

SAFE ENERGY

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**Nuclear India:
a dream
gone sour**

**Efficiency
without tears**

**Tritium:
a cause of
leukaemias?**

**Living with
windfarms**

**Rock lab or
Trojan horse?**

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COMMENT

THE shambles which has followed the brutal announcement of pit closures by British Coal – leading to a three month review – is just one of a series of developments which cumulatively constitute an energy crisis.

Desperately searching for a way out of the abyss in which he finds himself, Trade and Industry Secretary Michael Heseltine is floundering around hoping that the plethora of reviews he has initiated will provide his salvation.

His own Department's three month review, the scope of which is unclear, was initially designed as a holding operation to deflect the rage not only of the opposition parties, but many of his own back-benchers. With Arthur Scargill now heading John Major in popularity polls, and the miners getting the full support of the nuclear industry's unions, even the Cabinet now appear to understand that a genuine review is necessary.

The Trade and Industry Committee has also launched an inquiry: "To consider the consequences of British Coal's pit closure programme for the electricity consumer, the Exchequer and the economy, and to examine alternatives in terms of energy policy."

Professor Stephen Littlechild, under orders from Heseltine, has brought forward his examination of the dash to gas, to determine if the new gas-fired stations are more expensive than existing coal generation. A fact already apparent to all but Littlechild and Heseltine.

The argument about gas versus coal has overshadowed events in the nuclear industry, which is undergoing its own convulsions – perhaps even its death throes.

The cynical attempt by BNFL to 'bounce' Her Majesty's Inspectors of Pollution by starting up their THORP reprocessing plant at Sellafield in advance of the Inspectors' authorisation has been scuppered. HMIP, due to undertake an eight-week consultation on emissions from THORP, have already received a record 20,000 letters of opposition to the massive increase in emissions. BNFL hoped to start commissioning the plant – thus contaminating it with spent uranium fuel – and sort out the authorisations later.

It is 15 years since the public inquiry which gave THORP the go-ahead, and Environment Minister David Maclean has said it "would be crazy" not to look at things again. He described BNFL's manoeuvring as an attempt to "pre-empt the independence of HMIP".

NIREX's proposals for an underground rock laboratory at Sellafield, far from being borne of legitimate scientific investigation, are a cheap attempt to get underground without having to justify themselves to a full public inquiry. The rock lab will conveniently be in the same place as the deep dumps ventilation shaft – it is a desperate attempt by NIREX to get back on schedule rather than face up to the geological failings of their contrived site choice.

The most blatant of the subsidies to nuclear power – the Non Fossil Fuel Obligation – is now being seriously questioned. There is growing pressure from industry, consumer groups, National Power, PowerGen, the Office of Electricity Regulation and others, for the subsidy to Nuclear Electric – which puts 11% on electricity bills in England and Wales – to be reduced prior to its European Commission-enforced end in 1998.

There can be little comfort for the nuclear industry in the Department of Trade and Industry's forecasts for carbon dioxide emissions in 2020. Despite considering a range of scenarios, "each is based on the assumption that no further capacity other than Sizewell B is brought on stream." By 2020, nuclear power is forecast to provide just 1% of UK electricity.

All this makes clear that the Government does not have an energy policy. Its trust in a half-baked privatisation and market forces has proved to be misplaced. Whether, at the eleventh hour, they can salvage a coherent energy strategy must be in doubt.

Where does all this leave the 1994 review of nuclear power?

The key decisions on which the future of nuclear power hangs are being made over the coming months; there will be little if anything left to discuss come 1994. Either the industry's death notice will already have been signed, or there will be no alternative to its continuation.

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

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to shut-down a nuclear reactor in an emergency.

CONTRIBUTIONS

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

LETTERS

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

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FOR THE BLIND

The text of *Safe Energy* is now available on disk for people who are registered blind. This service is available at a charge of £3 above the appropriate subscription rate – this covers the cost of the disks and administration. Further information available on request.

CORRECTION

In "Korean proliferation risk" in the last issue, an error was introduced during editing to suggest that South Korea built a nuclear arsenal in 1971/2. It should have stated that they planned to build a nuclear arsenal.

PRODUCTION

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SAFE ENERGY

FEATURES

8 Nuclear India: a dream gone sour

India has been researching, building and operating nuclear power stations for forty years, and has the fastest-growing nuclear programme in the world – but at what cost? **Hugo Smith** of Chameleon TV and **James Cutler** of Yorkshire TV, who investigated India's nuclear dream for ITV's *First Tuesday*, report on the human impact.

10 Efficiency without tears

Action to combat global warming need not be costly; a range of options are available at no net cost, according to Dr Tim Jackson in *Efficiency without tears*. **Graham Stein** takes a detailed look at the Friends of the Earth report which advocates structural, regulatory and fiscal changes in the energy market.

12 Tritium – the cause of leukaemias?

Chapelcross, the UK's largest emitter of tritium, takes on a new risk as data from Canada suggests that these emissions are more dangerous than previously believed. **Ian Fairlie**, a researcher at Bart's Medical College, reports on Canadian Atomic Energy Control Board findings.

14 Living with windfarms

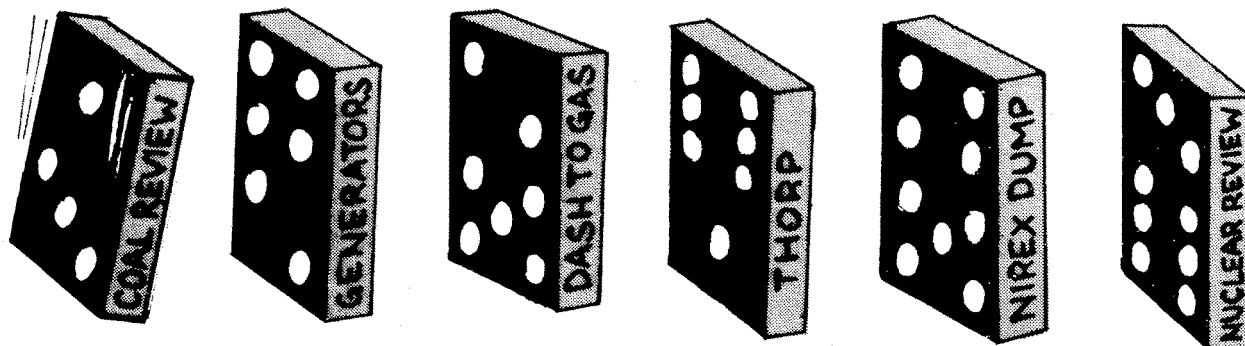
Bridget Gubbins, public relations director of North Energy Associates, travelled to Denmark and The Netherlands to study windfarms at first hand. She found many of the environmental concerns about wind power to be unfounded.

16 Rock lab or Trojan horse?

Nirex's planned underground rock laboratory at Sellafield is a manoeuvre to progress the building of the low- and intermediate-level waste dump with the minimum of public scrutiny argue **Dr Patrick Green** and **Rachel Western** of Friends of the Earth.

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Sale of the century

REPORTS in the Guardian newspaper that large parts of the nuclear industry are to be sold off to help cover the Government's public spending deficit have met with a mixed response from the industry and unions.

According to the report, "confidential plans" drawn up before the last general election to split up AEA Technology are being reactivated by the Treasury, with the aim of floating the company by 1995.

The Treasury are also said to be examining ways in which Scottish Nuclear (SNL) and British Nuclear Fuels (BNFL) can be sold by the end of the century.

The pre-election proposals formulated by the then Energy Secretary, John Wakeham, showed that substantial profits could be made by splitting AEA Technology and either floating the parts on the stock market or by selling them to private companies like GEC.

However, AEA Technology are "not aware of any plans" which would split

the company into saleable parts. Yet following the publication of a Monopolies and Mergers Commission report on the company its deputy chair, Dr Brian Eyre, commented that privatisation would be the "logical conclusion of its efforts to become a commercial venture," saying it would "need a further two or three years to establish the sort of track record for us to go into the private sector."

At the end of September AEA announced a net profit for the year 1991-92 of £16.8 million, overturning the previous year's £40 million net loss.

The selling of BNFL would be more politically "sensitive" says the newspaper report. However, the recent appointment of John Guinness - former permanent under-secretary at the ill-fated Department of Energy - as the company's chair with a brief that includes improving efficiency "raises the possibility of a sale later."

Unions representing the 25,000 strong workforce of AEA Technology and BNFL have condemned the proposals as "ultimate madness". Jack Dromey, national secretary of the Transport and General Workers Union,

said: "Britain's nuclear industry, already reeling from blow after blow from a government claiming to support nuclear power, would be reduced to a rump."

However, Dromey confirmed that privatisation was immanent: "Privatisation is on the cards. We are having discussions with the DTI and a number of options are on the table. We cannot say any more at the moment."

Arguing that AEA is a world leader in research and development on safety he said: "There is no way the market in Britain, obsessed with short-termism, would sustain this jewel of high technology."

SNL's Chair, James Hann, has always maintained that the best place for the nuclear industry is in the private sector: "I believe and I certainly hope that [the 1994 Government review of the industry] will be positive for the nuclear industry and I then believe that the Government will say: 'Fine, if that's the case, it must not be a drain on the tax-payer,' - which is another way of saying, 'let's privatise it'".

The Treasury have refused to be drawn into the controversy, dismissing the report as purely speculative. □

Power play

AS the Government decimates coalfield communities in the name of the free market and economics, calls are mounting for a reduction in the state subsidy which underpins the nuclear industry - the so-called Non Fossil Fuel Obligation.

A chorus of opposition from PowerGen, National Power, the Office of Electricity Regulation (OFFER), The Electricity Consumers Council, and the Coalition for Fair Electricity Regulation (COFFER) is calling for a reduction in the Obligation or levy.

This year the levy will amount to £1.2 billion - equivalent to 11% on the electricity bills of every household and company in England and Wales.

COFFER, which includes the big industrial users, wants a levy reduction because, they say, paying a premium of 11% on their fuel bills - some 98% of which goes to the nuclear industry - is making their goods uncompetitive with those produced by their overseas rivals with access to cheaper power.

Professor Stephen Littlechild the head of OFFER agrees with COFFER arguing that a levy reduction "would be a most practical way of responding

to the concerns from large users." Littlechild believes that the way the levy is set should be changed. It should be set in advance instead of being revised each year to produce a given amount of revenue, says Littlechild. Setting a declining path for the levy rate would, he believes, be the best way to give Nuclear Electric (NE) a sharper incentive to cut costs.

Dr Bob Hawley, Nuclear Electric's new chief executive, has rounded on Littlechild following his comments, saying they were superfluous because he had already set the company the goal of becoming profitable without the levy by 1995. Last year the company made a pre-levy loss of £738 million.

If NE do become profitable, as suggested, it will still need the levy to make provision for the reactors it inherited when it was formed in 1990 says Hawley. Any profits when they come will be needed to make provisions for power stations as yet uncompleted, such as Sizewell B.

However, the Government have ruled out any reduction in the NFFO in the near future because the Treasury, fully aware that the nuclear industry cannot stand on its own two feet, is unwilling to allocate public funds to bridge the gap. □

No nukes forecast

SIZEWELL will be the UK's last nuclear power station according to a Department of Trade and Industry (DTI) report which outlines how the Government will meet its obligations to reduce carbon emissions.

The report forecasts that by 2020 the progressive closure of ageing reactors will mean that the nuclear industry will contribute a mere 1% of power generation. While producing a number of scenarios the DTI comments: "Each scenario is based upon the assumption that no further capacity other than Sizewell B is brought on stream."

Renewable energy sources will fare only slightly better with the DTI estimating that they will account for 4%.

The bulk of the UK's demand will be met by gas fired power stations. By 2020 gas will account for some 57% of production. Until last year large gas stations were banned because of scarce supply. However, only 10% of the gas used in 2020 will be from UK sources.

Coal will continue to play a role in the UK energy sector says the DTI, "partly as a means of generators achieving a diversity of fuel supplies and particularly as a hedge against the possibility of higher gas prices." A figure of 27% has been attached to coal, however, nowhere does the report mention British Coal, all of the DTI's calculation are based upon imports of coal. These imports are expected to come from South Africa, Australia, the United States, Columbia and Indonesia. □

Plutonium play

PLANNED discussions on what to do with mounting world stockpiles of plutonium during the International Atomic Energy Agency's (IAEA) annual general conference, held in Vienna on 23 September, were cancelled because the US insisted "the timing is not tight."

Following statements from the IAEA's Deputy General Director, William Dirks, made in April, that excess fissile plutonium separated from civilian nuclear programmes "is going to pose a major political and security problem worldwide," ("Plutonium Pile", *Safe Energy* 89) the IAEA are keen to be at the forefront of plans to tackle the problem.

The IAEA secretariat are clearly angry about the US's interference, according to the industry journal "Nuclear Fuel". According to the journal, IAEA sources

believe the US move was borne out of embarrassment over "the still simmering issue of Iraq's nuclear weapons programme or the current furore over shipments to Japan of plutonium from France, and later the UK." Other commentators believe the US thinks the IAEA is too politicised to be allowed to control fissile plutonium stocks.

"The US tends to regard plutonium as a waste that is best retained within the spent fuel in long-term storage or final disposal in deep geological formations, while others see it as a valuable resource that would be a vital fuel in the future," a senior IAEA official said. "We at the agency do not take one side or the other, but we do think the issue of what to do with the mounting stockpile of plutonium should be discussed openly."

In their second annual publication of the IAEA File, Greenpeace also think that the IAEA as it is currently formulated

"should not be in charge of plutonium safeguarding since the agency is a promoter of the reprocessing technology that separates nuclear weapons-grade plutonium." The report "points to the contradiction that currently exists within the Agency which promotes the spread of nuclear technology while supposedly seeking to limit the proliferation of nuclear weapons."

Greenpeace believe that the best way to proceed would be to strip the IAEA of its promotional roles. □

* The IAEA File 1992, Greenpeace, 16pp, £3. The report also contains investigations of the IAEA's failure to tackle the problem of nuclear safety in Russia, to establish an adequate regime of international compensation for nuclear accidents, and its endeavours to demean the contribution of renewable energy to future supplies by publishing incorrect and misleading information.

Dounreay investigation

DOUNREAY will be the first UK nuclear site to be investigated by the European Commission, who will soon be conducting a review of the "operation of the facilities for environmental monitoring of Dounreay."

The move was announced in response to questions raised by Welsh MEP, Llewellyn Smith. Smith asked the Commission if it was "aware of risks posed to the water table and marine environment off the Caithness plant from the

shallow storage pits at ... Dounreay."

Acting Environment Commissioner Karel Van Miert, said that they were unaware of claims that Dounreay's shallow waste pits were leaking and had only just been made aware of waste disposal changes at the plant which caused an "appreciable increase" in radiation exposure.

