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RENEWABLE ENERGY FOUNDATION

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Dr Marc Rands
The Royal Society of Edinburgh
22-26 George Street
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15 July 2005

Dear Dr Rands:

Issues for Scotland's Energy Supply

On behalf of the Renewable Energy Foundation, I am submitting the accompanying files as Evidence for the consideration of the Royal Society of Edinburgh's independent inquiry into Scotland's energy supply.

The Renewable Energy Foundation is a not-for-profit organisation and a registered charity. The purpose of the Foundation is to commission research and publish data leading to a full and informed debate with regard to the potential for renewable energy, and thus to ensure that deployment of renewables is balanced, effective, and truly sustainable.

In responding to your request for evidence, the approach we have taken is to answer the consultation questions in short form in this covering document, and then to attach various documents generated by the Foundation and its consultants, or funded by the Foundation, which appear to us relevant to the issues in hand.

The documents attached are:¹

- 1. The Renewable Energy Foundation's manifesto for 2005, *Renewable Energy: The Need for Balance and Quality*.
- 2. Hugh Sharman, 'Why Wind Works for Denmark', *Proceedings of the Institution of Civil Engineering*, May 2005. This article was commissioned by the ICE, and wholly funded by the Renewable Energy Foundation. A second part is due for publication in November 2005.

¹ The documents are supplied as separate pdf files, named ref.for.rse.app1.pdf to ref.for.rse.app8.ppt respectively

- 3. Hugh Sharman, 'Why the UK should build no more than 10 GW of Wind Capacity', forthcoming in the *Proceedings of the Institution of Civil Engineering* in November.
- 4. David White, BSc, C Eng, F I Chem E, *Reduction in Carbon Dioxide Emissions: Estimating the Potential Contribution from Wind-Power* (December 2004). Report commissioned and published by the Renewable Energy Foundation as a contribution to the debate around the likely savings of CO₂ from randomly intermittent generation.
- 5. The Renewable Energy Foundation and Hugh Sharman, '2005–2006 Review Of The Renewables Obligation' (Oct. 2004). A response to the DTI's preliminary consultation on the RO.
- 6. The Renewable Energy Foundation and James Oswald, *The Scottish Executive 2005–2006 Review of the Renewables Obligation (Scotland) Order* (June 2005). This document was submitted to the Scottish Executive as part of the consultation on the RO, and a similar, though slightly shorter version was submitted to the DTI.
- 7. Renewable Energy Foundation, *Carbon Abatement Technologies (CAT): A Strategy For Fossil Fuel Power Generation* (Oct. 2004). This document was submitted to the DTI consultation on Carbon Capture Technologies.
- 8. 'Renewable Energy in Scotland: Principles and Limits', Presentation to the Highland Council, 13 April 2005.

The data and arguments presented in these texts are the foundations beneath the responses provided below, and may be read in conjunction with them.

The Foundation very much hopes that the submitted material will assist the Inquiry in its deliberations, and would be pleased to answer further questions, or to fund the appearance of any of its consultants before the committee.

Yours sincerely,

John Constable.

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RENEWABLE ENERGY FOUNDATION

Renewable Energy Foundation Response to the Royal Society of Edinburgh's Consultation Questions in relation to 'Issues for Scotland's Energy Future'.

INTRODUCTION

The Renewable Energy Foundation has not attempted to address all the questions outlined in the Royal Society's consultation document, or all aspects of those questions selected. Instead, we have concentrated on those issues most nearly relating to the deployment of renewables, and the ways in which flaws in the current renewable energy strategy impinge more generally on the overall energy system. The responses given here are reflections of REF's overall position, and are dependent on arguments and data offered at greater length and in discursive form in the documents which accompany this submission. Numerous cross references are included.

GENERAL QUESTIONS

How should Scotland provide for its energy needs over the next 5, 15, 30, 45 years, in the context of the likely UK, European and global energy environment?

