

To The Minister for Economic Affairs,
 Agriculture and Innovation
 Mr M.J.M. Verhagen
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Re Advisory letter on the emergence of unconventional gas

Reference 11/07

“The biggest energy innovation of the decade is natural gas – more specifically what is called “unconventional” natural gas. Some call it a revolution. Yet the natural gas revolution has unfolded with no great fanfare, no grand opening ceremony, no ribbon cutting. It just crept up.”¹

Dear Mr Verhagen,

In scarcely five years, the commercial production of unconventional gas reserves in the United States has brought about a structural shift in the world’s supply of natural gas. This important supply-side development comes at a time when the demand for gas is falling as a result of the economic crisis. Both developments have caused major changes in the international gas market. Against this background, the Dutch Energy Council believes that now is a good time to update its recommendations from five years ago on natural gas policy. This update of course takes account of and expands on the outcomes of the Gas Hub Consultative Platform.

Emergence of unconventional gas

In a period of just a few years, the emergence of unconventional gas on the supply side of the gas market in the United States (US) has changed prospects in the international marketplace. As recently as 2006, the US expected to import large and rapidly increasing volumes of LNG (Liquefied Natural Gas), resulting in increases in liquefaction capacity in

¹ Daniel Yergin, presentation at WGC 2009, 5-9 October 2009

countries with large gas reserves – in particular in the Middle East – and regasification capacity in the US and Mexico. Combined with the growth in demand for gas from Asia and increasing demand for gas imports into Europe, we concluded that the global gas market was set to become a seller's market for the foreseeable future. In this market structure, policymakers would also have to take account of the geopolitically sensitive concentration of the supply among a small number of countries (Russia and the Middle East). In other words, the lack of sufficient geographic diversification made Europe – and other regions – vulnerable in this seller's market, as the Energy Council indicated in the recommendations set out in the report on 'Gas for Tomorrow' (January 2005).

The rapid and large-scale growth in production of unconventional gas in the US has brought about fundamental changes in the global gas market. Estimates by the Energy Information Administration (EIA) in Washington had indicated that around 60 billion cubic metres of LNG would need to be imported in 2010, rising to 150 billion cubic metres by 2020. In reality, the US has imported around 10 to 13 billion cubic metres in recent years. Large volumes of LNG which were intended for the US, therefore unexpectedly came onto the global market, which was a bonus for gas-importing countries in Europe and Asia.

Increased supply of gas and diversification

The great success of unconventional gas production in the US has led to a lot of research into unconventional gas reserves elsewhere in the world. While this research is much less mature than the state of the art in exploring for conventional gas (which, in turn, is much less advanced than research into oil), the research outcomes have already made clear that the world's unconventional gas reserves are very substantial, and may be (more than) double the world's gas reserves. In its recent World Energy Outlook, the International Energy Agency (IEA) expects that the world's gas reserves will be sufficient for about 250 years at current production levels, representing a different order of magnitude than the 60 to 100 years which was previously assumed.

Furthermore, unconventional gas reserves are more geographically diverse. The potential is not only great in the US, but also in China, India, Australia, South Africa, South America, Europe (especially Eastern Europe) and Russia. This means that the much-desired geographical diversification of the gas supply is within reach. Not today and not tomorrow, but certainly within the foreseeable future – perhaps in about 10 years time.

Unconventional gas exploitation will be particularly valuable to countries that want to reduce their dependence on imported gas for strategic reasons. China and the countries of Eastern Europe spring to mind. In Poland's case, it are commercial players who are studying the potential, while in China the commercial parties are involved in partnerships

with a national oil company. Unconventional gas has managed to stand its ground even in a US market environment with lower prices. The production costs outside the US may turn out to be higher for a number of reasons, but this does not detract from the fact that unconventional gas has established itself in the market and has structurally increased the supply. Apart from the loss of the structural import of LNG by the US mentioned earlier, the potential or actual fall in demand for LNG elsewhere in the world will also put pressure on the LNG market. This brings opportunities for Europe, in particular for the Netherlands in its role as a gas hub for Northwest Europe, but only if sufficient LNG landing capacity is available. The increased supply of unconventional gas from our own soil should not figure in the decision on or timing of building new landing capacity for LNG; the policy should be focused on having sufficient LNG capacity in place to take advantage of these market opportunities. Especially in a supply-driven market, there is a lot of value in having a generous gas infrastructure available in order to seize market opportunities, and market players must be given the chance to utilise these.

