*PI[1of1] U Energy Review*

**RENEWABLE ENERGY - FURTHER NOTE**

Reference: Renewable Energy - Further Note
Date: August 2001

## 1. PURPOSE OF THIS NOTE AND WAY FORWARD

1.1 This …

1.2 The…

**Readers should not assume that the PIU has in any respect closed its mind. Questions are put in order to draw responses.**

1.3 We….

1.4 The …

1.5 We would also be grateful if interested parties could let us know as soon as possible if they consider this note overlooks key questions, if any of the questions posed, or propositions put, are fundamentally misconceived, or if the note contains any factual errors.

**Comment**

*Important areas that have not been mentioned are 1 definition of which power sources are included within the renewables heading 2 Health and Safety, 3 waste production, 4 costs of additional equipment. There are also factual errors in the renewables contribution claim – the reference source for the 2.8% and 0.9% should be quoted – presumably DTI annual statistics.*

*In section 10.2 fuels cells are included. These are not an energy source; they are only a conversion device – like an electric motor.*

*The life cycle $CO_2$ production per kWh should be tabulated, based on ExternE or other recognised databases, rather than using generalised statements.*
*There should also be some reference to the range of credible risks that could imperil the renewables on offer – ie anticyclones, droughts, pest damage to crops, floods and volcanic eruptions. It is not good enough to concentrate on the results if things go to plan. Realistic fault cases have to be modelled.*

## 2. WORK TO DATE

2.1 This note. ….

2.2 Work to date…..

## 3. BACKGROUND

3.1 Renewable date…..

3.2 Energy that is derived from, or energy demand which is reduced as a result of, appropriate management of, the bi-products of life will be analysed in a separate strand of work within the Energy Review. It will build on work already undertaken in the Resource Productivity project.

**Comment**.

*Paragraph 3.2 is excessively vague and unhelpful. A definitive list is needed of the systems that are included – eg are landfill gas, refuse and sewage sludge combustion included or excluded?*

3.3 Renewables generally have much lower environmental impacts than 'conventional' alternatives, and in particular have the potential to provide energy with very low emissions of $CO_2$ and with no radioactive wastes. Largely because of this, policy support for renewables has been expanded considerably in many countries, including the UK, in the last 10 to 15 years. Many countries, including the UK, have policies and targets intended to significantly expand the contribution of renewables.

**Comment**.

*Paragraph 3.3 is not correct. Renewables have had limited environmental impact to date, in proportion to their negligible contribution. Their adverse effects will become more obvious as larger schemes are planned.*

3.4 Renewables currently contribute around 2.8% of electricity and 0.9% of all primary energy. Of this, a large proportion, almost 50% is supplied by large hydro, with the remainder supplied by the 'new' renewables such as wind power and biomass.

**Comment**.

*This is not consistent with DTI data for year99/00. The wind power contribution is very small and should not be emphasised.*

## 4. TECHNICAL POTENTIAL

4.1 The technologies with the largest potential in the UK are on- and offshore wind, wave and tidal stream, solar photovoltaics and biomass (energy crops and agriculture and forest materials), and large hydro - though most large hydro potential has already been harnessed. Smaller contributions are possible from a range of other technologies,

such as small hydro and solar water heaters. A significant contribution could also come from large estuarine tidal barrages, most notably the Severn barrage[1].

**Comment**.

*This development will have an impact on about 200 sq mils of the Severn estuary. The environmental effect will be so large as to be almost unparalleled.*

4.2 Overall, despite. …..

4.3 It is possible to envisage an energy system based primarily upon renewables, and it is certainly possible for intermittent renewables (such as wind or solar) to supply 50% or more of electricity needs. However this would be likely to require the development of a range of associated technologies – such as the means to effectively store electricity and changes to the way local electricity distribution networks are managed. Reinforcement of the national electricity transmission grid and interconnection with the rest of Europe may also be required. Evaluation of such changes, their timeframes and their costs, will be an important part of the PIU's work on the potential evolution of energy systems in the long term.