According to a report published by Greenpeace at the end of August, Dounreay is one of the worst Scottish polluters of the sea. AEA Technology is allowed to discharge 900,000 litres of contaminated effluent into the sea every day. In addition they have permission to discharge 2.5 tonnes of lead, five tonnes

of zinc and 1.3 tonnes of chromium per year. All substances which are listed as dangerous in the Paris Convention, which has been signed by the UK.

■ Highland Regional Council are expected to consider an application from Dounreay's operators, AEA Technology, for a new 12,000 cubic meter waste pit in December.

Billed by AEA as an extension to their existing waste pit 6, the new pit will increase the sites shallow burial capacity by 35%. Not only is the pit designed to leak, it will play host to dangerous alpha emitting waste, even British Nuclear Fuels at Drigg in Cumbria refuse to take such waste. □

Transport report

ALL spent fuel should be regarded as nuclear waste according to a draft report by Llewellyn Smith MEP, produced for the European Parliament's environment committee, it calls for a complete ban of all imports into the European Community of spent fuel.

After being debated by the Committee on the Environment, Public Health and Consumer Protection the report will be presented to the Parliament for approval. Smith is calling on the Parliament to challenge the European Commission's view that reprocessing policy is a matter for national governments. He believes: "There may be areas where the principle of subsidiarity may be applied sensibly; the management of radioactive wastes is not one of them."

The key recommendations of the report are:

- that no radioactive waste, or spent fuel that will give rise to radioactive waste, should be transported in "the net export from one Member State to another";
- that an urgent ban is placed on the import of spent fuel from outside the Community;
- that the Commission's DG XI and Euratom undertake a full "cradle to the grave" environmental audit of alternative nuclear fuel cycle options, to be completed by May 1993;
- that until commerce in plutonium is halted completely, transports by air should conform to tough US safety standards, all sea transports should be on purpose built vessels and that transports of military plutonium should be conducted under the same standards to be used for civilian transports;
- that for the transport of irradiated fuel and high-level wastes emergency plans be set up in consultation with the

appropriate trade unions, existing emergency services and local authorities covering all ports and the entire transport routes on land, and that such transports be prohibited forthwith on roll-on, roll-off ferries or other ro-ro vessels within Community boundaries;

- that a study be undertaken by the appropriate Commission directorate of the options available for the redeployment of skilled reprocessing workers;
- that the Commission take an active role in reviewing the 1960 Paris Convention (and supplementary 1963 Brussels Convention) and the 1963 Vienna Convention on liability and compensation for transboundary damage done by nuclear accidents; and
- that proposals should be developed for the minimisation of the production of radioactive wastes, primarily from nuclear power plant operation and reprocessing. □

Dump delay

THIRTEEN coastal nations bordering the North Sea have agreed a convention to clean up the northern Atlantic, and in a last-minute compromise, to allow Britain and France to sign the convention, left the back door open for the dumping of bulky radioactive waste after a 15 year moratorium.

When the nation's environment ministers met in Paris during September all supported a permanent ban with the exception of France and the UK who wanted to keep open the possibility of dumping large items of radioactive waste from decommissioned power stations and submarines.

With 10 nuclear submarines due to be decommissioned by the end of the century, the British Department of the Environment said it wanted to wait until a review group of the London Dumping Convention (LDC) - a global convention

to regulate dumping at sea - had reported before committing itself on radioactive waste. UK Environment Minister, David Maclean, said: "There is not yet any proven acceptable land-based alternative, and it may be that disposing of these items at sea will represent the best environmental practice."

The new Paris Convention text says "the dumping of low and intermediate level radioactive substances, including wastes, is prohibited." The UK and France have been allowed an exemption to this rule but they will not be allowed to dump for 15 years from 1 January 1993. They also have to report "on the steps taken to explore alternative land based options" in 1997, and every two years after that. They also have to report on studies which show that "any potential dumping operations would not result in hazards to human health, harm to living resources or marine ecosystems, damage to amenities or interference with other legitimate uses of the sea." There is also provision to extend the moratorium for a further 10 years.

Britain's signing of the Convention represents a significant victory for Greenpeace, who were singled out in the brief given to Maclean, as "the most active in the UK in the run up to [the convention]".

In 1978 the Greenpeace ship the *Rainbow Warrior* first met up with the UK's radioactive waste dump ship in the North East Atlantic; the last annual nuclear waste disposal operation took place in September 1982. Following this the LDC voted for a ten year moratorium on the sea dumping of nuclear waste. In 1983 the UK Government were all set to ignore the ban, but a combination of Greenpeace, the National Union of Seafarers and public opinion forced a change of heart.

The battle will now move to the next LDC meeting to be held in London in November. Denmark and the other Nordic countries will be supporting a motion for a permanent worldwide ban on nuclear waste dumping at sea. □

Chernobyl cancers

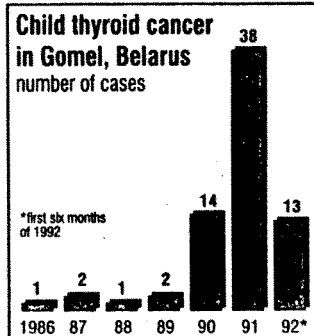
CANCER cases amongst those most effected by the Chernobyl disaster are beginning to appear at an alarming rate according to scientists in the Confederation of Independent States, backed by the World Health Organisation (WHO).

According to a report in the latest edition of the science journal *Nature*, children in Belarus, which borders the Ukraine, are 80 times more likely to develop thyroid cancer than those elsewhere in the world. 131 cases of the cancer were found in Belarus children in 1990, and the rate of registration has doubled since the disaster.

In a letter to *Nature* Dr Kazakov, who heads a team of scientists from the Belarus Ministry of Health, wrote: "The occurrence of this increase in thyroid cancer within a few years of exposure to radioactive isotopes of iodine is unexpected, but real. It poses both humanitarian and scientific problems, and is placing severe strain upon the health services of our new country." The team believe that the only "realistic explanation" for the increase is "that it is a direct consequence of the accident at Chernobyl."

The World Health Organisation (WHO) have independently confirmed the teams figures. Keith Bavestock, who was sent to validate the results, expressed surprise at the finding: "It is unexpected that it is so early. It may indicate the start of a much bigger thing, or it may be that there is a particularly sensitive sub-group within the population that we were unaware of." If it is the latter he added "it has implications for the rest of the world."

Previously, reports of increased cancer incidence have been rejected by western



Child thyroid cancer in Belarus
number of cases by region 1986-92*

| | |
|----------------------|------------|
| Brest | 18 |
| Vitebsk | 4 |
| Gomel | 71 |
| Grodno | 13 |
| Minsk | 12 |
| Mogilev | 4 |
| Minsk City | 9 |
| Belarus total | 131 |

*first six months of 1992

radiation experts, who said it was too soon to tell because traditionally it has been assumed that the latency period for cancers other than leukemia is at least 10 years. The WHO group said that the Belarus experience "suggests that the consequences to the human thyroid, especially in foetuses and young children, of the carcinogenic effects of radioactive fallout are much greater than previously thought."

Ukrainian investigations are beginning to show a significant deterioration in the health of the so-called liquidators conscripted to help clean-up Chernobyl in the immediate aftermath of the fire. Of the 600,000 people involved 180,000 are on a Ukrainian ministry register. While 74% were considered to be healthy in 1988 only 33% remained in that category by 1991. Among the 120,000 children born to Ukrainian-based liquidators since the accident, 70% of newborns were healthy in 1989 but only 40.5% remain so.

Natalia Soboleva, deputy director of the



ministry department responsible for radiological protection and health, comments "the percentage of healthy people is decreasing steadily."

While many of the diseases and causes of death are not traditionally linked to radiation exposure, Soboleva says the onset of disease amongst the liquidators is occurring at a young age: "They have become invalids at 35 or 40 ... we consider that when a young man dies" there is a strong possibility that his life has been shortened by his experience as a liquidator.

The Ukraine does not believe outside experts when they say there is no connection between this morbidity and mortality and the Chernobyl accident: "Ukraine has been an experiment ... The experts said it was too early [for the effects to be seen] their forecast was 1997. Despite that we have these cases of cancer."

Soboleva believes that the "Ukrainian scientists will be proven right - to my great regret." □

Hot spot

PREVIOUSLY undetected radioactive "hot spots" caused by discharges from Sellafield have been found by Friends of the Earth (FoE), casting doubt over the validity of official monitoring.

The 33 "hot spots" found by FoE's Radiation Monitoring Unit are in 17 locations along the estuaries of South Cumbria, Lancashire, Merseyside and North Wales. FoE are using the results to illustrate the inadequacy of the official investigations into whether or not the site's operators, British Nuclear Fuels, should be given permits to massively increase their discharges - sea and air levels by 6 and 80 times respectively - upon opening the Thermal Oxide Reprocessing Plant (THORP).

The Ministry of Agriculture, Fisheries and Food (MAFF) is jointly responsible with HMIP for authorising the increase in discharges from Sellafield. It must assess

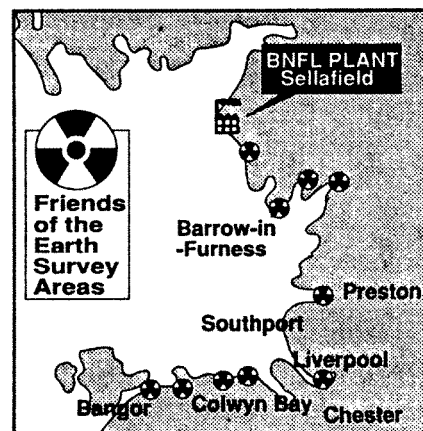
whether internationally recommended limits for public exposure to radiation are going to be exceeded as a result of the proposed increase. However, they are arguing that in making such an assessment, only the radiation risk to the public arising from future discharges need to be taken in account.

FoE have condemned this "slate cleaning" exercise in which the radioactive legacy from Sellafield will be treated as natural or background radiation ("THORP Still time to stop it", *Safe Energy* 90).

FoE Radiation Campaigner Dr Patrick Green said: "Even with only limited monitoring, it is clear that Sellafield has produced a formidable legacy of radioactive contamination ... Now BNFL wants to add to it."

BNFL has dismissed FoE's claims as "scaremongering and unnecessary. Their reports in the past have been found to be wanting and we expect this one to be the same."

HMIP will be holding an eight week



public consultation into the proposed discharge increases, which is expected to begin in late October. □

"Sellafield - The Contaminated Legacy" by Nick Cassidy and Dr Patrick Green will be published by FoE in November. It will constitute the main body of the group's submission to the HMIP consultation.

Sellafield cock-up

BRITISH Nuclear Fuels is waiting on the Nuclear Installation Inspectorate (NII) to give its permission for the recovery of 80 litres of plutonium nitrate which leaked out of an evaporator within its Magnox reprocessing plant on 8 September.

Initially the company thought it could rectify the problem by shutting the plant for only a few days, however, closer examination showed that a shut-down of several weeks would be necessary as

the plutonium nitrate solution had leaked within a sealed cell making safe retrieval a complex and dangerous operation.

"We can't do anything until we hear from NII," said the company: "We are putting it down to an engineering fault, but we don't know its cause - whether it was a valve or whatever - we can't gain access to that cell." BNFL say this is not a radiological incident "because the spillage is contained within the cell. It did not affect any of the workforce." □

THORP software faults

AN early version of the software which will monitor and control the Thermal Oxide Reprocessing Plant (THORP) contained over 2,400 faults according to British Nuclear Fuels (BNFL), adding further to fears over increasing reliance on computer software controlling nuclear plant.

Although BNFL now say the errors have been corrected, Grenville Harrop, the project and commissioning manager for THORP, said that 4% of the faults "could have placed a demand upon the safety systems".

The Nuclear Installations Inspectorate will be reviewing the software alterations: "We will be conducting a software audit later this year to check how BNFL handles its software procedures, looking particularly at faults and how they have been managed through to subsequent testing - and retesting if necessary."

Neil Storey, secretary of the British Computer Society's specialist group on safety related computer systems, says it is practically impossible to get rid of all the faults and that only exhaustive testing can get rid of all those that are related to safety. Adding, "It is only possible to completely verify programs up to 2000 lines of code in length - beyond that it becomes very difficult."

While maintaining that all problems have been rectified, BNFL refuses to reveal how many lines of code there are in THORP's control software. □

BNFL MOX

A decision on whether or not to build a commercial scale mixed-oxide (MOX) fuel fabrication plant will be taken by British Nuclear Fuels (BNFL) by the end of the year.

The plant will be built at Sellafield if BNFL decide to proceed. It would be operational by 1998 say the company. However, any decision would be taken on "solely ... commercial prospects." The plant would have an output of 100 million tonnes of heavy metal per year (MTHM/yr) and cost an estimated £200 million.

Because of the dismal state of world wide programmes for fast breeder reactors - only Japan now envisage using the technology in the foreseeable future - the only way recycled plutonium from BNFL reprocessing activities could be used is as a MOX fuel for light water reactors (LWRs) in one of five countries - Japan, Belgium, France, West Germany and Switzerland. The UK has no plans to use recycled plutonium.

In MOX fuel the fissile plutonium is substituted for fissile uranium as the main source of neutrons to sustain the chain reactor.

If plutonium is not refabricated within three to five years of reprocessing it degrades into a form where it's no longer directly usable - making a mockery of any reprocessing activities.

However, BNFL's decision will have to take into account the amount of MOX fuel likely to be demanded by the world market and that already being produced by other countries.

Nuclear industry estimates put the total demand for MOX during the 1990s at 250-300 MTHM/yr. Germany has a MOX fabrication plant which is 90% complete and expected to start up in 1995, with a capacity of 120MTHM/yr, Belgium are expected to upgrade its plant from 35MTHM/yr to 75MTHM/yr and France are planning 120MTHM/yr. If all these plant go into operation the supply and demand will be roughly in balance. A BNFL plant would only make sense if one of the other plant failed to operate. □

While most countries are shutting down or mothballing their reactors, India, with plans to spend over £3 billion by the turn of the century, boasts the fastest growing nuclear programme in the world. Following their *First Tuesday* television investigation into nuclear India, HUGO SMITH of Chameleon TV and JAMES CUTLER of Yorkshire TV, examine the human costs.

Nuclear India: a dream gone sour

FOR forty years the Indian Government has been researching, building and operating nuclear power stations. From the early research reactors to the American designed commercial reactor at Tarapur and the indigenously designed reactors at Kalpakkam, near Madras, the Department of Atomic Energy (DAE) has trumpeted the success of India, a third world country, in developing first world technology.

The achievement is undeniable. India has constructed eight reactors, to help cope with the ever increasing demand for power, and has ambitious plans for another 20 reactors over the next 20 years.

The Indian nuclear programme is entirely secret. Publishing information or photographs about any aspect of it is prohibited, carrying a penalty of up to five years in prison. Owning a Geiger counter is illegal. The *First Tuesday* crew had, therefore, to travel to India and make the film entirely secretly, smuggling in our own Geiger counter.

