The Myth of Resource Efficiency

Can energy efficiency save the world? Mike Hannis examines China's drive to achieve carbon savings in the light of a new book on the rebound effect.

With apologies to any readers who are not car drivers, here is a question about vehicle use. If your car did more miles to the gallon, would you drive it further? Perhaps some long journeys you had previously made by public transport would now be cheaper to do by car. Perhaps you might be tempted to drive more often instead of walking, or to make some new and previously unaffordable journeys.

William Stanley Jevons, the man who worked out that "less means more".

A modern vehicle engine can certainly get much more work out of a gallon of fuel than an older one of equivalent size. These efficiency gains, though, have been largely cancelled out by a number of compensatory factors. Firstly people drive further. Secondly, cars have become bigger, heavier, and more routinely equipped with power-hungry equipment such as air conditioning. Thirdly there are more cars, and the availability of more efficient models helps persuade people to replace their old ones earlier than they otherwise might have done. Finally, all this leads to pressure for more roads, and (as the UK governmment was forced to admit in the 1990s) more roads lead to yet more traffic. All these increases in consumption are prompted by efficiency increases. More fuel-efficient engines can be responsible for an *increase* in the total amount of fuel consumed.

This doesn't just apply to transport. As lower-energy bulbs become more common, people leave their lights on for longer. As houses become better insulated and heating (or cooling) appliances more efficient, people adjust their thermostats, spending the savings on more comfort. Fridges are now more efficient, but many have become bigger, not to mention fuller.

The Rebound Effect

This dynamic, has been known for some time to economists as "the rebound effect". But now it is the subject of a book by J Polomeni and others entitled *The Myth of Resource Efficiency: The Jevons Paradox*.1 William Stanley Jevons, was a 19th century economist who in 1865 predicted that as the performance of steam engines and industrial processes improved, more efficient use of coal would lead to more coal being used, not less. His paradox is that reducing the cost of consuming a resource leads people to consume more of it. As Jevons put it:

> It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth . . . As a rule, new modes of economy will lead to an increase of consumption.
>
> Now, if the quantity of coal used in a blast-furnace, for instance, be diminished in comparison with the yield, the profits of the trade will increase, new capital will be attracted, the price of pig-iron will fall, but the demand for it increase; and eventually the greater number of furnaces will more than make up for the diminished consumption of each.

Jevons' view was radical, not because he suggested that the rebound effect existed, but because he believed that rebound effects can be so significant as to cancel out the resource savings arising from efficiency gains.

If 100 per cent rebound effects do happen in real life, this would undermine the optimism of gurus such as Amory Lovins, of the Rocky Mountain Institute, who has long advocated that we can avert ecological crisis by increasing the efficiency with which we use resources.[2] Lovins regards rebound effects as "insignificant", and there have been studies which go some way to supporting his view. A 2001 report for the US Congress reported:

> Actual measures of the rebound effect for electric end-use equipment have been found to be between 0 per cent and 40 per cent. That is, the actual decrease in demand realized can range from 100 per cent to about 60 per cent of the projected amount. The result is very dependent on the type of device. For example, increasing the efficiency of home appliances (so called "white goods") showed no measurable rebound effect, while the rebound for space heating or cooling units ranged from zero to 50 per cent. The rebound effect for increasing automobile fuel economy has also been much studied. This rebound is generally reported to range between 10 per cent and 30 per cent.[3]

However, research into the rebound effect remains inadequate, and Government-sponsored environmentalists, much influenced by people like Lovins, tend to promote energy efficiency uncritically. A more subtle bias is also evident, in that these analysts tend to focus on benefits observed in isolated sectors, rather than on the effects of efficiency savings on whole economies.[5] This may be because when whole economies are looked at, the picture is generally not a rosy one.

It is often hard to prove causal relationships, but it is possible to track and compare trends in resource efficiency side by side with trends in overall resource consumption. This is what the second half of *The Myth of Resource Efficiency* attempts, and the conclusions it reaches vindicate Jevons rather than Lovins.

Carbon Intensity

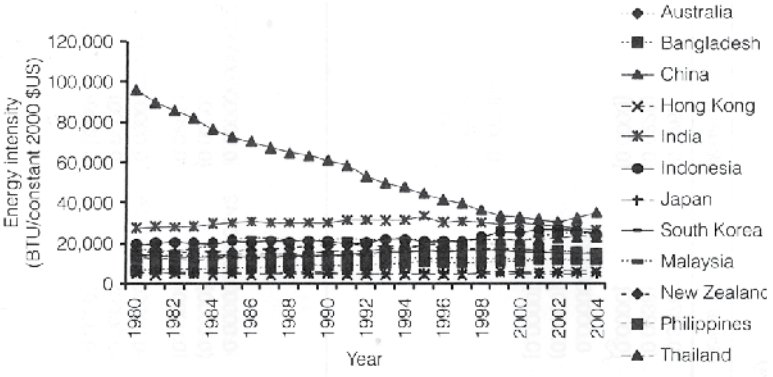
Economists use the term "energy intensity" to signify the amount of energy required to generate a given level of Gross Domestic Product. A country with decreasing energy intensity is getting more dollars' worth of output for the same amount of energy input. However, now the most prominent context for discussions of resource efficiency is climate change, and more attention is paid to "carbon intensity: getting more economic

output for the same amount of carbon emissions. At Copenhagen, China and India in particular promoted the idea that climate policy should focus on carbon intensity rather than on setting targets for overall or per capita carbon emissions.

