

# Are we running out of oil?

Dr Jeremy Leggett and Dr Ian Vann

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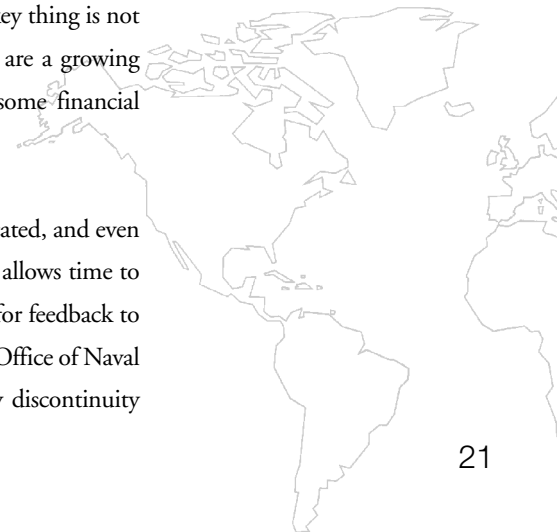
Oil is not actually going to run out – some will of course remain in the ground. But in practical terms it is clearly finite. The real issue, however, is about the transition from a time of increasing – and generally cheap – production, to a time where we have gone past the peak and into decline. Are we already there? How fast is the decline going to be? And what will this do to a global economy that we have collectively allowed to become oil-addicted?

Some people – the ‘late toppers’ – see the peak of production happening in the 2030s. Lord Brown often says in his speeches for BP that ‘we have got at least 40 years of supply’, and most oil companies believe this and, of course, all of OPEC. There have been some interesting adverts recently which could be interpreted as whiffs of doubt, particularly from Chevron. But almost all financial analysts and journalists believe that peak production is some way off.

The implication is that economies can in principle continue to grow, that there will be no dislocations, and plenty of time to develop alternatives. This is where the global warming and oil supply issues conflate, hence the BP/Shell type of approach. Renewables are important, and we are making progress, but are we displaying the entrepreneurial zeal that we have shown for a century on the hydrocarbon frontiers? We are not because we think we have time.

There is another camp that is still decidedly a minority. We are the ‘early toppers’, who see the peak of production occurring during this decade or, more likely, in the early part of the next. The key thing is not actually when this happens, but when the market will wake up to it. The ‘early toppers’ are a growing number of dissident experts, mostly oil company geologists, some futures traders and some financial analysts and journalists.

The implications of an early peak in production are not good. Economies will be dislocated, and even passionate advocates of efficiency and renewables like me cannot construct a scenario that allows time to develop alternatives. I really hope the analysis is wrong, and am constantly on the lookout for feedback to show that there is a flaw in it. But if the analysis is right, then, as the Department of Energy Office of Naval Petroleum and Oil Shale Reserves put it: ‘The stakes are large. A serious demand-supply discontinuity



## Environment on the Edge

could lead to worldwide economic chaos.’ They are desperate to get oil out of the kerogen in the oil shales to keep the US Navy afloat. And here’s another interesting remark: ‘We are not good at recognizing distant threats even if their probability is 100 per cent. Society ignoring this peak oil is like the people of Pompeii ignoring the rumblings below Vesuvius.’ This is heady rhetoric. It comes from no less a figure than James Schlesinger, former US energy secretary.

I spent most of my professional career as a creature of the oil industry. I worked on oil source rocks in and around the industry and was funded by BP and Shell, among others, at Imperial College. Admittedly this was a long time ago. But as my research was on climate change – and I hope we will touch on climate change in terms of the conflation of these problems – I worried because I felt I understood a bit about the climate cycle. So I left the oil industry and became a campaigner at the climate talks. I believe that if there is a solution to climate change, it will come not from governments but from a nexus of industry and consumers. I have decided to join that world.

I want quickly to put the argument for the early peak of production in a historical context. Many people new to the oil industry find it amazing that the peak of discovery in the United States, the year that the most oil was discovered in the lower 48 states, was 1930. The oil industry was a fully integrated one at the time of the First World War.

In 1956 one of our heroes in geology, M. King Hubbert, who worked for the Shell Research Laboratory, predicted that US production would peak in 1971. He was treated pretty shabbily: Shell insisted that he ditch his paper, but he went ahead anyway, and was vilified for his pains by the US Geological Survey. Meanwhile, US oil production did in fact peak much as Hubbert predicted. Does that extrapolate to the whole planet? It does in a way. There was a peak of production in America and there will be a peak of production in the world. And things will have to change, as they did in America.

