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RULING OUT THE WAVES

other problems our wave energy researchers may face, lack of Government support will not be among them'.
John Moore, Whatever
then Under-Secretary of State for Energy September 1980

the demise of the UK Wavepower programme

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RULING OUT THE WAVES

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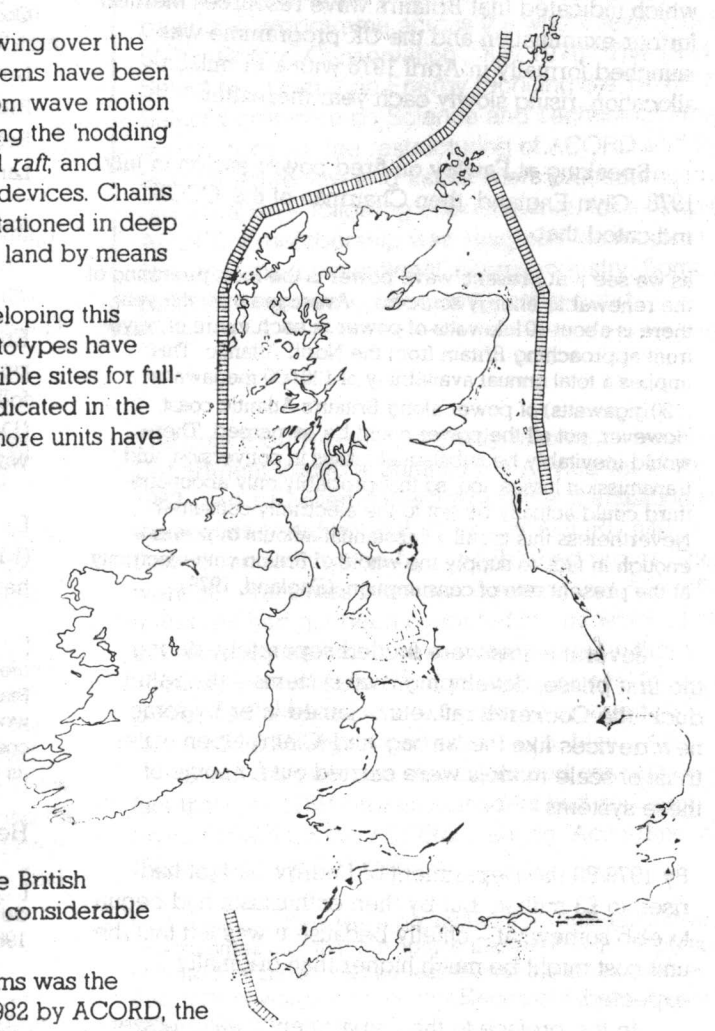
RULING OUT THE WAVES

Wave power

Waves are produced by the wind blowing over the sea. A wide variety of mechanical systems have been proposed for absorbing the energy from wave motion and converting it to electricity, including the 'nodding duck', a wave contour following hinged raft, and various oscillating column piston-type devices. Chains of wave energy converters could be stationed in deep water well off-shore, feeding power to land by means of marine cables.

Britain initially took a lead in developing this technology - several scaled down prototypes have been tested in open water. Some possible sites for full-scale wave-power systems are also indicated in the Figure. Smaller shore based or on-shore units have already been developed.

INTRODUCTION



However, the overall progress of the British programme has been the subject of considerable controversy.

The main focus of these criticisms was the programme review carried out in 1982 by ACORD, the Government's Advisory Council on Research and Development, which led to the dramatic cut backs in the wave power programme

... it is perhaps a pity from the viewpoint of a technical innovation that government funding had to be restricted at the point of demonstration, when funding overall normally has to increase quite dramatically. (F. Clarke, 1984)

Dr Freddy Clarke - Chairman of the Wave Energy Steering Committee/Research Director!
at Harwell from 1976 to 1981 responsible for ETSU,

We, as Members of the House of Commons, must rise above the merely technical arguments and try to fit the priorities into the overall policy structure.

the Secretary of State, David Hunt, when he addressed the House of Commons at the end of the October 1985 debate on Renewables:

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THE RISE AND FALL OF WAVE POWER

Official interest in wave power began around 1974 in the wake of the 1973/74 oil crisis. The National Engineering Laboratory completed a report in 1975 which indicated that Britain's wave resources merited further examination and the UK programme was launched formally in April 1976 with a £1 million allocation, rising slowly each year thereafter.

Speaking at Fawley oil-fired power station in July 1978 Glyn England, then Chairman of the CEBG, indicated that:

as we see it at present, wave power is the most promising of the renewable energy sources... Averaged over the year, there is about 80 kilowatts of power in each metre of wave-front approaching Britain from the North Atlantic. This implies a total annual availability of 120 000 megawatts (120 gigawatts) of power along Britain's Atlantic coast. However, not all the power could be harnessed. There would inevitably be substantial losses in conversion, and transmission losses, too, so that probably only about one-third could actually be got to the electricity consumer. Nevertheless this is still a substantial amount of power - enough in fact, to supply the whole of Britain with electricity at the present rate of consumption. (England, 1978).

Several teams were funded separately, during the first phase, developing rival systems - the Salter duck, the Cockerell raft, etc. - joined later by some new devices like the 'airbag' and 'Clam'. Open water trials of scale models were carried out for some of these systems

By 1979/80 the Department of Energy budget had risen to £3 million, but by then enthusiasm had begun to ebb somewhat - chiefly because it was felt that the unit cost might be much higher than originally expected.

In the preface to the Department's wave-power report (Energy Paper 42, 1979) the chairman of the Wave Energy Committee, Dr F. Clarke, suggested that electricity from first-generation wave power stations might cost between 20-50 pence/kWh. This estimate actually came from an earlier 1978 study by the Department's Consultants, Rendel, Palmer and Tritton. Since that time the device teams had made considerable progress - with some unit cost estimates falling to around 10p/kWh or lower (see Table 1) which had become the ETSU 'target' figure. ; soon after, it had dropped to below 10p per unit (the initial target) and continued to fall, to within reach of the new target of 5p/kWh. By 1981 some researchers estimated that 4p/kWh or an even lower figure might be reached

But some damage had evidently been done to the 'image' of wave power - and this was augmented by a downward assessment of the total scale of the wave-power resource. For example, instead of the original 80 kW/metre estimated to be available (as measured by the off-shore wave station India 500 km off the Outer Hebrides) only 50 kW/metre seemed likely to be available at the planned location of wave-power devices, closer to shore.

Table Estimated unit costs for wave-power systems (research team estimates)

System	Cost/pence		
	1978	1979	1980/81
Salter's Duck	20-40	10	4.5-5.6
Cockerell's Raft	20-40	12	9
Oscillating Water Column	20-40	13	6-11
Lancaster Airbag	5-10	6	3.5-4.7
Bristol Cylinder	not quoted	14	5-10
Belfast Buoy	not quoted	12	8
Lanchester Clam	not quoted	6	4-4.5

Source: Ross, D. (1981) *Wave Energy Newsletter*, no. 3, May.

In 1981 there were reports that the Department of Energy was 'planning to withdraw from funding wave-power projects' (*Electrical Review*, May 22, 1981) following a comment by the then Secretary of State (David Howell) that the renewables R & D programme was to be 'critically reviewed' the following year.

