



Forecasting gas markets – new disciplines needed this century

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1. Background

Natural gas is now more commoditised, more dynamic and in several competitions at once, making old forecasting methodology less applicable going forward.

The combined effects of economic downturn, new global liquefied natural gas (LNG) production and domestic shale gas development in the United States of America (USA) created large oversupply in the global gas market in 2009. With fragile economy, nuclear angst post-Fukushima, and clear signs of climate change, natural gas has a unique opportunity to become the fuel of choice for decades to come. But despite abundant gas, there is much uncertainty regarding future market developments. New approaches are needed to secure investments in natural gas across the value chain.

Gas is not the only fuel wanting to “win the future”, as it competes with coal, wind, hydro and other primary energy sources. With growing alternatives and choices for investments at all levels of consumption, supply constrained markets no longer unquestionably embrace any available gas. Suppliers, in response, are less price elastic making prices less reflective of costs, even in spot markets. Moreover LNG, no longer the solution of “last resort” at any part of the value chain, is becoming the “glue” in the market and harmonising prices. Governments and markets dislike integrated monopolies, but have not fully accommodated the new implications for security of supply and new infrastructure.

Load factor cannot be assumed to be high, as one future role for gas may be to balance electricity generation from renewables. Volatile prices will impact demand, supply and flow. Especially natural gas seems to be carving a space as the “elastic band”: When all the other fuels are decided, natural gas can do the rest. This could be electricity generation, balancing between wind, solar, other renewables or base load. It could also be gradual growth in transportation sector.

A key observation from the last decade is that while all energy is political, markets are becoming more dynamic to prices and the economy and this, in turn, impacts the future economy. We have worked with gas forecasting for more than 20 years, and see that new ways of working and thinking are needed to be prepared for the future. Essentially, this relates to forecasting (wider scenarios), organizational agility and robustness of investments to different market developments.

This paper outlines several aspects that need to be considered in understanding future energy use and the share of gas in this, with some examples from different gas markets, and suggests how to build scenarios to capture this dynamic world in the future.

A key question for all politicians and energy investors is:

What will the energy mix be in the future, and how will it impact prices, trade, need for investments and the economy in general? How do we forecast this?



2. Aims

A full picture view is necessary in forecasting, to understand market behaviour, impact of own strategies on other strategies and future value and price, rather than cost of supply only. This paper uses behavioural economics to discuss alternative approaches to building robustness in forecasting global gas markets, so as to minimise risk and to be open to upside in an unbundled but integrated and dynamic gas market. This new forecasting methodology will be helpful for companies and governments planning strategies and infrastructure so as to create good policies and strategies from a full-picture perspective, by better understanding this new way of market thinking for natural gas.

3. Methods

We have looked at gas market developments through several different lenses. By understanding market development expectations by different energy sources (e.g. coal, biomass, wind, solar) in different national and regional markets and the implied view on the role of gas, we position gas in the context of competition for winning the energy mix. This is an overview of issues to consider in addition to the traditional ones, of cost of supply, to illustrate their complexity and impact on decisions, planning, investments and views. In this way, we can discuss options for better forecasting.

Aspects to consider in forecasting an uncertain gas future

Geopolitics is increasingly important in understanding the changing roles of Russia, US, EU, China and others. Wei qi, the Chinese game of steady growth and protection, gives different long-term infrastructure and investments compared to focus on quarterly reports in Western markets.

Price is of course important as well. Elasticity develops with choice, income (lower elasticity with growing income), price levels (higher elasticity with higher prices), comfort with market economy (large variations, with many not changing supplier even if it is easy and economic).

Science and its **communication** cannot be neglected either and different stories emerge. Engineers typically wait for the world to come to the right and rational answer. Academics look at history for a long time to advice governments and regulators. NGO lobby groups and politicians move at a highly emotional level, often seen as “irrational” by industry, but which gets listened to. The story value plays itself a role in this; can gas win voter support or is it easier to sell other stories, such as hydrogen?

Technology is often seen as a main driver or constraint for investments. The focus is on cost reduction, assumed to solve the problem of rollout, neglecting business model (income), perceptions, alternatives and preferences in the market.

Individual **personalities** are important in this context. Some prefer simplicity and avoiding to be laughed at, while others are confident, secure and forward looking. The mix of “deep, I-people” and “wide, T-people” among pipeline builders, pension funds, oil and gas companies, regulators and politicians will trigger specific developments. Complexity and uncertainty often paralyse decision making. There is a bias for own technology, fuel, history, bad experiences in the past, often leading to dismissing other suggestions.

