

**CLAIMED AND REALISTIC CARBON DIOXIDE EMISSIONS SAVINGS AND
ELECTRICITY GENERATION FROM A PROPOSED WIND ENERGY
DEVELOPMENT AT AIRFIELD FARM, HINWICK, NORTH BEDFORDSHIRE**

AN INDEPENDENT EVALUATION PREPARED AT THE REQUEST OF CLOWD

by

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Introduction

The writer of this Note has, for many years, been involved in the promotion of new renewable forms of energy, the curbing of greenhouse gas emissions and human-induced climatic change, and related energy policy requirements. A summary of this background is provided below.⁽¹⁾ A group of objectors to the development proposed at Hinwick, known as CLOWD, has asked the writer for an objective assessment of the carbon dioxide (CO₂) emissions savings and electricity generation claimed for this proposed development by Entec, acting on behalf of Nuon UK Ltd., in their statements in support of the planning application.

Entec/Nuon UK Ltd. have claimed that annual CO₂ emissions savings will be achieved of 41,616 tonnes (over 1 million tonnes during an anticipated 25 year lifetime of the project).⁽²⁾ Entec/Nuon UK Ltd. have claimed that these emissions savings are based upon electricity generation of almost 5.59 MW, assuming maximum rated output of 20.7 MW (9 turbines with a technical optimum of 2.3 MW each) and a load factor of 27%.⁽³⁾ The claim by Entec/Nuon UK Ltd. of electricity generated is also the subject of critical review here.

The conclusions of this Note are summarised here for convenience:

- (1) Entec/Nuon UK Ltd base their calculation of CO₂ emissions savings upon the British Wind Energy Association's "Calculations for wind energy statistics", which assert that wind energy-generated electricity saves CO₂ emissions from coal (only). This is manifestly incorrect, and in a ruling dated 21st December, 2005, the Advertising Standards Authority formally rejected such a basis for calculating emissions savings. Using an objective basis for calculating CO₂ emissions savings, which reflects the actual split of coal, natural gas and oil in electricity generation in the UK, the annual savings from the proposed Airfield Farm development can realistically be expected to be at most 16,645 tonnes annually (far less than the 41,616 tonnes claimed by Entec/Nuon UK Ltd.). The outcome could be as low as 13,000 tonnes. Neither of these figures take into account the CO₂ emissions produced in the manufacture, transportation to site, and erection (including large volumes of concrete required to be made, transported and laid) of the wind turbines. The large reduction from the developer's claims is partly due to a more realistic pattern of fossil fuel use; and partly due to the more realistic load factor applied to a North Bedfordshire site even at a high contour level.
- (2) Entec/Nuon UK Ltd. base their claims on a load factor of 27%. This is a fair approximation of the UK average wind energy load factor, but this figure is severely distorted by the 36% achieved in Northern Ireland and the 30% achieved in Scotland.⁽⁴⁾ In the East of England region, based on a maximum of eight wind energy developments (2004 only – there were three in 2003, and two in 2001 and

2002 – clearly at sites with significantly higher average wind speeds than prevail in North Bedfordshire), the average load factor was only 24%. Because the average wind speed at the proposed location is only 5 metres per second at 10 metres above ground level (about 7 metres per second at a hub height of 80 metres above ground level – a figure confirmed by the senior wind energy consultant at the National Energy Foundation), the actual load factor at this location is not expected to be above 18%, and could range as low as 14%. Thus, instead of electricity generated of 5.589 MW, as claimed by Entec/Nuon UK Ltd., the actual figure is likely to be no more than 3.73 MW, and could be as little as 2.90 MW – about 50% of what the developer has claimed.

- (3) Entec/Nuon UK Ltd. have claimed that the proposed development would serve the needs of 10,000 average households in terms of electricity requirements. In fact the most optimistic realistic assessment is for 6,330 households' requirements to be met. The outcome could be as low as 4,924 households. Thus Entec/Nuon UK Ltd. have greatly exaggerated the contribution to the number of homes that the proposed Airfield Farm development could provide for.