Responding to these reports the Chief Scientist, Dr A. Challis wrote, in a letter to the *Financial Times* (May 27, 1981), that the wave-power programme had...

[...] produced a large number of possible solutions and there are grounds for continuous optimism about the feasibility of utilising this resource. The next phase, however, would involve work on a larger scale and this would be very costly. The Department would therefore wish to concentrate its efforts on a smaller number of devices.

Hence there was a need for an assessment exercise to

[...] decide whether or not to proceed with any of the devices which form part of the present programme. (Challis, 1981).

In 1980 the Department had in fact cut back on the number of wave-power projects it was funding - from nine to four, further funding for two of the early entries, Salter's nodding duck and Cockerell's raft, having been halted. Now the remaining systems were to be re-assessed.

According to David Fishlock writing in the *Financial Times* (May 13, 1981)

the four teams still being funded by the Department of Energy have until March 1982 to show that wave-power machines may achieve electricity costs as low as 5p a kilowatt hour at present prices.

But he added 'The Department expects that none of the four systems in test will succeed in this'.

Challis was insistent that no decisions had been taken and that:

I and the experts who advise the Secretary of State for Energy must keep an open mind until the results of the present phase of work are available. (*Financial Times*, 27 May, 1981).

ACORD

According to Clarke, ACORD 'reviews and gives advice to the Secretary of State for Energy on the R & D programmes of the nationalised fuel industry, and on the development of a balanced programme in the department's non-nuclear, non-marine R & D programme' (in 'UK Science Policy', Longman, 1984) and has the role of 'helping in the development of a balanced programme across the whole field' (Cmnd 6575, 'Energy Conservation', July 1976). The 1984 Select Committee on Energy (echoing the 1976/77 Select Committee on Science and Technology) made suggestions for the restructuring of ACORD and the associated review and assessment procedures and organisation - following criticisms that, for example, ACORD's membership was weighted too much in favour of the 'conventional' energy industry. Some restructuring was subsequently set in hand.

The research teams themselves were unhappy that they were being forced to produce cost estimates on such a short schedule and at such an early stage of development. Stephen Salter, the inventor of the 'nodding duck' felt that it was like trying 'to decide our aviation policy on the data available in 1910' (*Financial Times*, May 18, 1981).

As we shall see, the 1982 review of renewables R & D did in fact turn out to be more or less the final demise of large-scale wave-power research in Britain.

THE ACORD REVIEW

In 1982, the Department of Energy carried out a review of progress so far, aimed at identifying which systems should be funded in future. ACORD was charged with making the assessment as part of its regular round of reviews of energy technology R & D - with ETSU providing the background data for submission to ACORD.

It emerged that wave power had been all but abandoned - along with active solar, biogas and offshore wind.

There was considerable clamour for clarification - and in particular calls for the publication of ETSU's background documentation. Eventually these were acceded to.

The way in which this affair was managed drew as many criticisms as the actual conclusions. As we have seen, the demise of wave power - despite the £15 million that had been spent by that stage - had been rumoured some time before the ACORD review. But even after the initial news leaked out, following the ACORD meeting on 19 March, that it has indeed been unfavourably assessed, there were reports that a final decision on wave power would be delayed until September in order to take account of new data.

As *Engineering Today* put it on April 5:

An unexpected revolt by some ACORD members against the civil service advice led to a six-month reprieve for the programme. But the decision on how to deal with the recommendation has still to be made by politicians and their civil service advisors.

while *Electrical Review* on April 2 reported that:

The Council decided to urge the Department of Energy to give the four key teams another six months so that they would be able to examine and answer a consultant's report which prices all of them out of the 5p/kWh limit set by the Department.

Some of ACORD members were angry to discover that the teams had not even been shown the report, drawn up by the Government's consulting engineers, Rendel, Palmer and Tritton.

The Secretary of State for Energy, appoints ACORD members, who include representatives from the nationalised energy industries, the UK Atomic Energy Authority and the Science and Engineering Research Council, together with independent members drawn from industry and the academic world.

The confusion was at least partly resolved when the Department issued a 'Summary of Advice' on 27 April 1982 (see p5) even if there was some speculation that the summary did not reflect all that ACORD had recommended in their full, unpublished report. There were several press reports suggesting that ACORD members had not been consulted on the wording of the summary and that some at least were unhappy about it. For example the idea of a 'reprieve' for wave power had evidently more or less evaporated (D. Ross, *Wave Energy Newsletter*, No. 5, May, 1985).

Some disquiet was also expressed concerning the fact that the ETSU project managers had not been invited to attend the ACORD meeting. According to Flood, staff at ETSU were...

[...] upset that they were prevented from defending their programmes and that the advice that went to the Secretary of State for Energy was far less favourable to renewables than ETSU's would have been. (*Electrical Review*, 25 June 1982).

These issues were subsequently raised in a parliamentary question on 28th June, which 'asked the Secretary of State for Energy if he was satisfied that the summary of advice proposed by the Advisory Council on Research and Development adequately reflected the views of those serving on the council; and whether the views of those involved in renewable energy projects were excluded from the council's consideration'.

The Secretary of State (Mr Mellor) responded: 'Yes. There was no question of excluding the views of those involved in my Department's renewable energy projects. The reports of all the renewable energy steering committees were made available in full to the council and the chairman of the committees attended and took part in the discussion'.

So the chairman of the steering committees had attended - but not the project managers.

Advisory Council On Research and Development for fuel and power (ACORD)

Summary of advice to the Secretary of State for Energy on his research and development programme on renewable energy sources

1. In conducting its review, the Council kept to the fore the three principles underlying the Department's Renewable Energy R & D policy:

(i) that during the early stages of the programmes – when the techno-economic uncertainties surrounding technologies were high – as many resources technologies would be investigated as could sensibly and appropriately be accommodated within the available funds and manpower resources;

(ii) that as the uncertainties surrounding the prospects for economic development of technologies reduced through R & D, those which showed poor prospects of becoming economically competitive against other technologies expected to be available, would be dropped from the programme;

(iii) that only research and early development work – not normally beyond the first prototype stage – would be considered as potentially appropriate calls on the Department's R & D budget. Programmes were recommended on the basis that they would be supported at minimum cost to the public funds commensurate with considerations of efficiency, effectiveness and value for money.

2. General Recommendations

(11) *Wave power*: no new development work on wave power should be supported from the Department's R & D budget: however, a detailed comparison of the major systems was planned for September 1982 when most of the present work is scheduled for completion. The existing contracts should be allowed to run their courses. The results from all the projects should be prepared for publication by the Department. It was important, in the Council's view, to present the results in a tidy form so that the work supported to date would be available to Government and private sector should it be decided to re-consider the role of wave power in the UK energy economy. If necessary, limited funds should be made available to support this activity. The Council recommended that if the budget did not permit both the existing contracts to run their course and the results of the work to be prepared for publication, priority should be given to the latter.

Department of Energy
27 April 1982

REACTIONS TO THE ACORD REVIEW

ACORD recommended that no further work should be funded in the wave power, active solar, biogas systems or off-shore wind fields: existing results should simply be written up. But no details of future funding were cited. The impression was that it was now up to the Government, via the Department of Energy, to consider ACORD's advice. It later transpired that more or less the opposite was the case: the Department of Energy had evidently some time earlier proposed a reduced global sum for the next round of funding (£11-12 million for 1982 down from £14 million in 1981/82) and then, in effect, asked ACORD to suggest how it should be divided. ACORD's recommendations were then apparently accepted by the Minister more or less unchanged.