Production of unconventional gas is not always problem free. More drilling is needed to release the gas, but the surface area required for above-ground installations is small. Despite this, it is important for onshore production to get landowners on board by allowing them to benefit in the production that takes place on their land. Furthermore, drilling through aquifers poses a potential risk that needs to be managed. This is not an unknown point of concern, but it does require precise engineering and strong supervision. Production also involves using large volumes of water and additives to fracture the rock. Good water management and a sound understanding of the behaviour of rock formations during fracturing are essential, something that was perhaps initially lacking in the US. The Netherlands has a wealth of knowledge in this field, and we should develop and market this further.

Buyer's market

The emergence of unconventional gas has therefore made a marked contribution to structural change in the global gas market. Furthermore, economic growth in many countries has slowed as a result of the financial and economic crisis, in turn leading to falling demand for natural gas. It is certainly not a seller's market at the moment. And provided there is sufficient investment in the production of unconventional gas in addition to investments in conventional gas and LNG, it will be many years before the tide starts to turn the other way (to a seller's market). In the view of the Energy Council, this could take 10 years or more rather than 5 years.

In a market with at least the potential for more supply than demand, pressure on the price of gas will increase, especially on the widely used link between the oil price and the price of gas. If this is increasingly abandoned as a result of gas-to-gas competition and the resulting spot pricing, the price of gas will become more volatile. The gas market would then develop into a true commodity market where small surpluses in supply or demand can cause major fluctuations in price. In the past year, the price of oil has gone up while the price of gas has fallen. Price volatility will bolster the need to store gas. When prices are low, gas suppliers will prefer to store their gas and wait for better times. And vice versa. This is an important aspect in the design of a Dutch gas hub.

Unconventional gas has proved to be a real game changer in the global gas market, because:

- gas reserves have increased so much that there is now no barrier to gas expanding its market share (in Europe), particularly for electricity generation. Natural gas prices will also act as a stimulus for this;
- geographic diversification can be achieved to such an extent that, also in terms of the much-needed security of supply, there will no longer be any barrier to gas expanding its market share (in Europe), including in the electricity industry;
- as the buyer's market is expected to prevail for some time – as far as unconventional gas is concerned, also for technical production reasons – additional and new contract types, including short-term contracts, will start to appear in the gas market. Combined with the strong development of the spot market for gas, this will make it possible to spread commercial risks more effectively, which again will make it possible for gas to expand its market share (in Europe);
- the combination of the above points makes it possible for natural gas to play the role necessary to achieve an effective transition to a sustainable energy supply. For that, the European market share for gas can achieve strong growth –at the expense of the coal's share – partly in order to achieve lower CO₂ emissions in the short term.

Recommendations

None of this is going to happen by itself, and the Energy Council makes the recommendations set out below to encourage in its view desirable developments.

- Make unconventional gas production attractive for the owners of the land and the residents of sites (e.g. tenants) where unconventional gas is located. The reward should be simple in structure and offer more than a mere compensation package. It is absolutely essential that landowners and land users somehow gain a share in the government's production revenues for their active cooperation, in large numbers required, in the production of unconventional gas.