Relative environmentalism helps understand the image of gas. Prevailing views, such as “cleanest fossil fuel” or “replacing clean coal” are shaped along the value chain. Binary answers should be replaced by multi-disciplinary pictures to profile gas appropriately to each audience.



To understand all these aspects and integrate them in the full-picture forecast for natural gas demand, analysts must seek to answer a broad range of questions. This paper gives several examples of outcomes that have differed from classical expectations and some suggestions on how to understand markets better.

Examples of issues arising with more options

How much energy do we need for our homes?

- What will demand for household heating be? How will we shape living space? More or less space to heat per person? When will people be more efficient and how many new appliances that need electricity/ gas will they have?
- Which will be the preferred heating fuels – renewable/ low-carbon electricity (with losses) or direct fuels (many to choose from, but with different costs, logistics and emissions)?
- Switching requires investments – insulation, better appliances, new generation etc. Will each citizen take more responsibility in the future? If so, when and how much, and what will it do for demand?

Which industry will we have and how much energy will it need?

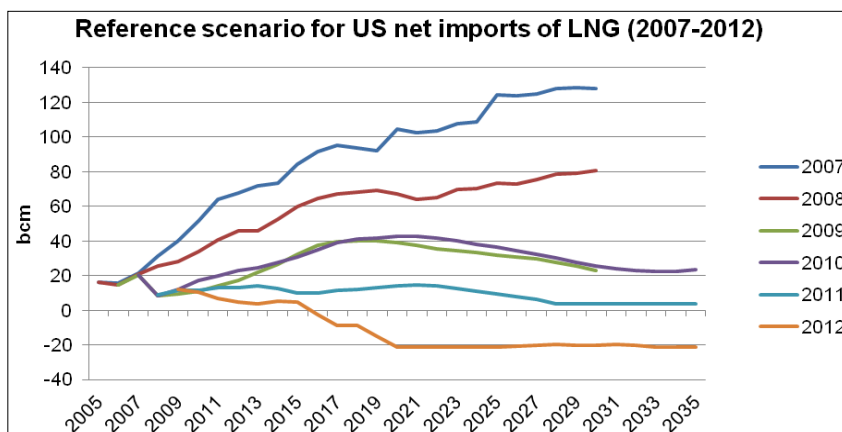
- Traditional heavy industry was often located near cheap energy sources – hydropower, “stranded” gas etc. Are other factors strong enough to determine relocation?
- New plants have better technology and greater freedom in location – logistics and many other aspects to consider with more options. Where will new industry go?
- As global industry optimizes portfolio, what will energy use and emissions be and how will it impact global need for further cuts?

Technology – what is around the corner, and even after that, and how can we use the best technology in the right place for better total solution?

- Transport/ transmission: Better ways of moving energy from production to consumption, new optimization of global portfolios, focus on transmission losses
- Generation of electricity: Oil is avoided, wind and solar have shown viability, nuclear oscillates between in and out of favour. Is gas the elastic band?

When analysing gas markets in light of these questions, new ways of forecasting emerge. The picture is completed by reviewing developments compared to what traditional forecasts had presented. To illustrate, an unexpected development in the USA has been changing from expecting more than 120 billion cubic metres (bcm) of net LNG imports in 2030 (triggering liquefaction investments) to now expecting to export.

Figure 1 – Fall in expected net imports of LNG in the USA, leading to global gas oversupply



Source: Energy Information Administration (EIA), Annual Energy Outlook (AEO) 2007-2012

Much production is happening at below what was earlier considered too low prices. With exports prices may rise again, but the USA seems to be happy in reducing its import dependency and planning for more use of gas in power, petrochemicals, and even the transportation sector. Meanwhile, the spare LNG is contributing to lower prices in other markets. We also notice that producers are behaving differently when this unexpected oversupply is impacting their profits.

How will the transportation picture look?

- How much will people/ goods travel and what will the allocation be between air, land and water? The variables change over time with lower prices for flying, gradual introduction of electric and gas vehicles, better fuels for marine bunkering and more.
- What is realistic to expect of citizens taking public transport, changing cars, and finding new ways of living? Price, convenience, interest in changing, available capital, and image are going to play a role in this.
- Depending on industry location, logistical needs of transporting goods, will consumers take part in paying for emissions?

