and author of *Energy from the waves*, is critical of the reports for their emphasis on economics rather than the environment.

Renewables reports: all about money

THE government has published two reports on renewable energy which it had been delaying for fear that they might develop into a general election issue. The fears were groundless. Both reports had been doctored to ensure that they gave no support to the argument that Britain ought to be investing seriously in clean energy.

The Renewable Energy Advisory Group (REAG) consisted of nine scientists who were presented as being independent. They were used in an exercise that was doomed in advance because they accepted the government's financial limitations.

From the report, a reader might think that renewable energy was all about money. It wasn't and isn't. Its original inspiration was the need to reduce pollution and stop using up finite resources. But REAG puts its main emphasis on costs, and imaginary costs at that, for new technologies. This leads it to accept that the government's miserable target of 1,000 megawatts by the year 2000 should be increased to only 1,500 — less than one large power station, a mere 2.5% of our installed generating capacity. It calls this a "significant contribution" and says "much of this will be in place as a result of market forces anyway." So government can sit back. And the report is presumably a waste of money.

All the cost calculations had to use the Treasury method of discount rates (see box), which is biased against capital-intensive projects. Those technologies with heavy expenditure at the start, and major benefits from "free fuel" later on, such as tidal, wave and offshore wind, appear formidably expensive. In addition, the Treasury is insisting on absurdly high discount rates, 8% and 15%, to discourage any expenditure. This is a problem in monetarist accountancy, not energy. None of this should have been the concern of scientists. If this was what was wanted, it would have been simpler to set up a committee of economists, auditors, book-keepers and experts in creative accounting and they could have invented any numbers they chose, just like the Treasury does with its forecasts.

The second report, by Tom Thorpe on wave energy, presents a similar problem. He is a public servant, employed by ETSU (the Energy Technology Support Unit), and

was given no choice about the discount rate. But he did make it possible for students of his two volumes to discover just how economically viable wave energy really is, when zero-rating or even a 2% rate is used.

Thorpe also revealed the wave energy device which appears likely to win the race to generate electricity in the open sea. Work to construct it off the north coast of Scotland, as a commercial venture, should start within the next 12 months.

The two reports should be considered separately.

REAG

On August 5 1991, Colin Moynihan, then Energy Minister, announced that he was setting up REAG, backed up by "information from a technical assessment being conducted by ETSU." He expected that the report "will be published early in 1992." This aroused suspicion. The general election was expected in the autumn of 1991 and the report could tide over the government by ensuring that energy did not become an issue. Against that, there was the fact that Moynihan, and the civil servant in charge of renewables, Godfrey Bevan, appeared genuine enthusiasts.

So if there was a dubious motive, it must belong to someone above them. The obvious suspect was John (now Lord) Wakeham, then Energy Secretary, who was and is widely regarded in Westminster as a master tactician, a card. What, in retrospect, is encouraging about this is that he understood and feared that energy and the environment could become a sensitive electoral issue; that is a lesson that other politicians — and environmentalists — need to learn.

Having assembled a committee of prominent scientists and businessmen, the Department of Energy played its master stroke. It laid down the terms of reference: "Consistent with current Government financial support for renewable energy to review strategy to stimulate the development and application of renewable energy technologies ..." Read it again. It is plainly a grammatical miscarriage, if not an abortion.

No-one would construct a sentence in that way. Plainly, it started life at the phrase: "To review strategy ..." But then someone decided that this was

giving the Group too much leeway. It might actually propose spending money! So what should have been the sub-clause was inserted at the front and whoever did the deed forgot even to insert a comma after the word "energy."

REAG was being told before it had even started work that it could not suggest any development which would cost much more than the miserable £24 million which was all that the government was spending. Who can have had the sort of mind that would make such a point? A civil servant, certainly, and therefore the person responsible, whether directly or indirectly, was the Permanent Secretary at the department, John Guinness. He is now chairman of British Nuclear Fuels.

The election was delayed and so was the report. It was virtually complete in March, 1992 when the election was called and could have been hurried through; instead, it was left to moulder. One of the members, Mary (now Lady) Archer, thought that the government would release it in time for her to talk about it at an energy conference last September. But with Moynihan losing his seat in the election, politicians seemed uninterested. It was only after a few prods in the press and in parliament that they finally released it as the House rose.

What does it contribute? There is a readable survey of the main energy sources, but no revelation. There are occasional remarks indicating that the committee has at least heard of the environment. It simply says that some renewables are not competitive "because current pricing systems do not take the environmental damage costs of established means of energy generation sufficiently into account." Sufficiently? They don't take it into account at all! Consider now how it tackles some of the specific sources:

Offshore wind energy: This is one technology which does not justify any further expenditure, says REAG. It is a very large resource but "it will require additional technology development before it can be effectively exploited." And it won't get it, if REAG has its way. This is baffling. Surely it was REAG's role to advocate development if it believes there is a "very large resource" to be captured? Wind power was represented by Dr. David Lindley, managing director of Wind Energy Group, which is doing very nicely from

the more limited resource on land. There was a CEGB plan for a wind turbine off Wells-next-the-Sea in Norfolk but it was dropped on privatisation. It would have demanded substantial investment.

Tidal barrages: The three-page summary proposes only that there should be "a thorough study" of environmental effects. Discount rates are cited as a reason for doing little. This should be contrasted with the classic report on the subject, *Tidal Power from the Severn Estuary*, published by the Department of Energy in 1981. It recommended an immediate design study costing £20 million and construction of a prototype caisson at a further cost of £25 million. Who was the author of this splendid, forward-thinking report? Why, Sir Hermann Bondi. And where is he now? Why, a member of REAG, whose report is decades behind the work which he accomplished 12 years ago. REAG seemed unaware of its existence. But Bondi wasn't. What has happened to the good man?

Solar energy: This receives a remarkably favourable report. Several technologies, including hot dry rock, are dismissed because they are only long-term prospects. But photoconversion, "is a legitimate subject for support ... to assess its long-term potential." Why the double standards? Could it be because this is a particular interest of one of REAG's more pushy members, Mary Archer?

Geothermal aquifers: The group dismisses it as being "mainly useful for district heating" (yes, why not?) and says market penetration would be "difficult" (so what?). It did not bother to visit the one site in Britain where an aquifer is working. It is only 75 miles from London, at Southampton, and was abandoned by the Department of Energy and the CEGB on the grounds that it was not fruitful. It was saved by the city council and a French company and, to ETSU's embarrassment, is now providing electricity for district heating at 2p a

kilowatt-hour. REAG puts the cost at 5p and does not say where it got its information. ETSU perhaps?

Wave energy: The Group stood back on the grounds that there was "a comprehensive review underway, the results of which were not available" — and then published a three-page survey (supplied presumably by ETSU) and recommended no funding for offshore waves. It knew nothing, but knew what it didn't like and recommended the abandonment of any "further" expenditure, apparently unaware that there isn't any. The only use for the waves was — symbolically — to break up oil slicks.

The Thorpe report

The wave review was set up in the summer of 1989 in response to the criticisms of official costings, chiefly by Professor Stephen Salter and a distinguished consultant engineer, Gordon Senior, who was attached to him as invigilator and then realised that the people who had employed him had got it wrong and Salter had got it right. The press and MPs were getting restless, two Select Committees called for an investigation and so a two-man, two-year inquiry was set up. One of the two left after a few months and Thorpe was left to carry on alone with the Department of Energy and later the DTI refusing to replace the missing scientist. Thorpe was harassed by the Wave Energy Steering Group which insisted on penny-pinching, sending him back again and again to visit the research teams and try to arrive at a precise mathematical conclusion on an untried technology. The one thing that is sure is that real life at sea will be different from any theoretical number.

The figures that he produced were disappointing. They ranged upwards from 6p for an Oscillating Water Column (OWC) on the beach, like the one at Islay. In the open sea, the cost would be 8p for the Clam from Coventry University and 16p for an OWC produced by the National

Engineering Laboratory at East Kilbride, and the same for a Salter Duck. If this sounds forbidding, take a lesson from recent history. ETSU put wave-electricity at 20-40p in 1978, which with inflation would now be 54-108p. And even in 1982 ETSU put the cost at 8p-14p which would now be 14-24p. So things are improving. ETSU has reduced the imaginary cost of a unit of wave-electricity in only 14 years from 54p to 8p!

What does this mean in reality? Thorpe has helpfully included graphs showing costings against different discount rates. All of the prices should be read against a zero discount rate, which is not unrealistic — it has been supported by distinguished economists who are in favour of progress, and by ETSU at one time. The picture then looks very different. The Clam costs 4-5p and the Islay model comes down to 3p.

Best of all, there is news that a newer device is likely to take to the water in the near future. Private sector funding has been obtained from, among others, British Steel and Scottish Hydro. It is called the OSPREY (Ocean Swell Power Respiratory Energy) and will stand in deep water (18 metres) off Scotland's north coast near Thurso. It has been designed by Professor Alan Wells, the inventor of the Wells turbine which has been adopted for most of the devices which use the suck-blow system of the Oscillating Water Column. The OSPREY is a development of it, a sphere standing on the sea bed, 20 metres in diameter, with twin chambers and twin turbines (Wells turbines, of course). It has been developed by Applied Research and Technology of Inverness, costs £1.9 million for the two-megawatt model (less than £1 a watt installed capacity) and will generate electricity for 4p a unit, zero discount rate. Construction will start this year and it should be generating at sea within two years.

This is the real world. It is opposed by fantasy-sums about the imagined cost of a technology that has been forced for so long to wait in the dry on land, while the energy of the waves goes to waste. □

DISCOUNT RATES

The discount rate is a method of calculating costs which is biased against what economists call "capital-intensive" projects. In ordinary language, it is weighted against any sort of investment in the future. It is favoured by the Treasury and imposed on all spending by government and quangos. Those projects which need heavy investment in the early stage but enjoy the benefits of low costs for fuel and maintenance suffer. But those which are cheap to build, like gas turbines, appear like a good buy, even though they will become increasingly expensive to operate as the cost of the gas rises with inflation and increased demand. Scotland's hydro-electric power, for instance, which produces our cheapest electricity, would appear prohibitively expensive and would never have been built, on the basis of the terms imposed by the Treasury today.

