

# An Ill Wind

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## Abstract

We, the residents of Planet Earth, are facing our greatest challenge ever: global warming. Centuries of plundering our reserves of fossil fuels have now set in motion possibly irreversible changes to our climate. If we are to stand any chance of averting global catastrophe we must urgently adopt an entirely new strategy for energy production, one based on clean renewable resources. In this article, we reveal the pros and con of wind farms. We show that the argument for a sustainable energy policy in Britain based entirely on wind turbines is overpowering.

## Quotation

*For they sow the wind, and they shall reap the whirlwind: he hath no standing corn; the blade shall yield no meal; if so be it yield, strangers shall swallow it up.*

— Hosea 8:7.

## Global Warming

Few reasonable-minded persons can fail to accept the inescapable truth that the Earth is undergoing one of the most rapid rises in temperature in its entire history. If care is taken to select the very best available evidence then the case for global warming is absolutely indisputable. For example, figure 1 shows part of the ‘HadCRUT3’ database of global temperature records compiled by the University of East Anglia's Climate Research Unit and the Meteorological Office.

Moreover, the evidence for global warming draws upon multiple sources:

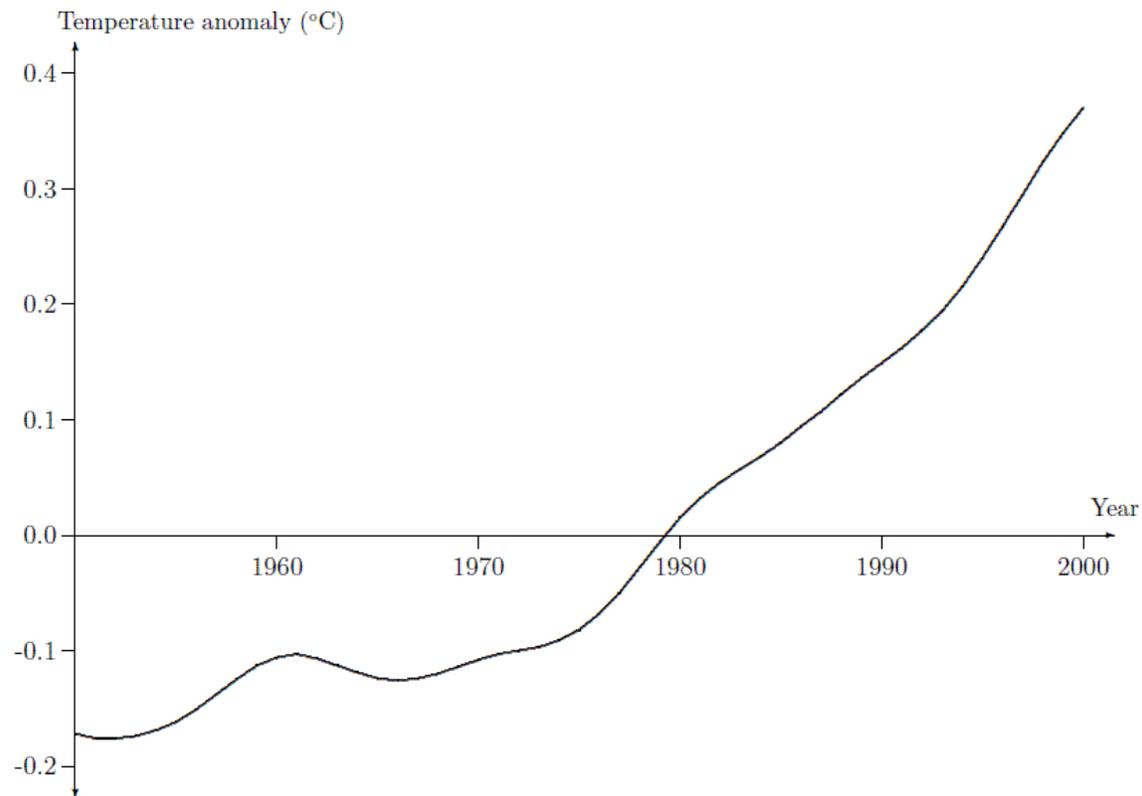
*That the world is warming is based on a range of sources: not only temperature records but other indicators such as sea level rise, glacier retreat and less Arctic sea ice.*

— P. Jones, Climatic Research Unit, University of East Anglia. Press Release 24/11/09.

