Smart Grids and Infrastructure

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Thanks you Chairman, it is a pleasure to be here, and a delight to have such an audience.

I will confine my remarks to electricity, and since there are substantial health, welfare and well-being co-benefits if we aspire to an energy system without any combustion, and that seems to imply electrification, this is not perhaps the restriction it suggests.

Electricity systems are unusual, probably unique, in having utterly no inherent storage. What we put in to it comes out immediately somewhere else. To be a bit metaphysical, it is great at transmission of energy through space, but quite useless at transmission through time. For all other markets the existence of storage is implicit and assumed, so meaningful "spot" markets can be defined and are useful. If properly run they can provide an index for settlement of forward, future and other derivative trading. In electricity "spot" can be and is defined in many different ways, possibly almost as many as there are A/C electricity systems, and few of them are transparent or easily understood.

But what Tesla-Westinghouse ac systems do offer is a system frequency. This is an inherent, physics based, system-wide signal, readily visible to all participants, that in the very real time of a few sub-seconds, integrates the balance of **all** demand and **all** supply. If demand is a bit higher than supply, the frequency drops, and if supply exceeds demand, it rises. So everything we do has an impact. In all other markets such a signal is indicated by a change in price after intensively competitive and, at least until recently, human based trading. I think that the frequency can tell, or at least modulate the spot price, without all that pain of trading.

Today, I fear, much of the value of this special signal is lost, partially through the engineering limitations of our big traditional gensets, but increasingly by a failure of vision. Too often the seeming attractions of the Smart Grid, with its pretentions to offer the sorts of innovation that IT has brought to many other aspects of our society, can also transform our electricity system. On their own they will not.

In my condemnation of the "Smart Grid", I do not mean to suggest that there are not some extraordinary and exciting innovations, including IT, that can and will play a role. Perhaps the most profound is the emergence of power electronics; technologies such as HVDC (High Voltage Direct Current), FACTS (Flexible A/C Transmission System), DFIG (Doubly-Fed Induction Generator), and indeed the possibility of safer low voltage DC in our homes (how many DC adaptors are there in your house?). All these can and will, along with IT, bring improved switching, reliability and control to the flows of electricity within the grid. If well used, I think they enable several attractive and market oriented approaches to operating our electricity systems more reliable and securely. I do believe, however, that the fundamentals will remain founded on the Tesla-Westinghouse concepts.

But Smart Grids do not provide storage. What goes in must still come out instantaneously. So we still have to continuously balance the grid.

Many of the sustainable ways of generating electricity are outside our control. Wind, wave, tide, solar – all vital, exciting and increasingly cheaper technologies – but not at our beck and call, coming when nature decides to deliver its free and everlasting fuel. This is great, but does not aid balance.

To maintain balance, we have traditionally relied on our big high emissions plant, which we have had to run at less than their full or most efficient output. The spinning reserve is capable of very fast change in output, and so absorbing variation. But when it is windy, there will be less of it, and we may have to keep the fossil plant on-line, just for the flexibility of its spinning reserve, and this will mean spilling, or in other words wasting, the potential contribution of the renewables.

So my first plea for infrastructure investment is to use the nations and the continents fridges and freezers to replace spinning reserve. The cost in the UK, spread over the normal 12 year fleet replacement life of the appliances is the order of £200m, and will save at least that every year, as well as around 1 million tons of CO2. In addition, it will free us of a growing constraint in our use of the renewables. Across Europe it will enhance the resilience of the system against many type of shock.

Nuclear does not help in balancing. Indeed quite the opposite. A key function of spinning reserve is to be there for when plant breaks down, and the UK needs to cover the potential instantaneous 1.2GW loss of its biggest power station – at present Sizewell. Our fridges and freezers can just about cover our needs for this, but the new nukes deliver 1.8GW, a 50% increase, and this will likely cost the UK an extra £200m

p.a. Further, the licencing of the new nukes makes them completely inflexible: either on or off, and sometimes off unexpectedly. So this seems one more good reason not to build such monstrous machines.

The other key source of flexibility is demand, which we have never before seriously attempted to influence. Yes, we do have the off-peak – an initiative originally designed to provide a use for otherwise unwanted overnight nuclear electricity, and it does make a difference.

Yet there are many uses of electricity that are inherently flexible, and the laundry machine is a useful example. Once loaded and set up, its operation is entirely automatic, and all we, as users, are interested in is when it will be ready, as we do not want our clothes to sit in the machines too long.

So what we want is options when we set it off. Broadly, a choice between urgent and cheap. To do this, the machine needs only to have a view of the future price of electricity. With this, it can plan, optimising its consumption to offer you different deadlines with different prices. This is a transaction with which most consumers can successfully engage. So too can dishwashers, battery cars, and your domestic heating systems, particularly if the heat source is a heat pump. What you achieve is transmission of demand through time – storage.

One way of delivering this is for an electricity retailer to broadcast a future price curve, accessible both by the electricity meter, and by the appliances. As forecasts change, or as events happen, it can broadcast change to this future price, and all the devices that can respond by changing their plans will do so. So the retailer has a tool to influence demand to match the generation they have available or have bought.

Ideally the same or a similar price can also influence small scale despatchable generation, such as CHP. It can also influence storage systems, such as pumped storage hydro, so they can plan their arbitrage between high and low cost times.

And since the meter knows the price, it can also calculate the bill.

I fear, for me, this is a benchmark by which I judge Smart Grid and Smart Meter proposals. The only real infrastructure investment is the price calculation and broadcasting system. Only those with smart appliances need to fit the meter, and we avoid that vast £11 billion cost of the UK smart meter programme.

The key barrier to this concept is the settlement system, by which competing retailers are allocated their share of the wholesale costs. It is too mind-numblingly complex

and boring to go into now, but it effectively punishes any retailer who tries to implement demand response.

This is a failure of ideology. An electricity systems is quintessentially a shared public good. Indeed, it is almost a definition of infrastructure that it is shared. And the increasingly contrived and seemingly desperate policy measures so as to delivery an essential public utility via profit and control oriented corporations have become perhaps the biggest barrier to the transformations we need. In electricity retailing, moderation of maximum profit by pseudo competition is a poor substitute for the participative shared stakeholder governance we actually need.

So we may well be stuck with the Stalinist approach of the smart grid, in which system operators, perhaps via aggregators, seek to monitor and control everything which uses or generates electricity, including people. Instead of it being your washing machine that offers you choices, it is the utility that decides whether it can run or not. It is inconceivable that individual consumer's desires will figure highly in their decision-making. Or, if it does, they will need to collect, store and analyse so much data about you that they could easily emulate George Orwell's Big Brother, although this time it may be called the Internet of Things.

We see some of this in the ENTSO-E approach to the new, pan European, grid codes, currently about to be passed into EU law. They demand the right to connect to almost anything, and to be able to monitor and control it. But not pay for it.

The magic of smart pricing avoids this need and risk and expense, yet still gives system operators the tools they need to influence demand, so that we return once more to doing our laundry when the wind is blowing.

I do not know how much more effective these approaches can make our electricity systems, but nobody else does either. There are good reasons for believing it will be quite a lot, and so can change, perhaps profoundly, the costs of transitions to renewable energies. So when it comes to costs, I treat £110 billion estimate offered by DECC with great scepticism. If we are intelligent, rather than smart, it can be a lot less.

So I hope I have presented you with environment rich in targets to shoot at, and I look forward to the discussion.

Thanks.