Atomic bomb

Begun in the 1950s, India's nuclear programme leaned heavily on the West's "Atoms for Peace" policy. Western aid and advice were provided at all levels. The first head of the DAE, Dr Homi Baba, even borrowed the West's claim that before the century was out "Electricity will be too cheap to meter." Western aid was halted in 1974 following the detonation of India's first atomic bomb.

In 1960, a Canadian designed research reactor was opened on the outskirts of Bombay at Trombay. The first commercial reactor, at Tarapur, was a 'turnkey' American 'boiling water reactor' - switched on by Indira Gandhi in 1970. The Canadians helped India to build their next CANDU reactor at Rajasthan, but withdrew all cooperation following the Indian nuclear explosion. Undaunted, India designed its own reactors and by 1983 had commissioned an indigenous nuclear power plant at Kalpakkam, near Madras. Today it has eight nuclear reactors operating, mines its own uranium, manufactures its own fuel rods and reprocesses and stores its own nuclear waste. It is entirely self sufficient.

The fuel cycle begins at Jadugoda in the state of Bihar, where 3,000 people mine and process 1,000 tonnes of ore daily. The workers are exposed to very high radiation levels, Mineworkers Union President Vyas Tiwari says that men sit almost naked on the raw uranium. He keeps a list of workers who have died of cancer and leukaemia.

The tailings pond at Jadugoda, designed as a water covered pond to stop the spread of radioactive waste from the mining process, has dried out completely - allowing radioactive dust particles to spread and contaminate the area. Local people walk across the dry 'pond' and graze their animals around it. We measured radiation levels 100 times normal background on the pond itself.

The villagers say their health is affected - skin problems abound; Lakipatha, a local villager has suffered the death of two of her children and is now nursing another sick, prematurely born, child. The local midwife says that many children in the village are deformed "they are born with no eyes, no limbs, they are not complete."

India also plans to use thorium, which occurs naturally around the beaches of Kerala, as a nuclear fuel. It is destined to be a blanket in future fast breeder reactors (FBRs). Here we measured radiation levels 300 times higher than background. The villagers live in palm leaf huts right on the radioactive sands. They have no idea that theirs is a radioactive environment.

The Government's Indian Rare Earths (IRE) mines 4,000 tonnes of the sand annually year but provide the workers and local people with no safety protection or information. It is shipped to the IRE headquarters at Allwaye. There, as local environmentalist V T Padmanabhan says, thorium (once refined) is stored in a large warehouse "which has cracks in the wall". If an earthquake or an explosion within the plant occurred "thousands of tonnes of radioactive thorium would spill into the backwaters and sea, contaminating thousands of square kilometres for millions of years." Padmanabhan sees the plant as a "time bomb" for the people of the state of Kerala.

For the residents of the village of Neen Dakara, built on the radioactive sands, the problem is more immediate. Titus is

eight years old, mentally retarded and unable to use his legs. Ignatious, six, is deaf and dumb and Jane, at 13 is unable even to feed herself, all are visible evidence of the long term effects of high radiation. Here Down's Syndrome and congenitally deformed children are a fact of life.

Padmanabhan's Centre for Environmental Concern has been conducting a large scale epidemiological study for the past four years. He has found a significantly higher rate of Down's Syndrome and congenital abnormalities in the high radiation villages compared to controls.

"The Government", says Padmanabhan, "do not even recognise the existence of abnormalities", and promises to "to campaign until justice is done to these people".

Contamination

At the Nuclear Fuels Corporation (NFC) in Hyderabad, raw uranium is processed into fuel rods. Security is very tight and the 150 acre complex is surrounded by high walls and security watchtowers. However, radioactive uranium waste and other highly toxic chemicals have been leaking into the surrounding ground water for years. Every single well is now unusable due to contamination, water for local residents has to be transported in.

The hazards to local people are obvious. Stories of contamination first came to light when two children were charred to death after handling a spent fuel rod (made from highly unstable alloy) found around the complex in the late 1980's. We found a number cancer cases in the local townships, including one woman with a massive abdominal tumour - which caused her death six weeks after filming. The woman was too weak even to speak coherently, but her mother like many in the area, is convinced of the NFC's responsibility. "Gases are released from the factory" she says. "It's because of what's in the air and in the water" that her daughter is dying.

The Government claims an operating success record. They claim the nuclear programme as an unqualified success and that the indigenous reactor designs are "almost completely failsafe."

Indian commentators are not so sure. *Times of India* journalist Praful Bidwai visited India's oldest commercial reactor, and was shocked by what he saw. Maintenance workers were "literally running in and running out" of contaminated rooms. Exposure was limited to less than thirty seconds, so high were the radiation levels.

Tarapur is also India's Sellafield; nuclear waste is brought to the plant to be stored and reprocessed. Bidwai says: "At Tarapur there is a waste management facility where radiation levels are really very, very high. Your entire annual dose would be exhausted if you were to work for maybe just an hour. And you found that they didn't even bother to take elementary precautions ..."

Bidwai also visited the Rawaattbhatta reactors in Rajasthan. There he found "extraordinary" levels of radiation up to "300 times the maximum permissible concentration of radioactive tritium in some rooms". The specialised health physicists were "absolutely blasé" about basic health and safety precautions. Even so, the Rawaattbhatta plant has suffered some 250 shutdowns due to leaks and emergencies, with one of the reactors being inoperable, due to a crack in the reactor wall, for over three years.

Elsewhere, problems are on a similar scale. The reactors at Kalpakkam - Madras Atomic Power Station (MAPS) 1 and 2 - have worked "less than 38%" since they went critical, according to A S Paneerselvan, a leading science journalist: "We have discovered that the Kalpakkam project consumes more electricity than it gives to the State Grid ... Whenever [the reactors are] down you need electricity to maintain the reactor[s] as well as the huge township which they have created for this reactor complex."

Kalpakkam is also host to India's most spectacular nuclear failure - the DAE's Fast Breeder Test Reactor (FBTR). It worked for

only 2 minutes after being switched on in 1985, joining the world's six other fast breeder programmes in abject failure. The DAE is undeterred, arguing: "Just because it does not work in the West, does not mean that it cannot work in the East". India's next FBR will cost £150 million.

One might think that in a country so rich in coal, hydro-electricity, solar and wind energy potential, that other forms of energy would be investigated as major power sources, and that local level generation would be essential. Transmission losses in a country the size of India are a significant problem in themselves. Alternative energy however, receives less than 2% of India's research funds while atomic energy gets 25%.

Hidden agenda

Critics are united in their belief that there is, as Professor Dharendra Sharma of Delhi's Nehru University explains, "a hidden agenda for nuclear power". It is, he believes, "a madness to produce nuclear weapons, to have the plutonium."

External analysts say that since exploding its first nuclear device beneath the Rajasthan desert the Government has been stockpiling material for atomic weapons. In February this year Agni, a home-developed intermediate range ballistic missile system, was tested successfully. No other country has developed this technology other than to deliver nuclear weapons.

We filmed at the Rare Materials Plant at Ratanhalli near Mysore in Karnataka. The plant produces weapons-grade highly enriched uranium for advanced thermo-nuclear weapons. It is India's most secret nuclear establishment and is at the forefront of the programme which has produced material for an estimated 40 to 60 warheads.

Such has been the intense military rivalry between India and Pakistan,

another nuclear weapons state, in the past twenty years - with three wars since India's independence and many border clashes - that analysts believe it is in this theatre that a double sided nuclear conflict is most likely to erupt.

Whatever the reasons for India's pursuit of nuclear power it is now, for the first time, facing opposition. A recent controversy has centred on the Rawaattbhatta reactors in Rajasthan. From the villages near the plant disturbing and persistent reports of cancers and birth defects have surfaced.

Many workers have been exposed to very high radiation levels. Manor Singh, was exposed to 2,600 millirems in half an hour, more than he should have received in one year, whilst working at the plant. He is now suffering from constant lung infections and has large burns all over his body. He believes the DAE are callous about the need for safety and that the workers deliberately expose themselves to radiation to earn more with the full knowledge of management and health physicists: all this for a wage of less than 50p a day.

Health problems

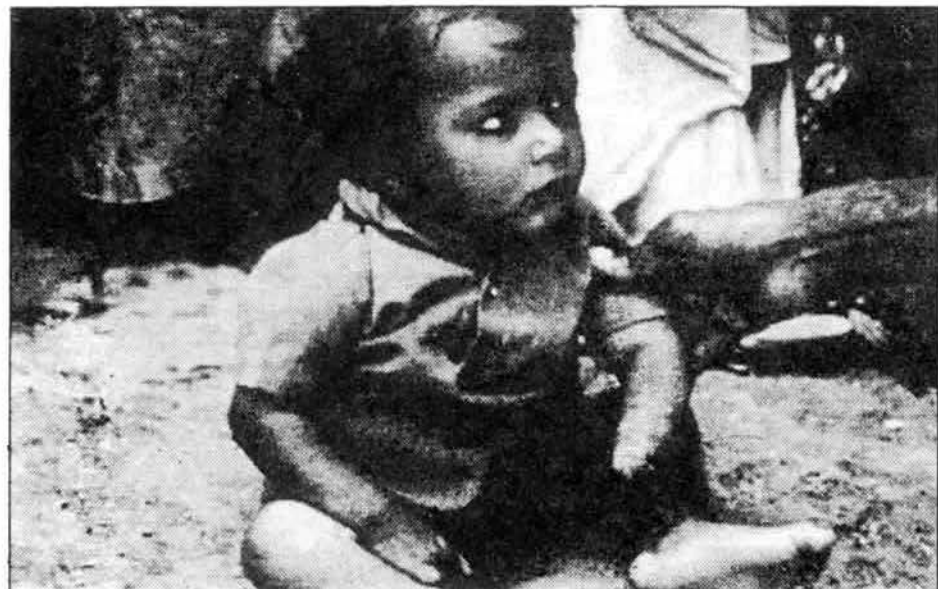
Villagers around the plant are severely afflicted. Badhri suffers from multiple bone tumours at the age of only eleven. Other villagers we found included cases of Down's Syndrome, severe brain damage, bone tumours and many congenital physical deformities, such as the boy born with two sets of teeth and no penis. One woman, Naryan Gee, was dying from a massive tumour on her neck.

Dr Sangamitra Gadekar of the Anamukti environmental group based in Gujarat, first highlighted the health problems in Rajasthan. She was alerted to the horrific extent of the locals' difficulties when she stopped at the village near the plant to break a journey. Whilst resting she noticed many deformed children in a village of only four to five hundred people. As she explains: "This is not rural India. I have worked in many hospitals in rural India, and in many places where there are no hospitals and it is not like this."

She is certain that nuclear power is the wrong path for India. "We must", she says, "say no to this kind of development where the price we have to pay is in the people's health". Dharendra Sharma and Praful Bidwai agree, condemning India's choice of Nuclear Power as wasteful and ill-fitted to the needs of the people of India.

Nuclear Power in India is, as Praful Bidwai says, "A dream gone sour." □

* First Tuesday, "Nuclear India: a dream gone sour" Chameleon TV/Yorkshire TV, ITV, 1 September 1992.



Reducing carbon dioxide emissions is generally seen as essential for combatting global warming, but the popular carbon tax is only one of the possible abatement measures. Here, GRAHAM STEIN takes a detailed look at *Efficiency without tears* by Dr Tim Jackson, which examines a range of proposals.

Efficiency without tears

RIGHTLY or wrongly, support for a carbon tax became a touchstone of environmental commitment both within the European Community and at the Rio Earth Summit in June.

The 1988 Toronto Conference agreement – for a 20% reduction in carbon dioxide (CO₂) output by 2005 – willed the end without establishing the means. This gives signatories flexibility in developing strategies, but runs the risk of governments failing to take necessary steps to achieve the target.

The carbon/energy tax proposals of EC Environment Commissioner Carlos Ripa di Meana (*Safe Energy 85 & 88*) aimed to ensure genuine commitment to CO₂ abatement. Although only one of a range of policies being developed by the EC, during the complex negotiations leading to Rio, the carbon tax came to dominate. Post Rio, with no international agreement on how to reduce CO₂ emissions, there is a need to look beyond the carbon tax.

In a recent report, for FoE, "Efficiency without tears"⁽¹⁾, Dr Tim Jackson develops his earlier work on abatement options. He assesses the potential contributions of 17 options and their costs of implementation (see Figure 1), calculating that a "46% reduction in CO₂ emissions can be achieved by 2005 in the stationary [ie non-transport] sector without using nuclear power." Indeed, many abatement options can be achieved at negative cost and the Toronto Conference target for the stationary sector could be met using negative cost options.

Many economic impediments to efficiency improvements exist, with the availability of capital being, perhaps, the most important. Many small- and medium- sized firms lack reserves and have difficulties raising outside capital, while local government bodies are often severely constrained on investment, and individual consumers either do not have access to capital or are unwilling to increase their debt burden.

With limited funds, energy saving investment is often eschewed in favour of other choices. For low income households financing efficiency measures is often difficult even when 90% grants are available – and in higher income households energy costs are a lower proportion of total expenditure giving little incentive to invest.

The rate of return demanded by investors further restricts investment. Jackson's figures (Figure 1) use, for comparison, a 'social' discount rate of 10%, but in reality higher rates of return are often sought. It is

not unusual for companies to pursue returns of 25-30%, and domestic consumers may want a returns of over 40%. These differing rates mean that from the investors perspective, rather than the 'social' perspective of Figure 1, the CO₂ abatement options are more expensive with fewer negative cost measures (Figure 2).

Taxation policy can also act as a barrier. Energy supply in the domestic sector is un-taxed while efficiency goods such as insulation material and domestic appliances are subject to normal VAT at 17.5%.

Lack of awareness and knowledge are also major obstacles to energy efficiency. Even where there is awareness of the need to save energy, there may be a lack of technical expertise.

Many obstacles result from underlying structural factors. The UK's energy industries have been dominated by supply-side investment (at discount rates of 10% or less) rather than demand-side investment (with much higher discount rates). Demand for energy services: warmth, light, etc, has traditionally been perceived as demand for energy itself, and energy efficiency has been ignored. This imbalance also exists in the marketing of energy services.

On privatisation, the electricity and gas industries were subject to price regulation, meaning that supply companies could profit from increased sales but could not recover capital costs of demand-side efficiency investment.

Another barrier is the so-called tenant/landlord problem. Many measures

such as double glazing or energy efficient white goods require investment by the landlord but the benefit accrues to the tenant. Similarly in companies and public bodies the people responsible for investment and those responsible for fuel costs are in different departments. In the building industry no financial incentive exists beyond the legal minimum for improving energy efficiency.

The failure in uptake of negative cost options (Figure 1) clearly shows that the present market is not a 'level playing field'.

Jackson believes that proposals for a carbon tax based abatement policy may not deliver the required reductions because even with a reasonably high tax investors may still be against many efficiency measures. However, he suggests the tax has a role in providing revenue for investment.