Indeed, the prestigious Nobel Prize was shared by the Intergovernmental Panel on Climate Change (IPCC) in 2007 for its work in drawing the world's attention to the witnessed rapid melting of glaciers worldwide and imminent massive rise in sea level:

*Widespread mass losses from glaciers and reductions in snow cover over recent decades are projected to accelerate .... For instance, partial loss of ice sheets on polar land could imply metres of sea level rise, major changes in coastlines, and inundation of low-lying areas, with greatest effects in river deltas and low-lying islands.*

— Nobel Lecture by R.K. Pachauri, Chairman of the IPCC, Oslo, 10/12/07.



**Figure 1: Graph of global temperatures from 1950 to 2000 (smoothed HadCRUT3 [sic] data).**

Carbon dioxide released by Man from fossil fuels is causing global warming [1]. Anyone who suggests otherwise risks undermining the national interests. This is something that no responsible person should contemplate:

*... we mustn't be distracted by the behind-the-times, anti-science, flat-earth climate sceptics.*

— Gordon Brown, Prime Minister, Reported by the Guardian 04/12/09.

*The sceptics are playing politics with science in a dangerous and deceitful manner.*

— Ed Miliband, Energy Secretary, Reported by the Guardian 04/12/09.

The Climate Change Act 2008 requires that, by the year 2050, the UK reduces its carbon account to less than 20% of the 1990 baseline [2]. The solution is of course to turn to renewable sources of energy, but which?

## Why Wind Power?

Tidal and wave power schemes can make a small contribution to the UK's energy needs, but opportunities to exploit them are limited. Similarly, solar panels can be used on a small scale to help heat houses, but are not a practical option for replacing power stations in Britain. Biofuels also have a small role to play, but are impractical on a large scale because they compete with and displace essential food production. There remains only one alternative that will more than meet our future energy requirements if promoted with sufficient vigour: the answer is unequivocally wind power [3]. We are fortunate indeed that this is a limitless resource and in Britain we have an abundance.

The total energy consumption in the United Kingdom is approximately 230 million tons per annum of oil equivalent and has grown only slightly between 1970 and 2008 [4]. This is equivalent to 2,675 ( $= 11.63 \times 230$ ) Terawatt-hours of electricity. Averaged over a year this requires the continuous generation of 305 Gigawatts of electrical power if we are to be self-sufficient. Modern wind turbines have a capacity of 3 Megawatts when running at full speed. Since the load factor of wind turbines is approximately 28.2% [5], this means that on average a wind turbine produces about 0.846 ( $= 3 \times 0.282$ ) Megawatts. Therefore 360,520 ( $= 305,000 \div 0.846$ ) will be required.

One difficulty is that if wind turbines are placed too close to one another then there is a significant loss of power [6] and increase in noise due to wake effects. It is recommended that they are separated by up to 10 rotor diameters to avoid this problem [7,8]. The blade length of a modern, efficient wind turbine is about 45 metres so this means that turbines should be separated by about 900 ( $= 45 \times 2 \times 10$ ) metres. This means that each turbine requires a clear area of 900m<sup>2</sup>.<sup>†</sup> Now the surface area of the United Kingdom is 242,900km<sup>2</sup> (excluding the Channel Islands and the Isle of Man) [10]. Therefore, in principle, there is space for 299,877 ( $= 242,900 \div 0.9^2$ ) wind turbines. However, we must allow a one-mile exclusion zone around certain sensitive sites: for example, see [11]. Nevertheless, this amounts to a shortfall of at most 12 turbines for each such special location. As there are a total of 646 MPs in the House of Commons, this means that in the worst case, even if every MP had to be accommodated in the same way as the Prime Minister [11], we can still install a total of 292,125 ( $= 299,877 - 646 \times 12$ ) wind turbines. This should be sufficient if we allow for the possibility of deriving a little energy from offshore turbines and other renewable sources too. Moreover, although at first sight it might be thought impractical to place a wind turbine in a large town or city, they are in fact ideal locations and are already under serious consideration [12,13,14].

