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The US's energy glut

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Few Americans, let alone anybody else, would have heard of Williston, a tiny town of 15,000 on North Dakota's prairie. But it is starting to get noticed. While most of the US is struggling amid an economic slump and high unemployment, Williston is booming. Such is the demand for labour that the local McDonald's fast-food restaurant was recently offering USD300 signing-on bonuses, while workers doing night shifts at petrol stations are reputedly being paid USD15 an hour. Roads in the once-sleepy streets are now clogged with traffic.

The reason for the transformation is oil, but not the type drilled using traditional methods. Williston sits above the Bakken, a 500,000-square-kilometre shale rock formation containing copious amounts of oil. Thanks to technological breakthroughs that have led to the cost of shale oil extraction plunging, North Dakota's production of crude has soared from just 75,000 barrels per day (bpd) in 2005 to 550,000 bpd today, more than any other state bar Texas. Even Ecuador, a member of the Organisation of the Petroleum Exporting Countries (OPEC), cannot match North Dakota's supply.

Shale extraction, along with increasing output from the Gulf of Mexico, where supply is almost back to what it was before the Deepwater Horizon spill in 2010, has reversed the US's long-term decline in crude production. Last year it pumped 6 million bpd, the highest level since 2003. "I've been studying energy markets since the 1970s," says Peter van Doren, a senior fellow at the Cato Institute in Washington, DC, "and for the first time since then, US oil production has gone up. It's stunning."

Analysts doubt that the trend is a short-term one, given the vast shale oil deposits in the US still to be tapped. "Shale oil represents a paradigm shift," says Seth Kleinman, global head of energy strategy at Citi. "Over the next three to four years, there's the potential to get an extra 3 million to 4 million barrels daily out of the US. That's dependent on prices and regulation, but it's not an outrageous forecast."

100 years of gas

Shale oil's rise has followed that of shale gas. Both are produced by hydraulic fracturing, or fracking, a process whereby water, sand and chemicals are blasted

into shale rock to break it up and release the gas or oil inside. Fracking has been around since the 1940s, but it was not until the late 1990s that techniques allowing for its use on a large scale were developed and combined with advances in horizontal drilling and seismic imaging.

From almost nothing in 2000, shale now accounts for one-third of US gas supplies. Such is its impact that the country has become the world's biggest and fastest-growing producer of natural gas. "Nowhere is the promise of innovation greater than in American-made energy," said US president Barack Obama in his State of the Union address in January. "Over the past three years, we've opened millions of new acres for oil and gas exploration. We have a supply of natural gas that can last the US nearly 100 years."

The gas glut in the US has led to prices falling steeply, from about USD9 per million British thermal units (Btu, a measure of energy) in 2008 to less than USD2 per million Btu earlier this year (although they have since risen to USD3). This compares to USD15 per million Btu in Japan and about USD12 per million Btu in western Europe.

The consequences for the US are already far-reaching. Gas is an increasingly important source of electricity, mainly at the expense of coal, a far dirtier fossil fuel. In the past six years, gas has gone from providing one-fifth to one-quarter of US power. Coal-generated electricity, which used to be dominant, fell to just 36% of the total in the first quarter of 2012, down from 45% a year earlier, according to the US Energy Information Administration.

In large part because of this, the US has managed to reduce its carbon emissions by more than any other country in the past five years. In Europe, where the use of coal has risen, to some extent because of higher gas prices, emissions have increased.

The cleanliness of natural gas led Jorma Ollila, chairman of Shell, to describe its use as "by far the fastest and cheapest way for the world to reduce carbon dioxide emissions in the energy sector". According to him, new gas power plants emit half the carbon dioxide of modern coal-fired ones.

Moreover, gas can be used far more easily than other fossil fuels in conjunction with renewable energy. Wind and solar farms usually need to be backed up by sources of power that can be ramped up suddenly when wind stops or light fades. Gas generators, which can be turned on and off quickly, meet this requirement well. "Gas-fired power stations are much easier to combine with, say, wind energy to solve the intermittency problem," says Christof Ruehl, chief economist at BP.