**Comment**.

*This must be the understatement of the century. Peak midwinter night time demand is about 40,000 MW. To provide this level of power with wind and solar generating 50% of our needs would require the complete redesign of the grid system, protection equipment, power control and banks of batteries or other storage devices. Part of your analysis should give estimates for the numbers of wind machines and quantities of solar plants or biomass plantations to achieve these percentage values which otherwise appear to be plucked out of the air with no justification.*

***Proposition: The UK could meet a significant proportion of electricity needs from renewable sources in the medium term – 20-30% by 2020 may be feasible. In the longer term, much larger proportions, 50% or more, appear possible***

**Table 1: Resource and cost in 2025 (derived from DTI 1998[2])**

| Technology | Cost* p/kWh | Economic potential at this cost* TWh/yr | Technical potential TWh/yr | Practicable potential TWh/yr |
|---|---|---|---|---|

All figures quoted are based upon 8% discount rate.

[1] Because it would involve a very large single infrastructure project – of similar scale to the channel tunnel - the Severn Barrage presents very different issues to the other renewables. The DTI are funding a scoping study for re-evaluation of the Barrage, the findings of this study will inform the Energy Review

[2] Supporting analysis for the Renewables Consultation: New and Renewable Energy: Prospects in the UK for the 21st Century, Supporting Analysis, DTI 1998

## 5. COST TRENDS AND DEVELOPMENT POTENTIAL

5.1 None of the …….

5.2 Significant and sustained. …..

5.3 The PIU's analysis of cost reduction potential used two complementary approaches to cost reduction assessment – engineering cost assessment and so called 'learning' or 'experience' curves:

> ***Question: Is the methodology utilised by the PIU for assessing cost reduction potentials appropriate and acceptable? Are there other factors that we have failed to take into account?***

5.4 Preliminary findings for renewables are as follows:

- There is**…….**
- There is also good evidence that PV is likely to continue to experience sustained and substantial cost reductions over the next 20 years. However, though PV will become cost competitive in many applications in sunnier climes, it will still **be some way from cost competitiveness in the UK – around 10 p/kWh**.

**Comment**.

*The expansion of any new technology always risks the exhaustion of resources that were adequate when it was in the embryonic state. This usually restricts the rate of expansion and may drive up costs rapidly. Has this issue been considered?*

- Offshore wind costs. …..
- Advanced combustion technologies for energy crops also have considerable potential for cost reduction, with capital costs projected to fall by around 50% as the technology moves from the current demonstration phase to commercial deployment. Reductions in crop production and processing will also be required if energy crops are to become cost competitive. This makes **cost reductions in biomass more difficult to assess. Best estimates lie in the range 2.5 – 4 p/kWh.** Energy crop plants have the very important benefit that they may be switched on at will and hence may be able to compete for higher priced 'peak' electricity.

**Comment**.

*Very little thermal plant can be switched on at will. Start up times are intimately connected to the thermal condition of the plant during its previous shut down. The rates of thermal expansion and movement have to be matched Steam turbines usually require continuous barring to prevent permanent mechanical damage during outages. Cycling of this type of plant is generally bad for longevity and reliability.*

*What calculations have been performed to predict the quantities of carcinogens that will arise from the burning of biomass and the associated debris?. All the processes that support biomass combustion such as vehicle and staff movements, waste disposal, building construction etc generate $CO_2$ . Biomass creates about four times the $CO_2$ of nuclear plant per kWh.*

- More uncertainty surrounds wave and tidal technologies, with many competing devices currently at an early stage of development. As yet it is not clear which technologies will 'win', and all face technical hurdles. Parametric estimates of potential costs suggest that costs will be of the order of **4 to 8 p/kWh** for early devices, but it is not yet clear when this might be achieved. The UK is currently at the forefront of wave and tidal power and continued development could be secured at modest short-term cost.

> ***Proposition: The cheapest options for exploiting renewable energy sources will become broadly cost competitive with 'conventional alternatives' within 20 years.***

**Comment**.

*A comment should be added, … that in spite of 30 years of study, very little has been achieved, apart from OSPREY, which sank after two days. It would be very helpful to have some indicative information about the physical dimensions of the structures that would be needed for a nominal plant rating of say 1000 MW. This would give some indication of the technical and environmental challenges involved – perhaps to the nearest hundred thousand tons.*

## 6. BUILD RATES AND POTENTIAL TARGETS FOR 2020

6.1 Cost reductions ……..

6.2 Further work will explore the possibility of a 30% target for 2020. A 30% target would make a major contribution to continued $CO_2$ emission reductions post 2010, with the potential to ensure that the projected upturn in emissions from the power sector between 2010 and 2020 does not occur. It would also help to promote diversity. Key issues include technical constraints upon build rate and total burden upon consumers – which will depend heavily upon cost reductions.

