

How technology led to tectonic shifts in oil and gas supply



By Daniel Yergin

Vice-Chairman, IHS and Pulitzer Prize-winning author



The world oil and gas industry is being reshaped by two major developments. The first is driven by economics; the second, by technology. They are rebalancing global energy and changing international alignments.

A decade ago, the oil price was destined, or so it seemed, to be US\$20 forever. Indeed, companies that did not throttle back on their capital budgets in those years were likely to be punished by investors. Yet, ironically, that was exactly when the oil price began its epic climb to heights that the world hardly thought possible – but a level to which it has now become accustomed.

The rise in prices was a register of an historic change in the world economy – the rise of the emerging market countries and the surge in their need for energy. For the price increase was triggered by the ‘demand shock’ that came from those countries. This reflected the success of globalisation – strong economic growth and rising income in developing countries. A new milestone on this road came this spring when the World Bank declared the Chinese economy is now bigger than that of the US. This whole development meant growing demand for energy – on a scale and speed that took the world oil industry by surprise.

As late as 2000, two thirds of world oil consumption was concentrated in the ‘advanced industrial countries.’ Today, over half of world demand is to be found in the developing world. In the developed world, oil demand is either flat or declining – owing to sated car demand, more fuel-efficient vehicles and changing demography. Virtually all the growth in oil demand in the years ahead will be elsewhere – in the ‘emerging market’ world as the income of people in those countries rises.

Changing structure

This shift in the dynamics of world demand is reflected in the structure of the industry. Consolidation has reduced the number of western IOCs – international oil companies. But it has brought important new players onto the stage. Less than a decade and a half ago, the three major Chinese oil companies were just establishing themselves as independent companies and implementing their IPOs. Today, they are among the major energy players of the world.

However, the world oil industry faces the challenge of meeting this growth in demand.

The answer is to be found in technology. In the

previous periods of ‘running out of oil,’ technology has been a very important part of the answer. So it is today. This time, the technological advances have taken the form of the ‘unconventionals.’ One example is ultra-deep water development. Another is the breakthroughs around Brazil’s off-shore pre-salt. This resource, along with the fading of Venezuela, will likely make Brazil the number one oil producer in Latin America. Saudi Arabia has implemented complex mega-projects that, by themselves, would constitute a significant oil producing country.

Canadian oil sands are another resource that is registering a global impact. By the end of the 1990s and the beginning of this century, a combination of technological advance and more realistic fiscal terms turned oil sands from a fringe resource into a global one. Oil sands output has increased from 0.6 million barrels a day (mbd) in 2000 to an estimated 2.1 in 2014 and is expected to hit 3.8 mbd by 2025.

Yet the most stunning example of technological breakthrough came in the United States, and it did so in the midst of an on-shore industry that was supposed to be moving off into a sunset of terminal decline. The breakthrough, of course, was shale gas.

Trial and error innovation

It took until the late 1990s, after a decade and a half of trial-and-error innovation in the face of much scepticism, to demonstrate that commercial natural gas could be extracted from shale rock. It took another half decade, until 2003, to successfully yoke that innovation to horizontal drilling. Yet it was not until 2008 that the impact began to be widely recognised in the oil and gas industry in North America.

Some still doubt its lasting power. In Europe, one hears it dismissed as the ‘shale gas bubble.’ But the reality is evident. A decade ago, shale gas was two per cent of US natural gas production; today, it is 44 per cent. Estimates of the resource continue to grow.

The same technology, applied to what has become known as ‘tight oil,’ has had a dramatic impact. Between 2008 and the spring of 2014, US crude oil output expanded by 3.2 mbd – a 64 per cent increase. The significance is not just to be measured in terms of production. The economic impact of this “unconventional revolution” is considerable; it supports over two million jobs, a number that is going up. When



I interviewed Ben Bernanke at CERAWEEK in March 2014, in his first major public appearance since leaving the chairmanship of the Federal Reserve, he summed up the impact this way – “one of the most beneficial developments, if not the most beneficial development, since 2008.”

Shale gas is also changing the competitive balance in the world economy. The abundance of this resource has driven down natural gas prices in the US to one-third the level of Europe, and one-quarter to one-fifth the level in Asia. This is giving energy-intensive manufacturing in the US a major competitive advantage over Europe. Over US\$100 billion of investment in new manufacturing in the US – from both American and non-American companies – is now scheduled, owing to the abundance of inexpensive natural gas.

Energy costs and competitiveness

European industrialists and political leaders are alarmed that European manufacturing will lose out in the global marketplace because of higher energy costs. This is of particular concern in Germany, which relies on exports for half of its GDP, and which has been embarked on a high-cost renewable energy strategy. The German economics minister, who is also the leader of the SPD party, has warned that Germany faces a “dramatic de-industrialisation” unless it brings down its energy costs.

