

-Title: The coming energy crisis, global warming and the role of renewables  
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-Date: 08/08/2005  
-Source: Edge Debate

There are two reasons why society has to get out of oil, and at first look they seem contradictory. One: oil is running out. Two: we cannot afford to burn it all.

Oil is running out because it is a finite resource. Much depends on when the 'topping point' - the so-called peak of production - will occur. Those who tell us it is far off include the US Department of Energy and the oil companies. Let's call them the 'late toppers'. They profess that some 2-2.7 trillion barrels of oil are left in known deposits and predictable future discoveries. 'Early toppers', such as the Association for the Study of Peak Oil and Gas, reckon on more like one trillion barrels. In a society that has allowed its economies to become almost inextricably geared to growing supplies of cheap oil, the difference is seismic.

If there are 2-2.7 trillion barrels left, the topping point lies relatively far away in the 2030s. The 'growing' and 'cheap' aspects of the oil supply equation are feasible until then, at least in principle, and we have time enough to prepare the alternatives that will follow the hydrocarbon age. If there are one trillion barrels left, the topping-out point is as close as 2008 plus or minus two years. The 'growing' and 'cheap' aspects of the equation then become impossible, and there is not enough time to make the transition from oil to alternatives.

Economies cannot run without energy, and global depression lurks around the corner.

This way of looking at oil, of course, assumes that we can afford to go on burning it for as long as we find and pump it, and most geologists, economists and financial analysts live in a culture that assumes this. But they are wrong. We can't. The reason is global warming. If left unmitigated at source - mainly, the burning of oil, gas and coal - global warming is also quite capable of kicking us into the next depression, never mind its effect on ecosystems.

Let me look first at the evidence for an early oil topping-out point, then at how the problem conflates with global warming, and finally at the role for renewables in the outcome.

How much oil is there in existing reserves? The answer is a big surprise for those unfamiliar with the issue. The common understanding is that the 'Big 5' Middle Eastern countries, Saudi Arabia, Kuwait, Iraq, Iran and the UAE, are overflowing with proved reserves. A growing body of oil industry insiders is claiming that in fact they aren't: they still have plenty of oil, for sure, but they have been inflating their statements of reserves since the mid-1980s, shortly after OPEC agreed a quota system for production, based on the size of national reserves.

More surprises follow for the uninitiated. The world's biggest oilfields, the giants of Saudi Arabia and Kuwait, were discovered way back in the 1930s and 1940s. The year in which most oil was discovered - the topping point of discovery - was as long ago as 1966. The last time a major oil province was discovered was the North Sea in the 1970s. The last time we discovered more oil in a year than was used was a quarter of a century ago. Half the world's current production of 80 million barrels a day comes from the 100 biggest fields. Almost all of these are more than a quarter of century old, and are all more than 2 billion barrels in size.

The average size of oilfields since 1980 has been 50 million barrels - less than a day's global supply. The average total of oil discovered each year for the last decade has been around 15 billion barrels. Discovery continues to dwindle, despite all the undeniable improvements in technology and the vast capital available to oil majors. Take giant oilfields, of more than 500 million barrels (and even though they are called 'giant', they still represent less than a week's global supply at current demand rates): in 2000 there were 16 discoveries, in 2001 nine, in 2002 just two, and in 2003 none. It takes six years from the discovery of an oilfield for the first oil to come to market.

The early toppers put 'proved' reserves at around 780 billion barrels. The late toppers tend to go with a standard line of 1100 billion, or thereabouts. How much remains to be added to these disputed reserves? There are three ways of making additions. You can explore and find more, you can enhance recovery from existing fields with technologies such as steam injection and horizontal drilling, or you can extract unconventional oil, notably the vast tar sands of Alberta in Canada.

There is nowhere near as much conventional oil left to find as has been found to date. Much of this has to do with how well past oil explorationists have performed, plus special and actually rather obvious site conditions needed for giant oilfields, combined with the length of time that geologists have been looking for them. Early toppers reckon that as little as 150 billion barrels remain to be found. Late toppers, such as the US Geological Survey, go up to

900 billion barrels. Growth of reserves from enhanced production, meanwhile, tends only to apply to the older fields. The technology used is clever and effective, but as one expert in the field says, those wheels have long since been invented. As for unconventional oil, it is hideously difficult to get out. To extract oil from tar sands you need to heat much more water than Alberta's farmers can spare, burning more Canadian gas than makes the process worthwhile in terms of net energy, even if you care nothing about the greenhouse implications. Even then, the IEA figures the most that can be hoped for on optimistic assumptions is 10 million barrels a day by 2030. That doesn't come close to bridging the gap between supply and anticipated demand: the US Department of Energy assumes we will need 120 million barrels a day by 2025.

How will the oil depletion and global warming issues conflate? Microcosms of energy innovation show what could have been done to cut emissions on a large scale since the 1990s. A notable example in the UK is Woking Borough Council, which has cut carbon dioxide emissions by 75% (116,500 tonnes) since 1990, via a hybrid energy system involving private wires, combined heat and power, solar PV and energy efficiency, plus or minus fuel cells and absorption chillers. The UK Government's view today is that "we could achieve a virtually zero-carbon energy system in the long term ... this is technologically and economically feasible ...". Just one member of the renewables family could contribute hugely to this goal: "... solar energy alone could meet world energy demand using less than 1% of land now under crops and pasture."

If we want to abate horrors of climatic meltdown, we have to stop burning oil, or more exactly back out of it and the other fossil fuels, and into alternative fuels, renewables, and the huge unmined (as it were) reserves that lie in end-use efficiency measures. This is the point at which the peak-production and global-warming imperatives for the Big Retreat from oil meet. The core question boils down to this: can we progressively replace oil and the other fossil fuels at just the right urgent pace to avoid economic calamity as a result of oil shock, climate shock, or both? Oil provides 40% of world energy and 90% of world transport fuel today.

The more optimistic practitioners in the embryonic clean energy industries believe our technologies could probably power and fuel the world in its entirety 10-20 years hence, given political will of the type directed at the war against terrorism. And why not? As the British Government's chief scientist has said, the threat from global warming - an inspector-proven weapon of mass destruction - is far greater. We couldn't plug the gap in four years. The grim reality seems to be that the shortfall between expectation of oil supply and actual availability will be such that gas, renewables, liquids from gas and coal, or nuclear - in themselves or in any combination - will not be able to plug the gap in time to head off economic trauma. Therefore, if the early toppers are correct and the oil topping-out point is indeed as soon as 2006, we are in big trouble - global warming or no global warming. Realization that growing supplies of cheap oil are no longer available will descend at some point this decade, the alternatives will not be ready in sufficient volume, and the economic dominoes will begin to fall.

Some other corollaries fall out of the analysis. Amid the ruins of the old energy infrastructure, the oil depletion and global warming issues will conflate, as many try to turn to coal in extremis. Renewable energy use, alongside energy efficiency, will increasingly substitute for oil and gas, growing explosively whatever happens. Whether this growth will occur instead of coal expansion, rather than alongside it, will determine if economies and ecosystems can survive the global warming threat. However the future pans out, renewable energy a central role in it. But if the early toppers are right, we will be called upon rather soon - along with all our sister low- and zero-carbon technologies - to lead the charge for damage limitation amid economic dislocation. Being a former geologist, with more than a decade's experience of the oil industry, I have to tell you that I think the early toppers are indeed right.

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