Why the world isn't running out of oil

Decades ago, the world was told it was running on empty. Today, we have more oil than we need. What's fuelling the boom in black gold?

Brian Viner, London Telegraph, 2-19-13

On the evening of April 18 1977, President Jimmy Carter invited television cameras into the Oval Office and portentously announced to the American people that "tonight I want to have an unpleasant talk with you about a problem unprecedented in our history. With the exception of preventing war, this is the greatest challenge our country will face during our lifetimes."

The unprecedented problem was energy. Or rather, the lack of it. "We simply must balance our demand for energy with our rapidly shrinking resources," said the 39th President of the United States. "The oil and natural gas we rely on for 75 per cent of our energy are running out."

Carter's talk was poorly received. Americans didn't appreciate the apocalyptic message, still less his vision for tackling the situation, with its rather schoolmasterly demand for a collective show of moral backbone. But hardly anyone questioned his facts. And yet he was about as wrong as he could be. Far from running out, oil and natural gas reserves were, if not inexhaustible, then unfathomably vast. Nobody knew that then, but they do now.

Moreover, as well as bountiful oilfields in North America, Russia, Saudi Arabia and other producers in the Middle East, there are massive, barely tapped reserves in South America, Africa and the Arctic: not billions of barrels' worth, but trillions. So the planet is not about to run out of oil. On the contrary, according to a Harvard University report published last year, we are heading for a glut.

The 75-page study, by oil executive Leonardo Maugeri, was based on a field-by-field analysis of most of the major oil exploration and development projects in the world, and it predicted a 20 per cent increase in global oil production by 2020.

In particular, the report highlighted the deep-water reservoirs in Brazil's Santos basin, which are thought to hold as much as 150 billion barrels of oil, Venezuela's "extra-heavy" oil in the Orinoco Belt, estimated at 1.2 trillion barrels, the oil sands in Canada, the Kwanza basin in Angola, and the Bakken and Three Forks fields in North Dakota and Montana, in the United States, which, Maugeri said, "could become the equivalent of a Persian Gulf-producing country" all on their own.

And the reason for this boom? A technological revolution that is transforming the way we both find and extract oil.

"We, as an industry, are now able to see what we had previously not been able to see, and find what we previously had not been able to find," says Gerald Schotman, Shell's chief technology officer, who is based in The Hague. "But we are also able to make more out of these reserves, by being cleverer about the ways we manage them."

One of the greatest advances, and the procedure that's dominated the headlines in recent years, for both good reasons and bad, is hydraulic fracturing, or fracking. In essence, fracking is a way of releasing oil or gas that is

numerous improvements, that it has become economically viable. Oil previously thought unreachable is now within our grasp.

And nobody is exploiting these advances with more enthusiasm than America. In just six years, the number of barrels being produced by the Bakken formation, a unit of shale rock occupying about 200,000 sq miles stretching from Montana to North Dakota, has increased 100-fold — from 6,000 a day to 600,000 a day – and made North Dakota the second-biggest oil producer in America, after Texas. The population of the main town, Williston, has tripled in 10 years as truck drivers and oilfield workers (not to mention strippers) have flocked there from all over recession-hit America. North Dakota has new businesses and new hospital wings, but also an infrastructure groaning under the weight of the influx. There is also a vociferous campaign against fracking by environmental groups who say the technique has the potential to contaminate underground water supplies, cause minor earthquakes and pollute the environment with vast quantities of toxic wastewater.

Supporters of fracking insist these dangers can be mitigated. And they point out the huge benefits. The boom in North Dakota is rapidly transforming America from a net importer of oil to a net exporter, thus reducing its dependency on the Middle East. China, Russia and Argentina, impressed by the results in the US, are also pushing ahead with their own fracking operations. And Linc Energy announced just last month that it was hoping to extract 233 billion barrels of oil from shale rock in the Australian outback, with a potential worth of £13 trillion.

But fracking is just one of many remarkable breakthroughs behind the new boom. As well as helping producers release so-called “tight oil”, technology has found a way to get at oil that’s mixed with sand and clay, known as tar sand, the largest deposits of which occur in Canada.

Again, like shale oil, extraction had been dismissed as economically unviable, but new processes that involve steam-heating the sands have made it a sound proposition; Canada is now producing up to 1.9 million barrels a day from oil sand projects, although, like fracking, it has attracted huge protests. Al Gore, the climate campaigner, has described tar sands as “the dirtiest source of liquid fuel you can imagine”, and labelled plans to build a major new pipeline from the tar sands of Alberta to refineries on the Texas Gulf, as “insane”.

The oil boom has also been fueled by new, more accurate methods of drilling. The invention of horizontal drilling means even if the surface site is several miles off target, companies are able to drill downwards and then turn sideways to get to the bottom of the well. A rig 300 miles out at sea can steer a drill down five miles, out five miles, and come within a couple of inches of the bullseye. In short, it means there is virtually no chance of drilling a dry well; oil companies had a 99 per cent success rate in 2011.