Discounting is based on the theory that costs which arise at the start of construction are of

greater value than costs (or benefits) in the future. So future expenditure and gains are "discounted." Then comes the question of what discount rate is chosen. For many years it was around 3-5 per cent per year. That encouraged growth. But in 1989 the Treasury was dominated by monetarists who wanted to hoard money, not invest it. It persuaded the Chief Secretary, one John Major, to increase the rate from 5% to 8%. The argument was that it needed to match the rate of return in the private sector. Since then the economy has crashed and returns have declined to a negative as companies have gone bust but the discount rate has stayed up high.

If it had been at this rate in the recent past, many major projects would have been forbidden. There is nothing sacred about 8%. OFGAS, the Office of Gas Regulation, has suggested that 2.5% to 5% is adequate. The Director General of OFWAT, Ian Byatt, himself a former Deputy Chief Economic Adviser at the Treasury, recommends

5%. Tim Eggar, the Energy Minister, disclosed in the Commons that the case for going ahead with the Thermal Oxide Reprocessing Plant at Sellafield is based on 6%.

ETSU (the Energy Technology Support Unit) itself wrote in 1985, in an earlier report on wave energy (R 26): "The simplest way of calculating the cost of wave energy is to divide the total cost of a wave power station (capital and interest cost plus the costs of operating and maintaining it) by the energy the station delivers to the grid." Exactly! How nice to find oneself in complete agreement with ETSU.

The problem of the cost of wave energy could be ended by a simple decision to slash the discount rate or better still abandon it and use the fair system of calculating the cost of building and running a power station, plus the cost of fuel if any, and dividing that by the number of units it will generate over its design-life.

It is often feared that countries acquiring nuclear power technology may subsequently obtain nuclear weapons. PETE ROCHE of Greenpeace examines the part played by the UK in the spread of nuclear technology, and finds that it is as culpable as any other country.

The UK's role in proliferation

THE UK, US and others have been quick to point fingers at North Korea, Iran and other Middle East countries and accuse them of attempting to obtain nuclear weapons. But if any effort to control the spread of nuclear technology around the globe is to have credibility, the same rules must apply to everyone. A closer examination of the role of the UK shows that its hands are far from clean.

The Nuclear Non-Proliferation Treaty (NPT), due for a major review in 1995, aims to curb the spread of nuclear weapons to additional countries, and reverse the nuclear arms race. The preamble to the Treaty also recalls a commitment by the nuclear weapons states to negotiate a comprehensive test ban treaty (CTBT).

The UK government has recently been particularly outspoken in its opposition to a CTBT. It has described the US testing moratorium as "unwise and misguided". The UK has also been accused of breaching Article VI of the NPT, which requires nuclear weapons states to work towards "general and complete disarmament". It is planning up to a four-fold increase in warhead capacity when the Trident programme becomes fully operational.

Former head of the Nuclear Energy Department at the Foreign and Commonwealth Office, John Gordon, has accused the government of breaching Article I of the NPT, which obliges the UK not to "assist, encourage or induce any non-nuclear weapon state to manufacture or otherwise acquire nuclear weapons." Documents released during the Matrix-Churchill trial reveal that not only were British companies supplying Iraq with machines which were used in their nuclear weapons programme, but also that the government authorised the sales in the knowledge that the tools were likely to end up in nuclear arms production. Foreign office minister William Waldegrave scrawled in the margin of one document "yes, I agree. Screwdrivers also required to make H-Bombs".

If British Nuclear Fuels plc's (BNFL's) Thermal Oxide Reprocessing Plant at Sellafield opens, we will be exporting some 40 tonnes of plutonium over the next decade to countries in western Europe and Japan. All of BNFL's customers will have an increasing stockpile of plutonium as a result. Not every country

committed to plutonium recycling has nuclear weapons ambitions, but it is the perception of that country's ambitions by its regional neighbours which is likely to aid nuclear proliferation. And plutonium has a half life of 24,000 years — governments can change. The US Department of Defense (DoD) takes a much stronger line against reprocessing than the UK. A recent plan by the Shoreham nuclear plant to send spent fuel to France for reprocessing was described by the DoD as likely to send an "unfortunate and extremely damaging signal ... The United States would be declaring that the proliferation risks posed by reprocessing — and separated plutonium under international standards are acceptably low. In the Defense Department's view they are not".

Nuclear services

BNFL has been making "strenuous efforts ... to establish new markets overseas where developing nuclear programmes are opening up new opportunities". (see for example "Korean proliferation risk" *Safe Energy* 90). It has opened an office in South Korea, for example, to market a range of growing nuclear services including reprocessing. Added to the growing stockpile of plutonium in Japan, BNFL's activities are likely to hinder the efforts of the international community to persuade North Korea not to pursue a nuclear weapons programme.

Dounreay has also been accused of undermining US attempts to eliminate trade in weapons-grade uranium. The US is pressing research reactor operators to convert to using low enriched uranium rather than highly enriched (HEU or weapons-grade) uranium. The Euratom reactor at Petten in the Netherlands is the first reactor to refuse to convert. It was prevented from buying fresh supplies of HEU fuel from the US by legal action taken by the Nuclear Control Institute. This is where Dounreay stepped in and offered to convert some unused German HEU into a form suitable for use in the Petten reactor. The US sponsored conversion programme could now be in jeopardy since many foreign research reactor operators have said they will convert to low enriched uranium only if everyone else does.

The use of HEU fuel for nuclear powered submarines is another area of proliferation concern, because it



encourages others to acquire nuclear propelled submarines. Argentina, Brazil, Canada and India all had plans to develop nuclear propulsion in the 1980s. Fortunately the first three have abandoned their plans for the time being and India has returned its submarines to Russia. However, it could be only a matter of time before other states seek to develop programmes in the future. While nuclear materials are being used in certain military activities, such as submarine propulsion, they can be withdrawn from nuclear safeguards. This could provide the opportunity for HEU to be diverted to a clandestine weapons programme.

The UK's activities have serious implications for its credibility as a leading international champion of non-proliferation and as a depository power for the Non-Proliferation Treaty. If the NPT is to maintain its credibility, the international safeguards system must be applied in an equitable manner to all signatories. Clearly export controls need strengthening if further Matrix-Churchill scandals are to be avoided, and the UK must be seen to be doing its utmost to achieve general and complete disarmament, starting with a CTBT. The NPT regime would also be greatly strengthened by ending reprocessing and the production of HEU. On current evidence the UK is a world class proliferator. If the NPT is to have any hope of success the UK should put its own house in order before pointing accusing fingers at North Korea and the Middle East. □

[The first preparatory conference (prepcon) for the 1995 review will be held in New York on 10-14th May 1993].

A key factor in the current chaos of the UK electricity industry is the 'dash to gas' which has utilised modern generating technology. STEVE MARTIN, press officer for Calder Valley Mineworkers Support Group, argues that the long-term benefits of indigenous coal can best be exploited by a similar use of modern technology.

A future for Britain's coal

THE problems with use of coal in Britain stem from the perception of it as a cheap commodity that can be directly burned to produce heat. When used in this way it produces large amounts of ash; and it emits sulphur and nitrogen oxides which cause acid rain, and carbon dioxide which contributes to global warming.

However, there are better ways of releasing energy from coal, and these are already being exploited by countries such as Germany, Japan, and the USA. Technologies have been in place for well over a decade for demineralising coal, removing sulphur before combustion, and converting coal to gas, which is a much more tractable and environmentally acceptable fuel. It is remarkable that Britain has steadfastly neglected this technology.

Electricity generation in a conventional coal-burning power station is profoundly inefficient: only 38% of the potential energy in the fuel is converted to electricity and, if flue-gas desulphurisation is employed this is reduced by a further 2%.

Combined Cycle Gas Turbine (CCGT) power stations convert fuel into electricity in two stages: first, burning gas drives a turbine and, second, the hot exhaust gases from the turbine are used in heat exchangers to generate steam. There are a number of clever ways of recycling heat to improve efficiency still further. The overall efficiency of gas-fired electricity generation is between 50% and 54% — considerably better than electricity generation by conventional coal burning. Foreseeable technological improvement suggests efficiency as high as 60% is realistic.

Furthermore, natural gas is easier to transport than solid coal, and since it is already relatively clean its combustion does not produce the same environmental problems as coal burning — virtually no contribution to acid rain, and less global warming effect because of the greater conversion efficiency and lower carbon content.

Clean power generation also raises the exciting possibility of urban siting of power stations, so that waste heat can be used for space heating in hospitals, schools, housing estates, and commercial and industrial buildings. By this "cogeneration" using CCGT technology, energy conversion efficiency could be increased to as high as 80%

The most obvious disadvantage of using natural gas in this way is that Britain's gas reserves are sufficient for less than a decade. We will thereafter need to import gas by pipeline from Norway and Russia, and by tanker (liquefied gas) from Algeria and Nigeria. Natural gas fired power stations will make us dependent on imports for the bulk of our electricity generation. Not only is this undesirable from the point of view of our balance of payments, but also it puts us at the mercy of our suppliers. Once we have lost comparable alternatives to gas-fired power generation, overseas gas suppliers will be able to dictate their price.

In any case, it is estimated that the price of natural gas will begin to rise sharply after 1996 because of the long distances over which it will have to be transported, requiring considerable capital expenditure for the necessary infrastructure. We can expect gas produced electricity to be cheap only for the next few years.

Future technology

Nevertheless, CCGT technology is almost certainly the power technology of the future. But the gas does not have to be natural gas. It is relatively easy to convert coal into gas (SYNGAS — carbon monoxide and hydrogen) by reacting steam with hot pulverised coal. Modern gasifier technology has already been developed by British Gas, Shell, Lurgi, Texaco and Siemens, and it is very efficient. Once SYNGAS is produced all the benefits of CCGT are available.

