

THE SAFE ENERGY JOURNAL

SCRAM

No.79 October/November'90 £1.00

**Japan's
plutonium
glut**

**A green view
of the Severn
Barrage**

**Electro-
pollution:
The killing
fields?**

**Greenhouse
conspiracy?**

**Contaminated
coast
controversy**

**Stand up for
renewable
energy**

**Dounreay's
deadly trade**

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**HINKLEY &
SEA**

COMMENT

LOW-LEVEL nuclear waste may end up in a near surface repository after all - not in the Tory shires as was previously proposed, but in 'nuclear' Jack Cunningham's constituency at Drigg, where BNFL hope the local population will be a little more compliant. Costs, of course, will be dramatically reduced. Another cost saving measure is the plan to build mounds over decommissioned nuclear power stations. In their desperate attempt to reduce nuclear costs, the industry want to leave us with a legacy of nuclear waste dumps scattered around our countryside.

As if that wasn't bad enough: both Dounreay and Sellafield are touting for business around the world. Nuclear waste imports into the UK are set to increase dramatically, with increasing quantities arriving on scheduled cross-channel freight ferries. Opposition to nuclear waste disposal is not peculiar to Britain, and governments around the world are quite happy to take up the UK's offer and send their waste here. By 1995, when the vitrified waste is due to start going back to the client countries, opposition to transporting nuclear materials could have reached such a fever pitch that we have no alternative but to keep it. Do we really want flasks of vitrified high-level waste travelling around the world anyway?

The case with which the nuclear industry could be revived in 1994 is shown by the Barnes report on the Hinkley C Inquiry. The blanket approval for the power station came as a shock, even to cynical anti-nuclear objectors. Whilst accepting that nuclear power is more expensive at the moment he says it could make a useful contribution to combating global warming and add to the diversity of supply. The industry has 4 years to bring down their waste disposal costs, come up with a cheap decommissioning plan, massage the figures here and there and bingo - the new improved PWR to be followed by the Safe Integral Reactor.

But by the same token, the anti-nuclear movement also has 4 years. This once impoverished section of the population with very few resources, now has support in some very unlikely circles. We mustn't fall into the trap of thinking we can sit back for a while.

As we go to press, and the Government conduct a new review of the potential for wave power, the Energy Technology Support Unit, rather the wave energy project manager, Roger Price, has advised the European Community not to fund wave energy research.

He said that the UK Government "would strongly oppose inclusion of any research and development on large scale, offshore wave energy devices".

Compounding the suspicion that the Units connection with the Atomic Energy Authority has seriously damaged its reasoning, he told the Community that, in 1982 prices, "the most likely cost of wave energy from the best offshore devices was estimated to be in the range of 8-14p/kWh". He added that this corresponds to 14-24p/kWh in 1990 rates.

However, earlier this year, a Government report on the Salter's Duck wave power device was withdrawn from scientific libraries, by the Government, because it contained a serious error, resulting in the doubling of the estimated cost of wave power (SCRAM 76). The unit cost was amended to 5.2p/kWh. Wave power funding was cut because the DoEn said in 1982 that no device could break 8p/kWh.

This latest revelation hardly engenders an optimistic attitude towards the new review.

The **SCRAM 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 (SCRAM)**. Views expressed in articles appearing in this journal are not necessarily those of SCRAM.

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We welcome contributions of articles, news, letters, graphics and photographs; which should be sent to SCRAM at the address below.

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SCRAM reserves the right to edit letters to fit the available space. All letters for publication should be submitted by the news deadline given below.

COPY DEADLINES

The Copy Deadline for **feature articles** for the next issue (December '90/January '91) is **6 November**. (Feature articles are approximately 800 words per page.)

News copy should normally be submitted no later than a fortnight after the features deadline.

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The advertising rates for camera ready artwork are:

Full page (190mm x 270mm)	£100
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BACK ISSUES

Back copies of the journal are available for most issues. Copies from the previous year cost £1.20 (inc. p&p) or £6 for the set of six. Issues more than a year old are 75p (inc. p&p).

SUBSCRIPTIONS

For details of subscription rates see the form on the back page.

PRODUCTION

Editors: News - Pete Roche
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COVER DRAWING

Cover drawing by Dennis Martin

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

☎ 031-557 4283/4

Fax: 031-557 5448 (no junk faxes)

ISSN 0140 7340 Bi-monthly

SCRAM

No.79 - October/November '90

CONTENTS

<i>Comment</i>	2
<i>Nuclear News</i>	4-7
<i>Features</i>	8-21
<i>Safe Energy</i>	22-25
<i>Reviews</i>	26-27
<i>Letters</i>	27
<i>Little Black Rabbit</i>	28

FEATURES

8 Japan's plutonium glut

Large quantities of surplus plutonium are likely to be produced in the 1990's. This will cause political and security problems, particularly in Japan, argue **Frans Berkhout** and **William Walker** of Sussex University's Science Policy Research Unit.

10 A green view of the Severn Barrage

Proposals for a Severn Barrage were the subject of a 2 year study by the Department of Energy, published last October. The author of the Severnside Green Party's response, **Graham Dummett** a chemical engineer, offers a 'green' approach to the issues involved.

12 The killing fields?

Roger Coghill, author of a new book *Electropollution: How to protect yourself against it*, considers the possible harmful effects of electro-magnetic radiation, including cot-death, ME, multiple sclerosis and AIDS.

14 Greenhouse conspiracy?

Much publicity was given to Channel 4's *The Greenhouse Conspiracy* which argued that global warming is not happening. **Martin Ince**, science correspondent of the Times Higher Education Supplement found the programme's approach fundamentally flawed.

15 Contaminated coast controversy

A Friends of the Earth (FoE) report *Unjustifiable Exposures*, featured in a Yorkshire TV documentary, has received much criticism. FoE Radiation Campaigner, **Patrick Green**, defends the report which details radioactive contamination from Sellafield of extensive areas of Lancashire farmland.

16 Stand up for renewable energy

It is time to face up to the conflicting local and global environmental interests of schemes such as a Severn or Mersey Barrage. **Dave Toke**, convener of the SERA energy group and author of *Green Energy*, puts the case for promoting a wide range of renewable energy systems.

18 Dounreay's deadly trade

With the fast reactor programme being shut down, Dounreay is attempting to generate income by 'accepting' spent fuel from research reactors world-wide. **Pete Roche** examines the military, storage and nuclear waste implications of this reprocessing trade.

20 Pollute Electric?

The area electricity boards and the supply industry could be playing a key role in protecting the environment. **Mike Harper**, FoE's assistant energy campaigner, reports on FoE's plans to put pressure on the English and Welsh area boards, and suggests structural changes to allow the industry to make a full commitment to promoting energy efficiency.

Australian contract sought

DOUNREAY have held "preliminary discussions" with the Australian Nuclear Science and Technology Organisation (ANSTO) with a view to securing a contract to reprocess spent fuel from the High Flux Australian Reactor (HIFAR). "Commercial negotiations", however, "would require prior Australian Government approval."

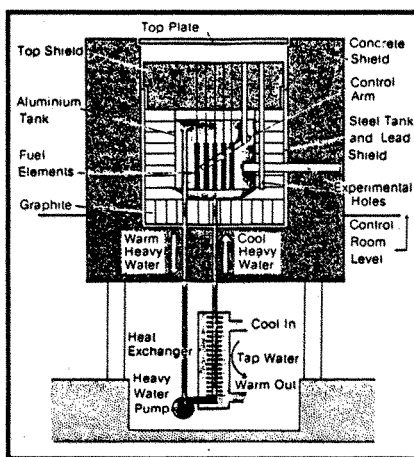
Australia has only one nuclear installation - Lucas Heights - about 30km south-west of Sydney. There are two research reactors on the site: the HIFAR and the smaller, low-powered, MOATA. Built in the late 50s, it has, until recently, attracted little attention from the anti-nuclear movement.

Out of the six DIDO-class reactors that were built only three remain open, the HIFAR, one at Risø in Denmark and one at Jülich in West Germany. The two at Harwell and one at Dounreay are shut.

Following the unexpected closure of the DIDO reactor at Harwell, in March this year, FoE Australia called for the closure of the HIFAR reactor in the wake of its first ever independent safety audit. Although Harwell claim that DIDO was closed for economic reasons, Paul Mobbs of the local Banbury Environmental Research Group has accused them of "being economical with the truth" (*SCRAM* 76). FoE's concerns have been confirmed by some of the Lucas Heights staff, who agree that the reactor should be closed down because safety has deteriorated.

The HIFAR reactor has received fuel elements from both the UK and the US. 150 spent fuel elements of UK origin were sent back to the UK in 1963. Around 1,400, of both UK and US origin, are in storage at Lucas Heights, and a further 50 or so accumulate with each year of operation.

In December 1985 the Australian Government announced its intention to transport some 450 of these spent fuel elements to the US for reprocessing. The Minister for Resources and Energy at the time, Gareth Evans, said "existing spent fuel storage capacity at Lucas Heights will be fully taken up during 1986 unless at least some fuel elements are removed or additional storage capacity is provided. The latter option is not desirable as it would merely defer a decision on eventual long term disposal."



HIFAR reactor schematic

After many postponements the 450 spent fuel rods have still not been shipped to the US. It was reported in February 1989 that they were packed up and ready to go, but had become victims of the US moratorium. The US Department of Energy (DOE) were forced to call a temporary halt to the import of foreign waste until an environmental assessment was carried out, after American anti-nuclear groups threatened to take court action; they had already stopped the import of Taiwanese nuclear waste. The environmental assessment has yet to appear.

If ANSTO do decide to send the 450 spent fuel rods - the tip of a very large iceberg - to Dounreay to solve their storage problem, it will be a much larger quantity than would come from most of Dounreay's other potential customers. For example, the only reactor known to have signed a contract with Dounreay is the Physikalisch Technische Bundesanstalt reactor in West Germany, which has asked Dounreay to reprocess 39 spent fuel elements.

However, ANSTO may think twice before sending their spent fuel to the UK. Their contract with the US DOE meant the waste would "be retained in the US and isolated from the environment". Sending spent fuel to the UK would merely defer the decision on long-term disposal. But, because of the success of environmental campaigns in the US, we may yet see nuclear waste travelling half-way round the world from a country with vast deserts to one stupid enough to take it. □

Fast Breeder

DOUNREAY management are exploring ways to keep the Prototype Fast Reactor (PFR) running after 1994, when it will lose its government funding. If Dounreay want to continue operating PFR without interruption they will have to order new fuel by the end of this year.

One option is to expand PFR's role in the development of the European Fast Reactor. Another is to build companion

generating capacity so that PFR can become a commercial generator. Currently PFR sells power to the Scottish Grid, but because its supply has to be interrupted to allow research work to be carried out, it is paid less per kilowatt-hour than it would be if it were a reliable supplier. So Dounreay is investigating the possibility of building other generating capacity, possibly non-nuclear, to supply power when PFR is off-line.

■ Superphenix, the French prototype fast reactor, has been shut down for the third

time this year, due to corrosion in its sodium filters. The French authorities are now seriously considering shutting the station permanently. Whatever decision is taken, Superphenix will not come back on line for several months.

■ The German fast reactor at Kalkar will not get an operating licence this year. First several technical problems must be solved. The West German government and the companies and utilities involved will decide what to do with the £7bn reactor next year. □

German contracts

WEST German utilities have signed reprocessing contracts with BNFL and their French competitors, Cogema. Of the country's 20 nuclear reactors, 6 will send all their spent fuel to the UK and 13 will send it all to France. The Muelheim-Kaerlich reactor will send half to each.

BNFL has won about 45% of the work on offer from the utilities, worth £800m. They will reprocess almost 1,600 tonnes of spent fuel sometime in the second decade of operation of their Thermal Oxide

Reprocessing Plant (THORP), which is expected to open in 1993.

BNFL argues that it already has a full order book for THORP's first decade, and the German business will help secure the plant's long-term future - it has a design life of 25 years.

Cogema has won contracts worth £900m to reprocess about 2,000 tonnes of spent fuel. Their UP3 reprocessing facility will begin reprocessing the German spent fuel in the year 2000, when all their current work is complete. Cogema's contracts with the German utilities contain provisions for cancellation should the German Government reverse its policy on reprocess-

ing. BNFL has refused to reveal whether their contracts contain similar clauses.

Cogema's contracts also allow the utilities to pay for an extension of the waste storage period in France, raising fears that German vitrified high-level waste may be stored in France for a significant period of time, pending the availability of a German repository.

■ BNFL has announced that its £240m vitrification plant at Sellafield is now operational. The plant has been built to convert high-level liquid waste, from both the Magnox and THORP reprocessing plants, into glass blocks. □

Ferry follies

IN June Greenpeace supporters chained themselves to a Dover-bound Sealink ferry at Dunkirk to highlight the increasing use of freight ferries to transport nuclear waste flasks from continental Europe on their way to Sellafield. On-board the ferry was a cargo of spent fuel from West Germany.

Current movements of spent fuel into the UK amount to about 300 tonnes per annum, with the bulk arriving at BNFL's private berth at Barrow docks, in a fleet of purpose-built ships. However, movements through Dover using scheduled cross-Channel roll-on roll-off (ro ro) freight ferries have increased dramatically, rising from two flasks in 1988 to 16 during 1989, and a scheduled 37 this year. Within the next few years spent fuel imports will rise to about 500 or 600 tonnes per year, and the imports via Dover will increase to between 50 and 100 flasks.

"These flasks pose an unacceptable risk, no matter which vessel they come in on", says Greenpeace's Jack Cade, but to have them coming in on ro ro ferries "shows irresponsibility beyond belief".

On top of this, vitrified high-level waste (HLW) exports are scheduled to start in the middle of this decade, with an average of 10 flask movements per year.

Greenpeace commissioned independent consultant engineers, Large and Associates, to investigate the safety of the import and export of radioactive materials. Their report* concludes that transporting spent fuel and vitrified HLW carries an unacceptable level of risk - an accident could result in intolerable consequences.

Lloyds register of shipping losses shows that the risk of losing a ship by fire or explosion to be about once every 245 years of ship operation. BNFL reckon that their specialised ships are exposed to a risk of 1 in 33,000 years. The UKAEA, who transport plutonium nitrate from Dounreay to Sellafield by sea, once or twice a year, reckon the risk of losing a plutonium nitrate shipment by fire is once every million years.

Ship fires are not exceptional events, and are characterised by high temperatures and long duration - often in excess of 20 hours - whether the ship is berthed or at sea. John Large concludes that if a spent fuel flask was caught in a ship fire, it could fail after about 2 hours. In a fierce fire, a significantly larger proportion of the flask contents would be released to the atmosphere than predicted by nuclear industry models. Similar conclusions are reached for both plutonium nitrate and the proposed vitrified HLW shipments.

BNFL's purpose built ships include additional collision bulkheads, segregated cargo holds, advanced fire suppression systems, and are staffed by superior certificate officers. Barrow has special handling facilities, regular emergency exercises, and local emergency services are kept fully informed. By contrast, the same spent fuel flasks arrive on scheduled freight ferries which have neither special facilities nor specially trained crews, the flasks share the cargo space with other hazardous cargoes, and Dover doesn't appear to have a flask accident emergency plan.

Despite the superior arrangements at Barrow, BNFL's risk estimates are questioned by Large. A recent American study considered a concept design for an 'unsinkable' ship for the transportation and emplacement of nuclear waste into the sub-seabed. Despite all the protection measures this 'unsinkable' and 'fireproof' ship still ran a risk of fire on board of once in every 5,100 years. In comparison with the 'unsinkable' ship, the BNFL Pacific class ships seem frail maritime structures, so their risk estimate of 1 in 33,000 years is hard to believe.

The International Atomic Energy Agency (IAEA) require that flasks are designed to survive the impact of a 9 metre fall (equivalent to an impact speed of about 30mph), being engulfed by fire for 30 minutes at a temperature of 800°C, and immersion at a depth of 200 metres for 1 hour. Large contends that these tests are not particularly onerous and certainly not representative of the harsh physical abuse prevailing in real accidents. Freight trains often exceed 30mph, and trains pass over viaducts and bridges considerably in excess of 9 metres -

as high as 42 metres on one route.

Real ship fires often burn for hours, if not days, at temperatures in excess of 800°C. How a flask could be salvaged from a vessel sunk at 200 metres within one hour is not considered by the IAEA.

The nuclear industry will not accept the possibility of a serious flask accident, so little data is available on the escape of radioactive materials from a ruptured flask. Large believes an extended ship fire could promote greater releases than normally assumed, even by critical analysts, because the fire could continue to rage once the fuel cladding has failed. Critical analysts often only consider the initial thermal mechanisms which breach the flask and promote failure of the fuel cladding. Large concludes: "a serious fire incident on board a ship carrying radioactive materials could, in the extreme, result in severe consequences for members of the public resident and working in the general area of the port." Deaths could amount to several hundred, with more if the accident was in Dover during the summer months - the long-term effect on the local economy would be severe.

■ A train carrying nuclear flasks from Sellafield to Oldbury was derailed in September and spilled its load at Sharpness, Gloucestershire. Nuclear Electric said there was "no danger" because the flasks were empty and did not break open.

A second train carrying empty fuel flasks had problems with an overheating axle and was forced to stop at a marshalling yard in Wigan. The fire brigade were called, but the axle cooled naturally within 30 minutes. Greater Manchester Fire and Civil Defence Authority have complained about British Rail's failure to inform them of the incident. □

* *Import/Export of Irradiated Fuel and Radioactive Waste to and from the United Kingdom* by John Large; 365pp, £25. Executive Summary free. Available from Greenpeace 30/31 Islington Green, London, N1 8XE.

