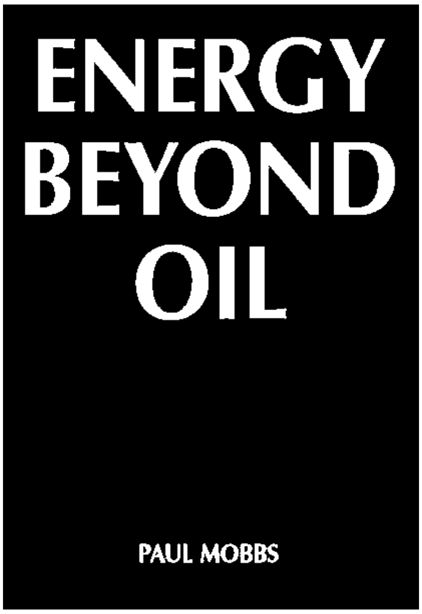
An Introduction



Why are energy prices rising? Why is nuclear power back on the agenda? Are wind farms and solar panels a solution to our energy problems? If energy is becoming scarce, exactly how might our use of energy have to change in the future?

These and many other questions are considered in the new book by Paul Mobbs, *Energy Beyond Oil*. The book examines the UK's energy future, and how imminent changes to our energy supply might affect our energy-intensive lifestyle.

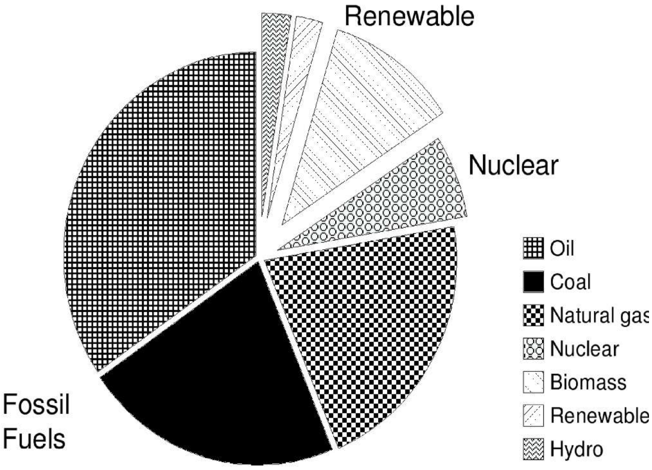
This briefing has been produced to accompany the short lecture developed from the themes covered by the book, and summarises the information they contain.

The genesis of *Energy Beyond Oil* was an attempt to answer a simple question that was posed in relation to the development of large-scale renewable energy projects – *how much energy is there left in the world?* This may seem relatively straightforward, but answering that question took two years of research.

The approach taken to research the the question was to dispense with pre-conceived ideas about our future energy supply. Instead the physical restrictions and practical limitations on a range of energy technologies were analysed, in order to produce a holistic view of potential future energy sources.

There are various physical laws that govern the use of energy. If we use these laws, together with scientific methods, to analyse how different energy technologies might affect our energy supply we find that many of the "alternative" options have little relevance to our longer-term energy future. Many of the alternatives to fossil fuel energy sources are limited by either: their use of scarce mineral resources; the land area or the amount of equipment that they require to operate; the 'net' value of the energy produced; or the environmental problems that the large-scale use of these technologies create.

The world currently uses in excess of 400 exaJoules of energy per year. That's a fairly meaningless number. To put it in context, that about one-third of all the energy that all the plants and trees on the Earth's surface absorb from the Sun by photosynthesis every year. It's over three times more than the energy contained in the world's tidal currents.



World Energy Use by Fuel, 2000
(from the United Nations Development Programme)

34% of the world's energy is sourced from petroleum, 22% from coal, 22% from natural gas, 11% from traditional biomass (firewood), 7% from nuclear, 2% from large hydroelectric schemes, and 2% from other renewable sources. However, following the current trends in energy use, 56% of human energy use (the oil and gas) is going to run out or be very scarce within the next fifty to one hundred years, and one third of it (the oil) will become scarce, and hence very expensive, within the next fifteen to twenty years. Consequently the key message from the book is this:

The scale of our use of energy today is so far outside the capacity of natural systems to provide by the use of renewable energy sources that it is unrealistic to believe that our current energy supply can be maintained. Once our use of fossil fuels is limited by their dwindling supply, or worsening climate change, the world's economy must undergo a significant contraction.

Over the next fifty to one hundred years, for a country such as the UK, that means cutting our use of energy by <u>two-thirds</u>.

The key message from *Energy Beyond Oil*: Don't think about when the energy will run out, think about how a reduction in oil and gas supplies will raise the price of our energy supplies

A key factor in analysing how our use of energy might change in the future is to look at how energy is used today. Energy economists, who study our consumption of energy, produce statistical models of that allow them to study current trends. Then, when a model properly represents the current situation, projections can be made of how energy use might change in the future.

