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Examination of WWF Scotland's Claims for Wind Generation in November 2014

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“The incidence of high wind and low demand can occur at any time of year. As connected wind capacity increases there will come a point when no more thermal plant can be constrained off to accommodate wind power. …………………………**This indicates the requirement for a major reassessment of how much wind capacity can be tolerated by the Grid.”**

ANALYSIS OF UK WIND POWER GENERATION
NOVEMBER 2008 TO DECEMBER 2010
March 2011

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Introduction

On 8th December 2014, WWF Scotland circulated a press release which started as follows:

> 'Big month' for wind power in Scotland - new data published
>
> **8 December 2014**
>
> **November 2014 was a "big month" for wind power in Scotland, new figures published today (Monday 8 December) reveal. [1]**
>
> Analysis by WWF Scotland of data [2] provided by WeatherEnergy found that for the month of November:
>
> • Wind turbines alone generated an estimated 812,890MWh of electricity to the National Grid, enough to meet the electrical needs of 107% of all Scottish households for the whole month – the equivalent of 2.6 million homes.

WeatherEnergy provide details of how, in the absence of official figures, they estimate Scottish only wind generated electrical output. The calculation of 812,890 MWh is accepted for the purpose of this paper, along with the assumption that average household consumption is 3790MWh and that there are 3.27 m households in Scotland.

However, WWF's claim that the wind energy "met the electrical needs" of numbers of Scottish homes is not accepted. We offer a definition of electrical need as follows:

The electrical need of all users is to have the required amount of electricity at the right time to do the job in hand, no more and no less - every time and at reasonable cost.

This paper looks at the patterns of wind generation and consumer demand for November 2014 and investigates the WWF claim that wind generation met the "electrical needs" of consumers. This paper shows that while wind did indeed produce sufficient equivalent electricity in aggregate, it did not meet their needs at all times. The needs of consumers were only met by having other forms of generation available to provide the power when wind was incapable of doing so.

Of course all generating stations require to be supported by others in the event of plant failure. However, the argument frequently advanced that wind energy is no different in this respect from fossil or nuclear plant is a false one and this paper demonstrates that the weather dependent, random intermittency of wind generation presents an altogether more complex and expensive grid operating and backup challenge.

The rosy picture painted by WWF is far from the reality of any significant dependence on wind for our electricity.

Method

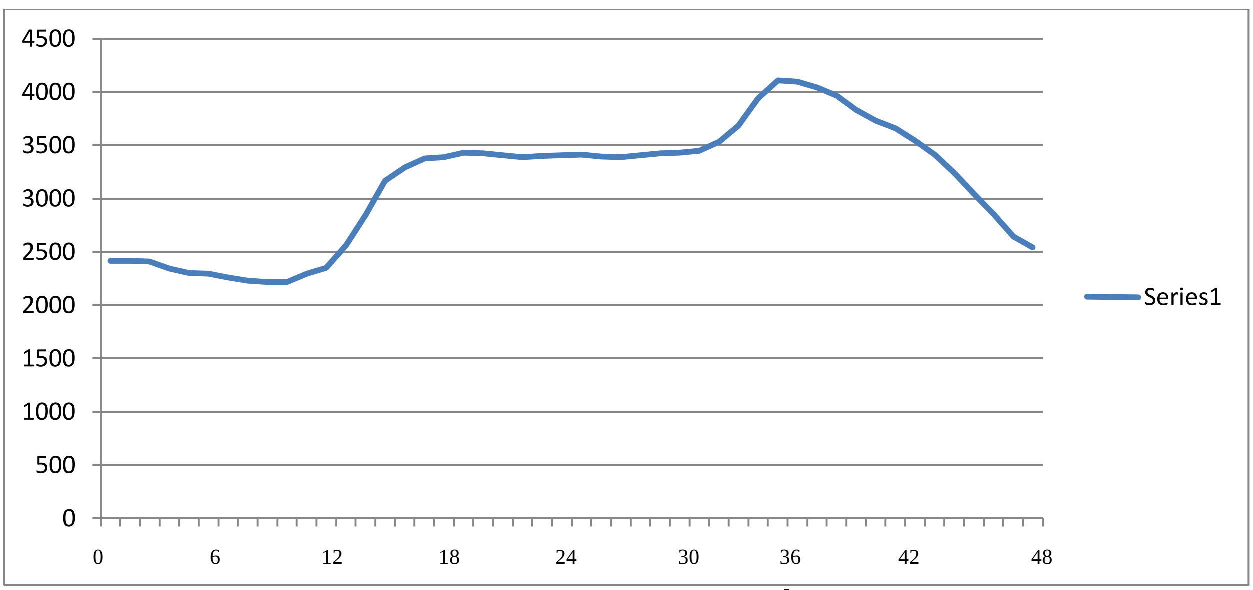
UK demand is taken as the actual total monthly UK electricity generation as recorded at half hour intervals and obtained from the ELEXON website. Scottish demand is taken pro rata to population i.e. 8.3% of the UK total, and distributed to the same pattern as UK demand.

