BEYOND PEAK OIL: Will Black Gold Turn Green?

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As the world glimpses the bottom of the (oil) barrel, Barry Brook ponders alternative fuels.

The modern world depends upon a vast legion of invisible energy slaves – the equivalent of 200 human workers per person for developed countries. Like servants of the kings of old, they service our every whim. From the food we eat to the cars we drive, our lifestyles are propped up by cheap, readily available energy. Oil.

But what if that multitude of energy slaves started to slip away into the night? What if the river of black gold started to dry up? The dire consequences for the continued prosperity of civilisation hardly bear imagining, yet that's just what's happening right about now (give or take a few years).

It's called "peak oil". That's the time when oil production reaches its maximum rate, despite the pull of the market demanding ever more supply. It's the natural consequence of the ongoing depletion of any finite, non-replaceable natural resource. Exploitation of it can't grow forever. At some point you start to run out.

Roughly speaking, peak oil is also the point at which we've used half of the world's total extractable oil supply. At this stage, there is still half left. But it's the tough half – the light, sweet crude has basically all gone and it's time to suck out the heavy, sour stuff. That takes longer, costs more money and takes more energy inputs. That's bad for growth.

Global oil production is currently stuck at about 85 million barrels per day. Serious energy analysts don't expect it to ever climb much above that level. A method of supply projection known as "Hubbert linearisation" – named after the analyst who successfully predicted the peak in American domestic oil production more than a decade before it happened in 1970 – suggests that there are about two trillion barrels of useable oil on Earth. That's the reserves of oil that yield more energy from their use than it takes to extract, pipe and refine them. We've used about one trillion barrels over the past 150 years. It will take a mere 50 years, if that, to use up the rest.

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At this point we have a few choices before us. We can watch modern society regress to a poorer and less productive state as energy runs out. We can continue to burn up that remaining one trillion barrels and take the climate system on a rollercoaster ride the likes of which humanity has never witnessed. Or we can find an alternative energy supply. Fast.

I'm optimistic that there are plenty of alternatives out there. For instance, in theory we can run most anything off electricity. That includes land-based vehicles, though not aircraft. We can make plastics and pharmaceuticals out of plant-based products instead of petrochemicals. We can store unused renewable energy in compressed air "batteries", molten salts, and in chemical forms such as hydrogen.

But what do we do about liquid fuels? For a while, crop-based biofuels were thought to be the answer. Grow great swathes of corn, soy, oil palm and the like, and use these to extract ethanol and biodiesel.

However, the biofuel bubble has now burst, as it is becoming increasingly clear that there isn't enough arable land or phosphate-based fertilisers to sustain the scale of industry that would be required to replace even a fraction of the world's fossil-based oil supply. The biofuels life cycle accounting just doesn't add up.

Or so it seemed. Yet many are now quite convinced that the light at the end of the tunnel is not the headlights of the oncoming freight train named Peak Oil. Instead, they say, it's the ignition of a new, clean-burning, carbon-neutral oil well known as second-generation biofuels.

Microscopic algae – tiny water-living plants – naturally produce oils in small quantities. This excretion is suitable for the manufacture of biodiesel. If grown over sufficiently large areas (deserts are perfect) there is theoretically almost no limit to the amount of hydrocarbons and derivative products (including plastics) that microalgal oil farms can produce. The problem is trying to achieve this at a cost-effective scale.

Currently there are three fundamental roadblocks. First, the algae need to produce more oils per plant cell. Second, the growth rate of algae needs to be enhanced in normal air – microalgal biodiesel production currently requires a concentrated stream of carbon dioxide, such as from a gas-fired power station or cement factory. Third, there needs to be a massive "learning-by-doing" experiment to assess the logistics and refine the efficiency of industrial-scale production.

All these are achievable (insiders say within 2–5 years) via a combination of genetic engineering, selective breeding, and research and development inputs from a variety of scientific and engineering disciplines. Oh, and plenty of money – but money well spent on innovation for energy security, not squandered on bad loans, hedge funds, derivatives and old-style fossil fuel infrastructure.

It's time for governments to set good forward-thinking policy that drives clean-tech research and fosters co-investment with industry. It's time for energy companies and venture capitalists to recognise that opportunities create the momentum.

Given the immediacy and seriousness of both the peak oil and climate crises, we have no time to waste.

Air New Zealand's Sustainable Fuel Aspirations

Air New Zealand expects to use at least one million barrels of environmentally sustainable fuel annually by 2013. Chief Executive Officer Rob Fyfe says the airline is growing increasingly confident that commercial quantities of environmentally sustainable fuels will become available over the next few years. "This fundamental shift in fuel options should be embraced by the industry, and we aim to see at least 10% of our total annual needs coming from environmentally sustainable fuels by 2013. Studies have already shown that sustainable fuels can lead to a significant reduction in carbon emissions with a 40–50% lower carbon footprint on a life-cycle basis," Mr Fyfe said.

Air New Zealand's next step in proving and commercialising sustainable fuels for use in air travel will be the world's first flight test on a large passenger aircraft using fuel sourced from the plant *Jatropha*.

Jatropha grows approximately 3 metres high and produces seed that contains inedible lipid oil, which can be used to produce fuel. Each seed produces 30–40% of its mass in oil, and *Jatropha* can be grown in a range of difficult conditions, including arid and non-arable areas.

Fyfe says any sustainable fuel must meet three criteria for the test flight program. "Firstly, it must be environmentally sustainable and not compete with existing food stocks. Secondly, the fuel must be at least as good as the product we use today. Finally, it should be significantly cheaper than existing fuel supplies and be readily available."

The *Jatropha* oil that Air New Zealand is sourcing comes from environmentally sustainable plantations in south-eastern Africa (Malawi, Mozambique and Tanzania). Air New Zealand requires the land for sourcing the *Jatropha* oil to have been neither forest land nor virgin grassland within the previous two decades. The quality of the soil and climate is not suitable for the vast majority of food crops. Furthermore, the plantations are rain-fed and not mechanically irrigated.

"*Jatropha* satisfies all our criteria, and furthermore it is likely to be available in the necessary commercial quantities to meet our needs within 5 years. We have already had offers from organisations in Asia and Africa willing to guarantee enough supply to meet our 2013 target," said Mr Fyfe.

Mr Fyfe says *Jatropha* is unlikely to be the only fuel that Air New Zealand is involved in testing. "Algae presents some extremely exciting possibilities for the aviation industry, and around the world hundreds of scientists are working to crack the process of turning it into commercial quantities of jet fuel." Source: Air New Zealand