## The Beauty of Wind

Ill-informed scaremongers and trouble-makers inevitably try to oppose and spoil any new technological advance. Wind power is no exception, although it is quite frankly

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<sup>†</sup> This amounts to a capacity of 3.7 MW/km<sup>2</sup> ( $= 3 \div 0.9^2$ ) which corresponds well to the 7.8 MW/km<sup>2</sup> ( $= 1.3 \times 6$ ) suggested by PPS22 for a stand-alone wind farm in which turbines can be placed close to the boundary [9].

impossible to understand why. One of the commonest complaints advanced by protestors is that a wind turbine spoils the landscape in some way. In fact, nothing could be further from the truth. Even the earliest windmills are picturesque (picture 1) while the turbines of today are sleek and elegant statements of a modern age (picture 2). They are even gentler on the eye than old-fashioned first-generation wind-power devices and even less obtrusive, often described as “visually permeable” [15] which is a most apt description: for example, can you see the wind turbine in picture 3?



**Picture 1: First-generation wind power.**



**Picture 2: Modern wind turbine.**



**Picture 3: Can you see the wind turbine in this scene?**

Another frequently voiced concern is to do with “shadow flicker”, in other words the gently moving silhouette of the blades. Some persons claim that they are irritated by any such movement. However, shadow flicker is hugely exaggerated. Flicker effects have been shown to occur only within ten rotor diameters of a turbine [16], so for a 3MW turbine with 45 metre blades this is only up to 900 metres! In the UK, shadow flicker can only affect properties that lie 130 degrees either side of north [17] and this is only 72% of the compass! The phenomenon is extremely rare and, if it occurs at all, lasts only for a few minutes on certain days of the year [18,19]. In particular three very unlikely conditions have to be met for shadow flicker to arise.

1. The sun must be shining, which itself is a rare occurrence in the UK.
2. The sun must be exactly at right angles to the plane of the moving blades in order that the blades cut through the rays of sunlight [20].
3. The rotor must be turning.

One of the greatest fears voiced by residents near a proposed wind farm site is that of noise. While it is true that early turbines could occasionally be heard, modern ones are not only nearly invisible (picture 3) but virtually silent too: indeed it is possible to hold a conversation easily, without raising one's voice at all, right underneath a running wind turbine [21]! In fact, as table 1 shows, even at a wind speed of 9m/s, at a height of 10m above the ground a modern wind turbine produces a sound power of only about 107dB(A), which is significantly less than 140dB(A), the threshold of pain [22]. In any case, the public are adequately protected from noise disturbance from wind turbines by stringent regulations that have been drawn up by a dedicated team of wind farm experts. These regulations comprise a detailed technical document of 153 pages and are known as ‘ETSU-R-97’ [23]; they have been specifically designed to allay any fears that residents might possibly have about noise from proposed wind farms. Besides which, if any resident does complain about the noise, the local council will ask the wind farm operator to arrange for the matter to be looked into [24]. A detailed survey of 133 wind farms operating in the UK showed that barely 1 in 5 have generated formal complaints about noise [25]. Luckily about 90% of persons who suffer adverse noise do not actually make a formal complaint [26]. This is important as future turbines will need to be much larger than those in the study.

The very low level of noise associated with a wind turbine would indeed be completely drowned out by ambient noise in towns and cities [21]. This is in some ways unfortunate because many persons find in the sound of a wind turbine delightful reassurance that the country's energy needs are being met in an ecologically sustainable way: for example, see the comments by Professor John Twidell made to the Swinford Inquiry [27]. However, built-up areas are ideal locations because wind turbines blend perfectly with modern buildings and are like moving sculptures that enhance the aesthetic qualities of the architecture. Moreover, there is more than adequate clearance between the tips of the

rotor blades and the tops of average buildings: see table 1 and figure 2 for details. Heat rising from buildings and obstruction to airflow near the ground will help to avoid stable atmospheric conditions occurring that have been thought in the past to lead to loud thumping noises (“aerodynamic modulation”) from wind farms [28,29], although this might often just be imagination [30].