The concentration on carbon/energy taxes, according to Jackson, are a result of the present political climate which favours market forces. Other measures are required, he says, including regulation and legislation.

The setting of emission limits could be used to encourage CO₂ emission abatement. There are examples of similar legislation; for instance, the EC Large Combustion Plant Directive on sulphur dioxide emissions where each country has a range of options for meeting the target. Other more market-based mechanisms including tradable emissions permits could also be used.

The setting of minimum standards of efficiency through building regulations is an

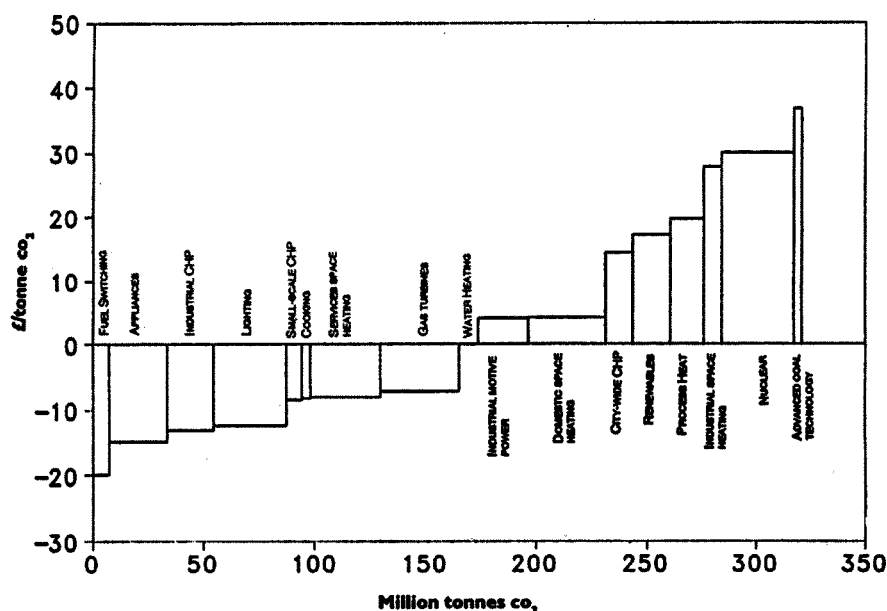


Figure 1: Savings curve for CO₂ abatement options (by the year 2005; 10% discount rate)

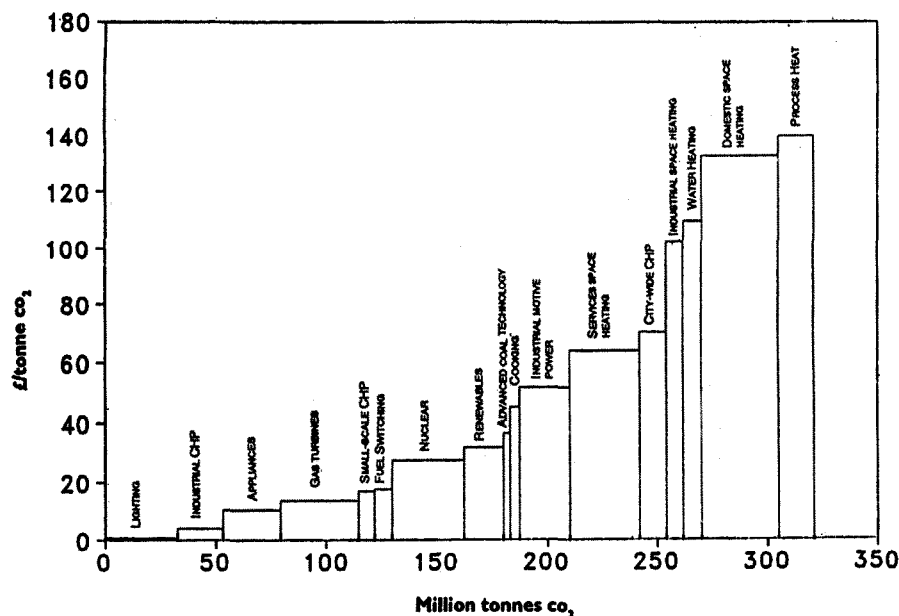


Figure 2: The investor's perspective (various discount rates)

accepted technique, but the UK's standards are well below those of many other countries.

The efficiency of white goods could be improved by introducing minimum standards. In addition, energy labelling would allow consumers to make informed choices.

One legislative manoeuvre to improve efficiency in commercial buildings and industry, without setting standards, would be to require companies to conduct energy audits and to set their own targets for energy efficiency improvements. Increased awareness would encourage the uptake of cost-effective measures.

The anomalous position in price regulation of the electricity industry could be overcome by the introduction of the so-called E-factor. This would adjust the price regulation formula to allow distribution companies to recoup invested in demand-side energy efficiency, and could be used to provide a positive incentive to sell less energy.

A range of financial options are available to adjust the market in favour of energy efficiency, including the removal of VAT from energy efficient goods. Several different energy taxes could be introduced: an input tax on primary fuel use; an output tax on emissions; a process tax on inefficient fuel use; or a consumer tax, eg VAT on energy supplies.

The provision of grants, low-interest loans, tax credits, product subsidies and regulatory price fencing for non-fossil energy systems could all offer incentives for CO₂ abatement. A number of measures are available to overcome the problem of ignorance. These include energy labelling; advertising and marketing; systematic education and training programmes; and research, development and demonstration.

Given the structural barriers to efficient and environmentally less damaging energy supply, particularly the imbalance between supply and demand, restructuring of existing institutions could improve the

position. In addition, an institution or institutions could be established to promote energy efficiency and energy services, involving government agencies, energy utilities and/or third parties. This could include the introduction of least cost integrated planning, reform of the structure of the market and funding of energy efficiency investments.

The role for direct government action, in addition to some of the measures mentioned above, could include establishing a National Energy Bank, a network of energy service companies and a more active Energy Efficiency Office.

It is also important to ensure that policy choices are non regressive. In general any burden of cost should fall on those most responsible for emissions and those more able to pay.

Jackson calls for a flexible approach, with policies constantly being assessed and if necessary revised as the effectiveness of policy choices may not be discernible at the outset.

It is also necessary to realise that though global warming is amongst the most serious of environmental threats facing humankind, policy choices should consider other environmental threats, "in particular the environmental threats of nuclear power should be borne in mind when considering the potential for non-fossil energy generation."

In Jackson's scenario, with a carbon tax as an add-on to other policies, the appropriate level for the tax would depend on the extent of carbon abatement required. He considers two levels of reduction. At the first level, policies are devised to reduce emissions to the extent that is already economic in terms of cost to the national resource - a 'no regrets' policy. At the second level, CO₂ reduction beyond those achievable by cost-effective (Figure 1) measures would be required. As a first step, the internalisation of known fossil fuel external costs could be used to make some non cost effective

measures economic. And given that some measures are achievable at negative cost, still further measures could be implemented at no net cost. Jackson calculates that 170 million tonnes per annum of CO₂ emissions could be saved by the year 2005 using first level measures - around a 20% reduction from 1987 levels in the non-transport sectors - and that a second level package could provide a 280 million tonne saving.

Jackson recognises that regulatory and information measures would not deliver the full 170 million tonne saving as some market barriers would remain, but believes a 130 million tonne saving could be achieved through market improvements. This goes a long way to meeting the Toronto target for non-transport sectors, but there would still be a need for financial incentives. The extent to which a carbon tax would be necessary to raise finance depends on whether the government or the consumer would be paying. In either case, the facilitating of negative-cost investments is beneficial to society as a whole.

If a carbon tax were to be used to raise all the money of a self-financing package, in order to achieve a first level strategy, taking account of the effect of the carbon tax itself, Jackson estimates that £350 million per annum would be required. This would represent an input tax rate of 6.5% on coal, 5% on oil and 3.5% on gas. A slightly higher tax (7% on coal, 5% on oil and 4% on gas) would produce revenues of around £400 million. The additional revenue could be used to cover the cost of structural measures and regulatory reform. The effect of the tax on low income households, while less so than that in other proposals, would still be regressive. This could be offset to some extent by financial assistance for energy efficiency measures. But, Jackson argues, as fuel poverty is a problem that exists independently of the need for CO₂ abatement it might be appropriate for the government to allocate financial support from outside the energy policy programme.

Jackson believes the idea that a carbon tax would reduce consumer surplus and therefore reduce overall economic growth is probably incorrect, as the present market distortions are leading to a misallocation of about £2 billion per year on inefficient energy use.

If in the future measures to reduce CO₂ beyond those which are cost effective are required - the second level approach - it would require a relatively straight forward extension of the process outlined above to implement those measures with the lowest positive cost.

By using a broad approach to CO₂ abatement Jackson concludes that the UK should be able to meet CO₂ reduction targets at little or no net cost. □

Reference

(1) "Efficiency without tears: 'no-regrets' policy to combat climate change" by Dr Tim Jackson, Friends of the Earth, July 1992.

The significance for the UK of reports from the Canadian Atomic Energy Control Board, linking tritium emissions with birth defects and possibly with childhood leukaemias is considered by IAN FAIRLIE* who looks at the high levels of release in the past and possible increases in the future.

Tritium - the cause of leukaemias?

RECENT Canadian reports linking tritium emissions from nuclear reactors with birth defects⁽¹⁾ and possibly with childhood leukaemias⁽²⁾ raise the questions of tritium emissions and possible linked effects in the UK. Tritium is a radioactive isotope of hydrogen and is a major source of radioactive pollution from Britain's nuclear facilities, usually the largest of the radionuclide emissions from nuclear facilities. The largest UK tritium emissions come from British Nuclear Fuels' Chapelcross plant in Dumfries, which makes tritium for nuclear weapons. Other major sources are the Sellafield reprocessing plant in Cumbria and other nuclear weapons and production facilities. The table ranks the discharges according to the volume of atmospheric emissions.

All nuclear reactors produce tritium in their fuel elements as a by-product of the fission of uranium and plutonium. Tritium is also formed by the neutron activation of deuterium, lithium and boron in the moderator, coolant and control rods. With Magnox reactors and Advanced Gas Cooled Reactors (AGRs), the main activation source is lithium impurities in the graphite moderators.

Tritium does not readily diffuse through the Magnox and zircalloy fuel cladding of Magnox and Pressurised Water Reactors (PWRs), whereas it diffuses easily through the stainless steel cladding of AGRs. Consequently, the tritium formed in the AGRs is released on site, while that formed in Magnoxes and PWRs is not released until their fuel elements are reprocessed. Larger amounts of tritium are therefore emitted from AGRs than from other reactors in Britain.

Nuclear fusion, if developed, it is believed would lead to a considerable increase in tritium emissions. The core of each reactor will contain an estimated 10kg (100 million curries) of tritium. If the lithium used within the reactor were to catch fire and burn with sufficient intensity then a substantial proportion of the reactors tritium could be released. It has been estimated that for every 1,000MW of future fusion capacity 110TBq/yr of tritium will be released into the environment in the form of "routine" discharges. A further

3.7×10^4 TBq/yr could be added from "accidental" releases.

Could tritium be the cause of the leukemia clusters near nuclear sites in Britain and Canada? Let's look at the available evidence.

Evidence against tritium

1. Human Health Reports

Circumstantial evidence against tritium from epidemiological studies and other health reports is beginning to mount up. For example, raised leukemia levels have been reported near Sellafield, Dounreay, and the Aldermaston/Harwell/Burghfield area in the UK; near the Pickering and Bruce reactors in Ontario, Canada; and near the Savannah River tritium plant in South Carolina, US. In all of these plants, tritium is by far the largest of their nuclide emissions (except for rare gas emissions at Sellafield) and in the Canadian case, little else of radiological significance is emitted from their heavy water reactors.

Perhaps more important is the new evidence⁽¹⁾ directly linking birth defects with tritium emissions from the Canadian Pickering nuclear station. Birth defects have also been found among the offspring of nuclear workers at the giant nuclear military plant at Hanford, Washington state, US; among the public living near Hanford; and among those living downstream from the Rajasthan heavy water reactors in India. Again, all these plants are heavy tritium emitters. Interestingly, major epidemiological surveys are presently being conducted both at Hanford examining the numbers of childhood leukaemias, and at Sellafield looking at the numbers of birth defects recorded there. However apart from the first Canadian study reported above, the other studies are still only circumstantial in their implications of tritium, so we should look at other sources of information. Let's start with tritium's properties.

2. Tritium's Properties

a. Tritium emissions are the largest of the radionuclide emissions from most UK nuclear sites.

b. Tritium in its most common form - tritiated water - is the most mobile

nuclide in the hydrosphere and biosphere. As a result residents near nuclear sites and nuclear workers will be tritiated to ambient levels in the atmosphere.

c. Tritium has the property of binding with the organic molecules of our bodies. Humans can also ingest organically bound tritium (OBT) in food grown in tritium-contaminated areas. This OBT delivers much larger radiation doses than tritiated water, because of its 30 to 60 times longer biological half-life, and because its heterogeneous distribution in cells is more serious than tritiated water's homogeneous distribution throughout body water.

d. Organically bound tritium is taken into account neither by NRPB, MAFF, DoE, or the Scottish Office in calculating doses to critical groups near nuclear sites, nor by nuclear employers in calculating radiation doses to their workers.

e. Animal experiments show that significant amounts of ingested tritiated food can wind up in the DNA of their organs. Tritium which is organically bound to chromosomes and their DNA, the crucial target for radiation's effects, will have a commensurately greater effect than tritiated water.

How radiotoxic is tritium?

Tritium is widely considered in radiation circles to be one of the least hazardous radionuclides because it is a 'weak' beta-emitter, and because tritiated water has a relatively short biological half-life in humans. Indeed tritium atmospheric emissions from most nuclear power stations are not monitored at present, and MAFF/DoE/Scottish Office do not place limits on their tritium emissions to air. Also, tritium is commonly omitted from discussions of major radionuclide discharges in official UK reports, or relegated to brief discussion in appendices. So what is going on here? Just how radiotoxic is tritium?

The answer is that the 'official' toxicity of tritium, ie its radiation dose per Bq as calculated by the ICRP is extremely low - the lowest of all commonly encountered radionuclides. As a result, the ICRP's Annual Limit on Intake for

tritium is the most lax of all common radionuclides. For example, it is more than 600 times more lax (for ingestion) than Caesium-137, and 1000 times more lax than Iodine-131, both commonly discharged from nuclear sites and comparable with tritium. Also, the Derived Generalised Limit for members of the public for tritium in green vegetables is 2400 times that for Strontium-90.⁽³⁾ But are the ICRP's calculations correct? How does the ICRP measure tritium's radiation dose per unit intake?

This is called dosimetry and the dosimetry of internally incorporated nuclides is complex, as it involves the use of metabolic models with many assumptions and differences of opinion. Essentially, one has to multiply together three factors. First, the tritium concentration in human cells or tissues (in becquerels); second, a dose coefficient or dose conversion factor, to convert this to absorbed doses (in grays); and third, a Radiation Weighting Factor or Q factor, to convert this in turn to an 'equivalent dose' (in sieverts), so we can add together the effects of different kinds of radiations.

