Driving down the cost of Decarbonisation

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As outlined in the report[1], there are several potential components to a viable decarbonisation agenda – renewables, nuclear, CCS, storage, transmission, efficiency. I approach this from the viewpoint of a response to the report, which is very different from a pure businessman or venture investor approach, because it asks whether dramatic cost reduction at scale is amenable to a global coordinated effort. In that context, where are the best opportunities?

This evening I will focus mainly on a select group of renewables technologoies, electronics, and storage. As you would expect I will be very opinionated, because why break the habit of a lifetime. I will close by making some remarks on what I feel is an unhelpful response on these issues from some of our industrial colleagues which has emerged over several years but been particularly prominent in the last six months, and which is a barrier to progress.

First point: This is about science, engineering, scaling up of manufacturing, and a process of industrialization. Not all of these are equally amenable to a global programme in my view. It would be unusual if scientific breakthrough were required that it could be orchestrated by a global coordinating body. But where that breakthrough has occurred, the engineering challenges can be parcelled out, coordinated, and tackled in parallel to make progress at pace. Likewise, for certain things, there are manufacturing and industrialization challenges. But each renewable and storage technology is different, and sits in its own particular state of development at this time. Therefore it makes sense to discuss them specifically.

So Second, A quick scamper through a selection of renewables technologies:

Solar

Solar costs already way down on panels. Remember that at small scale solar competes with retail electricity price, not wholesale, whereas wind will always be competing at wholesale. For much of the planet, solar, when the sun is shining, is already the cheapest form of electricity. Depending on the utility retail pricing during the day, it is at worst parity with fossil generation (of course this depends on coal, gas, and in some place oil price) and in many critical places it is much better than parity - 20% of the cost of what is being used. Or there is no electricity, and not easily possible to provide electricity quickly except by solar.

Clearly there are new PV materials that are at various places on the conveyer belt from laboratory to commercialization, and some of these will fall off. Perovskites have had the most publicity lately, but there is a very long way to go. If things went well, we might have commercial materials in the early 2020s. A global programme may be useful for those that are further along, but in my view it may not be necessary because the demand pull is so strong, and the manufacturing base is so similar to that for other electronic products. However, there is still an opportunity, particularly for large installations, in cost reduction and innovative solutions for balance of plant, beyond the panels, and I

[1] http://cep.lse.ac.uk/pubs/download/special/Global_Apollo_Programme_Report.pdf

think that a globally coordinated programme, breaking this into components, could be very productive.

Because it is mentioned in the report, a word about concentrated solar thermal. It is viable, can be done at scale as demonstrated in California and soon elsewhere, but it is expensive, and basically low tech – mirrors and steam generation. So I don't see that any big effort will result in a step change in costs.

Wind

Onshore wind is cheap, and has taken its place with nuclear as a major 'new' source of power. We have months where we get 15% of our electricity in the UK from wind, primarily onshore. In Spain onshore wind is usually the biggest single source of electricity over a year. While the report says that we need to step up investment to resume the cost reduction progress, I disagree. Much of the past cost reduction came from increasing the size of the turbines, but these are as big as they can be now, because it is just not possible to move bigger blades along roads. We are on the flat portion of the cost curve now, and the opportunity is small. But we learn the lesson that it took 20 years to drive down costs, and that is too slow.

Offshore wind is completely different – a concerted effort will easily take out 1/3 of cost, and industrialization will take out a further chunk. The trick for offshore wind is to accomplish in 5 years what took 20 for onshore. In my view offshore wind is the best candidate for breakthrough from a global programme. There is a lot to do, and parallel processing with coordination is the way to get it done. We can contrast the opportunity for wind with that for nuclear – thousands and thousands of wind turbines to be built, compared with tens of nuclear plants, maybe at an optimistic level 300.

Marine

There is a lot that could be said about wave and tidal power, but I will be very brief. This is a tempting target for a global programme, because the resource is big and costs are high, but I worry that effort here would be wasted. The costs are so high, the conditions so difficult, especially for ocean energy, that I think the mountain is too big to climb. Major industrial players have tried and given up.

Wind, marine, and solar require storage, about which more in a minute.

