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Wind Power in the UK: Has the Sustainable Development Commission got it Right?

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Even its supporters would probably now accept that in its early days nuclear power was oversold – the costs were underestimated ("too cheap to meter"); the practical problems (eg waste disposal) minimised; the benefits overstated; alternatives summarily dismissed; the risks ignored. The legacy of this overselling has been unhelpful – emotions are high on both sides and there is a climate of mistrust. It seems almost impossible to have a sensible debate about the place of nuclear in the energy mix, at a time when the need to look carefully at all non-CO_2 emitting sources has never been greater.

Have we learned from this experience? It does not always seem so. The current state of the debate about wind power presents many of the same unwelcome symptoms – exaggerated claims; confused arguments; strong emotions; neglect of the practicalities and risks. In this climate an authoritative and neutral examination of the issues would have been a helpful corrective. This is what the latest report of the Sustainable Development Commission (SDC) seems to promise. The Report, entitled "Wind Power in the UK" describes itself as "a guide to the key issues" surrounding wind power development, providing information to help "considered decisions to be made".

Unfortunately, but perhaps predictably, the Report fails to do so. The Commission ends up as just another cheerleader for wind power, using the Report to argue that "wind power must be made to work" because it is a "critically important part of the overall energy mix". In its bullish (not to say bull-headed) approach, the Commission is repeating the errors of the early advocates of nuclear: underestimating the likely **costs**; minimising the **practical problems**; overstating the **benefits**; and dismissing the **alternatives** – in a report which, at many points, shows a poor grasp of the issues.

Costs

The Report is remarkably free of doubt about the costs of wind power. It says "the generated cost of wind is quite accurately known from a number of studies and would seem to be around 3.2p/kWh for onshore wind energy and 5.5p/kWh for offshore." It gets these numbers primarily from three studies: one by Oxera; one undertaken for Windpower Monthly; and one by the IEA. There is nothing wrong with these studies in themselves (though that for Windpower Monthly might not be regarded as independent), but to suggest that they provide a consensus around a single number is absurd. They are no more than a sample of the available estimates, and they show a

wide range of costs – as is inevitable with a renewable resource like wind where costs are heavily site-dependent.

It is not just the Commission's choice of studies that is selective. Even within the chosen studies the choice of data is selective. For example, from the IEA study the only figure quoted is from Denmark. In fact, the IEA looks at a number of countries, and produces a range of figures, even for Denmark. It concludes that at a 5% discount rate, wind-power costs range "between 35 and 95 $US/MWh" with a number of plants below $60; while at a 10% rate (and the SDC acknowledges that a higher rate than 5% is appropriate in the UK market) the range is from $45 to $140 (roughly equivalent to 2.5 to 7.7p/kWh). Similarly, the Windpower Monthly data show a wide range of costs – quoted sample data range from 2.9 to 5 p/kWh for onshore and 5.2 to 6.9p for offshore.

It is in any event unclear how far figures for other countries, such as the IEA's, are relevant to UK circumstances (as the SDC makes clear elsewhere by dismissing overseas experience in other respects). The specific UK figures quoted by the SDC are not independent calculations but assumptions drawn from an Oxera modelling exercise, so their reliability will depend on how much the assumptions represent the ultimate reality. It would have been wise here for the SDC to have heeded the warning quoted in one of the key surveys of renewable energy (by two advocates of renewables) – that "paper calculations, however rigorous and plausible, [have] a limited relationship to the conditions faced by companies in the field. In fact it is particularly hard to generalise about the economics of wind energy."[1] No hint of these difficulties is given by the SDC.

Other recent estimates of UK wind costs have been higher than the SDC numbers. For instance, the Royal Academy of Engineering published a study on *The Costs of Generating Electricity* which gave a range of 3.7 – 5.4 for onshore wind and 5.5 – 7.2 p/kWh for offshore (the higher number in each case reflecting their calculations of extra system costs – see below). All such calculations can of course be challenged, but the point is not that one or other set of figures is wrong; rather, that there is uncertainty about the likely costs of wind power.