This overwhelming question, may be cut down to size, by playing upon the word 'how', taking it initially as a simple request for a description of those qualities which must be exhibited by any solution eventually selected. If asked, 'How should a car be driven on Scottish roads?', one response would be 'Safely, with due attention to local conditions, and consideration for other road users', with the specifics of exactly *how*, in concrete terms, these desirable abstracts should be realised, being deferred for subsequent discussion. Similarly, we might, in answer to the question as to how Scotland should provide for its energy needs, respond with a string of adverbs saying that it should do so

Securely

Reliably

Economically

Cleanly

Sustainably

This, in effect, is what the Government's *Energy White Paper* (2003) does, though the sequence in which it presents these topics suggests a lack of deep consideration of how

any of them are to be securely achieved, a point we discuss in detail in the Renewable Energy Foundation manifesto, *Renewable Energy: The Need for Balance and Quality*. Our argument in that text is that correctly prioritising these qualities for achievement is not necessarily to diminish the importance of any one of them, but to recognise that in order to be successful across so broad a range, it is a question of simple practicality to recognise that some qualities are dependent upon others. As we express this in the manifesto:

- If security of the primary sources cannot be guaranteed, then reliability at the point of use is questionable;
- If security and reliability of supply are compromised, then our economy will be damaged;
- If our energy supplies are insecure, unreliable, and unaffordable we will be unable to maintain and develop the high technological economy necessary to support our social aims and control the emissions of a large urban and industrial society.
- If the energy system in its total sense is unclean, as is seen in the CIS countries and parts of the developing world, then our social aims will be compromised by ill health in our population, for which there is growing evidence even in the UK (e.g. childhood asthma).
- And finally, if we cannot achieve any of the foregoing aims, our overall energy policy will be unsustainable, and the well-being of the United Kingdom and its people will be poorly served in the short, medium, and longer term.

If anything is, *prima facie*, evident with regard to the achievement of security of supply, it is that a broad range of primary sources must be built into and planned for. We are particularly concerned, for example, that the tendency towards a heavy predominance of gas in the generation of electricity is imprudent. Certain Governmental advisors, Professor Grubb for example, feel that a diversity of gas sources is functionally equivalent to fuel diversity, but this is not the view taken by many industry insiders, and it is not the view of the Renewable Energy Foundation.

In view of this, our first response to the question of how Scotland should provide for its energy needs can be augmented with the recommendation that Scotland's energy supplies should be produced from a diversity of primary fuels and obtained from a diversity of sources.

We note that renewable energy has a significant role to play in such a balanced portfolio, but equally, it must be emphasised that in the short and medium term that contribution can, for practical reasons, only be limited. Furthermore, in the longer term positive attitudes towards green energy must be tempered by realistic acknowledgment that the scale of its contribution may be limited by the inherent character of many

renewable sources, several of which are intermittent and some of which are randomly intermittent with regard to patterns of human need, thus necessitating deployment of energy storage on scales as yet uneconomic or uninvented. The costs of renewable energy are a further limiting factor which must be squarely faced by all concerned.

The reliability of energy provision hardly needs to be expanded upon, but there seems to be very little understanding amongst political decision makers that certain parts of the energy supply system, and electricity is the key example, are dependent on successful integration. Consequently, the 'team-working' qualities of any particular technology are relevant considerations. This is particularly important in relation to renewable energy, where, while all have something to offer, not all are equally valuable as team-workers. Consequently, the scale and pace of deployment needs to be carefully informed by qualitative considerations, not the satisfaction of crudely quantitative targets.

This is no mere theoretical anxiety. The current renewable energy policy has created an unprecedented drive for one technology, and we are particularly concerned that the scale of onshore wind development in Scotland at present is well beyond that at which wind can contribute to Scotland's energy future without causing additional problems and unreasonable costs. National Grid Transco has recently confirmed in a public presentation that some 17,000 MW of wind is currently applying for grid connection in Scotland.² Bearing in mind that Scottish peak demand is approximately 6,000 MW, and the interconnectors running south amount to only 2,200 MW, it is clear that incorporating such a vast wind carpet could only be managed with very large investment in grid expansion, an expansion which NGT itself currently costs at approximately £250,000 per installed MW (i.e. over £4 billion in total). It is not clear that this expenditure, and the environmental impact of the wind power stations and their associated grid, is proportionate to the benefit returned.

It is presumably unlikely that more than a fraction of this 17,000 MW will actually be constructed, but even only 30% of that total would represent a very large wind development programme, and we are particularly concerned that such unduly heavy commitment to undispachable intermittent generation may expose the Scottish electricity system to significant balancing problems. We note, for example, that an unexpected storm in West Denmark on the 8th of January 2005 caused the entire wind carpet to shut down to prevent mechanical damage, thus reducing its output from close to its theoretical maximum to close to zero in less than eight hours. Eltra, the Danish grid operator, successfully managed this event, and maintained uninterrupted supplies to the consumer, since, as is normal in Denmark, it was exporting wind energy at the time, and therefore had only to reduce these exports, and rely on the thermal plant which was already operating. These points are illustrated in the accompanying presentation made by the Renewable Energy Foundation to the Highland Council on the 13th of April 2005.³ The high winds of Scotland are, quite properly, seen as a resource, but it should be

² Lewis Dale, 'The Energy White Paper - Will it Deliver?', IEE seminar, 19 May 2005, at the Royal Society.

