



Rebound launch: keynote presentation

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It's a pleasure to be here. And I am glad to have the opportunity to welcome this important report.

Sustainability is a tough mistress. The challenge of mitigating climate change, of reducing our reliance on finite mineral resources, of remaining (broadly speaking) within environmental limits appears more and more demanding the closer we get to it. And many of our previous assumptions about achieving these goals now stand in need of scrutiny.

There is no one candidate for over-arching authority in approaching this task. But ecological modernisation is probably the closest contender for that position. Ecological modernisation holds that the route to sustainability is through constant improvements in technology, constant improvements in efficiency, supported and driven by economic growth. Ecological modernists argue that in the history of capitalist economies we already see plenty of evidence for those improvements. They suggest that there are structural incentives in modern economies constantly to seek out newer technologies with improved efficiencies. In defence of this claim there's certainly some evidence. The energy intensity of economic output in the UK has fallen more

or less consistently in the UK – except for a few hiccups – from the late 19th Century onwards. Energy efficiency of the iron and steel sector, as just one example, has improved by two orders of magnitude, per unit of output, since the industrial revolution. These are both clear examples of what is called in the trade ‘relative dematerialisation’. Relative decoupling of economic output from resource throughput. And it’s important evidence.

On the other hand there is much less evidence of absolute decoupling, particularly at the global scale. And it’s absolute decoupling from resource throughput – real reductions in overall energy use, in overall carbon emissions – that we’re after. Nothing else will really do when it comes to achieving energy security and beating climate change. When it comes to CO₂ for example, the best we have achieved so far in the UK is a reduction in the order of (less than) 10% over 1990 levels. And there is evidence that even these reductions would have been eroded if we had taken aviation, shipping and the carbon embodied in traded goods into account. Relative efficiency improvements are clearly happening. Absolute global reductions in energy demand and carbon emissions are much more elusive.

One of the things the ecological modernist position has to face up to here is the dynamics of efficiency and scale. It’s set out very clearly for us in this deceptively simple equation – the famous Ehrlich-Holdren sustainability equation:

$$I = P.A.T$$

Probably still one of the most useful bits of algebra in understanding the demands of sustainability, the Ehrlich equation tells us that the impact of human activities (I) is determined by the overall population (P), the level of affluence (A) and the level of technology (T).

The population factor is pretty clear (and pretty intractable with a global population racing towards 7 billion and expected to reach 9 billion by the middle of the century). Affluence can be cashed out (so to speak) as income per capita, or as GDP per capita at the national level. T is really an (inverse) efficiency factor. We can think of it as the resource (or environmental) intensity of GDP – for example – at the macroeconomic level.

The IPAT equation appears to offer us broadly three ways of achieving overall reductions in energy demand (for example). One, reduce the population – not a popular choice. Two, reduce the level of affluence (again not high on political priorities – although an interesting avenue to explore at various levels as I shall suggest in a minute). And three, improve technology: specifically to increase the energy efficiency of income generation, to reduce the energy intensity of the economy.

Given the unpopularity and political intractability of routes one and two, it's perhaps not surprising to find the mainstream response is to adopt route three as the preferred approach. Indeed an examination of the history of international policy from Brundtland onwards reveals quite clearly how route 3 allowed the world to steer an uneasy path between the demands of the North for population control in the South and the demands of the South for reduced affluence in the North. Option 3 emerges as an apparently politically neutral way through a tricky impasse.

But the first obvious problem here is precisely the dynamics of efficiency vs scale. Technology is an efficiency factor in the equation. Population and affluence are scaling factors. Even as the efficiency of technology improves, affluence and population scale up the impacts. And the overall result depends on improving technological efficiency fast enough to outrun the scale effects of affluence and population.

How can we be sure that it's possible for efficiency to outrun scale? What is the mechanism that drives efficiency improvements: efficiency improvements good enough to outrun scale? And here we come to our first real complexity in the modernist position. The case made by ecological modernisation is quite specifically that increasing affluence – economic growth, broadly speaking – is the mechanism for continual improvements in efficiency. In other words, we cannot think of P, A and T as being entirely independent factors in the impact equation.

Assuming affluence is a driver of technological improvement is tantamount to suggesting that T (in the equation) is a function of A. More precisely, an *increasing* function of A. Higher levels of affluence lead to better efficiency – lower energy intensity (let's say). Which places the onus on the ecological modernists to show how, in a situation of rising affluence (necessary for technological improvement), the scale of efficiency can continue to outrun the growth in income per capita necessary to continue to improve efficiency. In acknowledging (or claiming) the dependency of T on A, we are left with a more uncertain mathematics when it comes to delivering absolute reductions in throughput.

Now let's turn to the rebound effect. The broad argument of rebound is that improvements in energy efficiency (for example) don't always lead to reductions in energy demand. Steve Sorrell and his colleagues distinguish between two distinct kinds of reason why this might be the case. Let me illustrate at a very simple household level.