Biomass

There are still reasons for optimism, and this can have such a big impact at scale, across geography, without storage. Need to look globally at best way to do this, what are the best 'crops', for example, to accept truths about impacts where they are hard, but destroy malicious lies that stand in the way of progress. Biomass electricity is very amenable to an Apollo effort, and especially because of the systemic nature of the problem, biotechnology enabled intensification of production, links to advances in food production, farmers' income, and decisions about global land use.

Renewable heat

There is a big opportunity on heat beyond just efficiency. Renewable heat requires lots of clever engineering. The difficulty is that even in the developed world we do things so many different ways. But there are a hundred or more possible solutions out there already and these need to be screened and selected ones validated for scale-up. Again this is very amenable to an Apollo effort, and a big contributor especially in colder climes. And while we are at it, renewable cooling might hold some quick wins.

Now my third point, electronics and storage.

Electronics

In the absence of cheap storage, there have been great advances in electronics for easy switching between generation inputs. And this is very useful and important, because it allows, for example, solar and diesel to work together in places in Africa where those are the two best alternatives. This needs to be cheap, invisible to the customer, and able to work both quickly (cloud cover, abrupt drop in wind speed or change of direction) and at a range of scales, certainly from kw to multiple MW. While much has been done, we should view this as a key component for the Apollo effort.

Storage

I think we can all agree that storage is absolutely crucial, and it is one of those areas of investment that have no regrets. Whatever other technological progress occurs, we will gain from advances in electricity storage. We need it across scales. The biggest opportunity is in Li ion batteries, Cost have halved and halved again, and one more halving is possible which would get us to the $100/kwhr target. This means Li ion would be cheaper than lead acid within 5 years. Science, engineering, manufacturing. It requires everything. Because I am a chemist I am pessimistic on completely new batteries, because batteries are basically limited by the periodic table. However, new materials, such as graphene, new manufacturing ideas, such as semi liquid Li ion, and much better engineering, for flow batteries and other technologies, offer a lot of promise. I am a big support of flow batteries for utility scale storage. At the moment the chemistry is proven, and it has been shown that they can either be made cheap and work poorly, or expensive and work well. Clearly it is possible to get cheap reliability, and his may be just the right sort of engineering challenge for the Apollo team.

Now my fourth point.

In the last six months, really coming into focus for me with the speech of Ben van Beurden at the IP dinner last February, and increasing in volume since then, there have been some comments primarily from the oil and gas industry, that I think work against progress on the agenda. These messages are as follows:

- We need to shift from coal to gas in developed world, because renewables will not be big enough to take place of coal, let alone gas and oil, and as a corollary to this required shift, exploit shale gas to the maximum. It is the message on renewables, heard over and over again, that is most concerning.
- Develop CCS for coal in developing world and for gas in OECD. And this means the developing world needs to build new coal fired power stations because these will be cheaper than renewables, even though this is clearly not the case. Viscount Ridley is one of the loudest proponents of this myth, and other pick it up from him and repeat it. I am pessimistic about CCS, and I want to make clear that it does not solve the sustainable development problems of coal, which go far beyond CO2, and adds a tremendous cost burden to the energy. Again, in most of sub Saharan Africa today we can build PV at scale for less than coal, especially if it is new build state of the art coal power, with CCS, and with a grid that does not currently exist.
- Establish a carbon price globally. Very advantageous suggestion when you know that political consensus on global basis is completely impossible, and at low fossil fuel prices it would probably not be that damaging to demand. But it is particularly advantageous if you are a gas supplier, wanting to take some of coal's market share.
- Assertion that oil will continue to be overwhelming dominant fuel for transport for the foreseeable future. This might be true, but it fails to recognise our ability to progress biofuels for aviation, decarbonise electricity and install enough of it to charge electric

vehicles, at scale, during off peak hours, progress on storage, and make cars twice as efficient.

So I conclude by saying that there is a great opportunity, that a big well-funded global programme, if properly focussed, can make a difference, because while science breakthroughs don't usually happen from such programmes, engineering and industrialization does, which is good since that is where the big opportunities lie, But that an essential part of what we need to do is robustly counter untruths about renewables vs fossil fuels that are repeated over and over again.