Face up to natural limits, or face a 70s-style crisis

Why the depletion of Britain's energy resources represents a fundamental shift – *for better or worse* – in the operation of the UK's economy

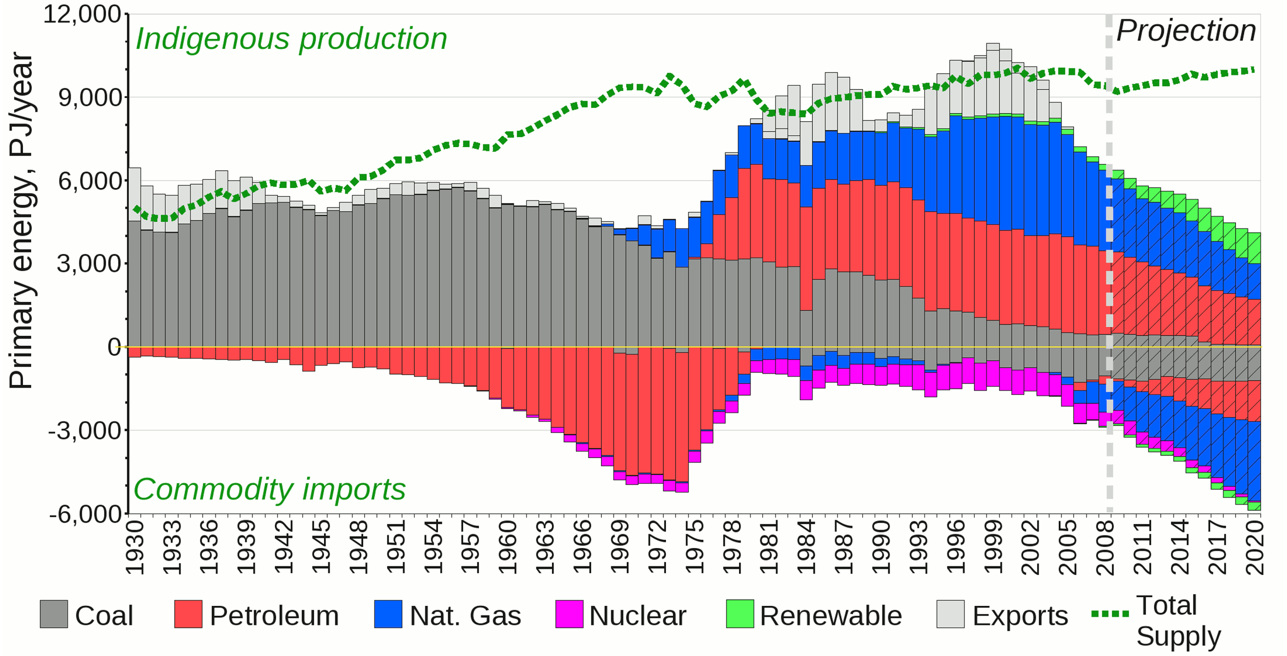
A "comment" piece for The Ecologist (long/fully referenced version) by [Paul Mobbs](), [1], January 2010

Recent gas shortages may have made politicians focus on energy security once more, but the deeper systemic problems of Britain's energy economy go far deeper than the limited capacity of our gas importation system. *Energy represents far more to the economy than just a fuel source; understanding the biophysical limits[2] on our future use of energy, and how this affects the general economy, is essential if we are to create a strategic vision that can address the ecological crises of the Twenty-First Century.*

Britain has a serious problem with its energy supply. After examining this issue for a few years now I perceive that the greatest difficulty we face is not that we lack energy resources (arguably we do), or that we are becoming precariously dependent upon imported energy (which we are), or that our large demand for energy makes reforming our economy extremely difficult (as evidently it does); the most significant problem is that the political and business community cannot accept that natural systems impose physical limits upon human society.

We may be told that our present problems can be solved through measures such as 'green growth', 'low carbon energy' or 'carbon markets', but such a view ignores the growing body of evidence concerning the relationship between the way the economic system operates and the physical nature of energy and material resources that the economy relies upon. What these limits imply is that voluntarily by consensus, or involuntarily by the circumstance of shortages and the economic crises this precipitates, we will have to do something that no one within the energy debate seems to be prepared to advocate clearly – *we will have to accept "having less"*.