Scottish blow to THORP

JAMES HANN, chair of Scottish Nuclear Limited (SNL) wants to negotiate cheaper contracts with BNFL for reprocessing spent fuel. SNL will also investigate whether it is necessary to reprocess spent fuel from its two Advanced Gas-cooled reactor (AGR) stations.

"There is a massive stock of uranium and plutonium, so we're saying why not dispose of the fuel on-site in a dry or wet store, avoiding transporting it. If necessary it could be reprocessed in later years", says Hann. Anyone who wants the uranium and plutonium in the spent fuel can pay for the reprocessing. On-site storage costs "look very, very favourable" and could halve SNL's costs compared with reprocessing.

Scottish Nuclear are also looking for a cheaper - "up to 50% cheaper" - method of decommissioning, as are Nuclear Electric. Billions could be saved if the nuclear companies did not have to stick to current government policy of returning the site to a green field.

Instead of dismantling the station bit by bit taking over 100 years, cutting up the bulky waste and sending it off to the Nirex repository, the reactor core could be encased in concrete and simply covered by a mound of sand and earth, landscaped and left for ever.

Anti-nuclear campaigners have opposed the plan (SCRAM 62), albeit in 100 years time, to cut up the reactor cores, disperse radioactivity around the environment, contaminate workers, and then remove the core to some previously uncontaminated place. However, Simon Roberts of Friends of the Earth says "this

picnic-site approach fails completely to address the long-term safety of our radioactive legacy". Once rainwater eventually gets into the entombed reactor, the industry would be relying on "chemical containment" to prevent radioactivity seeping into the environment. What the nuclear industry are proposing is basically a series of mini-Nirex dumps peppered around our coastline, rather than above ground, monitorable stores, which critics suggest.

■ Speaking at the launch of SNL's first annual report, chief executive Richard Yeomans revealed the full extent of the fuelling problems at Torness (SCRAM 75). While the refuelling machine is altered and redesigned, which will take until early 1992, the station will only be able to operate at 50 to 60% of design capacity. □

Nirex nightmare

BRITISH Nuclear Fuels (BNF) have announced plans to extend the life of their 'near-surface' low-level waste (LLW) disposal site at Drigg, a few miles south of Sellafield, in Cumbria. BNF say the waste site could accommodate all the UK's LLW until at least 2050.

Drigg was criticised by the House of Commons Select Committee on the Environment in 1986, which concluded that it "is not an acceptable model for any future disposal site". Since then improvements have been made. The trenches are now concrete-lined and will be capped and earthed over when full. BNF are also building a plant to compress and compact LLW which will start operating in 1993. BNF say the engineering improvements, together with the super-compact, will help to extend the life of the area at Drigg which already has planning permission, for another 60 years.

If the BNF plan is accepted, Nirex will lose most of its business. A deeper repository will still be required, but only for the much smaller quantities of intermediate-level waste (ILW). By 2050, Nirex had expected that it would have to dispose of 2 million m³ of LLW and 600,000 m³ of ILW. All their designs and planning assumptions will have to be recalculated.

Extending the life of Drigg offers several advantages to BNF. Sellafield currently produces two-thirds of the waste which goes to Drigg, and continuing to dispose of it there will be much cheaper than sending it to a Nirex deep repository. BNF is currently charging between £320 and £370 per m³ to dispose of LLW at Drigg, whereas Nirex

estimate that its average charge will work out at about £1,000 per m³. BNF would also be able to charge other LLW producers a high price, because their only alternative would be to pay Nirex an even higher price.

If Drigg does become the national LLW disposal site, this could make Dounreay more likely to be chosen as the site for deep disposal of ILW. The main factor favouring Sellafield, at the moment, is that transport costs would be cheap. However, the geology is known to be more complicated than at Dounreay, so the removal of the large volumes of LLW from the equation could just tip the balance in favour of Dounreay. An ILW repository could, of course, be built much smaller and extended more slowly.

The BNF plan has one advantage for Nirex. LLW contains organic material which produces explosive methane gas when it decomposes. Gas generation would be a major problem for Nirex, because any system which allowed gas to escape could also provide an escape route for radionuclides.

Nirex expects to start drilling the first of two test boreholes at Dounreay in October, and BNF are expected to apply for permission to drill three more test boreholes near Sellafield. Two boreholes have already been sunk on the Sellafield site, and planning permission has been obtained for a third on land adjacent to the site.

The idea of extending the life of Drigg for 60 years, appears to contradict statements made by the government's Radioactive Waste Management Advisory Committee (RWMAC) as recently as November 1989. RWMAC's tenth report talked of the "limited capacity" at Drigg and warned "that many non-nuclear industry users of radioactive materials are facing increasing difficulties in finding disposal routes for their wastes ... Disposal at Drigg with its increasing costs is often the only practical option available."

According to Christopher Harding, BNF chair, outside customers are now sending smaller volumes of waste to Drigg. This raises the question, if waste is not going to Drigg, where is it going? Are local authority landfill sites being used for waste that should be going to Drigg, but cannot because the

producers cannot afford BNF's charges?

During the decontamination of the Laporte site in Ilford, Essex (SCRAM 65 & 77), the low-level waste was originally destined for Drigg, but the site was unable to accept either the volume or the amount of radioactivity.

Eventually 2,000m³ of thorium waste was sent to a landfill site for controlled waste under a specific exemption order of the Radioactive Substances Act 1960 (RSA60).

The knock-on effect of BNF's plans could be more exemption orders, more waste being disposed of in local authority landfill sites and perhaps even illegal dumping.

This adds new urgency to the call made in SCRAM 77 by Friends of the Earth's radiation campaigner, Patrick Green, that the use of landfill sites for non-nuclear radioactive waste should end immediately, and for the DoE to carry out a complete review of the waste management practices and disposal routes used by the non-nuclear radioactive waste producers.

■ RWMAC's subgroup on safety assessment modelling for deep disposal were surprised to find that the number of comprehensive, site-specific assessments carried out in the UK "can be counted on one hand". They say full assessments are necessary to develop expertise, and confidence in the procedures.

A major reason for the small number of assessments, says the subgroup, "is the paucity of the detailed, site-specific information needed to carry them out". They say mathematical models "spanning such long time scales are inevitably subject to a high degree of uncertainty and the uncertainty will increase the further into the future the models are predicting".

Nevertheless, RWMAC are "reasonably confident that when the time comes to assess the actual deep disposal site for low- and intermediate-level waste the necessary assessment methodologies will be available." □

* Report of the RWMAC subgroup on safety assessment modelling for deep disposal sites for low- and intermediate-level radioactive waste. HMSO; 1990, 84pp, £8.

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PWRs are go

PROSPECTS for delays in plans to complete Sizewell B have come to light following the publication of the Hinkley C inquiry report. The computerised safety system (SCRAM 78) is still awaiting safety clearance, six years after the Nuclear Installations Inspectorate (NII) first identified problems with it.

Michael Barnes, the Inquiry Inspector, made it clear in his report that important questions about the safety system, planned for both Sizewell B and Hinkley C, still have to be resolved. The NII's main concern is with the computer software.

Meanwhile, Stop Hinkley Expansion have accused Barnes of being "an excellent mouthpiece for the Government's pro-nuclear policy". They say his 3,300 page report comes down in favour of Nuclear Electric all along the line.

Barnes makes a number of specific rec-

ommendations, most of which have been accepted by the Government. These include the publication of regular reports decommissioning costs, more detailed figures should be produced on plutonium stockpiles, and a series of improvements should be considered to the emergency planning arrangements.

Although Hinkley C has been given planning permission by Energy Secretary, John Wakeham, there will be no cash for construction before the 1994 review of the prospects for nuclear power. □

CARD

CUMBRIANS Against Radioactive Dumping are in the process of setting up a network of support groups in Cumbria. For more information contact Doug Smith 13 Solway View, Sunny Hill, Whitehaven, Cumbria CA28 7HL. □

Swedish nuclear phase-out

WHETHER Sweden will postpone plans to begin phasing-out nuclear power in 1995 may be decided this Autumn by the Swedish Parliament. Current indications are that, even if there is a postponement, there will still be a complete phase-out by 2010, as decided by the 1980 referendum.

Besides the nuclear phase-out, Parliament has committed Sweden to hold CO₂ emissions at 1988 levels, and not to develop any of the four remaining wild rivers in the north for hydro-electricity. Many believe these three aims are irreconcilable.

There are six political parties in Sweden's governing coalition, and all have different solutions to the problem. The largest party, the Social Democrats, appears to favour modifying Parliament's ban on increasing CO₂ emissions. They point out that Sweden has already cut emissions by 36% between 1970 and 1988.

If Parliament does not allow an increase in CO₂ emissions, the start of the nuclear phase-out may have to be postponed. Prime Minister, Ingvar Carlsson, is under increasing pressure to abandon the current timetable. Even within his own Party some members oppose the phase-out because of industry predictions of job losses caused by higher electricity prices.

Sweden generated 139.5TWh of electricity in 1989, 71TWh from hydro and 62.8TWh from nuclear. At an annual rate of 16,000kWh per person, the Swedes are the third largest consumers of electricity, following Canada and Norway. Sweden also has the third lowest prices for industrial and commercial electricity, after Canada and Australia. In fact consumer prices in Sweden are only just over half the average price for OECD countries.

Vattenfall, the Swedish power board which produces half of Sweden's electricity, has launched a SKr370m (£33m) energy saving campaign. Outside of the electricity-intensive industries, Vattenfall estimate that 12-19TWh could be saved.

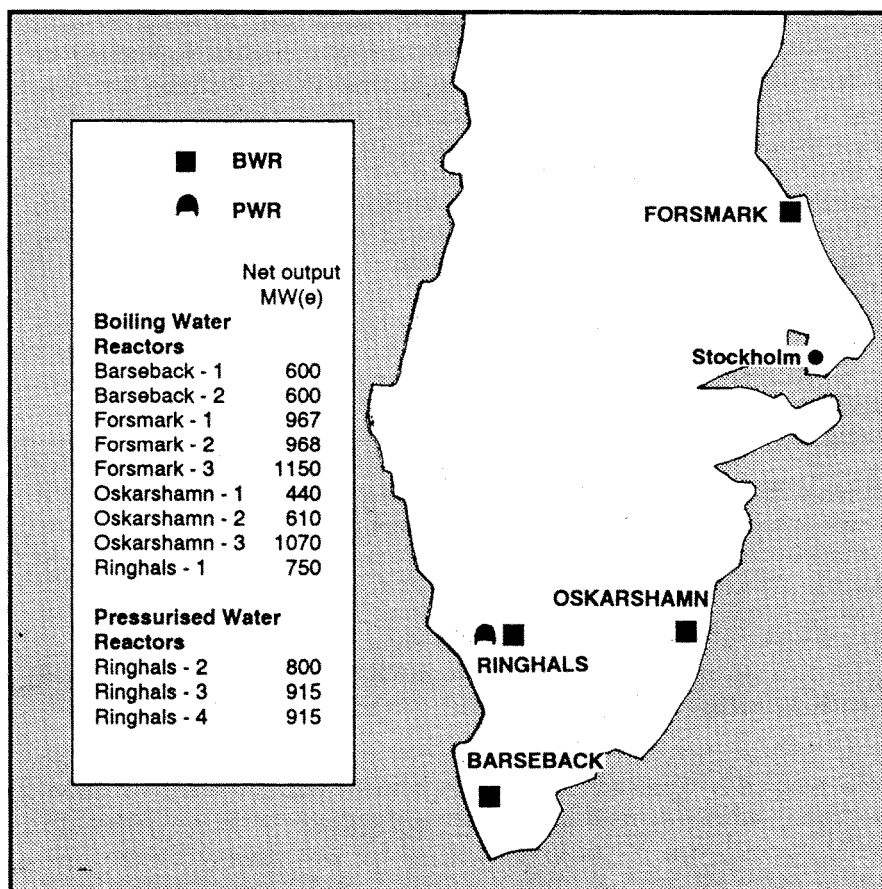
A joint study team from Vattenfall and the University of Lund (see Reviews pages) estimate that 44TWh could be saved by 2010 in their 'high-efficiency scenario', which would require policies to stimulate the introduction of energy-efficient equipment.

Sweden already has the world's first offshore wind turbine, and if successful 98 3MW turbines could be installed off Sweden's south coast. If economically feasible, wind turbines, both onshore and offshore, could be installed by 2010 to generate 5TWh.

Sweden has a plentiful supply of forestry waste and straw which could be used in biomass-fuelled district heating plants, and Vattenfall is investing SKr1bn (£90m) in biomass energy research.

The Social Democrats see natural gas as the prime source for new electricity generation in the immediate future. If they cannot persuade Parliament to relax the rules on CO₂ emissions, and the nuclear phase-out has to be postponed, most Swedish MPs will remain committed to a complete phase-out by 2010.

With sums of money being spent on energy-efficiency and non-nuclear energy sources, which make the UK's effort look like a drop in the ocean, the Swedes should have little difficulty achieving their objective. Swedish Industry may continue to put around scare stories about higher electricity prices and job losses, but with electricity prices already very low, Sweden looks set to remain resolute in its commitment to a clean environment. □



Spain's energy plans

SPAIN'S Minister for Industry and Energy has announced that, because of the Gulf Crisis, the long overdue National Energy Plan will now be further delayed (SCRAM 78).

Inevitably, the crisis has revived calls from Spain's pro-nuclear lobby to restart work and complete the Valdecaballeros 1 and 2 nuclear plants. Meanwhile Hifrensa, the Franco-Spanish consortium that owns the ill-fated Catalan nuclear power station Vandellós 1 - the first of Spain's ten nuclear power stations to be closed down - is considering converting the plant to gas-firing. □

Swiss referendum on nuclear power

SWISS citizens have voted for a ten year moratorium on the construction of new nuclear power stations, despite opposition from the Government and the power industry.

Swiss anti-nuclear groups had to collect about 150,000 signatures in order to make their demands the subject of a referendum. The moratorium received 54% of the vote, and so now becomes part of the Swiss constitution with no further action required by Parliament.

Another proposal calling for the closure of the five existing nuclear plants as quickly as possible was narrowly defeated

with 52.9% against.

Proponents of the moratorium now hope that Switzerland will have time to improve energy efficiency, assess alternative energy sources, and reduce dependency on nuclear power, which provides 40% of the country's electricity.

Voters also approved, with 71% support, a new law giving greater power to the federal government to determine energy policy. The government will now be able to set energy efficiency standards for industry, appliances and cars. It will be easier therefore for the government to promote energy conservation. □

Nuclear plans in Japan, France and Britain are set to produce large quantities of plutonium in the 1990s. FRANS BERKHOUT and WILLIAM WALKER of Sussex University's Science Policy Research Unit, argue that this plutonium will be surplus to requirements, and very difficult to use. It will pose political and security problems, particularly for Japan.

Japan's plutonium glut

IN 1992 an unusual ship will approach the shores of Britain and France. It will be heavily armed, and will fly a Japanese flag. Its mission: to escort a cargo of plutonium across the high seas to Japan. This voyage marks the beginning of the attempt to transport large quantities of plutonium between Europe and Japan.

As a nuclear weapon material, any movement of plutonium has implications for international security. Plutonium is also highly radio-toxic, and thus a danger to health and the environment. The transfers have a further political significance since this may be the first time Japan dispatches an armed force overseas since the second world war with an expressly military purpose. Japan's post-war constitution severely restricts the deployment of its military beyond territorial waters.

And for what purpose? To ship a material for which there is a very limited commercial requirement. Much of the plutonium will probably end up being stored and eventually treated as a waste.

Plutonium arisings in Europe

Plutonium is contained in spent nuclear fuel when it is extracted from the reactor. The fuel can then be sent for chemical reprocessing where the plutonium, uranium and waste products are separated. In all, some 80 per cent of the spent fuel so far produced by Japanese commercial reactors is set to be sent to Europe for reprocessing in new plants at Sellafield and La Hague in France, starting this year. Contracts for this work were signed in the late 1970s when the Japanese utilities realised that a domestic reprocessing capacity could not be provided soon enough.

By 2002 some 37 tonnes of Japanese plutonium are scheduled to have been extracted. Along with the nuclear wastes and uranium, all of this material is contracted to be returned. Production of plutonium in Japan could amount to a further six tonnes

by then. From around the turn of the century a new plant at Rokkashomura is planned to separate about 6.5 tonnes of plutonium per year (see figure).

Transporting plutonium in small quantities is nothing new, even between Europe and Japan. But concerns about nuclear safety, the environment and terrorist threats have led to a gradual tightening of regulations. Public opinion has also become more nervous about the movement of nuclear materials. In spite of this, the global scale of plutonium traffic is likely to increase three or four-fold over the coming decade.

Shipments to Japan will probably go by sea. Initially plutonium was to have been flown back, but this plan was scuppered after American objections. The US government maintains a wide degree of jurisdiction over Japanese nuclear activities through bilateral agreements and diplomatic influence. In 1988 a new agreement seeking to ease the sometimes fraught nuclear relations between the two countries was signed. This agreement allowed for plutonium returns from Europe by air.

Almost immediately, however, an amendment was proposed by opponents of the agreement and passed by the US Congress which substantially tightened the safety criteria applied to plutonium shipment casks. One effect was that it became necessary to test the integrity of the cask in a real air crash, by, for instance, deliberately crashing a Jumbo with one on board in the Canadian tundra. Such a test is not seen as feasible, although development work continues.