In such circumstances, one obvious recourse is to look at the real world – ie, not at theoretical cost calculations, but at the actual prices paid for wind power. These numbers are significantly higher. The current UK system of support for renewables is based on obligations which are tradeable in the form of Renewables Obligation Certificates (ROCs). The ultimate cost to the consumer is effectively capped at a premium which currently stands at a little over 3 p/kWh (in addition to the normal wholesale electricity price, recently around 3p) though in practice the cost of Certificates has often been higher. The total cost of offshore wind in the UK was calculated by the OIES at 8-8.5p/kWh[2]. Similarly the prices paid under Germany's support arrangements are much higher than the costs quoted by the SDC – the

[1] *Renewable Energy Strategies for Europe: Vol II.* Grubb, Michael and Vigotti, Roberto RIIA/Earthscan 1997

[2] *UK Offshore Wind Capacity – A Return to Picking Winners*. John Bower July 2003. Available on OIES web-site

structure of support is complex but is equivalent to 4-5p/kWh or more for onshore wind and over 6p/kWh for offshore.

These figures are important because they represent the actual prices paid, ultimately by consumers. It is misleading for the SDC to represent the numbers it quotes as representing the extra burden wind power will impose (as it does at a number of points, referring to "the extra cost to the consumer"). It is not, of course, theoretical calculations that matter to consumers, but the actual price they pay. But why should they have to pay such a high price, if the costs are as low as the SDC suggests?

The SDC ducks the issue. It refers to a recent National Audit Office (NAO) Report on Renewables, in which the NAO argues that the ROC arrangements mean that consumers are paying more than the cost of onshore wind power, but is prepared to accept that this may be necessary in the circumstances. Does the SDC agree that it is necessary? If so, its quoted cost figures do not represent the cost to consumers. If not, and if the SDC really believes its numbers with the confidence it claims, it should be calling for a change of policy – onshore wind energy is clearly being subsidised too much, not too little. On its cost calculations a fixed price of around 3.2p/kWh and 5.5p for offshore would be enough to bring forward all the wind power needed and the UK could save billions of pounds (literally) by replacing the existing system of support by a fixed price contract arrangement – releasing resources which could be used, for instance, to support other renewable sources. Would the SDC (and wind power operators) support such a change of policy? Somehow one suspects not. They are probably realistic enough to know that the risks are greater than they will admit publicly (and prepared for electricity consumers, rather than the wind industry, to bear those risks).

The temptation to optimism about costs is, of course, even greater when looking further into to the future. For 2020, the SDC relies primarily on another study, again brushing aside the evidence that a wide range of estimates has been made (including, for instance, the cost estimates for 2010 and 2020 in the Oxera report, which the SDC used as a source for current costs but ignores for future costs, presumably because its estimates are significantly higher than the SDC's preferred figures). The study cited by the SDC assumes considerable reductions in the cost of wind power by 2020 – the capital costs of wind generation are projected to almost halve; a number of other favourable assumptions are made. These assumptions are not impossible, but they are hardly neutral, and the SDC fails to take account of the risks and uncertainties.

It is true that wind power costs have fallen rapidly – but most of this reduction took place ten to fifteen years ago and the recent trend has been less pronounced. For instance, the SDC shows a chart of wind turbine list prices and comments that the price fell from 1400 euros/kW in 1990 to 830 euros/kW in 2004, a fall of around 40% – but without pointing out that over three quarters of that reduction took place between 1990 and 1994. A similar trend can be seen in the prices under the UK's previous system of support, known as the Non Fossil Fuel Obligation (NFFO). Under this scheme, the price for wind fell from about 11p/kWh in 1991 to around 3p by the mid 1990s. The fall led to confident estimates that wind power would soon

require no subsidy at all as it would be fully competitive with other sources. Yet, as the current support figures indicate, we are still in practice a long way from that stage.

Indeed even the low costs quoted by the SDC, after allowing for inflation, are little different from the price during the last round of NFFO (2.9p).

It is by no means clear that the cost of wind power will fall faster than the cost of alternative forms of generating capacity (where of course, technological advances are also being made). The problem with wind (as the SDC acknowledges at one point) is that the best sites in terms of wind resources are generally also the most difficult in economic and/or environmental terms (remote; offshore; in otherwise unspoilt landscape). While the costs of individual generating plant may fall, it does not necessarily follow that the cost of wind generation will fall.