Scottish total wind generation output is taken from the WE website and distributed to the same pattern as UK output.

Graphs are shown for demand and wind output for November 2014.

Demand pattern – explanatory note

The graph below is derived from Scottish demand figures for Wednesday 5th November 2014, calculated as above. The figures along the bottom represent the forty-eight half hour periods recorded by NG, so 0 is midnight, 24 is midday and 36 is 18.00 (6.00pm). The vertical scale is in Megawatt hours (MWh).



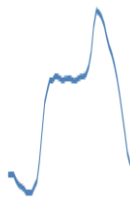
Scottish demand on Wednesday 5th November 2014

This is a typical example. By midnight, demand is fairly low and it drops further to a daily low around 5am. Then it rises until it plateaus around 9am. Around 3.30pm it starts rising again, peaking around 5.30pm from which time it falls again to a fairly low level at midnight.

Demand follows the daily rhythm of sleep, get up, have breakfast, go to school/work, come home from school/work, have supper, relax, go to bed, sleep.

This is the underlying pattern of demand every day. It varies from the working week to the weekend, at holiday times, from summer to winter, by the weather, and for big events such as the Commonwealth Games, but the underlying pattern is always the same. Put simply, the demand graph represents the "electrical needs" of the consumer.

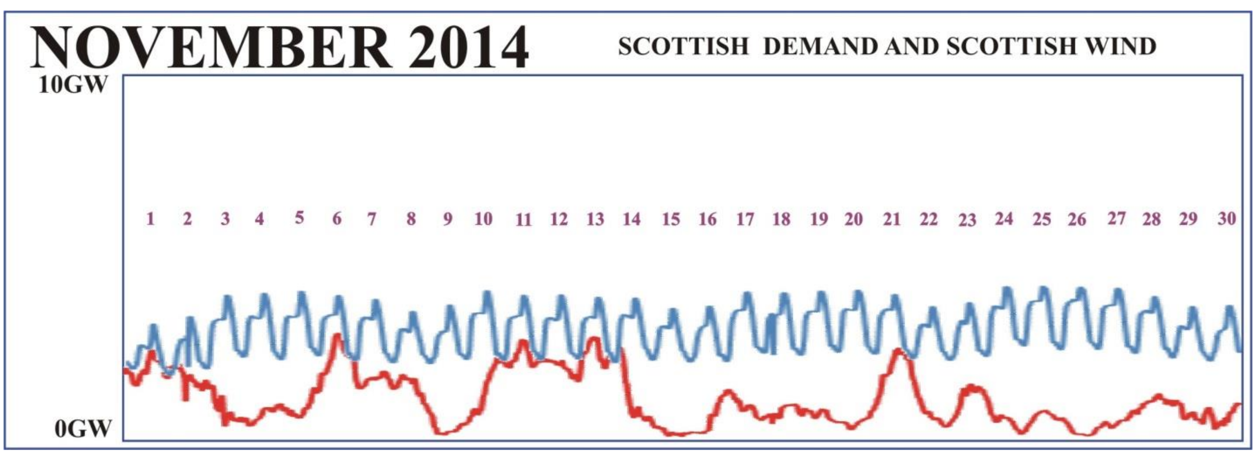
In the monthly graphs which follow, the pattern shows as distinct spikes, plateaus and troughs due to the need to fit the graph to a finite width of page, but the information remains the same. Each day's demand from midnight to midnight appears as an interlinked curve similar to this:



On occasion, instrumentation recording the generation output has technical faults and a rogue pattern of low or no demand is recorded. This accounts for the aberrations recorded on 2nd and 18th November.

November 2014

This graph shows demand and wind generation for November 2014.



The blue curve is demand - which equates to need - and the red curve is wind output. Demand follows a regular and predictable pattern. Wind generated electricity delivery is chaotic with no parallel relationship with demand (need). Clearly the need to have electricity **"at the right- time to do the job in hand"** would not have been served.

- There were high levels of generation on six days of the month, and there were low levels on nineteen days of the month.

- On four days, in terms of satisfying the electrical needs of the nation, wind output was effectively zero.

- On four occasions, wind output equalled or exceeded total demand

Wind output equalled or exceeded total demand

Let us examine “wind output equalled or exceeded total demand”. On the face of it, it sounds like a good thing. But was it?