There has been much debate in the last few years about "peak oil theory"[3], but in Britain we cannot talk in terms of a "theory" as our own energy production has demonstrably peaked[4] (see the graph below); Britain's oil production peaked in 1999, our natural gas production in 2003, and coal production peaked around 1925. The loss of this production means that the Government is losing billions of pounds each year in tax and production royalties, and simultaneously the economy is also being stretched by the growing cost of importing fuel to replace the lost production. As a result our economy is now experiencing, in microcosm, the effects that a peak in worldwide energy production might have on the global



economy over the next two or three decades.

If we look at how Britain's energy economy has changed over the last two centuries we can see an interesting trend emerging – one that demonstrates the evidence for a link between energy sources and the well-being of the general economy. Throughout its history, up to the Second World War, Britain was largely self-sufficient in energy. Then from the 1950s, on the back of the post-war consumer boom, this historic trend ended as imported oil gained a wider role in the economy and indigenous coal production declined. By the 1970s, when we imported about 50% of our energy needs, the imbalances in the national economy caused a whole range of economic problems; essentially because Britain was trying to spend more than it could create through its national income. What resolved this crisis, from around 1979/1980, was increasing energy production from the North Sea (not simply, as is often stated, the economic realignment of the Thatcher era). Once again Britain became a net energy exporter, and once again the strength of the national economy improved.

With the peak of North Sea oil and gas production, and with our demand for coal now largely met by imports, energy demand is once again becoming a drag upon the national economy. As the proportion of indigenous energy in the economy diminishes and the costs of energy rise, so our general economic well-being begins to decline too. What's important is not so much the balance of energy imports and production itself, but rather the costs that this balance imposes upon the economy as a whole. The operation of the modern economy is predicated upon cheap and plentiful energy supplies[5], and so the role of energy sources within economic well-being is critical. For example, recent research on the causes of the credit crunch[6] argues that it was high energy prices that initiated the crash, not sub-prime mortgages.

Less than a decade after being a net energy exporter, today we import about 30% of our energy supply. This means that, from producing a trade surplus of around £7 billion in 2000, in 2008 our use of energy created a deficit of £8 billion. The Government's own forecasts[7] predict that we could be importing up to 60% of our energy needs by 2020. As a result our dependence upon imported energy is not just an issue of "energy security", these trends are redefining the basis on which the economy operates; and unless we act to change it the economic difficulties of the 1970s are likely to return over the course of this decade.

What can be done to avoid this outcome? This again raises questions about how mainstream economists value different strategies, and only attach positive values to those strategies that can produce economic growth – a fact conspicuously demonstrated within the Government's official definition of "sustainable development"[8], which includes the criteria of the "maintenance of high and stable levels of economic growth and employment". Research suggests[9] that up to half the value of economic growth is the direct result of adding additional energy to the economy, and a further fifth is the result of improving energy efficiency. For this reason changing the dynamics of our energy supply, through falling production and/or higher prices, invalidates many of the economic norms of the past few decades.

In biophysical terms energy sources such as fossil fuels or renewable energy (and even food) have a value which they create through their production, and thus a financial and energetic return[10] that can be recycled back into the economy. To complicate matters this value is based upon the factors intrinsic to their production, and so the only way to compare one resource with another is to use a value that represents its life-cycle[11] operation, not simply its capacity for production or profit. For example, in general renewable energy does not perform in the same way as fossil fuels because its returns are lower, primarily because the thermodynamic quality[12] of the energy sources involved are lower, and so fossil fuels have traditionally had an advantage over renewable energy sources.

The other principle option to manage resources more wisely, improving the efficiency of use, is limited by the fact that it is not an open ended process; each improvement represents a one-time saving, and improving efficiency levels further requires that we invest in new technologies once more. This is because the thermodynamics of efficiency dictate that each new generation of technology must, on average, save less than the previous generation, and so ultimately efficiency measures represent a diminishing return – eventually you will have to put more into the system to reduce consumption (e.g., by making new gadgets) than it will save overall. In any case, if we look at the trends of the last century or so, the value of economic growth has in most years exceeded the value of improving efficiency. That's because efficiency improvements create a confounding economic feedback – cost reductions in one part of the economy will spur consumption elsewhere. As a result most efficiency measures will usually only dampen, rather than reduce, the overall level of consumption[13].