Jobs galore

The US economy is expected to benefit greatly from gas. For one, shale production creates jobs. North Dakota's unemployment rate of 3.3% at the end of

December was the lowest in the country and compared to a national average of more than 8%. John Felmy, the head economist at the American Petroleum Institute (API), believes more than 1 million jobs could be generated in the next decade thanks to shale drilling. He says such activity has transformed parts of northern Pennsylvania, where he grew up and which lies on top of the enormous Marcellus shale gas field. "I see things I never saw as a kid, such as 'Help Wanted' signs," he says. "It's not just the oil and gas drillers. It's all the suppliers, it's all the communities. The direct and indirect effects are significant."

Five years ago, US petrochemical companies, which use gas as a feedstock for their products, were moving their facilities to the Middle East to be nearer cheap energy sources. That trend is now being reversed. Dow Chemical last year cancelled plans to close a plant near New Orleans and has just announced the building of new one in Texas. The American Chemistry Council thinks about USD30bn of investments will be made in the next few years in petrochemical facilities, which should benefit domestic manufacturers of goods ranging from glass to tyres to fertilisers.

Plenty of commentators believe that low-cost energy, combined with a fairly cheap dollar and a falling wage gap between the US and many emerging markets, will help revive the country's industrial output. "It's a great recipe for manufacturing," says Vikas Dwivedi, head of oil and gas strategy at Australian financial services company Macquarie Group. "We may be on the verge of a new industrial revolution in the US."

Shale overhyped?

Some analysts believe the shale boom is overhyped. This is particularly the case, they say, with shale oil, which, owing to its large molecules being hard to extract through the fissures created by fracking, is more expensive to produce than shale gas. Until technological improvements solve the problem, many doubt shale oil's rise will continue as quickly as that of shale gas. "It's still unclear what the real potential of shale oil is," says BP's Mr Ruehl.

Others add that in the short term, the benefits of shale oil will be curtailed by the fact much of it is produced in regions lacking pipelines - in North Dakota, huge fleets of trucks are needed to transport the crude to refineries. "We've got real transport infrastructure issues," says Mr van Doren of Cato. "We're talking years before getting the pipelines up to date in terms of where the oil's being found."

Nonetheless, production of shale gas and oil is expected to carry on increasing. Optimists think US gas supplies, now about 650 billion cubic metres a year, could climb to 850 billion cubic metres annually by 2035, thanks mainly to shale but also to more discoveries of conventional gas. And the further exploitation of shale oil reserves in places such as California, Ohio and Texas will boost crude supplies for several years to come.

Such is the buoyancy of the upstream sector, it is now a commonly held view, including among the likes of BP, that within 15 years the US will be able to meet all its energy needs through domestic sources and the roughly 3 million bpd of oil it imports from neighbouring Canada and Mexico (at present it buys about 6 million bpd from the rest of the world). If this proves correct, it could have major geopolitical implications, including, perhaps, a change in the country's policies towards the Middle East. "It would mean living in a radically different world," says Mr Ruehl. "There would be big consequences that nobody can really forecast."

Politics and LNG exports

Until the middle of the last decade, it was widely assumed that the US would have to import liquefied natural gas (LNG). Several firms had invested billions of dollars in import, or regasification, terminals. But shale has drastically changed the outlook. "Five years ago I would have shared the view of a lot of people that we were going to import LNG in significant amounts," says API's Mr Felmy. "That's just not going to happen anymore."

Some LNG plants originally meant for regasification are now being turned into liquefaction facilities for exports. Earlier this year, the US government gave permission to the Sabine Pass terminal on Louisiana's coast to export LNG. But the likelihood of many more licences being granted is slim. The US, which exports virtually none of its crude, has long fretted about selling raw energy beyond its borders (although it has few qualms when it comes to refined petroleum). "The US has never been as comfortable exporting raw materials out of the ground as it has exporting manufactured products," says Mr Dwivedi of Macquarie. "The Obama administration has been supportive of LNG exports, but in a limited manner. It's got to let some projects through - it's hard otherwise to go around the world making speeches about free-market economies. But it doesn't want so much being exported that it raises prices locally."

Given the political sensitivity of gas exports, many analysts assume the government will allow them from no more than a handful of LNG terminals and try to cap foreign sales at about 10% of local production, which would not be enough to drive up domestic prices.