When was the peak of oil discovery in the world? It was way back in 1965, before England last won the World Cup. The first oil crisis was in 1973 at the time of the Yom Kippur war, and this is important for its economic ramifications. There was only a 9 per cent reduction in global supply for a very limited period, but a horrible recession nonetheless followed. The second oil crisis took place in 1978 during the revolution in Iran, followed by Saddam Hussein invading one of his neighbours

for the first time. This crisis lasted a bit longer. Demand went down by about 4 per cent and three things happened that don't pertain today.

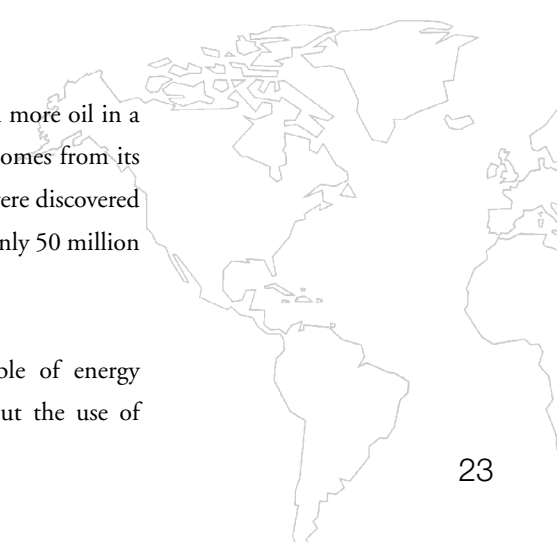
First the Saudis could – and did – turn off the taps. Second, we did not live in a 'just-in-time world': stockpiles, both national and corporate, could be used. Third, oil was entering the world market from newly discovered provinces in the North Sea and Alaska. So the crisis blew over and, from then until recently, we have had relatively low oil prices.

That in itself is an issue because of investment in the infrastructure. M. King Hubbert was right. This is the time to reflect on that steep downturn in the lower 48 states. There are arguments that secondary production enhances overall production, that all sorts of things can be done to lift the average of 30 per cent delivery from an oil field to 60 per cent or more – we can drill horizontally, for example – and this will solve the problem alongside finding new oil fields. But with 20,000 horizontal wells drilled, mostly in the United States, none of these techniques have made a blind bit of difference to the US downturn. To be polite about it, the downturn has shaped US foreign policy and therefore our world because they got it wrong. I am not going to elaborate on this: as you can imagine I could, but I think that is a debate for another occasion.

Colin Campbell and Jean Laherrère were the first oil industry 'early toppers' to speak out with their paper in the *Scientific American*. This was when the first warning sounded really loud and clear. Meanwhile conventional oil discovery was on a downward slope, even while there was a big upturn out in the North Sea and on the north slope of Alaska.

And we are still going down. It is not since the early 1980s that we have discovered more oil in a year than we have actually used. So this is the concern: 50 per cent of the world's oil comes from its hundred biggest oil fields. All of them are over 2 billion barrels in size, and all of them were discovered more than a quarter of a century ago. The average size of an oil field discovered today is only 50 million barrels, less than a day's global supply at current rates of demand.

Meanwhile, how reliable is BP's table of 'proved reserves' in their annual bible of energy production, the *BP Statistical Review*? These reserves are described as proved without the use of



## Environment on the Edge

inverted commas, and if you look at the compilation from the Middle East and the rest of the world since 1970, you might wonder what there is to be concerned about. Reserves appear to have gone up and up, from 600 billion barrels of proved regular oil reserves in 1970 to over 1.1 trillion in 2003. But if you read the small print in the *Review* you find that these are not BP's estimates at all. In fact, as the company explains in a footnote, it merely reproduces the data from various official sources.

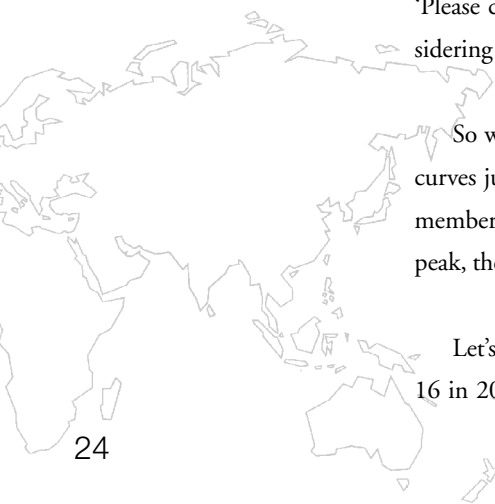
Our concern in the community of worriers is that in the 1980s lots of oil was reportedly found in the Middle East. But there are some interesting statistics from the countries concerned. Kuwait started massaging the figures in 1985, suggesting that their reserves increased dramatically overnight. (Reserves of course are in the eye of the beholder – it depends which geologist you talk to.) They went up from 64 to 90 billion barrels. Then a couple of years later they went up some more. That was too much for OPEC and most of the other states. Iraq jumped from 47.1 billion barrels to 100, and figures for other OPEC countries made similar leaps.