The US remains the world’s second largest oil importer, behind China, but its import level has gone down significantly – from 60 per cent of total demand in 2005 to less than 30 per cent today. This is dramatically changing the flows of global oil – in a way that reflects both the major trends. Countries that formerly relied on the American market are having to accelerate the re-direction

of their exports to Europe or Asia, and, in a knock-on, countries that counted on Europe are also having to shift more towards Asia.

Moreover, owing to the configuration of its refineries and the build-up of supply, the US has also become a major exporter of petroleum products – indeed, at almost 4 mbd, the largest refined products exporter in the world. The US refining system cannot absorb all the light tight oil that is being produced, and the ban on exporting crude oil looks soon to be lifted. That would mean that West African crudes, which have already lost their market on the US east coast, would also be competing with US light oil in Europe and Latin America.

Will the unconventional revolution go global and, if so, when? That is a big question throughout the global industry. In terms of resources themselves, there is ample opportunity. IHS has identified the 23 most promising tight oil plays outside North America. Work has begun in two at the top of the list, in West Siberia in Russia, and in the Vaca Muerta formation in Argentina. But it is still very early days. China is thought to have significant shale gas resources and – owing to urban

At the heart of the US shale revolution, the process of mixing water with fracking fluid





air pollution – strong incentive to develop it. There, too, however, it is still early days.

Moreover, development in the US benefitted from favourable circumstances – an entrepreneurial upstream industry with a large number of independents, a well-developed eco-system in terms of services, private ownership of mineral rights, and state rather than national regulation. Canada shares most of these attributes, as well as being highly integrated with the United States. But the absence of these conditions in most other countries will slow development there.

Yet the unconventional revolution is already changing the global market – and having some impact on global politics. Had the US remained on course to be a major LNG importer, the global LNG industry would have been much more stretched and challenged to respond to Japan's desperate need for LNG after the Fukushima nuclear disaster – and Japan would have been in an even more difficult position.

The big turn-around

But, in the years ahead, it is no longer a matter of the US just not importing LNG. A big turn-around is at hand. In 2008, the general expectation was that the US would soon become a major importer of LNG in order to meet what was perceived to be an imminent deficit of supply. But now the US is preparing to become a major exporter of LNG. The first shipments of LNG will probably begin around the end of 2015 or early 2016. By the beginning of the next decade, the US will be on track to rank with Qatar and Australia as one of the "Big Three" of LNG exporters. But it will not be alone in entering the LNG export market. There will also be other new exporters – East Africa, British Columbia in Canada (also from shale gas), Russia, and potentially the eastern Mediterranean. This will make the world natural gas market more diversified and more competitive.

The world oil market has been hit by a number of disruptions in the last few years, as well as the sanction-driven reduction in Iranian exports. Yet the oil price has been remarkably stable. The shortfalls – and the requirements of increased demand – have been met by a combination of increased Saudi output growing output from North America plus some additional output from other Gulf countries. It can certainly be argued that the surge in US production – a million barrels per day in 2012 and another million in 2013 – was critical to

the impact of sanctions on Iran, helping to push it into negotiations on its nuclear programme.

Another impact can be seen in terms of Mexico's energy reforms to open its oil industry to the world. The decline in Mexico's oil output has long signalled the need for a change, especially since oil revenues provide about 35 per cent of the national budget. But it took the unconventional oil and gas revolution in the US to help jettison a 76-year legacy of the 1938 nationalisation. Mexico could see the speed and scale of the revolution next door in the US – with Texas alone now producing more oil than Mexico. Mexico needs reliable, reasonably-priced natural gas to support its manufacturing industry; and shale gas resources could help assure that energy. But that requires foreign investment and technology.

Diversifying away from each other

It is much too soon to assess the consequences of the Ukraine crisis on world energy markets. But it is obvious that Europe will be seeking to diversify its sources of natural gas. That could include imports of shale gas in the form of LNG from the United States. In response to the crisis, German Chancellor Angela Merkel declared, "There will be a new assessment of our entire energy policy." Will that mean that Germany will also lift its de facto moratorium on natural gas drilling and begin to tap its apparently considerable shale gas resources?

For the last several years, Russia has been looking to diversify its gas exports away from Europe to the growth markets of Asia. New LNG projects have been announced. In the aftermath of Ukraine, Russia had further incentive to work out the disagreements on pricing arrangements that have, until now, held up pipeline gas exports to China. This strategy took a dramatic step forward in late May with the agreement for Russia to supply China with around one trillion cubic metres of gas over 30 years.

Amidst all of the changes and tumult of the last ten years, the oil and gas industry still faces the fundamental challenge that became so evident 10 years ago – meeting the world's need for energy to fuel economic growth. While the ongoing rise in costs has become a pervasive concern throughout the industry, technology continues to augment the industry's capabilities to do so. Yet it is that challenge that defines the industry's mission. For that challenge is also a responsibility. ■