Companies are drilling deeper than ever before, too. The Yastreb rig on Sakhalin Island, just off the east coast of Russia, has set numerous industry records and, last August, its operators announced they’d drilled the world’s longest extended-reach well, plunging eight miles into the Earth – which is deeper than Mount Everest is high.

At the moment, basic geometry prevents anybody going much deeper than that. As Lance Cook, chief operating officer for Shell Projects & Technology in China, explains, the well bores have to be reinforced with steel, so that they don’t collapse, but the only way to sink the individual steel casings is for each one to be marginally smaller than the one before.

And, as Archimedes would have understood, that imposes limitations on depth. “If, right now, a company wanted to drill to 20 miles, say, the first casing string would probably have to be bigger than the building I’m

Technology, however, has an unstoppable forward momentum, and what seems mind-boggling now will soon seem old-fashioned. In the past 10 years Shell has developed a technology called mono-diameter which will allow it to drop one steel casing through another, and then expand it to the same dimensions. In theory, this will facilitate the drilling of much deeper wells, although engineers still have to work out how to stop the steel melting at such depths.

As for the $64,000 question, that of where exactly the oil lies, there is a relentless quest for answers. Geologists at least know where not to look; hydrocarbons are formed by tiny decayed plants, algae and bacteria, which exist up to the outer reaches of the continental shelf, but not beyond, so mid-ocean drilling is pointless.

Closer to land, however, so-called "seismic vessels" trail between 10 and 20 cables, each up to nine miles long, probing sonically for oil and gas deposits. "With their trailing gear they are easily the largest man-made moving objects on Earth," says Robin Walker, vice-president of marketing for WesternGeco, which operates a number of these behemothic ships. And they are properly huge. The biggest of them, Ramform Sterling, owned not by WesternGeco but a Norwegian company called PGS, carries 400 tons of highly sensitive electronic equipment deployed over an area equivalent to 830 football pitches.

Each seismic vessel uses an air gun to fire acoustic pulses of compressed air into the water. Sound waves then bounce off the underwater rock and are picked up by the streamers, which contain underwater microphones. By studying this data, geologists can then map reservoirs and identify whether they're filled with oil, gas or merely water.

In the Seventies, seismic vessels tended to be converted fishing-boats, and the technology was only two-dimensional. Today they are custom built, cost up to £160m and use 3D imaging, greatly improving their accuracy. They are not infallible. Sometimes, the streamers get hopelessly knotted – "it's the world's biggest plate of spaghetti", says Walker – and can take weeks to untangle. But all the same, the level of sophistication is breathtaking.

"What is going on out there is the marine equivalent of the space programme," Robert Bryce, an American author and journalist specialising in energy issues, tells me. "And all of it is privately funded."

The sums involved make your head spin. In total, "upstream" energy companies (the ones involved in exploration and drilling) spent £800bn last year. Shell alone paid £63m for exploration rights in 5,000 sq miles of water off the eastern coast of Canada. It would not have done so without extensive data suggesting the presence of hydrocarbons, but all the same, in many ways the most striking sentence in the press release announcing the deal was this: "Shell said it has yet to determine if its new exploration blocks could contain oil or natural gas." What might Shell have paid if it knew for sure?

But competition among what the Pulitzer Prize-winning author Daniel Yergin calls "the wheeler-dealers, the operators, the finders, and the facilitators" is fierce. Everyone is out for their cut and executives are under pressure to buy up rights fast.

One of the fiercest battlegrounds over the past two decades has been Brazil. In years gone by the Santos basin, an offshore area 200 miles south-east of São Paulo, was impossible to probe for oil due to its thick layer of salt. (Salt is a poor transmitter of vibrations.) But improvements in seismology meant the area suddenly became a premier destination for oil companies and in 1999 Petrobras found a field containing around 700 million barrels of oil.

Africa, they reasoned that similar oil reserves may exist there as well. In February last year their theories were proved right when a reservoir was discovered in Angola's Kwanza basin thought to hold some 1.5 billion barrels of crude. Since then half a dozen oil groups, including BP and Total have secured exploration rights.

The successful bidders did not disclose the size of any so-called "signature bonuses" but it can be safely assumed they were hefty. In 2006, China's giant Sinopec corporation set a world record when it paid $1.1bn for one offshore block. How much of this money will go to the Angolan people is a moot point, of course. The history of oil exploration in Africa is not a happy one. Angola was ranked a lowly 168th out of 182 countries in Transparency International's recent "perceptions of corruption" index, so one has to wonder how much of the oil money will benefit the country's neediest citizens, and how much will end up furnishing the palaces of tinpot dictators.

But it is naive in the extreme to imagine the genie will ever be put back in the bottle. As Robert Bryce says: "The world runs on oil, period. No other substance can compete when it comes to energy density, flexibility, ease of handling, ease of transportation. If oil didn't exist we would have to invent it."