Within the UK most official energy studies are sponsored by the Department of Trade and Industry (DTI), who have responsibility for the UK's energy policy. The diagram below is based upon a DTI study, but it has been updated with the most recent statistical data for the year 2003. **The key feature of this diagram is that all the lines are drawn to scale – so you that can visually comprehend what energy sources flow where within the UK energy economy** (note, all the figures are in exa-Joules – EJ).

Just over one-third of the energy used in the UK is supplied by natural gas, oil provides just less than a third, much of the rest is provided by coal, and nuclear provides just under one-tenth (the 22% figure quoted by the nuclear industry is a proportion of the UK's *electricity* supply – but in fact nuclear produces just 8.4% of our *total* energy supply).

The amount of **oil** within the UK energy economy hasn't changed much in the last thirty years. This is because, as the industrial use of oil has fallen, the growth of the transport sector has consumed the spare capacity from industrial users.

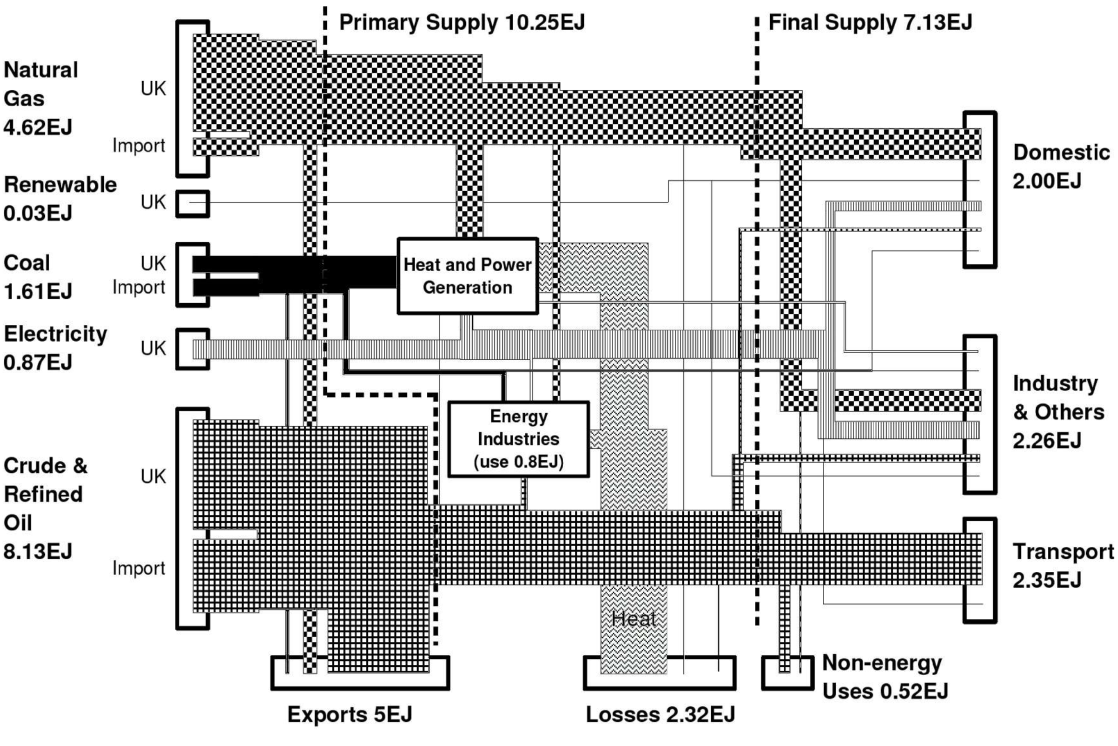
As the use of **coal**, and very shortly **nuclear power**, falls, the UK's demand for electricity is being met by burning more natural gas. Nuclear power has now passed its zenith. As no new power stations have been ordered most of Britain's nuclear capacity will be closed within fifteen years. Within a decade or so natural gas might provide two-thirds of all our electricity. At the same time, natural gas production from the North Sea is falling as those reserves are depleted.

Using the DTI's definition of **"renewable energy"**, less than three percent of the UK's energy supply came from renewable energy sources. However, most of the DTI's "renewable" energy sources involve the burning of gas from landfill sites (31% of "renewable" energy production), or burning car tyres (23%) and animal wastes (17%). In 2003, water power provided 8% of the UK's renewable energy, wind power 3% and solar provided less then 0.6%. The reality of the UK's renewable energy system is that it's a system devoted to waste management, not the production of energy to displace fossil fuels.

Looking forward, the UK, and the globe, face a major energy crisis in the next decade or so as we pass the date of **"Peak Oil"**.