If the emission of greenhouse gases were the only problem with our energy system today then we might be able to do something to address the problem. The unfortunate reality is that there are an inter-related group of difficulties (principally food production, water resources, energy/mineral depletion, population *and* climate change) that are systemically linked to the accelerating growth in human activity within a finite ecological system. Whether it is the ability of the environment to mop up carbon, or of the Earth's crust to provide the energy and material resources required to continue the industrialisation of human society, human development over this coming century is going to be constrained by these ecological limitations. This is not a new concern; it was highlighted back in 1972 by the Club of Rome's *Limits to Growth*[14] study, and by *The Ecologist* in its *Blueprint for Survival*[15]. The difference today is that the limitations on our future development are even more stark, and thus the outcome of present patterns of economic activity are seemingly more intractable; as confirmed in the recent re-evaluation[16] of the *Limits to Growth* (or *LtG*) model by the Australia's scientific research agency, CSIRO[17], which concluded –

> The observed historical data for 1970-2000 most closely matches the simulated results of the LtG 'standard run' for almost all outputs reported; this scenario results in a global collapse before the middle of this century... contemporary issues such as peak oil, climate change and food and water security resonate strongly with the feedback dynamics of 'overshoot and collapse' displayed in the LtG standard scenario.

In Britain we will have to reduce our economic activity – or "have less" – to solve our present economic difficulties; Britain is in ecological and economic "overshoot", and we're going to have to take action to resolve the problem before we just run out of energy, money, or both. The realistic way to reduce our impact on the environment, and manage the decline in resources, is to reduce economic growth – also called "de-growth"[18]; perhaps not directly, but because those strategies which make a significant difference to the level of energy and resource use will often lead to a reduction in economic activity. For example, the best way to reduce consumption is not to make things "more efficient" in their operation, it is to make them last many times longer by manufacturing them to higher standard – consequently less are sold, and as a result the standard index of growth, GDP[19], will fall; likewise, as most of the energy and resources used by modern gadgets is expended in their production[20], the best way to cut energy and resource use is not to simply recycle the waste products but to adopt measures that mandate the repair and reuse of goods – the result over time being lower economic activity and negative growth.

Britain's leading role in the industrialisation of human society was the result of our easily accessible indigenous coal and metal ore deposits, not just our technical acumen. The development of Britain as the "workshop of the world" in the Victorian era, and our role as the "Saudi Arabia of coal" in the early Twentieth Century, were built upon both this strong resource base and our imperial markets. If we used these resources to become the first nation to industrialise then it follows that we are likely to be one of the first to experience a decline in production too. If we can abandon the delusional notion that human society is not subject to ecological limits, then perhaps we can develop plans for the future that reduce our demands to within the Earth's natural capacity to provide for them – hopefully to avoid the worst aspects of the ecological crises predicted since the 1970s. Britain "made" the Industrial Revolution, and as a result of our present predicament we have the potential to solve the crises that will arise over the next few years by spurring a new "Ecological Revolution" – one that addresses these past excesses through redefining markets and economic theory within ecological and biophysical limits.

