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A RULE OF THUMB FOR UK WIND TURBINE OUTPUT

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In *Getting the Measure of Wind*, we saw that a wind turbine with1 MW (1 million watts) of rated capacity would provide 1600 UK citizens with 20% of their electricity requirements of 0.75 kW each (that is including direct and indirect requirements). That rule of thumb is easily varied to suit other wind situations, but we want to be sure it is right. The argument was arrived at by what may be thought of as a tortuous chain of logic. Some people, like me, suspect that a weak link may be lurking in any such chain. So let's work backwards from the result, to see if it gives what we would expect, or at least just *roughly* what we would expect, as we want to dodge around mathematics and logic as far as possible. Also let's try to keep to things that we can see and feel, like horses. Electrical power is such an abstract concept. Unfortunately we will have to start with a bit of mathematics.

We need to note that 1 MW is equal to 1000 kW (kilowatts). Then we have to take into account that the average infeed factor (the proportion of electricity fed into the grid compared to the rated capacity of the wind turbines) is 24% in the UK. So that means that 1000 kW of rated capacity is going to deliver 240 kW. If we divide this largesse among 1600 people, then each person will get 240 / 1600 = 0.15 kW.

The trouble is that the 0.15 kW will not arrive steadily. Here I think we need an equestrian analogy. Imagine we have two horses in harness, both with about the same power but they are different in temperament. The one called Windy is entirely erratic, occasionally pulling at full strength and sometimes mooching along without pulling at all. The other horse, Steady, will readily adjust his power output from nothing to full power to accommodate Windy's moods. By these means, the carriage proceeds at a steady pace.

Keeping our analogy close to the reality of wind, at first sight it might appear that Windy would only contribute the aforementioned 24% while Steady would have to do the remaining 76%. But actually things are not as bad as that when the wind turbines are connected over a wide area. For instance, if wind turbines were connected up all the way around the globe, then they would probably produce an absolutely steady 24% infeed factor, which would make them just as steady as Steady would be if he did not have to work in harness with Windy It is not practical to connect up wind turbines all around the globe, and in the UK we will probably have to settle for connecting them up over about 800 km. That serves to bring the peak infeed factor down from 100% to 80%.

Let's not trouble ourselves with mathematics at this point, but instead rely on a seat-of-the-pants feel for the likelihood that depressing the peak infeed from 100% to 80% will do enough good to improve the contribution that Windy can make from 24% to 30%. OK?

Now we can remind ourselves that the wind turbines are only going to provide 0.15 kW to each person (for each of the 1600). That tells us that with Windy doing 30% of the work, Windy and Steady between them are going to give us 0.15 / 0.30 = 0.5 kW.

One trouble remains. That is the cab driver. He doesn't want a steady speed. Often he wants to go far faster than Steady can manage. Thus we have to hitch a third horse to the carriage. This horse, Perky, is as powerful as Steady and has the same temperament. He will produce nothing or go full tilt as the cab driver wishes. Over the year, Perky adds an average 0.25 kW, so producing the full 0.75 kW desired by the cab driver. As noted above, this is exactly the amount that UK citizens want (in the form of electricity). Can you think of better harness arrrangement for Windy? If not, then it is apparent that there is no way we can change things in the UK (or USA actually) to make Windy provide more than 0.15 / 0.75 = 20% of the energy. Thus 1 MW of rated wind capacity will provide 1600 UK citizens with 20% of their electricity requirements, *but never more than 20%.* Q.E.D.

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