- Make it clear that the existing legislation and regulation is satisfactory, thereby providing clarity on the conditions in place for the production of unconventional gas.
- Assess possible variances in the quality of unconventional gas and find out what is needed for its treatment and transport. There is a role here for Gasunie to provide a stimulus for the aforementioned production.
- Encourage the development and utilisation of technologies to optimise production – in an economic and environmental sense – of unconventional gas, in particular focusing on water management below the surface and on the treatment of waste water.
- Continue to invest together with business and industry in the development of specialised knowledge in the Netherlands to achieve further improvements in the efficient use of gas in the energy supply.
- Continue to provide a stimulus for production from marginal resources: marginal fields onshore and offshore, unconventional gas, biogas and green gas. Set a production ceiling for the Groningen field to act as a stimulus for production from these resources.
- Encourage the use of gas in Europe and the Netherlands as part of the transition to a sustainable energy mix, e.g. by using gas rather than coal for electricity generation, by using gas and sustainable biomass in coal-fired power stations. This will ease the urgency of the large-scale implementation of carbon capture and storage (CCS) schemes because of the lower CO₂ emissions from gas.
- Use the opportunities presented, in particular by the increased supply of LNG, to the European gas market by making sure that the gas hub has sufficient LNG landing capacity.
- Call for clear communication from the European Commission about the role of gas in its sustainable energy mix.

M.J. Oudeman
(Chair)

Expanded background summary

to the AER advisory letter on the 'Emergence of Unconventional Gas' of February 2011

Unconventional gas

Unconventional gas has been called “a complete game changer”: it has the potential to cause a paradigm shift in at least the energy future of North America, but possibly also in other parts of the world.

What is unconventional gas? It is gas that is ‘locked up’ in tight rock formations, which means that it can only be extracted using innovative drilling technologies. It does not flow from a borehole like conventional gas, which forms in large underground accumulations. In general, unconventional gas is more difficult to produce and economically less viable, because the technology needed to produce it is not yet advanced enough or because it makes production too expensive. If the technology matures and production costs fall or if gas prices increase, it may become economically viable to produce unconventional gas.

The production of shale gas in particular has increased sharply in the United States (US). Shale gas is locked in various type of clay and shale layers formed from the mud of shallow seas that existed around 350 million years ago. This increased level of production has been made possible by recent technological developments in horizontal drilling and hydraulic fracturing (‘fracking’) of the layers where the gas is locked in. Fracking involves injecting water, often with added sand, into layers of rock to fracture them, with the sand remaining in place to prop the fractures open. It is in fact an artificial way of making the rock porous. Fracking is an established technology and is also used, for example, in conventional oil production and geothermal energy. The combination of horizontal drilling and fracking has proven to be an effective way of extracting gas from the rock layers to produce shale gas. Higher natural gas prices in the US made it economically viable to use these technologies. Since then, benefits of scale and further improvements in the technologies have cut production costs by half. This means that the production of shale gas is sometimes even less expensive than the production of some conventional gas resources.

Structural change in the global gas market

Five years since the Energy Council’s made its recommendations in ‘Gas for Tomorrow’, unconventional gas has drastically changed our view of the global gas market. Instead of the expected seller’s market and high oil and gas prices because of the expected scarcity of supply, it is now a buyer’s market with lower spot prices due to a supply-side surplus. The surplus has been caused by two developments: falling demand for gas as a consequence of the global economic recession, and a sharp increase in domestic production of

unconventional gas in the US. This means that US imports of LNG (Liquefied Natural Gas)² are substantially lower than expected, in turn meaning that large volumes of LNG became available in the global market.

Growth in the production of unconventional gas in the US has far outstripped expectations and means that the US is increasingly becoming self-sufficient in gas. In the last ten years, production of American shale gas has increased eight-fold. This made the US the world's leading producer of gas in 2009, instead of Russia. According to the EIA (US Energy Information Administration), shale gas production will increase further to account for 26 percent of the growing US gas production by 2035. In part because of this, the EIA has adjusted the expected imports of LNG into the US downward by a factor of 4 to 6. Because of the previously expected increasing need for imports into the US, big investments were made around the world in LNG liquefaction capacity. This LNG became available (and continues to do so) for other regions within the global gas market, and as such contributes to the available supply.