The renewable energy research community were horrified. It had been assumed that there would be a period for consultation. Thus Normal Bellamy of SEA-Lanchester (involved with the 'Clam' wave energy project) put it before the news finally leaked out:

Let us hope that Mr Nigel Lawson [the then Secretary of State for Energy] rejects what the ACORD report says about wave power and has the foresight to seize the opportunity which wave energy offers. If the Government does not back the development, there is a real danger that this British project will be taken over and developed by other countries – with the support of their Governments. (SEA-Lanchester 'Wave Energy Brief' No. 12, 1982).

The news that the total budget had been established long before the ACORD review emerged accidentally at a conference organised by the Institution of Mechanical Engineers on 21 May in London. This was, as one speaker noted, the first major gathering of renewable energy researchers since the ACORD recommendations had been published. According to Professor Brinkworth of Cardiff University Solar Centre the recommendations were 'precipitous' and 'extreme', while D. F. Taylor of the British Wind Energy Association saw them as 'premature'.

Brinkworth added that he hoped the Secretary of State would adopt a more flexible and enlightened approach – and *not* accept what he saw as ACORD's 'bad advice'.

At this point an understandably somewhat tremulous Department of Energy spokesman stood up and told the audience that in fact the decision had already been taken. The £11-12 million ceiling had been set long before ACORD's review and the Department would shortly be announcing specific programme budgets.

It transpired that the decision to reduce overall spending to £11-12 million, since 'it will not be possible to insulate this area from the savings the Government are making in public expenditure' had been first disclosed – but not widely appreciated – in a parliamentary answer on 31 March, and repeated on 17 May 1982, when Mr Mellor (then Secretary of State for Energy) added that the ACORD recommendations were 'acceptable to the Department [of Energy]'.

Subsequently in June 1982, Mellor outlined the specific 1982/83 budgets – £1 million for solar, £3 million for geothermal hot dry rocks, £3 million for aquifers, £3.2 million for wind and £3 million for 'completing' the wave-power work (concluding evaluations and writing up results).

He added 'no new development work will be initiated' on wave power, and that the active solar and biomass programmes were to be cut. (Tidal power, was not included in the ACORD review. Subsequently £250 000 was allocated for further desk studies on the Severn Barrage – matched by the same amount from industry.)

At a meeting in June 1982 of the all-party Parliamentary Liaison Group for Alternative Energy Strategies (which as noted earlier provides a forum for MPs and the renewable energy research community to discuss policy). Mr Mellor, facing a somewhat hostile audience, outlined the rationale for the cuts as follows:

The decision I announced in the House on 17 May in no way constitutes a termination of work on renewables [...] Rather, this is a decision to move on in our programme by concentrating our efforts on the most promising technologies. This has been inherent in all our work since the programme began seven years ago – sooner or later the field would have to be narrowed down.

But he didn't let ACORD off the hook too easily:

Our economic policy requires that we impose constraints on public expenditure. But the fact that these constraints led us to conclude that departmental funds for renewables R & D would probably be limited to £11-12 million a year for the next few years did not restrict ACORD in making its recommendations. The council was at liberty to recommend that this sum was clearly inadequate for the maintenance of a proper programme. It decided however that these funds were sufficient to conduct the proposed work on more promising technologies at the pace considered appropriate at this time. (David Mellor, then Secretary of State for Energy, PARLIGAES meeting, 29 June, 1982).

Faced with what might be seen as a fait accompli there was little the renewable energy research community could do but complain.

The bulk of their criticism subsequently moved from the 'public handling' of the news about the decision and on to the internal assessment procedures ACORD had used.

It was widely remarked that it was strange that the ETSU programme managers had, evidently for the first time, been excluded from the ACORD meeting. Clive Grove Palmer, the ETSU wave-power programme manager, subsequently took 'early retirement' at least in part because he was, he said, 'fed up' with the way in which the programme had been handled (*Engineering Today*, 3 May, 1982), although he insisted that he was 'not walking out in a huff'.

The wave-power researchers themselves were particularly incensed when it became clear that what they alleged to be inaccurate and out of date unit cost estimates had been used.

ETSU'S 'R13' AND 'R14' REPORTS

The focus of the reaction to the ACORD review then moved to the confidential ETSU background documentation.

Initially the Secretary of State for Energy had refused to make these internal reports public. But after repeated calls, a report (ETSU R13) was eventually released in November 1982.

The first ETSU report, R13, and a subsequent report, R14 (released shortly after), proved to be a mine of useful information - ETSU had done a considerable amount of interesting work. For example R13 developed on EP39's long range estimates of future potential contributions from each source based on the estimated scale of the resource, and also provided unit cost estimates. (see Table). On-land wind and tidal power emerge as front runners in Category A (which R13 labelled as 'strongly placed'), wave power being relegated to Category D ('long shots'), along with active solar power.

R13 puts it as follows:

Wave power is likely to be economic only in those futures more favourable to renewable energy technologies [...] Although wave power could just be economically acceptable at the bottom of its estimated cost range... other electricity generating sources... are consistently more attractive when analysed under the same circumstances.

TECHNOLOGICAL PROGRESS FROM 1983 ONWARDS

From 1983 onwards - following the ACORD review - the emphasis shifted to the wind, tidal and geothermal programmes.

Wave-power research, however, was hard hit by the cut-backs. As we have noted some £15 million had been allocated to wave-power research by 1982, with funding rising to a 'high' of £4.4 million in 1981/82 - 30% of total government expenditure on renewables - only to be cut back dramatically (down to £400 000 by 1984/85) following the ACORD review. The cut-backs had a dramatic effect on the wave-energy research community. Most device teams had to reduce manpower and scale down operations considerably. Some, like Wavepower Ltd. in Southampton, gave up entirely. But despite these funding setbacks, some wave-power research continued. An optimistic interpretation might be that the remaining teams were now 'leaner and fitter'. The emphasis shifted from large gigawatt-scale deep-sea systems to smaller in-shore coastal units for isolated island communities (see Michael Flood's, 'The troughs and crests of wave energy', CME, June 1985). However they were competing with Japan and Norway who have made fairly rapid progress in this field - and Britain seemed to be losing the lead. Perhaps inevitably then, the wave-power issue remained firmly on the political agenda - as the next section illustrates.

THE SELECT COMMITTEE REPORT AND THE WAVE-POWER DEBATE

in 1984, the all-party House of Commons Select Committee on Energy reported in fairly critical terms on the energy R & D programme. It included a review of the progress and potential of the various wave-power devices which differed strongly with the official view:

... When the Department of Energy's wave-energy programme began in 1976 the objective was to identify the size of the resource through a series of supporting studies and R & D on four competing systems - the Salter Duck, the Cockerell raft, the Russell Rectifier and the NEL Oscillating Water Column. The emphasis was on paper and laboratory feasibility studies, but all concerned knew that real knowledge could be gained only from sea trials. The object from the outset, therefore, was to select the most promising devices and test reasonable scale versions at sea. The programme has strong support from two Chief Scientists (Sir Walter Marshall and Sir Herman Bondi) and the chairman of the Wave Energy Steering Committee (Dr F. Clarke). Consulting engineers were retained to improve knowledge of device efficiency and capital and operating costs.