Parameter	Value
Electrical power (max)	3 MW
Sound power (10m high, wind 4m/s)	97.9 dB(A)
Sound power (10m high, wind 9m/s)	106.9 dB(A)
Hub height	80m – 105m
Rotor diameter	90m

**Table 1: Specification for Vestas V90-3.0MW wind turbine [31].**



**Figure 2: Modern wind turbine compared to 8 metre tall house.**

Another theoretical objection to wind turbines that one frequently hears voiced is the possibility that in freezing conditions ice might form on the blades and be subsequently thrown off. These concerns are somewhat fanciful for several reasons.

1. Ice forms only during periods of intense cold when high pressure forms over the country. During such periods, as we saw in the winter of 2009/2010, there is no significant wind. Ice cannot possibly be thrown from stationary rotors!<sup>†</sup>
2. Modern wind turbines have sophisticated ice detection sensors [31].
3. Ice will be a rare commodity indeed within just a few years owing to global warming.

A much more realistic consideration is the effect of wind turbines on wildlife. The occasional bird strike has been known to occur but the numbers are insignificant compared to those killed by vehicles on the road or aircraft in the sky. Moreover, the latter contribute significantly to global warming; climate change is a much greater threat to birds than collision with rotor blades! Besides which, pigeons are a nuisance, particularly in cities where they congregate in large numbers and damage stonework with acidic droppings. Although uncertain, and we would not wish to make any false claim, it seems plausible that the installation of turbines at 900 metre intervals across London and other major cities will be effective in controlling the pigeon population.

Similarly, many residents are troubled by moles which damage lawns and playing fields. Fortunately, moles are repelled by beating and pounding of the ground. Reverberations at multiples of blade-passing frequency can be readily detected at more than 10km from wind farms [32] and we are pleased to report that the first successful eradication of mole infestation at 930 metres has already been documented [33]. No mole in the United Kingdom will be more than  $636 (= 900 \div \sqrt{2})$  metres from a wind turbine under the present proposal, except for those in sensitive areas [11]. (Members of Parliament who are proud of their lawns might prefer to take this into consideration before deciding whether to invoke their powers of exemption.)

Lastly, let us turn to the thorny issue of the effect on property prices. This is the one criticism of wind turbines that is actually valid and it would be disingenuous of the wind farm industry not to concede the self-evident truth that inevitably prices will significantly rise [34]. Under the current highly restrictive planning laws, ecological pioneers have been extremely reluctant to invest in projects that are almost certain to be refused out of hand. This is because parochial, local planning departments do not have the national interests at heart. Following the paradigm shift in planning procedure that will be necessary if we are to save our planet, no obstacles will be placed in the way of green developers. This means that, without further hesitation, landowners will be handsomely

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<sup>†</sup> *During becalmed periods we should buy our energy from a neighbouring country such as France which has not yet implemented the same energy policy as ourselves and still has conventional power sources. However, this will entail upgrading our cross-Channel electricity link which unfortunately has only a 2GW capacity at present [7].*

rewarded for offering parcels of land that previously would fetch only a few hundred pounds on the open market. House prices too will be driven upwards by the increase in land value: enlightened persons who understand and appreciate the benefits of wind turbines will be keen to purchase the properties that are closest to turbines. (Members of Parliament might wish to consider this too rather than risk missing out on the coming new property boom, especially as they can no longer claim expenses on a second home.)

## The Road Ahead

The vision for a future Britain based on clean, sustainable energy is a universally accepted goal. However, it will be a struggle to achieve and there is no easy option. We suggest the following strategy for politicians/developers to overcome the anticipated (but totally unfounded) widespread resistance that is likely to be encountered from mis-informed local residents about implementation of the national array of wind turbines.