Supply and demand are poised to play a greater direct role in the pricing of gas. This will lead to more independent pricing. As a result, gas will behave more like a commodity, like oil and gold. Ample supply has caused a strong fall in the price of gas on the spot markets, resulting in a greater difference between the spot prices and the price of gas in long-term oil-indexed contracts. While in the past the price of gas has tracked the price of oil, the spot price is finding its own way. This means that the price of oil can go up while the spot price of gas falls. This will put pressure on gas exporters to adjust the price and volume formulas – be it temporarily or be it permanently – which they employ in their long-term contracts. It is expected that the increased levels of supply will continue for some time to come. Unless there is sufficient investment in the production of unconventional gas in addition to investment in conventional gas and LNG, it will be many years before the tide starts to turn the other way (to a seller's market). In part thanks to this, the spot markets will be able to continue their growth and accordingly start to play a bigger role in the trading of gas.

LNG will continue to offer the opportunity of flexible transport between the regions, in part driven by price differences (arbitrage). The liquefaction capacity of 360 billion cubic metres currently in place (June 2010) is already sufficient for this arbitrage role, certainly in combination with another eight projects currently under construction that will add almost 80 billion cubic metres³. If the cost of producing gas locally is higher than importing LNG, countries will then switch to LNG imports. This will result in increased numbers of varying

² To liquefy natural gas, it is cooled to -162°C at normal atmospheric pressure. This process reduces its volume by a factor of 600.

³ IEA World Energy Outlook 2010

and more complex LNG trading routes, thereby contributing towards gas price convergence across the various regions. It is expected that interregional gas trading will increase from 670 billion cubic metres in 2008 to almost 1,200 billion cubic metres by 2035. More than half of this growth in gas trading will come in the form of LNG. This will increase the share of LNG in traded gas from 31% in 2008 to 42% in 2035.

Potential doubling of global gas reserves and supply-side diversification

In its 'Gas for Tomorrow' report, the Energy Council claims that global gas reserves are still so extensive that there should be no need for a physical shortage on a global scale in the coming decades. And unconventional gas now offers the potential to double the world's proven gas reserves. The proven conventional gas reserves in the world are estimated at between 177,000 and 189,000⁴ billion cubic metres, a doubling of the 1980 figure.

Remaining producible conventional gas reserves are estimated to be in excess of 400,000 billion cubic metres. Expectations of the total volume of unconventional gas reserves in the world vary from 40,000 billion cubic metres to 453,000 billion cubic metres or even 921,000 billion cubic metres. This is where the potential doubling of the proven world gas reserves comes from, but even the lowest estimate is comparable to the current proven reserves of Russia at 44,000 billion cubic metres. In its recent World Energy Outlook, the International Energy Agency (IEA) estimates that the conventional and unconventional gas reserves will be sufficient for about 250 years at current production levels.

The fact that unconventional reserves are for a large part located outside the current major gas-exporting countries means that economically producible gas is not only abundant, but it is distributed more widely across the world than had previously been assumed. Take China, India, Australia, Indonesia, South Africa, South America, Europe (especially the eastern part) and Russia. If these countries are able to take their unconventional gas reserves into production, this will result in a diversification of the gas supply. Any European potential in unconventional gas production will contribute to the security of supply, but is not an essential condition to allaying concerns about the security of supply.

Estimates for Europe vary between 10,000 and 35,000 billion cubic metres of unconventional gas reserves. Energie Beheer Nederland (EBN) expects that around 195 to 335 billion cubic metres of gas will be producible⁵ (compared to current annual gas production in the Netherlands of 70 to 80 billion cubic metres). The marginal fields policy

⁴ BP Statistical Review of World Energy 2010: proven world gas reserves 187,490 billion cubic metres

⁵ *Financieel Dagblad*, 21 June 2010

in the Netherlands has shown that the production from a large number of smaller fields can have a significant combined value.

Some European countries have a strong political will to develop unconventional gas resources. Eastern Europe is turning to shale gas in the hope of reducing its dependence on Russian gas. It is expected that production in Europe will start to take off beyond 2020. Unconventional gas production is also growing in China. Due to strong growth in the demand for energy in China, the country is banking heavily on diversifying its energy resources and making them more sustainable. Gas is hailed in China's national strategy as the cleanest of the fossil fuels. Growing Chinese gas production means reduced demand from China in the global gas market for imports than would be the case without its own domestic production. So unconventional gas production for local use affects world gas market dynamics, as we already saw with the emergence of unconventional gas in the US. Indonesia and Australia are also estimated to be the next biggest producers of unconventional gas.