Moreover, the most effective way of generating SYNGAS uses coal as a slurry mixed with water, in which form it can be delivered by pipeline thereby saving on transportation costs. If the coal-water slurry is produced in the mine, it could be pumped to the surface, thus saving on mechanical haulage from underground. Savings on handling and transportation suggest the cost of Britain's deep mined coal (already the lowest in Europe) could be significantly reduced.

Gasification becomes even more attractive if the coal is first demineralised, since this eliminates the problems caused by ash in the gasifier, and it also removes pyritic sulphur. Demineralisation is carried out by blowing air through a coal/water slurry — the coal, being hydrophobic, sticks to the air bubbles and is carried to the surface, leaving the minerals in solution.

The remaining sulphur can be removed by Redox scrubbing at the precombustion stage: sulphur appears in SYNGAS as hydrogen sulphide, which can be oxidised to elemental sulphur using ferric chloride stabilised with nitrilotriacetic acid, the ferric ion is reduced to the ferrous form during the reaction and the oxidising agent is recycled after bubbling air through it to regenerate it.

This is a much more satisfactory solution to the sulphur problem than the current method of removing it as sulphur dioxide by flue-gas scrubbing, a cumbersome, costly and inefficient (only 90% removal) process, and one which consumes another resource (limestone) producing vast amounts of calcium sulphate waste (gypsum), with consequent disposal problems. Precombustion desulphurisation can be 99% efficient, and also produces the useful by-product (elemental sulphur), which at present we import.

The University of Manchester Institute of Science and Technology and Nottingham University are in the forefront of the new technologies for demineralising and desulphurising coal, but as yet neither British Coal nor the government has made use of their work.

Introduction of these technologies will present several advantages. Pits, miners jobs, and the British coal industry can be saved; employment can be created in the construction and power generation industries; energy costs to industry, commerce and domestic sectors can fall; fuel poverty can be seriously tackled; the rapid deterioration of the nation's housing stock can be reversed; and the country can gain by exports. And environmental damage resulting from years of thoughtless coal burning could be stemmed.

Britain's attitude to coal is hopelessly outdated. Clean coal technology offers us self-sufficiency in power generation for the foreseeable future, with environmental acceptability. Why do we persist in regarding our coal mines as liabilities? Clearly something has gone badly wrong in the decision making process when we seek to scrap our assets and ignore our resources; when short-term vindictive political considerations take priority over long-term economic, social and environmental improvements. □

As the state education system struggles on with insufficient resources to create or buy its own curriculum material, the nuclear industry gets its foot in the door. JAMIE WOOLLEY, lawyer with the Nuclear Free Local Authorities, suggests one way to counter this.

Schools' propaganda battle

THE nuclear industry has always had conflicting public relations goals: how to keep quiet about nuclear weapons but generate comfy feelings about nuclear energy — particularly after Chernobyl.

It makes a considerable effort in schools as research carried out for the UK Nuclear Free Local Authorities shows. British Nuclear Fuels (BNFL) produces 21 resource packs and targets its resource catalogue at all primary and secondary schools every single term. The Atomic Energy Authority provides free booklets, leaflets, posters, speakers, teaching packs, worksheets, videos, computer software and teachers guide booklets. Nirex provides a teaching pack *Safe for the Future* (distributing some 15,000 a year), a software package, talks and exhibition service. Nuclear Electric sent educational materials to 8,700 schools last year and Scottish Nuclear is developing materials. Nuclear Electric has also developed education programmes with Lancashire, Somerset, Suffolk and Essex education authorities and may well have others for the areas surrounding all their sites. BNFL, Scottish Nuclear and Nuclear Electric also provide free tours at their sites and exhibition centres. BNFL, for example, provide free transport throughout Cumbria for visiting schools to and from Sellafield.

But it's not just industry: under the Euratom Treaty member states of the European Community (EC) are committed to "... provide the conditions necessary for the growth of nuclear industries". After Chernobyl, the Commission reported that "... achievement of this (Treaty) objective requires the reassurance of the general public that both citizens and the environment are being adequately protected against the dangers of radiation ... (and therefore), a major and continuing information effort is also needed.", (para 53, COM (86) 434 Final). So the EC has already produced materials, including videos. In addition the EC's 5th Environment Programme, approved in Edinburgh under the UK Presidency in December last year, commits the Commission to spending 100,000 ECUs on preparing a Handbook for Teachers on nuclear energy to be distributed to schools. Does your MEP know?

Schools are so strapped for cash that they cannot afford to buy their own materials, so free material is naturally tempting and the nuclear industry can illustrate issues in physics, science,

technology, ecology and geology. But the material is not produced through a sense of altruism and fondness for learning: it is produced to get the message over. Directly or indirectly it overestimates the virtues of nuclear energy, underestimates the difficulties and avoids comparisons with alternatives.

What can be done to arrest this stream of one-sided material? In Scotland the regional education authorities retain control over the curriculum, although heads have some discretion over what to spend money on for teaching material. You can complain to the regional education authority that material is not compatible with balanced teaching of the relevant issues, but there are no specific legal requirements to support your argument. By contrast in England and Wales, (where state schools are subject to the centralised national curriculum and the local education authority has far less say) there are two very specific laws in Sections 44 and 45 of the Education (No 2) 1986 Act (see Box 1)

Partisan views

Section 44 places the education authority, the governors and the head teacher under a duty to forbid "the promotion of partisan political views in the teaching of any subject in school." These three words beginning with "p" are not defined. A recent House of Lords court case says that, if there are ambiguities in an Act, you can look at what Parliament said. On this basis "promotion" occurs when the views in question are not considered critically

and/or not presented along with countervailing views — one view is held to be the only valid view; and a "partisan" view is one which is unbalanced and lacks objectivity. A view would be "political" if it was "party political" at a local or national level, evidenced by, for example, an election manifesto, policy statement, or the view of a particular politician. But a view may also be political even if not held by a political party or politician as such, provided it is a view on an issue of some controversy.

Under section 45 the same trio of education authority, governors and head, must take "such steps as are reasonably practicable to secure that where political issues are brought to the attention of schools...they are offered a balanced presentation of opposing views." This applies in school and to extra-curricular activities (school trips to nuclear power stations, for example). What counts as a "political" issue is subject to the same interpretation as for section 44. Armed with references from election manifestos, policy statements, or politicians' speeches in the press or Parliament, it can be shown that many aspects of nuclear energy are political. If, therefore, a particular aspect of nuclear energy is a "political issue", the trio are legally bound to do their level best to make sure that opposing views to those expressed in the nuclear industry's material on the issue are presented on an equal basis in the school context.. The section does not simply say that if there is one view, another must be presented: it requires all views to be given an equal crack of the whip within reason. And the

BOX 1

Political Indoctrination

44(1) The local education authority by whom any county, voluntary or special school is maintained, and the governing body and head teacher of the school shall forbid:-

(a) the pursuit of partisan political activities by any of those registered pupils at the school who are junior pupils, and

(b) the promotion of partisan political views in the teaching of any subject in the school.

(2) In the case of activities which take place otherwise than on the premises of the school concerned, sub-section (1) (a) above applies only where arrangements for junior pupils to take part in the activities are made by any member of the staff of the school (in his capacity as such) or by anyone acting

on his, or the school's behalf.

Duty to secure balanced treatment of political issues

45. The local education authority by whom any county, voluntary or special school is maintained, and the governing body and head teacher of the school, shall take such steps as are reasonably practicable to secure that where political issues are brought to the attention of pupils while they are:-

(a) at the school; or

(b) taking part in extra-curricular activities which are provided or organised for registered pupils at the school by or on behalf of the school;

they are offered a balanced presentation of opposing views.

relevant views are not restricted to those of political parties but would include those of pressure groups or other organisations.

In interpreting these provisions the trio are obliged to consider the written guidance provided by the Department of Education and Science. (See Box 2) This guidance does not provide an authoritative interpretation of the law: only a court could do that, but it can also be usefully quoted.

If material is being used in schools in an essentially uncritical way and without balancing material such that breaches of section 44 and/or 45 appear to be occurring, what can be done? Where a duty is not complied with, the courts can be asked to enforce the duty by issuing an order preventing further breaches of the duty, but if there are specific complaint procedures in the relevant Act they must be used first. This is the case here for the education authority and the governors (but not the head teacher). Complaints against the authority or governors have to be made under arrangements for dealing with complaints which authorities had to establish under section 23 of the Education Reform Act 1988. (This deals with complaints that the authority or governing body "have acted or are proposing to act unreasonably with respect to ... the performance of any duty imposed on them by or under ... any ... enactment relating to the curriculum for ... maintained schools.") Advice on these arrangements given in Department of Education and Science

Circular 1/89 of 9 January 1989 envisaged that the first stage would be informal discussion with staff at the school, then formal complaint to the authority which might refer the complaint back to the governors, and if the complainant was not satisfied by the governor's decision, back to the education authority. Each school is supposed to have a copy of the complaints procedure available to the public.

Complaint

The Shutdown Sizewell Campaign complained under section 23 about the actions of Suffolk Education Authority which had produced the Sizewell Workpack for schools in its area with considerable assistance from Nuclear Electric. A panel appointed by the authority decided in July 1992 that there had been no breach of duty. (The authority was being asked to find itself at fault.)

If the complainant is not satisfied with the authority's handling of the complaint, s/he can then complain direct to the Secretary of State for Education under section 68 or 99 of the 1944 Education Act. (Again the Shutdown Sizewell Campaign has taken this step and the Department of Education is considering their complaint at present.) Section 68 deals with complaints that the education authority or the governors have "acted or are proposing to act unreasonably with respect to the ... performance of any duty..." Section 99 relates to a complaint that the education authority or the governors have "... failed to discharge any duty imposed on them ..."