The nub of the problem is that for tritium, important research has been ignored, faulty metabolic models have been used, and strongly differing views have not been taken into account in deriving these three factors, as explained below.

1. Organically bound tritium

For starters, organically bound tritium (OBT) is ignored by UK radiation

authorities in all three factors. For example, evidence has been ignored that OBT is metabolised and accumulates in our bodies, that significant doses can be obtained from OBT in tritiated food, and that tritium can be incorporated into our DNA – the crucial target for radiation's effects. OBT is much more dangerous to us than tritiated water, perhaps by as much as ten times.⁽⁴⁾

2. Toxicity reviews

Currently tritium's beta radiation is considered by the ICRP to be equally as hazardous (in terms of its Relative Biological Effectiveness or RBE) as gamma radiation and X-rays. However many cell and animal experiments show tritium is at least twice as dangerous and perhaps as much as 4 or 5 times more so. A major study by the US nuclear centre, the Lawrence Livermore Laboratory⁽⁵⁾ recently published risk estimates for tritium which showed that it was about 1.5 times more carcinogenic, 2 to 5 times more mutagenic, and 2 times more teratogenic than the ICRP's risk estimates from gamma and X-rays.

3. Chicanery over the Q Value

More worrying is the evidence⁽⁶⁾ from Dr Karl Morgan, a former chairman of a main Committee of the ICRP, that the ICRP has played fast and loose with tritium's Q value – reducing its value from 1.7 to 1 in 1969, allegedly in response to pressure from the US military who needed laxer limits to expand tritium production in the 1960's, during the cold war.

The result is all three factors are undervalued and their quotient even more so. Radiation doses from tritium are likely to be underestimated by the ICRP, perhaps by as much as 10 to 20 fold, depending on which factors are taken into account.

What can be done?

First the NRPB should commission a study into OBT. Second, MAFF/DoE/Scottish Office should place limits on tritium to air emissions from nuclear power stations and should require all nuclear operators to monitor their tritium to air discharges. The NRPB should also make recommendations on how to determine OBT concentrations using bioassay methods, and nuclear employers should use these to determine OBT concentrations in their workers and nearby residents. The ICRP should issue Annual Limits on Intake for OBT, and should increase tritium's Q factor to five as a precautionary measure, until its own researches on tritium uptake into our DNA have clarified the matter further. At least, these steps will be a start and will serve to focus badly-needed attention on tritium. □

A fuller version of this article "Tritium: The overlooked nuclear hazard" by Ian Fairlie appears in the *Ecologist*, Vol 22 No 5, September/October 1992.

* Ian Fairlie, formerly a nuclear campaigner for Greenpeace in Canada, is presently engaged in postgraduate studies in radiation biology at Barts Medical College within the University of London.

Tritium emissions from nuclear plants

| Nuclear facility | Tritiated water vapour emissions to atmosphere TBq/yr ⁽¹⁾ | Year |
|---------------------------------|---|------|
| Chapelcross | 1900 | 1990 |
| Sellafield | 593 | 1990 |
| Amersham Int'l (Cardiff Plant) | 180 | 1990 |
| AWRE Aldermaston | 100 | 1985 |
| AERE Harwell | 46 | 1990 |
| UKAEA Dounreay | 18 | 1986 |
| Amersham Int'l (Amersham Plant) | 14 | 1990 |
| Wylfa, Magnox | 13 | 1990 |
| UKAEA Winfrith | 8.4 | 1990 |
| Hunterston B | 8.2 | 1986 |
| Heysham 1, AGR | 3.2 ⁽²⁾ | 1986 |
| Hartlepool, AGR | 3.2 ⁽²⁾ | 1986 |
| Hinkley Point B | 3.2 ⁽²⁾ | 1990 |
| Dungeness B | 3.2 ⁽²⁾ | 1986 |
| Trawsfynydd | 2.7 | 1990 |
| Heysham 2 | 0.67 | 1990 |
| Pickering, Canada | 900 | 1990 |

Notes

(1) 1TBq = 27 curies

(2) Estimated figures

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As part of its promotion of alternative energy in Northumberland, the Druridge Bay Campaign set up an energy group to promote renewables. Members of this group have now established an independent company, North Energy Associates. BRIDGET GUBBINS, the company's Public Relations Director, travelled to Denmark and The Netherlands earlier this year on a Winston Churchill Memorial Trust Travelling Fellowship, to learn at first hand about windfarms.

Living with windfarms

I want to promote wind energy. But as recently as a year ago, I had never seen a modern wind turbine, let alone a windfarm. I had many questions about noise, appearance in the landscape, effects on neighbours, farmers and birds.

Europe's largest windfarms can be found in western and northern Denmark. Soon after arriving at Esbjerg by boat from Newcastle, (where one sees windfarms in the approach to the harbour) I visited the Velling Maersk/Tandpipe complex and Vederso Kaer near Ringkobing.

I left the house in which I was staying in the village of Vederso to visit the large windfarms nearby. Walking across the fields on the bitter cold April morning, North Easterly winds penetrating my winter clothing, I soon glimpsed the revolving blades in the bright sunlight, between the trees. When I estimated I was 500m from them, I listened very carefully (I was downwind) but could hear no noise. At 250m a swishing noise was barely audible, but it was confused with the rustling in the hedges. At a closer distance, it was still difficult to sort out wind turbine noise from normal background noise on this windy day. I was surprised at its insignificance. Is this what all the fuss is about?

Later experiences taught me that when there is a wind above about 12 metres per second, blade rotation and turbine noise is disguised. On calmer days, the turbines can be heard, but in most cases even the word "noise" is inappropriate. "Swishing" is more suitable. On the day the general election results were announced, I was walking along Ebeltoft pier in deep discussion with a companion. The 16 turbines above us were fully operational. Suddenly it occurred to us that we had not even been raising our voices as we talked.

One family, which lives as close as the regulation minimum 400m from the Vederso Kaer windfarm explained that on quiet summer evenings the noise can be irritating, but other families in similar circumstances did not object.

On the journey to Esbjerg, I had already seen many single turbines dotted round the countryside. They

were tall and conspicuous at close quarters, but the eye soon adjusts to them, and they quickly become unremarkable. The large windfarms, 96 machines at Velling Maersk and 27 at Vederso, were a new experience.

At between two and four kilometres, they are a landscape feature. If it is a bright and sunny day, and they are rotating, they catch the eye. Often the weather is dull and grey in our northern climes, and then they can barely be noticed at this distance.

However, when rotating in bright weather, the turbines imparted to me a sense of busyness and usefulness. One knows they are helpful without harming the environment. They reminded me of yachts with their white sails scudding around on blue water.

Planners and farmers

I had several interviews with planners in both Denmark and The Netherlands. In particular in Logstor, North Jutland, there had been objections from residents about the random profusion of wind turbines in the rolling countryside. The council decided to tackle the problem, and came up with the idea that in future there would be small clusters rather than single turbines, and they would be sited in non-sensitive zones. However, the farmers objected. Windfarming is profitable in the Danish economic climate, and the farmers all wanted a share of the pie. The council was therefore obliged to change to one turbine per farm. The planners were not too happy, and subsequent government guidelines mean that clusters will be encouraged in the longer term.

Wind energy provides about 2% of Denmark's electricity but regionally it is much higher. In Ringkobing District, 160 wind turbines supply about 45% of the area's electricity. In Logstor, planner Jorgen Krarup said: "In principle, in this region, each community could provide its own domestic electricity. More efficient windmills would make this possible."

About three-quarters of Danish windpower is supplied not by large windfarms owned by the electricity generating companies but by private owners and wind energy associations or

co-operatives. These small investors have received substantial subsidies in the past for the capital cost of erecting and purchasing the turbines. But there are other strong incentives to ordinary people as follows.

Anders Sorensen, a consultant to the Danish Windmill Owners Association, explained the system to me. More than half of a shareholder's electricity bill is tax. If he or she owns shares in a windpower association, the tax is returned. Therefore the electricity bill is halved.

The other half of the bill is the payment due for electricity used. The government regulations allow the householder to own shares up to the value of his or her domestic consumption. Therefore the shareholder sells electricity to the distribution company, contributing a substantial proportion of the remaining half of the bill. They are paid 85% of the consumer cost of electricity.

The Naismith family, for example, pay an annual bill of £380. If they were wind power association shareowners their bill would be £20. Once the cost of a bank loan to buy shares is repaid, they have virtually free electricity. As many people in Denmark have much higher electricity bills than this family, who live in an oil-heated house, corresponding savings are made.

Acceptability

It is also often easier to obtain planning permission for small clusters than large commercial developments, and local ownership helps. In Zeeland in The Netherlands, which I visited towards the end of my journey, many local councils actually own shares in Zeeuwind, the regional windfarm association. Involvement of local people is an important element in their acceptability.

Coming as I do from the Druridge Bay Campaign, I was particularly interested to discover Nojsomheds, Odde windfarm, on the island of Lolland, which was built on land previously earmarked for nuclear power.

I visited Fleming and Stine Haar, on whose land part of the nuclear power station would have been built. "About ten years ago, we found there was to be

a nuclear power station here," recalled Fleming. "No amount of compensation would make up for that. It would be dangerous to live here. We would hate to look out of our windows and see it."

Stine, his 19 year old daughter said, "The windmills are nice to look at. They have changed our environment, but not for the worse. I can see all 23 from my bedroom window, and also the 11 at the offshore windfarm at Vindeby. It's nice to see them going round."

In the early 80s, opposition to government plans for a nuclear power programme in Denmark grew, until finally, after a national referendum, the plans were dropped, and Nojsomheds Odde was saved. The country has no nuclear power stations.

Mayor Ejnar Rod, who had been totally opposed to the nuclear proposal, said: "The windfarm at Nojsomheds Odde is a fine monument to be built over the buried nuclear proposals."

Windfarms and agriculture

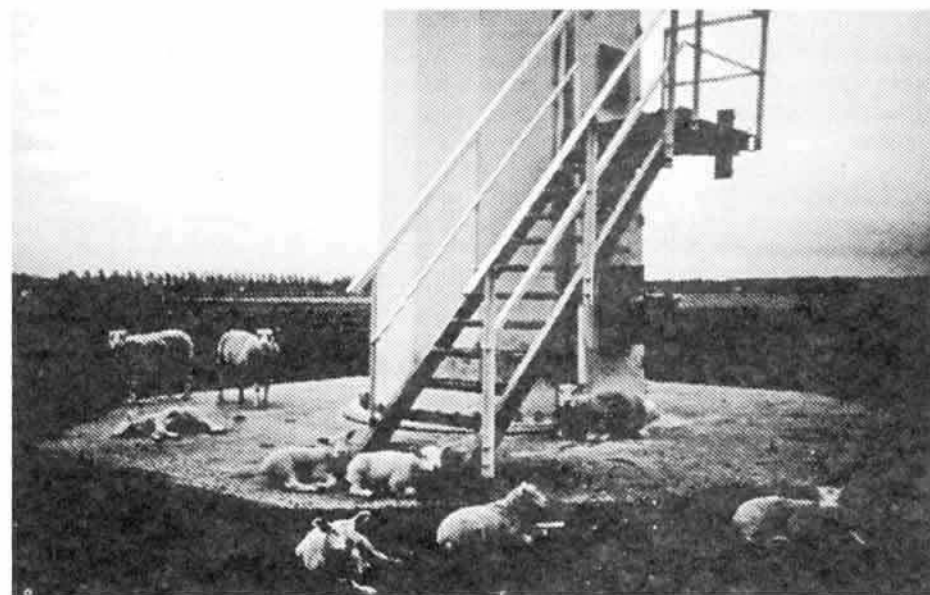
Everywhere I travelled in both countries, the wind turbines were working harmoniously with agriculture. Tractors were ploughing in Denmark, and the muck-spreaders distributing their pig-scented loads right up to the turbine bases. In The Netherlands, windfarms often line the protective dikes, where sheep graze continuously. Clearly once in operation, windfarming causes no problems for landowners.

I visited farmers in the Dutch province of Friesland who had many problems obtaining planning permission. Conflict between wind turbines' appearance in the landscape and their usefulness to farmers was obvious, and there were also great difficulties with the electricity distribution companies who had to connect the turbines to the grid.

Energy consultant Dirk van der Ham told me that distribution companies don't like renewable energy. "The grid is not designed for it. They see it as a waste of time, too small-scale. According to the law, they must take the farmers' electricity, but they are not obliged by law to upgrade the grid to enable this to happen. Consequently there are endless arguments."

In one case, farmer Peter Wolters was originally to be charged 120,000 guilders (about £43,000) for grid connection. After a long struggle, he and Dirk got the price down to 5,000 guilders (about £1,800).

Farmer Houtsma grows chicory, which requires storage in temperature- and humidity-controlled buildings. These are great energy guzzlers, and he



purchased his Lagerwey wind turbine for economic reasons. It paid for itself within five years, and now he wants another.

Many of these wind turbines are very close to the farmers' houses. I asked farmer Lolle Hylkema if the noise was a nuisance. He said, "It's not much. When it's your own project, you don't mind. Your own pigs don't smell."

2 or 3 blades

The two-bladed Lagerweys are already part of the typical Friesland landscape. The three-bladed designs now becoming familiar to many of us through the success of Danish manufacturers are also those most commonly found in the larger commercial windfarms in The Netherlands.

In two cases this year, in Germany and The Netherlands, planners have turned down windfarms with two-bladed machines.

One of the newest windfarms in the country is at Halsteren, near Bergen op Zoom. Here, the seven Windmaster 500kW and one Windmaster 750kW machines are two-bladed.

I visited Halsteren and observed them carefully. I could find no reason why they should be considered less attractive than three-bladed machines. I suspect our human innate conservatism is at work. Originally objecting to windmills unless they have wooden sails and towers (in which case they are historic monuments) the public has slowly come to accept 20th century designs. Now three-bladed machines have become traditional, and therefore acceptable.

At Norrekjaer in Denmark, the sound of skylarks drowned out the noise of the 78 wind turbines, and I saw a hawk flying across the land. In Vederso, jackdaws had tried so hard to nest in

the nacelle (compartment which houses the turbine at the top of the tower) that every little opening had to be blocked. Migrating geese evade the rotating blades, I was told by neighbours. At Ebeltoft pier I watched flocks of seagulls flying between the machines when their blades were rotating.

There is very little evidence in The Netherlands and Denmark of harm to birds. The number of victims appears to be comparable to that due to traffic. Certainly it is much less than the number of clashes with the high-voltage electricity grid or lighthouses.⁽¹⁾

The first windfarms are now appearing on the British scene. They will undoubtedly change our landscape somewhat, in their contribution to a safer world. But used in conjunction with other renewables, combined heat and power and vastly improved energy efficiency, there will be no need to plaster the landscape carelessly with wind turbines. There is much debate between all parties, but people have already begun to live with windfarms in Denmark and The Netherlands. I look forward to the day when we do too. □

Reference

(1) "Experience with a 15MWe windfarm in The Netherlands" by Sisouw de Zilwa and Bakema. EWEA Conference paper, October 1991.