National Grid (NG) has to ensure that enough generation is available at all times to meet demand and can rely principally on nuclear, hydro, coal, and gas to provide it - subject of course to plant failure, for which NG makes specific additional arrangements. So the fact that wind was virtually non-existent on three occasions and very low for a significant part of the month was not apparent to consumers - their electrical needs were met. The generators which meet that need when wind is low are still around and having to be paid when randomly a surplus of wind generated electricity becomes available.

When it is faced with an excess of generation in Scotland, NG has only limited options. Surplus electricity can be dispatched across the Scotland/England interconnector but that has limited capacity and England does not necessarily need or want surplus generation from Scotland at all times.

The other option is to close down (constrain off) surplus generation for which NG pays compensation, but even here NG’s options are limited. When the cross-border capacity is fully used, Scotland’s generation must be balanced in isolation. Nuclear cannot be closed down and sufficient responsive generation (fossil or hydro) must be maintained to keep the grid balanced within frequency limits.

The engineers in NG know what to do in such circumstances and that is to shut down the surplus wind generation, but NG is a Limited Liability company and its first duty is to its shareholders, so the accountants won’t allow the engineers to do what is economic for the customer and technically sound in generation terms. The reason is that wind attracts Renewable Obligation Certificates (ROCs) which effectively makes wind twice as expensive compared to coal or gas, and therefore at least twice as expensive to constrain off so NG always constrains off coal or gas in preference to wind, unless it has no other option for operational reasons.

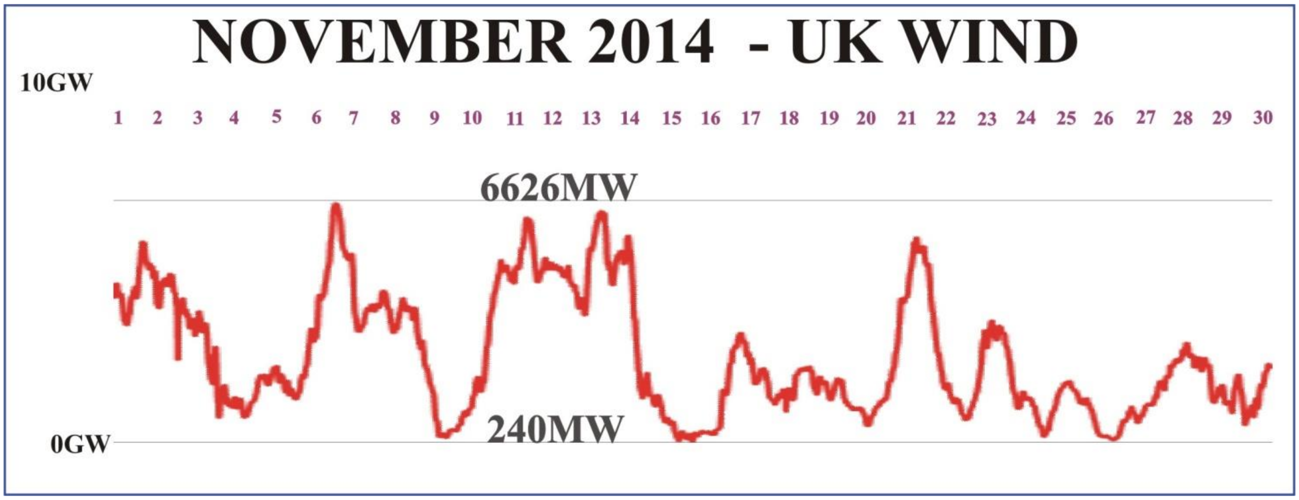
On the occasions when wind theoretically met the nation’s electrical demand, the consumers were paying gas and coal generators for not generating and at the same time paying wind generators twice as much for their electricity, and that situation persists to varying degrees whenever wind output rises.

Furthermore, when all other options have been exhausted, NG must finally constrain off wind generation at ransom-level prices averaging at the time of writing £73 for the loss of a ROC worth about £45.

Back up for wind energy is no different to back up for fossil or nuclear plant

Let's examine that claim.

To examine this statement, we consider November 2014 output from wind for the whole of the UK as shown in the following graph.



It can be seen that wind generation adds to the technical challenge of managing the supply of electricity and as wind capacity increases, this challenge will become greater if not impossible. The unnecessary duplication of generating systems (wind plus fossil) with one displacing or supporting the other adds significant capital costs to the overall electricity generating system.

Support for fossil and nuclear generation and support for wind is not the same. Support for fossil and nuclear is capacity which can be turned on to replace electricity which would otherwise be lost in the event of unexpected plant failure.

