Flawed reasoning about oil and gas

Sir — The review by Peter Kassler[1], the book he reviewed[2] and other similar works of recent years perpetuate an incorrect and insidious myth about the quantity and accessibility of petroleum and natural gas resources. This myth essentially claims that the world will run out of oil and gas at some future time because the resource is limited. Whereas any specific resource defined in a limited manner is indeed limited, concerns about imminent long-term shortages of oil and gas are flawed for several good reasons.

The amount of hydrocarbon available to mankind is not limited to that from conventional oilfields. Less than 5 per cent of the hydrocarbon in sediments worldwide, exclusive of coaly matter, is in the form of conventional oil and gas. Vast resources of heavy (viscous) oil exist, not only in Canada (250 billion cubic metres) and in Venezuela (300 billion cubic metres) but also in similar deposits in the Middle East, China, Russia and elsewhere.

The known amount of heavy oil is substantially larger than the amount of conventional oil, perhaps by a factor of two or three. These are seldom, if ever, included in the assessments of oil supplies.

Technological advances using horizontal wells, gravity drainage with thermal stimulation and other new production approaches[3] are rapidly lowering the costs of these resources. In Canada, operating costs have dropped from C$70–$80 per cubic metre in the late 1980s to C$25–$40 in 1996 for these technologies. Also, the exploration costs associated with these resources are essentially nil, whereas the exploration costs for conventional oil continue to rise inexorably (C$40–$50 per cubic metre in the Western Canadian Sedimentary Basin).

The implications for petroleum supplies are substantial. Consider the consequences if only 20 per cent of the Canadian heavy oil deposits are economically recoverable (an estimate I consider to be slightly pessimistic). This amount is sufficient to meet current US and Canadian consumption combined for a period of more than a hundred years. And Canadian "political and military disruptions" are modest, compared to recent Middle East events.

Despite being a political football, oil remains essentially a commodity. As conventional oil deposits are gradually depleted, prices will rise, and this will make non-conventional resources economically accessible. One may ask at what cost. In Europe, 60–80 per cent of the commercial cost of a litre of fuel is government-imposed taxes. A simple calculation shows that a commodity price of US$600 per cubic metre could be sustained without an increase in price at the pumps in Europe, if the governments involved are willing to forgo this lucrative source of revenue in the distant future. US consumers who benefit from low fuel taxation will have a different opinion on such a commodity price.

What is the consequence of rising prices for a commodity-priced barrel of oil? First, resources that have been considered marginal (oil sands, smaller offshore fields) become economically exploitable. Second, fields that had been abandoned after producing only 20–40 per cent of the oil in place with conventional technology will be redeveloped using gravity drainage methods to access a large proportion of the remaining oil. Third, if prices are sufficiently high, with some confidence of price stability, other vast resources become available for development. These include, for example, oil shales and coal.

It is estimated that 90 per cent of the non-coal hydrocarbons in sedimentary basins are found in shales. The Green River oil shales (actually kerogenous shales) of Colorado and Wyoming are but one example of such deposits, and the estimated hydrocarbon volume in this deposit is similar to that in the Canadian oil sands.

It is also possible to make synthetic crude oil through the hydrogenation of coal: the Sasol process in South Africa is the prime international example of such technology. Vast quantities of coal and low-quality lignite exist throughout the world for this purpose.

Finally, given a sufficient commodity price, one may even extract carbon (from atmospheric carbon dioxide or limestone) and hydrogen (from solar-powered electrolysis of water) and assemble synthetic gasolines from the basic elements. The only realistic limitation to this process is price.

The view, therefore, that hydrocarbon resources are inherently fixed or limited is false. Government policies are based on the politics of conventional oil, and these policies will be revamped as technologically intensive non-conventional sources of oil become, unavoidably, an increasing part of the commodity supply.

Limitations on oil use are therefore more logically related to environmental issues such as global warming and urban pollution; resource limits do not, for practical purposes, exist. Oil shortages are actually short-term shortfalls in cheap conventional crude oil supplies, and have little to do with the actual long-term hydrocarbon supplies.

Maurice B. Dusseault
Porous MediaResearch Institute,
University of Waterloo, Waterloo,
Ontario N2L 3G1, Canada
e-mail: mauriced@sciborg.uwaterloo.ca

1. Kassler, P. *Nature* **384,** 528 (1996).
2. Colitt, M. & Simeoni, C. *Perspectives of Oil and Gas: The Road to Interdependence* (Kluwer, 1996).
3. Dusseault, M. B., Geilikman, M. B. & Roggensack, W. D. in *Proc. Soc. Petroleum Engineers Heavy Oil Sym., Calgary, Alberta* (Publ. no. 30250, Soc. Petrol. Eng., 1995).

Roslin unfunded

Sir — The work of Ian Wilmut *et al.* (*Nature* **385,** 810–813; 1997) from this institute on nuclear transfer raises a number of general issues about the nature of research and its exploitation and funding, particularly in the United Kingdom. Biological research is going on in hundreds of laboratories, proceeding in the main by incremental steps. Not even scientific experts in a field know who will take the next step. This was exactly the case for our nuclear transfer research. Several laboratories in different countries were working on the same problem. My colleagues had one clever idea which put them ahead of their competitors — if we had stopped, someone else would have done it sooner.

Scientific progress cannot be easily regulated, but its application can. We see no reason for applying this technology to humans. But, of course, we see tremendous opportunities for application to animal biotechnology, whether for the production of valuable human proteins in animals for medical purposes or to maintain the competitiveness of our animal breeding industry.

Most of the funding for our nuclear transfer project came from the Ministry of Agriculture, Fisheries and Food, which has decided to withdraw further support. This decision raises the issue of the funding of animal biotechnology and similar strategic research in the United Kingdom. Although the UK Technology Foresight Plan provides clear objectives for strategic research, there is no adequate framework to implement them. We need a 5–10 year implementation plan for animal biotechnology to which relevant government funding agencies, as well as industry, can contribute. This might avoid future funding problems for high priority projects that fall between, or overlap, the policy objectives of different funding agencies.

Grahame Bulfield
(Director and Chief Executive)
Roslin Institute,
Roslin, Midlothian EH25 9PS, UK
e-mail: grahame.bulfield@bbsrc.ac.uk