This is an interesting trend. Most of these countries have 'discovered' exactly the same amount of oil every year as they have produced – something of a coincidence. In 1982 they agreed that their quotas would be tied to the size of national reserves, and the massaging of data started in 1985.

The point is this: these proved reserves would not stand up to scrutiny in any court of law and we have not been in to verify them for a quarter of a century, since the oil industry was nationalized in many of these countries. If you look at the 2005 G8 statement, the finance ministers say (and I paraphrase): 'Please could we come in and look at your largest oil fields, because it is really rather important considering that the global economy has been predicated on all this being as we think it is.'

So with a falling expectation of future discovery, and a rising expectation of future production, the curves just don't match. The doubters – ASPO, the Association for Peak Oil and Gas of which I am a member – think there is going to be a big mismatch, so rather than a rise in production with a distinct peak, there will be a kind of plateau where production flattens out for a while before starting to go down.

Let's look at the discovery rates for the giants, the oil fields of 500 million barrels or more: there were 16 in 2000, nine in 2001, two in 2002, one in 2003 and none in 2004 (*Petroleum Review*). But with



84 million barrels a day of global demand, 500 million barrels is still less than a week's supply. Bearing in mind that demand is growing at 2 or 3 million barrels a day, and we are depleting capacity at 4 to 5 million barrels a day each year (it could be a bit lower, but this is what EXXON will tell you), we need to find 6 to 8 million barrels a day of new oil annually to meet the combination of demand and depletion. This is new capacity, and even if we went out and found a big oil field today, it would be around seven years before the first oil came onto the market.

Any potential there might be in heavy oil is pretty well cancelled out by the downturn in regular oil, so any increase in hydrocarbons beyond 2010 is only achievable through natural gas liquids and gas itself. But even with an increase in gas production, and notwithstanding the geopolitics that half of it is in Russia and Iran, you get a combined hydrocarbon peak in 2015. We are not geared up for this and it is difficult to imagine the landing being a soft one.

If the analysis is correct, this monster is just around the corner, and in my view this is what we should be worrying about. It will have an enormous effect on the traders in London and New York.

Finally, I would like to close by discussing two other views because this is such a fast-moving debate. In the past year it has gone from being a 'hobbyist' issue, as people unkindly called it, to a mainstream debate, reaching the front page of *The Wall Street Journal* amongst others.

If demand continues to grow as expected, with China and India economically on course, the 6 to 8 million barrels a day of new oil that we need to find is equivalent to one Saudi Arabia's worth of capacity every year and a bit, but in 2005 we managed only 3.7 million barrels a day. The meeting of growing demand with expanding supply 'cannot be done indefinitely; it is not sustainable', as was observed by Dr Sadat Ibrahim Al Hussein, former head of exploration and production of Saudi Aramco in an interview with *The New York Times* in August 2005. He has gone a bit quiet since then, but this is a gentleman who essentially ran exploration and production. He was on the board of Saudi Aramco for many years and has just recently retired.

Then there is the view of the IEA (International Energy Agency). They have downgraded the way they think demand is going, but nonetheless made the point that non-OPEC countries will pass their



peak in production within a few years. They also point out that we will be relying on Saudi Arabia, Iraq and Iran for growth in supply to meet projected demand. But are we going to get it? They calculate that a \$20 trillion investment is needed by 2030. This is of course total energy, not just oil. But we are not investing at anything like that rate, and any apparent surge in investment in oil is illusory because of soaring drilling costs. 'This energy scenario is not only unsustainable. It is doomed to failure.' That was the view of the Secretary General of the IEA in late 2006, an agency set up to promote fossil fuels.

For reference I recommend *The Carbon War* on the history of the climate talks, and *Half Gone*, a commentary on this debate up to the time it was published. My closing thought is that in *The Carbon War* I describe the history of the debate that we had in the climate change community with the oil industry and BP. I am sure most people know that BP was the first company to break ranks and say 'Mea culpa, Houston we do have a problem. These environmentalists have been right. By the way all the people from NASA and NOAA and the Met Office, and everything else, they are right.' I believe that paraphrased statement, made in 1998 by Lord Brown, actually allowed Kyoto to happen. BP's view of this problem is very important, and that is my introduction to my debating partner.

Ian Vann

**I almost feel that we can go home now. I agree with everything Jeremy has said when it comes to the underlying information. I won't argue with his data. What I will argue with is what it means, and I will go right to the conclusion.**

The future of oil supply is as much about politics and the ability of an economic system to operate as it is about the resource itself. And today that ability is constrained by all kinds of political forces. But I would also assert that a peak oil hypothesis is not actually supported by the data. The reason that I am as passionate about stating the other side of the case as Jeremy is about stating his side is that I believe that wrong information will lead to bad decisions. As Jeremy pointed out so powerfully, if decline sets in in five years time there is no obvious solution to the problem, and the actions that people take now could have catastrophic consequences.

