Global markets feel the force of North America's 'shale gale'

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We are in an era of energy innovation. Never has there been so great an emphasis on innovation all across the energy spectrum – in terms of renewables and alternatives, but also in terms of conventional energy.

In terms of impact, the biggest innovation since the beginning of the new century, at least so far, is clear. It is a familiar resource – natural gas – but sourced in a new way. This is unconventional natural gas – more specifically shale gas. Some call its emergence a revolution.

The 'shale gale' is blowing powerfully all across the global energy industry. Yet this revolution arrived with no great fanfare, no grand opening ceremony, no ribbon cutting. It just crept up. In 1990 unconventional gas – from shales, coalbed methane, and so-called tight formations – was about 10 per cent of total US production. Today, unconventional gas is more than half of total production and is growing fast, with shale gas by far the biggest part. Shale gas alone was only one per cent of US supply as late as 2000! Today, it is almost 30 per cent of US natural gas, and could be 50 per cent within 10 years.

The potential of this 'shale gale' only really became clear around 2007. In Washington, DC, the discovery came later – only in the second half of 2009. A year later, it is changing the national energy dialogue and overall energy outlook in the United States. It is also affecting the global natural gas balance, and setting off a new exploration drive around the world.

This was not what was anticipated just a few years ago. From the time of the California energy crisis in 2000-01, it appeared that the United States was headed for an extended period of tight supplies, even shortages, of natural gas

While gas has many favourable attributes – as a clean, relatively low-carbon fuel – abundance did not appear to be one of them. Prices had gone up, but increased drilling failed to bring forth additional supplies. The United States, it seemed, was destined to become much more integrated into the global gas market, with increasing imports of liquefied natural gas (LNG). But a couple of companies were trying to solve a perennial problem: how to liberate shale gas – the plentiful natural gas supplies locked away in the impermeable shale. The experimental lab was a sprawling area called the Barnett Shale in the environs of Fort Worth, Texas.

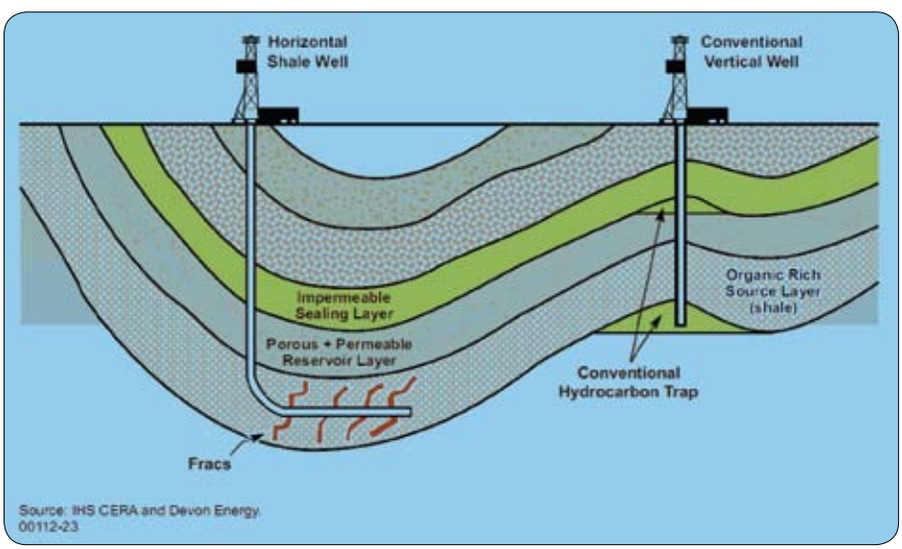
The companies were experimenting with two technologies. One was horizontal drilling, which opens up a much larger area of the resource-bearing formation.

The other technology is known as hydraulic fracturing, or 'fraccing.' Here, the producer injects a mixture of water, sand, and minute quantities of chemicals (typically less than 0.5 per cent of the total volume) at high pressure to create multiple fractures throughout the rock, liberating the trapped gas to flow into the well.

The critical but little-recognised breakthrough was early in this decade – finding a way to meld together these two increasingly complex technologies to finally crack the shale rock and thus crack the code for a major new resource. It was not a single eureka moment, but rather the result of incremental experimentation and technical skill – "trial and error," as one of the practitioners put it. The success freed the gas to flow in greater volumes and at a much lower unit cost than previously thought possible.

The shale gale also alters the way the industry operates. As IHS CERA observed in its new study, *Fuelling North America's Energy Future*, "Unconventional natural gas changes the supply risks from those of the traditional exploration and production business to those more akin to the manufacturing business."

In the past few years the revolution has spread into other shale plays, from Louisiana and Arkansas to Pennsylvania and West Virginia, and British Columbia as well. The province of Alberta has provisionally identified very large



shale resources, and other resources have been identified in eastern Canada. The state of Michigan has recently held successful lease sales in its Collingwood shale.