³ This presentation was made in advance of NGT's official confirmation of the facts, and at a time when the figure for wind applying for connection was 16,000 MW.

borne in mind that they also mean that tripping during storms will be more frequent than in low wind areas, and thus the management of the wind carpet may present technical problems which are to a considerable degree novel.

We note this imbalance in renewable energy deployment in Scotland since it is indicative of a worrying lack of balance and integration in the overall energy supply policy in Scotland. In the renewables arena the causes are to be found in faults in the artificial market, the Renewables Obligation Scotland, which has directed investment towards one, low-merit, technology, and simultaneously excluded other technologies and stifled innovation. Problems in the overall energy supply system have other and diverse causes, particularly the operation of the British Electricity Trading and Transmission Arrangements, but a common thread may be detected, namely an unhappy combination of free market and interventionist strategies.

We have noted that Scotland's energy supply needs to be integrated if it is to be secure, reliable, economic, clean and sustainable. However, it is not clear if a system with these qualities will most effectively result from free market activity or under intense legislative guidance. While the action of the free market can produce apparently designed results, the desirable integrated system, this seems to become progressively less likely when the market acts under the partial steerage of interventionist legislation, such as the Renewables Obligation Scotland (detailed criticism of which we have offered to the Scottish Executive consultation on the RO, the text of which accompanies this submission).

The Renewable Energy Foundation does not have a dogmatic policy on the beneficial nature of the free market. However, we are not convinced that the present mixed strategy, which creates the appearance of free market activity without the deep substance, may be rather less satisfactory than either:

- a more honest and forthright governmental management of the energy market, or
- a more rigorously non-interventionist approach.

We believe that this issue is one that the Royal Society of Edinburgh might fruitfully consider.

Should Scotland aim to be self-sufficient in energy in general, and in electricity in particular, despite trends towards interdependence within Europe?

On this point the Renewable Energy Foundation wishes to make only two, cautionary, points.

Firstly, while renewables have much to offer to Scotland's energy future, it would be most unwise to ask more of them than can be delivered economically and in a timely fashion. Well-intentioned, though ideologically motivated, projections of a predominantly renewable energy future for Scotland, or the UK, are almost certainly impractical, and will only condemn the renewables industry to inevitable failure.

Secondly, while 'self-sufficiency' is an attractive goal, and seems to lead in an uncomplicated way to security of supply, the concept is liable to lead to crude policy if it is not recognized that it is only the sense of *net* self-sufficiency that it enters the realm of practical action. This is in fact only to say that *absolute autonomy* is neither feasible nor practical. When this is recognized there is no conflict between interdependence within Europe and the desire for self-sufficiency. Scotland can aim for net self-sufficiency in energy, exporting and importing as appropriate and according to market advantage.

However, this net self-sufficiency must be sufficiently *robust* that reliability of energy supplies, and security of supply are both reasonably certain. Storage and stockpiling of reserves would, thus, not necessarily make Scotland autonomously self-sufficient, but it would offer a buffer to enable functional self-sufficiency for a period of time. It is reasonable to wonder if the operation of the free market is able to provide such a nuanced system, and we believe that the Royal Society might turn its attention to this issue.

What are the possible implications and consequences for Scotland, and the UK, of becoming increasingly reliant on imported oil and gas for their energy needs?

We have already noted some of our concerns on this point above, and further details are given in our manifesto, *Renewable Energy: The Need for Balance and Quality*. We wish to repeated here the observation that while renewables have something to offer in limiting dependence on imported hydrocarbons, both through the generation of electricity and the production of transport and heating fuel from organic sources, it is unhelpful to expect too much of them, and counterproductive to be insensitive to qualitative distinctions between them. We note, for example, that over-deployment of randomly intermittent renewables, such as wind power, to exclusion of firm generating plant, such as tidal and biomass, may actually make the overall system more dependent, not less, on fossil systems.