CO₂ Emissions Savings

The developer relies on the British Wind Energy Association (BWEA) for calculation of CO₂ emissions savings. However, the BWEA assumes that only coal-fired electricity generation will be replaced (an assumption ruled out of court by the Advertising Standards Authority on December 21st, 2005), and claims that this is because coal-fired plant is the most flexible part of the system and because nuclear and natural-gas fired plant should be disregarded because they operate at 'base-load'. It could be argued that at present, with nuclear power being phased out, wind energy is more likely to replace nuclear and hence unless and until there is a change of policy there will be virtually no CO₂ emissions savings. The Advertising Standards Authority ruling would reduce claimed CO₂ emissions savings by over 50%. A more objective, and internationally accepted, way of proceeding is to take the coal (roughly 33%), natural gas (roughly 40%), and oil (about 1%), components of fossil-fuelled electricity generation in the UK, together with adjustments for their carbon components (from about 1.0 for coal to 0.68 for natural gas). This has been done here. Instead of reducing the BWEA/Entec/Nuon UK Ltd. claims by over 50%, a more modest reduction is favoured here.

The next step is to investigate the claim made by Entec/Nuon UK Ltd. that CO₂ emissions are justifiably based on nine 2.3 MW turbines (total rated output of 20.7 MW) running at a load factor of 27%. This load factor is the UK average since 2000, and close to the UK average of 28% between 1998 and 2004. However, for reasons explained in the next section, this is an unwarranted basis for Airfield Farm.

One result is that the CO₂ emissions savings have to be greatly reduced. At best, these could be about 16,645 tonnes CO₂ per annum (contrasted with the 41,616 tonnes claimed by the developers); at worst just below 13,000 tonnes. No adjustment has been made for the substantial CO₂ emissions resulting from the manufacture, transportation, and assembly of turbines, blades, towers, and ancillary equipment required – of which the concrete requirements for access roads and foundations is huge. Manufacturers, developers, and the

BWEA are keen to understate the latter sources of emissions. Thus the BWEA states: "The average wind farm in the UK will pay back the energy used in its manufacture within three to five months, and over its lifetime a wind turbine will produce over 30 times more energy than was used in its manufacture."⁽⁵⁾ In fact the manufacturing stage is only a small part of the

total delivery and installation process, and although exaggerated claims exist that the full cycle creates CO₂ emissions which wind turbine operation can take up to 16 years to offset, a more realistic judgement is that they take up to three years to show a positive balance.

No judgement is made of the claim by Entec/Nuon UK Ltd. that over 1 million tonnes of CO₂ emissions will be saved over the assumed 25-year lifetime of the proposed development, except to observe that – in line with the above calculations – the lifetime savings would not be above 4000,000 tonnes on the basis claimed by the developers. It is known from Danish experience that turbines may be replaced within fifteen years.

Electricity Generated

Entec/Nuon UK Ltd. have claimed that with a rated capacity of 20.7 MW (nine turbines of 2.3 MW capacity), the Airfield Farm proposal would generate 5.589 MW of electricity at an assumed 27% load factor. This represents the actual UK average load factor achieved between 2000 and 2004. The UK Department of Industry's quarterly "Energy Trends" published a Special Feature in March, 2006, on Renewables which showed that for the years 1998 – 2004 the UK average was 28%. However, this average disguises significant regional variations. For Northern Ireland the figure was 36%; for Scotland 30%; for England as a whole 26%. Then within England there are significant variations, with North East England at 21% and East of England 24%.⁽⁶⁾ Both these figures reflect wind speed regimes significantly higher than the average wind speed in the area of Airfield Farm. Although there have been adverse criticisms expressed of the NOABL system, it is currently the most reliable official data source available. For the Airfield Farm location the UK Department of Industry (DTI) shows an average wind speed at a height of 10 metres above ground level of 4.9 – 5.0 metres per second (m/s).⁽⁷⁾ At 45 metres the average wind speed is 6.2 m/s. At a hub height of 80 metres the average wind speed can be expected to be barely 7 m/s. As various reports commissioned by the DTI have shown (e.g. OXERA, August, 2005), at average wind speeds below 8.5 m/s wind energy developments are unviable without massive and ongoing taxpayers' and government subsidy.

At such low average wind speeds, which are typical of Central England, load factors of 18% and below are to be expected. Although it has been correctly claimed that the UK has the best wind resource in Western Europe, that resource is not evenly distributed. The figures given for Northern Ireland, Scotland and English regions earlier demonstrates that point. The same is true for many other countries – which is why, in inland Germany for example, wind energy schemes have load factors as low as 12% against a national average in the range 22% to 24%. The latter figures reflect coastal Länder and offshore results.