The potential production of unconventional gas on a larger scale in Europe still needs to be proven and there are still many uncertain factors. Estimates for the presence of unconventional gas reserves are based on the presence of specific geological formations. At the present time, there is still too little information on whether the geological formations identified constitute potential production locations in a technical sense. Furthermore, in many countries the ownership of minerals often lies with governments, meaning that residents faced with the nuisance have less direct experience of the benefits of production. This, together with a lack of familiarity with gas production, can increase resistance towards production. Stricter environmental standards than in the US could also slow down the development of potential resources.

In Europe, businesses would not benefit from exemptions to the legislation as happened in the US, with special provisions in the Energy Policy Act of 2005 exempting producers of unconventional gas from the Safe Drinking Water Act. The EU's REACH Regulation (Registration, Evaluation, Authorisation and restriction of CHEMical substances) is also applicable to the production of unconventional gas and aims to protect people and the environment where chemicals are used in the production process. In the Netherlands, inspectors with the State Supervision of Mines (SSM) have been appointed to supervise compliance with REACH and the Dutch Environmental Management Act. In the Energy Council's view, the existing legal and regulatory framework in the Netherlands is satisfactory.

Greater role for gas possible in transition to sustainable energy mix

With the emergence of LNG and unconventional gas presenting increased opportunities to achieve security of supply, there is for the time being no need to reduce the share of gas in the European and Dutch energy supply. On the contrary. Gas deserves a more prominent role in EU climate and energy policy, along with clear communication from the European Commission on the role of gas in a sustainable energy mix.

Although global demand for gas is expected to grow by on average 1.5% a year until 2030, European demand for gas is surrounded by uncertainties. Ever-increasing demand in Europe is no longer something we can take for granted. The uncertainty in the demand for gas is primarily attributable to the power sector. Apart from clarity from the European Commission about the role of gas in a sustainable European energy mix, what is important in the longer term for the development of demand for gas in Europe is its competitive position vis-à-vis other fuels used for electricity generation. With lower spot prices for gas expected to last for many years to come, and the continuing pressure to reduce CO₂ emissions, an investment in a gas-fired power station could turn out to offer better value than an investment in a coal-fired plant. Furthermore, the gas chain produces less CO₂ per kWh_e without carbon capture and storage (CCS) in place than the coal chain does with incomplete carbon capture. According to GasTerra, the argument still holds even if 80% of CO₂ emissions are captured⁶. This would make it possible to achieve an immediate reduction in CO₂ emissions in the production of electricity, and any delay in the development of CCS for broad application in coal-fired power stations would pose less of a risk. Even running a coal-fired station on gas results in a significant reduction of CO₂ per MWh_e (518 kg/MWh_e compared to 855 kg/MWh_e)⁷. The CO₂ emissions from gas can be reduced even further by using biogas and green gas. Because of their flexible capacity, gas-fired power plants provide a better back-up for the fluctuating electricity production from solar cells and wind power than coal-fired power stations can.

For this reason it is unfair that the emphasis is primarily on coal and CCS in the transition to a more sustainable energy mix, without looking at the better opportunities that gas can offer in the coming decades. Furthermore, the price of coal has been volatile for a number of years now. And the price is still rising on the back of increased demand for imported coal in China. The coal price climbed sharply in recent weeks due to the floods in Australia. China's imports combined with growing demand in India has shifted the route taken by South African coal towards Asia, away from its traditional route towards the European market. This means that European consumers will also become more sensitive to the ups

⁶ GasTerra, presentation by G.J. Lankhorst, Energy Delta Convention 2010, 23-24 November 2010

⁷ KEMA, calculation made on behalf of AER

and downs of Columbian exports (influenced by heavy rains) and Russian supplies (dependent on volatile railway capacity).