ACORD reviewed the programme in 1978 and 1979 and advised the programme team of the importance which the Council (ACORD) attached to a sea trial near full-scale.

The next objective for the programme team was to reduce the generation costs to 10p/kWh or below. In June 1980 they were asked by ACORD to select the most promising devices and to identify one to be taken to sea trials. In March 1981, ACORD set the team a deadline of March 1982 to select a prototype device and to halve the cost target from 10p to 5p/kWh. In anticipation of the 19 March 1982 meeting of ACORD, the programme team prepared a further set of cost estimates and recommended a further 12 months work to finalise details of the prototype for sea trials. Unlike all previous ACORD meetings at which renewables R, D & D had been discussed, the programme managers were excluded (by the Chief Scientist) from this meeting. At that stage, the device teams were close to the 5p/kWh target and some thought they could achieve a lower figure. However, at around the same time, ETSU had advised ACORD that unless wave energy could achieve under 4p/kWh it 'did not match in with what the system needed.'

The Department issued a Press Release on 27 April 1982 formally announcing its decision, on the advice of ACORD, sharply to reduce funding for the wave-energy programme, although ETSU's analysis (on which ACORD's recommendation was allegedly based) was not released until December 1982. The result was that £15 million had been spent abortively with the object of undertaking sea trials near full-scale, the projects then considered to hold the greatest promise were run down, the sea trials were not undertaken, and the only remaining parts of the wave-energy programme were two devices previously considered to be the higher cost ones and which were still at the small-scale laboratory stage.

The evidence on the wave energy programme hardly inspires confidence in the Department's sponsorship of renewable energy R D & D, for the following reasons:

- (a) Despite it being obvious to all concerned from the outset that not much of value could be learned without sea trials on a reasonable scale, none have taken place;
- (b) The Department's enthusiasm for wave energy was apparently beginning to wane in the early 1980s, but the situation changed suddenly in early 1982. As ACORD's deliberations remain secret, we merely point to the fact that

ETSU'S 'R13'

Table Summary categorisation of renewable energy technologies

	A	B	C	D
Heat producers		Passive solar space heating Geothermal aquifers	Solar water heating Geothermal (2) hot dry rocks	Active solar space heating
Electricity producers	Onshore wind Tidal	Small scale (1) hydro	Offshore wind Small scale wind (3)	Wave
Fuel producers		Biofuels: combustion; anaerobic digestion of animal wastes	Biofuels: anaerobic digestion of vegetable wastes; thermal processing	

Category A includes technologies that are economically attractive now or in the near future and for which a route to their exploitation, without too serious difficulty, can be envisaged. Category B technologies are also economically attractive but there may be factors mitigating against market uptake. Category C technologies are generally further away from the deployment stage. They might be less cost effective than competing renewable energy technologies or they might only be cost effective at a future date. Improvements in the cost or performance resulting from further R & D may improve the prospects for such technologies. Category D covers technologies which the analysis shows may be cost effective only under the most favourable circumstances (i.e. with very high costs of conventional energy) and in the very long term. In some cases (1) little further R & D is required, in others much further information is required on the technology (2) or on the market features (3) before an adequate assessment of the potential is possible.

Electricity production/ultimate potentials as a percentage of current annual electricity consumption.	Unit costs/ pence per kWh	Heat production/ultimate potential in mtce per annum
off-shore wind	50% (149 TWh per annum)	3.1-7
on-shore wind	20% (50TWh per annum)	1.9-4.3
tidal (all sites)	15% (13TWh per annum)	2.8-3.1
wave power	25% (66 TWh per annum)	4-12
geothermal hot rocks	10% (2500 TWh per annum over 100 years)	4-5.2
small wind	10% (25 TWh per annum)	—
micro-hydro	1% (1.8 TWh per annum)	—

the ultimate potentials cited here are the technically feasible potential contributions leaving aside economic and environmental constraints.

(Abstracted from ETSU R13 (1982))

there was a new Secretary of State (Mr Nigel Lawson) who was known to be eager to reduce public expenditure, that two known supporters of wave energy (Sir Herman Bondi and Dr F Clarke) had recently left the scene, and that there was a new Chief Scientist (Dr Challis).

(c) In slashing the wave energy programme, the Department - and, by implication, ACORD - allegedly used the argument that wave energy could not meet a specific cost target, when neither they nor anyone else was in a position to know whether this was the case or not. The whole reason for embarking on the programme was to create an option for a future in which energy prices might be considerably higher than today (the 'insurance' argument.) There is no evidence that the Department has ever assessed the much larger expenditures on the fast breeder reactor and fusion research against a similarly stringent cost criterion - certainly not at such an early stage in their development.

(d) It has been the Department's avowed aim to be in a position to decide in 1985 which renewable energy options to carry forward to prototype development. Wave energy, previously the Department's favourite horse, was effectively withdrawn before the race began. In consequence, we doubt whether a competent project team could now be re-assembled without great difficulty to pursue the work vigorously from where it was left in 1982.

If there was any truth in earlier assertions that with wave power Britain was leading the world in a new technology with exciting prospects, that claim now has a hollow ring. We withhold judgement about the Department's current enthusiasm for wind energy, but note that the Department and ETSU (and, by implication, ACORD) attached the lowest priority to wind energy not many years ago. We are driven to the same view as the former Select Committee on Science and Technology - that the renewables R D & D programme has not been carried forward with the commitment and consistency which the objectives required. Ten years have slipped by since the 1973-74 'oil shock' and there is little progress to show as far as renewable energy sources are concerned. (Select Committee on Energy, 1984)

Clearly the Select Committee were less than happy with the way the review had been conducted... and implied that wave power could have been found to be viable if given a reasonable chance. This is clearly a matter of opinion: the official view may well turn out to be correct. (After all the claims made by the device teams are likely to be somewhat more optimistic than those produced by independent assessors.) But an obvious question which arises (assuming one accepts this type of criticism) is: why was wave power so harshly treated? It could be simply that the Department received bad advice or that the uncertainties were, genuinely, large. But several commentators have pointed out that when nuclear power was at a similar stage of development (in the 1950s) the unit cost uncertainties were similarly large and yet the nuclear programme was pursued with considerable vigour.

Either way, the device teams had been in a difficult position. Some commentators have argued that part of the problem was the undue sense of urgency

that prevailed: the rival device teams evidently felt they were in a race to get cost estimates down sufficiently to justify continued funding. They were clearly right! But this did not necessarily lead to good engineering. After all there was in reality no real urgency: theoretical and tank studies could have been spread over several years before going to sea with prototypes. However, testing a working prototype at sea obviously had attractions in terms of political expediency!

Time pressures like this are obviously just some of the problems facing innovators working, inevitably, in an uncertain technical and financial environment. But the researchers clearly felt their problems were not eased by the way the assessment had been performed, or by the way the programme had been managed. As one researcher, Stephen Salter commented, somewhat bitterly, before the ACORD decision:

I am sure that many people engaged in the work whether from device teams, consultants or administration will agree with me when I point out that improvements could be made to the administrative machinery. So much of it seems designed to delay and demoralise. (Salter, 1981)

Another had put his criticisms of the wave-energy steering group's activities even more bluntly, suggesting that the researchers were often kept 'in the dark' so that they 'did not know which way they were steered'. (Quoted in *Eclipse of the Sun?*, Friends of the Earth, 1982).

