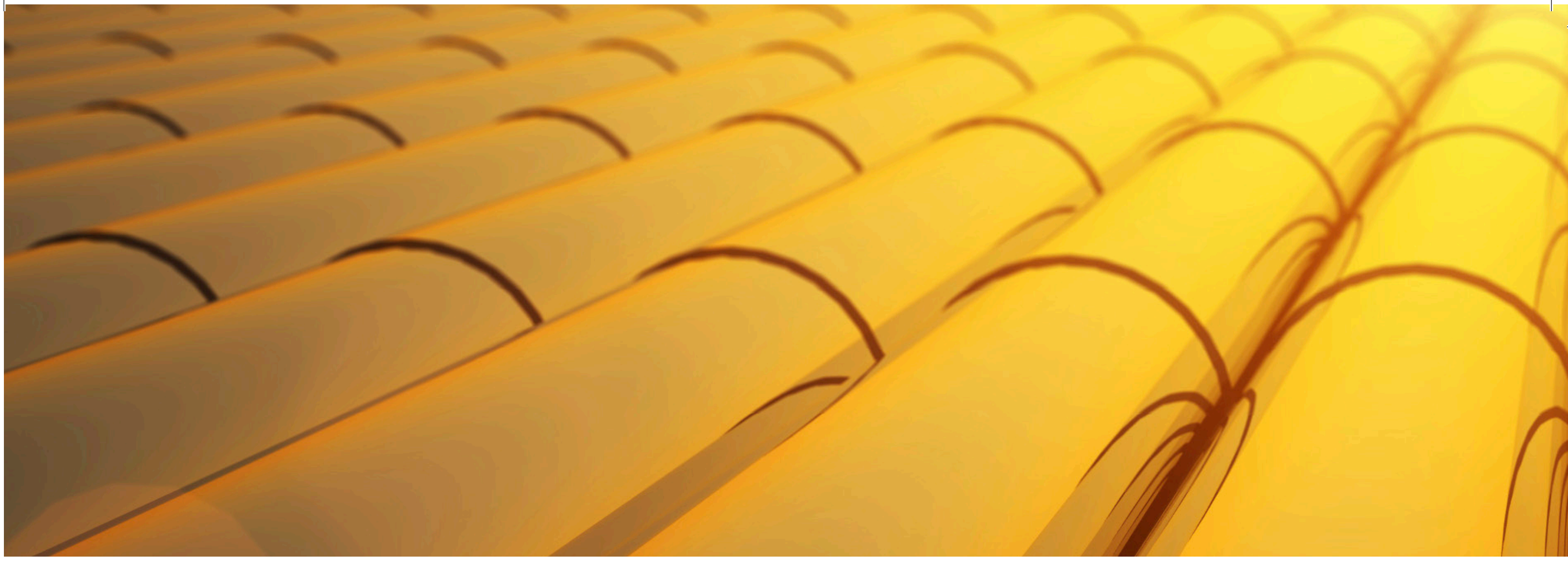


International Gas Union

News, views and knowledge on gas – worldwide

Prospects for Natural Gas

Identifying the key developments that will shape the gas market in 2050

INTERNATIONAL GAS UNION
UNION INTERNATIONALE DU GAZ

Foreword

Well processed forecasting and scenario thinking are interesting and draws attention, and since the World Gas Conference (WGC) in Argentina (2009) IGU has every triennium presented a long term outlook as part of the IGU effort on advocacy.

The report “Natural Gas Unlocking the Low Carbon Future” was the first one presented in 2009, followed in 2012 by “Global Vision for Gas: The Pathway towards a Sustainable Energy Future”.

Now I am pleased to present the Prospects for Natural Gas: Identifying the key developments that will shape the gas market in 2050” composed by IGU Programme Committee B on Strategy.

The report has been developed under the leadership of Fethi Arabi from Sonatrach and Ulco Vermeulen from Gasunie, and I would on behalf of IGU like to thank them both for their efforts. The study has specifically given attention to the role of technology and innovation on both demand and supply side and furthermore on key policy developments affecting the long term gas market. Many experts inside and outside IGU have contributed to the report where a special mentioning and thanks goes to IGU Wise Persons Coby van der Linde, Daniel Yergin and Nobuo Tanaka.

All major energy scenarios and publications are positive about the long-term future of gas and foresee significant increase in gas demand in the decades ahead but we also know that we cannot take any projections for granted. There are many challenges ahead for the gas industry, which will require adequate responses from IGU and its members.

- The world LNG market has further growth potential and may contribute to a further globalization of gas markets, improving security of supply and demand.
- Through the last decade unconventional gas production has tremendously improved the availability of gas resources, and there are a number of R&D programs ongoing to reduce bottlenecks in the production and reduce emissions which I hope will increase the support from politicians globally.
- Gas for Transport, both onshore and offshore, has a huge growth potential around the world. It will become an important demand category as emissions and pollutions from this sector will be reduced.
- Gas and renewables. Based on it attributes gas is the ideal partner for renewable energy sources like solar and wind.