Note however that the section 23, 68 or 99 procedures do not apply to the third of the trio: the Head Teacher. To that extent the Head Teacher would appear to be vulnerable to direct court action and a suitably worded letter to the head pointing out the personal nature of the liability might concentrate the mind in a way that the complaints procedure might not.

These procedures must be seen as a method for raising and publicising the issue and bringing pressure to bear for the withdrawal of the relevant materials or the provision of balancing materials. It would be naive to expect the procedures alone to yield results and a mistake to overlook the possibilities for publicity they provide. Realistically all those parts of the education system involved may well be reluctant to make a decision which appears to interfere with the professional judgement of any other part of the system, whatever sections 44 and 45 appear to say. □

Acknowledgement:

Thanks to Ann Rodgers for help in preparing this article.

Contacts:

For the legal arguments: Jamie Woolley 0742 735920.

For research on nuclear industry material and the availability of alternative material: Olive Bowers 061 2343325.

For practical experience of using the complaints procedures: Stop Sizewell Campaign, Peter Lanyon 0394 386273.

BOX 2

The treatment of politically controversial issues in schools

1. One of the principal functions of education is to prepare pupils for the active discharge of the responsibilities of citizenship. So issues of a politically controversial character will figure by design in some parts of the curriculum and can arise spontaneously in others. In treating such issues the education service in this country has long applied the principles appropriate to a free and open society. Sections 44 and 45.. protect pupils against political indoctrination and biased teaching by anyone who does not support these principles.

2. The duties imposed by section 44 would not be satisfied simply by issuing instructions forbidding the pursuit of activities or the promotion of views of a kind mentioned in that section. LEAs, governing bodies and head teachers should take such further steps as are necessary and reasonably practicable in order to secure that what is forbidden does not take place. Section 45 also applies directly to LEAs, governing bodies and head teachers and requires them to make judgements as to what will constitute a balanced presentation of opposing views. Such a presentation does not necessarily require a statement of all known viewpoints on every issue; but it should help pupils to understand why different sections of society hold opposing, and sometimes extreme views on the same issue, and to analyse critically and

evaluate their reasons for holding these views. In appropriate circumstances the terms of both sections will apply to books, leaflets, posters and any other publicity or information which schools provide or make available for their pupils.

3.... The treatment of politically controversial issues is a subject which can properly be included in an LEA's statement of curriculum policy, in the aims of the governing body, and, where necessary, in any modification which the governors make to the LEA's policy. If the LEA or the governors wish so to address the treatment of politically controversial issues they will need to take into account, amongst other things, representations from the community served by the school and any views expressed by parents at the annual parents' meeting. These matters in turn affect the head teacher when he (sic) determines and organises the school's curriculum, and the steps he takes to ensure its delivery.

4. The Secretary of State believes that sections 44 and 45 should not inhibit schools from dealing with controversial issues within the curriculum. Schools play an essential role in developing and teaching attitudes, knowledge and skills which are necessary for the proper appreciation of our society's fundamental values, notably its commitment to parliamentary democracy, the freedom of the individual within the law, and the equality of all citizens under the law. Pupils need to be equipped with the intellectual skills and

knowledge which are necessary if our society's fundamental values are to be understood, critically appraised, developed and defended. Among the attitudes, knowledge and skills to be encouraged are a rational and analytical approach to evidence and argument, both in forming opinion and resolving differences; the ability to detect bias; awareness of the duties and rights of citizenship; respect for the law and for the rights of other; including the right to hold their own opinions and to express them within the law; and an understanding of how law is properly changed and developed.

5. In fulfilling the duties imposed on them by sections 44 and 45 of the Act, LEAs, governors and head teachers should be ready to encourage schools to tackle issues that are politically controversial in accordance with the principles set out above. Teaching staff should at all times seek to distinguish between fact and opinion, be ready to acknowledge personal bias, make clear that on matters of opinion views other than their own may be legitimately held, and encourage pupils to form their own conclusions on the basis of evidence and reflection and of discussion with others. How this is best done for pupils of varying maturity and understanding is a matter of professional judgement by the teacher and calls for the exercise of professional responsibility within the duties imposed by this Act.

DES Circular 7/87, Education (No 2) Act 1986; Further Guidance, Annex 11.]

With the terms 'greenhouse effect' and 'global warming' now in common use, PAUL GILL, a graduate in environmental technology, looks at the background and underlying science of climate change, and makes recommendations for the future.

The science of climate change

IN the past, human populations have exploited the opportunities presented by climate change, adapted to them or moved. Humans crossed the Bering Strait and fled south into the Americas to escape the last Ice Age; droughts in the Sahara pushed populations southwards, or led to special adaptations like those of the Bedouin or Bushmen. The warm period between the 11th and 15th centuries AD attracted farmers to Greenland. During the Little Ice Age from the mid 15th to the mid 19th centuries Europeans, dismayed at their worsening climate, set out to more hospitable shores where they conquered and pillaged. The natural resource costs and benefits of these actions continue to this day.

Today, it can no longer be doubted that the greenhouse effect is being intensified ('enhanced') by human activity. The remaining uncertainties concern the magnitude, timing and regional distribution of the consequent climate change. The costs of control will almost certainly be elevated if action is delayed and the precautionary principle is not adopted. And today the size and extent of the global population precludes migration as an acceptable way of avoiding the impacts of climate change.

Yet, so far only the Netherlands has published its greenhouse gas (GHG) emission inventory and reduction strategy in accordance with the 1992 UN Framework Convention on Climate Change (FCCC) ("Climate change convention", *Safe Energy* 92). A Bill containing legislation to ratify FCCC is currently being prepared by the Swedish government. Britain and other European Community and Organisation for Economic Cooperation and Development (OECD) nations plan to ratify the FCCC by 1994.

While Britain's Department of the Environment (DoE) has recently published a discussion document outlining possible strategies to reduce carbon dioxide (CO₂) — but not other GHGs — in which the reality and seriousness of climate change threats, and the need for precaution are acknowledged, very little action is promised. Most attention is focused on inviting business and individuals to take voluntary action, reducing "the need for Government intervention" ("Climate for change", p20).

To understand the magnitude of what must be done, we must first gain a better understanding of the greenhouse effect: of the gases themselves, of other factors affecting climate, and of the relationship between the sources and sinks of GHGs.

The heat of the sun, together with the planet's own geothermal energy, causes the Earth to radiate warm, invisible infrared radiation, almost all with a wavelength between four and one hundred micrometres (µm). Whereas most solar radiation, which is at shorter wavelengths, passes through the Earth's atmosphere, a large proportion of the Earth's infrared radiation is absorbed by GHGs. The trapped heat energy is reradiated, mostly back towards the Earth causing the greenhouse effect.

The greenhouse gases

The contribution of any GHG to the greenhouse effect depends on the wavelength(s) at which the gas absorbs infrared radiation and its concentration and location in the atmosphere. Global warming potential (GWP) is a globally averaged measure of the warming effect of a GHG relative to CO₂ defined over a specified number of years.

UK CO₂ emissions in 1990 were around 160 million tonnes of carbon according to the government, at which level it is committed to aim to stabilise emissions by the year 2000. In comparison, the Netherlands plans a reduction of 3-5% in its CO₂ emissions of 50 million tonnes of carbon.

Methane (CH₄), which has a 100 year GWP of 11, is released by bacterial and other microbial decomposition of organic matter under anaerobic conditions. Ice core data suggests that the atmospheric content of CH₄ has more than doubled since pre-industrial times to 1.7 parts per million, with a 0.6% annual rate of increase. The high rate of increase is probably due to anthropogenic interference, even though emissions are less dominated by industrial sources than those of CO₂. Coal mining, waste disposal in landfill sites, and natural gas leakages are all significant sources. Increases in wet rice cultivation, forest burning and cattle production are responsible for agricultural sources now contributing 35% of global CH₄ emissions.

The total CH₄ emissions for the UK are roughly calculated to be 4.2 million

tonnes per year (Mt/y) compared to 0.96Mt/y for the Netherlands. The Dutch national strategy aims to reduce emissions by 10% by 2000. Methane was referred to only once, and other GHGs were not even mentioned, in the DoE discussion document!

Levels of nitrous oxide (N₂O), from a pre-industrial concentration of 280 parts per billion by volume (ppb), have risen to 310 ppb. Atmospheric concentrations of the gas, which has a 100 year GWP of 132, are currently increasing at 0.2-0.3% per year, largely as a result of increasing use of nitrogen fertilisers which release N₂O.

The production of adipic acid for nylon manufacture has only recently been recognised as a major source of N₂O. Global emissions from this source have been estimated at 0.7Mt/y, of which 13% is emitted from UK factories. The major British producer, ICI, aims to eliminate emissions by 1996. Fossil fuel combustion and catalytic converters are additional sources of N₂O. There are almost certainly other industrial sources which have not yet been identified.

The total UK emissions of N₂O are at least 0.16Mt/y. The published estimate for the Netherlands is 0.04Mt/y, which is probably an underestimate. Under the Dutch GHG emission reduction strategy emissions will be stabilised by 2000.

Because of their effect on the ozone layer, the leading producers of chlorofluorocarbons (CFCs), ICI and Du Pont, have cooperated with efforts to eliminate production of CFC-11 and CFC-12 by 1996. However, Du Pont has recently built a new plant to produce hydrochlorofluorocarbon (HCFC) substitutes which are, like CFCs, potent GHGs, and has successfully lobbied for their production to continue until 2030. In 1990 ICI produced up to 30,000 tonnes of HCFC-22, which has a 100 year GWP of 1,600. The figures for CFC-11 and CFC-12 are 3,400 and 7,100 respectively.

Due to the limitations of CFC data, and secrecy surrounding its release, the overall emission figures of 20,323 tonnes CFC-11 and 22,205t CFC-12 in 1988 must be regarded as conservative estimates.

Whether located in the stratosphere or troposphere ozone is a powerful GHG.