The history of policy interventions underlines a related message, which the SDC fails to address – wind at the best sites can indeed be low cost, but if you want a large scale wind programme you cannot use only the best sites, so you cannot base your calculations on the best sites. This was a major debating point of the 1990s – the UK praising its NFFO system for bringing down the costs of wind, while Germany said that higher prices were necessary to bring on large quantities of wind generation. Experience suggests that Germany was right (it has achieved much higher levels of wind power). The UK has implicitly accepted this by moving to a higher level of support (instead of no support, which was the aim of the NFFO scheme). It is likely that the trade-off between quantity and cost remains – that is, that a relatively high price will have to be paid to encourage significant investment in wind.

Practical Issues

Another aspect of the SDC's optimism is to minimise the practical problems, which fall into a number of categories.

The environmental problems are beyond the scope of this comment. However, it is notable that while the SDC recognises their existence, it takes the comfortable view that most of the problems can be overcome by good planning (ie it does it not recognise siting issues either as one of the costs to be taken into account in any social costing; or as a barrier which will make the achievement of its target more difficult and more expensive).

It also skates over the costs of integrating wind into the electricity system ("system costs"), which increase as wind capacity increases as a proportion of the system. The problem can be exaggerated – but it can also be downplayed, and it is no surprise that the SDC chooses the latter course. Indeed it shows some impatience with the issue, arguing at various points that the variability and unpredictability of wind power is "not a problem" or a barrier – just an extra cost (as though that disposed of the issue).

Similarly neglected are the problems (both economic and environmental) of the extra transmission lines which would be needed to bring significant quantities of offshore generated power down from the West Coast of Scotland or other remote sites. For

system costs overall, as with generation costs, the SDC quotes only estimates favourable to its case – as noted above, much higher estimates are possible, as shown by the Royal Academy for Engineering. The SDC also dismisses practical

experience, preferring its more favourable theoretical calculations. Some examples are given below.

Capacity factors: one key underlying assumption is the capacity factor, ie how much of the time wind capacity is actually generating. The SDC uses a figure of 35% for the UK (30% in the short term). It is true that this figure has theoretical support, in the sense that wind speeds are appropriate for power generation for that proportion of the time in UK circumstances. But again, it is worth bearing in mind the warning quoted above about the possible gaps between theoretical expectation and actual performance (and, for instance, the gap between expectation and performance with nuclear). The fact is that nowhere in the world does any country with significant wind capacity get anywhere near the 35% figure. In both Germany and Denmark (the leading countries for wind power) capacity factors are generally 20% or lower. The SDC dismisses this experience on the basis that circumstances are different there. More surprisingly perhaps, it also dismisses UK experience, suggesting that the figures in the UK of under 25% in 2002 "and a number of other years" are untypical.

There is certainly a good case to be made for saying that future capacity factors are likely to be well over 20%, but to jump to 35% without looking at the sensitivity of the calculations to lower figures is to ignore the risks, which are high. If capacity factors turn out to be nearer 20% than 40% the costs and benefits will change proportionately – there could be a range of uncertainty on this factor alone of 2 to 1 or more (the unit costs go up and the environmental benefits go down if the capacity factor is lower than expected, so the cost/benefit ratio suffers doubly).

Capacity values: the discussion of this issue in the SDC report is confused and confusing and will certainly not help inform the debate (a much better explanation is available in the IEA study referred to). It is not even clear whether the authors have understood the interrelated issues of capacity factors and capacity values[3]. The SDC says that it is "commonly assumed" that more wind power in the system will lead to a need for more reserves, specifically that "if the average output of wind plant is 35% of its rated output …. the remaining 65% must be provided as reserve, or backup capacity". It goes on to say that "this reasoning is seriously flawed". Yet – leaving aside the question of whether it is correct in its description of what is commonly assumed – its own discussion shows that the position is arguably worse, not better, than in its 35%/65% example. The normal calculation, which it appears to accept, is that at a 20% penetration (which is its aim) wind has a capacity value of only 20%,

[3] Confidence in the Report's understanding is not enhanced by a mistake on p11 where the SDC says "Assuming a wind power [capacity factor] of 30%, 9,500MW of installed wind capacity will produce around 31,500 GWH of energy". The true figure is around 25,000GWh. Given that not all the calculations in the Report can be so readily checked, there may well be other mistakes – see the discussion of benefits below.

not 35%. It is not at all clear what the SDC means when denying what it describe as the common assumption.