Notes/References

1. Paul Mobbs has been working as an independent environmental consultant since early 1992. In 2001 he changed direction to focus his efforts on the energy and resource dimensions of environmental issues. Since 2002 he has toured the country giving workshops and presentations on these issues as part of his association with the Free Range Network, and in 2005 he published one of the first UK-centred books on peak oil and energy depletion, *Energy Beyond Oil* (Matador, 2005, ISBN 9781-9052-3700-5). Further information is available from http://www.fraw.org.uk/ebo/index.shtml
2. For a general explanation see Wikipedia: 'Biophysical economics' – http://en.wikipedia.org/wiki/Biophysical_economics; for a more expansive explanation in relation to energy and the economy see *The Need For A New, Biophysical-Based Paradigm In Economics For The Second Half Of The Age Of Oil*, Charles A. S. Hall and Kent A. Klitgaard, International Journal of Transdisciplinary Research, vol.1(1) p.4-22, 2006 – http://www.peakoil.net/files/the%20need%20for%20a%20new%20biophysical-based%20paradigm%20in%20economics%20....pdf
3. See Wikipedia: 'Peak Oil' – http://en.wikipedia.org/wiki/Peak_oil; Peak oil is the point in time when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline. The concept is based on the observed production rates of individual oil wells, and the combined production rate of a field of related oil wells. The averaged production rate from an oil field over time usually grows exponentially until the rate peaks and then declines – sometimes rapidly – until the field is depleted. This concept is derived from the Hubbert curve, and has been shown to be applicable to the sum of a nation's domestic production rate, and is similarly applied to the global rate of petroleum production.
4. The issue of peak oil, gas and coal, and how our historic energy supply has shaped the economy today, was outlined in a recent presentation given to the All Party Parliamentary Group on Peak Oil and Gas (APPGOPO) – *Peak Oil, the Decline of the North Sea and Britain's Energy Future* (Tuesday 24th November 2009); copies of the paper, the slides and an audio/video recording of the presentation are available on-line from the APPGOPO web site – http://appgopo.org.uk//index.php?option=com_content&task=view&id=55