Ozone itself is very short-lived in the troposphere and rapidly decomposes forming hydroxyl radicals which attack methane and other volatile organic compounds (VOC — or hydrocarbons). However, nitrogen oxides (NO_x) and carbon monoxide (CO) from vehicles and NO_x from power stations upset the balance of these reactions, with ozone levels actually being increased in the troposphere.

Existing pollution controls incorporated into the Dutch emission reduction strategy aim to reduce CO emissions by 50% from 1990 levels, and those of VOC by 60% and NO_x by 55% from 1988 levels, by 2000.

Not all anthropogenic effects increase global warming. Stratospheric ozone depletion by CFCs may have offset some of the enhanced greenhouse effect that CFCs cause. Sulphur dioxide (SO₂) in the troposphere is oxidised to sulphate aerosol particles which directly reflect solar radiation and also increase the reflectivity of clouds; both these effects have offset global warming in the Northern Hemisphere. However, once efforts to reduce sulphur dioxide pollution are implemented these 'sulphate veils' will rapidly disperse. These counter-effects to global warming have only recently been incorporated in computer models of climate change.

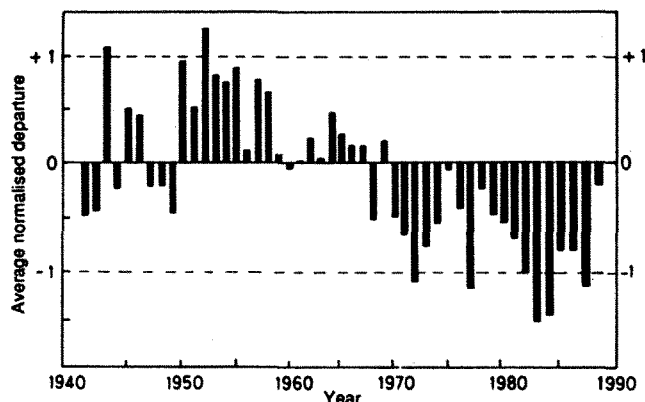
The current emphasis on CO₂ in policy analysis reflects its present pre-eminent role in enhancing the greenhouse effect. Furthermore CO₂ emissions are easier to control than those of CH₄ or N₂O, for which sources and sinks have yet to be fully quantified.

Water vapour and CO₂ strongly absorb infrared waves, except between 7 and 13µm. This 'infrared transmission window' permits up to 80% of energy radiated from the ground in the waveband 7-13µm to escape into space. The atmospheric concentrations of CO₂ and water vapour are now so high that most of the Earth's radiation apart from the window is already being absorbed. The implication is that further CO₂ emissions will trap progressively less heat and the relative importance of other GHGs is likely to increase.

CH₄, N₂O and ozone all absorb within the infrared transmission window, as do some CFCs and their relatives. Additional CH₄, N₂O and ozone cause a proportionally much greater warming than CO₂. It has been estimated that halving tropospheric ozone would cause a 0.5°C cooling, while a doubling would warm the planet by 0.9°C.

Global temperatures are also affected by other factors and vary on a wide range of timescales and as a result of volcanic eruptions, the El Nino/Southern Oscillation, solar variation and other factors.

Hothouse Earth by John Gribbin



Variations in rainfall in the Sahel region of Africa, as deviations from the long-term average

Predictions under "Business-as-usual" scenarios — published in 1990 by the Intergovernmental Panel on Climate Change — for the rate of change of global mean surface temperature are 0.3°C per decade (range: 0.2 to 0.5°C) rising to 1°C above present by 2025, and 3°C by 2100. Surface temperatures have already risen by 0.3-0.6°C this century, with seven of the eight hottest years occurring within the last decade.

The global mean sea level has risen by 15cm this century. It is predicted to rise by a further 6cm per decade (range: 3 to 10cm) and reach 65cm above present by 2100. Almost all of this can be explained by thermal expansion of the oceans but snowfield and glacial meltwater has made a contribution and this additional influence is expected to continue.

Starvation

While some developed countries' cereal producers may benefit from climate change, there is likely to be a 9-11% average decrease in less developed countries' production, resulting in a global reduction of 1-7%. Cereal price increases of 25-150% may drive a further 60 to 300 million people below the 'starvation line'.

Agro-climatic zones will move to higher latitudes and altitudes. For each degree centigrade temperature rise, movement could be as great as 300km towards the poles or 150m up mountains. Species which are currently restricted in where they can live by temperature will be forced to adapt or move.

Encouraged by warmer winter, summer and night temperatures a wide range of potential agricultural pests could increase. Insects carrying plant and animal diseases are on the increase in southern Europe.

The projected rates of warming would be greater than the planet has experienced in 10,000 years and the global mean surface temperature may reach the highest in 150,000 years. Projected temperature increases are recognised as being too great for many

sensitive species to migrate to suitable climatic zones. And those that can; may find the daylength and/or light intensity unsuitable.

Estimates of the size of terrestrial carbon sinks, rates of emissions through deforestation and burning, and rates of carbon fixation are controversial. In countries with large areas of forest, inland and coastal waters and peatlands, carbon may remain fixed for long periods.

Any reductions in deforestation rates with the elimination of wasteful biomass burning will have some effect on balancing the carbon budget — balancing sources and sinks. Land use changes that could be achieved in the UK would only make a modest contribution to this goal.

Only if the products of forests grown for timber or paper are taken out of the carbon cycle for long periods will such enhanced sinks make a real contribution. Fuelwood is important in displacing the use of fossil fuels, but does not act as a sink. Coal and other fossil fuels must be increasingly turned to higher quality end uses, such as plastics and pharmaceuticals.

Reductions in emissions of NO_x and SO₂ should reduce forest damage. This would assist the maintenance of existing forest sinks, and protect newly planted ones.

CO₂ emission reduction targets should be set immediately, and detailed inventories for each GHG should be made to permit the setting of future targets. Noting the uncertainties in CH₄, N₂O and ozone sources and sinks, it would be foolish to trade off reductions in any of these GHGs for increases in CO₂. □

* "Climate change: our national programme for CO₂ emissions", DoE, December 1992.

Two briefing papers by Paul Gill: "Climate change: policy, impacts and sustainable solutions" and "Climate change: the contribution of science to UK policy" are available from SCRAM at £3.00 each (plus 10% p+p)

Committee coal call

MOST of the 31 coal mines under threat of closure should be saved, according to the House of Commons Trade and Industry Committee.* However, Michael Heseltine seems intent on risking a backbench revolt by opting for a minimal reprieve for the pits.

The committee proposes a subsidy for English and Welsh generators to allow them to purchase an additional 15 million tonnes of coal per year (Mtc/y) for five years, and it calls on the government to require the generators to contract for an additional 5Mtc in 1994/95. This would bring the total to 55Mtc in 1993/94, 50Mtc in 93/94 and 45Mtc in each of the following three years. A further 3Mtc of coal per year in the non-electricity market should be subsidised for five years.

The subsidies would be conditional on British Coal (BC) meeting specified reductions in operating costs and on keeping open as many pits as possible.

A Coal Reserves Authority should be established to act as custodian of Britain's coal reserves and consider licence applications for former BC mines.

The nuclear industry had feared that part of the price for saving pits would be closure of its Magnox stations, but the committee stopped short of such a call. However, it proposes that the nuclear element of the Fossil Fuel Levy, currently paid to Nuclear Electric (NE), be reduced to "a sum sufficient to cover the liabilities which are to be discharged by 1998," and that the Levy

go to a trust to be responsible for NE's inherited liabilities. This would ensure that the Levy income "is used for its intended purpose" and "make clear that NE does not need and does not receive a subsidy for current operations." The 1994 nuclear review should, the committee says, be brought forward to this year.

In considering the environment, a carbon/energy tax is opposed "unless it can be shown that the tax is essential to achieve the UK's or the EC's commitments on CO₂ emissions and is more cost-effective than other measures."

The group urges the government to ensure that PowerGen (PG) installs FGD (flue gas desulphurisation) on a further 2GW of coal-fired plant, which taxpayers have already paid PG to undertake.

Subsidies should be available for either further FGD or clean coal technology, depending on relative cost effectiveness. "The government should demonstrate its commitment to the long-term future of the coal industry by announcing support for clean coal demonstration projects" and the DTI should determine future funding for research into coal use, including work at BC's Coal Research Establishment.

Stricter planning guidelines on open-cast mining are proposed, which would reduce output from 18Mtc/y to around 10Mtc/y.

The use of orimulsion should be restricted to plant fitted with FGD — a measure the committee believes would make the filthy Venezuelan oil/bitumen fuel uneconomic.

Several changes to the present electricity market are put forward, including a delay in

the liberalisation of supply to consumers below 1MW (ie continued monopoly protection for the regional electricity companies), and a reassessment of the effects of the 'pool' (spot market for electricity). Imports from France should be subject to the Fossil Fuel Levy, and export through the interconnector encouraged to ensure "equal trade both ways."

On the dash to gas, the committee believes that "careful consideration" should be given before any new gas plant is given consent. However, it recognises the benefits of CHP (combined heat and power) and schemes using sour gas, which is unsuitable for domestic use. In order to reduce the impact of those gas-fired combined cycle gas turbine (CCGT) projects already completed or under construction, it is suggested some capacity could be used as mid-merit or peak generating rather than baseload plant. Such a move could be facilitated by allowing CCGT operators to sell-on gas they are committed to buying under take-or-pay contracts.

The committee is highly critical of the Director General of Electricity Regulation, Professor Stephen Littlechild, believing he has failed to discharge his duties satisfactorily. It argues for a number of changes to the role of the Director General and also suggest establishing an Energy Commission to increase "the level of public information and scrutiny in the energy field." □

* "British energy policy and the market for coal", House of Commons Trade and Industry Committee. HMSO (HC237), January 1993.

US energy questions

IN Bill Clinton the United States apparently has a president intent on change. What this will mean for US energy policy is not yet clear, but the presence of Senator Al Gore Jr as vice-president has given environmentalists cause for optimism.