THE SECOND ACORD REVIEW

Recommendations resulting from the review carried out by ACORD emerged in June 1985, and a Government response was made in July. There were few surprises - on-land wind, tidal and geothermal were seen as 'promising'. Some biofuels and passive solar were 'attractive'; active solar, off-shore wind and photovoltaics as 'long shots' - but wave power was finally rejected.

The ACORD recommendations were based on ETSU's 'R30' overview report 'Perspectives for the exploration of the renewable energy technologies in the United Kingdom' (produced by the Chief Scientist's Group).

Each technology is assigned to one of three broad categories:

- economically attractive,
- promising, but uncertain,
- long shots.

R30 commented:

Wave-energy converters and active solar space heating are examples of 'long shots'. Under the future fuel price assumptions of the Department of Energy's 1982 Energy Projections, these technologies would be expected on economic grounds to make no significant contribution to UK energy supplies in the foreseeable future. A technical breakthrough could change this position.

Subsequently, *RE News* (October 1985) added that:

ACORD considered that the 'long shot' category should be further divided into those technologies where benefit might be obtained, from maintaining a minimum level of R & D with the necessary international collaboration, i.e. the real 'long shots', and into those where effort should be limited simply to keeping up to date with progress elsewhere and on which, otherwise, expenditure should cease completely - the 'rejects'.

ACORD recommended that wave power should be relegated to this latter category and that the current geothermal aquifer programme should be wound up. The Parliamentary Under Secretary of State, David Hunt, in a statement in the House of Commons in July 1985 in response to a parliamentary question, confirmed that he had 'accepted ACORD's advice to discontinue work on wave power and geothermal aquifers in order to concentrate resources on more promising technologies'

Overall, this second review created somewhat less of a public debate than the first, although the final rejection of wave power did generate considerable disquiet within the renewable energy research community especially given the fact that the Norwegians at this point were commissioning a small (500 kW) shore-based wave-power unit, with estimated unit costs of only 3.4p/kWh, compared to the 9-15p/kWh estimate, albeit for large deep-sea systems, in R30. This estimate in return was much higher than the 4-12p/kWh given in the ETSU's 'Strategic review of the renewable energy technologies' (R13).

In R30, however, ETSU comments that 'the probability of achieving a cost lower than 9p/kWh is small' and adds 'although costs of 5-6p/kWh have been claimed for some devices so far these are unsubstantiated.'

The debate on estimated costs for wave power continues...

THE HOUSE OF COMMONS DEBATE

A half-day debate on alternative sources of energy was held on 25 October 1985 in the House of Commons.

The conservative MP, Tony Speller, then chairman of the Parliamentary Alternative Energy Group insisted:

[...] we must return and consider the Norwegian experiment, which uses British technology. It is too easy to say that it is a long shot and we should forget it. An island nation which has tidal water flowing to and fro, hydropower and other sources of water should not write off wave power as a long shot. There is fantastic power available.

Alex Eadie (Labour) commented that 'backing only winners in research and development is a contradiction in terms... There will be losers in research and development'. He called instead for 'technological pluralism'

Malcolm Bruce, of the Liberal/SDP Alliance, invoked the conspiracy theory. 'It seems that there is a conspiracy afoot to prevent the full-scale development of alternative sources of energy.'

In all there were twelve contributions from all sides of the House many of them sharply critical of the Government's handling of the wave-power decision. According to Eadie: 'the decision was a blunder and the Government are in danger of making themselves look foolish.'

Bruce commented:

Those who have received representations from people involved in the wave programme will have been struck by the degree of bitterness with which they have greeted the cut in that programme, not to mention the bitterness they feel about the way in which they are judged by comparison with the conventional and established forms of energy renewal, both in terms of expected rates of return and the amount of investment that they are allowed to use to overcome their problems. Just when they think that they are getting there, the funding is cut from under them and the opportunity to go ahead with something with real potential is closed off.

CONCLUSIONS

Assuming a relatively small budget at a phase when several programmes could conceivably expand rapidly, there would obviously be conflicts - and the need for choices to be made.

Of course some critics argue that the process of convergence - choosing which technologies to focus on, and which to ignore - had been carried out at too early a stage, before the options had been properly explored, with wave power being the obvious example.

But assuming choices did have to be made, the question then becomes: were these choices made fairly? Some would judge that on purely technical or economic grounds. Others would apply strategic 'political' criteria, such as employment implications - Britain's shipyards could benefit from work on wave-power systems construction. Others again might be inclined to see 'deviousness' in the handling of the ACORD decision and the renewables programme in general: they might ask whether wave power was 'set up' only to be knocked down so as to discredit renewables generally, thus reflecting the Government's basic disinterest in renewables? This view has certainly been forcefully put by one commentator, David Ross, a journalist who has taken a particular interest in wave power.

For example, giving evidence to the Sizewell 'B' public inquiry (Day 313, 17 January 1985) Ross quoted from a leaked CEB internal memorandum (the *Times*, 11 April 1978) produced in 1978 which commented that:

Studies have shown that apart from limited special applications, the use of renewable energy sources for electricity generation is likely to be less economic than nuclear power. Nevertheless, it is important to explore these alternatives in order both to satisfy ourselves that nuclear expansion is fully justified, and to demonstrate this to others, since groups opposing nuclear expansion have made substantial progress in the past few years.

Ross interpreted this as indicating an intention to conduct what he called a 'spoiling operation' on the renewables - with wave power being set up only to be knocked down.

Whether or not you accept conspiracy theories what seems to emerge from this situation is an indication of the up-hill struggle likely to be faced by any new set of technologies attempting to break into a well established field, unless it has powerful corporate or Governmental supporters or can clearly demonstrate its superiority over what already exists, without such support.

Perhaps the last word in this review should go to one of the researchers, Stephen Salter, who, in a paper on wave power to the Royal Society of Arts in 1981, gave some impression both of his view of the obstacles to progress and some hint of the environmental conviction which underpins much enthusiasm for renewables:

We are attempting to change a status quo which is buttressed by prodigious investments of money and power and professional reputation. For 100 years it has been easy to burn and pollute. 100 years of tradition cannot be swept away without a struggle. The nearer renewable energy technologies get to success, the harder that struggle becomes.

AFTERWORD

In producing this study I have drawn extensively on the files of NATTA - the Network for Alternative Technology and Technology Assessment - of which I am an active member, and I have had the benefit of contributions and comments from several other NATTA members.

I should point out that I have only used published material in compiling this case study. I have not looked 'behind the scenes' at the informal processes that presumably have gone on. For an intriguing account of the latter in the case of the development of wave power, see David Ross, *Energy from the waves*, Pergamon, 1981 (2nd edn.). More recent developments have been covered in the Open University Appropriate Technology Group's reports on the two 'Wave Energy' seminars it organised in 1983 and 1984.