The supply impact has been dramatic – and sustained. In the US Lower 48, states thought to be in decline as a natural gas source, production has grown by more than 20 per cent since the beginning of 2007. This increase is more than most other countries produce in total.

Equally dramatic is the effect on US reserves and resources. The numbers can be overwhelming. Proved reserves rose from 177 trillion cubic feet (Tcf) in 2000 to 245 Tcf in 2008, even while the US produced nearly 165 Tcf during those years. Estimates of probable, possible, and speculative US gas resources from the Potential Gas Committee, representing both academic and industry experts, rose by 800 Tcf over this same time period (from 1,091 Tcf in 2000 to 1,836 Tcf in 2008). When we add IHS CERA's own estimates of US shale and tight gas resources into the mix, we estimate that the total gas resource base in the United States exceeds 2,800 Tcf.

While all of this new resource does not yet qualify as proved reserves, most of it is discovered – there is little exploration risk associated with shale gas. With more drilling experience, US estimates could rise dramatically in the next few years. At current levels of demand, the United States has about 120 years of proved and potential supply – a number that is bound to go up as more and more shale gas is found.

To have the resource base suddenly expand by this much is a game-changer. But what is getting changed? It transforms the debate over generating electricity. The US electric power industry faces very big questions – and great uncertainty – about fuel choice and what kind of new generating capacity to build. Given the long life of such facilities, utilities have to anticipate not only future demand, but also carbon policies.

Yet, it seems likely that in the face of new climate regulations, the increased availability of gas will likely lead to more natural gas consumption in electric power because of gas's relatively lower carbon dioxide emissions. Natural gas-fired power plants can also be built more quickly than other types of plants.

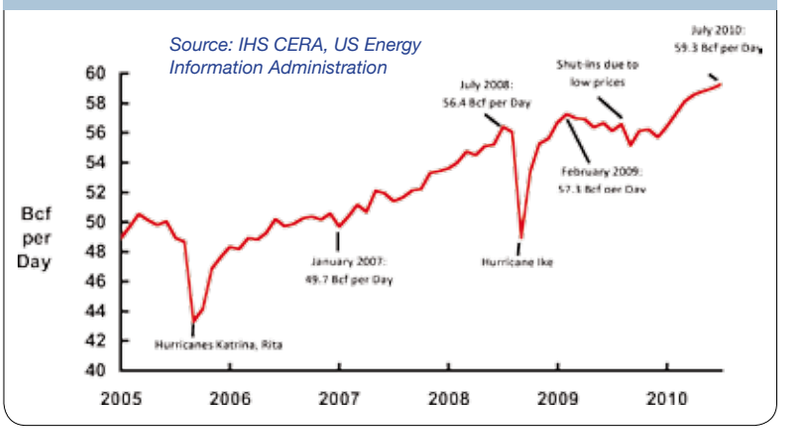
Some areas such as the Northeastern states, which traditionally have imported the bulk of their energy from elsewhere, will find reliable gas supplies much closer to home. It could also mean that some buses and truck fleets will be converted to natural gas. Energy-intensive manufacturing companies, which have been moving overseas in search of cheaper energy in order to remain globally competitive, may now stay (or return) home. But these industrial users and utilities have long investment horizons. Both have been whipsawed by recurrent cycles of shortage and surplus in natural gas over several decades; and they are understandably cautious and will require further confirmation of a sustained shale gale before committing.