A Campbell peakist – as mentioned by Jeremy – would say that peaking will occur around 2010 and then drop away, with a total of 2 trillion barrels under the curve. Others, of whom I am one, would say that there is rather more oil underneath that curve. It is the fundamental notion of the cumulative resource underneath the curve that actually defines its shape.

Nobody denies that ultimately it will turn over. The issue is when. There is little doubt about what has already been produced – around a trillion barrels. Reserves too are quoted at around a trillion barrels, so it does appear to be half gone. But what is quoted as reserves depends on people's plans.

Exploration could reveal perhaps 0.25 trillion barrels, perhaps 0.75. As you apply new technology and attack the amount of oil that is left in the ground, existing reserves could grow by anything from a low-case scenario of 0.5 trillion barrels to a high-case scenario of 1 trillion barrels. And non-conventional oils such as heavy shale oil, oil sands and so on, supply another range of outcomes – from 0.25 to 1.25 trillion barrels, depending on what people do.

In comparing today's world with M. King Hubbert's 1951 prediction for the United States of America, the most profound difference is that the world as a whole does not behave as an economically rational marketplace. Something like 75 per cent of all the known oil in the world is in those countries where the control of activities is in the hands of national oil companies. However, only 15 per cent of the wells that get drilled occur in those countries.

Yet more extreme is exploration activity. The last five years have seen 13,000 exploration wells, excluding the United States of America (which would add as many again). Of those, only around 1 per cent were drilled in the Gulf OPEC states. This is not rational economic behaviour. You do not normally focus activities in the places that are less likely to harbour the commodity you want. This is politically motivated, and hence the model that M. King Hubbert applied to the United States – which was entirely economically rational, with activity driven by market forces – does not apply here.

Now, the first trillion barrels of total production has already gone, and if you just took the reserves at their halfway point they would decline tomorrow. But by adding in exploration, reserve growth and unconventional sources, then you have anything up to another 3 trillion barrels. Under this scenario, and



if production were to remain constant at 2005 levels, decline would not set in until we are into the next century. If world demand continues to grow at its current rate, then the onset of decline will not occur before 2020, 2030 or 2040, depending on how much of this oil comes to market. Let's look at the individual components.

### Conventional oil

If you extrapolate the future based on today's track record – with limited access and only a couple of major new provinces and fields – you might expect to find an additional 0.25 trillion barrels of conventional oil. If, however, access opens up over the next decade to where most of the oil in the world actually is, then you might see a very different picture. For instance, there is currently no exploration in Iraq, there is very little in Iran, and there is none in Saudi Arabia. There is also very little in Russia or Venezuela. So the areas where most of the oil is, and that hold the greatest potential for finding more, are in countries where no exploration is happening.

But a world in which access to those countries is not unimaginable – where, if you like, the economic rationality of the oil game can be played effectively – could produce a further 0.75 trillion barrels of conventional oil.

### Reserve growth

Reserve growth is difficult to get at, but recent studies at BP suggest that it is actually 2 per cent annually, depending on which measure you are using. As an analogue for the world, BP's widely scattered oil fields are pretty much like other oil fields. Today, BP runs with an average recovery factor (the amount produced as a proportion of the total oil in the ground) of around 45 per cent. With current affordable technology we can take that to 55 per cent. But when you look at the theoretical limits of where future technology and economics could take you, it is an average of 65 per cent – which still leaves 35 per cent behind. This average covers the whole range, from oil fields that will produce 90 per cent plus of all the oil in the ground to those that will only produce 20 per cent. The current world average recovery factor is around 35 per cent, rather lower than the average of people like BP, operators who are essentially driven by economic motivation. But it is not unreasonable to assume that known technology could raise the average recovery factor to 55 per cent. This would bring an additional 1.3 trillion barrels of conventional oil.

### Non-conventional oil

There is a lot of future in non-conventional oil. You start with at least 7 trillion barrels in the ground. Remember the world total cumulative consumption to date is 1 trillion barrels. The majority of non-conventional oil (around 66 per cent) is found in countries of economic rationalization such as Canada and the United States. I do not include the current state of Venezuela, with 19 per cent, in that assertion. But most of it is in the western hemisphere and most of it is amenable to the application of current technology.