Physical security

However, sea transport raises all sorts of new questions about both safety and the protection of plutonium from sabotage and theft. Internationally-agreed rules require that when plutonium is being moved it should be accompanied by armed guards, tracked more or less continuously by

radio or satellite, and that a suitable response force is on hand should the shipment be attacked.

Establishing this security infrastructure has proved to be a headache for the Japanese government. To deflect national and international concerns about its intentions, it has decided to give the task of escorting plutonium shipments to the Coast-guard, rather than the Navy. In doing so, it has attracted strong criticism from the growing nationalist tendency at home for having been too timid. Doubts have also been expressed in the US about Japanese competence to mount robust anti-terrorist measures in view of their relative inexperience.

Providing satellite surveillance is well within Japanese capabilities, but the question of the response force is still unanswered and will undoubtedly be politically difficult to handle. Although in the past France and the US have helped out in these situations, they have let it be known that they now see plutonium transport as a Japanese responsibility.

Having been forced into sea transports, Japan is finding difficulty in protecting what it sees as its national interest by itself. It also risks changing its standing in the world order into a more aggressive one. This is a serious dilemma for an infant Superpower which thrives on good relations with other countries. As the Japanese inhibition to send mine-sweepers to support the Gulf blockade shows, there is still extreme sensitivity about sending troops overseas.

Plutonium use in Japan

What then is the plutonium needed for? Are the benefits of plutonium use commensurate with the political problems its handling and transport throws up?

There are two main civil uses of plutonium - recycling as fuel in fast or in thermal reactors. Japan has long had a strong commitment to develop more advanced and plutonium-

consuming fast reactors. During the 1990s three research and demonstration reactors could consume a maximum of about nine tonnes of plutonium. Therefore, out of a total production of 43 tonnes, over thirty tonnes would, in principle, be available for recycling as fuel in commercial thermal reactors (mixed-oxide (MOX) recycle).

The utilities, who own the plutonium, are chary about this. Using plutonium in commercial reactors is more costly than standard enriched uranium, there are new operational and safety problems which they must learn about, and there is local opposition to plutonium use on grounds of safety. Since most of the European utilities with plutonium are also trying to get MOX programmes off the ground, there will be a world shortage of MOX fuel fabrication capacity during the 1990s. All in all, it looks highly unlikely that the Japanese will be able to absorb the large amounts of plutonium which the European reprocessors will return to them over the next fifteen years.

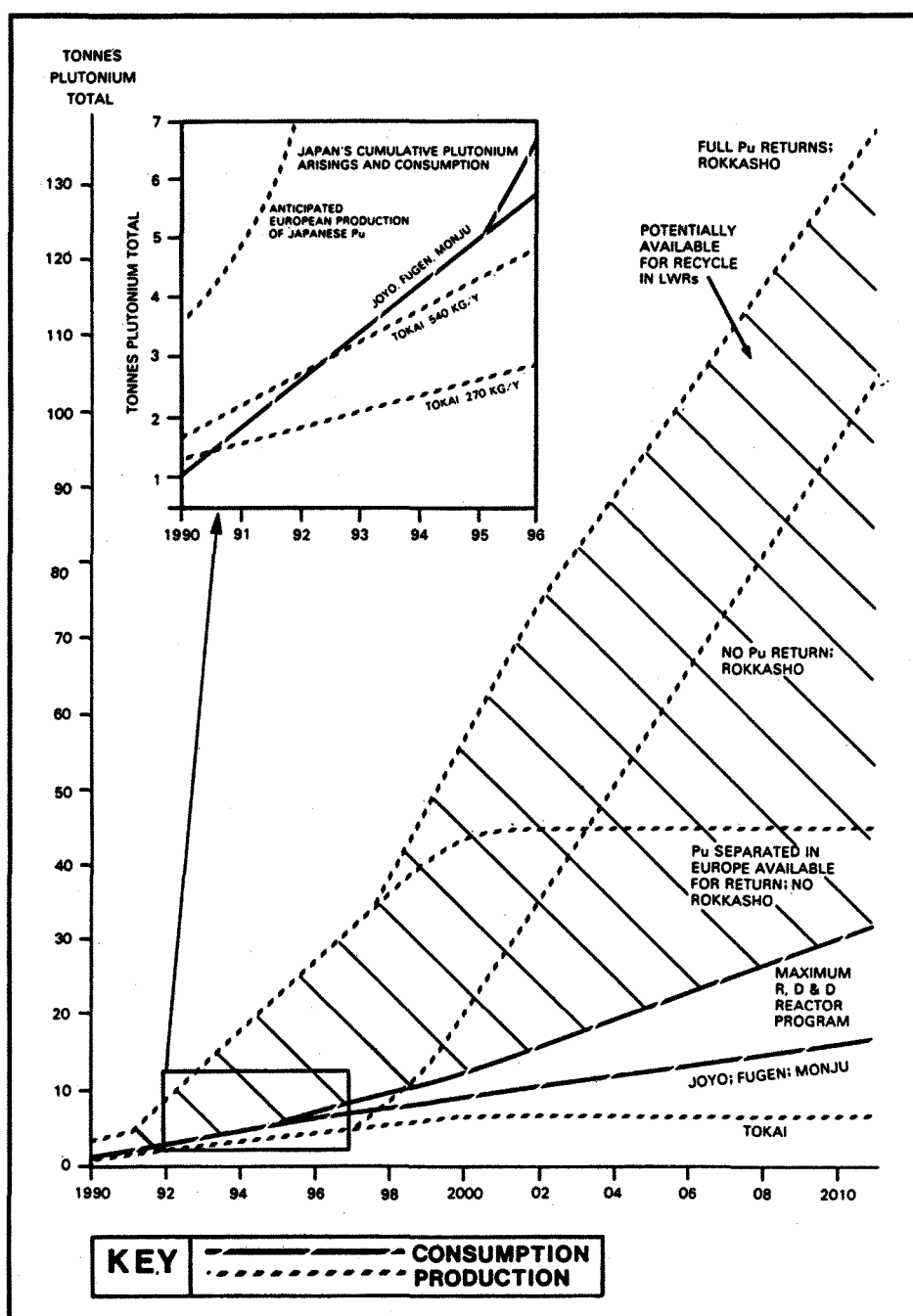
Instead, much of it will be stored, either at Sellafield and La Hague, or in Japan. If the Japanese choose to store the plutonium in the UK, this will add to the 30 tonnes already stockpiled at Sellafield. Due to the build-up of gamma-emitting americium-241, these stocks will very quickly become unusable for MOX fabrication.

International predicament

The coming plutonium glut is not just a Japanese problem. Several European countries, including Britain and France, will also face mounting stocks. By early next century about 100 tonnes of civil plutonium and a similar amount of military plutonium could be surplus to world requirement.

From both a security and environmental perspective, separated plutonium is just about the last material which should be accumulating in stockpiles around the world. The economic costs of gearing up for plutonium handling and use will also be great when compared with the costs of simply storing the spent fuel. It is therefore important that supply is brought in line with requirement.

But this is difficult for two main reasons. First, the interests of the reprocessing companies remains strong. Huge investments have been made in new plant over the past



Anticipated production and consumption of plutonium in Japan - 1990-2010

decade and the reprocessing contracts with electric utilities are binding. In Britain and France political support for reprocessing also rests on its military role. Second, the utilities do not have ready alternatives for storing their spent fuel. Reprocessing is an easy, albeit costly and not necessarily environmentally preferable, way of getting rid of nuclear power's principal waste management problem. The utilities are also fearful that if reprocessing were to end, this would reduce the future viability of nuclear power and make it more difficult to operate existing reactors.

THORP and the French plants are coming on stream at a very inopportune time, but it will be difficult to cancel them altogether. The

two French lines are already operating, THORP is nearly complete. Having invested a total of over £5 billion in building all three of the plants, there will be a strong argument for making them work. However, it is irresponsible to ignore the enormous costs and uncertainties of operating at full tilt. This is in no-one's interest, bar BNFL and Cogema. Instead, there should be a phased reduction of output and a thorough reappraisal of alternative fuel cycle strategies which do not involve reprocessing. □

■ The authors of this article, together with Tatsujiro Suzuki wrote an article entitled *The approaching plutonium surplus: a Japanese/European predicament* published in *International Affairs Magazine*, 66, 3 (July 1990) pages 523-543.

Last October the Department of Energy (DoE) published the results of a 2 year study into the proposed Severn Barrage; they invited comments on the report. Here GRAHAM DUMMETT chemical engineer and author of Severnside Green Party's response*, gives "a green perspective" on the Barrage.

A green view of the Severn Barrage

THE Severnside Green Party, made up of the twenty local branches in Gloucestershire, Avon and Somerset, responded to the Severn consultation in a thirty page report which gives cautious and qualified support. It was a difficult decision: on the one hand the barrage has the potential to produce 6% of the UK's electricity without adding to global warming, acid rain or drawing on the diminishing stock of fossil fuels, but on the other, a price has to be paid.

The Party had to face up to the sheer size of the barrage - the antithesis of the corner-stone of much Green thinking based on Schumacher's "Small is Beautiful" philosophy - and also the halving of the area of intertidal mud flats upstream of the barrage, changing the ecological balance of the Estuary.

The construction of the barrage will be massive by any standards. If built its output, at 17TWh pa, will be thirty times larger than that of La Rance Estuary Barrage, in France - the largest so far built. Its generating capacity, 8640MW, will be over twice the size of the UK's largest power station, the coal-fired Drax. It will enclose a basin of water three times the size of Loch Lomond and will cost more than the Channel Tunnel to construct.

A barrage's main generating weakness lies in the surge nature of its output. In the case of the Severn the electricity generation surge will, dependent on the height of the tide, last for 4-7 hours on a 12 hour 40 minute cycle. With a maximum generating rate of over 8000MW, inefficiencies will be induced into the grid as other power stations have to be turned down. This problem was not addressed fully by the project managers and requires a complete examination.

The Party's report demonstrates that in terms of fuel consumption per unit of electricity produced, the barrage, with its generating facilities built into a permanent structure, is an attractive asset. Approximate comparative estimates were made to ascertain the energy required to construct, operate, maintain and replace components for the Severn Barrage, on-shore wind generators and coal-fired plant. From the projected

output of electricity for each facility, the unit cost of electricity was calculated in tons of coal equivalent (tce) burnt over each facility's life:

- SevernBarrage (120yr life) 3,750 tce/TWh
- SevernBarrage (240yr life) 2,950 tce/TWh
- On-shore Wind 4,700 tce/TWh
- Coal (operational fuel only) 400,000 tce/TWh.

In these terms, the barrage is marginally more attractive than land based wind turbines and, of course, over a hundred times more attractive than conventional coal-fired plant.

Longevity discounted

The Official Report took a different approach and used the discounted cash flow technique to assess the project's viability. Such a computation has two weaknesses; it does not reflect the environmental contribution nor does it take into account the longevity of the barrage. The second failure has led to the high projected cost of electricity, 7.2p/KWh; a unit cost that would be virtually the same if the barrage had a life of 40 years rather than that of a facility that will probably last as long as man requires electricity. The City however is wedded to gaining a short term return on its investment.

Attractive as it is in terms of fuel savings, a barrage costing £9.7 billion is an expensive item and can only justify the expenditure of public money if the future demand for electricity cannot be met from a combination of other renewable resources and the extension of the use of combined heat and power (CHP) stations. In addition, to justify the expenditure, any projection of electricity demand must be subject to an intensive programme of energy conservation to reduce it to a minimum.

To test whether such resources could meet even a modest growth in demand, a tailing-off of economic growth and consequent electricity demand growth to zero by 2008, together with the phasing out of nuclear energy and all

imports by 2028, was assumed. Against this backdrop an estimate was made of the potential to reduce this minimum 'carry on as we are' demand over the next 30 years.

Because the major energy savings are to be achieved in the way the Nation heats its homes and factories, runs the transport system and operates the process industries in which electricity plays only a small part, the potential for reducing demand may seem modest. Nevertheless a potential reduction of 28.5% was identified. History has demonstrated, with past oil price hikes, that demand is elastic to price, as may be demonstrated again if the present Middle East crisis persists. To achieve the proposed conservation objectives a significant tax on fossil fuels must be applied.

On the supply side, only the commercially and practically proven methods of generating electricity from renewable resources and the extended use of CHP, either by burning selected waste or fossil fuels, were considered. The renewable resources were thus reduced to on-shore wind and tidal power. This is a regrettable position to have to take, as undoubtedly Government neglect and removal of support for research into wave, offshore wind and geothermal power has denied the Nation these alternative resources at this critical time in the evolution of the world's industrial society. An evolution which presently exacts a high price from the Earth.

The paper assumed, in line with CEEB thinking, that 45TWh (15% of the projected demand in 2028) could be

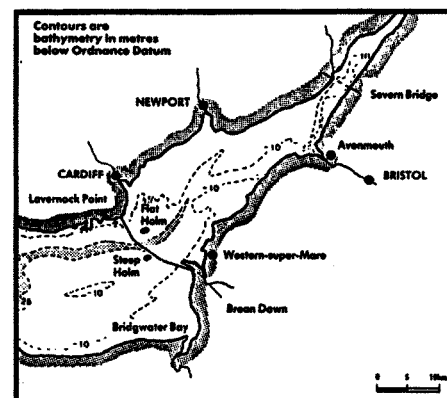


Figure 1. The Severn Estuary

supplied from on-shore wind and a further 23% from the extended use of CHP in the process industries, district heating and in providing energy to hospitals, swimming pools and hotels.

This simple analysis indicates that if tidal power is not utilised, over 88TWh of electricity will still be generated from conventional fossil fuel plants, with their attendant inefficiencies and hazardous emissions. The building of the barrage is therefore justified on the grounds of reducing gaseous pollution and the graph (Figure 2) shows the contribution both the Mersey and Severn barrages make to the projected energy balance and the reduction of the Country's dependence on fossil fuel burning in conventional power stations to the generation of 70TWh. Unfortunately with continuing economic growth, as experienced over the past ten years, this figure would rise to an estimated 136TWh making justification for the barrage even greater.

Caution needed

Nevertheless the size of the barrage also justifies a note of caution and the report recommends that the projected one mile long Mersey Barrage is completed before work starts on the ten mile long Severn facility. The turbine generators for the larger barrage are 20% bigger in swept area than any of that type so far built. Such an increase in size requires significant development work and an increase in manufacturing capability. In addition the construction environment in the Estuary with its prevailing SW winds, not infrequently at gale force, and fast moving currents is at least inhospitable and often dangerous.

The resultant delay will put back the start of the project some ten years; time in which experience can be gained, a civil engineering disaster avoided and the engineers can investigate and develop the report's proposal to incorporate wind and wave power facilities into the structure. The Party believe that the former can be achieved without damaging the aesthetics of the skyline and the latter would reduce the energy of the sea and thus give some protection to the barrage's structure. To achieve the inclusion of these additional facilities, the report asks the Government to switch the £250 million currently spent on the non-safety aspects of nuclear research to the development of renewable energies.

Because of the impact that the barrage and the associated basin would have on the ecology of the Estuary, the Party have rejected some proposals in the Official Report and asked for other safeguards. A major issue is tourism, for

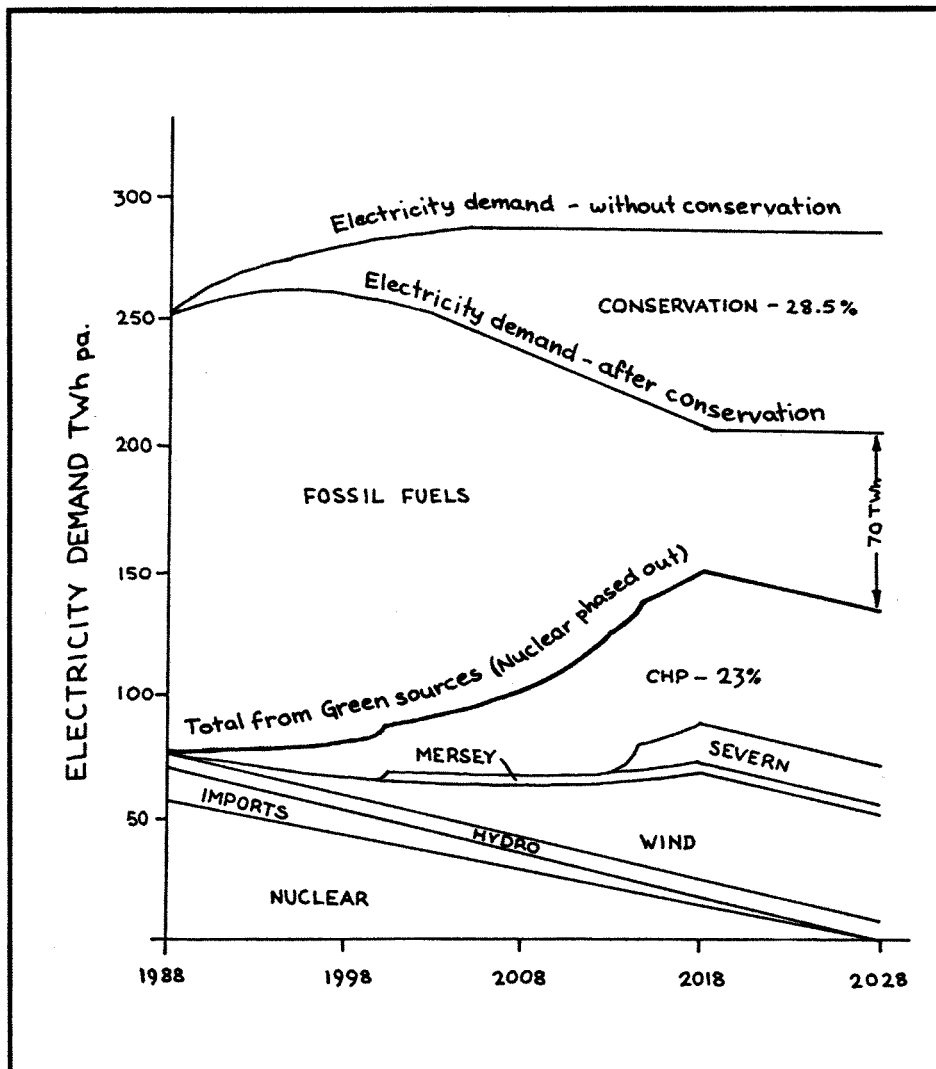


Figure 2. Combined supply demand scenario - zero growth in GDP by 2008

which the sponsors wax enthusiasm. It is inevitable that the pressures will be there and the Green party are very concerned. They have asked for strict planning controls and that the proposed road across the barrage is not built. A rail link would be a more acceptable alternative and would link up with the rail heads at Brean Down and Lavernock Point. These branch lines, not in the official Report, are requested in order to reduce road traffic during the eight year construction period.