It may simply be confusing the issue in its use of the terms "reserve or backup capacity". But, avoiding those terms, the bottom line is clear, even in the SDC calculations – that in a system with around 20% wind in 2020, significantly more total capacity will be required (105GW as compared with 84GW) than without the wind element. The amount of non-wind capacity required is only slightly less in the wind case than in the base case (7%). It will have to operate at a lower load factor, because the wind power will take priority, operating whenever it is physically able to do so. At those times a large amount of non-wind plant (up to 26GW in this example) will have to be turned off, or put on standby. At other times, when the wind is not blowing, that plant will be needed again.

This is a serious challenge – the greater the proportion of wind, the less attractive it is for developers to build other sorts of plant (because of the lower load factors, and the uncertainty about whether they will be properly compensated for it). The likely outcome is that less new non-wind plant will be built (though nearly as much is still required) – ie, that the power generation fleet will get older and less efficient, with lower environmental performance.

Other practical issues: there is no room here to go through all the purely practical and logistical problems connected with implementing a major wind power programme, but they are of central importance, given the enormous increase in the scale which the SCD is proposing and the largely untried challenges of offshore operation. (Although offshore power is not its primary focus, the cost and benefit analysis in the Report relies on a significant contribution from offshore). It would have been sensible for the SDC at least to have acknowledged that such problems exist. They were highlighted recently, for instance, in a Report by The House of Lords Committee on Science and Technology (*Renewable Energy: Practicalities*, July 2004) which commented that "the potential obstacles to large-scale wind development remain formidable" and that "it remains to be seen whether offshore wind power can fulfil the vital role assigned to it". The NAO also points out that risks and costs are likely to be high for offshore wind and that the potential is very uncertain. Rather than addressing such issues, the SDC prefers to ignore them, apparently taking the view that with sufficient will any problem can be overcome. This is simply to wish away the uncertainties – wind power may well be more difficult, more expensive, and slower to develop than they assume. Certainly, that has been the history of wind in recent years in the UK.

Benefits

The benefits identified by the SDC are to a fair extent the reverse of the coin of their optimism about costs. High capacity factors and high assumed rates of penetration increase the benefits in terms of lower emissions; along with the low assumed costs, this improves the cost/benefit relationship.

But once again, some of the calculations seem at the very least obscure, and possibly based on a misunderstanding. The Report says (p 36) that, on the assumption that wind makes up 20% of total output in 2020, the CO_2 savings can be estimated at 7.8 MtC, and claims that it is following UK Government methodology. But this seems very unlikely. The UK Government's own figures give a saving of 2.5MtC from a 10% penetration in 2010 (Section 6.9 of the recent Climate Change Consultation Paper). Since the SDC is projecting only a slow increase in electricity demand

between 2010 and 2020, the same methodology should produce a figure of well below 6MtC for 20% penetration by 2020. It is unclear how the SDC has reached a higher figure. One possibility is that its figure for the CO_2 emissions of generation displaced relates to current average gas-fired generation, as one reference in the text suggests, rather than to the displacement of new generation, which is the assumption in the Government methodology. New generation is likely to be more efficient – and would presumably be even more efficient by 2020, further reducing the savings from its displacement. When looking forward this far into the future, to use current figures as the basis for savings calculations, if that is what the SDC has done, is not justifiable.

So, even on its own terms, the SDC figure seems significantly overstated. But the argument could easily be mounted that it should really assume no benefit at all. Unlike the Government, the SDC rules out nuclear power (see below). After 2010, at any rate, its proposed wind power programme would effectively replace the nuclear plant that is expected to retire over the following decade – at least in the sense that, by a curious coincidence, the amount of wind power the SDC would like to have on the system by 2020 (20% of generation) is more or less equivalent to the amount of nuclear generation that is due to be retired by 2023 (all stations except Sizewell B). In other words, if the SDC policy was followed, the net impact in terms of non-CO_2 emitting generation would be nil, while the impact on the environmental performance of fossil generation would be adverse, as explained above. An SDC policy would therefore in all probability lead to higher, not lower, CO_2 emissions from electricity generation.