In many developed countries, stakeholders across the value chain deplore the complexity of setting up the infrastructure for gas-fuelled vehicles. However, this has been achieved in many emerging economies with great success. China is now following the lead of Pakistan and other countries in offering CNG to vehicles, even from unconventional gas (in this case, coal-bed methane). The fuel is cleaner and cheaper than the alternative, as well as profitable for the supplier (see the figure below). Assumptions of what is possible should always be checked against what has already been achieved in different markets/ sectors, in order not to dismiss weak signals for new trends that can significantly impact the market.

Figure 2 – Private international gas company in China specialised in gas to transportation



Source: Sund Energy



4. Results

Forecasting gas markets in an uncertain world requires a holistic view, enhanced by confident and well experienced people, who have been challenged more than once on their perception of the truth/future. They typically have experience from multidiscipline work and international, long-term solutions. For an investor, it is important to understand thoroughly the field (who are the decision makers, what the alternatives are and what the perception is towards one's product/ service). Competition is essential, even when very different and acting according to different principles. It is most dangerous when consensus within a silo becomes not only the right but also the moral answer. Different mindsets, different skills and other diversity should help.

Understanding human behaviour is relevant in many parts of the gas markets

Although many natural gas markets have developed under national monopolies with limited choices for consumers and for which investments to make, market liberalization has shown that given more variety in supply, choices are more diverse than some had expected. How consumers and investors think is crucial in understanding future outcomes in gas availability and price, both essential elements in forecasting future demand for gas.

An organisation transforming from being a monopoly to becoming one of many players in a competitive market will take some time to define new ways of working and thinking. In this transformation process, many elements are impacting the speed and direction, naturally adding to the complexity of predicting which decisions will be made in the future. Utilities often have a different approach and risk management compared to oil companies, even if with increased integration, they are involved in the same decisions in the gas value chain.

Prices – what is best?

From an environmental viewpoint, high prices are good because they trigger efficiency, fuel switching and focus. For the economy, low prices to consumers but high prices on exports are favoured. More efficient markets move from regulated prices to functioning markets with price signals sending balancing measures – theoretically an efficient solution (if all are “rational”). Volatility is cumbersome for many, and even staunch capitalists prefer predictability in pricing – between users and over time: Oil, gas, electricity. Regulation should give competition and lower prices, but other factors often make prices rise – difficult to communicate to market/ population.

Demand side has become very important – volume, load factor and willingness to pay

Consumers in one country can, collectively, make very different choices from consumers in another country, based on different perceptions. These perceptions are coloured by experience, insight (or lack of it), marketing/ story-telling by governments, companies and non-governmental organisations (NGOs) and more. We recommend a wider outlook for natural gas forecasters to understand the next 20 years better than if only traditional forecasting methods are used. Allowing for different views will make the companies able to take measures to mitigate risk earlier and even to capture future opportunities better.

What do consumers want and from whom, in the short and long term?

They consider more than price when choosing a supplier, and even when looking at price, there could be very different preferences. Most surprising to many regulators has been the fact that when given the option to choose supplier in competitive markets, some will choose not to do so, even if the cost of energy could go down. They may also not select what is best



for them. Ofgem, the United Kingdom (UK) regulator, has documented this in a paper¹. This is to replace a fuel in use. Understanding behaviour and change management is even more important in making assumptions of future changes to behaviour, such as making new investments to reduce energy use at home or in transportation. Insulation and electric cars may well be economic, but often not done.

When changes are done, the choice of investment, such as a new car, is seldom (if ever) only driven by cost. Stepping out and making a change away from the familiar technology requires additional strength and insight. There are great cultural differences in this respect, between countries and between parts of society in each country. To illustrate, while the USA has for many years tried to be less dependent on oil, and oil prices have risen, there has still been a preference for American cars over Japanese cars.

It will be interesting to follow the growth of natural gas vehicles, with domestic cheap natural gas as an attractive fuel for many, but needing investment in cars and infrastructure. In parallel many other countries, with less oil and less money, have introduced natural gas vehicles (NGVs) on a large scale many years ago – both compressed natural gas (CNG) and liquefied petroleum gas (LPG). With Chinese investments in the car industry, coupled with a decision to use more gas to replace oil, this could facilitate cheaper cars which again could help more countries introduce NGVs.

Strategy and story telling

Both countries and large companies will explain their actions with a story, explaining how this decision or investment is better than alternatives. This is selling the idea, something that happens at many levels and appeals to emotions, not only cost and income. Further, the skill of telling these stories could at times differentiate who manages to get the change implemented and who does not. NGOs use this in their work, as does advertising. Utilities and gas companies have not been used to marketing in the same way, and may underestimate the value, as they have a generic product. However, we see that consumers are influenced also in their decisions related to energy use (and emission reduction) by what they can tell their friends, which story they present to change cars, install new heaters etc. Even fashion or fad plays a role here (as it does in companies and their strategies over time).