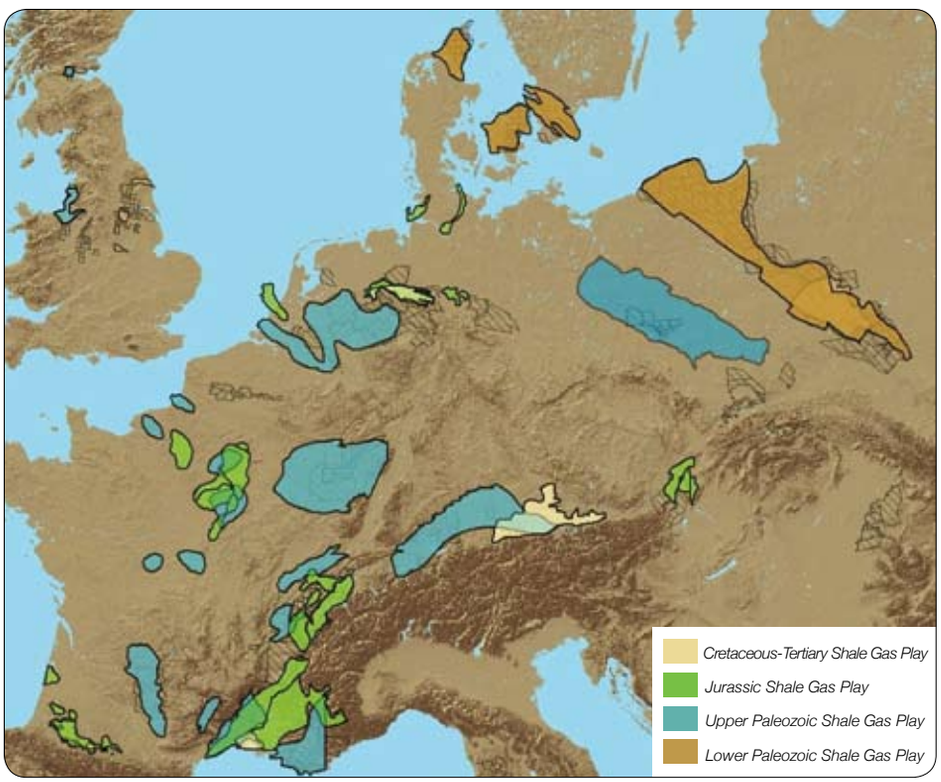
More abundant gas will have another, not so well recognised effect: facilitating renewable development. Sources like wind and solar are 'intermittent'. When the wind doesn't blow and the sun doesn't shine, something has to pick up the slack, and that something is likely to be natural gas-fired electric generation. This need will become more acute as the mandates for renewable electric power grow.

So far one potential political obstacle to development of shale resources across the United States has appeared: water. The most visible concern is the fear in some quarters that hydrocarbons or chemicals used in fraccing might flow into aquifers that supply drinking water. However, in most instances, the gas-bearing and water-bearing layers are widely separated by thousands of vertical feet, as well as by rock, with the gas being much deeper.

Therefore, the hydraulic fracturing of gas shales is unlikely to contaminate drinking water. The risks of contamination from surface handling of wastes, common to all industrial processes, requires continued care. Though fraccing uses

Unconventional Gas Has Led to Very Rapid Production Increases in the US Lower 48





Source: IHS CERA, Breaking with Convention: Prospects for Unconventional Gas in Europe, Multiclient study, forthcoming

a good deal of water, it is actually less water-intensive than many other types of energy production. The impression is sometimes given that water issues involved in on-shore energy development are not regulated. In fact, they are highly-regulated, but part of that is done under state, rather than federal, regulatory authorities.

Unconventional natural gas has already had a global impact. With the US market now oversupplied, and storage filled to the brim, there's been much less room for LNG. As a result more LNG is going into Europe, leading to lower spot prices and talk of modifying long-term contracts. The traditional gas suppliers to Europe are trying to assess how much of this European over-supply is temporary, the result of the recession, and how much is more structural.

But is unconventional natural gas going to go global? A shale gas revolution in Europe and Asia would change the competitive dynamics of the globalised gas market. But will it? Preliminary estimates suggest that shale gas resources around the world could be equivalent to or even greater than current proved natural gas reserves.

Activity is picking up smartly outside North America, but it is still early days. Interest is rising in China. Initial efforts in Europe have been mixed. To bring greater clarity, IHS CERA is currently analysing 34 different plays in Europe to understand prospectivity, and we expect to have conclusions over the next few months.

But the physical resource will be only part of the answer in Europe. In the United States the independent oil and gas sector, open markets, and private ownership of mineral rights facilitated development. Elsewhere development will require negotiations with governments and potentially complex regulatory processes. Existing long-term contracts, common in much of the natural gas industry outside the United States, could be another obstacle. Extensive new networks of pipelines and infrastructure will have to be built. Many parts of the world still have ample conventional gas to develop first.

Moreover, major new LNG projects are coming on line, and some of that supply will be very competitive. In addition, there is an important consideration here. A growing European gas market would require additional supplies. If some of those are met by indigenous new European Union supplies, that would actually increase the sense of security on the part of importers in terms of being comfortable with the greater imports from outside that will be needed in a growth scenario.

This new innovation will take time to establish its global credentials. The United States is really only beginning to grapple with the significance. It may be half a decade before the strength of the unconventional gas revolution outside North America can be properly assessed. But what has begun as the shale gale in the United States could end up being an increasingly powerful wind that blows through the world economy. ❑

Daniel Yergin is Chairman of IHS Cambridge Energy Research Associates (IHS CERA) and author of The Prize: the Epic Quest for Oil, Money, and Power, *which is now in a new, updated edition.* The Prize *won the Pulitzer Prize and was a number-one bestseller. He is an author of IHS CERA's study* Fuelling North America's Energy Future: The Unconventional Natural Gas Revolution and the Carbon Agenda *and an advisor to the new IHS CERA study* Breaking with Convention: Prospects for Unconventional Gas in Europe.