Finally, although gas is abundant, cost-effective and environmentally friendly, we have to recognise that these benefits are not self-evident and need to be communicated and advocated to secure an important role for gas in 2050.

All these issues are analysed in our report which I hope you will find informative and most interesting to read.

April 2015

Pål Rasmussen
Secretary General of IGU

Contents

Summary

All major energy scenarios are positive about the long-term future of gas. Whether it is the International Energy Agency (IEA), the World Energy Council (WEC), Shell or ExxonMobil, they all forecast significant growth of gas demand in the decades ahead. Indeed, in most scenarios, gas will be the world's biggest energy source in 2050.

Does this mean we can look forward to a Golden Age for Gas as predicted by the International Energy Agency (IEA)?

When we look at forecasts made in the past, for example by the IEA, we see that they have often managed to predict future developments quite well. Twenty years ago, the IEA forecasted that gas consumption would grow from 1916 bcm in 1991 to 3163 bcm in 2012. The actual demand in 2012 was 3093 bcm. This seems reassuring.

Yet, we also know that we cannot take any projections for granted. There are many challenges ahead for the gas industry that require timely and flexible responses.

In this report we will discuss the key developments that may significantly impact the gas market up to 2050, based on the work of International Gas Union (IGU) Programme Committee B on Strategy during the 2012-2015 triennium. Furthermore IGU Wise Persons Coby van der Linde, Daniel Yergin and Nobuo Tanaka give their vision on the long term outlook for gas.

First, we look at innovations in the market and how they may boost or limit demand and supply for gas. We will discuss the many opportunities in the transport sector, in LNG and unconventional gas and we will look at the ways in which gas can work together with renewable energies such as solar and wind power.

Second, we will look at how policies may affect the gas market. We will discuss issues related to energy security, to the environment and to climate change and its accompanying trend towards decarbonising energy supplies. The latter is currently seen as one of the most important challenges the energy sector faces.

A GOLDEN AGE FOR GAS ?

Gas has many things going for it. It is widely available, cost-effective and clean. Gas projects can also make a substantial contribution to local economies. As the least carbon-intensive fossil fuel, gas contributes to reduced greenhouse gas emissions if it replaces coal (mainly in electricity generation) or oil (mainly in the transport sector). In combination with carbon capture and storage (CCS), gas can be a fully zero-carbon option.

But the benefits of gas are not self-evident for everybody. Hence the industry must be constantly engaged in active and transparent communication about the qualities of gas and the role it can play in a long-term strategy towards decarbonisation. Support from consumers and other stakeholders (policymakers, NGO's) is the gas industry's 'license to grow'. They need to have confidence in the qualities of the product and to be sure that gas is of benefit to them. We end this report with some reflections and recommendations.

Chapter 1 Energy outlooks to 2050

1.1 Basic assumptions

Predictions of the future are obviously fraught with uncertainties. There will be unexpected developments, game-changers, upsetting our expectations. For example, in the 1980s people believed in a future with much more nuclear power generation, but the Chernobyl disaster in 1986 changed all that.

Nevertheless, the global energy sector is huge and not liable to abrupt reversals or revolutions. Change tends to occur gradually. Consequently, forecasting the future can be done with some degree of confidence. As an example, the table below shows energy demand levels predicted 20 years ago, in the 1994 edition of the IEA's World Energy Outlook (WEO), for 2012, compared with the actual numbers. As can be seen, the reality did not differ much from the forecasts.

	Actual 1991	Forecast 2012 in 1994	Actual 2012
Coal	2275	3506	3773
Oil	3072	4455	4108
Natural Gas	1727	2850	2787
Nuclear	549	724	674

Table 1: projected (in 1994) and actual energy demand in 2012 in Mtoe (million tonnes of oil equivalent) [1]

But this comparison covers just 18 years. And the figures mask some significant changes in the outlook for gas: in 1994 the WEO foresaw a growth of the global gas market of 3% per annum by 2010, while the latest WEO (2014) assumes just 1.5% annual growth. In other words, although the current demand for gas matches the forecasts from 1994, the current annual growth of the global gas market is only half of what was predicted in 1994, despite the conscience of climate change.

One reason why we can have some confidence in the demand projections is that we can be reasonably sure about the future growth in world population and in the general economic development taking place across the world, including the drive to escape from energy poverty.