To understand this, listening to the market and politicians is helpful, and following diverse decisions and their reasoning give insight into process and preferences. However, there is also a case of cognitive dissonance, where people will answer what is expected, but still do completely different actions. They may say they want fewer emissions, and still buy a larger car. Similar to smoking and other complex areas of decisions and stories, this is not what is expected by the models that assume rationality, but if rationality is assumed the forecast will be very wrong.

Companies and personalities

There are strong cultures, almost personality traits, in many companies. This has been noticed in the mergers of British Petroleum (BP) and Amoco, Exxon and Mobil, Statoil and Hydro. Although all populated by well educated and rational people, they found (sometimes to their surprise) that what was considered a good strategy or investment with lots of upside in one company was seen as irrational and risky in another. So consolidating people and portfolios has proven more difficult than some had thought. There is often a winning culture coming out, and this is often reflected in the remaining team. Some are more opportunistic, others risk averse.

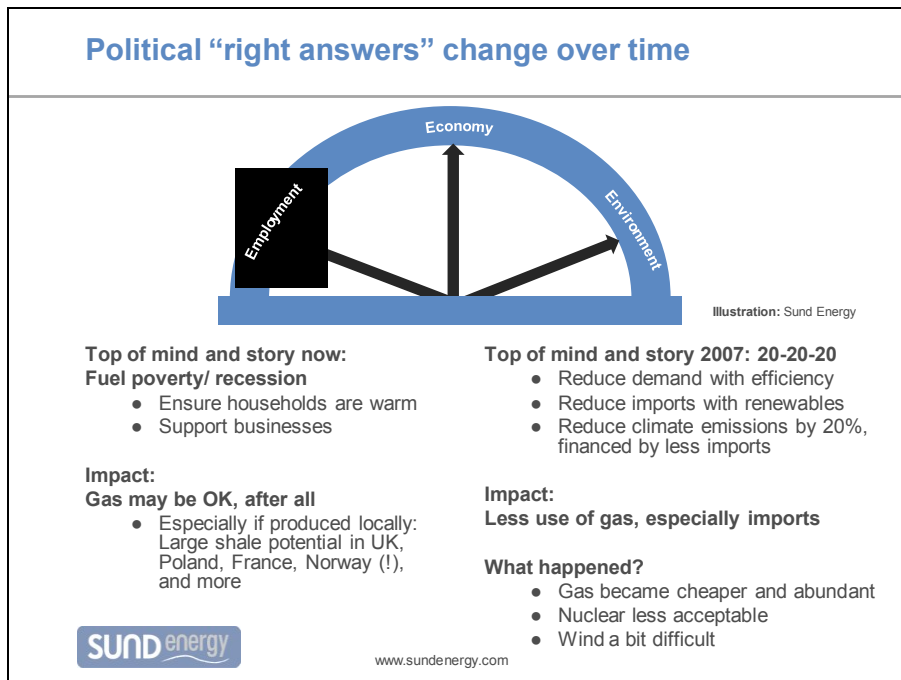
¹ Wood, Jake. Ofgem. March2011. What can behavioural economics say about energy consumers? http://www.ofgem.gov.uk/Markets/RetMkts/rmr/Documents1/Behavioural_Economics_GBenergy.pdf

The markets are complex, so even in hindsight it is difficult to judge what the best / right answer was given the insights and priorities at the time. This opens for decisions to be driven by peer pressure (“we should have LNG ships, too”), personal protection (not wanting to be ridiculed later), or risk seeking (the possibility of striking lucky and standing out). Much has been written about the human factor’s contribution to the financial markets in the last couple of years. Assuming there is no human factor (only cost-focused rationality) in energy and environment will lead to wrong forecasts.

Politicians’ behaviour

Although gas markets are developing, politicians still have a strong impact on energy policy, which again will impact the use of gas (especially if gas is expected to be the residual/ elastic band). How much can we afford to mitigate emissions and how much is enough? We have seen political preferences change:

Figure 3 – Illustration of shift in political focus in the European Union



Source: Sund Energy

Source of gas and security of supply

Many countries have strong preference for own energy, even if imports could be cheaper. This is relevant up to a point, of course. Even China will import coal when this cheaper and easier than using own resources. However, having own energy, such as unconventional gas, will impact politicians perceptions of what the voters will want. The trade-off between feeling vulnerable to foreign oil and gas suppliers and having own production with some challenges is interesting to follow in USA, UK, China, Poland and Germany this year.