We draw your attention to the rich body of practical experience now being comprehensively reported by the German grid operator E.ON Netz, whose *Wind Reports* for 2004 and 2005 are crucial documents for your consideration. In a speech given by the CEO of E.ON Netz, Martin Fuchs, on the 16th of June 2005, it was observed that 'wind power plants with a 48,000 MW output will only replace a secured 2,000 MW of thermally generated power – the equivalent of just two new-generation coal blocks.' This level of capacity credit, effectively zero, is deeply disappointing, but must be faced.

What is the feasibility, availability, reliability, sustainability, efficiency, capacity and risks of the different energy generation technologies?

Remarks on this issue have already been made above, and are found elsewhere in our submitted documents. We add here, that we believe that the Royal Society of Edinburgh's inquiries would be greatly assisted, in the field of renewables, if they paid particular attention to the already very extensive renewables deployment in Europe. We believe that the experience in Denmark and Germany is particularly relevant for UK

policy, and make reference to a study conducted with Renewable Energy Foundation funding, 'Why Wind Works for Denmark', by the consultant Hugh Sharman. This study was commissioned initially by the journal of the Institution of Civil Engineers, and was supported by the Foundation as part of a collaborative venture. The first part of the article has just been published, and the second, provisionally entitled 'Why the UK should build no more than 10 GW of Wind Capacity', is now passing through the proof stage. We note that this material is less positive about the prospects for wind than much material currently emerging from the wind industry itself, or in texts over which it has had considerable influence. We note, for example, that the recent and widely publicised Sustainable Development Commission report *Wind Power in the UK* (the technical sections of which were written by the retained consultant of the British Wind Energy Association, David Milborrow⁴) is unreasonably optimistic about the prospects for wind. Our own data and the material produced by our consultants will give grounds for this statement, but we would wish the Inquiry to note that we are by no means the only source of criticism. Mr Malcolm Keay, one of the UK's leading energy analysts, and now of the Oxford Institute for Energy Studies, has issued a carefully reasoned and extremely incisive critique of the SDC's report, in which he detects many flaws and an overall tendency to 'boosterism'.⁵ We concur with Mr Keay's findings, and urge the Royal Society's Inquiry to ensure that it consults as widely as possible on this matter so that it may avoid the pitfall into which the Sustainable Development Commission has fallen.

The Foundation believes that while the potential for renewable energy in Scotland is considerable, a period of reflection on the relative merits of the various technologies is required. This is particularly important given the fact, now increasingly appreciated, that the role of the United Kingdom in addressing climate change is not quantitative, but qualitative. The UK emits approximately 2% only of the global total of carbon dioxide. Even if the whole country were to become, magically, a zero-carbon state, a reduction of 550 million tonnes per year, this would have no significant effect on the steadily increasing global total of 24,000 million tonnes per year.

Therefore, we conclude that the UK's role is to reduce emissions in such a way as to present an economically compelling example to the developing world, such that China, say, looks at our example and, seeing that emissions can be reduced without harm to the economy or the environment, decides to adopt similar strategies, perhaps purchasing technology and know-how from the UK.

To put this in a different way, it is quite crucial that our assessments of the 'feasibility, availability, reliability, sustainability, efficiency, capacity and risks' of the various technologies are as thorough as they may be, and driven by concerns with

⁴ Data provided to Renewable Energy Foundation in response to a formal request to the Sustainable Development Commission under the Freedom of Information Act.

⁵ Malcolm Keay, 'Wind Power in the UK: Has the Sustainable Development Commission Got it Right?', Oxford Energy Comment (May 2005). Available from the Oxford Institute for Energy Studies: <http://www.oxfordenergy.org/>.

regard to economic practicality. A naive endorsement of renewable technologies, without any regard to their intrinsic qualities and merits, will impress no one.

In pursuit of this we urge the Inquiry to obtain comprehensive data regarding the performance of current renewable energy installations in Scotland, and elsewhere in the UK if this is considered relevant, so that the character of their output, on the time scales relevant to grid balancing, can be estimated.

There is currently data emerging in Europe that suggests the possibility for 'Extreme Spiking' in areas with strong winds, and these are highly relevant to the planning, and while Scottish wind installations are likely to return relatively favourable overall load factors the generation profile on short time scales may present hitherto unappreciated grid integration challenges. In connection with this we urge the Inquiry to add a further area to its considerations, namely the use of energy storage systems. As is well-known, electricity cannot at present be stored on the industrial scale. However, there are energy storage solutions, the flow battery for example, which, though arguably inapplicable at national level, might have something to offer to remote communities, such as islands, wishing to remove themselves from the grid.

