Bulletin

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Value for money or fairy gold?

MEASURING THE COST-BENEFIT OF INNOVATION INVESTMENT

Politicians love the idea that the innovation fairy will bring down the cost of low-carbon energy, thus making climate change a lot less painful. But wand-waving innovation investment programmes also have a cost, which may divert resources from other options for reducing emissions. Testing the cost-effectiveness of initiatives such as the new "Mission Innovation" is therefore vital. Our work on its forerunner suggests the new programme is good value at planned levels, and that higher levels of investment in this area may indeed be justified.

New technologies are expected to provide a major part of the solution to climate change. At the Paris Climate Change conference in December 2015, 20 governments, including the UK's, signed up to Mission Innovation, under which countries representing 80 per cent of the world's public spending on clean energy

R&D, have committed to double their investment in innovation over five years[1]. In tandem, 28 investors led by Bill Gates set up the Breakthrough Energy Coalition to bring new capital from the private sector to support emerging innovations in this area[2].

Governments plainly have an important role to play in lowering barriers to innovation, addressing market failures and so forth. But direct investment in innovative technologies involves, by definition, a leap in the dark - and at the same time may divert attention from less politically attractive alternatives, such as subsidising the roll-out of existing low-carbon technologies. So how can we be sure that increased spending on low-carbon innovation is a good thing in general, and directed to the best programmes in particular?

Frontier's recent work with the Grantham Institute, at Imperial College London, provides one example of how the net benefits of RD&D programmes can be assessed. Frontier was asked to assess the potential benefits associated with the Global Apollo Programme (GAP), which was a forerunner of Mission Innovation.

MINDING THE GAP

Previous research on the impacts of RD&D programmes has found that their impact on technology costs depends not just on the absolute level of investment in these programmes, but on the degree of the step-change. Essentially, diminishing marginal returns apply in the field of RD&D spending.

This finding is instructive when applied to renewable energy, where public investment in innovation has been low: in total, well under $40bn has been spent globally on RD&D for key renewables (solar PV and wind) and storage since the 1970s.

The GAP asked governments to spend 0.02% of GDP on RD&D into renewables and enabling technologies for the next ten years. This would have meant about $15bn every year from 2016 to 2025: delivering a major increase in cumulative public investment in RD&D on key low-carbon energy technologies. We sought to estimate the impact of such a step-change on technology costs.

Our assessment focused on the benefits associated with reducing the cost of electricity generated from solar PV and wind. We estimated the cost reductions from GAP investment in the technologies themselves, as well as in the storage and grid technologies required to integrate them into the electricity system.

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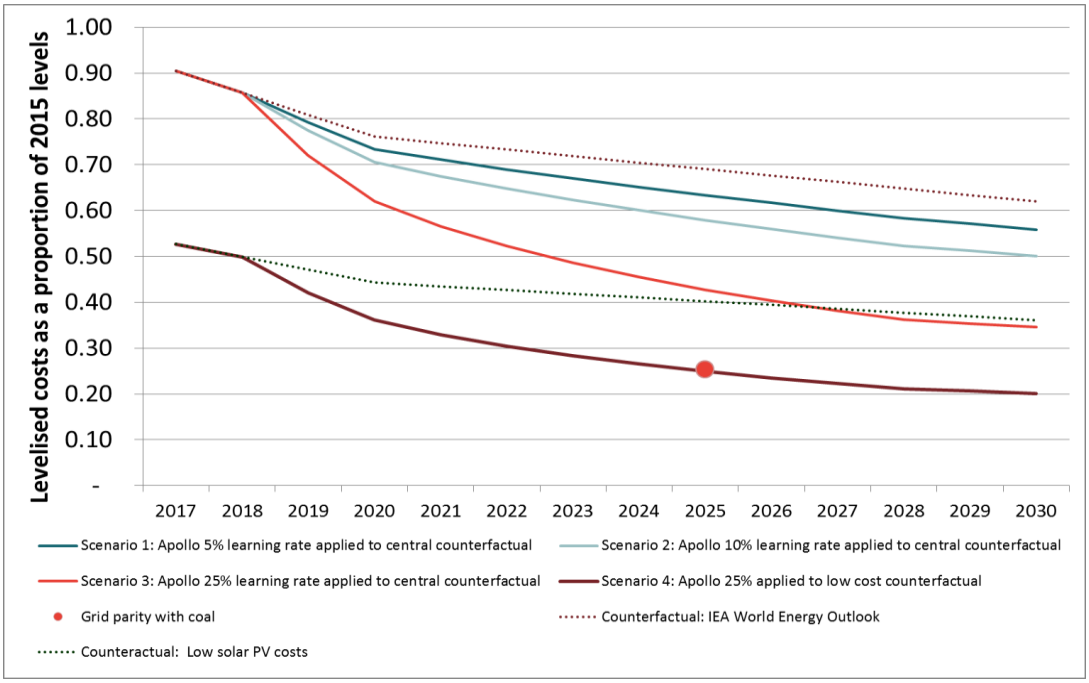
1 http://mission-innovation.net/