Gore has strong environmental credentials: he organised hearings on global warming in the late seventies; and led congressional efforts to encourage energy efficiency, reduce emissions of CFCs and promote nuclear arms control. And his recent book "Earth in the balance" sets out a powerful environmental agenda.

Of course, in the real world of government there are many different demands on energy policy, but environmental groups are pressing Clinton to adopt a "sustainable energy blueprint". A package which would create a million jobs by the year 2000, triple the use of renewables and reduce total energy use by 10% by 2010 and reduce greenhouse gas emissions by 25% by 2005 has been endorsed by groups including Friends of the Earth and Environmental Action.

The Gulf War highlighted US dependence on imported oil, and either Clinton maintains an open ended

commitment to military intervention in the Middle East or extensive changes are made to the fundamentals of US energy policy. Any move for change is likely to be fiercely resisted by the powerful military, industrial and oil lobbies.

In his early days as governor of Arkansas — one of the poorest states in the Union — he came under pressure from the states two largest economic forces: logging and chicken farming. Believing that the necessary price for securing jobs was environmental degradation, he gave in to the industries' demands. His record since then has improved, and his plans for stimulating economic growth are subject to a 'green screen' to block environmentally harmful proposals.

In looking for early signs of how the Clinton administration's energy policy will shape up, key appointments are being scrutinised. John Gibbons, the new adviser on science and technology, began his career as a nuclear physicist at Oak Ridge National Laboratory in Tennessee, moving on to interdisciplinary research on energy use and the environment. Since 1979 he has been director of the congressional Office of Technology Assessment, where he has earned a reputation for avoiding taking controversial political stands. US environmental pressure groups have, however, welcomed the appointment, calling Gibbons thoughtful,

knowledgeable and skilful in navigating Washington's political waters.

Clinton's choice for Secretary of Energy is Hazel O'Leary, an electricity utility executive who served in the Department of Energy under President Carter and in the Federal Energy Administration during President Ford's administration. O'Leary is well versed in nuclear power issues: as vice president of Northern States Power Co, she was on the front line in the utility's clash with Minnesota regulators over expanded spent fuel storage for the Prairie Island plant; and in March last year she told the Senate Energy and Natural Resources Committee that resolution of the waste issue was the key to nuclear power's fate in the US, saying "It is not reasonable to assume that responsible business people will risk billions of dollars to invest in new nuclear plants when there is no place to store fuel."

O'Leary is an enthusiastic supporter of energy efficiency, a point she stressed several times to reporters after Clinton's announcement of her appointment. Describing US dependence on imported oil as "unconscionable", and calling for change at the energy department, she noted that a wide array of demand side and supply side options would be necessary. She also backs renewable energy technologies, and believes that natural gas should be used as a 'bridge' energy source until these can be developed to maturity. □

Reaaargh!

A target of just 1,500MW for renewable energy by the end of the century has been called for by the government's Renewable Energy Advisory Group (REAG).^{*} The long awaited findings ("Reviews delayed", *Safe Energy 91*), published just before Christmas, do however include a number of proposals which are more encouraging for supporters of renewables.

The 1,500MW figure, a 50% increase on the government's present target, is far below the 3-4,000MW proposed by the now scrapped House of Commons Energy Committee.

REAG, recognising the environmental and sustainability benefits, states that renewables "can and should make a significant contribution to future energy supply in the United Kingdom." Government intervention in the market is necessary because of the distorted market and "institutional barriers and constraints".

The group believes that renewable technology needs to be "well established in this country against the time when the market becomes favourable." And, with a possible 60TWh/yr coming from renewables by 2025 (20% of present

supply), it is essential to have the "manufacturing capability and for electricity companies, planning authorities, local communities and users to be well acquainted with the characteristics of renewables," so they "can be exploited by industry as soon as they become cost-effective".

In addition to the low target for the year 2000 — "shrivelled ambition" according to Simon Roberts of Friends of Earth — there has been criticism from some quarters of the treatment of individual renewables.

Hydro power (large and small scale) and solar water heating are considered "close to technical maturity" and requiring little further research and development (R&D). In need of "modest" government R&D are energy from wastes and crops, horizontal axis wind turbines, passive solar and tidal power. Photovoltaics and geothermal hot dry rocks are seen as less appropriate to the UK but worthy of international collaborative study.

The losers in the REAG report are geothermal aquifers, vertical axis wind turbines and large offshore wave energy devices, which are considered not to justify "further significant public R&D expenditure." Professor Stephen Salter, designer of Salter's Duck (see "Wave costings" below), described the group's

conclusions as "nonsense", citing design improvements in wave energy devices.

In an effort to divorce renewables from their present incongruous links with nuclear power, the group calls for the splitting of the NFFO into nuclear and renewable components, with a Renewable Energy Obligation (REO) — which should be extended to Scotland and Northern Ireland. And the Energy Technology Support Unit (ETSU) should be renamed to reflect its renewables role "clearly independent from the nuclear industry".

REAG argues that additional changes to the REO should include:

- fixed term 10-15 year contracts with support commencing from the commissioning date of the plant;
- the introduction of technology bands, with indicative band sizes; and
- government consideration of the disadvantage placed on heat-producing schemes.

In a mixed bag of a report, there is little doubt that the government will seize on the modest short-term target as an excuse for continued backsliding on support for renewables, leaving the group open to accusations of political naivety or hypocrisy. □

^{*} "Renewable Energy Advisory Group: report to the President of the Board of Trade", DTI, November 1992.

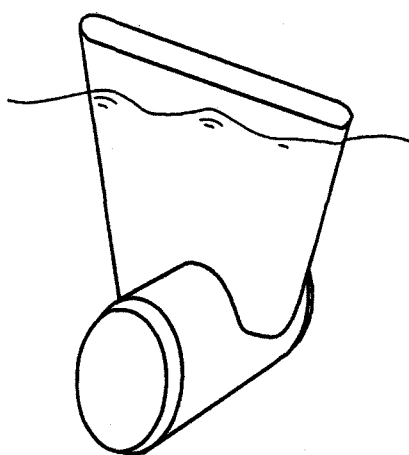
Wave costings

WAVE power has been priced at between 6 and 20p/kWh in a Department of Trade and Industry report^{*} released just before Christmas. The much delayed review was carried out by Tom Thorpe of the Energy Technology Support Unit (ETSU), and its findings could well be used to keep offshore wave power in the doldrums.

The cheapest electricity price is attributed to the Queen's University of Belfast Shoreline Gully Oscillating Water Column (OWC) design ("Wave power first", *SCRAM 83*) undergoing testing on Islay, Scotland. At an 8% discount rate it is costed at 6p/kWh, or 9p at 15%. Although such devices offer lower capital and maintenance costs they are site dependent and the total resource is therefore relatively small.

For offshore devices, the 'technical resource', allowing for configuration limitations, inefficiencies, etc, is put at an average of 7GW for inshore locations and 10GW for deeper water. This corresponds to about 11-15% of current UK electricity capacity with a strong seasonal correlation to demand. However, the report argues that economic constraints mean "the 'Practicable resource' would be much smaller."

Of the four offshore devices examined in detail, the Sea Clam (a spine-based flexible bag developed by Coventry



The Lancaster University PS Frog

University and Sea Energy Associates) was considered the most economic: 8-9p/kWh at 8% discount rate, 17p at 15%.

Two other offshore devices, the Bristol Cylinder and the National Engineering Laboratory OWC, were costed at 12-20p and 16-29p respectively.

Salter's Duck, developed at Edinburgh University by a team headed by Professor Stephen Salter, was at the centre of controversy over the 1982 review ("Wave Scandal", *SCRAM 67*). The device has now been priced at 16-26p. However, Salter — while praising Tom Thorpe for his work in carrying out the review — told *Safe Energy* he believes substantial cost reductions can be achieved. A report in *New Scientist* suggested that

improvements identified by the review but not included in the costings could reduce the figure to around 4p/kWh (at 8% discount rate).

Three latecomers in the wave power stakes, which were given less thorough consideration, are: the Lancaster University PS Frog ("Wave progress", *Safe Energy 92*) costed at 6-9p/kWh at an 8% discount rate; the Applied Research and Technology Osprey, 7p/kWh at 8% and the Ecovision Lilypad, 15p/kWh at 8%.

Given the sorry history of wave power reviews, the report is at pains to point out the level of consensus achieved, especially with the various design teams. The review itself identified a number of design changes to several of the devices resulting in reduced cost and improved performance.

The main criticisms with the report are over the economic assessment. The high discount rates of 8 and 15% used in the report are particularly harsh on projects with high capital cost and lengthy construction time but low running costs. In addition, particular concern has been expressed that the costings in the report will be compared with electricity prices from other generating plant and the electricity pool price which aren't subject to the same economic rigours. □

^{*} "A review of wave energy Volume 1 Main report" by T W Thorpe, ETSU; DTI, December 1992.

Climate for change

THE Department of Environment (DoE) views its role in reducing carbon dioxide (CO₂) emissions as encouraging action by others. A discussion document on climate change*, in response to the Rio Earth Summit ("One small step", *Safe Energy 89*), suggests a minimalist information-based role for the government, with the bulk of the responsibility to meet CO₂ emission targets falling on voluntary measures from individuals, businesses, voluntary organisations and the public sector.

The most interventionist policy discussed is the European Commission's proposed carbon/energy tax ("EC energy/carbon tax", *Safe Energy 90*), though the DoE may prefer a straight carbon tax which, it argues, "would be likely to achieve greater savings" in emissions.

Energy Paper 59 ("No nukes forecast", *Safe Energy 91*), published earlier in 1992, predicted an increase in UK emissions by the year 2000 of 10 million tonnes of carbon (MtC) from the 1990 level of 160MtC. Despite 70% of this increase being attributed to the transport sector, most of the new report is concerned with homes, offices and

factories. Its emphasis is on encouraging energy saving and fuel switching.

On transport, the document offers little more than a suggestion that: "Car manufacturers could launch national and local competitions for fuel efficient driving." More effective measures, like emission regulations, "would be difficult to formulate" and "tend to restrict the choices available to the motorist and the manufacturer."