Silting problem

The deposition of silt is a natural phenomenon in the Estuary but is undoubtedly aggravated by the expansion of industrial farming and the consequent erosion and washing of sediment into the rivers that feed the basin. However with the existing large tidal range an equilibrium is established with the excess silt being washed away to sea by the fast moving currents. This will not be the case once the barrage is built, when overall current velocities will be a fraction of what they are today. The siltation process must be reversed as the deposition of silt, especially in the estuaries of the smaller rivers where the

shipping docks are located, could have severe commercial consequences. The Party therefore advocates the imposition of a national tax on the chemical fertilisers and pesticides that are at the root of the problem and to use the revenue to encourage organic farming in the Severn catchment area.

Pollution will also be a problem in the more static waters of the basin. The project managers were not specific on who would finance the cleaning up of the existing discharges into the Severn or on the standards to be met. The submission asks for the former question to be answered and that all discharges from industry, radiation sources and sewage meet Fresh Water Fishery standards.

Finally the wildlife must be protected and the submission supports the additional studies that the Official Report recommends, so that the peace, solitude and beauty of many parts of the Estuary can be retained. □

* *The Severn Barrage: A Green Perspective*, available from Graham Dummett, The Old Smithy, High Street, Spaxton, Bridgwater, Somerset.

In 1900, when most houses were heated by gas or solid fuel, only 4% of mortalities were caused by cancer, but today, one in three die of the disease in developed countries. ROGER COGHILL, author of a new book *Electropollution: How to protect yourself against it* *, explains that a whole range of new mysterious diseases including cot-death, ME, multiple sclerosis and AIDS, all have distinct similarities to electro-magnetically engendered disorder.

The killing fields?

NUCLEAR energy supplies only a small fraction of the United Kingdom's electricity. It is rightly condemned as uneconomic and potentially hazardous. But electricity itself is just another part of that same electromagnetic (EM) spectrum which embraces gamma rays, X-rays, and the entire gamut of ionising and non-ionising radiation.

Some have long argued that the non-ionising part of this spectrum is harmless to organic life, unless applied in power densities strong enough to heat the body's tissues. Indeed, present exposure limits are based on that single unsubstantiated premise.

Over the last few decades our consumption of EM energy has proliferated, with our inventiveness developing new forms of telecommunication, lighting, heating and instrumentation. But at the same time, there has arisen an increasing, unspoken awareness that EM energy - particularly the alternating kind at power frequencies (50Hz in this country) which illuminates and heats our homes, offices and factories, and drives our appliances, office equipment, and most industrial machines - is having a slow, invisible, but deadly effect on our brains, body cells and tissues of which we are all composed.

Artificially generated electricity is in any case a very new phenomenon: the world's first commercial radio broadcast station opened only in 1920; radar was first deployed in 1938, thus permitting our fighter pilots, though outnumbered ten to one, to 'see' enemy bombers approaching our shores; and television became a broadcast reality only in the early fifties.

Those of us who remember such marvels have since been further amazed by electromagnetic miracles like programmable electric washing machines which have replaced the

mangles and copper boilers of the forties, and the cordless telephones, satellite communications, microwave ovens, and desktop computer screens which now contribute daily to an electromagnetic ocean in which we are inevitably bathed. The question is, are we yet biologically adapted enough to swim safely in this ocean?

The practical use of electricity, like X-rays, was itself discovered only about a century ago, before which mankind's only contact with these energies were the sun on his or her back, the moon, planets and stars at night, and the usually gentle geomagnetic fields of Mother Earth.

"Nature hardly ever bestows a riskless benefit", to quote Baruch Modan, one of the world's top radiation scientists, who has been concerned about the impact of non-ionising EM energy. To judge from the evidence we may already be paying a biological price for the benefits of electric blankets (threefold increase in the incidence of foetal abnormality, miscarriages, and cot death), radar, (spermopenia, inhibited immune function, brain tumours, Downs Syndrome children), and domestic electrical power transmission (childhood leukaemia, depression, suicide).

Carcinogenic risk

The uncloyed sweetness of tomorrow's electric world was brought to a juddering halt a few weeks back. A new scientific review whose authors, staff from the venerable US Environmental Protection Agency (EPA), had spent two years carefully assimilating evidence, concluded:

"Concerning exposure to fields associated with 60Hz electrical power distribution, the conclusion reached in this document is that such exposure is a 'probable' carcinogen risk factor, corresponding to a 'B1' degree of evidence that it is a risk factor. This

conclusion is based on 'limited' evidence of carcinogenicity [in] humans which is supported by laboratory research indicating that the carcinogenic response observed in humans has a biological basis, although the mechanisms [are] only vaguely understood."

Other substances given similar ratings include PCBs, DDT and formaldehyde. This terrifying statement was deleted in mid-March 1990 by the EPA's director William Farland in what he subsequently called "a personal decision", and the report has still not been officially published. Its publication had been planned for the annual Bioelectromagnetics Society (BEMS) meeting in June - a gathering of the world's foremost professional researchers in the field - of which there are only a handful of UK members.

Fortunately I happen to be one of these few, and have just released a book, *Electropollution*, which puts into ordinary language the evidence which the EPA had uncovered. Moreover at the recent Standing Conference on Low Level Radiation at Bangor I succeeded in persuading delegates to add non-ionising EM radiation to their remit. My small consultancy has already been hired to monitor a number of planned EM emissive sites, from radar installations to power lines, and I am gaining a good deal of field experience of just how pernicious these invisible radiations can be in the long term, particularly inside the home, where electric fields can locally be many times the norm as a result of unbalanced ground return currents. These unbalanced fields can be injurious to human life.

Though the computer database at my laboratory contains some 2,500 scientific references to the bio-effects of EM energy, I only selected about 250 for inclusion in my book, and also added a number of case histories from personal experience.

The central question, behind which sceptics of such effects like to shelter, is just what is the mechanism by which cells are damaged from EM insult? Without being able to explain this the proponents of electropollution are at a disadvantage. However, we still do not know how asbestos or smoking causes cancer, yet legislation has been introduced against such perils. I therefore propose a clear biological mechanism to explain how EM fields interfere with the brain's own transmissions (we know them crudely as EEG records) and the supporting evidence is quite prodigious. I am now seeking funds to test the hypothesis (cerebral morphogenetic radiation) and if it proves correct it may have a paradigmatic effect on medical theory.

Tests in the laboratory confirm that even very weak alternating EM fields can significantly (up to 40%) diminish the capability of the immune system, and the same has been found from higher (radio) frequencies. It is a chilling thought that, against a background where even the discoverers of HIV (the so-called AIDS virus) are now beginning to disbelieve its causal role, two thirds of current U.S. AIDS patients were born at precisely the same times and locations where microwave telephony and commercial TV broadcasting stations were established in the late forties and early fifties. The structure of the cerebral hemispheres in the human brain is such that the areas of motor and sensory activity concerning the immune system appear to be very close to those governing the genitalia, which may throw light on the link between homosexuality and AIDS. This is important since despite incorrect government propaganda, the HIV virus does not by any means satisfy the postulates necessary to confirm viral

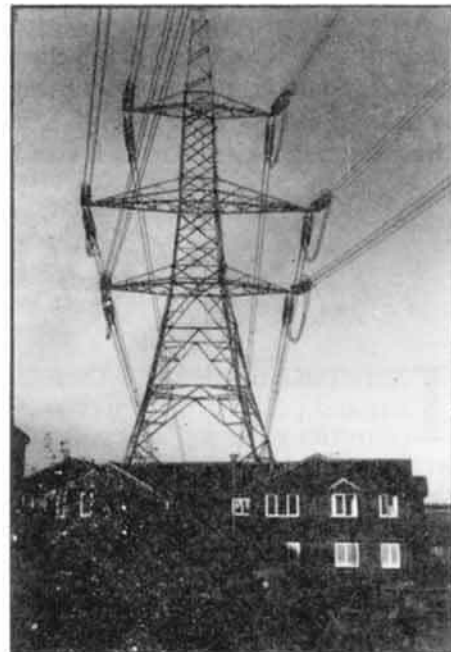
infection laid down by Robert Koch a century ago, and since accepted by all today's microbiologists. At its worst then, electropollution may already be damaging the immune systems of the world.

Global problems

The problem is not confined to the human species: unprecedented whale beachings, pernicious avian mis-migrations, and serious marine mammalian immune deficits are appearing throughout the world, and even the deforestation of pine trees in Europe is most pronounced near the radar surveillance systems at the east-west borders. Continual bombardment of the lower ionosphere by satellite communications uplinks could also be having a deleterious effect on our precious ozone layer: we do not know, for the research has never been done, often because governments do not wish to fund research with such potential intrusions on our commercial electromagnetic life.

So for the moment the evidence of elevated incidence of Downs Syndrome children near radar stations, of childhood leukaemia clusters in proximity to power lines, and the high numbers of brain tumours among those whose occupational exposure to EM energy is above average are all being ignored or swept under the carpet by the National Grid Company. The EPA statement may change this, though a similar concern was voiced the year previous by the US Office of Technology Assessment.

For those battling to be heard on electropollution the problem, as always, is getting funds to carry out the necessary research. I have applied



to several government funding agencies and pseudoagencies, like the Foundation for the Study of Infant Death (I had unearthed a high correlation between cot death and the strength of electric field where the hapless infants had been sleeping and want to carry out a proper case control epidemiological study). Despite the matter even being debated in Parliament and voiced loud in the media I still haven't yet managed to complete the project through lack of finance.

Others have faced similar problems. Stephen Perry, who found a significant link between living near powerlines and suicides, had to fund his own research. So did Lennart Tomenius who found elevated incidence of leukaemia among children living in higher than normal electric and magnetic fields. So did Nancy Wertheimer, who above all others first drew attention to the hazards following her impeccable research project on leukaemia in Denver, Colorado, in 1979. She told me recently that she can no longer cope with the attendant publicity, and that her next project will take her away from the field.

But "the truth will out" as the proverb goes, and it will be interesting to read the text of the directors' General Undertaking in the forthcoming flotation prospectus of various parts of the electricity industry when they discuss the potential health hazard to the public from their product. □

* *Electropollution: How to protect yourself against it*; by Roger Coghill. Thorsons; 1990, 187pp, £5.99.

Minimum Safe Distance from power lines (metres)

Type of line	Sleeping	Long-term working (over 4 hours)
400 kV	250	100
275 kV	200	150
132 kV	150	75
11 kV	50	25
Transformers (11kV/240V)	50	25
Substations (metal clad)	100	50

From *Electropollution*

Channel 4's programme *The Greenhouse Conspiracy**, was billed as the "first debunking on television" of global warming. It set out to smash the scientific consensus that global warming is a real and serious threat. Yet, it contained no mention of the International Panel on Climate Change, which concluded recently that the threat is indeed real. MARTIN INCE, science correspondent of the Times Higher Education Supplement, reviews the programme and finds it fundamentally flawed in its approach and methods.

Greenhouse conspiracy?

IN the last week of August, scientists and politicians from over 70 countries gathered at Sundsvall, in Sweden, to agree about something. So far, so remarkable. Even more surprisingly, the thing they agreed on was not some simple matter like the Gulf or apartheid. Instead, they decided to sign a treaty which will, hopefully, lead to a world-wide agreement on reducing emissions of greenhouse gases by over half during the next few decades. If it all happens, the result will be wide-ranging economic change affecting every country in the world.

The day after the agreement was signed, I was talking about it on LBC, the local London radio station. The interviewer's first question was why the agreement was needed. Hadn't scientists shown, just a few weeks ago, that the greenhouse effect was a complete myth? He was referring not to some definitive piece of scientific research but to a TV programme, *The Greenhouse Conspiracy*, made by Hilary Lawson for Channel 4's flagship science series, Equinox.

Lawson is a talented journalist and Equinox is always superb television. Only a totalitarian could object to Lawson's right to make the programme. The problem is that it has entered public consciousness as proving that the greenhouse effect, global warming, is not as serious as the environmental scaremongers make out, but is in fact based on a series of misunderstandings about the science of the greenhouse effect, the way science operates and - most importantly - how society deals with uncomfortable scientific findings.

Lawson's programme sets out to show that the greenhouse effect is backed not by evidence, but by scientists looking for grants and politicians seeking a cause. He claims that the Earth is not getting warmer, that the so-called greenhouse gases do not actually cause warming and that the computer models used to predict future temperature rises do not work.

His attempt to prove all this could be analysed at vast length, but it rests mainly on a look at temperature records for the last decade. Records from weather stations point to warming, but he claims that this is due more to their being mostly in cities, which trap heat. Instead he says, we should look at satellite temperature measurements, which show no warming. In fact, meteorologists do try to correct for the 'heat island' effect. More importantly, the temperatures recorded on land and in space (and shown in the programme) are uncannily similar, considering they use quite different techniques to measure temperatures at different places. The data shows that there may have been warming, and that the average temperatures for the last decade were affected by a cold-spell in the mid-1980s.

Long term view

The Earth is so large that it takes decades for its weather to change appreciably. Which is why greenhouse supporters base their evidence not on a few years of warming but on data collected over the last century. Over that time the Earth's temperature has risen by half a degree, while greenhouse gas concentrations have also increased. The connection between the two is regarded as pretty definite by most meteorologists, which explains why US opinion polls of the experts outvote the mavericks on whom Lawson relied.

The real message for anyone interested in how science works is that Lawson has failed to grasp the difference between laboratory sciences, based upon proof, like chemistry (add the blue liquid to the green one, and every time a red solid is produced) and subjects like human intelligence, evolution, meteorology and astronomy, where you can only look at the evidence that presents itself and form an opinion. You cannot get a dozen Earths and rerun them to see if the greenhouse effect happens or human beings evolve.

Lawson is on equally shaky ground when he examines the laboratory proof of the greenhouse effect. In one sequence, in which anyone doing GCSEs could spot the mistakes, he shows he does not understand just how the greenhouse effect might cause global warming, and implies that the different gases might somehow interfere with each other's greenhouse effects. In fact, the effects add up in a simple and ominous fashion.

His apparent ignorance and lack of understanding are already being exposed, for example at least one complaint of bias has been submitted to the Independent Broadcasting Authority. There is also criticism of his methods. At least twice in the programme he asks searching questions and then proceeds to show the interviewee's cautious preliminary remarks while cutting out the answers, making the subject look evasive instead of helpful.

The most telling moment in the programme is the last quote, from US meteorologist and greenhouse sceptic Pat Michaels, who asks whether on the basis of the evidence to hand, we are really going to alter the world's economic direction fundamentally. The fear of altering the economic status quo, is the main reason for US, and other, Governmental reluctance to accept global warming. It is, however, quite remarkable when politicians like Margaret Thatcher see sense so fast about the greenhouse effect.

It is in the nature of the greenhouse problem that world-wide, decades-long programmes of action are needed, and that the action needs to be taken even before the final proof is in. The biggest mistake we can make is to postpone any action until after the greenhouse effect has changed world climate and sea levels beyond the point where many countries - the poorest - are able to cope. □

* *The Greenhouse Conspiracy*, Equinox, Channel 4, 12 August 1990.

"Misleading"; "wrong"; "latest scare tactics"; "making horrifying results out of rather reassuring data"; these are just some of the comments levelled at the recently published Friends of the Earth (FoE) report, *Unjustifiable Exposures**, on the radioactive contamination of two rivers in Lancashire. PATRICK GREEN, FoE's Radiation Campaigner explains.

Contaminated coast controversy

A FoE report*, featured in the Yorkshire TV documentary *Sellafield - the Contaminated Coast*, in April, and published in July, showed that the legally permitted discharges from Sellafield have contaminated extensive areas of Lancashire. Farmland up to 60 km south of the discharge point and along a 22km inland stretch of the River Wyre and 14km of the River Lune is affected. The report concluded that people occupying areas around these rivers may be exposed to radiation in excess of levels commonly regarded as "acceptable".

All the contamination found on the Lune was up-river of the single Ministry of Agriculture, Fisheries and Food (MAFF) monitoring point. On the River Wyre contamination was also found further inland than is monitored by MAFF. This demonstrates a clear failure of MAFF to detect the extent of the contamination and inform the public of the possible hazards.