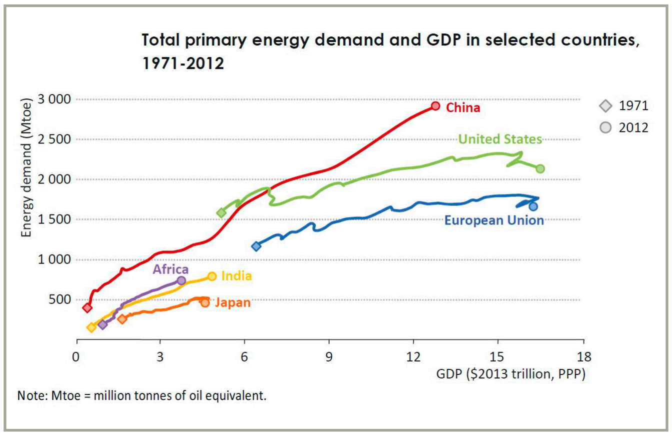


Figure 1: Total Primary Energy Demand and GDP in selected countries. Source: WEO 2014.

According to most scenarios, world population will rise from over 7 billion now to over 9 billion in 2050. This supports the expectation that world energy demand will rise despite increases in efficiency.

Energy demand increases with increasing wealth and GDP. Consequently, in developed countries the average consumption of energy is far higher than in developing countries. When developing countries rise from poverty, energy demand for heating, cooling, electricity, transport and industrial use will inevitably rise. An increase in standard of living in developing countries is therefore accompanied by higher per capita energy consumption. This will stimulate global energy demand. This additional demand will only be partly met with renewable energy supplies.

In this report the focus is on the global gas market, but note that to speak about the global gas market is somewhat difficult as there are large differences between regional markets around the world. As Figure 2 shows, significant variations exist. Moreover, growth in population, economic developments and consequently changes in energy demand patterns will differ greatly across the world over the next decades. Furthermore, gas prices differ around the world. In North America, due to the shale gas revolution, gas prices are currently much more competitive than in Asia; gas prices in Europe are somewhere in between. The IEA foresees in its World Energy Outlook 2014 that these price differences are structural. These price differences affect the competitive position of natural gas versus coal and oil in the various parts of the world in coming decades.

[1] WEO 1994 projected the global energy demand for 2010; the 2012 data have been derived from the 2010 projections, using the annual growth rates in the WEO 1994 report.

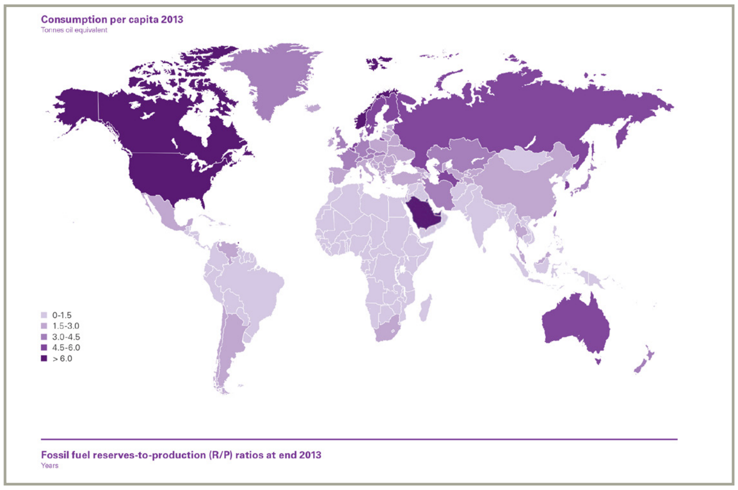


Figure 2: Primary Energy Consumption per capita in 2013; Source: BP statistical Review 2014.

1.2 Analysis of leading energy scenarios to 2050

For this chapter a number of energy scenarios have been consulted from reputable sources. Table 2 lists the scenarios used.

	Name	Institute	Year	Source
-	Current Energy Demand	IEA	n.a.	IEA WEO 2014
A	Shell Blue Prints	Shell	2008	Shell Energy Scenarios to 2050
B	Shell Scramble	Shell	2008	Shell Energy Scenarios to 2050
C	IEA Baseline	IEA	2010	An Economic Projection to 2050
D	IEA Blue Map	IEA	2010	IEA 450 ppm scenario
E	Shell Mountains	Shell	2013	Shell New Lens Scenarios
F	Shell Oceans	Shell	2013	Shell New Lens Scenarios
G	WEC Jazz	WEC	2013	World Energy Council
H	WEC Symphony	WEC	2013	World Energy Counsel
I	WEO New Policies	IEA	2014	IEA WEO 2014
J	A view to 2040	ExxonMobil	2014	The 2014 Outlook for Energy
-	IEA 2DS, 4DS & 6DS	IEA	2014	

Table 2: Investigated 2050 scenarios

All scenarios present outlooks to 2050, with the exception of the World Energy Outlook (WEO) 2014 and the ExxonMobil scenario, which look ahead to 2040. In the latter cases, the 2040-data have been extrapolated to 2050. Four scenarios were published in or before 2010. Six are more recent. None of the scenarios assume major technological breakthroughs.

Additionally, in its Technology Perspectives 2014 the IEA has developed three scenarios which correspond to an estimated global temperature rise of 2, 4 and 6 ^{o}C. These three scenarios are used as a reference in this analysis. Details about the scenarios used can be found in open-access sources.

