Why we must prepare for a low energy society

Mandy Meikle suggests that the focus on a low carbon future is sending us down the wrong path.

Since the Rio Earth Summit in 1992, the focus for tackling climate change has been on ways to reduce carbon emissions. The 2010 figure for the annual atmospheric CO_2 level is 390ppm, a rise from 356ppm in 1992.[1] Our focus on emissions is failing.

Even though the renewable energy industry is growing, renewable technologies are barely making a dent in carbon emissions, not least because of the pace at which they are being outrun by the rising demand for energy. Countries such as China, India and Brazil have rapidly growing economies; economies grow by using energy and most of that energy comes from fossil fuels. Unless we change direction, the trend will continue.

Compounding this situation is the fact that the search for new sources of fossil fuel is taking us further offshore and into ever more hostile environments, where the costs of extracting energy sources – financial, environmental and in terms of energy itself – escalate quickly.

We have confused talking about tackling climate change with actually doing it. I suggest that we cannot solve climate change by trying to 'decarbonise' our society or even our economy because our society and economy are defined by high levels of energy consumption, and specifically by a dependence on energy-dense, carbon-based sources for that energy. Climate change is the symptom of our unhealthy and unsustainable relationship with energy. We will need to revisit and radically alter the nature of this relationship to solve it.

More than carbon

The tough reality is that renewable energy technologies cannot power the industrialised world in its existing form. In 2008, the total amount of 'primary' energy the world used was 12.3 billion tonnes of oil equivalent and of this, 81% was energy from fossil fuels.[2] In an effort to come up with more understandable numbers, researchers at SRI International, California calculated that the world consumes roughly one cubic mile of oil (CMO) per year.[3] This figure was then used to quantify comparable energy outputs from alternative energy sources with startling results.[4] The study claims that the amount of energy contained in one CMO is equivalent to 50 years of continuous output from four dams the size of the Three Gorges dam, or 52 nuclear power plants, or over 90 million solar panels.

The point of this exercise is not to belittle renewable energy but to wake us up as to just how energy-dense oil is and to how dependent our global infrastructure is on fossil fuel energy, especially from oil. Moving to renewables will not replicate this output. It is not enough to build wind farms wherever the grid can support them, or to transport solar power from the deserts. We need to consider that the future will entail less available, affordable energy for us all.

Many consider nuclear power to be a solution, including the environmental journalist George Monbiot, who made the point recently that it is too much to expect renewables to replace the output from nuclear power plants (around 2% of final energy consumption[5]) as well as from fossil-fuelled power plants. I agree; but argue that, rather than simply accepting nuclear, which has its own problems, we need to reassess our attitudes to energy. The days of cheap, plentiful energy from fossil fuels are coming to an end and neither nuclear power nor renewables nor a combination can replace what fossil fuels have provided for us.

Of this we have had plenty of prior warning, from Hubbert's 1956 paper on the peak production of fossil fuels[6] and the 1972 report *The Limits to Growth*,[7] to extreme weather events, economic collapse and the soaring cost of oil. Yet we are ignoring these warnings.

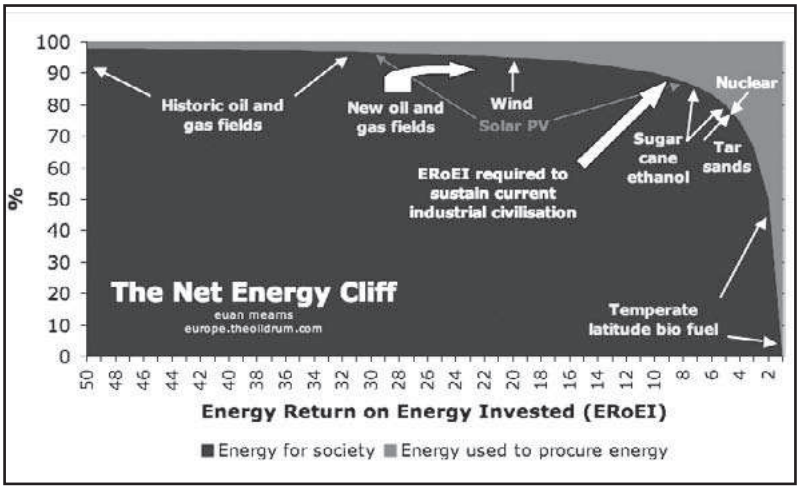
Falling energy returns

A good way to gain a deeper understanding of why a major shift is inevitable is to consider net energy. Current ideas about how to 'de-carbonise' our energy systems either fail to acknowledge the associated fossil fuel input (every device other than those produced by hand from hand-prepared, locally sourced natural materials and dragged to site by horse or human has a fossil fuel input) or fail to actually reduce energy use (for example, carbon capture and storage requires additional energy to run, thereby reducing the energy available from the coal itself) – or both.