I install some cavity wall insulation in my house. It makes the fabric of my home more thermally efficient. For the same degree of thermal comfort, I now require fewer energy resources, less fuel consumption. Clearly an advantage. I am just as warm as I was before but now I burn less gas and it costs me less money to heat my home.

Two things can go wrong here. In the first place, I may decide to increase my level of thermal comfort – or at least, let's say, to raise my indoor air temperature (they're not quite the same thing, of course!). Instead of taking all the savings achieved through cavity wall insulation as cash in hand, I spend it burning more gas. This is called direct rebound.

Suppose on the other hand I am already warm enough, thanks very much. (In today's over-heated built environment thermal comfort rapidly turns to thermal discomfort.) I am still left with the 'problem' of extra disposable income from my avoided expenditure on unburnt fuel. What do I spend that money on?

One potentially interesting option here would be for me to invest this money in some (rather expensive) home generation – roof-integrated photovoltaics (PVs) let's say – with a payback period in excess of 10 years. This is arguably quite justifiable, from a carbon point of view, highly ethical behaviour. In fact, the more expensive my preferred low-carbon technology, the greater the good. It's a kind of 'anti-economics' of personal carbon abatement!

Apparent perversities aside, I am more likely to spend my windfall elsewhere, on some other goods and services – a new car, maybe, or a holiday abroad. Either of which requires additional energy, generates additional carbon. This is what the report calls indirect rebound.

The critical question – the question Steve and his colleagues have tried to address – is how extensive these two kinds of rebound might be.

This is clearly an absolutely vital thing to know. A particular concern is this: is it possible that my 'alternative' use of the cash savings from improved efficiency lead to even more energy demand than I would have generated without the intervention? The wrong choice of new car, for instance, or a holiday far enough away, might quickly swamp the carbon gains from improved cavity wall insulation. This is the situation the economists describe

as 'backfire'. A situation in which the overall effect of improving T in the Ehrlich equation, leads to an overall increase in I – something quite unforeseen by the ecological modernist.

The challenge here for the conventional position is enormous. Whether or not my cavity wall insulation engenders backfire, the fact is that with constant or rising income, I am looking to spend my money somewhere. If I save it on energy in the home, it will be spent on other goods and services; all of them with some energy impact. Even if I am taxed more heavily – and have less to spend myself – the government will be happy to spend the excess, on my behalf, somewhere in the economy. If they choose to spend it on roads, say, or on military defence – each of which induces more energy demand, more carbon – then the upshot will be some rebound, possibly even backfire.

One way out of this predicament, some have argued, is to pursue a strategy of 'sufficiency' – a voluntary curtailment of income growth. The Ehrlich equation certainly suggests this route as a quite legitimate way of reducing impact. My own research group, RESOLVE, while not exactly predicated on reducing income and expenditure, is keen to understand those who do engage with this strategy at a personal or household level – precisely because it can lead to carbon reduction *at the household level*.

Unfortunately, the rebound effect suggests something quite pernicious here. Indeed, the premise of rebound is that there is an increase in affluence associated with an improvement in efficiency. Not only is technology, T, an increasing function of affluence, A, but affluence, A, is an increasing function of technology. Improved efficiency generates increase affluence which generates (according to the ecological modernists) more efficiency, more affluence and so on. Far from looking at a simple product of three independent variables, we now appear to be in a self-reinforcing positive feedback between affluence and technology, potentially – and I emphasise potentially – geared in the direction of rising impact.

This, of course, is a rather different situation than the one envisaged by ecological modernisation. Made even more complicated by a suggestion in a forthcoming paper by Blake Alcott in the journal *Ecological Economics* that even the strategy of curtailing affluence at the national level – the sufficiency strategy writ large, as it were – invokes a rebound effect. Sufficiency reduces local demand, suppresses global prices and induces increased spending outside the national boundary. A particularly pernicious form of the well-known ‘free-rider’ problem: my ‘carbon sacrifice’ makes it easier for others to indulge their own ‘carbon sins’.

I’ve sketched here something deliberately bleak. It may well be too bleak. Much depends on understanding the complex dynamics between efficiency and scale: the dynamics of rebound. Which is precisely why the research review carried out here by the UK ERC represents a vital part of the evidence base needed to steer the UK – indeed to steer the world – towards a low carbon society – towards sustainability.

Sustainability is a tough mistress. Understanding the challenge ahead demands the kind of diligence and attention to detail witnessed in this report. Which is one of the reasons I particularly welcome it. I’m slightly alarmed to learn that this launch represents the end of the endeavour, when there is clearly so much more work to be done! I wanted to be able to wish you all the best in solving the problems you have so clearly identified. Perhaps those wishes must be saved for someone else brave enough to take it on. At any rate, please let me know when you have the answer!

Thank you.