Two types of scenarios are distinguished: forecasting and 'backcasting' scenarios. Forecasting scenarios are derived from a set of assumptions including expected future energy policies. The outcome is the result of the assumptions. Backcasting scenarios assume a particular outcome, typically the realisation of a certain climate goal, and then the assumptions are designed to fit this outcome.

All scenarios in table 2 are of the forecasting type, except the IEA Blue Map scenario and the IEA's 2, 4 and 6 ^{o}C scenarios. The main parameters that have been used are economic developments, growth of world population, energy prices and energy policies. Typically, scenarios are developed for various regions of the world and the results are summed to achieve global figures.

In this report we focus on primary fuel demand, which is equivalent to the amount of energy that needs to be produced. The unit we use is the ExaJoule (EJ). One ExaJoule equals 10^{18} Joule and is equivalent to about 26 bcm (i.e. 38 MJ/m^3) natural gas or about 0.5 million barrels per day (mbd) of oil during a year. Electricity production (hydro, wind, sun and nuclear) is weighted for its energy content.

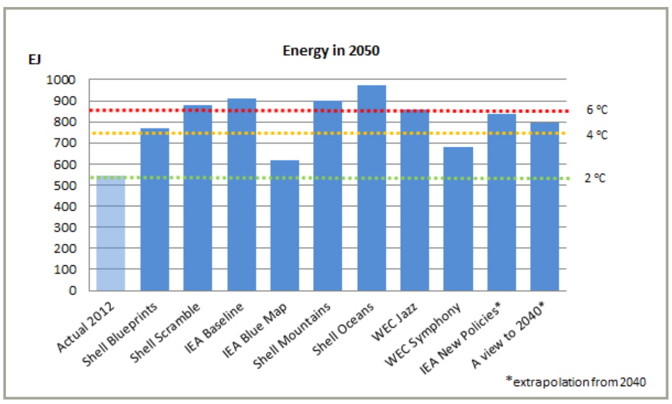


Figure 3: Energy Demand

Figure 3 presents the primary energy demand for each of the scenarios considered. As a reference, the primary energy demand in 2012 of 540 EJ is shown. The three IEA scenarios of 2, 4 and 6 ^{o}C are illustrated as dashed lines. On average, the investigated scenarios show total primary energy demand in 2050 of 820 EJ. This is 50% above current levels and equivalent to an compound annual growth rate (CAGR) of 1.1%. The 820 EJ is slightly above the IEA scenario corresponding to a global 4 ^{o}C temperature rise. There are no substantial differences here between the scenarios published in or before 2010 and the more recent ones.

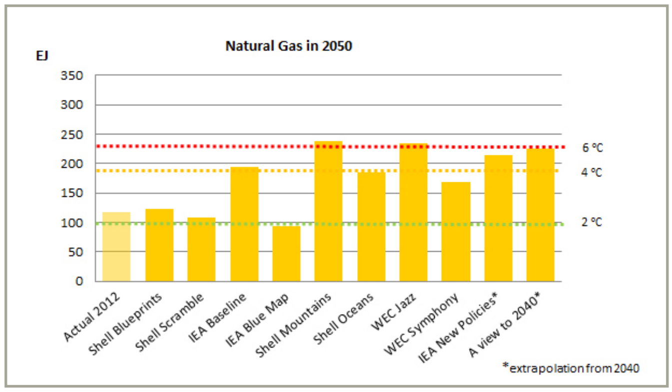


Figure 4: Natural Gas Demand

Figure 4 presents, in a similar way, the expected demand for natural gas. In this case, the more recent scenarios show a much larger demand for natural gas (210 EJ on average) than the older ones (130 EJ). This is likely triggered by the unconventional gas revolution. A natural gas demand of 210 EJ in 2050 corresponds to an annual growth rate of 1.5%. This average from the recent scenarios is comparable to the outcome of the IGU scenarios for 2050 - Baseload (250 EJ) and Pathways (220 EJ) - presented at the IGU World Gas Conference (WGC) in 2012.

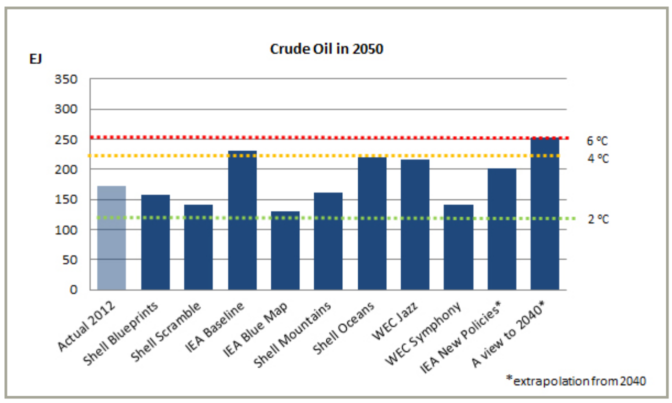


Figure 5: Crude Oil Demand

Demand for oil, figure 5, is expected to grow at a much slower rate than for natural gas, from 170 EJ in 2012 to 200 EJ in the most recent scenarios. OPEC forecasts for 2040 a relatively high global primary energy demand of 880 EJ. OPEC also predicts higher contributions of fossil fuels in 2040: an oil demand of 210 EJ and both a gas and coal demand of 240 EJ in 2040. The difference between the earlier scenarios and the more recent ones is less than in the case of natural gas.