5. See *The End of Cheap Oil*, Colin J. Campbell and Jean H. Laherrère, *Scientific American*, March 1998 – http://www.fraw.org.uk/library/peakoil/campbell_1998.pdf
6. For example – *Consequences of the Oil Shock of 2007-08*, Professor James Hamilton (Department of Economics, University of California), The Brookings Institute, conference draft Spring 2009 – http://www.brookings.edu/economics/bpea/~/media/Files/Programs/ES/BPEA/2009_spring_bpea_papers/2009_spring_bpea_hamilton.pdf
7. For the latest information on production and the projections for future imports see the *Energy Markets Outlook* report on the Department for Energy and Climate Change web site – http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/markets/outlook/outlook.aspx
8. Section 3, Chapter 1, *Securing the future – The UK Government Sustainable Development Strategy*, Cm6467, March 2005 – http://www.defra.gov.uk/sustainable/government/publications/uk-strategy/documents/SecFut_complete.pdf
9. As outlined in my paper for APPGOPO, there is a range of research that covers the many different aspects of the inter-relation of energy and growth. For example: *Two Paradigms of Production and Growth*, Professor Robert U. Ayres (INSEAD and Chalmers Institute of Technology), Dr. Benjamin Warr (Centre for the Management of Environmental Resources, INSEAD), 2001 – http://www.etsap.org/worksh_6_2003/2003P_Ayres.pdf; *Useful work and information as drivers of growth*, Professor Robert U. Ayres (INSEAD and Chalmers Institute of Technology), Dr. Benjamin Warr (Centre for the Management of Environmental Resources, INSEAD), 4th November 2002 – http://www.issi.it/gruppi di lavoro/sviluppo sostenibile/Decrescita/docs/AYRES Work&Information 02.pdf; *Accounting for growth: the role of physical work*, Robert Ayres and Benjamin Warr, Journal of Structural Change and Economic Dynamics, vol.16 no.2 p.181-209, June 2005 (an earlier version of this paper available from http://www.iea.org/Textbase/work/2004/eewp/Ayres-paper1.pdf).
10. See Wikipedia: 'EROEI' (Energy Return on Energy Invested) – http://en.wikipedia.org/wiki/EROEI; see also the article by Nate Hagens, Why EROEI Matters (April 2008) on The Oil Drum (in six parts) – http://www.theoildrum.com/node/3786, http://www.theoildrum.com/node/3800, http://www.theoildrum.com/node/3810, http://www.theoildrum.com/node/3839, http://www.theoildrum.com/node/3877, http://www.theoildrum.com/node/3910 and http://www.theoildrum.com/node/3949. In physics, energy economics and ecological energetics, EROEI (Energy Returned on Energy Invested), ERoEI, or EROI (Energy Return On Investment), is the ratio of the amount of usable energy acquired from a particular energy resource to the amount of energy expended to obtain that energy resource. When the EROEI of a resource is equal to or lower than 1, that energy source becomes an "energy sink", and can no longer be used as a primary source of energy.
11. See Wikipedia: 'Life-cycle assessment' – http://en.wikipedia.org/wiki/Life_cycle_assessment; the term 'life cycle' refers to the notion that a fair, holistic assessment requires the assessment of raw material production, manufacture, distribution, use and disposal including all intervening transportation steps necessary or caused by the product's existence – the sum of all those steps is the life cycle of the product. The concept also can be used to optimize the environmental performance of a single product (ecodesign) or to optimize the environmental performance of a company. Common categories of assessed damages are global warming (greenhouse gases), acidification, smog, ozone layer depletion, eutrophication, eco-toxicological and human-toxicological pollutants, habitat destruction, desertification, land use as well as depletion of minerals and fossil fuels.
12. See Wikipedia: 'Energy Quality' – http://en.wikipedia.org/wiki/Energy_quality; *energy quality* is the contrast between different forms of energy, the different levels within ecological systems and the propensity of energy to convert from one form to another – the concept refers to the empirical experience of the characteristics of different energy forms as they flow and transform.
13. Variously called "Jevons' Paradox" (http://en.wikipedia.org/wiki/Jevons_paradox), the "Rebound Effect" (http://en.wikipedia.org/wiki/Rebound_effect_%28conservation%29) or the "Khazzoom-Brookes postulate" (http://en.wikipedia.org/wiki/Khazzoom%E2%80%93Brookes_postulate); an extensive discussion of the problems of efficiency can be found in the UKERC's recent report, *The Rebound Effect: an assessment of the evidence for economy-wide energy savings from improved energy efficiency*, Steve Sorrell, Sussex Energy Group/UK Energy Research Centre, October 2007 – http://www.ukerc.ac.uk/Downloads/PDF/07/0710ReboundEffect/0710ReboundEffectReport.pdf
14. See Wikipedia: 'Limits to Growth' – http://en.wikipedia.org/wiki/Limits_to_Growth; the latest release of the study was published in *Limits to Growth: The 30 Year Update*, Donella Meadows, Jorgen Randers and Dennis Meadows, Earthscan 2004, ISBN 978-1844071449 (paperback), £16.99.
15. See Wikipedia: 'Blueprint for Survival' – http://en.wikipedia.org/wiki/Blueprint_for_Survival; the original magazine publication, *Blueprint for Survival* (The Ecologist, vol.2(1), January 1972), is available via The Ecologist's archive – http://www.theecologist.info/key27.html
16. See the 'Conclusions' section of *A Comparison of The Limits to Growth with Thirty Years of Reality*, Graham Turner, CSIRO working Paper Series 2008-9, June 2008 – http://www.fraw.org.uk/library/peakoil/csiro_2008.pdf
17. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is the national government body for scientific research in Australia, and it supports the Australian Federal Government and providing new ways to benefit the Australian community and the economic and social performance of a number of industry sectors through research and development; see Wikipedia: 'CSIRO' – http://en.wikipedia.org/wiki/CSIRO
18. See Wikipedia: 'De-growth' – http://en.wikipedia.org/wiki/De-growth; proponents of de-growth argue that decreasing demand is the only way of permanently closing the demand gap – to exist with the lower production levels capable with renewable resources demand, and therefore production, must also be brought down to levels that prevent depletion and are environmentally healthy. Moving toward a society that is not dependent on oil is seen as essential to avoiding societal collapse when non-renewable resources are depleted.
19. See Wikipedia: 'GDP' – http://en.wikipedia.org/wiki/GDP; the basic measure of a country's overall economic output based upon the market value of all final goods and services made within the borders of a country in a year.
20. The issue of the sustainability of digital electronics/technologies is the subject of a forthcoming new presentation that I'll be bringing out later in 2010, *Limits to Tech*. For a good article on the subject see, *The monster footprint of digital technology*, Kris De Decker, Low Tech Magazine, June 16th 2009 – http://www.lowtechmagazine.com/2009/06/embodied-energy-of-digital-technology.html

Paul Mobbs/Mobbs' Environmental Investigations

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