Note

This article is drawn from "Living with windfarms", a 30 page full colour report, with maps and photographs, available from November 1992. Including detailed discussions with planners, politicians, representatives from electricity distribution companies etc, it contains recommendations for action and useful hints for those who wish to encourage windfarm development. Available from North Energy Associates, 2 Old Bakehouse Yard, Morpeth, Northumberland NE61 1AS. Price £10.00.

As part of its plan to build a nuclear waste dump at Sellafield, Nirex has announced the development of an underground laboratory. Dr PATRICK GREEN and RACHEL WESTERN of Friends of the Earth warn that the laboratory is a manoeuvre to permit construction of the dump itself with as little examination of its safety as possible.

Rock lab or Trojan horse?

FOR the second time in a year, Nirex is proposing a major change in its strategy. It no longer plans to submit a planning application for a nuclear waste dump next year. Instead, it proposes to develop an underground "laboratory". Yet, this latest plan is not part of a careful evaluation of whether or not Sellafield is a suitable site, let alone whether or not disposal is a safe option. Nirex's rock "laboratory" is a Trojan horse designed to allow stage one of repository construction to proceed without a detailed safety case.

When Nirex announced, in July 1991, that Sellafield was its "preferred site" for an underground nuclear waste dump, it aimed to submit a planning application in the autumn of 1992. A planning inquiry was expected to be held in 1993/94 and Nirex hoped to have the dump in operation by 2006.

Since then things have not gone well for Nirex. In June 1992, a one year delay was announced. "Insufficient information" to proceed and a need for "fuller understanding" of the geological and hydrogeological conditions in the Sellafield area were the stated reasons, prohibiting a "well founded planning application".

Unfavourable hydrogeology

Nirex was forced to announce the delay because the preliminary results from boreholes one to four suggested that the hydrogeological conditions in the Sellafield area were not as predicted.

Yet, only five months earlier, Nirex had written to the Chief Executive of Cumbria County Council stating: "Geological investigations already completed ... give sufficient basis for preparation of a preliminary safety assessment, to be submitted with any planning application for a repository made towards the end of 1992."

The data from Nirex's boreholes had suggested that instead of moving slowly towards the deep rock formations beneath the Irish Sea, water from the proposed dump would move relatively quickly upwards to a layer of rock that was tapped in some places for drinking water.

These fears were compounded by the publication of a report by consultants

acting for Cumbria County Council. It concluded that the dump would be sited in a mixing zone between saline and fresh water in an area with upward groundwater flow.

In response, the Council argued that Nirex "would have considerable difficulty in developing and maintaining a safety case" for its dump.

Despite having to announce a one year delay, Nirex does not publicly view these results as "bad news". Indeed, its Managing Director, Michael Folger, has stated that the general picture at Sellafield is "so far, so good".

A new strategy?

The reality is rather different. The concept of a rock laboratory is being promoted in Cumbria as part of a more considered approach to allow the geology and hydrogeology to be studied at depth before a final decision is made to submit a planning application.

A rock laboratory would also appear to be in keeping with the views of the Governments Radioactive Waste Management Advisory Committee (RWMAC) and the House of Commons Environment Committee. John Knill, chair of RWMAC, has commented that a rock lab would be a sensible development.

The Commons Environment Committee specifically recommended, in 1986, that a basic geological research laboratory be set up prior to the construction of any dump. It said, that "such a site should be designated as an experimental facility, explicitly excluded from being a potential operational facility."

This need for basic in-situ research was reiterated in 1990 in a report prepared for the Department of the Environment (DOE) which argued: "Prior to planning and carrying out a site investigation it is essential that the correct concepts, tools and techniques are available for use on a routine basis. To achieve this in the UK ... almost certainly requires an experimental site in order to test the concepts of groundwater flow and to allow the tools and techniques to be developed."

Nirex have not undertaken this experimental work and, despite their

"laboratory" proposals, do not intend to. Nirex intends to progress with repository construction with only a slight change to the original timescale.

An investigation of the host rock at depth was always intended as the first stage of repository construction. The major difference is that Nirex now intends to submit a separate planning application for this stage. Previously, underground rock characterisation could not have begun until after a major planning inquiry had taken place. As part of this process, Nirex would have had to prepare a detailed safety case for the dump.

Vulnerable safety case

However, sources close to Nirex have revealed to FoE that the company was concerned that, under the original plan, it would have been vulnerable at a public inquiry because its safety case would have been based upon limited information. Nirex did not intend to present a full safety case at the inquiry, arguing that it could not do this until dump construction had begun and the geology and hydrogeology had been investigated at depth.

Consequently the "laboratory" planned by Nirex is not the separate experimental site recommended by the Environment Committee, but merely part of the repository excavation programme already planned for Sellafield. A rock laboratory is a misleading term. Nirex's facility would more appropriately be called an Underground Rock Characterisation Facility.

Research produced for the DoE has outlined the type of work that would be conducted during the rock characterisation phase of construction. This is not the same as the experimental work that would be carried out in a true purpose built laboratory.

The information gathered during excavation would be used to:

1. hone the design of the repository to fit the host rock;
2. determine whether or not the generic tests and concepts developed by Nirex are relevant to the specific site at Sellafield;

3. determine whether or not the mathematical assumptions made about the behaviour of groundwater at the site produce accurate predictions of field results; and

4. carry out in-situ testing of engineering systems such as sealing and backfilling methods.

Although a certain amount of this work could also be undertaken in a genuine rock laboratory, particular problems of shaft location, especially at Sellafield, limit the amount of research that can be done during site investigation.

Nirex's rock characterisation facility will consist of a vertical shaft down to a depth of 650m, with a 30m horizontal tunnel being constructed from it at this depth. Nirex intends that this system will form part of the ventilation system for the dump when [if] constructed.

Implications for safety

However, the construction of this shaft could have major implications for the post-closure safety case. Boreholes can provide the most open pathways for the transport of radionuclides and a shaft could present even more of a problem. It could act as a significant by-pass for contaminated water through an otherwise impermeable layer.

Research produced for the DoE has stated that it is important to position any shaft with consideration to the direction of any regional groundwater flow. However, "more data will be required in the direction of radionuclide transport from a repository, and it is in this direction that, by definition, areas of upflowing groundwater must exist."

Ground water movements at Sellafield have already been shown to be moving in an upward direction. In addition, the amount of data that can be obtained from a shaft depends on the type of rock excavated. In softer formations, particularly those with higher hydraulic conductivities, there is perhaps less that can be obtained from the shaft itself because it cannot be constructed without some form of temporary support. This is likely to be provided by an ice curtain or some form of grout injection, to prevent groundwater ingress and shaft wall failure.

At Sellafield, a repository within the basement rock would have to be accessed by a shaft through the St Bees Sandstone, which is highly permeable in its upper parts, such a shaft would almost certainly require freezing.

If Nirex do decide to go ahead with an excavation at Sellafield, it is imperative that the programme allows sufficient

time for adequate safety assessment work. The DoE report commented extensively on the need for adequate preparation prior to shaft excavation and the protracted timescales that this requires. The report outlined a six stage programme which included two years of borehole monitoring prior to shaft construction and three years for construction of the shaft - concluding that: "There is therefore a considerable period of time before any underground work can commence."

Monitoring prior to shaft construction is critically important; construction of the shaft will disturb the groundwater flow and these changes will provide the first opportunity to test the groundwater flow models on a large scale. By drilling, testing and monitoring boreholes in the area of the proposed shaft for a sufficiently extensive period before any construction commences, the changes due to the shaft construction should be adequately quantified. Obviously if these measurements are not taken prior to construction then predictive tests on the effect of shaft construction cannot be made. Nirex's programme for the rock characterisation work has been leaked to Friends of the Earth.

It intends to submit a planning application for three boreholes in the area where the rock characterisation facility (RCF) shaft will be constructed. One of these will be drilled exactly where the shaft will be sited. The other two will converge with it at depth. However, the timetable does not include a two year monitoring period.

Nirex's timetable

The planning application for boreholes will be submitted during October and Nirex hopes to have approval by the end of November 1992. Nirex intend to submit a planning application for the rock "laboratory" in the first half of 1993 and anticipate receiving planning approval towards the end of 1993. After this construction could start, and by the first half of 1996 access down to 650 metres (in the Borrowdale Volcanics) should be established. Within six months Nirex intends to decide whether to proceed with the repository at Sellafield. It would submit a further planning application in late 1996. It now anticipates obtaining approval in 1999. The target date for repository commissioning is 2007, only one year later than originally envisaged.

Thus, even though Nirex propose to rush headlong into stage one of repository construction, without first building the separate research laboratory urgently called for by the Environment Committee they also propose to cut corners in the characterisation work.

However, before moving on to this stage, it is important that the decision is made on whether the site is likely to prove suitable for a dump. If it is clear from the outset that the site would be unsuitable there is little point wasting money on an extensive underground excavation. The DoE report referred to above commented: "The earlier stages of a site investigation programme at a potential repository site are designed to increase the confidence in the safety assessment and the geotechnical design work to a level at which a choice can be made on the general suitability of the site."

The site investigation work carried out so far at Sellafield has strongly suggested that geology and hydrogeological conditions beneath Sellafield are unlikely to be suitable as a dump site. On this basis, the local authorities should refuse Nirex's application to build the RCF.

However, as explained, by promoting this as a rock laboratory Nirex clearly hopes that its RCF will be viewed as simply more detailed investigations to back up its borehole work.

Sellafield not suitable

However, even if Nirex were proposing to construct a research based rock laboratory, Sellafield would not be the place to do this. Research produced for the DoE has advised that attempting to undertake basic research work at Sellafield would be costly and time consuming: "Obtaining the same insight into the site investigation methodology will be much more costly if it is carried out as part of the main investigations [at Sellafield] because the time and cost implications of this learning process increase very markedly with depth."

Nirex's latest plan must be seen for what it is. A Trojan horse, designed to allow them to begin stage one of repository construction without having to produce a safety case at a major public inquiry. □

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Rethinking High-Level Radioactive Waste Disposal A Position Statement of the Board on Radioactive Waste Management, Commission on Geosciences, Environment, and Resources; National Research Council, National Academy Press, Washington D.C. 1990.

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Coal chaos

WHEN, on Tuesday 13 October 1992, British Coal (BC) announced the closure of 31 of its remaining 50 pits and 30,000 of 53,000 miners, it sent shock waves across the country.

A massive rundown of coal had been widely predicted - by the Energy Select Committee ("Coal at the crossroads", *Safe Energy* 84), the NUM, merchant bankers NM Rothschild, and the Coalfield Communities Campaign⁽¹⁾, amongst others. But the severity and speed of closure, together with the insensitivity and crassness of the announcement itself, caused uproar even amongst many Tory MPs.

The strength of opposition to the plan forced Trade and Industry Secretary Michael Heseltine, who had approved BC's plans, to make a statement to the House of Commons on Monday 19 October. However, all that Heseltine had to offer was a stay of execution for 21 of the 31 pits earmarked for closure.

But closure early in 1993 seems inevitable. BC have yet to obtain contracts with the National Power/PowerGen generating duopoly beyond next April. The 31 pit closure plan was based on deals for 40 million tonnes per year being agreed, which Heseltine described as the most optimistic possibility. With predictions ranging as low as 20 million tonnes, far from some of the 31 pits being saved, even more closures may follow.

Market forces

The Government has argued that the closures are the result of market forces - and on that one point they are right. With the forecast total demand for coal by the year 2000 put at 42 million tonnes per year, compared to the current 105 million tonnes,⁽¹⁾ then closures are inevitable.

But the market in which coal is having to compete is not free. The electricity supply industry is dominated by the duopoly. The 'dash to gas' ("It's a gas", *Safe Energy* 88), which has been described by BC's chair Neil Clarke as "economic madness" is an attempt by the Regional Electricity Companies (RECs) in England and Wales to free themselves

of the duopoly stranglehold. But even with the present low cost of gas, the electricity produced will be more expensive than that from the existing coal stations they will replace ("Call for electricity shake-up", *Safe Energy* 88).

The other major competitor to coal is nuclear power. Michael Heseltine has made much of the £18 billion subsidy to British Coal (BC) over the past 12 years. But BC has received no subsidy for the past two years.

Meanwhile, the nuclear industry in England and Wales receives an annual subsidy of around £1.2 billion through the Non Fossil Fuel Obligation, and in Scotland - in addition to a £1.4 billion debt write-off - Scottish Nuclear has 15 year contracts for all its output at an artificially high price of around 3.6p per unit ("Power profit", *Safe Energy* 90). In addition, the Government is contributing

"If British Coal were paid the same subsidy per unit as Nuclear Electric, British mines could supply their coal to the generators free, deliver it free, give the generators £10 a tonne to burn it, and leave themselves with another £10 profit."

Malcolm Edwards
former BC commercial director

large sums to decommissioning costs on both sides of the border.

So, while market forces have done for coal, it is an artificial market created by the Government when they privatised the industry and continued to prop up nuclear power.

Even within the coal sector, BC is being asked to compete with subsidised foreign coal, and coal from countries like Columbia, which is mined in conditions unacceptable in this country.

Another tack taken by the Government in trying to defend pit closures has been to play the environment card, arguing that less coal being burned will help combat global warming. While containing a semblance of truth, it does not tell the whole story. There are advantages in

replacing coal stations with gas generation. Combined cycle gas turbines have a thermal efficiency of around 50% compared with about 32% for existing coal stations. And gas produces only about 60% of the CO₂ of coal. This however misses three crucial points.

Firstly, gas is a premium fuel, it can be burned in the home at nearly 100% efficiency. Secondly, money spent on more expensive gas generation (and nuclear power) could be far better spent on energy efficiency ("Efficiency without tears", p10/11). Finally, whatever happens in Britain, coal will remain a major world fuel; Britain is a world leader in clean-coal technology which, while no panacea, offers significant reductions in coal-fired emissions ("Clean coal confusion", below).

Irreversible

Pit closures are usually irreversible, the coal left in the ground could only be mined at prohibitive cost. In strategic terms it is nonsense to run down an industry which on BC figures could meet present levels of demand for the next 600 years, and rely instead on gas, which might only last 50 years, leaving the country dependent on imported coal and gas with the risk of supply disruption and price hikes.

Former coal board chairman Lord Ezra told *Safe Energy* that the sacrifice of a national energy asset was a decision which Britain would, sooner or later, regret.

Already there are indications that several of the 'dash for gas' schemes will not be completed.