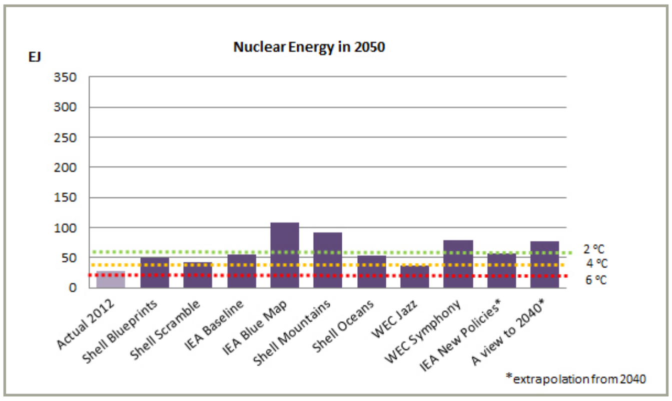


Figure 6: Nuclear Energy Production

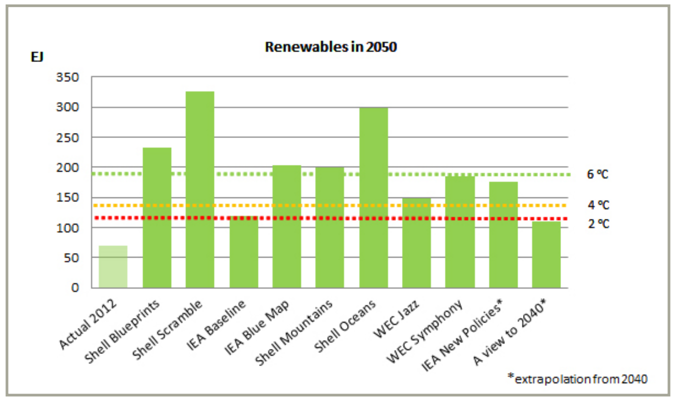


Figure 8: Renewable Energy production

The output from nuclear power stations, figure 6, is expected to grow from about 30 EJ[2] currently to 65 EJ, an annual growth rate of more than 2%. There are significant differences between the scenarios, indicating the uncertainty about the future of nuclear energy. Interestingly, there is no clear difference between scenarios before and after the Fukushima incident (2011).

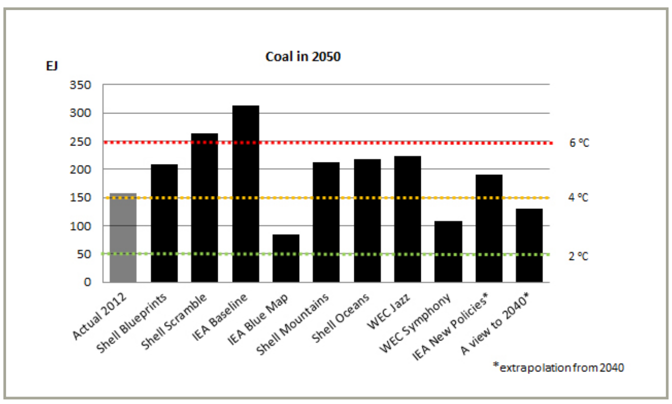


Figure 7: Global Coal Consumption

Despite worldwide concerns over air pollution (NOx, SOx, fine particles) and climate change (CO2), global coal consumption, figure 7, is predicted to grow in most of the scenarios, although the more recent scenarios show a much lower average growth rate (0.3%) than the earlier ones (1.3%). A widespread usage of CCS in 2050 is not assumed in any of the scenarios.

All scenarios assume significant growth of renewable energy. The average annual growth rate forecast for renewables, figure 8, is almost 3%. The scenarios differ hardly in the amount of hydropower output expected (about 20 EJ in 2050) and the contribution of biomass is assumed to double from about 50 EJ to 100 EJ in most scenarios.

The scenarios agree that wind and solar will grow substantially over the next decades, but disagree on the expected growth rates and therefore also on the outcomes for 2050.

Perhaps the most important conclusion to draw from the forecasts is that the demand for fossil fuels is projected to increase. Furthermore, whereas in the older scenarios coal demand was expected to show strong growth, more recent scenarios suggest that natural gas demand will lead the pack. In addition to a stabilising demand for coal and oil, all scenarios also show a modest increase for nuclear and a significant increase of renewable energy.

