The effectiveness of renewables, specifically wind, in meeting emissions reduction targets in Scotland

Executive summary

Wind power, as a means to meet emissions targets in Scotland, cannot be subjected to a meaningful cost-benefit analysis because the level of true emissions savings is completely unknown. Estimates of emissions savings from the wind industry, Scottish and UK governments are not scientifically rigorous. Operational data from the Scottish and UK electricity sectors should be made publicly available for rigorous empirical analysis. In the absence of this, studies from other countries suggest that emissions savings from wind energy are very much lower than commonly supposed, putting into very serious doubt the likelihood of meeting emissions reduction targets in any meaningful sense. This is particularly so when wind is set to play a central role in electricity generation.

The report rather triumphantly states (p.87) ‘The Scottish Governments support for renewable electricity is delivering huge savings in greenhouse gas emissions. The UK Department of Energy and Climate Change estimated that Scottish renewable generation displaced 8.3 MtCO2e across the UK electricity grid in 2011.’ Put in the context of total annual UK greenhouse gas emissions of the order of 650 MtCO2e, there seems little justification for such self-congratulation! Below I outline evidence suggesting that even this paltry 8.3 MtCO2e could well be a severe over-estimate.

1. Cost-benefit analyses for the role of wind in meeting emissions targets depend on accurate scientific determination of carbon emissions savings from wind power in Scotland.

While the carbon emission at source from wind power is zero, the net carbon emission through integration of wind into an electricity network is not zero. I refer the reader to reference [1] for a detailed explanation of this. In order to determine the cost-benefit ratio of wind energy we need to know the carbon cost per unit of electricity consumed. These data are not publicly available in the Scotland or the UK as a whole.

2. Government and industry figures for emissions savings are theoretical only.

These figures are generally based on the assumption that one unit of wind-generated electricity displaces one unit that would otherwise be generated from the fossil fuel/nuclear mix with a pro rata savings in carbon emissions. The reality is not so simple in a complex network with many variables on the demand and supply side; these can be hard to predict [1]. Oswald et al. [6] concluded that increased use of wind in the UK would likely cause utilities to invest in lower-efficiency gas-fired generators that would be switched on and off frequently, cutting their energy efficiency and increasing their emissions. It was concluded that “neither these extra costs nor the increased carbon production are being taken into account in the government figures for wind power.”
3. The reduction in carbon emissions through wind energy deployed in Scotland must be measured empirically, not just guessed

Since it cannot be assumed that one unit of wind completely replaces one unit of fossil fuel, the only way to know how much carbon is being saved is to measure it. However, publicly available estimates of the emissions savings from wind in Scotland or the UK appear to be little more than a guess; these do not in my view meet rigorous scientific standards. In correspondence in 2010 with DECC I requested data for the measured emissions savings from wind energy in the UK. I was told that these data were not centrally held by government; this is an extraordinary admission and it means that we simply do not know if current energy policy is delivering any emissions reductions at all.

4. International attempts at empirical determinations of carbon emissions reductions raise severe doubts about the cost effectiveness of wind

Measurement of the effect of wind on emissions from entire networks is not straightforward. However, a number of international studies have attempted to address this issue [e.g. 2, 3]. In two cases, detailed operational data have been available and analysed: the Bentek report on wind in Colorado and Texas [4] and Udo’s analysis of the Irish network, EirGrid [5]. The conclusion of the Bentek report [4] is that wind does not save fuel and does not reduce emissions in Colorado and Texas. While the Scottish situation is not the same as that in Colorado and Texas, this report should nevertheless be of the utmost concern. Wind conditions in Scotland are not likely to be much different to those in Eire. Udo’s review of the Irish system concluded that despite a massive investment in wind energy only a 5% saving in fuel had been achieved [5]. Moreover, le Pair et al. [1] note that a number of factors were not taken into account in this analysis and so the emissions savings may be even less than estimated.

5. Countries with very high wind penetration do not have markedly lower carbon emissions

In a report from 2007 [7] it was noted that carbon dioxide emissions in the electricity sector (tonnes per capita) were low for nuclear intensive systems such as France (0.6) and Sweden (0.8) whereas countries with a very high wind power capacity had very high emissions, notably Denmark (4.3) and Germany (3.7). At the very least these data suggest that a high penetration of wind does not necessarily lead to a dramatic decrease in carbon emissions. Again this should raise serious concerns that emissions targets will never be met in reality.

6. Conclusions

There must be a scientifically valid assessment of the true emissions reductions attributable to wind energy in the Scottish context; it is essential that the emissions savings be measured empirically using the highest standards of scientific rigour. Unless this is done, the true effectiveness of the Scottish wind energy programme in meeting emissions targets will remain unquantifiable and the targets will be meaningless.
7. References


My interest in wind energy is purely as a private concerned individual, albeit a scientifically literate one. I am a university professor with a background in the physical sciences, qualified up to Ph.D. level. However, I have no professional interest in wind energy and the views expressed herein do not represent those of any institution or professional body with which I may be associated.