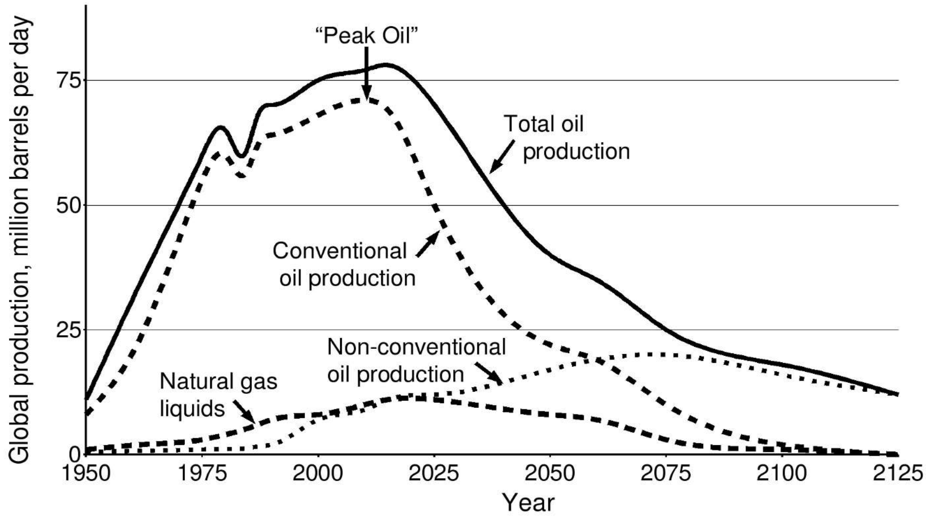
There are various explanations as to why oil prices rose so sharply during 2004 and 2005. Most of these explanations were related to the high level of demand for oil from China and India. However, although increasing energy demand has led to a rise in the cost of all energy sources, the problems with the oil supply are very different. Oil supply is not keeping pace with demand, and one of the likely reasons for this is that global oil production is about to peak.

During the 1950s an American geophysicist, M. King Hubbert, used data from oil fields in the



Energy sources and supply in the UK, 2003 (drawn to scale)

USA to demonstrate that oil production followed a clear statistical trend – a *bell curve*. In 1956, he predicted that US oil production would peak in 1970, and, give or take a few months, he was correct. This led to other oil analysts, using Hubbert's method, to produce studies that predict a peak in global oil supply between 1996 and 2035, but most of the studies centre on the period between 2005 and 2014.



A projection of future oil supply past 'Peak Oil'

The diagram to the right shows a projection of global oil production over the next century. *Conventional oil* production, from oil wells, makes up most of the oil the world uses. There are other unconventional sources of oil, but these cost more to produce, and their productive capacity is far less than conventional oil fields.

As you can see, the peak in production of conventional oil is followed very quickly by a large contraction in production. However, the overall level of production – the solid line – does not fall as steeply because production from other, more expensive unconventional sources, reduces the rate that global oil production falls overall.

The fact that oil production peaks and falls is not an indication that the oil is about to run out. In fact, when production peaks, half the oil that the world is likely to produce is still under the ground. The problem is that oil production, and oil prices, are closely related to the rate of economic growth. As was shown in 1980, high oil prices dampen growth and can trigger a global economic recession. In fact, as shown in the graph, the only period over the last fifty years when world energy consumption fell was during the global recession of the early 1980s.

The recent high oil prices, although numerically greater, are only half the value of the 1980 oil price if you take inflation into account. However, if the oil price continues to rise, reaching over $75 to $80 per barrel, it would have serious economic consequences. If global oil production is about to peak, and there is growing evidence from around the globe to indicate that it could do so over the next few years, then global oil production will fall. This will of course cause prices to rise – *sharply*.

For this reason the key message from the *Energy Beyond Oil* research is: **we shouldn't think about when the oil will run out – we must instead concentrate on the level of oil supply and how this will affect the price we pay for our energy supplies**.

It's also worth noting that natural gas, too, will have a peak in its supply. This has been projected at between 2030 and 2040, although the recent large increases in global use of natural gas led the UK's Parliamentary Office of Science and Technology to move this date forward to the "2020s". This is significant as by then the UK will be dependent upon natural gas for a major part of its energy supply.

The USA has experienced the domestic problems of peak oil since the mid 1970s – it now imports 60% of its oil demand. Oil production from the North Sea peaked in 2000, and already the fall in production has led the UK to import ever larger amounts of oil. North Sea gas production has peaked, and the UK is importing more gas from Russia and Central Asia via pipelines, as well as building facilities to import liquefied gas from Indonesia and Malaysia. **However, if the oil and gas supply is going to peak and contract over the next two or three decades, where will we source our energy from in the future?**

Recently there have been signs that the UK government is more attracted to nuclear power. For environmentalists the objection to nuclear has been the issues of waste disposal and accidents, but there is a third issue that they have so far ignored – *the uranium supply*.