Of course, all such calculations are highly assumption-dependent, and the SDC's approach is not particularly egregious in this respect - though it is a highly risky way to aim at emissions reduction. But what is particularly striking is that even on its own, very favourable, assumptions, there appears to be little case for subsidising significant amounts of wind! That is, even if you accept the SDC's optimistic view of costs; its dismissal of the practical problems; the failure to cost the environmental downside; and the optimistic view of the environmental benefits themselves – even after taking account of all these favourable assumptions and internalising the benefits of the assumed CO_2 emissions saving, the cost of wind on most scenarios examined by the SDC (for gas prices and carbon costs) still exceeds the benefits. The best the SDC can come up with is that "the social benefit of having 20% wind output **might** outweigh any costs" (p 37 - my emphasis. Once the risks and sensitivities are factored in, it is highly likely that the benefits will not outweigh the cost). It is not clear whether the SDC really understands what it is saying (unless its approach is simply that wind power is necessary, whatever the cost). A very uncertain benefit calculation like this cannot conceivably justify the sort of ambitious wind programme the SDC is

promoting. At most it would lead to a cautious approach, on the lines that the challenge of climate change is so great that it is worth pursuing all options which might have potential in combating it, including wind.

Alternatives

It is particularly unacceptable for the SDC to draw such strong conclusions when its consideration of the alternatives is so cursory. It is perhaps unfair to expect it to consider all energy sources in depth, but it need not have ventured into this area at all – it could have rested with the more modest and more defensible conclusion suggested above. Instead it has disposed, in a paragraph or two, of each of the various alternative sources, in a way which will persuade only the committed.

The cursory dismissal applies even to alternative renewable sources. The Foreword to the Report says that it "confirms that wind is … the cheapest …. of the UK's renewable resources". In fact, the Report does no such thing, as it does not even attempt the comparison. Admittedly, a proper comparison of the costs of different renewable sources would be very difficult, given the various uncertainties referred to above. But what can be said with reasonable confidence is that there are several renewable sources which are relatively low cost – including hydro, sewage sludge digestion, landfill gas, municipal solid waste combustion and biomass co-firing. In dismissing these, the SDC is making an ecological, not an economic judgement – it does not regard them as truly sustainable. That judgement is in itself fair enough – that is what a Sustainable Development Commission is supposed to do – but it is wrong to conceal the judgement in a statement about cost. Others could make different judgements – indeed, the alternative sources referred to are not just part of the Government's current definition of renewables, but the major part, making up over three quarters of the total. Renewables of the sort favoured by the SDC (wind, wave, solar PV) are minor players, despite the impression given by the Report.

The SDC predictably dismisses coal, gas and nuclear in a few paragraphs, taking the opposite approach to the one it takes on wind (cost is now a key issue: the arguments that gas prices are likely to go up and that carbon sequestration will only "come at a cost" are put forward as reasons for rejecting them as long term players. Compare this with the comments on wind variability above as "not a problem, just a cost"). Nuclear is dismissed with the words "It is the SDC's view that it has far fewer advantages to offer, in terms of combating climate change, than the combination of energy efficiency, renewables and combined heat and power". This may well be its view, but to understand how far the SDC's view departs from reality, the reader is referred to the recent OIES comment "CO_2 Emissions: Time for a Reality Check" – available on the OIES web-site. The SDC's preferred combination of measures may have its advantages, but it is demonstrably not a good way of combating climate change.

Conclusion

One should not expect the SDC to come up with a coherent overall approach to energy and the environment. However, it is fair to ask it to present a properly argued case for wind power if it wants unwilling communities across the country to suffer the environmental consequences (and unknowing consumers to bear the cost). It has not done so. The fundamental problem remains that all forms of energy generation have environmental impacts, and that any form of generation employed on a large scale has

large scale impacts. Wind power is no exception to this rule (any more than hydro or nuclear proved to be). Instead of pretending that wind is a "silver bullet" providing the unique way out of the quandary, and should therefore be "made to work", the SDC should help in the effort to consider wind on a rational basis along with other sources, balancing the advantages and disadvantages in particular situations. In many cases, wind will clearly come out well, and it certainly has a part to play in the future energy system, but that role should not be exaggerated. Overselling any technology damages above all the technology itself. Wind power deserves better than the SDC's boosterism.