Economists are divided over whether shale's rise will cause global energy prices to fall. They tend to agree, however, that increasing supply from the US alone would probably not be that consequential, especially if demand from emerging markets, particularly Asian ones, continues climbing. Mr Dwivedi argues that of the world's oil production, about 5%, or 4.5 million bpd, is being lost annually as existing wells get older. Today's US shale oil supply of about 750,000 bpd is far from being enough on its own to make up for those losses. "In a 90 million-barrel-a-day global market, it's not flooding the system with crude oil," he says.

China catches up

It would be different matter, however, if more countries extracted their shale and other unconventional reserves in the same manner as the US and Canada, which has vigorously exploited its oil sands over the past decade. That few have so far has little to do with them lacking deposits. Instead, North America has simply done more than other regions to modernise and liberalise its energy markets and foster competition. Fracking technology and horizontal drilling ultimately came about thanks to companies and the government - both driven by high oil prices - investing hundreds of millions of dollars to find ways to extract hydrocarbons from shale cheaply. "Unconventional fuels are not coming from the US and Canada because that's where the resources are," says Mr Ruehl of BP. "It's because that's where the competition and free access are. They are probably the most competitive upstream regions in the world. The shale gas revolution is a consequence of this."

Progress is beginning to be made elsewhere. China, which already produces unconventional gas in the form of coal bed methane, has barely touched its shale reserves, which could be even bigger than those in the US. But its state-owned companies have started forming partnerships with foreign firms to rectify this. The International Energy Agency believes production of gas in China could reach 480 billion cubic metres by 2035, with unconventional types providing 390 billion cubic metres of that.

Australia has plenty of shale and tight gas deposits, which it wants to tap more in the coming decade. Already the world's fourth largest LNG exporter, it is boosting its liquefaction capacity in anticipation of this.

Even in Africa, where plenty of recent conventional oil and gas discoveries have been made, notably in Ghana, Uganda, Mozambique and Tanzania, shale gas exploration is taking place. South Africa, which has plenty of shale, imposed a moratorium on fracking last year following protests from environmentalists, but it is now considering lifting it. In the Republic of Congo, Italy's Eni is carrying out the first development of oil sands on the continent. Little has happened with unconventional deposits elsewhere in Africa. But that is likely to change. "It's the future," says Rolake Akinkugbe, head of energy research at pan-African lender Ecobank. "It's not a matter of if Africa will move in to the unconventional space, it's more a matter of when."

What about Europe?

Plenty of analysts have speculated about whether the shale revolution will spread to Europe. The continent is yet to produce any shale gas, despite having big reserves. This is largely due to Europeans being far warier about fracking than Americans. France, thought to be home to Europe's largest shale supplies, and Bulgaria have banned the practice. The main concerns are that fracking can cause earthquakes (it was temporarily suspended in north-west England recently because of a small tremor linked to shale drilling), contaminate water supplies

and cause methane, a greenhouse gas, to escape into the atmosphere.

In May, Vermont became the first US state to prohibit fracking. And New York state is considering following suit. But few others are likely to. The bulk of the research done so far - based on evidence from the tens of thousands of wells sunk in the US - suggests there is little danger if existing regulations are adhered to, with the risk of earthquakes reckoned to be negligible and water contamination unlikely given that fracking typically takes place well below the water table. Methane leaks, while harder to quantify, are thought to be no worse than those from conventional gas wells. "The results that have started to come out suggest very strongly that the negative environmental consequences related to shale are due to poor well-completion rather than hydraulic fracturing," says Paul Stevens, a senior research fellow at UK think tank Chatham House.

As such, several economists believe Europe is hurting itself by not embracing shale technology. "Europe will have to come around, unless it wants to be a massive importer of energy and have that be a big drain on its current account," says Mr Dwivedi. "At some point, someone's going to say: 'How is it safe everywhere else but not here?'"

European shale production could also be held back by geology. Differing rock formations in the US and Europe have led scientists to believe that drillers in the latter might not be able to use the same technology that has served Americans so well. Poland, which has made the most progress on the continent, having awarded more than 100 shale exploration licences in an effort to reduce its dependency on Russia for energy, suffered a blow in June, when Exxon Mobil said it was stopping testing after finding less gas than expected, and implied that new techniques would anyway be needed to extract what was there.