Net energy return or Energy Return on Energy Invested (EROEI) – the amount of usable energy 'produced' compared with the energy used to acquire that usable energy – provides an important measure. As the quality of the coal and oil extracted falls, more energy must go into accessing and processing the fuel than was previously the case. In the 1930s, some of the best returning US fields produced oil with an EROEI of 100,[8] meaning that one unit of energy invested in extracting these shallow, onshore reserves produced 100 units of energy – a 99% net energy return. Today the average is about 11.[9] This is still a good return but as the quality falls and as we move to more hostile environments to find new oil, the net energy returns fall. While the debate rages over the size of remaining fossil fuel reserves, their quality receives much less attention.

It is important to recall that industrial societies emerged in the context of energy returns in the high double digits – 50 or more (a 98% return). Today, 20 (a still respectable 95% return) is about as good as it gets (see Figure 1). This might appear to strengthen the position of nuclear power, but the problems of supply and falling quality also apply to uranium supplies.[10]

Relatively little work has been done on EROEI calculations and the figures are hotly debated. Added confusion arises because some authors account for invested energy in financial terms and also because



Energy returns from various sources expressed as % energy returns and EROEI (NB. EROEI are sometimes expressed as ratios, e.g. 50:1 is 50)

of other factors (the return on biofuels, for example, is affected not just by the technology but on local agricultural methods – see Table 1). However, it is clear that historically, oil returned more energy than it does today. The best of the alternatives produce electricity, not liquid fuel, and liquid fuel alternatives do not produce sufficient net energy returns to sustain current industrial civilisation.[11]

Beyond the imagination?

The impossibility of infinite growth and the peaking of all non-renewable resources[13] is something we should be working diligently to address. As Herman Daly puts it, "The closer the economy approaches the scale of the whole Earth the more it will have to conform to the physical behaviour mode of the Earth. That behaviour mode is a steady state – a system that permits qualitative development but not aggregate quantitative growth".[14] In 2010, the New Economic Foundation published *Growth Isn't Possible: Why We Need a New Economic Direction*[15] in which it considers a hamster that does not stop growing at puberty but instead continues to double its weight each week. By its first birthday this 'impossible hamster'[16] weighs nine billion tonnes. There is a reason why in nature things do not grow indefinitely.

A steady-state economic system that maintains, not drains, resources is not a new idea. John Stuart Mill, one of the founders of classical economics, argued that once the work of economic growth was done a "stationary economy" should emerge, in which we could focus on human improvement.[17] Mill was speaking in 1848, before the commercial exploitation of oil unleashed the glut of energy that we have spent the last 150 years expending to develop our complex and populous society.

I would argue that stationary growth is finally here, but it has not been planned as Mill proposed. Rather, it is being imposed by nature because there are limits to growth, whether we like it or not. However, there is great resistance to this perspective. A few years ago, I was talking to a well-respected geologist about the need to stop focusing on a low carbon future and move to a low-energy system. He said, "I can imagine a low-carbon future; I cannot imagine a low-energy one". There are many studies of how society can move away from fossil fuels (such as the Centre for Alternative Technology's *Zero Carbon Britain 2030*[18]) but these are dismissed as idealistic and unworkable.

Energy supply is intrinsically linked to economic growth. To argue that energy supplies are constrained, regardless of the reason, is to argue against the continuation of economic growth. As we in the industrialised world do not have a workable alternative to global capitalism, such arguments are dismissed as scaremongering. Is it that we cannot imagine a low-energy future, or that we do not want to?

Fuel/technology	EROEI
Oil and gas together	19 (2005 global average)
Coal	50 to 85 but in steep decline
Tar sands	1.5 to 7
Oil shale	1.5 to 4
Nuclear power	1.1 to 15
Hydropower	11.2 to 267 (highly site variable)
Wind power	18.1 to 24.6
Solar photovoltaics (PV)	3.75 to 10
Geothermal energy (indirect)	2 to 13
Wave energy	15 (Portuguese Pelamis device)
Ethanol	0.57 (from sugar cane, Louisiana) to 10 (sugar cane, Brazil) 2 to 36 (from cellulose)
Biodiesel	1.93 (from soya) to 9 (palm oil)

Table 1: EROEI values for a range of technologies[12]

What kind of future?

First and foremost, a low-energy future will be a localised future and waste will be a misnomer. While it may satisfy market economics, shipping food around the world is not a viable option in an energy-constrained world. Many people react to arguments against growth-based economics with horror; getting the message across that the current system of endless consumption and economic growth will cease is not going to be easy.

The more I have looked into the energy crisis, the more I feel that the next big leap forward will not be technological, but psychological. We must re-examine our relationship with nature, for all resources come from nature. We need to stop talking about outcomes like saving ecosystems without also asking why we are destroying ecosystems in the first place. As Paul Kingsnorth points out, this squabble between worldviews is not about numbers at all – it is about narratives.[19] We have many cultural narratives to address, but our relationship with energy has to be the first.

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Notes and references

(web links correct as of 15 September 2011)

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