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P5_6 White Elephants

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Abstract

The government recently gave the go ahead for the construction of Hinkley C, a 3260MW nuclear power plant. The project will cost £16bn. We investigate the power output achievable if the money was instead spent on constructing onshore wind farms. We find the total energy produced from the nuclear plant is 1.63 times that of the wind farms over an 80 year window.

Introduction

A recent news article [1] has informed the public of the government's decision to allow the construction of Hinkley C, a $3260MW$ nuclear power station in Somerset [2]. The plant will be completed in 2023 and will last 60 years. In the comment section of the BBC news article there was the following quote [1];

> **David Parker**
> 21ST OCTOBER 2013 - 11:57
> "A good deal for the taxpayer I wonder? £16bn and ten years at least before a single Megawatt comes out of it. The installed and connected cost of a 2MW wind turbine (average) is £2.5m. So we could have 6,500 x 2MW turbines for £16bn and they would be adding to the grid incrementally from day one and with grid scale battery tech moving apace, Hinkley would emerge as a costly white elephant."

We investigate the scaled power production and overall efficiency of such a scheme.

Details

We found the cost of a $2MW$ onshore wind turbine is quoted at $\sim£3m - £4m$ [3] instead of the $£2.5m$ suggested in the comment. We therefore assume a price of $£3.5m$ per turbine bringing the stated quota to $4{,}571$ turbines. The average lifetime of a wind farm is quoted at ~ 20 years (240 months) [4] [5]. However, the actual time that the farm is generating power is only $120{,}000$ hours bringing the efficiency of the turbines to 66% [4], effectively outputting an average power of $1.32MW$ over its lifetime.

We propose the construction of onshore wind turbines, from January 2014 at a rate of 7 per month. This build rate was chosen to scale the energy production over the lifespan of the nuclear plant as seen in Figure 1. It was assumed that any financial interest gained on the available funds at least scaled with inflation over the course of these 60 years such that this constant build process could remain active. The build time for a turbine is taken to be 2 months [5], after which it was assumed to add energy to the national grid at the previously calculated average power of $1.32MW$. Turbine production can continue for ~ 55 years until the original budget has been spent.

The construction time of the nuclear power plant is estimated at 10 years [1]; after this time we assumed the power production would be a constant $3260MW$, as stated in the specification [2]. The plant will last 60 years at this level of power production. The results are shown in Figure 1.

The total energy produced from each scheme is the area under the two graphs in Figure 1. The area under the nuclear operation graph sums to $6.168 \times 10^{18} J$. The area under the wind operation sums to $3.774 \times 10^{18} J$. Thus, taking the ratio, the nuclear program produces 1.63 times the energy of the wind program over the 80 years depicted.

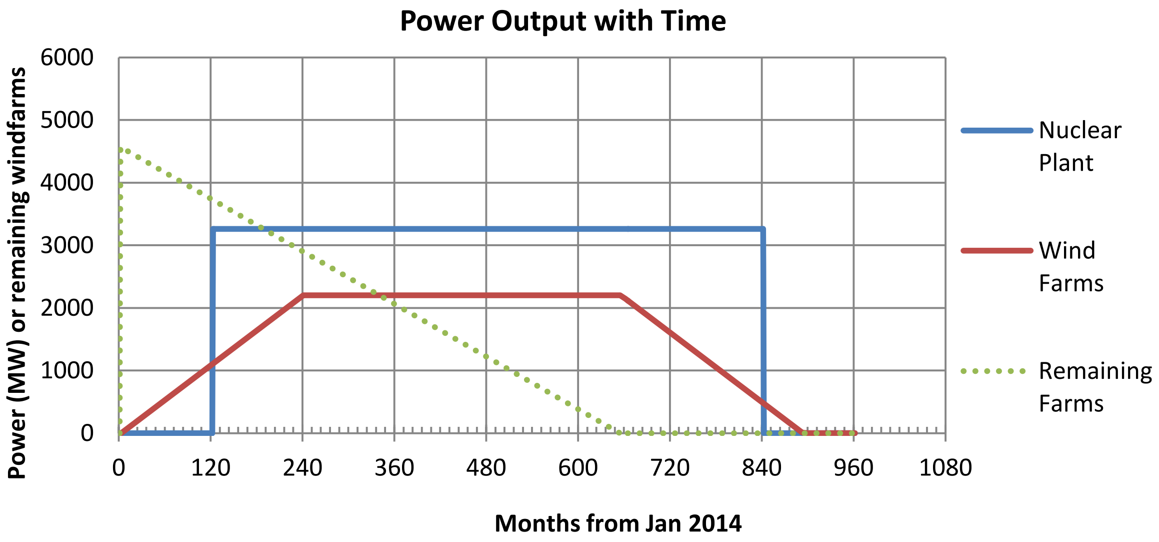

Figure 1: Comparison of power output as months progress from Jan 2014. The two methods of power production can be compared here. The dashed line represents the remaining quota of wind farms to be constructed.

Discussion

Figure 1 shows that as soon as the nuclear facility is switched on it is generating energy at a much greater rate than the wind farms. This continues for its 60 year life time where in the last 15 years the wind turbines steadily decommission.

One benefit of the wind program is that the money is not immediately spent leaving open possibilities of investment above the inflation rate. However, this opportunity has some risk associated with it and may not make up the difference in energy production seen here. Furthermore, the risk of the wind farm program is less orientated on one object. If the nuclear plant had to shut down the whole power output (or at least one of the two $1630 MW$ reactors) would cease contributing to the power supply. If a single wind turbine had issues the result would barely be noticed.

Conclusion

The nuclear operation is 1.63 times more productive than the wind operation over the course of the 80 years monitored. It would appear that the money is better spent on the nuclear plant if everything runs smoothly. We assumed all the wind turbines would be onshore however in practice some of these may need to be moved offshore driving up the cost per wind turbine further.

References

[1]http://www.bbc.co.uk/news/business-24604218, last accessed 23/10/2013.
[2]http://www.edfenergy.com/about-us/energy-generation/new-nuclear/hinkley-point-c/whats-happening.shtml, last accessed 23/10/2013.
[3]http://www.windustry.org/resources/how-much-do-wind-turbines-cost, last accessed 23/10/2013.
[4]http://www.windmeasurementinternational.com/wind-turbines/om-turbines.php, last accessed 23/10/2013.
[5] http://www.ewea.org/wind-energy-basics/faq/, last accessed 23/10/2013.