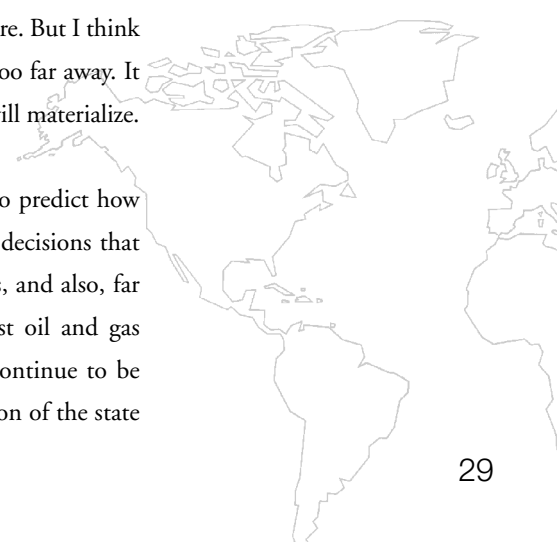
The application of that technology is already happening. Oil sands growth in Canada, for instance, is set to increase very significantly under today's price scenarios. Depending on people's desire to push for technology, depending on price and on economic rationality, there are somewhere between 0.25 and 1.25 trillion barrels out there.

That takes me back to my first point. The world of today does not behave in an economically rational way, so industry appears to be heading towards a crisis. But the oil is there, so this is predominantly a matter of investment. Without it, a decline in oil is perfectly possible, but a decline is not a fundamental given fact of geology. It is the consequence of politics and hence is amenable to change.

**Bernie Bulkin:** Jeremy, do you wish to comment on Ian's presentation?

**Jeremy Leggett:** I agree about investment. This is really where the crisis will play itself out – in countless investment decisions by folk looking to find the giant oil fields that are supposed to be there. But I think that one by one all these little dramas behind closed doors will result in 'no' votes. It is too far away. It is too risky. My prediction, which I firmly hope is wrong, is that not enough 'yes' votes will materialize.

**Ian Vann:** The element of this debate that I find most difficult to deal with is trying to predict how the world will behave. The underlying geology I am absolutely convinced by, but the decisions that Jeremy is talking about will play out in thousands of scenarios in individual companies, and also, far more importantly, among the decision makers who rule the countries in which most oil and gas actually occurs. It is those decisions that will determine the future. But if decisions continue to be played out as they are today, in circumstances of economic irrationality, for the protection of the state



and in many instances of national companies that are not open to competition (and in many senses not even competent to do the job), then oil supply will get very difficult, and the possible consequences are horrifying.

### Q & A

**Q:** Aren't the Saudis behaving extremely rationally? There is no motivation for them to do exploration now when they can do it at any time in the future. Aren't they being rational in aiming to maximize total income through a combination of price and production?

**Ian:** From the viewpoint of rationality of an individual producer who can control the market, of course they are behaving rationally. But from the viewpoint of global market rationality this could be mistaken. There is a risk that high prices will ultimately drive new technology away from the internal combustion engine, away from the use of gasoline for transportation. I would also argue that they are driving the world towards a destiny that none of us would like, a destiny that carries the threat of real violence in the world, and therefore is quite irrational in the political sense.

**Q:** I would like to ask the panel to comment on the Middle East. If I understand correctly, the optimistic projections are that 50 per cent of the new oil will come from that region. But I would have thought that has been pretty well demolished by Matt Simmons' book *Twilight in the Desert*. Do you discredit his analysis?

**Ian:** I must admit I found it a pretty disappointing book as it had a lot of anecdotes but told me very little. Of course it focused on particular issues in Saudi. If you look around other areas of the Middle East, to the north for example, Iraq has not been explored since the 1950s or 1960s. It has had no significant new technology in the last 25 to 30 years, and it has a national oil company whose leadership tell me that they do not have the competence to do the job they are being asked to do. Iraq today has reserves of the order of 100 to 150 billion barrels, and there is no reason why that figure cannot double. I pick Iraq because it is the most obvious example, but it is by no means unique. Saudi Arabia, on the other hand, has some of the most competent national oil companies in the world. Saudi

Aramco certainly has some of the finest equipment, technology and management. Matt Simmons' book talks about problems with some oil fields, but I am not convinced that those problems will have the result that Matt suggests.

