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Budget 2017 - wind and solar are essential to combat climate change!

Ervin Bossanyi

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David Cameron's Conservative government did its best to kill off the UK's lowest-cost renewable energy technologies, onshore wind and solar. But in next week's budget, the Chancellor can put that right. Renewables are low carbon, quick to deploy, have low environmental impacts, and enjoy high public support, writes Ervin Bossanyi. It's time to give them a break!



Wind and solar power at work on the Westmill Cooperative Open Day 2015. Photo: Richard Peat via Flickr (CC BY-NC-ND).

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I started working on wind energy in 1978, for a research project on grid integration of wind energy.

In those days, even though there was no wind energy to integrate, there was a widely-held belief that it would be too intermittent and unpredictable to be useful.

The research clearly demonstrated that despite this variability, wind energy could still make a valuable contribution and reduce our dependence on fossil fuels.

This was important at that time, because OPEC had started to flex its muscles and pressure oil consumers. More recently, the urgent need to combat climate change has become the most important driver.

Since the 1970s, wind power technology has advanced tremendously. The most obvious advance has been the sheer size of wind turbines. By the 1980s, some national programmes tried to build large megawatt-scale experimental turbines, but they were thwarted by a poor understanding of atmospheric turbulence and fatigue loading.

Commercially successful designs evolved instead from much smaller kilowatt-scale turbines. These have gradually evolved into the high-tech giants of today: the latest offshore wind turbines with rotor diameters of 180 metres (the London Eye is 135 metres) are the world's largest-ever rotating machines, generating eight megawatts each.

The early wind turbines were very simple, with stiff, fixed blades rotating at a constant speed. Since then, with the development of modern power electronics, the rotor speed can change with varying wind speeds, leading to higher aerodynamic efficiency and reduced structural loads through smoother operation. Using electronic control systems, the pitch angle of the blades is changed to maximise power production and reduce wind loading.

Advanced composite materials using glass and carbon fibre technology have led to the development of very lightweight, strong and flexible blades of great length which can resist the severe fatigue loads experienced when rotating through turbulent winds; and laser beams can measure approaching wind speeds.

Dramatic cost reductions

With these and many other advances, the price of wind energy has been falling dramatically. Increased sophistication has led to high efficiency with lower use of materials, and increased energy production.

Crucially, large cost savings have also come from industrialisation of production and installation processes, made possible by the large numbers of turbines now coming off the production lines; while increased confidence in the technology has meant lower financing costs.

Costs have fallen so far that onshore wind farms are now the cheapest way to generate electricity in many areas (*The Independent*, 2015), even without accounting for the pollution and climate costs of their fossil-fuel and nuclear competitors. Consequently, installed wind power capacity is growing rapidly worldwide.

Solar photovoltaic costs are also plummeting to similar levels. In 2015, 77 per cent of all new generating capacity built in the EU was renewable (two-thirds of it wind power), while for fossil-fuel and nuclear plant, the amount decommissioned dwarfed any new build (*WindEurope*, 2016).

Even offshore wind power, previously predicted to remain roughly twice the price of onshore, has suddenly plummeted in price. During 2016, two developers defied experts by presenting offshore wind farm bids in the Netherlands and Denmark at prices similar to many onshore farms (*The Telegraph*, 2016). The same could happen for floating turbines, which will allow wind energy to be harvested from sites with deeper waters.

Despite impressions gained from many media reports, official public attitude surveys indicate very high (typically 70 per cent - 90 per cent) public approval rates for renewables. In the UK, 71 per cent are in favour of onshore wind and eight per cent against (UK Government, 2016).

Coupled with the creation of local employment, reduced dependence on imports from politically sensitive countries and short build times, further investment in renewable generation would appear to be a no-brainer. In any case, it is essential to meeting the legal obligations arising from the Paris Climate Agreement outlined at COP21.

The low cost means that subsidies are not needed, or at least can be lower than those already given to traditional sources of energy (*The Independent*, 2015).