Scenarios are of course not predictions. Moreover, the scenarios show significant differences in their outcomes. Expected gas demand in 2050 in the more recent scenarios varies between 170 EJ and 230 EJ, rather a wide margin, indicating the uncertainties surrounding the underlying assumptions.

[2] The generation of 1 EJ electricity output from Nuclear power is equivalent to the input of 2 EJ of natural gas (assuming a power station efficiency of 50% even though the efficiency of the most advanced gas power stations is over 60%).

Chapter 2 Key technical and market developments

All scenarios in the previous analysis are based on certain assumptions regarding technological developments, prices, availability of energy, and policies and regulations. In the following part of the report we will highlight key developments that may impact these assumptions and thereby the outcomes of the scenarios.

In the Triennial Work Programme leading up to the World Gas Conference 2015, IGU's Programme Committee B on Strategy has discussed these key developments. In a series of rounds, using the Delphi methodology, a panel of IGU experts identified a range of key technical developments which may significantly impact the natural gas market in the mid- to long-term (2025-2050). The experts were asked to rank the developments based on expected likelihood and degree of impact. The developments ranked highest on both can be summarized in four key areas:

- Global LNG
- Development in unconventional gas
- Gas and renewables
- Gas for transport

We will discuss these below. In the next chapter we will look at key developments in policies and regulations.

2.1 Global LNG

The production of gas as LNG has grown significantly in the last decades and further growth is projected. In the next five years, 35% more LNG liquefaction capacity will come on stream (figure 9). With the growth of liquefaction capacity, LNG trading has also grown.

Historically, the LNG market has been characterised by strong long-term relationships between sellers and buyers to make investment possible and reduce uncertainties.

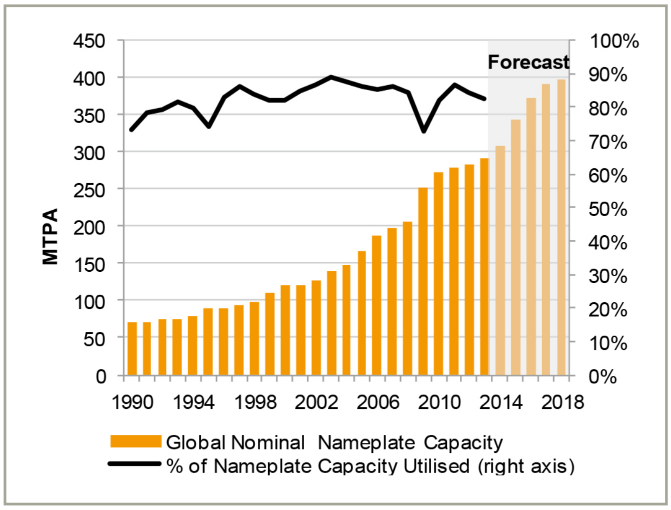


Figure 9: Global Liquefaction Capacity Build-Out. Sources: IHS, IGU, Company Announcements

As the LNG market matures, the market structure is gradually evolving into a more varied mixture of commercial arrangements, with a higher share of short-term trading relations. This development is accompanied by the introduction of spot markets and by technological developments which make gas more easily tradable.

An important development in the LNG sector has been the introduction of floating LNG. Floating liquefaction has the potential to create a new natural gas monetization avenue for gas that would otherwise be stranded. Floating liquefaction may also be used to avoid flaring of gas from remote offshore oil production locations.

The floating liquefaction technology is still accompanied by various operational uncertainties, raising the question as to how quickly it will add meaningful volumes to the LNG market. The success of the large Prelude LNG project due online in 2017 will provide a clearer indication of how quickly and to what extent floating liquefaction could progress.

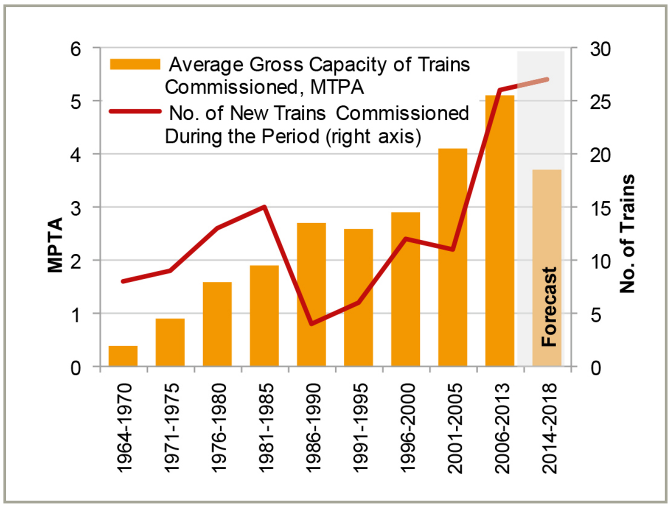


Figure 10: Active Floating Regasification Capacity by Status. Sources: IHS, Company Announcements

Floating LNG is also being developed on the regasification side of the LNG chain. The IGU World LNG Report 2014 shows that 10 out of 29 LNG importing countries now have floating LNG regasification capacity. Figure 10 shows the rapid growth in floating LNG regasification capacity.