Attitudes to the risk of disrupted imports and the risk of pollution from domestic shale are difficult for most people and politicians to relate to in rational terms and will be influenced by emotions of vulnerability, perceptions of alternatives and personal experiences. On top of this, politicians will try to do what is right for the people in an even bigger picture: The overall energy, environment and economy. All this is difficult and changing over time.



Infrastructure – some stories to illustrate different rationalities and forecasting

We have worked closely with many large gas infrastructure projects and followed even more globally over many years. Below are examples to illustrate the points made above.

UK supply infrastructure:

The Interconnector was built after gentle nudges from the government to be able to export excess gas while getting ready to import gas from the continent as domestic production declined. Even with this in place, the government wanted more and provided incentives for investors to build import capacity to the country. Much was built, adding now to competition in the UK market, bringing prices down compared to an alternative scenario where capacity would have been limited. The Interconnector was seen as “a bad investment” by several private investors when it was made in the late 1990s, but in hindsight it has been profitable and is still exporting. In fact, for many gas producers in the UK, having more export capacity would reduce the bottlenecks of the market when it is overflowed (with resulting very low prices).

EU supplies:

In a similar policy mode, the EU wanted to diversify its supplies of gas with more sources, preferably by pipeline. Caspian/ Iraq were chosen as the new area of resources, and therefore a new source to tap into, under the assumption that pipelines are better than LNG both for price and security of supply (even if much LNG to Europe is delivered at spot gas prices). A pipeline to cross Turkey, Nabucco, was planned by several downstream companies, with strong support by the EU, especially in the stimulus package early in the recession. However, this pipeline is not being built yet, and it has the classic signs of perceived risk outside comfort zones. While downstream markets are wondering whether there are sufficient gas reserves, producers are concerned whether there is enough new gas demand and whether prices are high enough to develop the fields profitably.

In addition there is a sprinkling of geopolitics, EU membership and other issues (including pride, it seems) further delaying a final decision (one way or the other). Meanwhile, the Nord Stream pipeline from Russia to Germany in the Baltic Sea has been built to circumvent the Ukraine and remove one risk of supply regularity. A second pipeline for Russian supplies, South Stream, is moving ahead, with a very experienced western Chief Executive Officer (CEO), Marcel Kramer, increasing the chance of this pipeline being completed long before Nabucco. Both pipelines have investors that are downstream companies, and the latter even has a power company among shareholders, Electricité de France (EdF). For the EU to get more pipelines like this on private initiative, while sending the message that gas is less needed and they are building their own system (both reducing the profitability of traditional pipeline economics) is expensive to count on. For some, it will be more attractive to aim for other markets.

China and the Tarim Basin (Turkmeni gas):

When it was suggested that China could be a market for Turkmeni gas, this was seen as “irrational”, for reasons of distance and price. The pipeline was built, is being used and in addition, China imports LNG to several ports (paying more than many market economies). The decision was easier to make in a government-controlled economy than for a private investor in a deregulated gas market, and is now providing lower transmission costs than would have been the case if a smaller dimension had been chosen for the pipeline.

Supply cost curves cannot be assumed

Traditionally, supply cost curves have been used. Gas was supply-constrained and suppliers were assumed to be rational. Once pipelines were built, they were assumed to be full for 20 years. Extrapolation of past growth and fixation on economic growth was a classic approach



in many “old” industries. We have all learned that it is rational for a monopoly with obligation to supply a market with energy to use the lowest cost option first, and then gradually move up the merit order.