The Foundation will leave detailed discussions of the conventional technologies to those individuals and organisations with appropriate knowledge, mentioning only that we recognize that however attractive it may be to postulate a predominantly 'renewable' future for Scotland, this is neither practical nor responsible. Conventional generation will be with us for the foreseeable future, and this fact has a considerable bearing on our assessment of the way in which we should develop renewable technologies. Simply put, we argue that we must think of the electricity generation portfolio as an integrated system, and individual power stations, and technologies, as team-workers. Consequently, we suggest that a major principle in the evaluation of renewable technologies is the degree to which they are effective collaborators within the group.

We have made this argument at length in various of our documents, and will here only recapitulate the main conclusion which emerges. Those renewable technologies which deserve most encouragement are those which are capable of delivering 'firm' power (in the technical sense of timely energy supplied at a certain rate). We regard the Renewables Obligation as flawed in-so-far as it fails to offer more to technologies which themselves have more to offer, and thus create a situation in which investors simply seek the cheapest qualifying ticket for the subsidy stream. As is well known, this cheapest ticket is onshore windpower. So long as this situation prevails, investors will not support the development of more demanding technologies, such as marine tidal systems and biomass.

What are the economic issues of capital investment in the supply and distribution of energy that need to be considered?

As already noted above, the cost of expanding and reinforcing the Scottish grid to accommodate and transmit renewable energy to English centres of consumption is extremely high in both financial and environmental terms. It must be questioned whether

this is a reasonable investment, and we note that the current complaints that renewable energy is being inappropriately charged for grid use may be misplaced. A biomass generator, which can be situated close to a centre of consumption, and provide waste heat for district heating, is intrinsically more valuable than a large wind installation at a very remote location requiring extremely expensive and underutilised grid expansion. It is not unreasonable to expect those proposing remote wind installations to pay proportionately for this grid connection.

ENERGY DEMAND

What will the impact of energy availability and price be on the demand for energy by commerce and industry in Scotland?

This question lies beyond the remit and expertise of the Renewable Energy Foundation, but we wish to note that German studies are beginning to show that increased electricity prices, resulting from renewable energy legislation, causes the export of jobs from high consuming industries such as aluminium smelting (and possibly paper production). It is imperative that this situation is avoided in Scotland, and we would suggest that the Inquiry attempts to acquire the latest information from Germany on this matter.

What are the likely trends in the demand for energy for transportation in Scotland? What is the likely time-scale and scope for substituting other power sources for fossil fuels? What are the likely investment costs?

Transport in the UK as a whole is projected to grow rapidly, and Scotland seems unlikely to be able to exhibit a different trend. The attraction of biofuels, and hydrogen, are obvious, but it seems necessary, again, at this point to caution against any expectations of rapidly substantial deployment of renewable energy for fuel, and certainly for renewably generated hydrogen. Currently, biofuels are, in our view, under-encouraged, but remedying this situation needs careful thought. We remain dubious with regard to the use of a Renewable Fuel obligation to stimulate rapid adoption, partly because the example of the Renewables Obligation for electricity is not encouraging. We suspect that careful analysis would reveal that a more substantial tax break, guaranteed over a longer period, would be much more likely to produce a fruitful competitive market between techniques, thus ensuring that the renewable fuels industry in Scotland is effective and economic.

At present, the timescales for producing an organically sourced fuel stream for transport are entirely dependent on legislative action, and could be shortened considerably, but this will only be worthwhile if the technologies adopted are those with long term futures. Sheer speed for its own sake is to be discouraged.

ENVIRONMENTAL AND SOCIAL ISSUES

What are the environmental concerns that need to be taken into account, in terms of the impact on ecological and other natural resources, as well as waste management and impacts on the landscape?

The impacts of various energy technologies are too well-known to need much comment here. However, we wish to note a fundamental principle of planning law that we feel may be obscured in the overheated and poorly informed debate about low-carbon energy. At the heart of every planning decision is the balance between the benefits and disadvantages of a proposal. Clear analysis of both is therefore crucial if the decision is to be just and appropriate, and, most importantly, if the decision is to contribute to the creation of the economically compelling advertisement for low-carbon energy, which we have noted above is the UK's true role.