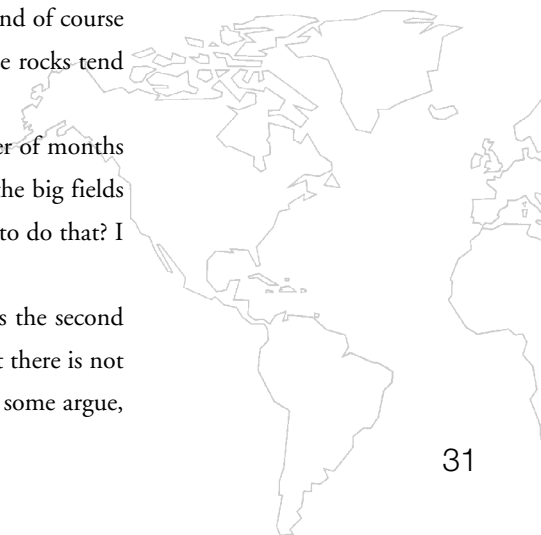
**Jeremy:** Can I just say that there are anecdotes and then there are anecdotes. In a country where the West has not been able to conduct any sort of verification for more than a quarter of a century, we are almost forced to look at a few anecdotes. Should we not worry about my own anecdote regarding the departed head of exploration and production at Saudi Aramco and his view? We need, and the world expects, Saudi Arabia's production to go from 10 million barrels up through 15 and on to 20 million barrels to keep the whole thing going for a peak of production in the 2020s and 2030s. Yet the gentleman who was in charge of the whole thing said we are never going to get beyond 12 million barrels a day.

Also anecdotally, the last westerner to run Aramco said: 'We have found the elephants, we know where the source rocks are, we know where the big structures are, and they have been drilled. We are not going to find these multi-billion pound quantities in Saudi Arabia.'

The argument goes that we have only drilled X wells in Saudi Arabia where X is a very small number, but we have drilled Y wells in the rest of the world when Y is an enormously high number, and this is supposed to show that we can find more oil if we simply drill more wells. What that ignores is the lesson of so many countries and provinces: you find the big fields first because they tend to be geologically obvious. We have been running seismic tests for many decades, the surface of the planet was fully explored by the 1950s, and every anticline in America was drilled by then. There are not many more places we can go and look. If the oil is there, it has got to be in deep water, and of course we now know that deep-water results tend to be pretty disappointing and that the source rocks tend to be gas prone. I don't get any comfort from this.

I do think the verification point is important. This issue could be resolved in a matter of months if competent teams went in to do the verification. All they would have to do is look at the big fields to see whether the supposedly existing reserves are there. But are we going to be allowed to do that? I don't think so.

The Kuwaiti government has turned around and said that the Burgan field, which is the second biggest in the world, is really ailing. Now there are worries in the Kuwaiti parliament that there is not actually as much as their national oil company are officially telling the world. Therefore, some argue,



they should sit on it, including for domestic use. It is going to be valuable. So I would agree with Ian on this point: it does depend on surface politics rather than subsurface geology. That is another reason for concern of course.

**Q:** What about the reassessments of reserves in the Middle East? Are they suspect and should we really take out a few hundred billion barrels from the figures?

**Ian:** When those reserve reassessments were made they looked mightily suspicious since they were all occurring at exactly the same time. However, at the time they were carried out, the ongoing activity of production, the ongoing application of technology, and the growing potential of that technology to produce more were not taken into account. The numbers you find in the Middle East, mainly national estimates of oil and gas, are not very reliable. But when you calibrate them to something you actually know, it seems on average that they are not too bad. This is because while some people exaggerate, others do not see the possibilities that technology can bring. It is pluses and minuses.

Take Kuwait for instance, where the Burgan field is the second or third largest in the world. It's a wonderful oil field, but when water starts to come into the wells it is shut down at only a 5 or 10 per cent water cut (the water cut being the proportion of water to oil in a particular well). In other great oil fields of the world that are operated by national oil companies with today's technology and the investment capability to take care of things, you would run to a 95 or 98 per cent water cut and still get lots of oil. The competence and capability of the operators, and the extent to which nation-states are willing to invest and allow national companies to invest in the resources to increase the potential of those fields, is enormous compared with anything you would do today in the North Sea.

**Q:** It may be too soon in the discussion to move onto issues of conflation with global warming, but I just wondered if either of you or someone else here could remind us roughly what the number is if you burn a trillion barrels of oil. How much does the temperature of the Earth rise? What is the prediction?

**Jeremy:** Let's look at how the IPCC (Intergovernmental Panel on Climate Change) is approaching this critical threshold problem. There is general consensus around the view that we dare not go above a 2°C increase in the global temperature. That was set by the European Union as a target as long ago as 1996. It is not clear how scientifically rooted that is, but there is a general feeling that beyond that level the

feedbacks kick in and everything can go really haywire. We dare not go above that level, whatever level of atmospheric carbon dioxide equivalent that entails.

If you look at it in terms of the carbon arithmetic, 400 billion tonnes of carbon would, in the middle range of the estimate, generate enough heat to lock us into that temperature rise. So we must not go above 400 billion tonnes of carbon. Now if the late peakers are right about the trillions of barrels of easily recoverable oil that are out there, and we throw in easily accessible oil from the oil sands of Canada, we have around 700 billion tonnes. Actually it makes no difference if the early peakers are right, because just in oil you are over the 400 billion tonnes. Then you have got the 500 billion in gas and – this is the killer – 3,500 billion tonnes in coal.