Dave Elliott

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Natta

this case study is based on
THE BRITISH GOVERNMENT'S RENEWABLE ENERGY R & D PROGRAMME 1974-85
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The Open University Press

It is being published, together with some additional appendices, in the NATTA Report series in order to make it available to a wider audience. Like all NATTA Discussion papers it provides an opportunity to discuss wider more contentious issues than are covered in our Newsletter. As such it should not be taken to represent the views of NATTA, (or of course the Open University) but only those of the author.

June 1987

Appendices

- 1 RENEWABLE ENERGY IN THE UK
- ESTIMATES OF OVERALL POTENTIALS
- 2 Department of Energy expenditure
- 3 Wave Energy seminar at the Open University

Update

The Norwegians are considering installing 10MW of coastal wave energy systems following on from their two very successful shore based projects.

*New Scientist (18 Dec) carried a useful report on the Norwegian projects by Mike Flood.

Since Norway launched the first wave power stations (500kW + 350kW) in November 1985, three units have been ordered by overseas customers. Portugal is buying an oscillating water column, in which the rise and fall of the waves drives a bubble of air through a Wells turbine, for use on the Azores; Indonesia is buying a Tapchan, which is likely to be used on the island of Bali; and, the USA has decided to construct a 2 MW Tapchan, which will be constructed on the north coast of Puerto Rico. This latter order is seen by the Norwegians as a significant breakthrough into the American market, with enormous potential for future export trade.

The units for Portugal and Indonesia are likely to be in the 1-1.5 MW range.

RENEWABLE ENERGY IN THE UK

Britain is very well placed to exploit natural energy sources. The UK has some of the world's best wind, wave and tidal energy resources, together with significant potential for power to be generated from direct and indirect solar, biomass, water power and (non-renewable) geothermal energy. Taken together the ultimate technical potential - the theoretically possible total contribution - has been put (by Dr J. K. Dawson of ETSU) at up to 200 million tons of coal equivalent per annum, assuming, that is, that all or most of Britain's renewable options were successfully developed. This total is about as much as we obtain from North Sea oil and gas at present.

In terms of electricity supplied to the national grid, ETSU's 1982 report 'Strategic review of renewable energy technologies' (R13) estimated the following long-term technically possible contributions.*

On-land wind	20% of current electricity demand
Off-shore wind	50% of current electricity demand
Wave power	25% of current electricity demand
Tidal power	15% of current electricity demand
Geothermal hot rock	10% of current electricity demand

* These figures are the 'maximum technical potential contribution (not allowing for economic or environmental constraints)' as R13 puts it in the case of wave power; although the off-shore wind estimate is seen as 'allowing for some but not all economic and environmental constraints'.

ETSU R13 (1982), 'Strategic review of renewable energy technologies', Report no. 13, Energy Technology Support Unit (ETSU), Department of Energy, HMSO.

Ultimate potential of renewables (EP39 uses the phrase 'potential ultimate market'. Source: EP39, 1979.

Solar space heating	40-80 mtce
Solar water heating	10-20 mtce
Vegetable fuel	60 (but only 15 mtce as useful fuel)
Waves	10-40 mtce
Tides	4-10 mtce (Severn) 2-3 mtce (others)
Wind	land based up to 10 mtce Coastal up to 5 mtce offshore 10-20 mtce
Geothermal	Several tens of mtce

ETSU EP39 (1979), 'Energy Technologies for the UK (1987)', Energy Paper 39, ETSU/Department of Energy, HMSO.

Wave: Professor Peter Chapman of the Open University Energy Research Group estimated that by 2025 the UK could obtain up to 120 mtce from wave power systems - a figure derived from a CEEGB assessment (Chapman, 1977).

P. Chapman *Alternative Energy Sources in Nuclear Power and the Energy Future* proceedings of Royal Institution Forum, October 1977

1978 White Paper

The White Paper on alternative sources represented the [Labour] Government's reply to the Third and Fourth Reports from the Select Committee on Science and Technology, Session 1976-77.

Wave Power

'Wave Power constitutes a major potential, as the Committee concluded, for large-scale electricity generation, provided the considerable technical problems can be overcome and economic viability can be established. Progress in the wave power programme which was launched in 1976 has been encouraging. Of the devices under laboratory examination, work on two has already advanced from small-scale laboratory tests to trials at one-tenth scale in open water, on Loch Ness and Solent.'

Early estimates of the potential of renewables by 2000 AD

Data from Energy Commission Paper 1

Energy source	mtce per annum
Solar space heating	1
Solar water heating	4
Biomass fuel	3
Waves	up to 15
Tides	up to 4
Wind	up to 8
Geothermal	up to 4
Total	39

Energy Commission (1977), Energy Commission Paper 1.

Possible energy supply from alternative sources by 2000 AD (official estimates)

Energy source	mtce per annum
Solar: space heating	3
water heating	3
biomass fuel	3
Waves	up to 15
Tides	up to 10
Wind	up to 8
Geothermal	up to 4
Total	46

Source: Government Green Paper, *Energy policy: a consultative document*, Cmnd 7101, February 1978.

ESTIMATES OF OVERALL POTENTIALS

Department of Energy Expenditure in £M on Renewable Energy Research and Development

	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
Wind				0.3	0.6	0.8	0.9	2.5	2.5	4.8	5.4
Wave				1.8	3.0	3.3	4.4	3.1	1.0	0.4	0.4
Geothermal aquifers				0.2	1.3	1.7	2.6	1.5	1.8	1.1	0.3
Geothermal hot dry rocks	0.5	0.3	1.3	—	—	0.6	5.6	3.0	2.9	4.6	3.5
Solar				0.2	1.2	0.9	0.7	1.4	0.9	0.5	0.7
Biomass				—	0.1	0.3	0.4	0.7	0.3	0.2	0.8
Tide				—	0.6	1.4	0.4	—	—	0.3	0.1
ETSU services		0.7	1.2	1.1	1.4	2.2	2.3	2.0	1.9	2.1	2.0
Total	*0.5	*1.0	*2.5	3.6	8.2	11.2	17.3	14.2	11.3	14.0	13.2

*Includes energy conservation Research and Development.

(Source: Department of Energy).

Proportional spending on renewable energy research and development. Figures are in millions of \$US. Source: International Energy Agency, Paris 1984.

Country	i. Total R&D expenditure on energy	ii. R&D spending on renewables	ii as % of i
UK	411	19	4.7
Japan	1446	83	5.8
US	2359	239	10.2
CEC	409	45	11.1
Norway	24	3	12.4
Denmark	12	3	25.0
Sweden	110	33	30.0

NUCLEAR R, D&D	£ millions					
	1980/1	1981/2	1982/3	1983/4	1984/5	1985/6
UK	186.2	205.4	214.8	203.8	196.2	189.6

This paper was originally presented to the Wave Energy Group of the Open University.

HOUSE OF COMMONS

APPENDIX 3

Second Report from the ENERGY COMMITTEE ENERGY RESEARCH, DEVELOPMENT AND DEMONSTRATION IN THE UNITED KINGDOM

APPENDIX 3

The Assessment of Wave Power by the Department of Energy

Paper by Dr Denis Mollison of Heriot-Watt University & Edinburgh Wave Power Project

1. Introduction

The current round of assessment of wave power by the Department of Energy differs from previous rounds in two important ways. First, the criteria for justifying further support were changed without warning to a direct comparison between estimated costs of different renewable energy sources; this is unsound both in theory (see Section 1) and in practice (Sections 2-4). Secondly, the conduct of the assessment has been like something out of "Alice through the Looking Glass": the decisions were taken (early in 1982) before the reports on which they were based had been carefully considered (see Sections 3 and 4) or in the case of the crucial consultant's report on Wave power, even written (see Section 5).

