WHAT CAN WE DO WITH ELECTRICITY FROM WIND AND PHOTOVOLTAICS?

Even if we assume intermittent electricity is free (or it is decided society will pay for it, regardless of cost) it is difficult to find useful ways to consume it.

The first few wind turbines and photovoltaic panels superficially seemed to serve a purpose. The myth was still pervasive, in those days, that fossil carbon emissions merely needed reducing rather than eliminating completely. And electricity was largely generated from high-carbon fuels like coal, so displacing some of it with low-carbon generation really did reduce emissions. Nowadays, we are aiming for zero fossil carbon emissions, and it is obviously misguided to replace existing (largely gas) generation with a combination of gas and renewables.

Since wind and solar generation sometimes reaches zero, none of it can be relied upon for grid use or continuous industrial processes. That means, for such uses, 100% of it must be duplicated by other generating sources which are dispatchable. Most countries cannot expand their geothermal or dam hydro generating capacity much, so the remaining low-carbon dispatchable sources are nuclear and, in some places, some run-of-the-river hydro. There is no point in using wind or solar in parallel with either of these because neither of them can usefully be turned down in order to save their fuel. Instead, the result would be that, whenever intermittent power became available, their power production would just go to waste. Nuclear fuel is so environmentally low-impact and cheap compared with the expensively maintained nuclear plant that there would be no real reason to try to save it, whereas river flow obviously cannot be turned down. (These combinations have actually been tried, with adverse and expensive consequences.)

Gas-fuelled generation does work well with intermittent renewables, because gas fuel is cheap and gas-fuelled generating plant is expensive, so turning it down whenever there is wind or sun does save money and resources. If fossil gas can somehow be made harmless to the climate, then here is a solution. It is alleged (but it sounds unlikely) that carbon can be captured from the exhaust of gas-fuelled generators and permanently stored in old oil and gas wells, without using much energy to do so. A slightly more credible recent announcement is the successful development of a gas turbine which runs on fossil gas and oxygen (instead of air) to produce CO_2 exhaust which is pure enough to be buried in old gas or oil wells with almost no extra processing or energy requirement. Indeed, lots of oxygen will be freely available in future because it is a by-product of the splitting of water to produce hydrogen. Either of these carbon-trapping approaches will slowly use up the available gas and oil wells and will carry the risk of CO_2 eventually escaping. However, CO_2 can also be stored permanently and safely in underground deposits of basalt, which is plentiful enough to store all anthropogenic fossil carbon but not always available near to desired generating sites.

It is clear that intermittency cannot be economically or practically cured with such things as interconnectors or demand management. Similarly, beyond the topographically limited (and largely already exhausted) potential for pump storage, there is no realistic hope of efficient and affordable grid-scale electricity storage. The nearest feasible thing is conversion of water to hydrogen, then underground storage of the hydrogen, then conversion back to electricity. If done with simple cold electrolysis, this loses much of the energy in the process, thus resulting in the re-created electricity having an unacceptably high carbon intensity and cost. Most of the hydrolysis plant would inevitably stand idle most of the time, reducing the efficiency further and further increasing the carbon intensity, and this leads us to expect that the decision would be made to discard a lot of the intermittent electricity, also increasing the carbon intensity of the remainder. Fortunately, a similar but more efficient process uses heat, which will be available at nuclear plants, as well as electricity. It would seem a bit perverse (and expensive) to convey intermittent electricity to nuclear plants which typically have quite a lot of electricity already, but at least that would be a way of using up some of the intermittent electricity from wind or solar. More efficient still (but not yet widely available) is splitting of water to create hydrogen using high temperature nuclear reactors, but this is basically done without use of electricity so this could not serve as a way of using up the output from wind or solar generation.

From all the above, pending more information, it seems unlikely that wind or solar generation can sensibly contribute to the grid, although the grid might be used to transport it to somewhere if some other use for it can be found.

What, then, can we do with intermittent electricity? Intermittent power, it turns out, is remarkably un-useful stuff. The problem is not just that we might have to wait a long time for it to turn up, but also that much of it often never will turn up. Some applications, like pumping of water for drainage or water supply, might be able to wait quite a while for their electricity if necessary, because they usually don't need doing immediately. But such things absolutely do need doing eventually, typically within hours or days, to avoid disastrous consequences. The same applies to manufacture of most things, if the things are worth manufacturing at all. It might seem that most industrial processes could cope with interruptions if necessary but, in the real world, we can predict they would not put up for long with such grievous lost utility and efficiency, at least without good reason. In practice, electricity is only of real value if it is continuously available.

Inevitably, as the most scalable low-carbon source, nuclear will eventually not only be dispatchably providing almost all electricity but will also be creating a surplus whenever demand is not at maximum. The surplus will, of course, vary in available power, but it will not vary anywhere near as problematically as renewable electricity tends to (as apparent, for example, from comparison of the two frequency distributions). This varying surplus from nuclear generation will compete for use, and possibly also for payment, with the varying "surplus" from wind and solar. A major difference between the two is that the "surplus" from wind and solar is not exactly surplus, because it is the entire output from these generating sources and ostensibly the sole justification for them existing. In other words, the varying surplus from nuclear really is a surplus because we cannot sensibly and conveniently avoid producing it, whereas ceasing to produce the varying "surplus" from wind and solar would allow society to stop paying for the maintenance of wind turbines, photovoltaic panels and associated transmission and power conditioning infrastructure. Clearly, for various reasons, the nuclear surplus will be consumed in preference to the wind and solar "surplus" whenever both are available. This suggests that intermittent electricity from wind and solar will inevitably have very low (or no, or negative) financial value. But is that the same thing as it having no potential application at all?

There is a good argument to say that financial considerations don't really apply to wind and solar generation. If they did, we would not have seen the huge percentage growth in their deployment over recent decades. Grid-connected wind and solar generation make money for some people, but they inevitably cost money to society. This situation might well continue, if society continues to not notice what is going on. For as long as it does continue, there will be plenty of varying electricity being generated, and governments will feel some obligation to at least make it look like such electricity is being used for something. That might result in energy-intensive things getting done that no one would otherwise have been willing to pay for. Obvious examples are removal of CO2 from the atmosphere or oceans, recharging of aquifers with desalinated water, feeding of some of the world's hungry, or manufacture and storage of stuff (like fertiliser) that might be useful someday.

Socially and environmentally beneficial applications for wind and solar electricity seem like a good thing, which might partially counteract the damage done by such renewables to the prospects of sane electricity provision. However, the beneficial activities would only get done intermittently, so they might perform more as greenwashing than actual work done, and in practice the availability of intermittent power might result in beneficial applications getting done far less than would have been the case if society had been forced to face reality and commit itself to doing such jobs properly, continuously and relatively efficiently.

But perhaps, in any case, we have drifted too far from reality. Most of the above discussion implicitly assumes that electricity from wind and solar will continue to be available even after nuclear has taken on the role of providing almost all of humanity's electricity needs. But wind and solar generation was never intended to function in such a context. The whole point of intermittent renewables has always been to obstruct or replace nuclear and/or to keep a foot in the door to allow continued sale of fossil fuels. Once it becomes apparent that nuclear has prevailed in this fight, surely neither the fossil fuel industries nor the current ideological lobby are really going to care whether grid-connected photovoltaic and wind-derived electricity continues to be generated or not, and the grid renewables generation lobby will eventually find it difficult to obtain the necessary financial support from society to perpetuate their pointless function. This will leave the world littered with renewables infrastructure as a symbol to our culpability, but at least it will simplify things and solve the problem of what to do with poor quality, spasmodic electricity.

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