However, both MAFF and British Nuclear Fuels (BNF) have ignored this fact. BNF commented: "The Lancashire County Council monitoring body (RADMIL), Government scientists and BNF Health and Safety experts have all condemned the anti-nuclear group's latest scare tactics."

Such comments are to be expected from BNF and MAFF. In fact, RADMIL welcomed the FoE report. Its own report supported the FoE data, but differed in its interpretation. The leader of Lancashire County Council commented: "These two reports highlight the importance of continuously re-assessing the interpretation of data in this critical area of public concern."

"Both reports agree on the basic data. The difference comes in interpreting the data in relation to national standards."

Along the two rivers the principle exposure pathway will be to gamma radiation from the contamination. Doses can be estimated by applying occupancy rates to the measured hourly dose-rate in an area. The resulting figures can be compared with the National Radio-

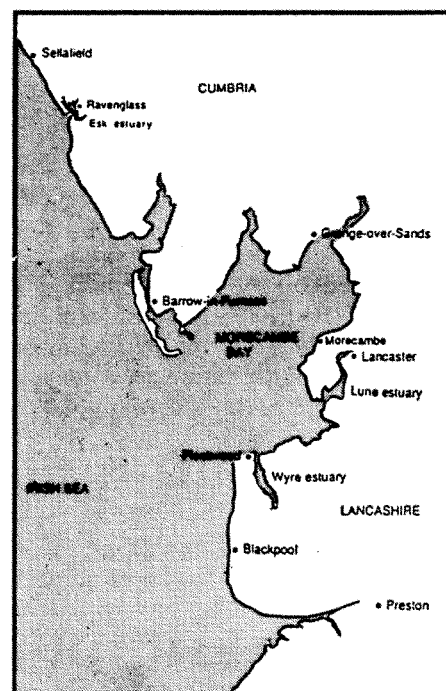
logical Protection Board's (NRPB) annual site specific limit for members of the public of 500 μ Sv. The NRPB recommended this figure in 1987 and stated at the time that it regarded a 1 in 100,000 risk as the maximum "acceptable" for a member of the public. Since that time the NRPB has increased its estimates of radiation risk. At the Hinkley Inquiry it repeated its judgement that a 1 in 100,000 risk is the maximum acceptable. It has also commented, outside the Inquiry, that this level of risk would imply a dose limit of 200 μ Sv for the public. This figure was used as the basis of the assessment in the FoE report. RADMIL however used the current NRPB figure. MAFF, predictably, used an even higher figure of 1000 μ Sv, arguing that this applies to both pre-existing contamination and that arising from current discharges!

The FoE report estimated exposures for two types of individual: (i) those identified as spending time at specific locations and (ii) those who could potentially spend time in contaminated areas in the future.

This approach was criticised by MAFF. If contamination exists, but they cannot identify anyone as exposed to it, then the contamination is of no concern to them; this is absurd. MAFF's approach ignores the fact that habits change and any contamination of the environment is a source of potential exposure at present or in the future. RADMIL also support FoE on this point: "Changes in habit will alter exposure; contributions to the radionuclide burden of the sediments from the nuclear industry, although declining, still continue and there is therefore a continued need for assessment of public exposure."

MAFF, BNF and RADMIL all argue that actual exposures are within currently accepted limits. This, however, does not automatically mean that they are acceptable. The dose limits, or targets recommended by NRPB are but one part of an overall system of protection which is ultimately based upon the recommendations of the International Commission on Radiological Protection (ICRP).

The first ICRP principle requires that:



"no practice ... shall be adopted unless its introduction produces net positive benefit". This is known as the justification principle, but it has effectively been ignored in the regulation of Sellafield discharges. The recent review of the liquid discharge authorisation for Sellafield made no reference to justification. BNF admitted on *Sellafield: The Contaminated Coast* that reprocessing is not necessary, and is a purely commercial venture.

The occupants of the area surrounding the Rivers Lune and Wyre, past, present or future, do not receive any benefits from their exposures to Sellafield contamination. Society does not receive any environmental benefits. In fact, as BNF acknowledge, the only benefits received by the occupants are the economic benefits which stem from the revenue BNF make out of reprocessing.

The price society has to pay for this is widespread contamination of the environment. Occupants of the area surrounding the Rivers Lune and Wyre could face an increased risk of cancer. The price is unacceptable and the risks are unjustified. □

* *Unjustifiable Exposures*, published by Friends of the Earth, July 1990.

All forms of energy have some impact on the environment. DAVE TOKE, covener of the SERA energy group and author of *Green Energy*, published by Green Print, argues that the time has come for environmentalists to stop opposing renewable energy projects *carte blanche* and begin weighing local impact against global impact, even if that means accepting a Severn or Mersey Barrage.

Stand up for renewable energy

IF the anti-nuclear movement is to retain its credibility in a world that is taking urgent action to counter the awesome possibility of global warming, then it has to become a lot more enthusiastic about renewable energy sources than it is at the moment.

The problem is that our attitudes are still guided by the thought that our energy needs can be met, in the short to medium term, by conservation of fossil fuels, with renewable energy only to be researched as a long term term option.

This attitude has, in the last couple of years, been entrenched by the growing realisation that renewable energy, coming as it does from natural sources, itself impinges on nature and has sometimes quite noticeable environmental impacts. These days, in some fundamentalist quarters, you will be regarded as backward if you insist that we need to encourage windfarms. You will be regarded as being beyond the pale if you support large-scale tidal schemes.

Such attitudes are extremely short-sighted, and need to be challenged. Energy conservation must be the foundation stone of our policies. Yet even if the most optimistic, technically achievable, energy efficiency scenarios materialise in the next three or more decades we are still going to be using at least forty, or more likely fifty per cent, of the energy we use now.

Barring an extremely rapid deployment of non-fossil energy sources, this country is still going to be using very large quantities of coal, oil and gas. As energy efficient as we may become, we shall still be producing much more carbon dioxide (CO₂) than many other parts of the world do now, and the world will not come anywhere near achieving the CO₂ reductions demanded by climatologists and scientists.

So what are we going to do? Are we seriously going to tell the drowning

inhabitants of third world river deltas and Pacific Islands that we cannot cut down our fossil fuel use further because we cannot stand the view in rural England to be marred by the sight of windmills? Or that we cannot possibly use some of the growing amount of surplus farmland to grow trees for energy because we want the land to grow wild instead?

Such attitudes are likely to be angrily dismissed as being extremely selfish, and deservedly so.

Economic growth

Of course, some might reply that there is another alternative, rejecting the economic growth associated with the sort of industrialism that has been accepted as virtually the definition of progress itself. Now if we are to come close to achieving the most optimistic energy efficiency scenarios we certainly need to alter the way we improve our living standards. We need to favour services and lighter types of industry, that use resources most efficiently, rather than the more traditional heavier, smokestack, industries that have produced most pollution. But we will still need lots of energy from non-fossil sources.

Beyond this, we need practical proposals, not merely lofty moralistic pronouncements about making sacrifices that impress the faithful but do nothing to address the hopes and fears of the mass of ordinary people.

If we are to be practical, and not consign ourselves to some purist 'greener than thou' ideological ghetto we must confront the need to decide our own list of priorities. Everything we do has environmental impact. Absolute green purity resides only in the graveyard. If we do not make a choice between conflicting local and global priorities then the decisions will be made according to a different agenda altogether.

We cannot, for instance, declare that we do not 'need' a particular renewable source when its impact is

less than that of fossil or nuclear sources. Jonathon Porritt, writing in the July issue of *World Magazine* talked about the need to make such comparisons, and commented:

"How, for instance, does the potential threat to wildlife from a large tidal barrage on the Severn estuary weigh against the proposal to build another nuclear reactor further down the estuary at Hinkley Point?"

"I can't help thinking that some environmentalists just don't want to engage in such uncomfortable comparisons, preferring the easier (but possibly rather dishonest) route of opposing anything that seems to have any impact on the environment. Such self-indulgence is unlikely to win much support from an understandably concerned public, who now expect environmentalists to be at least as good at coming up with the answers as at highlighting the problems."

Nightmare

The anti-nuclear case is an extremely powerful one. Conventional nuclear power is bad enough, yet to make a continuing large impact on global warming through nuclear power we would need fast breeder reactors to make limited uranium resources go further. Such a strategy would produce the sort of hellish nightmare that has been so eloquently described by Walt Patterson⁽¹⁾.

If we want a rapid phase-out of nuclear power, in the next 10-15 years, then we are going to be at a disadvantage unless we can argue for a rapid build-up of renewable energy sources.

There are bountiful, and ultimately limitless, possibilities of doing this in the medium and long term through offshore wind, solar power, wave power, mini-hydro, geothermal power and so on. But we also need to do as much as we can now. We really cannot afford to be *too* choosy. We need to encourage the rapid

deployment of sources like onshore wind, biomass waste, power from burning specially grown trees and tidal power.

Biomass sources are plentiful and very important; they can be used in conjunction with combined heat and power. They are also storable and can thus be used to complement other intermittent natural energy sources.

We must make every effort to do all these things by being as environmentally sensitive as possible, favouring decentralised, co-operative, and small-scale projects above others. But can we really afford to rule out projects like the Mersey, and Severn tidal barrages?

I do not think we can as long as we are still deriving energy from fossil fuel and nuclear sources.

In the medium term we are going to have to use renewable electricity for transport purposes. This illustrates the need to maximise rather than minimise the output of renewable energy sources.

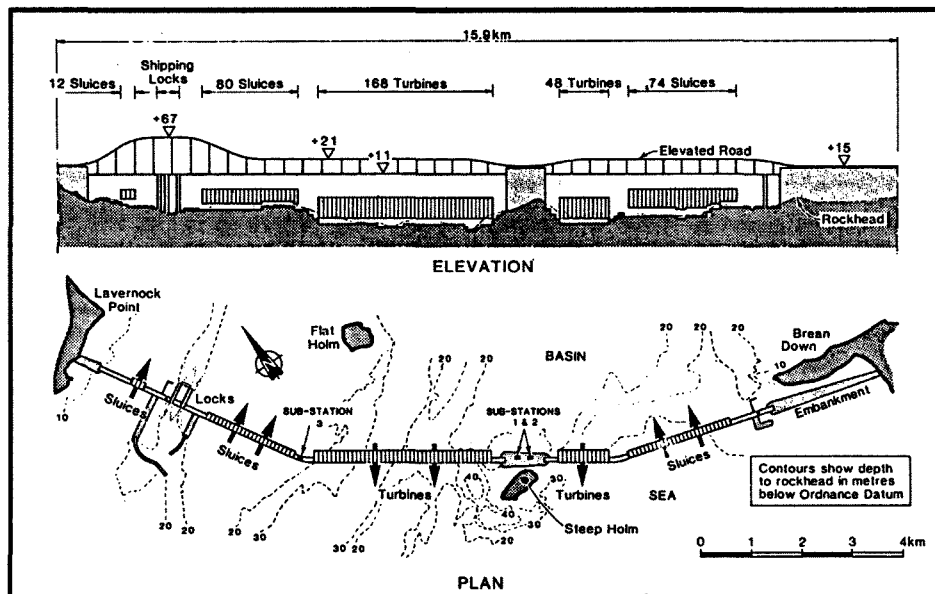
Promoting renewables

There are lots of practical ways we can encourage renewables in the UK. Intervention like tax incentives, efficiency standards and other forms of regulation can produce considerable cuts in carbon emissions, as well as saving consumers money. Surely we can claw back some of these savings through, for example, energy taxes to finance energy conservation (particularly to counter fuel poverty), and of course, renewable energy.

We can set up regional investment boards to lend money to decentralised renewable energy projects at a low rate of return taking account of the fact that they are more capital intensive than fossil fuel power stations. We can set up a Renewable Energy Agency to research and to deploy large scale projects such as offshore wind and wavepower schemes.

At the moment it is nuclear power that receives a number of different types of benefit from the state, including the fact that it is now, as a state run industry, assessed at a much lower rate of return than renewables which have to raise their investment on the market.

We should be aiming for cuts in present levels of carbon emissions of



Proposed Severn Barrage layout

at least 20% by 2005, in accordance with the 1988 Toronto Conference declaration on global warming. However, to achieve really high levels of CO₂ abatement and energy efficiency in areas that are difficult to influence with energy efficiency standards we will need to phase-in high levels of carbon taxes. Such tax levels will not damage our living standards provided we redistribute the tax revenue in an egalitarian way.

High carbon taxes will benefit renewables tremendously. I calculate that, with carbon taxes and given access to cheap sources of finance, renewables should be providing the bulk of electricity in as little as 30 years time. By contrast, nuclear power is so expensive that it will be uncompetitive even without a 'nuclear tax' to account for nuclear power's environmental consequences⁽²⁾.

Help needed

For all this to happen there has to be a renewable energy industry in the first place. Renewables desperately need help now. The newly privatised electricity distribution companies seem positively opposed to helping renewables, regarding them as inconveniences, and the government seems to lack the will to force them to take a more positive attitude.

The government claims it is helping renewables by setting up a renewable electricity quota in England and Wales calling for 600MW of renewable energy by the year 2000. There are proposals for renewable projects that would fill the quota several times over in the next couple of years, never mind over the next decade. But the

government has been very slow to make decisions about the programme.

Bizarrely, a ruling by the European Commission that nuclear power should not receive support from the levy on fossil fuel for more than eight years, has also been applied to renewables with the result that prospective wind and biomass projects have had to face the daunting task of repaying their private investors in less than eight years. Of course the ruling hardly matters to nuclear power which is now in the public sector.

Despite the good work done by various organisations, there is no well-financed, high profile, organisation like the Association for the Conservation of Energy that can champion the cause of renewable energy in the effective manner that the cause deserves.

We seem to spend a lot of time saying that renewables are good in theory, while in practice giving other things priority. If we are to show that we have solutions then we must devote more time to pressing the case for renewables, and think twice before crossing them off the list because they conflict with some other priority. □

Notes

(1) *Going Critical*, Paladin, 1985, and other publications by Walt Patterson.

(2) See D Toke, *Carbon taxes and renewable energy sources*, Open University Energy and Environment Research Unit, 1990.

■ SCRAM invites comments on this and other articles in the Journal.

West Berlin's Environment Minister, Senator Michael Schreyer, has refused to license the research reactor at the Hahn-Meitner Institute (HMI), which was planning to send its spent fuel to Dounreay. PETE ROCHE examines Dounreay's attempt to boost its income by offering to 'accept' spent fuel from research reactors around the world.

Dounreay's deadly trade

ANTI-NUCLEAR groups are claiming victory, following the West Berlin Senate's rejection of a no confidence vote in their Environment Minister. The HMI reactor, BER-2, was one of three reactors on the verge of signing a contract with the UK Atomic Energy Authority (AEA) to send its spent fuel to Dounreay in Caithness for storage and possible reprocessing.

Brian Wilson, Labour's Scottish Transport Spokesperson, described the decision as "a victory for international co-operation on environmental matters", following an extensive lobbying campaign by the Scottish Nuclear Free Local Authorities and anti-nuclear groups to persuade the Senate to support Schreyer's stance. However, victory may be short-lived. The West German Federal Government are now expected to try to over-rule Schreyer's decision. When Allied rights over Berlin end in October, the German Atomic Act will become law and the Federal Minister of Environment and Nuclear Safety can order a licence for BER-2. The Director of the Physikalisch Technische Bundesanstalt (PTB) research reactor in Braunschweig, Lower Saxony, has confirmed that he has signed a contract with Dounreay.

Dounreay announced in May this year that they were hoping to sign contracts worth £6m with the JEN reactor near Madrid and the Euratom high-flux reactor in Petten, the Netherlands, as well as the HMI reactor. However, the UKAEA's fuel services division hope their foreign business will eventually build up to around £25m per year. Any new reprocessing work Dounreay can attract "will go some way to securing approximately 500 jobs within the fuel services business", say the AEA.

The closure of the DIDO and PLUTO reactors at Harwell in March (SCRAM 76) ended the Dounreay Materials Testing Reactor (MTR) reprocessing plant's contract to reprocess 250 spent fuel elements a year. Although the MTR reprocessing plant has the capacity to handle 900 fuel elements per year, 758 is the most it has ever received.

Formerly, spent Highly Enriched Uranium (HEU) fuel from research

reactors could have been sent to the United States. However, increasing opposition in the US to imports of spent HEU fuel forced the Department of Energy to declare a 'moratorium', in December 1988, until an environmental impact assessment can be carried out. This has created problems for a number of the research reactor operators, around the world, who are running out of storage space for their spent fuel. Dounreay is "quite happy to take the work from the USA".

Since the mid-1950s, the US has been exporting HEU fuel to foreign countries for use in research reactors. The US had nuclear co-operation agreements with 43 countries between 1954 and mid-1984, and had exported about 16,700kg of HEU. Because of HEU's importance as a bomb making material these agreements included proliferation clauses. The agreements also gave the research reactors the option of returning their spent fuel to the US for reprocessing and disposal. However, by the end of 1983 only about 1,500kg of spent fuel, from 14 countries, had been returned.

Weapons connection

The returned spent fuel was reprocessed to extract the unused enriched uranium at either the Idaho National Engineering Laboratory or the Savannah River Plant in South Carolina, both US Department of Energy (DOE) military facilities. The resultant high-level waste was put into large storage tanks at the plants, and the recovered uranium was then sent to another DOE military facility at Oak Ridge, Tennessee, where it was mixed with similar material and converted into a metal form. "The metal is then shipped to the Savannah River Plant where it is fabricated into nuclear fuel. This fuel, called driver fuel, is used in Savannah River's production reactors to irradiate other materials that are converted into defense-related products, including plutonium and tritium", according to a 1984 report from the US General Accounting Office (GAO)⁽¹⁾.