1. **Offshore** — Large wind turbines are more likely to be accepted if the public think that they will be placed out at sea. Therefore whenever discussing wind turbines always do so in the context of offshore sites. Despite the horrendous costs of construction and maintenance and the colossal difficulty of connecting them to the national grid, some offshore turbines will be needed anyway to assist in the 68,395 (= 360,520 - 292,125) shortfall of onshore ones. So think of the offshore turbines as a loss-leader in the enterprise.
2. **Increment** — Rather than make the intention explicit and risk public shock and misunderstanding, overcome resistance incrementally. Construct the national array one small piece at a time, each segment referred to as a “wind farm” or by some other innocuous agricultural term. It is best to start in areas of relatively sparse population and limited political leverage such as the Borders or Wales, but some should be in the Home Counties too to test the water. At least one should be in London at an early stage. It is important that the turbines are distributed everywhere otherwise large protected zones might form. Once the public are used to seeing turbines wherever they look it will be easier to fill in the missing sections (except in sensitive areas [11]).
3. **Shame** — Suggest to the public (though of course not to politicians [11]) that to be against the erection of wind turbines near their homes is socially unacceptable, like not wearing a seatbelt or driving past a zebra crossing: make the ordinary resident feel as guilty as possible for having subversive thoughts about offering any resistance.<sup>†</sup>
4. **Temporary** — Pretend that the “wind farms” will be temporary, say lasting 20 years or less. Many of the local residents who opposed the original planning application will have died or more likely left the area by then anyway. This will make it doubly easy to “re-power” the wind farm with even larger turbines when the time comes to upgrade and coalesce with its neighbours!
5. **Name** — The development companies should have sensitive, green name like “Sustainable Solutions”, “Community Energy”, “Clean Power” etc. It would be most

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<sup>†</sup> *As much as we would like to, we cannot claim credit for this superb idea as apparently it has already been suggested by Ed Miliband, the Energy Secretary [35].*

inappropriate to use a title that emphasizes the huge corporate profit<sup>†</sup> such as “Industrial Hyperturbines Ltd”, “Whirlwind Investments Inc”, “Global Wind Enterprises” etc.

6. **Investment** — It is vital that speculative venture capitalists continue to fund the assembly of the national turbine array despite the significant risk that the bubble might burst owing to widespread public opposition [33,36] and/or the credit crunch [37]. Therefore emphasize the morality of the investment in terms of saving the planet.
7. **Empathy** — “Wind farm” developers should frequently express total conviction at involving the community and consulting with the local people. They should remind themselves and take comfort in the fact that on each occasion it is only a temporary irritation until planning approval is obtained.
8. **Support** — Make liberal use of the groundswell of support that is freely available from radical environmental groups. For example, a unique supporter's letter can be generated automatically by anyone over the internet in order to outnumber local residents who might oppose an application [38], nobody really cares where they live anyway. It would of course be much better if local planning authorities could be bypassed altogether. It is reassuring to see that moves are afoot to do this [7,39,40]; the salvation of our planet is a battle and democracy has to be suspended in time of war.
9. **Nuclear** — Give tacit support (but not too vocal please as it has a bad press) to the nuclear industry because sadly, no matter how much we would wish to, we simply cannot erect the national turbine array overnight. Nuclear fuel will run out in about 40 years time and that will dovetail nicely with the final touches to the national array.
10. **CO<sub>2</sub>** — Avoid too much reference to carbon dioxide in case someone suggests capturing it from the combustion products of fossil fuels; this would make wind turbines completely redundant at the present time as they are not economically competitive. However, it will be a lot easier to implement the national array now while climate change is the focus of everyone's attention than in 200 years time when fossil fuels run out. (Also, there might be a tricky problem with wind turbines and claims about carbon saving.)

## Epilogue

Regrettably there are reports that Denmark has made no carbon saving at all despite generating 19% of its electricity from wind [41]. Worse still, experts are now beginning to voice criticism of the global warming movement itself [42,43]. The next thing that they will be telling us is that the Himalayan glaciers are not about to vanish after all! At best this is extremely embarrassing. At worst it may in time completely undermine pseudoscience without which the wind farm industry would not be where it is today. If further ghastly revelations of this kind are permitted it will indeed be an ill wind that blows no commercially opportunist wind-farm entrepreneur/landowner any good at all!

*B.S. Todd 08/03/10*

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<sup>†</sup> *From Renewables Obligation Certificates and Climate Change Levy exemption whose cost is ultimately passed on to the electricity consumer [7].*

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