The global increase in LNG liquefaction and regasification capacity may lead to more liquidity in the global gas market. This would increase resiliency in supply and demand for individual countries and could reduce interdependencies. It could also limit the impact of potential interferences in the gas chain, thereby increasing trust from public and politicians in the proper functioning of the gas market and enhancing the reputation of natural gas as a reliable energy source. The reduction of risks in the gas chain will also lower financing costs.

However, further significant growth of the global LNG market cannot be taken for granted. High production costs have driven up LNG prices and threaten to make LNG uncompetitive with alternatives like coal in markets that are strongly dependent on LNG, such as Asia. This could hinder new gas reserves from being developed and consequently jeopardize the anticipated further growth of global gas trading after 2020. For the global gas sector it is important therefore that cost inflation in the LNG chain is controlled.

Visions from IGU wise persons on the long term Gas Market

Nobuo Tanaka:

High prices could threaten demand growth

The International Energy Agency (IEA) predicted in the World Energy Outlook special report in 2012 that a Golden Age of Gas would become a reality only if a significant proportion of the world's vast resources of unconventional gas can be developed profitably and in an environmentally acceptable manner. A set of "Golden Rules" was proposed to address the environmental and social impacts of unconventional gas production. As these conditions have generally been met, North America is achieving energy independence and environmental sustainability at the same time. Cheap gas helped to return the US to economic growth while reducing CO2 emissions by stimulating fuel switching from coal to gas.

The shale gas development may even change global energy geopolitics as shale gas will be exported in the form of LNG. The shale gas revolution is no longer confined to North America. China has started production because China needs to switch from coal to gas much more than the US to reduce air pollution. Argentina is following. And yet, some European countries continue to ban hydro-fracturing due to possible environmental impacts. Further technology development and regulatory adjustment may be needed in these countries.

In terms of sustainability, further efforts are needed to make natural gas totally CO2-emission free. Eventually Carbon Capture and Storage (CCS) technology should be applied to gas power plants through an appropriate carbon tax or other form of carbon pricing.

Another challenge is the pricing of gas. After the Fukushima nuclear plant accident Japan significantly increased the import of gas and oil and drove spot prices high. Japan spent more than $40 billion annually to fill the gap of zero nuclear power. While this outflow of national wealth may undermine the success of the so-called Abenomics, impacts are not limited to Japan. Higher gas prices may hurt many developing countries much more severely than Japan. Reasonably priced gas is very important for the sustainable development of emerging economies.

Japan can contribute by restarting nuclear power plants sooner rather than later to reduce pressure in the market. North American export of LNG will provide an opportunity for establishing reasonable pricing based on the market rather than on oil price indexation. The large price gap between Henry Hub and Asian imports is a consequence of the structural changes wrought by the shale revolution. The higher the wet contents of gas from the well, the lower the break-even price for gas in the US market.

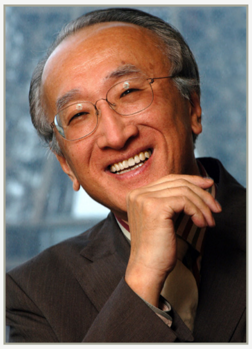
Therefore, the higher the oil price (wet contents being sold as light oil), the lower the gas price. Oil indexation is outdated and should be modified under such a market reality. The competitiveness of Asian economies will be seriously undermined if the Asian premium persists.

Asian consumers may start collective bargaining for future supplies and seek more gas trades in Asian gas hub markets. To create hub markets such practices as destination restriction clauses in supply contracts should be outlawed as has been done in Europe.

US shale exports will certainly lower import prices but further diversification is important. Russia may play a significant role. The recent Gazprom-CNPC gas deal may be the gamechanger. Pipeline extension to the Pacific coast from Siberia will provide an opportunity to further extending it to Japan. Japan should change its 100% dependency on LNG by a pipeline connection with Russia.

It is quite natural that producers prefer higher prices but they will suffer if excessive price kills demand growth in emerging countries. Producers and consumers agree that supply-side security and demand-side security are two sides of the same coin. The shale revolution on the supply side requires structural changes on the demand side, especially in the Asian gas market. The Golden age of Gas will certainly come when these conditions are met.

Nobuo Tanaka is Global Associate for Energy Security and Sustainability at the Institute of Energy Economics in Japan. From 2007-2011 he was Executive Director of the International Energy Agency.



