Can the US shale gas revolution be repeated elsewhere?

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It is a remarkably short time since the outlook in the US and Canada was one of an irreversible decline in the domestic production of natural gas, and a corresponding steady increase in the need to import LNG in order to keep the market supplied. Significant investments were made in LNG import terminals, and in liquefaction capacity, particularly in Qatar, on the back of this, universally shared, outlook. However, one result of the move of the Henry Hub price into double digits occasioned by the tightening supply/demand balance was to motivate a number of independents to take another look at the shale gas resource that was known to exist but, with a few local exceptions, had been considered much too costly to exploit.

Those independents soon discovered that, by applying the latest that the industry had to offer in terms of drilling (horizontal/directional), imaging (3D seismic) and completion (hydraulic fracturing) technology, they could radically improve the production economics of shale gas. The rest is already history, in the shape of the spectacular surge in activity that has completely transformed the outlook for domestic gas supply, leading, amongst other things, to talk of Reserve/Production ratios heading for three figures, as compared to less than ten no more than a few years ago. In other words the prospect now is of self-sufficiency in gas for the foreseeable future, to the extent that there is now much talk of the possibility of building new liquefaction capacity to export, as LNG, those volumes surplus to domestic market requirements.

The North American supply surge has already been felt elsewhere in the global gas market, with the displacement of the LNG volumes originally destined for the US market having contributed to generalised over-supply over the last two to three years, at least until the boost to demand from Japan post-Fukushima. The key question now is whether, in a world where security of supply has become a preoccupation of increasing importance, the North American experience can be replicated elsewhere, generating significant new sources of domestic supply in the major consuming nations and thereby reducing their dependence on imported gas.

The answer has little to do with the existence or otherwise of a resource base – the geology in question is not limited to North America, and resources on a similarly impressive scale are known to exist elsewhere. Illustrating this is the study published earlier this year by the US Energy Information Agency (EIA), which provided an initial assessment of technically recoverable shale gas reserves in a total of 48 basins in 32 countries outside the USA. Table 1 reproduces some of these figures, and compares them with the current estimate of proven (conventional) gas reserves in the selected countries in question.

The figures are undoubtedly impressive. But "technically recoverable" does not mean the same thing as "economically recoverable", and says nothing about the cost of developing and producing the resource in question. So the vital questions are to what extent the cost structure created in North America can be replicated elsewhere, and how does the resulting cost structure compare to that of alternative, imported sources of gas – remembering that the world overall is not running short of conventional gas.

An answer to these questions would start by considering the factors that came together to unleash the shale gas revolution in North America – the technology factors were clearly critical, but were

Table 1: Recoverable shale gas reserves

Country/Region	*Proven gas resources (end of year 2010) - tfc*	*R/P Ratio (end of year 2010)*	*Technically recoverable shale gas reserves - tfc*
USA	272	13	862
Mexico	17	9	681
Canada	61	11	388
Latin America	262	46	1225
Africa	520	70	1000+
China	99	29	1275
India	51	29	63
Australia	103	58	396
Other	(5224)		(639)
World	**6609**	**59**	**6622 (but based on only 33 countries)**

by no means the only ones – and assess the extent to which these factors are present elsewhere.

- **Existing pipeline infrastructure.** Building up supply from shale gas involves the drilling of many wells one after the other (in a process that has been described as "gas farming") and the ramp-up of production is accordingly a long, relatively slow process. Slow ramp-up rates depress the economics of new pipelines, and so the absence of need to create major new infrastructure, at least in the early stages of development, effectively removed one obstacle to its development in North America.
- **Proximity to end-use market.** This clearly relates to the availability or otherwise of existing infrastructure. Where no such infrastructure exists, the greater the distance of the shale resource from its intended market, the more challenging the economics will be.
- **Drilling cost.** This will, first and foremost, be a function of geology. A huge amount of work remains to be done in terms of deepening understanding of shale gas formations outside of North America, but initial indications in, for example, Europe and China are that the identified formations are in general likely to prove more challenging. Features such as greater depths and more complicated geology will mean that individual well costs will be higher, and often significantly so.
- **Liquid spot and forward market.** This factor has perhaps been under-appreciated, as it provided the independents in the US with both the signal and the confidence to look again at shale gas, in the knowledge that they would be able to monetise whatever gas they were able to produce, whether it be for one month or five years, into a fully fungible market and at a known price.
- **Supply side factors.** These refer in particular to the technical support industry that is a feature of the North American scene, and which is such an enabler of entrepreneurial behaviour. Drilling rigs available for hire in North America can be numbered in the hundreds, while in Europe only in the tens. Nor does Europe have anything like the oilfield service infrastructure that North America enjoys. Another supply side constraint is the availability of water, given that the hydrofracking technology that is so crucial to the economics of shale gas production requires such significant quantities. Much attention has focussed on the possible danger of hydrofracking contaminating ground water sources (though the evidence tends to suggest that the real issue lies with waste water handling and treatment). But it may be the absence of available water supplies in the first place that presents a significant impediment to development.
- **Favourable regulatory environment.** A large number of elements go to make up a favourable regulatory environment, and these for the most part remain to be defined outside North America. In Europe, the situation is likely to be far less favourable, as evidenced by the case of France, which has recently imposed a total ban on shale gas development involving the use of hydrofracking. In general, NIMBY (not in my back yard) factors are certain to be far more prevalent, especially in the absence of the mineral rights that American landowners tend to enjoy and which serve to incentivise their cooperation. Outside the US landowners generally do not own the minerals under their land.

An early assessment, therefore, is that whereas all these factors successfully came together in North America to enable the shale gas breakthrough, nowhere else has the same combination today. This may change over time. But one can conclude that it will in all probability take more money and time to develop shale gas outside North America than inside it.

A key question, then, is how will the cost of shale gas outside North America compare to the cost of conventional gas, even if imported from distant sources. While the security of domestic supply certainly has attractions, such attractions tend to diminish when they involve a significant price premium. This may be particularly pertinent in Europe, where the shift to a more "normal" traded commodity pricing structure suggests that prices will increasingly be set by fundamentals and therefore reflect the cost of supply. In such a scenario, with Gazprom in the role of marginal supplier, the market price target that unconventional gas would have to aim at would be the long run marginal cost of Russian gas, probably from the Yamal peninsula. With such a price likely to be in single digits, the target may prove a challenging one. In China, too, shale gas from the Tarim basin in the north-west of the country, relatively disadvantaged when compared to the shale resources existing in the Sichuan basin in the south-west, might find it hard to compete with imports of conventional gas from neighbouring Russia if that competition were purely cost-based.

The real challenge, then, facing the development of shale gas resources outside North America may be the fact that, unlike in North America, rival conventional gas should not be in short supply, even if not necessarily from a domestic source. ■