Thus, although no plutonium or tritium - vital ingredients in nuclear weapons -

is produced from the reprocessed spent fuel itself, "the fuel is consumed during the fission process that irradiates other materials to produce defense-related products".

Countries exercising their option to return spent fuel for reprocessing and disposal were "given a credit, equal to the value of the uranium extracted from the returned spent fuel during reprocessing, on their next purchase of highly enriched uranium".

When the GAO report was published, several MPs from European non-nuclear weapons states objected to the use of their HEU in the US military programme. For example, Almar Metten, a Dutch MEP asked the European Commission on 17 April 1985 if it was "aware that spent nuclear fuel from the Euratom high-flux reactor in Petten is being used at the Savannah River plant in the United States as a driver fuel in the production of material for atomic weapons?" In response, the Commission issued a bland assurance that the reprocessing "does not result in any net increase of defence-related material. Of course, the Community is in no way involved in the United States weapons programme".

'Swedish' bombs

Despite the HEU extracted from foreign research reactor spent fuel making up "less than 1% of the driver fuel", Miles Goldstick⁽²⁾ has calculated that the Swedish Research Reactor at Studsvik has contributed several bombs to the US nuclear arsenal: "However small, the trade represents a direct Swedish connection to the US nuclear weapons industry, the only number of nuclear bombs that is insignificant is zero." There is clearly a moral dilemma here, particularly for a neutral country like Sweden.

According to the GAO "the only use DOE had for the driver fuel produced from previously burned highly enriched uranium fuels was in the Savannah River Plant's reactors".

Why should this be the case? If the recovered uranium cannot be fabricated into fresh fuel for the research reactors,

what will Dounreay do with the recovered uranium if the reprocessing goes ahead?

According to independent nuclear physicist, Walt Patterson, fuel fabricators may not be prepared to use the recovered uranium because it could be "unacceptably dangerous for their staff to handle [and] will contaminate their facilities", especially when there is such a glut of fresh uranium on the world market, and it "is certainly a possibility" that the recovered uranium will end up in the UK military programme: "it would be perfectly acceptable for use in [nuclear powered] subs".

Nuclear waste

Dounreay has offered to store the spent fuel from research reactors until 30 September 1994. If the client decides they don't want it reprocessed it must be removed from Dounreay by 30 September 1996. If the reprocessing goes ahead, waste, conditioned for transport and subsequent storage, will be removed from the UK not later than 25 years after reprocessing. So the research institutes could have 'solved' their waste problem for up to 29 years.

Patterson's opinion is that the research institutes don't care what happens to their spent fuel as long as they get it off their premises: "The only reason why it has to go through this reprocessing route is because that is the only thing that is on offer to them. Nobody is prepared to take the stuff off their hands and just store it for final disposal ... it certainly has nothing to do with any economic resource recovery."

As with all foreign reprocessing contracts signed by the UK nuclear industry since 1976, the UKAEA claim the Dounreay contracts will have 'return to sender' clauses for the waste. Yet no waste has been returned to clients from Sellafield. A letter from the British Embassy in Bonn to the West German Foreign Minister states that "the UKAEA shall have the option to deliver to the Federal Republic of Germany the radioactive waste which will arise from the reprocessing of the irradiated fuel in question (or the equivalent of such waste), provided it has been put in a form in which it can be transported safely to the point of storage and stored in accordance with all relevant regulations".

But what happens if the client countries do not have the facilities to accept the waste when the 29 years is up? West Germany, for example, with six research reactors, is experiencing problems with its nuclear waste disposal policies, just like everyone else. The red-green coalition which runs the Niedersachsen State Government has now decided to block the completion and operation of Germany's radioactive waste disposal site at Gorleben. Coming on top of the abandonment of the Wackersdorf reprocessing plant in Bavaria last autumn, this means that the German waste disposal policy is in tatters.

Dounreay claim that reprocessing research reactor spent fuel does not produce high-level waste. This was certainly not the case when spent fuel was returned to the US. According to

the GAO report "the waste ... contains high-level radioactive products and is stored in large tanks by DOE." Reprocessing increases the volume of waste by about 160 times.

Even if the high-level waste does get returned to the country of origin, this could still leave Dounreay lumbered with large quantities of low and intermediate-level waste. Government policy "in respect of some of the less radioactive wastes" is to study "whether it would be sensible to substitute an equivalent quantity in radiological terms, of higher level wastes" (Hansard 2 May 1986 cmns 502-503). Indeed, as the Northern European Nuclear Information Group point out, "they can never return the waste they will pump into our environment".

Political opposition.

All the opposition parties in Scotland have spoken out against these contracts. Brian Wilson comments: "the Labour Party in Scotland is opposed to Scotland being turned into the European reprocessing centre for research reactor fuel ... we believe on-site storage options that avoid high risk transportation operations are the best solution to nuclear waste."

Jim Wallace, Liberal Democrat MP for Orkney and Shetland, has called for a UK moratorium on the storage and reprocessing of spent HEU fuel, and the Scottish National Party has called on the European Community to ban the movement of nuclear waste between states.

Reprocessing contracts signed with BNFL, worth £800m, with seven West German nuclear stations, dwarf the Dounreay contracts, valued at somewhere between £6 and £25m. However the ongoing political storm which the Dounreay contracts have stirred up, from Iceland to Berlin, could have repercussions well beyond Scotland, with implications for Sellafield and the trans-frontier movement of spent fuel and nuclear waste across Europe. □

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1. Letter from Peach Dexter at US General Accounting Office to Richard Ottinger, Chairman of the Subcommittee on Energy Conservation and Commerce, House of Representatives. 13 Dec 1984. (GAO/RCED-85-47). Available free from GAO, Washington DC 20548.

2. *Studsvik, US Nuclear Bombs and US Nuclear Waste* by Miles Goldstick. 11 Sept 1989. Available from WISE Stockholm c/o FMK, PO Box 8083, S-10420 Stockholm, Sweden.

Kilograms of Highly Enriched Uranium returned

Country	Prior to 1982	1982	1983	Total
Austria	2.3	0	3.6	5.9
Belgium	63.2	19.1	0	82.3
Canada	268.9	34.0	0	302.9
Denmark	25.9	3.3	3.3	32.5
France	324.6	101.8	25.1	451.5
Italy	9.6	12.7	0	22.3
Japan	61.8	29.8	17.9	109.5
Mexico	0.4	0	0	0.4
Netherlands	80.4	24.6	32.2	137.2
South Africa	14.3	11.9	0	26.2
Sweden	153.8	13.6	12.5	179.9
Switzerland	0	6.8	0	6.8
United Kingdom	0.3	0	0	0.3
West Germany	93.5	31.1	14.2	138.8
TOTAL	1,099.0	288.7	108.8	1,496.5

Source: Compiled from US Department of Energy records and information collected at the Savannah River Plant and the Idaho National Engineering Laboratory during a review by the US General Accounting Office

Friends of the Earth are launching a national initiative to 'take the heat off the planet' and to put it on the English and Welsh area electricity boards who have so far failed to recognise their key role in the defence against global warming. This situation could be different, explains MIKE HARPER, FoE's assistant energy campaigner; area electricity boards, and the supply industry in general, could play their parts in protecting the environment, through a full commitment to promoting energy efficiency, if the structure of electricity privatisation allowed it.

Pollute Electric?

AT the end of October, the world's Governments will meet in Geneva for the 'World Conference on Climate Change' to agree a response to the environmental crisis of global warming. At the same time, the UK Government will begin privatising Britain's prime contributor to global warming - the electricity industry - but, in so doing, will bring about a structure that will help to increase global warming.

It has now become 'conventional wisdom' that energy efficiency is the most cost effective way to reduce the environmental implications of electricity generation. This message has been echoed by politicians and experts of every hue and is paid lip-service in the recent Government White Paper on the Environment. In short, reducing electricity consumption is essential for the future protection of the environment. In addition, energy efficiency can play a key role in enhancing the stability and security of an electricity system in the face of fuel price volatility arising from unpredictable political upheavals.

However, UK electricity boards have not yet learnt to embrace the concept of meeting electrical service requirements in the domestic sector (lighting, refrigeration, etc) through the direct promotion of electricity efficiency measures. "Meeting demand" is still perceived only in terms of supplying more units of electricity.

Worse still, the UK electricity boards see privatisation only as an opportunity for expanding electricity sales in the domestic energy market. Mr Jim Smith, Chair of Eastern Electricity, reflecting the profit-based commercial environment post privatisation, delivered a paper to an Institute of Electrical Engineers Council meeting in March attempting to "show how major a contribution in reduction of energy consumption and CO₂ emissions can be made by switching demand from other fuels to electricity". This, despite the fact that electricity used for domestic heating produces 3 to 4 times more CO₂ than using gas directly⁽¹⁾.

Post privatisation, it will not be in the

financial interests of the electricity boards, in England and Wales⁽²⁾, to initiate demand-reducing energy efficiency programmes in the domestic sector as a means of satisfying consumer requirements for electricity services. The financial framework under which the electricity boards are obliged to operate is structured so that they are only able to recoup the costs of electricity supply and not of electricity saving programmes.

The pricing formula ($RPI - x + y$) will induce the electricity boards to sell more electricity each year as a means of maintaining high profits. This is because the y-factor, which relates to costs which can be passed on to the consumer, only covers costs arising from electricity supply. In addition, the x-factor, which relates to operational efficiency, will work as an annually increasing incentive on the electricity boards to improve system efficiency (NB not energy efficiency). The combination of these two factors creates a powerful stimulus for electricity boards to increase sales of electricity. Therefore, without a sharp and profound structural reorganisation, the electricity boards themselves will be condemned to a course of maintaining pollution levels to maintain profit levels.

Stony disinterest

As the Electricity Bill was passing through Parliament in 1989, FoE and other environmental groups tried to inject the legislation with tough requirements for promoting energy efficiency. Though an amendment passed in the House of Lords was rejected when the Bill returned to the Commons, the episode did force a concession, albeit minor, from the Government on how to promote energy efficiency. Other attempts at revising the licence conditions for the electricity boards⁽³⁾ met with stony disinterest from the Department of Energy.

The electricity boards themselves now recite the customary excuses; that it was the Government who created the structure not them; that their business is to meet demand through supply; and, that the public is not ready for, or

interested in, greater energy efficiency.

The opportunity for 'turning the heat on the electricity boards' has arrived.

There are many and diverse examples of where electricity companies have learnt to meet demand for electrical services through integrating demand side measures with supply side measures ("integrated resource planning"). American and Australian utilities are often quoted as the best examples for such activities, though models closer to home in Scandinavia and Denmark are available and programmes in Spain and Germany are now also being developed.

Swedish efficiency

For example, Vattenfall, the Swedish power board, has recently launched a £35 million campaign to reduce the electricity consumption in the domestic and commercial sectors. It estimates that the potential for saving electricity is 12-19TWh per year - 4-5TWh from introducing state-of-the-art equipment and 8-14TWh from more effective electricity use. The full saving represents about one fifth of Vattenfall's total load. They are using low-energy lightbulb promotions and newspaper articles in an attempt to heighten public awareness of energy efficiency.

In Australia, the other Mr Jim Smith, the Chair of the State Electricity Commission of Victoria (SECV), has also set down what his plans are for the future - they differ somewhat from those of his British namesake: "Our studies show that better efficiency in the use of energy saves the community money and is by far the most effective response in meeting the greenhouse challenge ... Our responsibility is to balance supply and demand in the State."

The SECV is investing \$(AUS)55 million in conjunction with the State Government in 29 different energy efficiency programmes. The expected saving will avoid the construction of a 2000 MW power station.

Boston Edison, in the USA, the largest New England electricity utility, earlier

this year announced that it would invest \$215 million in energy efficiency programmes to remove the need for more generating capacity. Over the next five years the programmes are expected to save about 1TWh (roughly equivalent to the amount generated by a 120MW power station). It hopes to save two dollars for every dollar invested, on account of "an innovative economic incentive system"⁽⁴⁾, which allows the utility to recoup the costs of the programme and a portion of the \$400 million saving as profit. The rest of the saving will be passed on to the customers.

The EC DG XVII (the energy directorate of the European Commission) is finalising arrangements for programmes in 'integrated resource planning' for the electricity sectors in both Spain and West Germany. These programmes are expected to yield preliminary results at the end of 1991 and should provide precedents which can be replicated in other EC countries.

There will no doubt be sceptical electricity boards and Government Ministers who insist that such energy efficiency programmes are appropriate only for excessively regulated systems and not therefore suitable for the UK. Is it indeed surprising, that a Government which is trying to bring about the largest privatisation to date, should resist major structural adjustments? And in any case, won't the Electricity Act guarantee greater energy efficiency?

The reality

Section 3.2b of the Electricity Act, 1989, places an obligation the Director of Electricity Supply (Professor Littlechild) to promote the efficient use of electricity sold to the public. This obligation manifests itself in terms of the degree to which electricity boards provide information on the efficient use of electricity. At this elementary level alone, the electricity boards have fallen desperately short of the mark.

Codes of conduct were submitted by each electricity board to the Office of Electricity Regulation (OFFER) for consideration. OFFER has declared that "it is highly unlikely that any will be approved as they currently stand"⁽⁵⁾. The draft codes of conduct themselves were a collection of 'hints' on how best to use electricity (cooking with lids on, etc); no mention that nobody wants electricity per se, but merely the services it provides; no mention that different makes and models of appliances use different amounts of electricity; no mention that passive solar architecture can reduce the need for artificial lighting and heating; no mention that



gas is more energy-efficient in some applications. Instead, the draft codes of conduct read like sales-brochures for Economy 7 heating. Economy 7 can lead to a reduction in costly peak generation, but, unless associated with a genuine reduction in demand, by and large, does not reduce electricity consumption or associated pollution.

This first attempt by the electricity boards at drafting codes of conduct on energy efficiency demonstrates that programmes for energy efficiency and attempts to diminish the impact of global warming will be as doomed to failure post privatisation as they have been prior to privatisation.

Next steps

The electricity boards need to be sent two messages.

Firstly, they need to know that the public is aware of what is happening to the environment, is aware of the need for change and is anxious to help. For this purpose FoE is asking individuals to set themselves a target of 20% reduction in their personal electricity consumption. One of the golden aims of privatisation is "to put the customer firmly in the driving seat"⁽⁶⁾ - this campaign is intended, therefore, to test that assertion by putting the heat on the electricity boards. By informing your electricity board that you have set a 20% target and by asking your board for financial support to help meet the target, you will help to force them to recognise the fragile commercial future they face. On 28 August, 1990, UBS Phillips Drew published a report on the

12 electricity boards in England and Wales identifying a reduction in electricity sales through consumer purchasing fluctuations as one of the major commercial risks for the soon to be privatised companies.

Secondly, the electricity boards need to know that there is a way out. Specific changes to the structure are identified in a forthcoming report to be published by FoE⁽⁷⁾.

Before real improvements can take place, however, the electricity boards must feel the heat and must learn to respond. □

NOTES

1. *Warm Homes, Cool Planet*, by Neighbourhood Energy Action, Friends of the Earth, Right to Fuel and Glasgow Heatwise, 1990.
2. The Scottish boards, "who do things differently", have a vertically-integrated structure which enables 'integrated resource planning' to take place with less structural adjustment and therefore should be treated separately.
3. The Licences set down exactly what each electricity board can and cannot do in respect of its business and related activities. They contain the pricing formula discussed above.
4. *Nature*, Vol 344, 22/3/1990.
5. This was declared in a letter to FoE from the head of Consumer Affairs at OFFER.
6. John Harris, Chair of East Midlands Electricity Board, 22/7/1990.
7. *Pollute Electric*, by FoE, 1990. From FoE, 26-28 Underwood Street, London N1 7JQ.

Energy research funding

NUCLEAR power's domination of the Department of Energy's (DoEn) research and development budget for 1990-91 means that other more deserving technologies such as clean coal plant, wave power and energy conservation are being starved of funding, according to the Energy Select Committee's 7th report *.

In the current year the nuclear industry will consume £129 million, 72.1% of the budget. The bulk of which, £84.6 million, will be spent on the fast breeder reactor, despite plans for scaling funding down to £10 million a year in 1994, and the Government's own estimate that the fast breeder might not be needed until 2120.

Giving evidence on behalf of the DoEn, the Permanent Under Secretary, G H Chipperfield, said: "At the moment we regard the basic research resources that are being put into nuclear compared with non-nuclear programmes as being justifiable by the actual projects that are being done in either case." He also indicated the possibility of additional research being needed into decommissioning and radioactive waste management.

Fusion attracts the second largest chunk of the budget, most of which will be pumped into the Joint European Torus project based at Culham. The immediate objective of which is "the establishment of the scientific and technological base for the construction of an installation designed to achieve and study the ignition and prolonged combustion of plasma and related technological problems." However, the DoEn believes that nuclear fusion is a least 60 years away from commercial application. The committee view this expenditure with some bewilderment, noting: "It has not even been established that fusion will produce more power than it consumes."

The treaty which established the JET programme, signed in 1977, makes it clear that the host country will have to meet the costs of decommissioning the experimental plant. The Government estimates that the cost of decommissioning will be around £90 million, adding this is "a preliminary estimate and subject to considerable uncertainty". The Committee are concerned by the fact that this estimate is very much higher than was expected in 1977. It seems unlikely that the new estimate will be higher than the eventual cost.