It is suggested that: "Individuals could be encouraged ... to think more carefully about their transport choices." Unfortunately, given the effects of bus deregulation — lower bus use and the outlawing of cross-subsidy from profitable to non-profitable routes — people are likely to decide to go by car.

The DoE has left the key issue of

electricity generation to the Department of Trade and Industry's coal review. And it is further constrained by the rider that: "the programme should be consistent with the Government's objectives and priorities for public expenditure." Its approach is, of necessity, aimed at what others can do for it.

The stark warning in recent TV adverts of the threat of global warming is part of the DoE's Energy Efficiency Office "Helping the Earth begins at home" campaign. It is a message which the government itself does not seem to have taken on board. □

* "Climate change: our national programme for CO₂ emissions", DoE, December 1992. Copies can be ordered on 081-809 4609, the closing date for submissions is 31 March 1993

	million tonnes carbon (MtC)				
	1990	1995	2000	2005	2020
Households	41	39	41	42	42
Industry/agriculture	56	56	58	61	71
Commercial/public	24	23	26	30	45
Transport	38	41	45	49	62
TOTAL	160	159	170	183	221

Emission projections under central scenario, Energy Paper 59

Acid comments

SERIOUSLY underestimated by the government, according to atmospheric pollution specialists. Department of Energy (DoE) calculations show 8% of UK soils at risk from acidification by 2005, but calculations made for Friends of the Earth (FoE)* based on methods used in other European countries, reveal that "at least 47% of UK soils will still be at risk ... early next century."

'Critical load' maps — showing the maximum pollution which ecosystems can tolerate without long-term damage — have been produced by the DoE in a way which incorrectly classifies large areas of land. The UK was originally mapped in 1km squares, assigning one of five critical load categories to each square on the basis of its dominant soil type. These results have now been lumped together for 20km squares, with the most frequent category of the 1km squares being assigned to the whole of the larger square. This has led to significant areas of land being wrongly

attributed higher tolerance levels.

Calculations of critical loads will be central to crucial negotiations within both the European Community (EC) and the UN Economic Commission for Europe (ECE) which will consider more stringent acid emission controls.

The 1985 UNECE Sulphur Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution (CLRTAP) — the '30 per cent club' — is being renegotiated for revision in November 1993. The UK opted out of the original protocol, but is coming under increasing pressure to sign the revised version which will be based on critical loads.

Policy gap

The CLRTAP oxides of nitrogen (NO_x) protocol, which the government has ratified, commits the UK to freezing emissions at 1987 levels by 1994. Estimates suggest that present government policy may not be sufficient to meet this obligation.

The EC has recently published new overall aims for reducing SO₂ and NO_x, based on critical load scenarios, as part of its fifth Environmental

Action Plan. And critical loads may also be used in the 1994 review of the EC Large Combustion Plant Directive.

According to Andrew Tickle, air pollution consultant to the World Wide Fund for Nature, "critical loads were pioneered by Britain in order to give proper scientific criteria to the acid rain debate. They became official government policy. But now that scientists have begun to map critical loads, the results are proving most unwelcome to politicians."

■ Acid rain problems in Asia are to be monitored by an international network of scientists following a \$1 million grant from the World Bank. By mapping the ecological impact of acid rain across the continent, the researchers hope to alert Asian governments to the damage caused by individual emissions of sulphur and nitrogen oxides, and to recommend ways of reducing the discharges. □

* "Critical loads and UK air pollution policy", Andrew Tickle and Jim Sweet, Earth resources research Ltd. Friends of the Earth, January 1993, £6.00.

UK wind update

NINETEEN-NINETY-TWO saw the completion of 7 new wind farms totalling 29MW, but it was not all plain sailing for the nascent industry. Less than half of the 43 projects awarded contracts under the Non-Fossil Fuel Obligation (NFFO) have been granted planning permission, with 11 refused consent and five schemes having withdrawn.

Some of the projects which have

been refused planning permission are still being actively pursued by their developers and the position should be improved by new planning guidelines issued by the Government.* However, delays together with the 1998 cut-off for NFFO funding will make it increasingly difficult for these projects to make a commercial return.

Amongst those wind farms currently under construction is the largest outside California, USA. The 103 turbine, 31MW development at Llidiart y waun and Penrhyddlan

started to feed power to the grid on 26 November last year, and is due to be completed early in 1993.

Average output from each of the 300kW turbines is expected to be around 100kW.

The project is a joint development by Japanese firm Tomen, Californian wind farm specialists Seawest, and British firm Ecogen. □

* "Planning policy guidance note: renewable energy" PPG22, Department of the Environment and the Welsh Office, February 1993.

UK WINDFARMS

Site	Developer	Turbine Type	No. of Turbines	Installed MW	Commissioning Date
OPERATIONAL					
Delabole, Cornwall	Wind Electric	Vestas Windane (Denmark)	10	4	November 1991
Carland Cross, Cornwall	Renewable Energy Systems	Vestas Windane	15	6	August 1992
Haverigg, Cumbria	Windcluster	Vestas V27	5	1.25	October 1992
Cemmaes, Powys	National Wind Power	WEG MS-3 (UK)	24	7.2	November 1992
Rhyd-y-Groes, Anglesey	Ecogen	Bonus (Denmark)	24	8.4	December 1992
Chelker, Yorkshire	Yorkshire Water	WEG MS-3	4	1.2	End 1992
Blyth Harbour, Northumberland	Blyth Harbour Wind Farms	HMZ Windmaster (Belgium)	9	2.7	End 1992
Winterton-on-Sea, Norfolk	Euros Power	Vestas V27	10	2.25	End 1992
UNDER CONSTRUCTION					
Great Orton, Cumbria	Carter Wind Turbines	Carter (USA)	10	3	January 1993
Coal Clough, Lancashire	Renewable Energy Systems	Vestas Windane	24	9.6	February 1993
Penrhyddlan, Powys	Ecogen	Mitsubishi (Japan)	43	12.9	Early 1993
Llidiart y waun	Ecogen	Mitsubishi	60	18	Early 1993
Cold Northcott, Cornwall	National Wind Power	WEG MS-3 + 1 WEG 40	21	6.4	Spring 1993
Llangwyrfon, Dyfed	National Wind Power	WEG MS-3	20	6	Spring 1993
Werfa, Glamorgan	Windstar Turbines	Windstar (China)	10	0.5	Spring 1993
Ovendon Moor, Yorkshire	Yorkshire Windpower	Vestas Windane	23	9.2	Summer 1993

Sources: Windpower Monthly; Electrical Review, Department of Trade and Industry

Hydro revamp

RETROFITTING ageing hydro plant to improve its efficiency and output is becoming big business. In Canada, the Ontario government has just given approval for a £600 million 20-year project to renovate 34 small hydroelectric stations in the province.

By installing newly designed turbines, generating capacity can be improved by 15-20%, and redesigned and manufactured waterways and generator sets can give even greater improvements.

Christian Habegger, general manager of hydraulics with Sulzer-Escher Wyss — one of the world's top three turbine manufacturers — predicts the retrofit business will continue to grow, especially in industrialised countries where nuclear power has become unpopular.

Habegger believes the technology could also be helpful in eastern European countries with many hydro plants in poor condition and a need to shut down dangerous nuclear stations. □

Solar success

THE world's biggest array of thin-film photovoltaic modules, at Davis in California, USA, has been declared a commercial success by the scheme's backers.

Installed in September 1992 by Advanced Photovoltaic Systems (APS) of New Jersey, USA, the 9600 module pilot project has been evaluated by scientists from utilities and government agencies. Pacific Gas and Electric, a leading member of the consortium behind the project, has now connected the 479kW array to its grid.

Walter Andrews of APS claims that thin-film photovoltaics — made from amorphous silicon deposited on a substrate of glass titanium oxide — provide more watts per dollar than any other photovoltaic. □

Algae power

A 25kW engine is being run on dried and powdered algae at the University of the West of England. The key to the process is the device for growing the algae, known as a Biocoil. It is a 5 metre high transparent tube through which the algae are circulated allowing them to grow far more efficiently than in a traditional lagoon.

The only inputs to the system are sunlight and nutrients; carbon dioxide fed to the Biocoil is produced when the dried and powdered algae is burned.

"It sounds Potty," admits Paul Jenkins of the university's faculty of engineering, "but it works. The algae burn a treat." It is planned to scale up the process to a 600kW pilot plant, and Jenkins believes that generating costs of 3p/kWh are possible. □

REVIEWS

Cool energy: renewable solutions to environmental problems (revised edition); by Michael Brower.

The MIT Press; 1992, 191pp, £11.75 pb £22.50 cloth.

Writing on renewable energy seems to be a more successful growth industry than is the subject matter. However, *Cool energy* is a welcome contribution to the discussion of renewables. The American perspective of the book has its disadvantages, only one page on wave power for example, but as Brower notes "the United States contributes about 24% of world carbon dioxide emissions from fossil fuels," so it's a perspective of great interest.

Since the days of President Carter, which saw the California wind rush and solar panels on the White House roof, it has been a lean time for US renewables. The hostility of the Reagan years, which saw drastic cuts in research funding, was symbolised by the removal of the White House solar collectors.

Brower advocates the 'no regrets' approach to CO₂ abatement with "measures that make sense from an economic and environmental perspective regardless of whether global warming is accepted as fact."

On nuclear power, with no new stations ordered in the US since the Three Mile Island accident in March 1979, Brower sees the key impediments to any long term future for the industry to be safety and cost.

As well as a general look at renewables, there are individual chapters for different types. On solar energy, Brower points out that the land take per kilowatt hour generated is equal to or less than that for strip mining coal. Wind energy has the potential to supply "perhaps 20 percent or more" of US electricity,

though Brower bemoans the lack of resource data on promising sites. Biomass, rivers and oceans and geothermal energy are all covered in reasonable detail.