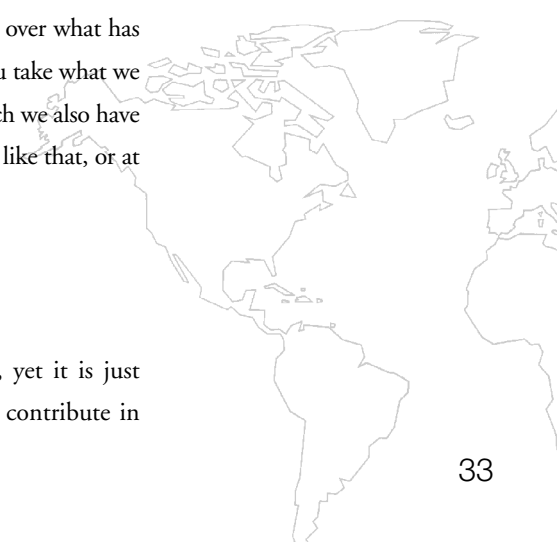
**Q:** To what extent should the petroleum industry be held to account for the climate change threat?

**Ian:** You have touched on a hobbyhorse of mine. I think we are all accountable in the matter to be honest. We all choose our lifestyles and we all choose to drive our motorcars.

**Jeremy:** Of course I agree. We are all part of the solution. We all have to bear total responsibility for this. And if we solve the problem it will be because some kind of renaissance enables us to do so. But the idea of common responsibility did not help the tobacco industry, and society is now looking to the company executives for recompense. So if I were a hired consultant to leaders of oil companies I would be counselling extreme caution. It is highly likely that society will look back in anger on all this and do so through the courts. We have already seen what is happening to BP through cost-cutting on health and safety issues around the fire in the Houston refinery. There are going to be real issues and real scrutiny over what has been said in this period, such as statements like ‘there is 40 years of supply’. This means you take what we are burning today, project it into the future and then divide it into the proved reserves, which we also have reason to believe are somewhat dubious. I would be counselling against making statements like that, or at least that they be couched in very big caveats, as Chevron and Total are beginning to do.

**Q:** How successful has solar energy been as a viable alternative to oil?

**Jeremy:** Solar energy is one of the fastest-growing, most exciting markets in the world, yet it is just a pimple on the backside of this problem. We are still miles away from being able to contribute in



## Environment on the Edge

any significant way. But it is a member of a growing family of clean technologies, and given a bit of time and real seriousness of intent it could become very important much more quickly than people think.

**Q:** If we are going to convert to a low-carbon future, does this mean that much of the oil you are factoring in as consumable will not be available for conventional use because it will be needed for the conversion process?

**Ian:** I do not stand here as some advocate for the continuation of hydrocarbon use. This was not a debate around demand. This was a debate around whether we should actually focus on the supply side of the problem in a more effective way. I think that some of the worst early peakers live in hope that early peaking will come along and solve the problem. But I believe that people have to solve the problem.

**Q:** I understand from both speakers that they tend to agree on the geology but worry about where human behaviour might take us. Given that you are talking about Iran, Iraq and Saudi Arabia, to what extent will the political tensions in that region not only get in the way of oil production but also shape the nature of conflicts and governance as oil becomes more of a pressure point?

**Jeremy:** I think that we are playing a very dangerous game in the Middle East and we are compounding these problems many times through our own response to America's oil supply issues. I commented earlier on the peak in 1970 and the dramatic downturn that followed, leading to the United States of America importing more and more every year. They have shaped up to address this problem in the wrong way. They have not gone the Amory Lovins way. They have not gone the way of energy demand management.

One of the most dramatic statistics in all this is how much Detroit would have to retool in order to obviate the need for all current imports from the Middle East. If people do not know this statistic, it is 2.7 miles per gallon. This is just a slight mpg increase in the shocking average of the American car fleet. That is the road we should be going down. But America has gone the other way, reshaping its armed forces as an 'oil protection force'. That is the terminology that the Pentagon uses, and many of us would question one of those words. This is wrong, and Britain has been wrongheaded in backing it, which is really deepening the problem.

**Q:** Could you tell us a bit more about the oil sands?

**Jeremy:** This issue brings us to the conflation with global warming, and it is absolutely essential that we start looking at the carbon implications. You have to burn huge amounts of gas to heat the water to extract the oil. It is incredibly carbon intensive.

I am sure everyone realizes that this is a very different form of oil. You are basically dealing with bitumen, which is solid and very difficult to get at and process. If you look at what the IEA – not known for a lack of optimism regarding what can be done in terms of fossil fuels – are projecting for the future, they say that by 2030 we will be producing the princely amount of 10 million barrels a day.