The cost of renewables is largely the up-front capital cost, with very low running costs thereafter, so the only incentive needed is a mechanism to give confidence that future prices paid for the energy will be maintained sufficiently to pay back the capital.

This will encourage investment, and not only for large projects: at the local level there are already many successful community-owned wind energy projects.

Penetration of wind energy

In 2015, world-wide wind power capacity reached 430 gigawatts, deployed in many countries across the globe (GWEC, 2016). China and Europe each accounted for about a third of this, and North America about a fifth. Wind's share of electricity production reached 42 per cent in Denmark and 12 per cent in the UK, but is not yet four per cent worldwide.

Although the penetration of both wind and solar energy is increasing rapidly, there is still a long way to go. The need for climate change mitigation means that we must aim towards 100 per cent renewables as rapidly as possible, not just for electricity but also for our even greater heating and transport needs, which are largely met by fossil fuels at present.

Resource availability is not a problem: energy from the sun, which drives both solar and wind power, reaches the earth at a rate 10,000 times greater than we need, and is available in every part of the world. Unlike much biomass production, direct solar energy can be prioritised on more marginal land and buildings to avoid land use competition with food production.

Wind power even acts as an efficient concentrator of solar energy: despite its slender blades and a very small footprint, a three-megawatt wind turbine might generate on average as much as the solar energy falling on one to two hectares of land.

An integrated energy system

One tricky issue remains though: how to continuously match supply and demand, given that renewable generation varies with the availability of wind and sunshine, from minute to minute and throughout the year. For example, occasionally the UK experiences several consecutive days of low winds during the winter.

This is something we can deal with, but a flexible three-pronged approach is needed, involving interconnection, storage, and demand response, and dealing with the whole energy system: not just electricity but also heating, cooling and transport. This makes the solution more complex, but also more tractable because it introduces many synergies.

Interconnection means building more transmission lines, which can transmit electrical power almost instantly over continental-scale distances, so that supply, demand and storage capacity can be balanced across a wide area.

The cost is significant, but large new interconnectors are already being planned and built because the benefits are clear (*The Independent*, 2016). More will be needed, for which international political cooperation is needed, not least to agree the necessary funding mechanisms.

UK a world leader in dynamic demand and electricity storage!

Energy storage comes in many guises. Broad categories include electric batteries, hydropower reservoirs, flywheels, thermal reservoirs, fuel stockpiles, etc - and each of these can have different manifestations, with very different characteristics.

Short-term battery storage can help buffer the electrical grid against mismatches over seconds to hours; and wind turbines themselves can be used like flywheels to provide short-term storage for a few seconds.

Hydropower storage can last for days or weeks, while surplus renewable energy can be converted to gas which, together with methane from human and agricultural waste, would be stored to smooth out inter-seasonal variations in heating demands, and used to top up electricity generation when needed. This is just a small sample of the possibilities.

Demand response is perhaps the simplest and most cost-effective tool available to help balance the electricity grid on timescales from seconds to a day or more. It means reducing demand when power is in short supply, and using more when it's plentiful.

Combined with storage and modern electronic controls, in many cases the user need not even notice. Every heater, fridge and freezer is a thermal energy store whose power consumption can be re-timed, within acceptable limits, to suit the needs of the grid, and there is much talk of using the batteries of electric cars in a similar way.

No time to waste!

So, the technologies to enable a 100 per cent renewable energy system are available today, and improving all the time, but how can we manage the development of an energy system of such rapidly increasing complexity, fast enough to keep up with climate change?

Carefully constructed market arrangements are a necessary tool, but they still have to be policy-driven and are never perfect, so mandatory regulations will also be needed. For both reasons, concerted political action is surely required, and awareness leading to action at all levels of society.

There's no time to waste.

Sign the petition: 'We're calling on the government to stop blocking onshore wind and solar. Will you add your voice?'

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