2 www.breakthroughenergycoalition.com

Previous research has estimated "learning by research" rates for wind and solar. These are empirical estimates of the cost reduction in a technology observed for each doubling of cumulative RD&D (distinct from any cost reductions that follow increased deployment). They provide a measure of how much RD&D spending reduces the cost of the technology, taking into account previous levels of spending and diminishing marginal returns.

The literature indicated learning by research rates of 5%-25% for wind and solar power. Applying these rates to future cost projections for wind and solar (including storage and grid-supporting technologies), we found that the costs of solar PV generation, for example, could be 37-75% lower by 2025. At the most optimistic end of this range, solar would reach grid parity with coal by the mid-2020s (Figure 1)[3] .

Figure 1. Solar PV electricity generation cost scenarios



Source: Frontier Economics and Grantham Institute, Imperial College London.

The Grantham Institute then used its global energy systems model to examine the impact this approach would have on the global costs of meeting the 2OC climate change target. TIAM-Grantham simulates transition to a low-carbon

[3] This scenario (Scenario 4, in Figure 1) is optimistic, compared to our other, more conservative scenarios, although we believe it is within a plausible range. For Scenario 4, we applied the highest learning rate from within our range (25%) to our most optimistic view of what could happen to solar costs in the absence of the GAP. Under these assumptions, our analysis suggests that solar PV would reach parity with coal in many parts of the world in the mid-2020s, even when grid and storage costs are included, and no carbon price is applied.

energy system, by choosing the least-cost global energy technology and fuel mix consistent with reducing CO2 emissions to a specified level. Estimates of the global benefits of the programme came from comparing scenarios with and without the GAP, after allowing for the cost of the GAP itself.

This analysis found that the GAP could save $0.7-$4.0 trillion globally of the cost of meeting the 2OC target, in total out to 2040. And if anything, these benefits are understated, because we did not include the effect on productivity or spillovers to other sectors. Nor did we take into account the wider benefits associated with renewables - for example, the impact of air quality on health, or the socio-economic effects of connecting more off-grid properties.

Spending commitments made under Mission Innovation during the Paris negotiations are lower than under the GAP. The large benefits we estimate for the higher levels of spending under the GAP suggest that while Mission Innovation is a great start, further investment would also be beneficial.

Could some of this further investment come from the private sector? Or is there a risk that the private sector might actually scale back its efforts in response to a significant increase in public funding? Recent Frontier work for BIS examined the evidence on the 'crowding out' effect in innovation.[4] While the literature is mixed, the balance of findings point to public investment in RD&D leading to crowding in of extra private investment as well. Indeed, the formation of the Breakthrough Energy Coalition by Bill Gates suggests that this is already occurring in response to Mission Innovation.

CONCLUSIONS

While diminishing returns reinforce the need for governments to be wary of over-investing in innovation, as opposed to using scarce public funds to encourage the roll-out of existing technologies, our analysis suggests that at planned levels of spending, Mission Innovation is likely to yield significant benefits. Indeed, our analysis would support higher levels of public investment in renewables RD&D, closer to the $15bn a year globally envisaged under the GAP. Mission Innovation is not likely to be enough to tackle climate change on its own, but neither does it show a misplaced belief in the innovation fairy. Our analysis suggests it is a significant step in the right direction.

[4]Frontier (2014), *Rates of return to investment in science and innovation* http://www.frontier-economics.com/documents/2014/07/rates-of-return-to-investment-in-science-and-innovation.pdf

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