> ***Question: What role, if any, should expanded and longer term targets play for the development of renewables? Should such targets be regulatory or aspirational?***

**Comment**.

*A comment should be added to indicate the proposed split for the 30% target ie 10% wind, 10% biomass, 5% PV. Without these values, the impacts are concealed by the vague integrated figure.*

## 7. INFRASTRUCTURE ISSUES

7.1 Most analysts suggest that the current UK grid system could accommodate around 20% of electricity from intermittent sources, such as wind and wave energy, before technical and managerial changes are required. The intermittency of a diverse and geographically dispersed input from such renewables would not impose any statistically significant burdens on the system as the level of fluctuation would be no greater than the normal variations in demand. However, the economics of such supply sources under current electricity trading arrangements for England and Wales are more complex (see Paragraph 11.4 below). It is also possible that localised network constraints could become significant in some areas – at both the level of local distribution networks and the transmission grid, for example the development of northern Scotland's wind resources may be constrained by both the limited capacity of the local network and of the interconnector with England.

**Comment**.

*Statement 7.1 hides a multitude of problems. The environmental impact of constructing multiple interconnectors would be very great. Whose responsibility would it be to pay for this new system. If added to the cost of wave or wind power it would make it very uncompetitive. The Scottish Parliament may reject the schemes and large parts of the country could be vulnerable to interruptions through faults or sabotage. The control of mains frequency and voltage without unwanted harmonics would be an enormous challenge.* **Building, operating, maintaining and dismantling large offshore structures such as wind machines and wave power systems will involve very many hazardous tasks. The HSE should be asked to extrapolate the numbers of extra injuries and fatalities that would be expected, compared with low risk alternatives such as thermal nuclear and gas-fired plants.**

7.2 With a view to the longer term the implications, both technical and economic, of a much larger contribution from renewables requires further analysis. Preliminary work on the options for accommodating high levels of intermittency has been started. This suggests that the development of energy storage technologies and of systems for the active management of local networks could be important for the cost effective management of large penetrations of renewables. This is an important area for future analysis.

***Proposition: Network and 'intermittency' constraints will not have a major impact on the development of renewables for the foreseeable future. However, additional development of key technologies for dealing with intermittency should be prioritised in order to hold open the option of much larger contributions in the longer term.***

**Comment**.

*Statement 7.2 could necessitate the complete redesign of the grid and distribution network, to displace a system that has worked well for 70 years. The financial and environmental implications of enormous storage systems throughout the whole of the UK are staggering. It is difficult to believe that any BPEO would conclude that such a route was optimal.*

## 8. ENVIRONMENTAL IMPACTS AND PUBLIC PERCEPTIONS

8.1 The environmental impacts of renewable energy technologies are generally very low compared to fossil fuel alternatives. Atmospheric emissions of most technologies are effectively zero at point of use, with the exception of biomass technologies. All technologies have very low lifecycle emissions of CO2, with most lifecycle emissions arising from manufacture and installation of plant (biomass technologies produce CO2, but low or zero net emissions are possible as CO2 is absorbed in growth by plant-based fuel). Renewable energies produce very low levels of toxic solid wastes (heavy metals are associated with the production of some types of PV cell) and no radioactive wastes.

**Comment**.

*Statement 8.1 is not accurate. Many studies have looked at the $CO_2$ outputs for the credible power systems. Nuclear performance is substantially better than hydro, PV , biomass and wind, although they are better than fossil fuels. Where are your references?*

8.2 Renewables can have significant local environmental impacts. These include:

- wildlife and habitat changes;
- visual (landscape and architectural) intrusion;
- noise.

Wildlife and habitats can be altered by many technologies and it is important to note that impacts can be both positive and negative. For example: wind turbines can have some impact on bird populations (though in almost all studies this has been demonstrated to be low); wave energy technologies and offshore wind platforms create new sub-sea structures, which may create new habitats, but installation may cause some habitat disturbance; and biomass plantations change habitats (with the potential for both negative and positive implications) and may have implications for water abstraction.

***Proposition: The environmental impacts of renewables are generally low***.

**Comment**.

*It would be far better for wildlife to plant permanent hardwood forest in large parts of the country than temporary biomass plantations. What are the views of the CPRE and the National Trust?*

### *8.3 Perceptions*

There is …..