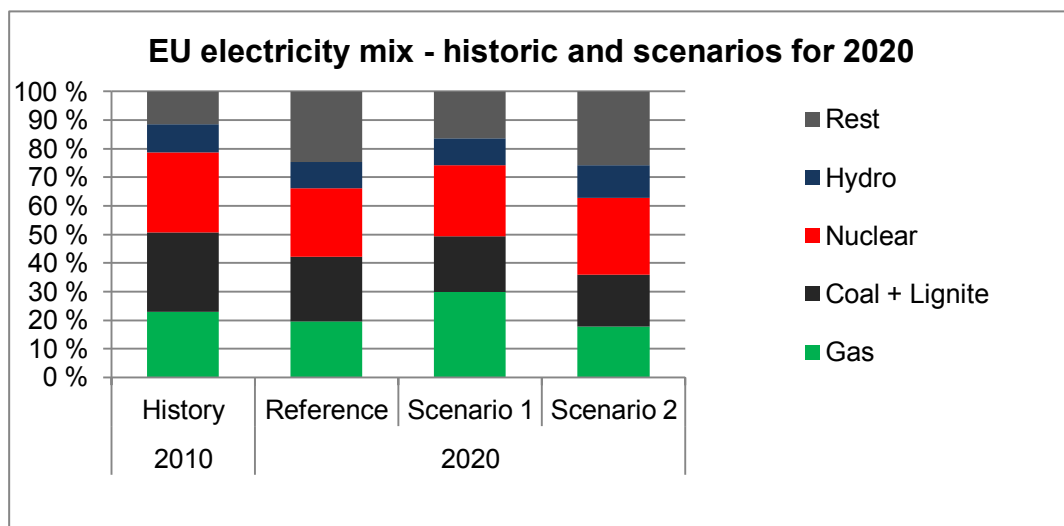
However, with only one asset and no obligation to supply, one will use different criteria and perhaps on an hourly basis decide to run or not run your asset. This asset will not wait for all the ones below it in the merit order, and there could well be even costlier supplies being offered to the market. This has to do with people, too. Optimising hourly, daily, annually or even never are all valid models in different companies. Turning off an asset meant for base load can feel painful for some dedicated operators, even if this means the company makes more money by improving prices and returns.

Example outcome: Sund Energy scenarios

In the USA, we see that lower prices impact policies and how attractive gas is in the full energy picture (and especially electricity generation). We have built on this logic and used the methods described above to develop scenarios for each of the 27 Member States of the European Union (EU27) and compared these with the current European Union (EU) outlook for future generation. We see that lower gas prices could give a gas share in the electricity mix of 30%, which is higher than in 2010 and much higher than the EU had expected (below 20%). On the other hand, higher gas prices would encourage other fuels to develop more and even lower gas shares than what the EU had expected. High gas prices could encourage more unconventional gas production in Europe, dramatically reducing imports.

Figure 4 illustrates the range of these scenarios, as a result of the described forecast methodology. This could be relevant for the development of gas supplies to Europe in the future. In scenario 1, low gas prices would give low netback to distant sources, such as the Barents Sea. In scenario 2, high prices could lead to a fuel switch in the electricity mix, reducing import needs significantly.

Figure 4 – Gas role in the electricity mix will depend on relative prices



Sources: European Commission/ PRIMES, 2010 and Sund Energy, 2011

5. Summary/ Conclusions

To manage risks in the future and capture new opportunities in a robust manner, new types of forecasting gas (and other energy) markets are needed. Departing from binary thinking and extrapolation is a good start. Understanding prices is essential, and using diverse teams and more market dialogue will provide better outlooks. Much of this is in how we work, not only the tools we use, so a more dynamic mind set for a more dynamic gas market.



Giving more time to understanding markets, sentiments, public debates and politics will be a good investment going forward. IN this complex and interesting globalizing world, understanding its people of today and the future is important. Even if all cannot be understood (even by the decision makers themselves), acknowledging the fact that all is not rational is a first step to avoid the trappings of believing in clean, uniform rationality and supply cost curves.

Diverse teams, cross energy, cross culture and less consensus will enable this shift and could even add to wider understandings in other areas vital to the energy business. In addition to diverse teams, it is important to be conscious of information sources and industry dialogues. It is only natural to choose sources that support own views, but this is done by “the other side”, too. Therefore, selecting information sources that cover not only other companies, industries and technologies should be sought out, but even sources advocating against your own, to understand the views better.

These days, this is easier with social media, websites and more. From there, direct dialogue with climate advocates, politicians and electricity industry will help even more in widening the outlook. When markets are forecast in this way, strategies and infrastructure will be designed for better robustness and optionality, and may look very different from the days when the gas industry could expect straight-line extrapolation of base load demand.

This has been written for the gas industry to be more qualified in forecasting. We also have academics looking at energy and environment, and we see that there is even more silo-thinking at times when the thinking is strictly organized in geology, technology, and that anything to do with economics or consumers are left to the social/ humanist or policy institutes. These people then advise governments on what is best to do for their country – again in separate ministries for energy, economy and environment.

This paper will be presented at the World Gas Conference (WGC) 2012 in Kuala Lumpur, and we welcome a good discussion!