In our view, and that of many other experts, it is extremely difficult for those responsible for making these decisions to obtain sufficiently accurate information. There is a regrettable tendency in the renewable energy industry to exaggerate the likely benefits, and to dismiss or illegitimately diminish any disadvantages. This is particularly true in terms of Carbon-Dioxide saved, where renewable generators tend 1. to make maximally favourable assumptions as to conventional plant displaced, 2. fail to put their proposed savings in national and global context. We believe that the Royal Society's Inquiry might contribute to this by itself providing a rigorously grounded commentary on this matter, thus offering a benchmark.

Other areas of impact which are currently mishandled at planning include the impact on bird- and bat-life, and noise effects on local communities. The first of these is being closely studied by other groups, and doubtless the Royal Society will be taking evidence from them, but the issue of noise nuisance is extremely vexed, and there is much poor and misleading evidence available. We note, in particular, that the recent report by the Sustainable Development Commission, referred to above, is distinctly misleading in its treatment of the likelihood of noise nuisances for nearby residents consequent on wind development. Together with this submission we are including a copy of a letter (Appendix 9) sent by one of Europe's leading empirical experts on wind turbine noise, G. P. van den Berg of the University of Groningen, to the Sustainable Development Commission. As the Inquiry will note, Van den Berg observes that the SDC's report is neither thorough nor impartial with regard to this issue.

Can the objectives of environment improvement and economic growth both be met without a major increase in energy costs? What steps should be taken to enable an informed debate on the issue?

It seems reasonable to expect that energy costs will rise regardless of any attempt to reduce emissions or increase the proportion of renewable energy. Thus, we interpret the question as meaning 'without a major increase in energy costs over and above those determined by the market'. The blunt answer to this is *no*.

Even its most ardent supporters should acknowledge that renewable energy is expensive. Encouraging research and adoption at this early stage will inevitably involve some degree of expenditure beyond the cost of conventional generation. As is suggested by our arguments above, we do not believe that rapid adoption is desirable for its own sake. Therefore, the justification of the premium cost being paid to encourage renewables must be that the value of these renewables is high and has a long-term future. In our view this must mean that **renewables, particularly for electricity, should favoured if they are capable of 'firm' generation**, and it is awareness of the intrinsic merits of each technology that will ensure an informed debate on this matter.

Alternatively, we might say that **while additional cost cannot be avoided, we should endeavour to ensure that this cost is an investment**.

What are the social values and consequences of energy generation and distribution on employment opportunities, health, and energy affordability?

We have noted above that developers proposing renewable developments tend to exaggerate the benefits of their developments. It is notable that while all developers are willing to claim that their chosen industry will create jobs, closer examination of the business does not always substantiate this claim. One of our points, made in our criticism of the Renewables Obligation as submitted to the Scottish Executive, was that the current form of subsidy support will tend to suppress domestic innovation and industry, and favour the importing of established, low cost, technologies from abroad. Thus, while biomass, biofuels, and the marine renewables industry, such as tidal systems, and to a lesser degree offshore wind, does offer some promise of favourable employment outcomes for Scotland, there is little prospect of the onshore wind industry creating anything more than short term employment in construction, and very limited employment thereafter in maintenance.

It is therefore most important to ensure that nuanced discrimination is necessary when assessing the social value of a renewable energy industry. The Renewable Energy Foundation's preliminary assessment of the potential social benefit from organic energy projects in rural Scotland is positive, and suggests that they are worthy of support. The marine industries offer considerable potential not only for employment and income, but also for innovation, producing new industries with lively potential export markets.

In addition, we would note that since organic electricity projects can be located in reasonable proximity to centres of load, these projects could be incorporated with District Heating developments targeted at mitigating fuel poverty.

With regard to energy affordability, it is unfortunately true that any system of support for renewables tends to increase electricity prices, and thus to penalize those with low incomes. We have noted this point in our manifesto, and we regard it as a serious point of criticism when levelled against the Renewables Obligation overall. Although we have contributed to DTI and Scottish Executive consultations on revisions to the RO and suggested banding, we have made these suggestions in the spirit of co-operation, as attempts to improve a system which we believe might be better

reconsidered from the ground up or cancelled altogether. In fact, we are by no means convinced that an obligation system, or a guaranteed feed-in tariff as has operated in Germany and Denmark, is the best way to achieve renewable energy development in its most economic and innovative form. This is an issue to which the Royal Society might profitably direct its attention.