The Committee questions the wisdom of the Government's obsession with all things nuclear: "We doubt that an R&D programme which involves spending three times as much on nuclear R&D as on all other energy R&D put together is a good reflection of the UK's future energy needs." They believe that in light of "major changes underway in the energy field and measures to control CO₂ emissions ... it is likely that few of the assump-

tions which originally determined the present allocation of the Department's R&D budget remain valid.

"We believe this makes a fundamental review of the structure and the size of the ... expenditure essential, and we recommend that the Department undertakes such a review."

While coal-fired power stations' outpouring of carbon dioxide may be taking most of the flak for the the greenhouse effect it is still the main source of electricity in this country, and is likely to remain so for the foreseeable future. However, only £7.6 million has been earmarked for research and development into clean coal technologies. In particular the Committee are concerned about the Government's commitment to the 'Topping Cycle', a new coal design being pioneered by British Coal (BC), which could lead to efficiency improvements of around 20% - meaning a reduction in CO₂ emissions of 20% per unit of electricity produced. Last year the Government promised £8 million for the research programme (SCRAM 73), however, it was dependent upon BC securing industrial partners to provide the remaining cost of the programme. Unfortunately BC have failed to do this and consequently have received no funding at all. The Committee finds this situation "unsatisfactory" and notes "this [condition] apparently does not apply to any nuclear R&D". They call for Government money to be made available "so far as it is necessary to prevent the project being delayed by lack of funding."

Wave power

Government funding of wave power, £200,000, is "tiny" say the MPs. It will remain so at least until the results of a DoEn review of wave power is completed sometime late in 1991. Chipperfield argues that the review is not - as is widely believed - a response to allegations of corruption in the DoEn's last wave programme which was run-down in 1982-83 but "simply one of a series of periodic reviews of renewable energy sources taking account of changed conditions and technologies". The Department, referring to the Salter's Duck wave power device, "does not accept that there were serious errors made in the earlier evaluation of the project" and "does not accept that there was any question of bias in the assessments that were made in the past". Chipperfield hopes that the review will be "forward looking". The Committee are unconvinced: "In our view there is a case to answer."

They see no reason for the review to take 2 years, arguing that there are two distinct types of wave power being dealt with. Coastline devices, for which the field data is being gathered and offshore designs, on which no new work has been done since the mid-80s. They call for the review to "be conducted in 2 stages: a review of offshore wave energy to be completed in a much shorter time than 2

	1990-91 Estimates £m	% of total R&D
Nuclear R&D		
General safety	2.8	1.6
Fast Reactor	84.6	47.2
Fusion	26.9	15.0
Nuclear Materials		
Management	4.1	2.3
DRAWMS	5.9	3.3
Safeguards (R&D)	1.0	0.6
Underlying Research		
Levy on other nuclear programmes	3.7	2.1
Total nuclear	129.0	72.1
Non-nuclear R&D		
Oil and gas production technology	3.7	2.1
Offshore safety	7.0	3.9
EOR (R&D)	0.65	0.3
Coal based energy	7.6	4.2
Renewables	20.3	11.3
Energy efficiency		
RD&D	11.0	6.1
Total non-nuclear	50.25	27.9

years, and a review of shoreline wave energy to be completed once the results from the field experiments in 1991 are available.

"If the review identifies significant errors in earlier assessments of wave energy devices such as Salter's duck, we recommend that an independent body be established to examine how such errors came to be made (in particular whether there was any deliberate distortion of evidence) and to publish its findings."

Perhaps the most ridiculous of all the Department's misallocations is the fact that the publicity and information campaigns of the UKAEA will receive £3.1 million which is almost equal to the entire budget for all other energy publicity. In particular they regard "the amount provided for nuclear publicity by the UKAEA as disproportionately large by comparison with the amount spent on energy efficiency". Chipperfield told the committee that the nuclear publicity provided "value for money". It is necessary, he said, because nuclear power was a subject "on which there is a great deal of misunderstanding ... and ignorance and fear and the Government ... have taken the view that there is a need for a substantial effort to be put into public education and information." On energy efficiency he comments: "general publicity messages were not bearing fruit as they had and there was greater public understanding of energy efficiency generally".

It is hard to understand the logic of a Government continuing to shore-up the nuclear industry when the guardians of Tory democracy - the free marketeers - have donned the black hanky and passed sentence. □

* Energy Committee Seventh Report. The Department of Energy's spending Plans, 1990-91. HMSO 1990, £7.85.

Paper tiger

STRIVE"; "Promote"; "Encourage"; "Stimulate"; "Inform" and; "Press", after "Government", are the most over-used words in the Government's long awaited white paper on the environment*. Notably lacking from the paper are "Legislate" and "Deadline".

There is nothing particularly new concerning energy in this white paper, it is no more than a collection of previously stated policies.

Carbon dioxide emissions will be brought back down to their 1990 levels by 2005, "if other countries take similar action", it says. This, in combination with "challenging" measures to tackle other greenhouse gasses, will result in cutting Britain's contribution to global warming to 80% of 1990 levels by 2005.

New approaches to pollution control that increase reliance on the operation of the market will be promoted, rather than the more traditional technique of setting standards in laws and regulations. In contrast: "the Government will also press for agreement in the European community on a common energy labelling scheme for electrical appliances, and minimum efficiency standards for equipment such as central heating boilers, fridges, washing machines and industrial heating."

An energy tax "has been ruled out for the next few years", the white paper explains that "in the immediate future the reduction of inflation is of overriding importance". This, amongst other statements, gives credence to the feeling that this is not quite the white paper that Environment Secretary, Chris Patten, would have liked to publish, but a compromise to other, stronger, Government Departments.

Energy efficiency gets the credit it

deserves for being "the cheapest and quickest way to combat global warming", and being "in the economic interests of energy consumers - from individuals in their homes to large companies". However, "many of the Government's initiatives aim to inform the consumers of these benefits and encourage them to take action". Once again an indefinite wording creeps in - "encourage". This seems to run contrary to the recently published Department of Energy report on energy efficiency in the home (see p25).

A new ministerial committee, headed by the Energy Secretary, will be set up to promote energy efficiency and monitor developments. It will work with government departments and local authorities to "stimulate" improvements.

Renewable energies are non-polluting, and therefore useful in combating global warming. Following many caveats the paper says that "renewables may contribute up to the equivalent of nearly a quarter of current electricity supply by 2025". Although the paper says that the Government will set a 1,000MW target for renewable generating capacity by 2000, it is difficult to see how on current levels of funding and only a 1,000MW platform that the renewable contribution could jump to this level. A question that will, perhaps, be answered following the promised review of "their alternatives strategy in 1991, to assess the extent to which renewables could help to further restrain the greenhouse effect". Then again perhaps not (see NFFO set, below).

Combined Heat and Power will be "promoted" under the Energy Efficiency Office's Best Practice Programme and "if possible" it will identify and promote a doubling of Britain's present capacity to 2,000MW by the year 2000.

The Government is responding "decisively to the threat of acid rain", yet it

blocked the formation of the European Large Combustion Plant Directive on acid emissions for years, and consistently refused to join the '30% Club'. The paper claims that the Government "has a substantial programme of action in hand", this is difficult to swallow (see p25), as they are in the process of backtracking on commitments made during the late '80s.

Again another department has triumphed over the Department of Environment. The lure of the 'great car economy' is clearly stronger in the Government than the desire to curb acid rain: commenting on the commitment made in 1984 to cut nitrogen oxide emissions by 30% of their 1980 levels by 2000, it argues: "Since then there has been substantial growth in road traffic which will make achieving this aim more difficult, but it remains an aim for which to strive."

Nuclear power gets little attention and only mild promotion as a means to combat the greenhouse effect. The Government is keen to maintain the nuclear option, but only if it "becomes more economic and the industry demonstrates that it can maintain high standards of safety and environmental protection". Adding: "The relative economics of nuclear power (and also renewable energy) could improve if the environmental costs of fossil fuels are taken into account on a comparable basis: more work is needed to explore this." However, again, they don't say if this work is planned. One wonders what happened to the 'Pearce Report'?

This most positive thing in the report is commitment to publish at "regular intervals" detailed statistical bulletins on the state of the environment. Regular intervals has not been defined. □

* *This Common Inheritance - Britain's Environment Strategy*. HMSO. 1990, 300pp, £24.50.

NFFO set

CONTRACTS for 102MW of renewable energy generating capacity have been awarded under the Government's Non-Fossil Fuel Obligation (NFFO) amidst claims that the figure could have been significantly higher if it wasn't for draconian financial constraints.

Of the 75 schemes, chosen from over 350 projects put forward, equal to 2GW of power, 25 will burn gas from landfill sites, 26 are hydro projects, nine wind schemes and seven waste burning designs. They will be guaranteed a market for their power for the next 8 years at a price of 6p per unit of electricity produced.

Many of the companies seeking entry in the Obligation say that there are two main reasons why their projects were unsuccessful: the levy will only operate for 8 years, while many of the proposals have a longer payback period, and a clause in the

NFFO which forces companies to continue with the projects even if some unforeseen hitch pushes the return on investment to as low as 1-2%.

Peter Musgrove, the managing director of the Wind Energy Group, said: "This [the clause] is not a normal commercial practice. We are being told we should throw dice over delays which are outside our control."

The 8 year limit was imposed by a European Community ruling designed to protect British tax-payers from having to support the costs of nuclear power - which accounts for some 8,000MW of the NFFO. However, in August, a spokesperson for Leon Brittan, the competition commissioner in Brussels, said that it was not too late for Britain to ask the EC to consider nuclear power and renewables separately. The Department of Energy says it does not intend to reconsider the NFFO until 1994, when they will review Britain's commitment to nuclear power. □

Ethical investment

A £1 million share issue has been launched by the Centre for Alternative Technology, to fund an ambitious development of the site at Machynlleth.

After 11 years of presenting alternative technology in action the centre is anticipating a large rise in the number of visitors each year, from 75,000 this year to 150,000 in 1994.

Four large "interactive" video displays will provide information on various aspects of the green home, countryside and farming, transport and mobility, and energy. The countryside display will incorporate an underground walk through a giant model wormhole, showing a mass of microscopic creatures. Twin mountain railway carriages, driven by gravity, will make passage up the 300ft slope from the car park much easier. New shops and cafes are also planned. □

■ Shares at £1 each (minimum 100) from Centre for Alternative Technology, Machynlleth, Powys, SY20 9AZ.

Wind farm dropped

ONE of the three, Government backed, experimental windfarms planned for England and Wales has been dropped by National Power because of the expense involved in laying access roads on the deep peat deposits of the Pennines, where the farm was to have been built.

The announcement was made on 23 August at the inauguration of Europe's largest vertical axis wind turbine, at National Power's Carmarthen Bay test site in Wales. Costing about £2 million the turbine, built by VAWT a subsidiary of the civil engineering company McAlpine, will produce enough power for 500 homes.

Colin Moynihan, the new Minister responsible for alternative energy sources, who presided over the opening ceremony, said that wind power was one of the most promising of the renewables and could account for 10% of the UK's current elec-

tricity consumption by 2025. Adding, that events in the Gulf had "again demonstrated that experimental developments of this kind are likely to take on a growing importance both to this country and the world's long term energy provision."

The British Wind Energy Association (BWEA) welcomed the new turbine, but said it was "an isolated achievement amidst very slow progress being made to harness wind energy resources in the UK". Indeed, a prominent member of the BWEA, former chair Professor Norman Lipman, now head of energy research at the Rutherford Appleton Laboratory, told the British Association earlier in the month that wind power could provide up to 30% of Britain's electricity needs by 2020, and 40% of Europe's. Admitting that at the moment wind power would cost around 6p a unit, more than the 4.5p claimed for conventional power stations, he argued that if the Government invested in a serious programme then costs would fall by over a third. □

Private wind

ON the day National Power announced the abandoning of the Pennines proposal, Yorkshire Water and Yorkshire Electricity revealed their plans to build an entirely private wind farm on Ovenden Moor - land owned by Yorkshire Water.

At an estimated cost of £10 million, the farm will consist of around 35 medium sized machines producing enough power for 4,500 homes. The planning manager for the project, Stewart Reid, of Yorkshire Windpower Ltd, a new company set up to build and run the farm, says "Subject to

planning permission and construction, we should start generating electricity by the end of next year."

Planning permission is not, however, a foregone conclusion. Several proposed windfarms have already fallen foul of local authority planning committees. Another smaller windfarm proposal from Yorkshire Water came to a grinding halt, earlier this year, after objections that the turbines would spoil the local landscape.

Reid is aware of the problem and has consulted a landscape expert, who will advise the company on where to place the turbines to minimise visual intrusion whilst still taking best advantage of the wind resource. □

Renewables and Dounreay

CAITHNESS would be an ideal area in which to establish a centre for developing alternative energy sources, according to a report* produced by Orkney CADE (Campaign Against Dounreay Expansion). Written by two local engineers, it argues Caithness has an excellent climate for developing wind, wave and solar energy, and that the technical expertise and hardware amassed at Dounreay would be well suited to the task.

To date, a mere £160 million has been spent on the development of all the renewables, "the same amount is to be spent on the Prototype Fast Breeder reactor (PFR) at Dounreay before its closure 1994". It observes: "Imagine what could have been achieved if the £4 billion consumed by the fast reactor programme, not to mention the countless billions spent on the nuclear industry, had been spent on renewables."

Caithness "arguably" boasts one of the best wind climates in Europe for the exploitation of wind power, with a mean

annual wind speed of 8-12m/s, high by any standard and, in addition, "the terrain is relatively flat so access roads will not be a problem".

The northern coast of Scotland, with its vicious Atlantic rollers, presents an excellent opportunity to test many different kinds of wave power device. Indeed, it was with the north of Scotland in mind that Edinburgh University's Professor Stephen Salter designed his eponymous 'Duck' wave power device - where high wave power availability in the winter and high energy demand are particularly well matched.

Borrowing an argument from Kerr MacGregor, chair of the Scottish Solar Energy Society, himself a campaigner for developing renewables in Caithness, they argue that "ten months of Shetland sunshine is worth more gallons of oil or kilowatt hours of electricity than two months of Sicilian sunshine". This is because the longer period when space heating is required in Shetland, or Caithness for that matter, means that although less heat is produced per hour it is more valuable - it does not necessarily refer to electricity

Con-fusion

OVER £30 billion will need to be spent by the European Community during the next 50 years if nuclear fusion is to become a commercial reality, according to Charles Maisonnier, the Director of the Community's fusion research programme.

Speaking at the 16th International Symposium, which attracted over 500 delegates, held in London at the beginning of September, he said the first commercial electricity nuclear producing fusion reactor would not begin operating until 2040 at the earliest.

He also told the Conference that an expert scientific review panel, convened by the Community, had recommended that fusion should remain as a top priority. Their report, which concludes "the problem of energy supply and the need to preserve ... global climate mean it is one of the few remaining practical options", will soon go to a meeting of the European Council of Ministers, which will have to make a decision on the future direction of Community fusion research.

Currently the Community expends £250 million a year on fusion, mainly on the Joint European Torus (JET) fusion device in Culham. JET, it is claimed, is close to the break even point - when as much energy is got out as is put in. It is, however, only a research device and two further devices will have to be built to prove the technology according to Maisonnier.

The review also warns that potentially serious environmental problems must be overcome before the research proceeds any further. The main fears are: there is no expertise in dealing with fusion fires and; large amounts of radioactive waste could be created, however, Dr Sebastian Pease, a UK fusion pioneer, hopes that a suitable material can be found that could virtually eliminate radioactive wastes, "but as the basic fusion process hasn't yet been demonstrated you can't be sure." □

generation.

Dounreay also boasts a power transmission line which will be made redundant in 1994, when the PFR closes.

In the longer term the Centre could expand into work on energy conservation, energy efficient electrical appliance design and work on alleviating the problem of radon gas build up in the home.

However, the proposal could meet with opposition from some alternative energy researchers who have in the past had their fingers burnt by the close connection between the Department of Energy's Energy Technology Support Unit (ETSU) - the body responsible for both energy efficiency and renewable energy development - and the United Kingdom Atomic Energy Authority (UKAEA). ETSU is based in a couple of portacabins at Harwell, the headquarters of the UKAEA. □

* *Centre for Alternative Development in Energy* by Edward Kelsall & Kenneth Low. CADE, 1990, 6pp, £1. Available from: Richard Levens, Berriedale Cottages, St Margrets, Orkney.

Efficiency begins at home

DOMESTIC electricity consumers could cut their fuel bills by 40% if they switched to using currently available energy efficient appliances, cutting UK emissions of carbon dioxide by almost a tenth, according to a Department of Energy (DoE) report* published at the beginning of September.

Compiled by the March Consulting Group for the Energy Efficiency Office, it shows how peak energy demand could be reduced by 10% and the nations annual fuel bill by £1.5 billion, negating the need for 5,000MW of generating capacity.

Refrigeration and lighting offer the highest potential savings, up to 70%, while across the board the average saving would be 40% using the best available techno-

logy in the UK, and 45% using the best available in the world. The report also notes that current research promises to boost the saving to 60%.

While energy efficient appliances are usually more expensive, the average pay back period is only 4 years. Despite the huge saving to be made, the authors found little or no interest in the energy efficient appliances currently in the shops by either consumers or retailers.