As might be expected from this, the Department of Energy's detailed report on the wave energy programme 1976-82 presents a pessimistic view of future prospects (see Section 6). It includes several clear instances of omission or distortion of facts which do not fit in with this official pessimism.

2. Criteria for assessment

In December 1980 the UK wave energy community were set a target of 5p/kWh for the next round of assessment. The cost referred to here is not what one might hope to achieve ultimately, but a conservative estimate of the cost of a current design. If this target were achieved, it was promised that steady support for further work would follow.

However, the criteria actually adopted in March 1982 were quite different: cost estimates were compared with those for other renewable energy technologies. These comparisons were unsound in practice (see Section 3), but why make them at all? Wave power is still at an early stage, where indicative costings (as defined in the previous paragraph) are useful, but should not be confused with the limits of what may be achieved, which have clearly not yet been reached.

Research into the Fast Breeder and Fusion reactors is not judged in this way: the FBR will not be economic until the next century, while fusion reactors are not even technically feasible as yet. Nonetheless, they have steady support assured at a level far greater than the entire budget for renewable energy technology.

3. ETSU R13: "Strategic Review of the Renewable Energy Technologies"

A basic flaw in this paper is the claim that the various electricity producing renewables have been compared on a common basis, and that it is quite clear-cut that wave power is the most expensive (see Para 29 on page 20).

First, the claim that they have been assessed on a comparable basis is simply untrue. Wave power has always had its costs assessed by the Department of Energy's civil engineering consultants, Rendel, Palmer & Tritton, and it is not fair to compare them with estimates prepared on a quite different basis. For instance, the wind energy section includes estimates by a large US company hoping to open up a market for its produce; it is easy to guess that such estimates would be multiplied by two or three if subjected to RPT's pessimistic scrutiny.

Secondly, the ranges of costs quoted overlap, so that even if they are accepted, the report's conclusion that wave power is definitely the most expensive is incorrect.

4. ETSU R14: "Contribution of Renewable Energy Technologies to Future Energy Requirements"

This Report by the Chief Scientist's Group is yet worse. Any assessment of the contribution from renewables will rest largely on a comparison between their likely costs and the costs of established sources such as coal and nuclear. This report considers a range of scenarios with varying cost forecasts for the established sources; yet for the renewables, where costs are in most cases less easy to forecast, they use a single set of estimates. This clearly makes for an inadequate investigation. This statistical illiteracy: a lack of plain commonsense when assessing uncertainties: is very worrying, particularly in a Chief Scientist's Group which one would expect to be of high calibre.

Still worse, the single estimate which they use for each renewable is the arithmetic mean of the highest and lowest values quoted in the "Strategic Review". This assumption (which is hidden in Para 190 on page 70 of the report) makes little sense for any of the renewables, but is particularly nonsensical for wave energy.

For waves, the range given in the "Strategic Review" was 4 to 12 pence/kWh; the width of this range was mainly due to differences between designs, with the most economical designs estimated at about 4 pence, the least was at about 12. (It is worth noting that one of the latter, the NEL design, is now being supported by the Dept of Industry with £300,000 for a feasibility study; this suggests that the DTI agree that RPT's figures may be pessimistic as estimates for the eventual cost of wave power.)

Thus the Chief Scientist's Group simply took 8p/kWh as the definitive cost of wave power devices. Presumably if a design producing free electricity had been among those considered, wave power would still have been rejected as costing "on average" 6p/kWh! I hope no further comment is needed on this report.

5. RPT's report

The recommendation in the "Strategic Review" to cut wave power funding, which was approved by ACORD in March 1982, was a provisional recommendation ("it is strongly recommended that no decisions are made before the detailed device cost review has been completed", Para 246, page 100). However, now that the device cost review is completed, we find (Para 9.2 of RPT's report on the Duck): "As a result of the economic predictions of earlier assessments, wave energy is no longer considered to be a priority area for UK R&D, and in this situation it is difficult to see any way forward for this device". One cannot but admire this neat device whereby each party passes the buck to the other - it is worthy of the Red Queen in Lewis Carroll's "Through the Looking Glass".

6. The Dept of Energy's Wave Energy review paper, 1984 (in draft)

(a) Presentation is ludicrously pessimistic on occasion: for instance, it presents the seasonal variation in the resource so as to make it appear that the relatively greater wave energy resource in winter is a bad thing!

(b) Comparative costings use 1982 figures except for wave energy, where pessimistic 1984 figures (9p/kWh upwards) are used: estimates for some other sources of energy have risen significantly over this period.

(c) These 1984 figures omit the Duck, although the D of E are now conceding the reliability argument, and should therefore allow a figure of at worst about 5p for the Duck. (Other devices may be being similarly ill treated, but this is the example with which I am best acquainted.)

7. Conclusions

The UK is one of a number of countries with a substantial wave power resource. It is renewable, with few environmental problems. We cannot yet predict how cheaply it can be harnessed, but there is quite a good chance that it will be economic.

The UK still has a world lead in wave power research. For this to be maintained requires a research programme with steady support, at around £1m per annum, for a number of years, building up to a prototype (costing of the order of £10m) if and when a design of sufficient economic and technical promise is ready (5-15 years?). It also requires that the Government stops knocking wave power: the removal of control from the so-called Energy Technology Support Unit at Harwell would be a powerful morale boost for the wave energy community.

from a seminar on Wave Energy organised by the Alternative Technology Group and held at the Open University on 29 June 1983.

Charter for Renewable energy

Britain has amongst the world's best wind, wave and tidal energy potential — and an industrial infrastructure well suited to the development of the necessary energy conversion technologies. So says the **CHARTER FOR RENEWABLE ENERGY**, calling for serious investment in these fields. An edited version of the charter follows.

As North Sea oil and gas reserves are depleted, the renewable resources could take over with the money earned from North Sea oil and gas being used to help to move towards a sustainable energy economy, based on a diverse range of secure, indigenous and non-polluting energy sources.

Sensibly targeted investment in renewable energy projects can ensure that employment is created in just those areas and regions hardest hit by the recession — e.g. shipbuilding (wave power), aerospace (wind), power engineering (tidal).

Such a programme will take time to develop and complete — and it will have to be integrated with programmes of investment in energy conservation, and the energy efficient and environmentally sound exploitation of our remaining fossil fuels.

Clearly, coal will and should remain our major energy source into the far future — with efficiency of use improved through the adoption of combined heat and power. Flue gas scrubbers and fluidised-bed combustion techniques are necessary to reduce acid pollution.

But renewables can begin to make an important contribution immediately — more necessary if the development of nuclear power is further constrained.