The market response

The market has already responded to the emergence of unconventional gas in the US. This could be taken as a sign of faith in the potential of unconventional gas production. Small and new businesses in particular have pioneered to find opportunities to gain market share. In the past year, we have witnessed the response to this by the large multinationals: they have consolidated their share in the technology and the production of unconventional gas in their business by the acquisition of smaller companies. Various large multinational oil companies see unconventional gas production as a new opportunity. BP, ExxonMobil and Shell have all expanded their portfolios in unconventional gas. Gas is also taking an increasing share in the overall portfolio of these companies.

Exploration by international operators is going on in the Netherlands too. In the Oost-IJssel licence area, the Australian Queensland Gas Company is exploring for coalbed methane. And Cuadrilla Resources is eyeing North Brabant province and Noordoostpolder. Even private equity investors, such as the Dutch Indofin Group and the American Quantum Energy Partners, are looking to invest millions in Europe's new gas resources.

Policy that fits

To make the most of the great opportunities that are now available for gas in a sustainable energy mix, it is important to provide a new stimulus for the cleanest fossil fuel in a sustainable European energy mix.

With increased opportunities to achieve security of supply through diversification in the country of origin, there is no longer any need to reduce the share of gas in the European and Dutch energy supply. In Europe in particular, there is still scope for an increase in the use of gas-fired power stations as a fast and relatively inexpensive way to reduce CO₂ emissions. The use of gas in Europe for electricity generation could and should therefore be given more of a stimulus. The intention set out in the Dutch government's coalition agreement that 'In the European Union, the government will seek, amongst other things, a CO₂ efficiency standard for power stations' could make a good contribution towards this. However, it is important that the entire coal and gas chains are considered, and not just the power stations. Furthermore, the CO₂ efficiency standard for coal-fired power stations should be set in such a way that investment in gas-fired stations in the coming decades frequently represents a more attractive proposition. Because of the relatively low capital outlay, shorter

construction times and the modular design of gas-fired power stations, the depreciation period of gas-fired plants is sufficiently short to avoid any long-term lock-in that might have a detrimental effect on more sustainable energy options. Gas-fired plants play an important role as a flexible back-up for the fluctuating electricity production from solar cells and wind turbines.

In the context of state revenues from gas and limiting the decline in European gas production, the Energy Council recommends that the necessary preparations are made so that governments are ready and can act fast, now that we are presented with an opportunity to seize the potential of unconventional gas production. Because of the value of domestic gas production, stimulus measures should be put in place for the production of unconventional gas in the Netherlands and Europe. For the Netherlands, this means a stimulus for production of marginal resources: marginal fields onshore and offshore, unconventional gas, biogas and green gas, achieved in part through a production ceiling for the Groningen field which encourages production from these resources. Clarity should also be given as early as possible on the conditions for the production of unconventional gas: will additional legislation be introduced or will the existing legislation and regulatory framework be considered satisfactory? The Energy Council is of the opinion that current legislation and regulations are satisfactory. Additionally, unconventional gas production should be made attractive for the owners of the land and the residents of sites (e.g. tenants) where unconventional gas is located. The reward should be simple in structure and offer more than merely a compensation package. It is absolutely essential that landowners and land users somehow gain a share in the government's production revenues for their active cooperation, in the large numbers required, in the production of unconventional gas. Assess possible variances in the quality of unconventional gas in good time, and find out what is needed for its treatment and transport. It might require the coordinated construction of multiple pipelines to one treatment centre and a certain degree of sequencing in the licensing of sites. The costs associated with the process be picked up by the gas producers and not by the tax payer.

Finally, for the sake of the economic value and the sustainability aspects that gas will continue to offer in the coming decades and in order to further improve the efficient use of gas within the energy mix, the Energy Council recommends forging a partnership with business and industry to retain and strengthen specialised knowledge on gas in the Netherlands. Encourage the development and utilisation of technologies to optimise production – in an economic and environmental sense – of unconventional gas, in particular focusing on water management below the surface and the treatment of waste water.