ENERGY FOR HUMANITY_

100% RENEWABLES

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Some believe that we can eventually run the whole economy on renewables (usually wind and solar),while others dismiss this as delusional, suggesting instead that their own favoured technology is the only way ahead.

In practice, some combination of energy efficiency, renewables+storage, nuclear and carbon capture and storage (CCS) may well be more cost effective and robust than any one solution. The latest edition of the OECD Projected Costs of Electricity study[1] rightly states "There is no single technology that can be said to be the cheapest under all circumstances". System costs, market structure, policy environment and resource endowment all continue to play an important role in determining the overall value to the system of an incremental investment in generation.

Not all commentators are careful to distinguish between energy (includes fuels for transport and heat) and electricity. If we are to get all our energy from renewables, we need to electrify heating and transport, or develop some sustainable biofuels, all discussed elsewhere on this site. This note focuses on the constraints on an all electric renewable future.

For those in the developing world who have no access to grid power, solar combined with battery storage (provides 2-5 hours of backup) is life changing and typically less expensive than kerosene for lighting and perhaps diesel generated electricity. They are often using biomass for cooking, so renewables are a complete solution, until they want more power - perhaps air conditioning as well as lighting and phone charging - and higher reliability. At this point, solar plus storage begins to look quite expensive - and very expensive in areas with winters or serious seasonal clouds and rain, which can reduce solar panel output by 65% to 90% for days at a time, requiring much larger volumes of storage to maintain service. And much of what is supplied to developing world societies (fertiliser, vehicles, diesel, cell phones) is made in the industrial world, using fossil fuels.

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Given current renewable and storage technologies, the all electric renewables solution does look impossibly expensive for most industrial societies. This is not the case for countries that already get most of their electricity from hydro electric power, such as Norway and Costa Rica. Their grids can absorb large volumes of renewable power, since hydro can change output very fast and often there is not enough rain to run hydro flat out, hence it is beneficial to close it off when renewables are plentiful.

Grids with less hydro storage can still use what they have to smooth out varying supply and demand, complemented by dispatchable demand (flexible consumers) and large scale electrical transmission to move surplus power to areas of high demand. On a breezy, sunny day, we can envisage most of demand being met by wind and solar. But the annual average output of solar in UK is 9% of its peak (fixed panels), while offshore wind may manage an average of over 40% of peak. Other places do better; US or Middle Eastern solar can get well over 20% and wind load factors of 50% are not unknown in the high plains of the US amongst other areas. Nonetheless there will often be lengthy periods with very low renewable production. In UK and similar northerly countries, there is little solar in winter, on average about 11% of what is available in summer. Of course there is often wind in winter, but there are also winter periods when an anticyclone covers the UK for days, far longer than any storage technology can handle. Long anticyclones don't happen every year, but they are common enough to need something to get us through them.

In a scenario with lots of renewable generating capacity, we therefore need to match nearly all the renewables capacity with some other no-carbon generation technology, ie hydro, nuclear or CCS. That other supply will run during the 60% to 90% of the time when wind and solar are running at less than full power, can have high running costs, but must have low capital costs, since we need to pay them back all the time. Thus wind and solar, would act as a fuel saver for gas fired CCS (NetPower's Allam cycle could be a good candidate) but do not replace capacity; in markets with high gas prices this could be economically sensible - but the cost to run CCS would have to be high, otherwise we may as well run it all the time and not bother with the renewables. The fuel cost of coal and nuclear is generally very low, while capital and fixed costs are high, so they are not a good match for low load factor renewables. With today's technology, the 100% renewables solution does not look like a viable option.

The more energy efficient we are, the less we need of everything and many efficiency investments are more cost effective than energy supply opportunities - and we should obviously do all the profitable or low cost things first. Of course we can choose to spend a lot of money on energy, but, given the angst about domestic power and gas prices, there seems to be little public appetite for this. And there are other challenges in the world that need investment. We should therefore strive to be as efficient as possible in our energy consumption, especially as we transition from combustion engines to electric vehicles and so forth so that we need less generating capacity. But efficiency cannot entirely replace consumption and money saved on one form of energy may be spent on other energy intensive goods, absent significant carbon taxes to refocus consumption to low CO_2 services.

www.oecd-nea.org/ndd/pubs/2015/7279-proj-costs-electricity-2015-es.pdf