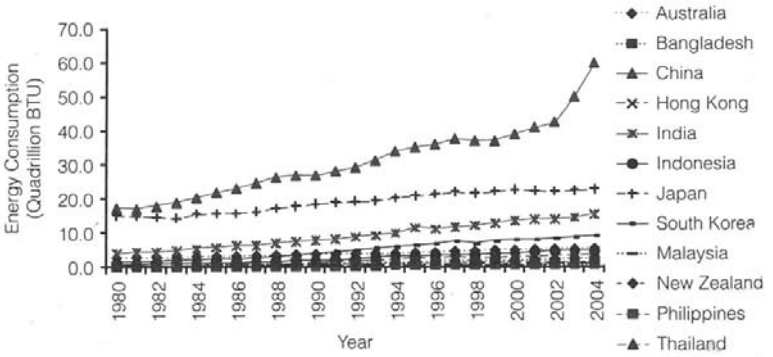
But will this produce overall reductions, which is what the world needs? The Chinese target is to reduce carbon intensity by 45 per cent by 2020 compared to 2005 levels. They assume, however, that their economy will continue to grow at eight per cent per year. This implies that even with the efficiency savings, their carbon emissions will increase by 90 per cent over the same period. They have suggested that overall emissions will in fact peak somewhere between 2030 and 2040.

The graphs on the right, taken from *The Myth of Resource Efficiency*, suggest that as regards the energy efficiency of national economies, Jevons may well have been right. As energy intensity has dropped in China, overall energy consumption has grown dramatically. It is likely that the same is true of carbon intensity.

There are many different ways of calculating carbon intensity and comparing it with overall emissions at a global level, but the version below from Oxfam, is typical: it depicts carbon intensity falling significantly while overall emissions continue to rise, and even to accelerate.[6] This does not show any causal relationship between the two trends, but it gives good grounds to question the wisdom of relying on technological advances to bring about reductions in emissions.



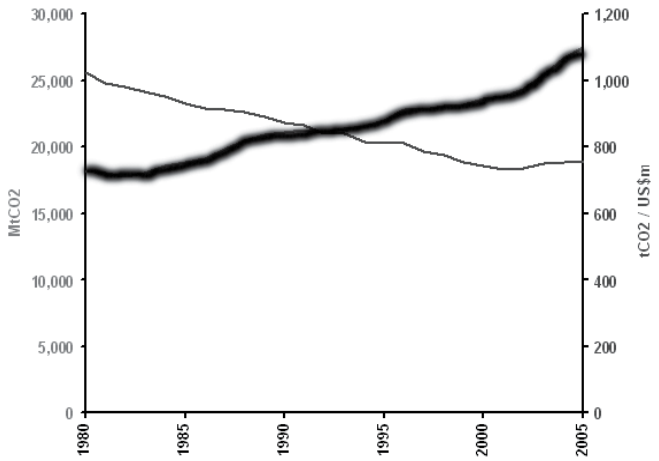
Energy intensity in 12 selected Asian countries, 1980–2004



Energy consumption in 12 selected Asian countries, 1980–2004

In the both the graphs pictured above, the line to note is the top one,which represents China. The top graph shows that in 1980 China used far more energy than any other country to produce a given amount of GDP, but over the last 20 years its energy efficiency has improved dramatically. However the lower graph shows that while China's energy efficiency has improved, its total consumption of energy has shot up. By contrast, India and most other countries have not witnessed great improvements in energy efficiency, but their total energy consumption has risen much more slowly.

In the absence of binding carbon caps, more carbon-efficient technology may prove to be part of an overall pattern of economic activity which leads to more carbon being emitted, not less. Efficient use of resources is certainly a good thing, and waste a bad one. Technology which helps us use fuel and other resources more efficiently can be very beneficial. But this is no substitute for aiming at actual reductions in resource use, or for addressing the underlying social and economic structures that drive unsustainable consumption. As advocates of steady-state economies have been pointing out for many years,[7] continued economic growth will eventually cancel out any efficiency savings.



The thick line shows total global emissions (million tonnes of carbon dioxide,shown on the left) rising over the period 1980-2005. The thin line shows the fall in carbon intensity (tonnes of carbon dioxide per million dollars of output, shown on the right) over the same period.

REFERENCES

1. J.M Polimeni, K. Mayumi, M Giampetro & B. Alcott, *The Myth of Resource Efficiency: the Jevons Paradox*, Earthscan 2008.

2. Lovins' influential books include *Factor 4: Doubling Wealth, Halving Resource Use* (Earthscan 1998), calling for a fourfold increase in resource efficiency. In later works he has suggested that ten- and even twenty-fold increases would be reasonable targets.

3. Gottron, Frank: *BRS20981: Energy Efficiency and the Rebound Effect: Does Increasing Efficiency Decrease Demand?* online at www.ncseonline.org/nle/crsreports/energy/eng-80.cfm?&CFID=8528214&CFTOKEN=36683570

4. See eg Mol, A.P.J., Sonnenfeld, D.A., and Spaargaren, G., (eds.) *The Ecological Modernisation Reader: Environmental Reform in Theory and Practice* (Routledge 2009). Joan Martinez-Alier in *The Environmentalism of the Poor* ,Jon Carpenter, 2002 pithily describes this way of thinking as the "gospel of eco-efficiency".

5. York, Richard: *The Treadmill of (Diversifying) Production* (Organization & Environment 17(3), September 2004)

6. www.oxfamblogs.org/fp2p/?p=925

7. An excellent recent British example is Tim Jackson's *Prosperity Without Growth: Economics for a Finite Planet* (Earthscan 2009)