Who will pay for it?

If this is the case, it is unclear where the money to develop the necessary technology will come from. Mr Stevens says that government research into fracking was crucial for the establishment of the US's shale industry. But European politicians seem loath to get involved in a similar manner. "A lot of people hold up the US shale gas revolution as a triumph of market forces," he says. "There is an element of truth in that. But what those people forget is that the US government poured hundreds of millions of dollars into the sort of research and development that commercial companies wouldn't normally do.

"In Brussels, the attitude is: 'We'll leave that to the private sector.' There are questions marks over whether that will actually work."

Another disadvantage for Europe is that its gas pipeline network is less extensive than the US's. And in the US, private landowners tend to have the rights over any minerals below their property. In Europe, these often belong to the state, which provides less incentive for landholders to agree to shale production.

As such, few believe Europe will catch up with the US any time soon. "People who are talking about a shale gas revolution in Europe within five or 10 years are being completely unrealistic," says Mr Stevens. "If you're talking 10 to 15 years, that's different."

Natural gas is not yet a normal commodity in the manner of oil and coal, which are each priced more or less homogeneously across the world. No such thing as a global gas price exists. Gas markets function on a national or regional basis, rather than internationally, with only a third of the hydrocarbon being traded across borders, compared to almost 70% of crude.

This is due to the expense of transporting gas. Moving it between continents, which tend not to have connecting pipelines, requires turning it into LNG. And liquefaction terminals, where gas has to be cooled to -161C, are far from cheap. One being built on Australia's western coast, the Wheatstone LNG facility, will cost an estimated USD30bn.

Gas markets thus resemble those of oil before the introduction in the 1970s of large tankers, which greatly lowered transport costs and led to the commodity being properly globalised. Nonetheless, analysts believe that LNG capacity and trade will grow as producers look to benefit from the high gas prices in Asia and Europe. As this happens, prices between different regions should begin to converge, even if it will still be years before LNG shipping costs fall enough to create a single gas price. "Ultimately, I think the international gas market will [experience something] similar to what happened when the oil tanker was invented," says Mr Ruehl. "It won't happen tomorrow, but the trend is towards an integrated, global gas market."

Worries for OPEC

This phenomenon, more than increasing shale supplies in the US alone, is likely to impact traditional oil producers, particularly OPEC members, significantly in the coming decades. Expectations used to be that higher global demand for energy in the next 20 years would be met almost entirely by OPEC. Mr Stevens says shale has debunked that assumption. "For a long time, the attitude among many of the OPEC countries has been: 'We don't have to do very much. We'll just sit back and wait because eventually the world will have to come to us. We've got the oil.' That's no longer necessarily the case. The smart ones within OPEC are increasingly concerned."

OPEC, which declined to put forward a spokesperson for this article, has acknowledged the threat of shale oil and gas. In a speech in June, its secretary-general, Abdalla Salem el-Badri, said they were "potential game changers". But he emphasised the environmental concerns about fracking and said that "while technology and scientific innovation will help eventually solve these problems, it will take time". Several analysts believe this attitude is too complacent and that

OPEC countries will start to suffer from rising energy supplies beyond their borders a lot sooner than they expect.

Shale has already had profound consequences in the US. It is not inevitable that its effect on the rest of the world will be as significant. A crash in oil or gas prices could halt shale projects and cause drillers to stop investing in research. The expense of LNG technology will hinder the establishment of a world gas market for years to come. And environmental fears, particularly in Europe, have yet to be allayed. But most people who have had direct experience of shale energy play down such concerns and argue that its impact will be deep and lasting. Peter Voser, chief executive of Shell, an organisation scarcely known for its hyperbole, recently said that "the natural gas revolution is the most significant energy development in decades". So much so that Shell thinks it will, for the first time in its history, produce more gas than oil this year.

At the least, the rise of shale oil and gas and the increasing development of other unconventional energy sources across the world put to bed the theory of peak oil. "It was always a very flawed concept, largely because nowhere in the analysis were price and cost mentioned," says Mr Stevens. "But while it never had much credibility with a lot of economists before, it has even less now."