"Major" government initiatives will be required if this situation is to change. "Minor" acts such as energy labelling, they comment, are unlikely to have much effect in isolation. Initiatives could include subsidising efficient products, higher electricity prices or setting tough efficiency standards which manufacturers would have to meet. Setting standards has an advantage in that it would not victimise the poor in the same way an energy tax or

higher fuel prices would.

The report argues that an "energy cost" approach would meet with some hostility from consumers but if efficiency was promoted as part of an environment programme it would be more likely to find favour. Ray Gluckman, director of March's energy division, said: "Retailers, we felt, didn't really understand the issues, and a lot of manufacturers didn't seem to have any policy on what level of efficiency they might accept." The market works largely on "energy points" - a fridge at £299 is much more acceptable than one priced £305, and the retailer wants as many goodies packed into the price as possible. "Attractive controls and design are far more likely to sell than energy-saving", say March. □

* *Energy efficiency in domestic electrical appliances; HMSO, 1990, £24.*

Acid comments

WHILE 700 delegates from 24 countries met in Glasgow, at the International Conference on Acid Deposition, to discuss advancements in scientific understanding of "acid rain", three major reports have been published outlining the severity of the problem.

A report by the IIASA, an influential Austrian research group, said that acid rain will destroy 118 million m³ of wood - worth £16 billion - every year for the next century. It concludes that massive emission reductions, greater than those agreed by the European Community, are required to stem the "huge economic losses".

A restricted United Nations (UN) report, which was circulating at the conference, warned that "millions of Europeans live in areas with air pollution levels severe enough to cause each year thousands of premature deaths and [leave] many more chronically ill and disabled." Children and old people who are already suffering respiratory problems are most at risk. It, like the IIASA report recommends emission reductions in excess of those already agreed.

A second UN study said that over one quarter of Britain's trees have been badly damaged, and that overall they are more severely affected than in any other Western European country. However, at the

recent meeting of the British Association for the Advancement of Sciences, Dr John Innes, of the Forestry Commission, denied that there was any link between acid rain and damage to British trees. This was fiercely contested by Dr David Fowler, of Edinburgh's Institute for Terrestrial Ecology, who has shown definite links between acid deposition and damage to young trees, under experimental conditions.

Professor Fred Last, of Edinburgh and Newcastle Universities, chair of the conference, echoed the fears of many acid rain scientists, warning that their funding must not be cut and called on Governments worldwide to resist the temptation to cut research into acid rain. He said: "Problems of acid deposition are related to the standard of living associated with industrialisation and the possession of the car. If you have a small increase in the standard of living in parts of Asia there will be a major expansion in pollution emissions. The problem is becoming worldwide, but we are hardly thinking about it in these countries."

While the scientists discussed the minute intricacies of the problem, a little publicised consultation document was issued by the Department of the Environment (DoE) on how Britain plans to meet its commitment to the European Directive on reducing acid emission to 40% of their 1982 levels by 2003. The document was quickly disowned by the power boards.

Both National Power and Power Gen - who are committed to fitting 4GW of coal plant with flue gas desulphurisation equipment each - dispute the cost of the programme, £6 billion, given by the DoE, are obviously worried about the effect of such a financial commitment on their privatisation portfolios. Scottish Power said it had no commitment to reducing acid pollution.

The DoE have also missed the June deadline for informing the European Commission how it will meet the directive. In addition, they were supposed to produce a final, detailed, report on the Government's plans by July 31. Andy Tickle, Greenpeace's acid rain campaigner, comments: "The Government announced its Fgd programme in 1986 and so far not one power station has been fitted. West Germany announced its programme in 1983 and has now fitted every power station. Since 1980 they have cut sulphur emissions by 85%."

The most poignant speech given to the conference was made by a Czechoslovakian scientist, Dr Tomas Paces, who pointed out that in his country, and other Eastern European states, reducing acid emissions was way down the public's list of priorities - after a new car, a video and a microwave oven. "You have 22 countries here but the countries with the most pollution and which produce the most pollution are not here," he said, "I think it is a pity".

In his country the problem is very complicated. It is short of money and relies on high sulphur coal burnt in outdated coal plant for most its power. What can we do, asks Paces? "The Hungarians don't want us to build hydro electric power stations. The Austrians don't want us to build nuclear power stations. Sweden doesn't want us to burn coal, and the Russians are not sending us enough oil." He is, however, confident that Czechoslovakia's problems can be over come, but "it will take time". □

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REVIEWS

Nuclear Disasters And The Built Environment, A Report to the Royal Institute of British Architects; by Philip Steadman and Simon Hodgkinson. Butterworth Architecture; 1990, £40.

The title does not do justice to the work. Certainly these authors, assisted by a most distinguished team, deal with the built environment; coming from RIBA it is this section which is uniquely authoritative. But rural Britain also receives attention. Reactor accidents and nuclear war are covered; also emergency planning, or what passes for that. The most chilling topic is that of reconstruction after nuclear war. There is an adequate account of reactor technology, also of the principles of radiological safety and of nuclear science - the lot in fact.

How well does it succeed with such a huge coverage? In my view brilliantly. Nobody covers such an enormous span without errors, usually of judgement, I detected very few questionable statements. The splendid

and highly pertinent diagrams are another matter and need looking at carefully. I give only one instance: on page 81 there is a map showing possible targets for nuclear attack. Although nuclear submarine bases are provided for in the key they have been unaccountably omitted from the map itself, thus creating the illusion that Faslane and Coulport would be the ideal funk-holes to make for if you can get there in time.

But trivial faults such as this do not really matter when compared with the excellent and well-ordered text; the fact that every vital statement receives an authoritative reference; and that there is a fine analytical index. In fact, except in regard to specialised issues such as nuclear waste, a nuclear critic needs no other guide than

this. It is not a specialised document written principally for architects but is also "directed towards the general public" (page 4).

What a pity, then, that very few members of the general public will ever see it; for this A4 paperback a centimetre thick sells at £40. This is pure White Knight:

"For I had hit upon a plan
To dye one's whiskers green -
And always use so large a fan
That they could not be seen."

In fact this outcome is simply one small instance of many that decisions made in Britain should not be assumed to be rational or even sane.

I conclude, therefore, by referring to a few issues which are wholly authoritative and partly new: the effect of nuclear war on the Built Environment (the similar section on nuclear power disasters are also authoritative but they are not new). Guard them well, for they are all you are ever likely to see of a splendid document murdered by 'economics'. Two seem to me especially

important.

Firstly, although these writers are meticulous in avoiding overstatement, no power on earth can resist the impact of accurate and detailed scholarship. Their analysis of civil defence makes it quite clear that British policy has always been that, in nuclear war, the civil populations shall be destroyed in proportion as the facilities on which they formerly depended have been destroyed. They do not say so, but they do not need to: no other conclusion can follow from the data presented. Take a deep breath: this is the least inhumane solution for a country too small for bombs too large.

Their second conclusion is that rebuilding of cities after heavy nuclear attack may well be never attempted. Others have suspected this before; the RIBA team give in detail the reasons why (page 124).

But only a long review could do justice to this document. So try to get it into your library - if they have £40 to spare.

DON ARNOTT

Electricity: efficient end-use and new generation technologies and their planning implications; T B Johansson, B Bodlund and R H Williams (Eds). Lund University Press; 1989, 947pp.

Hydrogen as an energy carrier: technologies, systems, economy; C-J Winter, J Nitsch (Eds). Springer-Verlag; 1988, 377pp, DM158.00.

Sweden, committed to phasing out its nuclear capacity (currently around 50% - see SCRAM Nuclear News this issue), limiting expansion of hydro-electric and reducing carbon dioxide emissions, will need to do some very careful energy planning. Commissioned with the support of Vattenfall, the Swedish State Power Board, as the basis for a Congress held last year, *Electricity* is an ambitious but realistic attempt to present the choices available.

The book covers a wide range of electricity technologies - with emphasis put on reducing demand through energy efficiency. Combining, as it does, technology and economics, the reader is offered a very useful reference book of practical energy options.

A similar approach is adopted by *Hydrogen as an energy carrier*, which considers the possible future use of hydrogen on technical and economic grounds. The idea

of the Hydrogen Economy (SCRAM 77) has been around for a considerable time, but this book is the most comprehensive and realistic I have seen on the subject.

Both books cover a wide range, and on their own admission cannot therefore deal completely with any one area, but they are more than detailed enough for most purposes and both are fully referenced (almost 2,000 references between them) to allow further in-depth study, if required.

A system considered in both books is the possibility of using photovoltaic solar cells to produce hydrogen by electrolysis, with the hydrogen then producing electricity as required by means of a fuel cell (SCRAM 76). The editors of *Hydrogen as an energy carrier* suggests that the poorer "sun rich countries with [limited] energy infrastructure, can

profit early from decentralized solar energy plants employing hydrogen as energy storage medium"; and they believe that such development could bring about "a fundamental equalization of ... trade balances".

Electricity is packed full of ideas on energy efficiency, everything from low energy lighting to Combined Cycle Pressurised Fluidised Bed Combustion of coal.

One area which the Swedish book, to my surprise, made only passing reference was wind power, despite offshore wind being an area of active research in Sweden (SCRAM 78). That said, I can find very little on which to fault either book; the high technical content inevitably reduces readability, but as sources of information for those concerned with energy choices for the future, they are both excellent.

GRAHAM STEIN

REVIEWS

Coal-Use Technology in a Changing Environment - the advance continues; by Walt Patterson.

Financial Times Business Information; 1990, 118pp, £215.

Coal, contrary to the predictions of energy analysts in the 1970's, is not in short supply, nor is it expensive. It has, however, been cast as the main villain in global warming. The Government are using global warming, and coal's role, as a platform from which to promote nuclear expansion - despite the moratorium on ordering new nuclear plant brought about by privatisation.

Patterson believes that it is not coal that the finger of blame should be pointing at, but at the generators who burn it in antique power stations.

Following on from his ear-

lier volume, *Advanced Coal-Use Technology*, he charts the considerable advances made in the design of coal-fired power stations, since 1987.

"Reducing carbon dioxide emissions", admits Patterson, "means burning less fossil fuel". Henceforth, he says, the battle for the global fuel market will not only be waged on price, reliability and convenience but on "environmental impact and efficient end-use of the energy produced". Coal, he believes, can meet the challenge.

New designs, developed over the last 20 years or so, can not only burn coal more efficiently but can do it with

less impact on the environment. Fluidised bed combustion (FBC), to mention but one, operates at a temperature below 900°C - typical coal-combustion systems operate at over 1,000°C - which significantly reduces the evolution of nitrogen oxides. By adding limestone to the bed, sulphur dioxide emissions can be cut by up to 95%. Patterson notes that the resultant calcium sulphate is at least as useful as the waste from a flue gas desulphurisation (Fgd) unit. Reducing emissions from FBC does not, however, involve the massive capital investment necessary for Fgd nor does it reduce the operating efficiency of the plant. FBC boilers are also typically 10% cheaper than conventional plant.

The developing world will turn to coal to fuel industrialisation, as the developed world did before them. If the

global warming is to be tackled it will be improvements in coal-combustion technology exported to developing countries - or even donated - that will prevent their necessary industrialisation from undermining any attempts to stabilise carbon dioxide levels.

In this country clean-coal also has a role to play. It is widely accepted that investment in energy conservation is about 7 times more effective in reducing CO₂ emissions than nuclear power, therefore if we invest in clean-coal, which is considerably cheaper than nuclear power, we will free money that would be more effectively spent on conserving energy.

To be sure, this is an extremely useful and timely volume, boasting Patterson's customary readability and accuracy.

MIKE TOWNSLEY

Deadly Deceit: Low-Level Radiation, High-Level Cover-Up; by Jay Gould and Benjamin Goldman. Four Walls Eight Windows (distributed by Turnaround in UK); 1990, 222pp, £12.95.

This book relies heavily on work by Ernest Sternglass, who has a reputation for going way over the top in claims about effects of low-level radiation. But then it's easier for the nuclear boffins to smear him, than to investigate his claims thoroughly.

Rather than concentrating on cancer statistics, this book looks at excess deaths in the US after Chernobyl, Three Mile Island and other accidents. As many as nine million "excess deaths" may have been caused by radioactive pollution. The Chernobyl data "offer strong evidence for a relationship between the measured radioactivity in milk and the changes in monthly mortality for adults and infants across the country."

Bird surveys confirm these findings with "a strong correlation between ... iodine-131 in milk and decreases ... in numbers of small, arboreal insecti-

vorous birds."

The authors claim "US Government publications systematically covered up increased death rates after reactor accidents". It's difficult to say whether the authors are paranoid, but if they are only half-right there should be urgent investigations into the connections between hormonal and immune deficiency diseases (including AIDS) and radiation. Does the sudden appearance of Lyme disease (juvenile arthritis caused by a tick which previously only affected deer) in 1975 have any connection to a radiation release from the Millstone plant in Connecticut the same year, or is that just a coincidence?

The facts in this book point to radiation having much larger effects than previously thought, and are crying out for further investigation.

PETE ROCHE

When the bough breaks ... Our children, Our Environment; by Lloyd Timberlake & Laura Thomas. Earthscan; 1990, 262pp, £6.95.

"We do not own the earth, we have merely borrowed it from our children", or words to that effect are oft heard trickling off the tongues of politicians, airing their green credentials, this book brings them into perspective.

It opens: "Every year, 14 million children under the age of five die in the developing world, not in a drought and famine year, but in an 'ordinary' year."

In writing it to accompany the TV series of the same name, the authors have provided a savage indictment against the short-sighted exploitation of resources, both

human and environmental.

"A world in which poverty is endemic will always be prone to ecological and other catastrophes", warns the Brundtland Report. This book demonstrates the strong connections between poverty and environmental destruction. The fuelwood crisis in many developing countries, for example, is leading to the wholesale clearing of vast areas, then once bereft of their trees the land dries up and dies.

It is often difficult to decide which books to read from the plethora of environmental tomes flooding into book shops, but if you don't read any other this year, read this one. It is not just about children, it is about all of us, we were all once children. Timberlake is a name to look out for, a mark of quality and readability.

MIKE TOWNSLEY

1. State Parties recognise that every child has the right to life.
2. State Parties shall ensure to the maximum extent possible the survival and development of the child.

Article Six of the 1989 UN Convention on the Rights of the Child.

LITTLE BLACK RABBIT

Idly browsing through back copies of Atom, the magazine of the UK Atomic Energy Authority, Little Black Rabbit came across a book review in the September 1979 issue. *Is nuclear power necessary?* by Amory Lovins, published by Friends of the Earth, received unfavourable comment.

Amongst the criticisms was Lovins use of 1GW as the typical size for US nuclear stations up to the year 2000; the reviewer predicted "modest continuing progress toward larger station sizes - say typically 2GW in the mid 80s and 3GW in the early 90s". In reality, there have been no nuclear power stations built in the US since then, and in Britain Sizewell B, and Hinkley C (if ever built) are planned to be just 1.2GW. It looks like Lovins was a lot nearer the mark than Atom's contributor.

Our reviewer's insight continues "the impetus for nuclear power construction is [based on] straightforward cost considerations", and that Lovins offers "a bewildering mass of supporting references ... as proof that the 'market' does not want nuclear energy (when all the evidence is that it does)". To round things off, our reviewer tells us "nuclear power does not have to be necessary. It only needs to be safer, cleaner and cheaper than other ways of producing electricity. That is just what it is and Lovins has done nothing to show that it is not."

So who was our perceptive reviewer from 1979? Well just between you, me and Little Black Rabbit it was one L G Brookes, UKAEA Economic Adviser!



A recent issue of LBR's favourite magazine *Nuclear Forum*, carries a report on how nuclear power can save children. The piece is based on the thoughts of Nuclear Electric's Dr John Wright, who claims nuclear power could alleviate an energy shortfall in the third world and reduce infant mortality by up to half a million each year. The article states "Dr Wright emphasises that this is a very simple and in no way rigorous calculation".

A simple calculation by LBR came up with the facts that in Britain, Scotland has the largest per capita nuclear capacity; it also has the highest infant mortality rate.



"There is increasing scepticism about the future greenhouse effect and policies unnecessarily tied to it may lose popular support as confidence declines in the whole greenhouse issue." So ran a quote from US energy expert Dr Bob Billings in an advance press release from the Watt Committee on Energy. British Coal, acting as hosts for Dr Billings, must have been well pleased with their choice of speaker as they sat down to listen to his presentation to the Committee.

Amongst the comments made by BC's guest was: "I would be heartbroken if in five years time my work were used as justification not to take action on the greenhouse effect." Not quite what BC had

been hoping for, and to their further embarrassment Dr Billings went on to forecast doubling of CO₂ emissions would increase global temperatures by 2-4°C.

Perhaps BC should seek advice on 'expert' selection from Mrs Thatcher or the nuclear industry.



LBR has discovered that the first ever *New Scientist*, 22 November 1956, carried an article by Scientific Editor, T A Margerison, titled "Where do we go from Calder Hall?". The introduction states "Middle East oil supplies are threatened. Coal is scarce and dear. The answer should be a vast stepping-up of our atomic energy programme."

The threat to oil supplies in 1956 was of course the Suez crisis. The faith in nuclear power was touching if unjustified. Much the same arguments are being used by supporters of nuclear power now, but the nuclear image is more tarnished.

In conclusion Margerison says "it will require something not far short of military planning if the atomic energy programme is to be expanded significantly [and] make any significant improvement to the present critical fuel situation."

"Military planning" is a particularly apposite phrase, because fuel crises come and fuel crises go, but the link between the military and nuclear power go on and on; as does T A Margerison, who went on to work for the Nuclear Electricity Information Group - now British Nuclear Forum!

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