## 9 SECURITY

9.1 Renewable energy is able to provide security to the energy system. This is because UK produced renewable energy reduces the need for physical import of energy. Moreover, small generators aggregated together are more reliable than a single unit of equivalent size. Together, this means that renewable energy should increase system security. An Embedded Generation Working Group (EGWG) was established to address a range of issues associated with small-scale generation and reported in March 2001. As the Report pointed out, because of the current design and operation of the distribution network, electricity system security benefits provided by multiple generation points are undervalued or ignored and even, in some situations, negated.

**Proposition: Renewable energy is an important tool in increasing the security of the energy system**

**Comment**.

*Security is achieved by diversity, reliability and redundancy. Renewables may introduce diversity, but their reliability will fall well below that of the systems they replace. The claim for redundancy is weak, but so many are prone to common mode failures. For example a long winter anticyclone would affect PV, wind and wave plants simultaneously. They may contribute in a small way to diversity, but the claim to increase security may be difficult to defend if fossil fuels are available from several parts of the world.*

*The present grid system provides 99.98% supply continuity. It is the low voltage distributors that are prone to weather related and other faults. Since it is these that would be used by embedded generation plants, there is little reason to believe that network would show any tangible benefits if small plants proliferated.*

## 10 RENEWABLE ENERGY POLICY

### *Overview of past and current policy*

10.1 The …

10.2 A supporting programme ran alongside the NFFO, aimed at stimulating the development of a range of new and renewable technologies:

- a range of biofuels (used either as static energy sources or as (partial) alternatives to petrol and diesel);

- wind;
- fuel cells; **fuels cells are a conversion device and not admissible**
- solar (both PV and solar water heaters);
- small-scale hydro (on rivers); and
- wave and tidal power.

10.3 Most….

10.4 The Utilities. ….

***10.5 A New Strategy for Renewable Energy***

- ***The*** Funds….

***10.6 The Renewables Obligation***

Electricity Suppliers in Great Britain will be required to purchase a certain proportion of renewable electricity from a range of eligible technologies. The Government has already undertaken a preliminary consultation on the proposed obligation and the statutory consultation is currently underway with a view to laying the Order before the House in October and bringing the Obligation into effect on 1 January 2002.

**Comment**.

*There should be an unambiguous list of those technologies that are renewable and those that are borderline, but excluded. Without such a list, the 10% renewables contribution is open to manipulation and fraud.*

***10.7 Recycling of the buy-out***

The buy-out….

***10.8 Climate Change Levy Exemption***

**Comment**.

*The failure to include nuclear power in those power sources that are exempt from the CCL is perverse and quite blatant political interference. The thinking that permits this decision to go uncorrected must be reversed before more harm results.*

***10.9 Capital Grants***

The level .

***10.10 Research and Development***

DTI's budget.

***10.11 £100M Additional Support***

The Prime Minister announced £100M additional support for renewable energy earlier this year to *"help us to promote solar PV, give a boost to offshore wind, kick start energy crops, and bring on stream other new generation technologies"*. The PIU has been leading a piece of inter-departmental work on analysis and recommendations for use of the additional funding and final decisions on how this funding will be allocated will be published this Autumn.

## 11 INSTITUTIONAL BARRIERS TO RENEWABLE ENERGY

11.1 The PIU

11.2 Obtaining Planning Permission

Difficulty in…..

11.3 Regulation of Networks

Although it is . …..

11.4 The New Electricity Trading Arrangements (NETA) commenced in March 2001. They encompass the basic principle that those wishing to buy and sell electricity should be able to enter into freely negotiated contracts to do so. Because NETA is still only a few months old, there is little empirical evidence to demonstrate how it is impacting on renewable generation (and also small-scale CHP, which shares some characteristics). There is likely to be a settling down period while actors become more familiar with its workings. It is thus hard to reach a firm conclusion about the long term, real effect of NETA on the scale of the impact on smaller, or intermittent, generators. Nevertheless, from the evidence available so far, it does appear to be possible that NETA is creating difficulties for small scale renewable and CHP generators.

**Comment**.

*Electricity for most practical purposes, cannot be stored and so there is basic need to be able to forecast the availability of supplies to meet demand. The difficulty that some renewables have of meeting this fundamental requirement operates against them under NETA, as it should. It is self defeating to bend the rules to allow unreliable supplies not to penalised for such an important failing.*

11.5 At the . …..

***Comments are invited on current institutional barriers to renewables, their current impacts and how they should be overcome.***