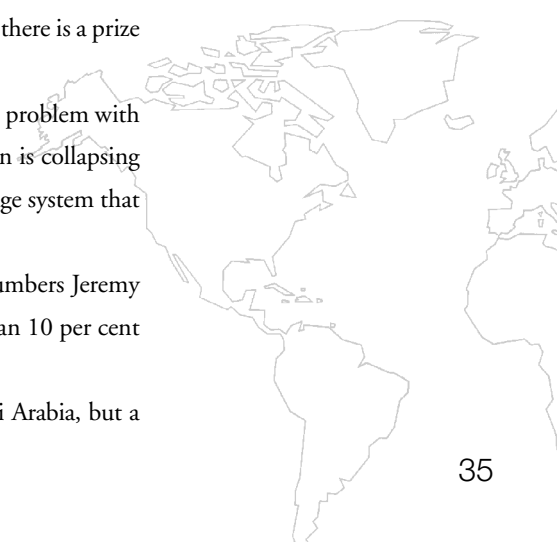
When you compare this with some of the figures that we have talked about regarding the depletion rate today, when you read the business magazines, you might imagine there is a bonanza, a kind of Klondike, a new Saudi Arabia. But every dollar of investment that is on the table now, if it hits pay dirt, if you will pardon the pun, will by 2015 produce 3 million barrels a day. This is where we are so dysfunctional. Many of the magazine articles on this issue are written by journalists who have no conception of the real problems of depletion or of the difficulties of bringing new capacity online. As a scientific statement there are indeed trillions of barrels of oil – or should I say carbon – in the oil sands and shales. But are they going to become productive? And should we allow them to, given the carbon implications? These are going to be the big issues of the next decade.

**Ian:** We start with a lot of hydrocarbon underground. It is very difficult to take out and it takes a lot of energy. If you look at the cost of doing that today, probably the best 10 per cent of oil sands will happily produce economically at \$35 a barrel, including a notional carbon tax. In economic terms there is a prize there as long as you believe in rates of \$50 or \$60 dollars in the future.

But Jeremy is also right about it taking an incredible amount of activity, so the biggest problem with the development of Canadian oil sands today is exemplified in Fort McMurray. The town is collapsing under the amount of investment, the inflow of people, the quantity of equipment, a sewage system that cannot cope, a water system that does not work, and so on.

So, slow growth of heavy oil is the most likely scenario. I do not disagree with the numbers Jeremy has been talking about. However, 10 million barrels a day in the 2030s is a little more than 10 per cent of total production, so you are talking real money.

Non-conventional sources are a contribution, not a great white hope, not a new Saudi Arabia, but a



## Environment on the Edge

contribution. They will come online because the whole thing is driven by economics and the possibility of access. It is not actually the smartest thing to do but it is the possible thing to do and hence it gets done.

**Q:** About a decade ago we won the argument to keep Antarctica out of this debate. There are 40 years left to run of the Antarctic Environmental Protocol. Would you like to speculate on the geopolitical pressures to reverse that decision as this scenario plays out? Is there any oil in Antarctica?

**Ian:** Of course history usually points to the fact that whether there is oil or not does not matter because the debate is driven by whether or not people want there to be oil. My own view is that Antarctic gas and oil resources are pretty limited and not worth the effort, very different from the Arctic. I am sure there is a huge environmental debate waiting to take place around the Arctic. If the kind of scenario I envisage occurs, the Arctic rim of offshore Russia will necessarily be one of the world's large producers.

**Jeremy:** My view would be that even if there were megatonnes of oil in Antarctica it would be morally wrong to go and exploit it, especially given the principle of the Antarctic Treaty.

I think I envisage a future of economic dislocation (with a level of 98 per cent confidence in the arguments), and believe we will come through in one of two ways: a free-for-all which has us producing liquids from coal and anything else we can find, never mind about the environment; there will be war and it will be very gruesome. I personally worry about the scope for the rise of fascism on the back of economic dislocation. If that happens Antarctica will undoubtedly end up getting explored comprehensively in a very short time.

The other scenario is where we grasp the opportunity to get it right. We have a massive family of technologies, incredible innovation in low carbon, and that is the route we choose to go down instead of going for far-frontier hydrocarbons and near-frontier coal. These are very fast-moving technologies and we can do it much quicker than people think. We can construct a massive silver lining to the cloud. But I fear that there is little chance of us avoiding a big economic downturn.

Dr Jeremy Leggett, author of *Half Gone* and CEO of Solar Century

Dr Ian Vann, Group Vice-President, Exploration & Production, BP

Moderator: Professor Bernie Bulkin