The implications of seeking to place wind energy developments in low average wind speed areas are numerous: a misallocation of national, regional and local resources; intensification of cost and availability pressures on the industry (bearing in mind these large turbines were originally designed for offshore use); a reduction in regional, and thus national, load factors; and lower CO₂ emissions savings and electricity generated than claimed and anticipated.

The resultant outcome of wind energy developments such as Airfield Farm is that the load factor can be expected to be below 18% (compared to the 24% East of England average, and 27% national average), and could be as low as 14%. This has dramatic consequences for both CO₂ emissions savings and electricity generation. Instead of the 5.59 MW output ('net export') claimed by Entec/Nuon UK Ltd. the actual outcome can be expected, at best, to be no more than 3.73 MW – and could be as low as 2.90 MW (just over 50% of what the developers have claimed).

It may be of interest to record that the low average wind speed regime in Central England, and its implications, have been pointed out to various specialists, including Graham Sinden of the Environmental Change Unit, University of Oxford (whose recent work reflecting the UK's wind generic resource has been widely quoted) and the British Wind Energy Association. None of these specialists has attempted to counter the points made, presumably because they are inconvenient for their narrow agendas.

Homes Provided For

Entec/Nuon UK Ltd. claim that an average 10,000 homes will be provided for by electricity from the proposed Airfield Farm development.

For the reasons of low average wind speed and lower than claimed load factors, in fact at best only some 6,330 homes would be provided for (at worst closer to 4,900). Thus the developer has greatly exaggerated the possible benefit. For an area of England where energy from wastes, biomass and biofuels has far greater potential (leaving aside the possibilities of micro-generation) this is an attempt at imposing a gross misallocation of resources which has little or nothing to do with optimising renewable energy developments in the area or the country at large. As a doyen of the UK wind energy industry, and international authority on this subject, has remarked of this and similar plans in the area: "It's crazy!" Or, as the director of a leading national organisation concerned with sustainable development has remarked: "This is the sort of thing gifting the nuclear option to those who favour it."

In a broader context, the contribution of the proposed Airfield Farm development to electricity generation and CO₂ emissions is trivial. One need not look further than the CO₂ emissions generated at the adjoining Santa Pod Raceway, or those that will result from the planned expansion of Luton Airport, to confirm that view. Thus the claim in the main volume of Entec's Environmental Statement that the contribution to the reduction in greenhouse gas emissions will be "Significant" is a further gross exaggeration and distortion.⁽⁸⁾

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References:

1. The writer is Chairman, Policies Committee, World Renewable Energy Network and Congresses. Associate Editor: "Renewable Energy", a journal published by Elsevier. Described by, and appointed as, "Expert Reviewer" by the Intergovernmental Panel on Climate Change (IPCC), Working Group III, with special reference to energysupply and use matters. Previously a Lead Author, Contributing Author, Synthesis Report drafting team member, and Editorial Reviewer for the IPCC. Author: "Energy Policies for Sustainable Development", being the policies chapter of "World Energy Assessment: Energy and the challenge of sustainability", UNDP/UNDESA/WEC, 2000. Contributor/Lead Author: "World Energy Assessment Overview – 2004 Update", UNDP/UNDESA/WEC, 2004. Joint Editor: "Renewable Energy Sources: A Guide to the Future", Kogan Page, 1994. Author of numerous papers and reports on climatic change and energy matters. He has delivered papers on these matters in over fifty countries.
2. See Entec statement on behalf of Nuon UK Ltd., of September, 2005, Table 2.1, page 7.
3. See (2) *supra*.
4. See March, 2006, issue of "Energy Trends", Department of Trade & Industry, Special Feature: "UK onshore wind capacity factors 1998 – 2004", p. 29.

5. British Wind Energy Association at www.bwea.com/edu/calcs.html
6. DTI: "Energy Trends", March, 2006. Special Feature: "Renewables", Table 1, page 29.
7. See www.dti.gov.uk/cgi-bin/nre/noabl1.pl
8. Entec UK Limited/Nuon UK Ltd. "Proposed Wind Farm at Airfield Farm: Environmental Statement – Main Volume", Table 6.2, page 61.