The book also has an interesting chapter on energy storage, which will become increasingly important with growing use of intermittent renewables like wind power. Though, as Brower recognises, this problem is often overstated, it must be addressed, and a range of possibilities are suggested — with the surprising omission of flywheels.

While there is little in terms of content to distinguish "Cool energy" from a plethora of other books on the subject, it is neither too technical nor too simplistic, producing a useful text for those seeking a general overview of the full range of renewables. It also includes an interesting background chapter on the environmental need for renewables, and concludes with a section on "policies for a renewable future" which is as relevant to the UK as it is to the US.

GRAHAM STEIN

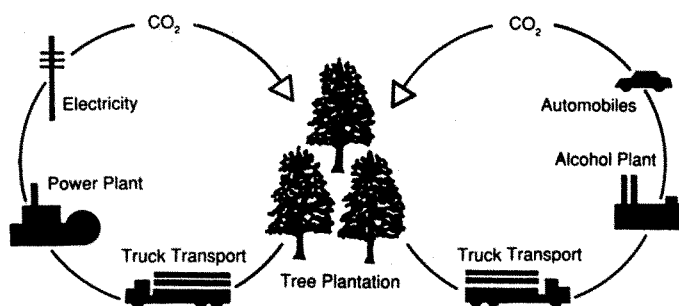


Figure 5.5 When biomass is produced and consumed for energy in a sustainable fashion, about the same amount of carbon dioxide generated in combustion is reabsorbed in plant growth, so there is no net contribution to greenhouse warming. This figure shows two possible fuel cycles, one supplying transportation fuels, the other electricity. Source: Weinberg and Williams (1990).

Plutonium: deadly gold of the nuclear age; by a special commission of International Physicians for the Prevention of Nuclear War (IPPNW) and the Institute for Energy and Environment Research.

International Physicians Press; 1992, 178pp, £15.*

As you would expect from IPPNW, this latest publication gives a comprehensive account of the health dangers of producing plutonium. There are also chapters on warhead dismantlement, plutonium disposal and nuclear proliferation.

The sections I found newest and most original were those on high-level waste — information not well known about reprocessing in the former Soviet Union is included. A chapter devoted to the Kyshtym disaster of 1957 describes "a curious sort of collusion ... between the

Soviet and US weapons establishments, for fear that a concerned public would raise uncomfortable questions about the weapons complex or shut it down."

Kysthym — one of the world's worst nuclear accidents was caused by an exploding high-level waste tank — a potential hazard hardly discussed in the UK since the Windscale Inquiry — perhaps it should be revisited. A further chapter is devoted to the potential for explosions and fires in high-level waste tanks: "at various locations around the world, workers and nearby residents will be stuck with

risks of tank fires and explosions for periods ranging from years to decades, even if reprocessing were to be stopped today." Nor is contamination confined to the former Soviet Union — some 750,000 gallons of liquid waste containing more than half a million curies had leaked out at Hanford in the US by the late 1980s.

IPPNW makes a series of recommendations. They want no further separation of plutonium for military or civilian purposes, and existing plutonium stockpiles, whether civilian or military, should be put under secure international control. All plutonium should be treated as waste material — never again to be used.

There is little on the hazards of plutonium transport, only passing reference to Japan's plans to import around 40 tonnes from Europe by sea, and

nothing about internal flights of plutonium within Europe, flask safety and so on. The section on nuclear proliferation is pretty thin — it would have been interesting to discover whether the medics pointed fingers in the usual direction of the Koreans and Arabs or blamed the real proliferators — the UK's BNFL and Cogema of France. Nevertheless a useful book, whose main contribution will be to renew debate on the safety of high-level waste tanks, at a time when arguments over Sellafield's future are raging.

PETE ROCHE

* Available from Medact (IPPNW's British section which recently changed its name from the Medical Campaign against Nuclear Weapons to Medical Action for Global Security — Medact), 601 Holloway Road, London N19 4DJ (071 272 2020), price inclusive of p&p.

REVIEWS

The dammed: rivers, dams, and the coming world water crisis; by Fred Pearce.

The Bodley Head; 1992, 350pp, £18 hb.

"The dammed" (pun intended) provides Pearce with a catchy title, but his book actually deals with a wide range of water management systems. He details many failures of such schemes, often through colonial arrogance, and contrasts this with ancient and successful irrigation methods which have gone almost unnoticed.

The basic message of the book is that attempts to dominate the powerful forces of nature are doomed to founder, while projects which work with nature can flourish.

The catalogue of displaced people, increased flooding, reduced soil fertility and drought resulting from attempts to command the world's rivers justifies the underlying anger that has inspired this book.

The culprits in Pearce's view are "the engineers" — anti-rationalists, mystics and ideologues. What he seems to ignore is that the ancient water systems he rightly admires were built by the engineers of their time, and that many latter-day engineers do not share the views of their technocratic contemporaries.

To be fair, the true culprits behind the mega-schemes are also mentioned: imperialist nations, autocratic regimes and the World Bank. Pearce observes that: "Large water projects are both the consequence of and the justification for authoritarian government," and "domination over rivers produces domination over people too."

Several chapters look specifically at hydroelectric projects, and opponents of

renewable energy will find plenty of statistics to support their views. The rate at which siltation is reducing reservoir capacity is indeed alarming. "Most of the largest hydroelectric dams in the world today, occupying the best sites for power generation, will have lifetimes shorter than the average coal mine," comments Pearce.

The real lesson though, which should be familiar to *Safe Energy* readers, is not that hydro power cannot provide renewable energy, but that small-scale schemes that work with nature are better than large-scale projects that seek to control it.

Such a philosophy did not appeal to the British in India and Egypt, intent on growing cotton for their mills, nor does it to premier Li Peng in China or Colonel Gaddafi in Libya. Li Peng plans a superdam on the Yangtze River which will take 20 years to build, cost \$20 billion and displace a million people. Many believe the project will do

more harm than good, and the risk of the dam failing has been likened to the Sword of Damocles. Gaddafi plans to "pump half as much water from the desert ... as gushes from the world's oil wells" and transport it across the country through two massive pipelines (the first was completed in 1991). The Colonel talks of "several hundred years of production", his engineers predict fifty. The total cost will be \$20 billion, \$130,000 per hectare of irrigation: the whole project is a massive gamble. Yet, the desert the pipes run across shows the remains of "water-gathering structures that made it possible 2,000 years ago to farm the desert."

Pearce's book is well worth reading, an interesting blend of history, hydrology, engineering, people and politics, or as the jacket blurb puts it, "the first comprehensive study of river exploitation and man's attempts to replumb the planet."

GRAHAM STEIN

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**The social and environmental effects of large dams
Volume 3 - a review of the literature;
edited by Denys Trussell.**

Wadebridge Ecological Centre; 1992, 243pp, £30.

This volume is a timely reference for those wishing to look at various aspects of dams and related issues.

Including reviews of 370 articles, reports and books in 18 categories, it is designed for "people campaigning in opposition to large dams."

Of particular interest to *Safe Energy* readers is the chapter on hydro-power, but there is much of interest on related environmental issues, including: displacement of peoples; floods and flood

control; economics of dams; and structural safety.

GRAHAM STEIN

The earlier volumes in this series, which is edited by Edward Goldsmith and Nicholas Hildyard, were "an overview" published in 1984 and "case studies" in 1986.

All three volumes are available from WEC Bookservice, Worthyvale Manor, Camelford, Cornwall PL32 9TT, at £30 per volume (£45 for non third world institutions).

LITTLE BLACK RABBIT



Nuclear ETSU

The government's Energy Technology Support Unit (ETSU) has been trying hard to distance itself from its nuclear paymaster and landlord, the Atomic Energy Authority (AEA) at Harwell. How embarrassing for ETSU then that the AEA's own newspaper "AEA Times" should insist on using the phrase "Our Energy Technology Support Unit".



NE goes solar

Guests at Nuclear Electric's Christmas party must have pondered the significance of the gifts NE were handing out — pocket calculators, solar powered.



NE's handy hints

And even more interestingly, Nuclear Electric's Heysham power station calendar for 1993 contains handy hints for a nuclear emergency. In the event of evacuation residents should take their pets with them, but they are reassured that "no harm is likely to come to them if they are left behind." However, on a more cautionary note, residents are advised not to stop to harvest fruit or vegetables from their gardens.



Letter from Warrington

LBR has been sent an interesting cutting from the letters page of the Cardigan and Tivy-Side Advertiser. Joseph Lythgoe has put pen to paper to vilify wind power — "monstrous Meccano sets" — and aims to establish a national opposition force to wind power. Strangely, his address is a PO box, even stranger it is in Warrington — the home town of British Nuclear Fuels. LBR would be interested in hearing about any similar letters.



Nuclear free sponsorship

On a trip to Nuclear Free Manchester to visit the Museum of Science and Industry LBR discovered a number of non-nuclear electrical exhibits sponsored by British Nuclear Fuels.



Bond spy story?

Martin Bond, whose latest book is Nuclear Juggernaut (Reviews, Safe Energy 89), recently went on a tour of Sweden, Denmark and the Netherlands photographing renewable energy projects.

On his return to London he found his flat had been burgled, but his hi-fi and other saleable items had not been taken. All that was missing was the entire contents of a filing cabinet: files and photos on the nuclear industry. "Has anybody got a grudge against you?" asked the local police before 'screening out' the case within days. This was despite sightings from neighbours of two men carrying material from the flat and fingerprints inside the wrecked filing cabinet.

Oh yes, and another thing, his phone was out of order as well.



Gore blimey

When Andrew Warren, Director of the Association for the Conservation of Energy, noticed that ACE's fundraiser at Sadlers Wells coincided with the Presidential Inauguration in the USA, he decided to turn it into an Inauguration Party to honour Al Gore — the environment vice-president.

Helpfully added to the invitations was a note that "the Vice President may not be present all of the time."

Warren was amused to receive a phone call from a humourless Under-Secretary at the Department of the Environment inquiring at what time precisely Al Gore would be attending.

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