The massive cutback in coal, with the likely loss of 30,000 or more BC jobs, up to 15,000 contractors jobs and another 50,000 in related industries, is in itself tragic. That it is not justified in energy, economic, environmental or strategic terms makes it sheer lunacy. It has never been more obvious that this country urgently needs a sane and sustainable energy policy. □

Reference

(1) "The end of coal?" by Stephen Fothergill and Nigel Guy. Coalfield Communities Campaign, October 1992.

Clean coal confusion

WHILE coal will never be a clean fuel, it is possible to clean up its emissions. So long as coal is a major world fuel it is important that it is used in the least environmentally damaging way.

Britain has been at the forefront of clean coal development, through the Coal Research Establishment (CRE) near Cheltenham and British Coal's Grimethorpe Research and Development centre. Grimethorpe was closed earlier

this year ("Coal Collapse", *Safe Energy* 87) and the CRE is likely to be shut down.

The planned privatisation in 1993/4 of what's left of British Coal, means that Britain will have little interest in clean coal technology.

"If this proves to be the case", commented one CRE researcher, "a lot of us will go to the US, which is very interested in the technology."

A range of technologies have already been developed which could reduce emissions from coal-fired power stations. These include: flue gas desulphurisation, low NO_x (oxides of nitrogen) burners;

circulating fluidised-bed combustion; pressurised fluidised-bed combustion; and integrated coal gasification and combined-cycle. The last of these, known as the 'Topping Cycle', was being developed at Grimethorpe. These technologies offer reductions in sulphur dioxide and NO_x (which cause acid rain) and in some cases, through improved efficiency, reductions in carbon dioxide (CO₂).

The CRE is, for the time being, leading a research effort co-ordinated by the International Energy Agency into ways of removing CO₂ from flue gas emissions. □

Energy efficiency

FAILURE of the privatised electricity supply industry to embrace energy efficiency has been addressed in a report⁽¹⁾ from the Director General of Electricity Regulation, Professor Stephen Littlechild.

One particular area of concern, the price regulation formulae, has also been raised in response to Littlechild's review of price control.⁽²⁾

Amongst those calling for an 'E-factor', to encourage demand-side energy efficiency measures, are ten of the 12 Regional Electricity Companies (RECs) in England and Wales. Littlechild has now asked "independent consultants to investigate the scope of beneficial demand-side measures."

Amongst other failings in the present system identified by respondents to Littlechild's consultation were:

- the inefficiency of over-capacity resulting from the 'dash-to-gas' [Council for the Protection of Rural England];
- the problem of the low 'pool price' paid to small generators such as local combined heat and power [Brewers' Society];

- the failure of RECs to recognise the value of localised generation in reduced demand on the distribution network when determining connection charges [James Capel & Co Ltd];
- the underpricing of transmission costs, discouraging location of generation near demand [National Consumer Council];
- the failure to promote fuel substitution, load management and energy saving [Association for the Conservation of Energy (ACE)]; and
- the absence of least cost planning [ACE].

On the last of these points, Littlechild accepted that Scotland - with its vertically integrated generation, transmission and distribution - was best suited to least cost planning, but gave no commitment to any such measure.

The message from Littlechild is that he believes competition, where it exists, will of itself lead to improved efficiency, with intervention only required where competition is lacking.

■ A new Government campaign to encourage households to save energy began in October.

Through TV and press adverts the Department of the Environment aims to change people's habits - not just to save

money but for the sake of the planet. More than a quarter of the UK's carbon dioxide (CO₂) emissions come from domestic energy use.

The advertising campaign is backed with free leaflets about energy saving methods, the costs involved and the payback periods.

Environment Minister Michael Howard, launching the campaign, commented: "Not enough people yet realise just how much unnecessary damage is caused by inefficient use of energy." Adding that: "By taking the right measures, every home could save £100 a year and reduce its annual CO₂ contribution by one and a half tonnes."

Eventually, Howard conceded, "more difficult measures" such as energy taxes and government incentives would be needed.

The Government's own record on energy saving is not encouraging. Having pledged to cut energy use in its buildings by 15% over five years, latest figures show their energy consumption is actually rising. □

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- (1) "Energy efficiency: the way forward", OFFER, October 1992.
- (2) "The supply price control review", OFFER, October 1992.

Thai efficiency

THAILAND is to invest millions of pounds in energy efficiency. With the world's highest economic growth rate in the late 1980s, Thailand does not want to follow countries like Indonesia, the Philippines and Vietnam where electricity demand is outstripping supply and blackouts are common. The Thai government sees energy efficiency as the best answer to growing demand.

US energy efficiency specialists working on the programme see the \$456 million package as a blueprint for other developing countries.

Much of the funding for the programme will come from a tax on oil and other refinery products which is expected to raise \$55 million a year.

A conservation fund to stimulate consumer demand for energy efficient household goods is to cost \$60 million.

Another part of the scheme is a five year plan to enable generating companies to supply electricity at the lowest economic and environmental cost. This will include the adoption of tariff systems aimed at smoothing out the peaks and troughs in demand and the promotion of energy saving. The World Bank's Global Environment Fund will provide the projected \$183 million cost of this part of the programme.

The Electricity Generating Authority of Thailand (EGAT) estimates that by 2010 generating capacity will have

tripled to 30,000MW, at a capital cost of \$30 billion.

EGAT and the Washington DC, USA based International Institute of Energy Conservation claim that the efficiency programme could cut growth by a quarter over the next decade. The initiative will, according to EGAT's economic policy department, "free up new power" more cheaply than new power plants.

■ The Thai programme could be well utilised in other developing countries (DCs). Gordon Mackerron of the Science Policy Research Unit at Sussex University predicts an upsurge in fossil fuel use as DCs turn away from nuclear and hydro power.

Though India, Pakistan and China are still looking to nuclear power, others including Brazil, Mexico and the Philippines have "given up serious ambitions" in nuclear energy according to Mackerron.

Between 1980 and 1986, electricity consumption in DCs rose by 7% a year, compared to 2% in the wealthy OECD nations. Mackerron expects the rate in DCs to increase to 10% when the world economy recovers.

"We may therefore expect to see a much heavier concentration on coal and gas as new power sources in the developing world," says Mackerron. To avoid this "we need to rig the economic signals being sent to DCs." He proposes that the World Bank, instead of funding new power plants should support energy efficiency drives. □

Dam near finished

THERE is continuing controversy as the Gabčíkovo hydro scheme in Slovakia nears completion. With the Danube due to be diverted at Cunovo on 31 October, turbine tests have already taken place.

Hungary, originally a partner in the scheme, is now opposed to the project ("Dam argument", *Safe Energy* 89). Although the environmental group Danube Circle, who have led opposition to the dam complex, fear the Hungarian government's position is weakening, the threat to take Slovakia to the International Court of Justice in The Hague remains.

The response from Slovak premier Vladimir Meciar, who recently visited Hungary, is that Slovakia will not exist as a state until 1 January 1993, so the Hungarians must sue the federal government in Prague. And even after 1 January, Meciar says he will have "no time to be sued". □



EC renewables boost

A new scheme for the promotion of renewables has been proposed by the European Commission (EC). The ALTENER programme - to help mature renewable technology into the market place by removing barriers to trade - will be discussed by the Council of Ministers on 30 November.

It is expected that a budget of around 40MECU will be approved for the five-year programme. Previously the Commission has concentrated on developing technologies, however, it is now also concentrating upon developed technologies because plans to stabilise carbon dioxide (CO₂) emissions at 1990 levels by 2000 cannot be achieved "without a significant increase in the contribution of renewable energy sources towards the energy balance."

ALTENER aims to produce a 180 million tonne reduction in CO₂ emissions by 2005 through a doubling of the current contribution made by renewables to total energy demand. This would involve a trebling in the production of electricity by renewables from 25 to 80TWh per year, and the securing of a 5% market share of total fuel consumption for biofuels.

Five main renewables are identified for support: biomass, small hydro (under

10MW), photovoltaics, windpower and geothermal.

Many of the programme proposals deal with biomass, which is linked to reform of the Common Agricultural Policy. Through a string of Research, Development and Demonstration (RD&D) proposals, ALTENER hopes to replace excess food production with fuel crops, in particular biofuels. The emphasis on biomass RD&D has been criticised by *Windpower Monthly* editor Lyn Harrison as "changing the whole focus of the programme. No longer does it have a clear objective: the construction of a framework for developing a market for all renewables."

The programme aims to increase biomass and waste electricity generation from the present 6.3TWh per year to 20TWh by 2005, fuelwood and other biomass used for direct heating from 25 million tonnes of oil equivalent (MTOE) to 55MTOE, and the introduction of biofuels to produce 11MTOE.

For geothermal power, which is envisaged as a spin-off from oil drilling, an increase from 3TWh/yr to 9TWh is proposed. Photovoltaics could be producing 1TWh of electricity by 2005, while windpower could expand from 0.9TWh/yr to 20TWh/yr, and small-scale hydro from 15TWh/yr to 30TWh/yr.

Much of the legislative framework for creating a renewables market is already in place or under discussion, and there are existing national and European RD&D programmes. In addition, an ecotax on pollution is already being considered. "However, these technology promotion and tax measures will not be sufficient to enable renewable energy sources to play a significant role," according to the ALTENER proposals. "They should be supplemented by other, flanking measures which come under this programme and which will have to be underpinned by national measures."

The flanking measures proposed are market promotion, financial and economic training and information, and third country co-operation.

Of the 40 million ECU (MECU) budget to 1997, a total of 22MECU would be for financial and economic measures - with 10.5MECU of this reserved for biofuels. Feasibility studies would get 5MECU; local development plans, 3MECU; and guarantee of financial risk, 3.5MECU. Market promotion would receive 3.5MECU; training, publications and courses, 10MECU; and information exchange 4.5MECU.

ALTENER funding would represent between 30 and 100% of the total cost in each of these areas. □

Renewables stalemate

LITTLE progress has been made in agreeing an extension to the subsidy for renewables in England and Wales beyond the European Commission (EC) imposed 1998 cut-off date. Negotiations between London and Brussels are at a stalemate, with neither side accepting responsibility for the delay.

The Commission have made it clear that it was only the subsidy to nuclear power - an established technology - to which they objected. Stating that they would "give sympathetic consideration to any proposals to extend the UK's support for renewables beyond 1988."

However, that's not how the British Government views things. The new Energy Minister, Tim Eggar, has

indicated to the UK Association of Independent Electricity Producers that delay is the result of disagreement between EC directorates. "There is", says Eggar, "no conspiracy against renewable energy in Whitehall."

This impasse is despite EC approval already having been given for renewables subsidies in Italy, Germany and most recently Denmark. The Danish programme will provide windpower with guaranteed sales at 85% of the pre-tax domestic selling price.

The delay in reaching agreement for the UK is seriously undermining the already much delayed 1992 renewables order in England and Wales ("NFFO delay", *Safe Energy 90*) and may also affect plans for the introduction of similar schemes in Scotland and Northern Ireland. □

Windfarm developments

DETAILS of a 24 turbine windfarm at Coal Clough near Burnley were announced in August. The 9.6MW development, which will cost £11 million, is due to be completed in early 1993.

Wind Resources Ltd, which will build the windfarm, is jointly owned by two distribution companies, South Western and Manweb, together with Renewable Energy Systems Ltd, a member of the Robert MacAlpine construction group.

The Coal Clough scheme follows the company's first venture, a 6MW windfarm at Carland Cross, Cornwall ("UK wind developments", *Safe Energy 89*).

■ A single turbine in the Yorkshire Pennines has received retrospective planning permission from Bradford Council. The turbine, with a 100 foot high pylon, in the village of Haworth - which was home to the Bronte sisters - was opposed by some villagers. But with an equal number in support, Bradford Council gave their approval.

The decision follows planning permission being given for several windfarms in the Pennines, where expected controversy failed to materialise. □

Fuel cell funding call

A call for Department of Trade and Industry (DTI) support for fuel cell development has come from a consortium of three UK companies.

This could, they say, be the last chance for Britain to retain a stake in a clean, efficient technology - invented in Britain 150 years ago ("Unlocking the fuel cell's potential", *SCRAM 76*).

The consortium: British Gas; Vickers Shipbuilding and Engineering (VSEL); and metals specialist Johnson Matthey, intend to develop a proton exchange membrane based fuel cell. The technology is expected to reach the market early next century.

Although Britain pioneered fuel cell technology, the Japanese now lead the field. A DTI decision on funding is expected by the end of this year. □

Reviews delayed

OPPONENTS of renewable energy inside the government machine have obstructed the completion of two inquiries which were established in the run-up to the general election. An investigation into wave energy, which was supposed to last for two years, is 18 months past its original completion date; and a committee of leading scientists who are investigating all renewable sources has so far taken nearly twice the amount of scheduled time, *writes David Ross*.

Interestingly, both groups were set up with target dates which should have taken them until just after the general election....

The wave power inquiry was set up in April 1989, when most people thought that the government would go to the country after four years, in the summer of 1991, and was supposed to last for two years. But the government delayed the election and the inquiry dragged on.

The more extensive review was established in August 1991, with the election now expected in the autumn; and the committee was to report "early in 1992." But the election was postponed again, until April 1992, and the committee's work most conveniently dragged on and on. Both reports are still awaited.

The wave energy inquiry was originally

allocated to two scientists from the Energy Technology Support Unit (ETSU). It was a response to the mounting criticism of the way the original programme had been mishandled and eventually shut down. These had been led by Professor Stephen Salter of Edinburgh University, inventor of Salter's Duck, who had won support from two Select Committees. But from the start wave energy researchers were suspicious and at a conference in Coventry demanded to know what an inquiry would turn up which was not already known about wave power.

Lone investigator

One of the scientists soon resigned and the government rejected a call in Parliament by John Home Robertson (Salter's MP) for him to be replaced. The other, Tim Thorpe, was required, alone, to investigate all the wave energy devices, cost them, discuss his costings with the research teams, then discuss the conclusions with the Wave Energy Steering Group and seek agreement between the two sides down to a decimal of a penny.

Thorpe has won the respect of researchers but his task is a labour of Sisyphus. No one will or can know just what wave electricity will cost until the Department of Trade and Industry provides the money for a full-scale prototype to go to sea, and Thorpe has

been driven to the verge of a breakdown by three-and-a-half years of wrestling with nit-picking opponents of wave power, backed up by institutional reluctance to give a fair shout to any prospect of change.

The other inquiry includes leading scientists and environmentalists such as Sir Hermann Bondi (former Chief Scientist), Dr Mary Archer (solar power), Dr David Lindley (Wind Energy Group), Professor Arnold Wolfendale (Astronomer Royal), Gerald Leach (Stockholm, IED and the UN). Its first chairman was Colin Moynihan and when he lost his parliamentary seat there were some inside government who would have liked to see the whole project disappear.

This they did not achieve, but they have kept the talking going far longer than expected. Mary Archer was billed to be a star speaker on the opening day of the World Renewable Energy Congress at Reading on September 14, discussing the findings which, she had expected, would have been published long before. Instead, without explanation, her place was taken by the energy campaigner from Friends of the Earth, Mike Harper, who remarked dryly that he had been called in to replace a member of a government committee.