The world's **nuclear power** reactors split atoms of uranium-235 to produce energy. However, uranium-235 only makes up 0.7% of the world's uranium resources. At current rates of use, where nuclear provides just over 6% of the world's energy supply, there is enough uranium to keep the reactors running for 80 to 100 years. But if the nuclear sector expanded, producing perhaps 30% of the world's energy, then the supply of uranium-235 would last just **20 years**. To use the other 99.3% of the uranium resource we would have to develop *fast breeder reactors*. The problem is that not only would this require a large expansion of nuclear reprocessing (for the UK it would meaning building another one or two Sellafield-like plants), but as yet no one has produced a working fast breeder reactor design. All the experimental fast breeder plants around the world have been shut down because of 'operational problems'. Even with fast breeders, nuclear power might only last a century.

What about **coal**? The UK has enough coal to last about 25 years, but if we tried to produce all our electricity using coal it would last about 10 years. Globally, at current consumption, there is enough coal to last around 200 years, but if the world tried to get most of its energy from coal it would last less than a century. There's also the problem of climate change, which pretty much precludes the use of coal as a major energy source because of its large carbon emissions. If we use the coal, we would wipe out a large proportion of the planet's species, including humans.

This leaves **renewable energy**. The problem is, as outlined at the beginning, our use of energy today is far in excess of the capacity of natural systems to supply our energy demand. When renewable energy is featured in the media it is described in relation to either (a) electricity supply or (b) domestic energy use. In fact, electricity represents just 18% of the UK's final energy supply, and domestic consumption is 28% of the final energy supply – consequently the current debate is considering less than one-third of the problem.

A good example of the problem with the debate over renewable energy is **biodiesel**. It takes 0.85 hectares of oilseed rape to run an average car on biodiesel for one year. That means that all the oilseeds produced in the UK would only run around 425,000 cars. To run all the cars in the UK would take an area slightly larger than the entire UK land mass.

Of all the renewable technologies **wind power** is the most dense source of energy. The problem is that energy production from wind is unpredictable. Producing an amount of energy equivalent to the UK's electricity supply each year would require 4% of the UK's land area to be densely covered with over 50,000 of the largest wind turbines currently manufactured. To produce all our energy from wind (which is, theoretically, impractical) would require a third to a half of the country to be densely covered with wind turbines.

Hydrogen is another technology that is often associated with our future energy supply. However, as a major energy source, hydrogen is next to useless. This is because, like electricity, hydrogen is a *carrier* of energy. To use hydrogen you must first make it, and therefore it can *never* be an energy source.

So, what's the solution? This may sound a little Zen-like, but to understand the solution requires that we understand what the solution is not. The solution is *not* to seek to produce more energy, but to accommodate the absence of energy – ***we must use less***.

Oil production is going to peak – if not within the next few years then certainly within the text ten or fifteen. When it does the global economic system will have to contract. The global economy requires continual growth to create the wealth to provide more commodities and services. Less energy implies **negative growth**, because the levels of efficiency savings we might achieve are far less than the level by which our energy supply will contract. As noted earlier, the only time that energy use fell over the last fifty years, enabled by strong negative growth, was during the global recession in the early 1980s.

If we look at what natural systems might provide, using truly renewable energy technologies, then **over the next fifty to eighty years the UK will have to cut its use of energy by 65% to 75%**.

That might sound like the end of the world, but a large part of the world's population already live at or below this level of energy use. What's more, we won't cut our energy use because we will all 'go green'. Instead, higher oil (and gas) prices will restrict our use of energy and we will be forced to make cuts.

Therefore we have two choices: We can wait for the crunch, and then hope that things sort themselves out; or, we can plan today, and act tomorrow before the crisis takes hold, to reduce our energy use and get more energy from localised renewable sources.

In short, it is up to us all, on the basis of how we each view the evidence about the coming 'energy crunch', to plan our energy futures "beyond oil".

Energy Beyond Oil
by Paul Mobbs

Published by Matador Books, distributed by Troubador.
ISBN 1-905237-006, £15.99.

Available in bookshops, June '05, or order online at www.troubador.co.uk

For information about *Energy Beyond Oil*, including references to all the materials used in the production of this briefing, and to download further information and updates, see the EBO web site at **http://www.fraw.org.uk/ebo/**

If you would like to get in touch about The Energy Beyond Oil Project, or perhaps organise a lecture or workshop in your area, you can email Paul Mobbs via ebo@fraw.org.uk.

***Energy Beyond Oil – An Introduction*, April 2005. By Paul Mobbs, 3 Grosvenor Road, Banbury OX16 5HN.**