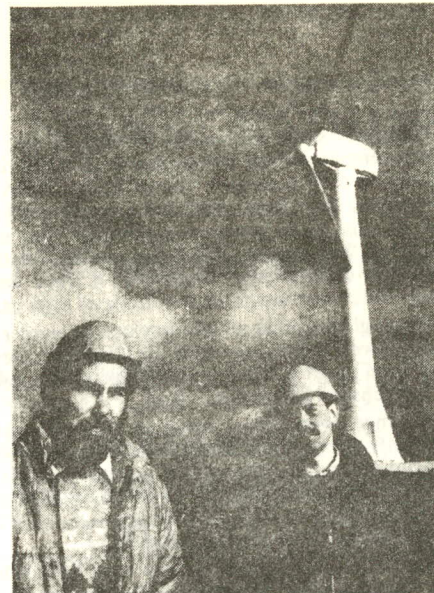
Renewable targets

The following is a reasonable, realistic set of targets for the UK government over the next decade:

2GW* of installed on-land wind turbine capacity, in "wind farms", feeding the National Grid. Howdens and the Wind Energy Group in the UK manufacture suitable systems which are already being used in the USA. There a total of 1.2GW has already been installed, 500MW* within one year. There would also be an important role for smaller, independent, wind turbines in remote areas, or for agricultural use.

Clearly environmental factors will need to be considered but windpower is currently one of the most cost-effective means of generating electricity. Further research should improve reliability and performance.

Subsequently we should install up to **2GW of off-shore wind-turbine capacity**. Off-shore wind could in principle provide



JOHN ABERDEIN, PPC for Orkney and Shetland (left), and MIKE MALINA, co-chair, SERA, showing the way forward from nuclear power at the site of the three MegaWatt Wind Generator, Burger Hill, Orkney.

up to 50% of our current electricity requirements — at competitive prices!

A commitment to one or more tidal barrages, with the Severn or Mersey Estuaries being perhaps the most obvious sites. Both could easily be completed by the year 2000. However the environmental impact of such schemes needs to be assessed in detail.

There are 11 possible sites for tidal barrages with a total potential of some 15% of current UK electricity requirements. The Severn Barrage would be the largest single scheme (7GW installed, supplying some 6% of the current UK electricity requirement), and also promises the cheapest electricity (less than 3p per unit). However this does not include environmental protection costs.

Re-funding of the UK Wave Energy Programme with at least £50 million allocated immediately to the development of a number of full-scale prototype systems. Leading contenders are the *Oscillating Water Column*, the *Ring Clam* and the *Tapchan*. The OWC and the Tapchan are already operating successfully in Norway.

Other devices which are not yet at this stage but would benefit from research funding include the *Salter Duck*, the *Belfast Buoy*, the *Vickers Duct* and the *Bristol Cylinder*. This programme could expand rapidly subsequently and lead to a significant contribution to UK electricity supplies — up to 25% of current demand.

Expanded funding for solar, biofuel and geothermal developments. Biofuels and geothermal energy represent amongst Britain's largest potential sources — while the utilisation of direct solar energy can play a significant role in fuel saving in domestic, industrial and commercial buildings. The ultimate potential of direct and indirect solar has been put at 10% of

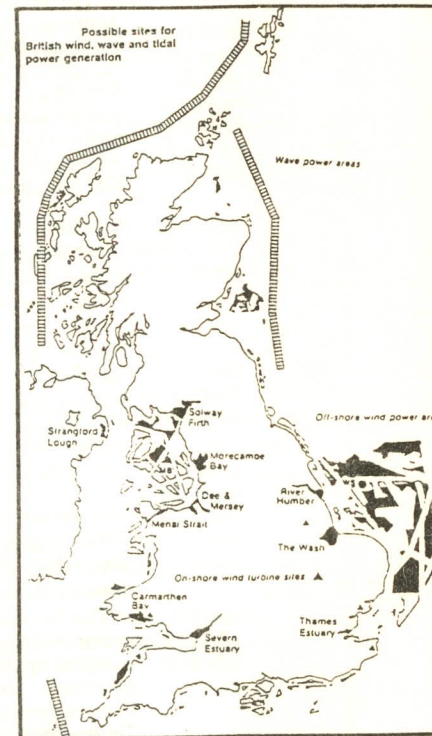
the UK total primary energy requirements, in the form of heat, while geothermal sources might well supply up to 10% of our electricity.

The next stage

Obviously there are many as yet unresolved environmental, technical and institutional issues. These include public and private sector roles, national and local programmes, etc. Most important is the creation of a positive climate for renewable energy developments — with some clear targets and a firm sense of purpose.

We suggest that a **Renewable Energy Agency**, outside the Department of Energy, but responsible to the House of Commons via the Secretary of State for Energy, be set up.

This could sponsor research into environmental impacts; manage demonstration projects and technical research; examine institutional and other barriers to the implementation of renewable energy technologies; propose legislation to remove such barriers.



We hope that the proposals made in this Charter will interest industrial, environmental and political organisations, and will stimulate the rapid development of what we believe are the energy technologies of the future.

Readers interested in sponsoring the Charter for Renewable Energy should write to the Charter at 9 Poland St., London W1V 3DG.

*1 gigawatt (GW) = 1 million kilowatts (kW) — enough power to keep one million one bar electric fires burning.

*1 megawatt (MW) = one thousand kilowatts.

natta Network for Alternative Technology and Technology Assessment

NATTA - the Network for Alternative Technology and Technology Assessment - is an independent national coalition of people active in the renewable energy and allied fields and concerned with the development of solar, wind, wave, tidal power, recycling etc. It produces a bi-monthly 30-page newsletter packed full of news and information ('hard information on soft technology') drawing on information sent in by members. Individual membership costs £6 p.a., £8 (waged) and entitles you to receive the newsletter. (Libraries, institutes and affiliated groups pay £20 p.a.). National conferences are held each year which provide an opportunity for members to shape overall policy. Currently the Network, which has some 400 members, is being administered by one of its affiliates, the Appropriate Technology Group at the Open University.

Affiliated organisations include: the Centre for Alternative Technology (Wales); the Northumbrian Energy Workshop; ERRL (linked to FOE); SCRAM/Information Service on Energy (Scotland); and SERA. We liaise closely with many other groups, including UCAT, NEW, ITDG, PARLIGAES, (PAEG) UDAP, SCEPTRE, CAITS and LEEN.

NATTA can supply posters, speakers, a slide and speaker's notes set, and special technical reports. We also operate technical advice and careers advisory services. Our introductory publication is entitled 'Alternative Technology: an answer to the energy crisis?' (80p). There is an active 'Women and Technology' sub group, and a London NATTA regional group.

The aims of NATTA are:

1. To promote the development of alternative technology (renewable energy sources, alternative food production, transport, building construction and design, work organisation etc.) through its own publicity, direct lobbying and liaison with environmental and political pressure groups.
2. To support and initiate small scale local level research projects in the AT field by providing a national level organisation capable of attracting, or co-ordinating, funding from official sources and foundations, on behalf of its members.
3. To provide a communication channel within the AT movement, as as to avoid duplication of effort and to ensure the rational, socially and environmentally sound development of AT within the UK, at both community and national level.
4. To co-ordinate and if necessary publish critical assessments of 'official' AT projects and programmes, drawing on the expertise of its members.

NATTA is a voluntary non-profit organisation - so we welcome donations.



£1

Natta, c/o Alternative Technology Group, Faculty of Technology,
The Open University, Walton Hall, Milton Keynes, Bucks.