It is more than ironic; it is tragic that we have a government which regards renewable energy as a political football, to be used to make it appear more wholesome than it is at election time. □

Waste not

POWER from waste is on the increase, with several new projects planned. Thames Water plan to supply electricity to the National Grid from the largest sewage works in Europe, Beckton in Barking, Essex. Methane is already used to generate electricity for the works, and following a £10 million modernisation, 8MW of electricity sufficient to supply 6,000 homes will be produced.

A similar scheme has been developed by Wessex Water in Bristol. They have invested £10 million in a scheme which will produce electricity and fertiliser. Electricity sales will make the company £800,000 a year.

A £15 million waste incinerator is planned for Lerwick, Shetland. The plant will burn waste from North Sea oil companies along with domestic waste to produce steam which will be used by Scottish Hydro at their adjoining power station.

Waste management company ABT (UK) plan a £40 million waste fired generating plant for a site north of Carlisle. The proposal, which is causing some environmental concern, would burn 125,000 tonnes of waste a year, initially chicken litter and tyres. The plant would supply enough electricity for 10,000 homes.



Europe's largest plant to generate electricity using methane from refuse is to be built in The Netherlands. The combined heat and power station will meet the energy requirements of around 15,000 households.

■ Energy crops in Britain could provide the equivalent to 10 million tonnes of coal, the British Association heard in August. A panel of agricultural scientists and economists considered the replacing of Britain's over-production of food with crops for fuel. They believe that fields of short-rotation coppice willow trees could become as common as fields of wheat or barley. □

Energy R&D

CUTS in government research and development (R&D) spending on nuclear power will not benefit clean coal technology and renewables. While nuclear power R&D for 1992/93 at £86.1 million is down £7.8m on the previous year, the total for non-nuclear funding is almost unchanged at £36m.

Despite the government's 'Coal Task Force' advisory committee recommending an expenditure of between £377m and £820m over the next decade on clean coal technology, its R&D funding for 1992/93 has been cut to £3.2m from the previous years figure of £4.1m ("Clean coal confusion", p18).

A new programme for fuel cells, concentrating on solid oxide and solid polymer cells, is to get £0.6m. Of the renewables, biofuels gets £3m for 1992/93, an increase of £0.25m, and windpower will receive £7.9m up £0.2m. However tidal power R&D has more than halved from \$4.2m to £2m, and geothermal has been cut by £0.7m to £1.3m.

Solar power, including photovoltaics, will again receive £1.9m. Funding for small shoreline wave power will continue, with £0.3m for 1992/93, but there will be no money for off-shore wave at least until the Energy Technology Support Unit review is published ("Reviews delayed", above). □

REVIEWS

Privatising electricity: the politics of power by Jane Roberts, David Elliot and Trevor Houghton.

Belhaven Press; 1991, 192pp, £12.99pb, £35hb.

Not only an interesting account of the UK's electricity privatisation, this book offers constructive ideas on how to develop the industry for the future.

The first chapter looks at the economic theory of markets. The authors suggest in the introduction that "those seeking less theoretical analysis could skip this chapter" - don't. It contains some jargon phrases like 'allocative efficiency' and 'long run marginal cost', but it explains the principles of market efficiency in a clear and concise way (even if you don't agree with them). It also looks at ways of incorporating environmental factors into the market.

Looking at the privatisation process of the Thatcher years, the authors explain the triple conflict of privatisation, liberalisation and non-market objectives, with particular reference to the Telecom and Gas sell-offs.

After describing the pre-privatisation structures of the UK electricity supply

industry (esi), the authors recount the privatisation and explain the objectives behind it, both open and hidden. They deal primarily with England and Wales, suggesting that the very different set-up in Scotland deserves a book of its own.

The ineptitude of the then Energy Secretary, Cecil Parkinson, in setting the targets for the privatisation is laid out. The nuclear fiasco and the failures to provide adequately for energy efficiency and renewable energy are considered in some detail.

Looking to the future, the authors consider how the structures and objectives of the industry can be changed. Firstly, in assessing the challenge of combating global warming and the need to reduce carbon dioxide emissions, they explain why the free-market philosophy will be unlikely to provide the complete answer. In conclusion, they consider the success and failure of the government privatisation, on its terms,

before advocating "ways to move forward to a saner energy policy, based on the principles of equity and sustainability."

I have few criticisms of the book, but in occasional references to political alternatives to the Thatcher philosophy, the Labour Party view is given almost exclusively, and its policies are interpreted in a most charitable way.

The authors also appear unrealistically confident that nuclear power is in irrevocable decline, and the statement that "The full cost of the nuclear power programme

has been revealed" is simply not true - waste storage/dumping and decommissioning costs remain as elusive as ever. These are however minor quibbles in the context of the book as a whole.

In explaining the economic theory of the market and privatisation; detailing the privatisation of the esi in England and Wales; and proposing ideas for improving the industry for the challenges of the future, "Privatising electricity" is well worth reading.

GRAHAM STEIN

MARKETS - THEORY, PRACTICE AND PRAGMATISM

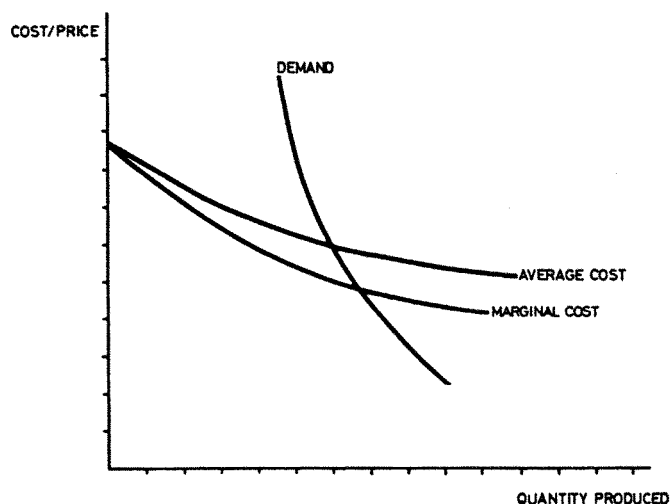


Figure 1.2 Marginal cost, average cost and demand in a monopolistic market

The Swedish electricity market: from monopoly to competition.

NUTEK, 1992, 161pp, £20.

In contrast to the UK's privatisation of electricity, the Swedes are seeking to introduce competition into their mixed ownership electricity supply industry (esi).

Early in 1991, the National Energy Administration (NEA) launched a study into the structure of the Swedish electricity market. The NEA was later absorbed into the Swedish National Board for Industrial and Technical Development, NUTEK, and this book is the report of their findings.

The study was started under a Social Democrat

government and continued by its successor - a four party non-socialist coalition. The move to increased competition therefore has widespread political support amongst Swedish political parties.

The Swedish esi is very different from that in the UK, although Vattenfall (the Swedish State Power Board) generates around half the electricity, there are more than 20 other power utilities, many of them privately owned and several with their roots in the Swedish basic in-

dustry. These include Sydkraft AB, mainly owned by southern municipalities and also by private interests, and Stockholm Energie AB, owned by the city of Stockholm.

Between the generators and the consumers, there is the Vattenfall-managed state grid, regional networks and over 300 local distribution utilities.

With similarities to Scotland, Sweden has an abundance of cheap hydro power, and through a programme of nuclear building now has an excess of generating capacity.

The Swedes intend to introduce competition in all electricity generation, all sales and all electrical energy utilisation. It has been appreciated that the trans-

mission of electricity is a natural monopoly which should be controlled by regulation.

By opening up the distribution networks in a non-discriminatory manner they plan to allow open competition in the sales of electricity. With trade in electricity at national, regional a local marketplaces.

Except for the now near universal belief that competition inevitably increases economic efficiency, there is little dogma in this report. Instead we have a careful weighing up of the pros and cons of various options. And with the emphasis on competition rather than ownership, these proposals are in stark contrast to the UK's approach.

GRAHAM STEIN

REVIEWS

Windscale 1957: anatomy of a nuclear accident by Lorna Arnold.

Macmillan; 1992, 235pp, £40hb.

Lorna Arnold's book makes fascinating and rather disconcerting reading. It recounts the story of the people who designed, built and operated the first British nuclear reactors at Windscale in Cumbria. These were built to produce plutonium for Britain's first atomic bomb and in 1957 one of them caught fire.

This is an official history. Its author is a consultant to the Atomic Energy Authority which she joined in 1959, two years after the accident she now recounts. However, this is not what one would expect of an official history where we are told only what we need to know. As an official account it is exemplary. It is also thoroughly readable. Arnold possesses a rare talent for making complex subjects both accessible and interesting.

Arnold states that her aim was to set the 1957 Windscale accident in the historical context of the immediate post-war period and the early days of the cold war; to describe the event and its consequences; and to evalu-

ate it from the vantage point of 1990.

Her sources were official papers in "several Government Offices" as well as in the Atomic Energy Archives. She states that all of the AEA documentation, "with the exception of one or two items" was opened in the Public Record Office at Kew Gardens in January 1988 and 1989.

Sceptics, of which I am one, may well ask about the material that has not yet been released to the public, and nagging doubts must remain. However, Arnold is a professional historian with a reputation for not pulling her punches.

Her biases are obvious but these do not, and should not, detract from the value of this book. Her bottom line is that the accident was "almost certainly inevitable" and she reminds us that the Windscale piles are still there, full of radioactivity in an uncertain physical condition.

The main reason for writing a book like this is not just to recount and explain the past but also to ask if the

lessons have been learnt. Arnold's view is that technologies learn from their mistakes and accidents. From this point of view, nuclear technology is "no exception" although she considers that the industry can "not afford accidents and must learn without them".

She concludes that the fire "undoubtedly yielded invaluable and timely lessons on nuclear safety", with little human damage "or perhaps none". Technical lessons have undoubtedly been learnt, but the political ones have not.

The real issue is not who gets the blame when something goes wrong, but who was given the benefit of doubt about safety before hand. The political circumstances at the time of the Windscale Fire were different from today but the way in which scientific uncertainty is approached has changed little. Things may be more transparent and visible today, but the results are often the same.

No one involved in the development or the operation of the Windscale piles argued that the operation was risk-free. Quite simply the political need for plutonium was judged to outweigh the unquantifiable risks. The benefit of the doubt was

given to the plant and those running it.

This is as true today as it was in 1957. The risks can never be defined precisely and it can never be proven that a particular individual has suffered or will suffer as a result of routine or accidental radiation exposure.

Current safety standards are obviously better than they were in 1957, yet they still do not err on the side of caution or give the benefit of the doubt to those facing the risk. Even now, when things go wrong, as they did with the Windscale Fire, arguments are made that things could have been worse and the implications are always played down.

As Arnold recounts, the Windscale Fire spewed a large quantity of radioactivity into the environment. Yet, Windscale before and after the fire is responsible for the largest radioactive discharges into the environment in Europe. I look forward to the day when Arnold writes the history of Sellafield's routine discharges. At present, we can only speculate on the skeletons that remain hidden in BNFL's cupboard, but no doubt when this door is opened we will not like what is found.

PATRICK GREEN

LETTERS

Dear Sirs

My attention has been drawn to "Cumbria planning study" (*Safe Energy 90*) on the Interim Report on "Planning and renewable energy: a joint study in Cumbria and South Lakeland".

I am sorry you found the study negative. It is, we believe, a pioneering and useful attempt to test out the practical and realistic options for exploiting the renewable technologies.

The joint ETSU/Cumbria/SLDC study aimed to test at local level how one set of environmental objectives - using

non-fossil fuel energy sources - could be balanced against an equally important objective - conserving the landscape and ecological diversity of Cumbria for the benefit of future generations. The study aims to produce draft strategic and local policies which will embody this balancing act.

That there are practical, technical and environmental limits to the use of the renewables is self evident - they are not a panacea. The study soberly reviews the situation and explains the judgements that need to be made.

Finally, I take exception to your final critical mention of

ETSU. ETSU staff have played a fully committed and positive role in relation to renewables - if anything seeing more opportunities than the planners!

The study has demonstrated so far that renewables have indeed a very bright future, but wishful thinking and an unwillingness to face facts is not a basis for building the environmentally sustainable future we seek.

Yours sincerely
John Hetherington
Group Leader,
Environmental Planning
Cumbria County Council

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LITTLE BLACK RABBIT



Royal flush

The Princess Royal the most popular member of the monarchy in Scotland since she was spotted singing Flower of Scotland before a rugby international at Murrayfield, has tarnished her image by visiting Torness Nuclear Power Station. The cost of her visit included £10,000 for a new loo. Staff are reportedly "not amused" by the cost of the visit whilst 100 staff are being made redundant.



Say it with coal

President Michael Heseltine's Department of Trade & Industry has, in the middle of the coal chaos, been issuing civil servants with a document stating its objectives. It says that the DTI will "promote the economic development of UK energy sources"; "maintain confidence in markets"; "and respond flexibly to the needs of different regions and areas with special difficulties". Tell all that to the miners!

LBR has two useful facts relating to the above to pass on:

1. It is perfectly legal to send a suitably wrapped and correctly stamped lump of coal through the post.

2. Michael Heseltine's address is: DTI, 123 Victoria Street, London SW1E 6RB.



Innocent regulation

Electricity regulator Professor Stephen 'Jimmy Cricket' Littlechild is facing legal action over his failure to stop the 'dash to gas'.

However his protagonists - COFFER (Coalition for Fair Electricity Regulation) may have prejudiced their case by employing solicitors called Stephens Innocent.



Lapin à Paris

Sad news has reached LBR of three French cousins who, deaf to LBR's warning, set up home at a low-level nuclear waste site just south of Paris. They were caught and killed by the French Atomic Energy Commission (CEA). Despite initial denials, CEA finally admitted that the youngest rabbit contained 3 times the permitted level of radiation. Data on the two adult rabbits has not been released.



Trident's pills

Schools around Sellafield have for a while had stocks of potassium iodate tablets for pupils in the event of a nuclear accident - which couldn't of course happen outside school hours.

Now residents of Barrow-in-Furness will be given potassium iodate tablets on request - just in case any of the Trident submarines being built there should meet with a mishap. But what about the rest of us?



Turkish Greeks

Nuclear Electric's Trawsfynydd power station, one of the least successful nuclear power stations of all time, recently hosted a group of Greek Trade Unionists.

NE's account of the visit placed their guest's home town of Lavrion 600 miles east of Athens which would put them in the middle of Turkey. Geography, like generating electricity, is clearly not their strong point.



Scrambled Eggar

In the aftermath of the initial pit closure crisis, Energy Minister Tim Eggar was due to appear on BBC TV's Breakfast News.

Eggar was, however, kept waiting for a few minutes before his interview. Irate that such an important and busy person as himself should be treated so shabbily, he threw a wobbly. By all accounts the fuming Minister very nearly walked out.

How would he react if he was sacked?

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