Reserve generation supporting wind commonly described as "backup" is hot standby generation to cover shorter term increases/decreases in wind speeds. Beyond that, baseload generation is shut down when wind rises, and switched back on when it drops. This is also commonly, and erroneously, described as "back up" as there is no reserve generation maintained to replace generation lost when the wind is absent. Rather, wind competes with baseload generation for its place in the generation mix and wins, but not on normal criteria such as "best" or "cheapest".

Wind always wins because, due to the value of the Renewable Obligation Certificate, it is the most expensive generation to National Grid to constrain off when there is too much electricity being produced. This displacement of previously contracted generation adds further consumer costs due to the displaced generation having to be paid constraint payments.

Back to electrical “need”. Did wind generation provide electricity at “reasonable cost” during November 2014? Given that it starts twice as expensive as coal, gas or nuclear, the answer is already NO before we even consider the operational costs of allowing wind generation on to the grid.

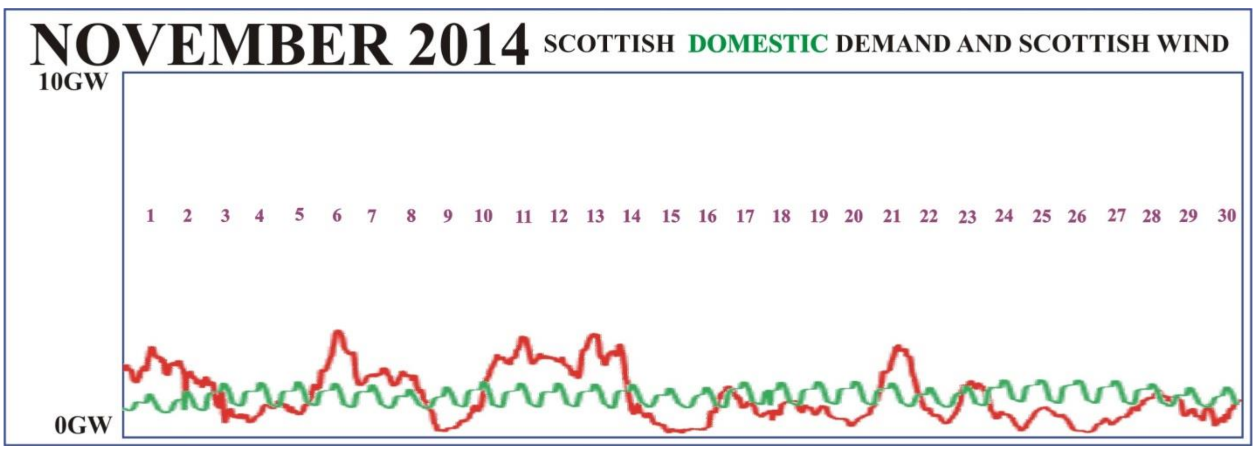
Homes supplied

WWF, and virtually every wind generator, regularly cite the number of homes supplied or "meeting the needs" of numbers of homes but electricity supplying homes cannot be segregated from electricity supplying everything else, so to claim or suggest that by generating an equivalent volume of electricity to the total required by all those homes is no more relevant to reality than determining the number of domino tiles required to be laid end to end to stretch around the world. It is a number of no worth whatsoever.

What is important is how the electricity is delivered, and how relevant it is to the needs of society.

It is fanciful but if we imagine that **homes only** could have been supplied with wind generated energy in Scotland in November 2014, how would that have worked?

Domestic consumption is variously estimated at being between 35% and 40% of total demand so for this illustration, 37.5% of the demand calculated for Scotland alone has been used in the following graph. Domestic demand is shown in green, and Scottish wind generation as previously calculated is in red.



In this scenario, wind output was 1129MW on average, and demand would have been 1142MW on average, effectively the same. However, this would be a very difficult scenario for National Grid to control. One third of the time, too much generation; two thirds of the time, too little.

Only on the sixteen fleeting occasions where the red and green lines coincide, would precisely the right amount of electricity have been supplied. That however is analogous to believing that a stopped watch is more accurate than one which is five minutes slow, in that the stopped watch is correct twice a day but the slow watch is never correct.

Conclusion

Scottish wind generated electricity in November failed on all counts to satisfy the electrical needs of the consumer which were:

"to have the required amount of electricity at the right time to do the job in hand, no more and no less - every time and at reasonable cost."

Finally, to illustrate the gravity of the present situation, wind generators have been paid £113m since 2010 to stop generating when there is no outlet for their excess production. £37m of that has been paid since 1st October last year, including £8m in the first 15 days of 2015. Newspaper headlines recently proclaimed that wind constraint costs were £1m a week in 2014. In the first half of January 2015, it was half a million pounds a day.

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