2.2. Developments in unconventional gas

The impact of unconventional gas on the gas market in recent years has been large. In the US shale gas production soared from 1% of natural gas production in 2000 to 39% in 2012. The question is if this American 'shale revolution' (figure 11) can be duplicated elsewhere and have a significant impact on long term global gas markets. Unconventional gas development surely has a lot of potential but also some challenges to overcome.

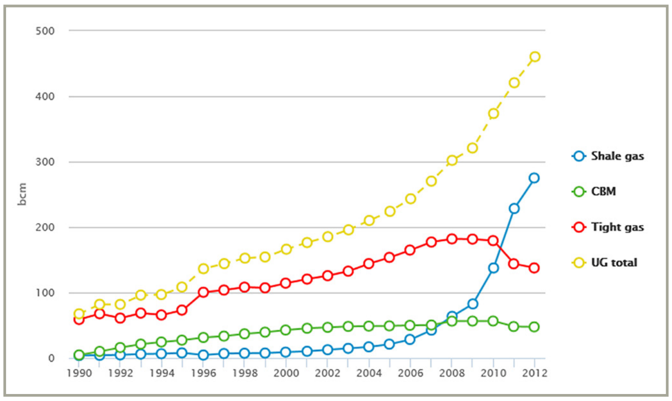


Figure 11: US Shale Gas Production in bcm; IEA Unconventional Gas Database

Unconventional gas includes shale gas, but also for example coalbed methane (CBM), tight gas and gas hydrates. Unconventional gas refers to natural gas originating from reservoirs other than traditional sandstone or carbonate reservoirs, with less permeability and/or low porosity. It is less easy to extract, which, all other things being equal, makes it more expensive than conventional forms of gas production.

Because the unconventional gas industry is still at an early stage of development, its success depends strongly on experimentation. There is no blueprint for a successful approach that works for every basin. Unconventional gas therefore requires a different approach than conventional projects. Regulation must accommodate for the flexibility needed by an industry still under development. At this stage stakeholder management is of key importance to secure a license to operate.

Shale gas

Although the successful development of shale gas in the US and the pace and impact it had, took many by surprise, it did not come out of the blue. It took many years of investment in R&D, testing and collaboration by many different parties involved, including US-government funded basic research and private entrepreneurship. In the end the key to success was combining the two existing techniques of hydraulic fracturing (which had been around since the 1940s) and horizontal drilling (since 1980s). Their combination and improvement led to a large decrease in production cost. Other prerequisites for success were the available infrastructure and access to market.

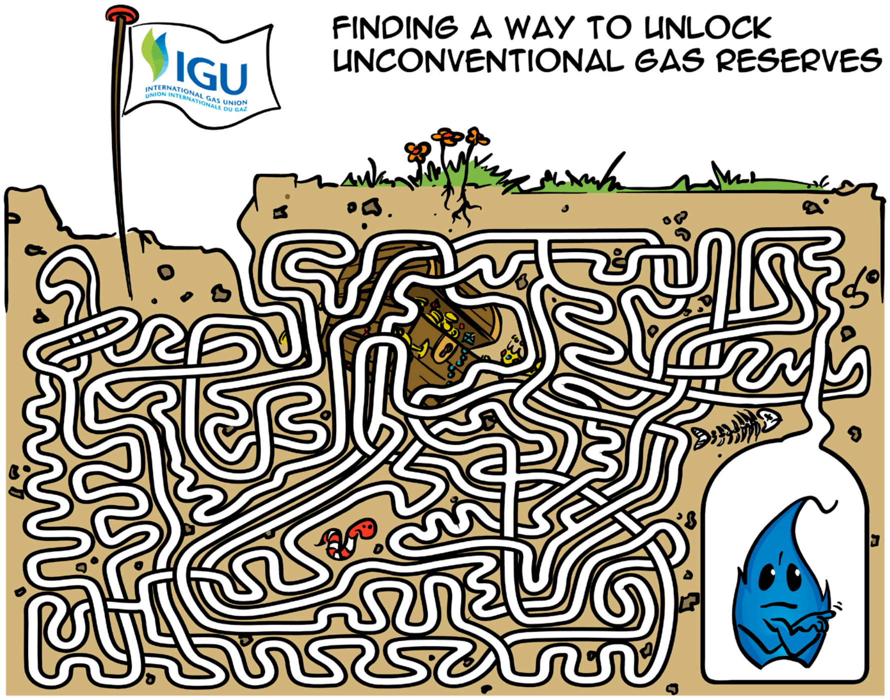
Up to now the US shale story has not been successfully duplicated elsewhere in the world for various reasons. In Europe there is a lot of public resistance and several countries, including France and Germany, do not even allow exploration activities. In other countries, such as Denmark, the UK and Poland, the sentiment is more positive and wells have been drilled, but there has not been any commercial production of shale gas yet.

One lesson to be taken away from the US experience is that successful shale gas development requires the involvement of private entrepreneurs aiming for innovation. Every shale play is different and it needs perseverance and a supportive environment to find the key to success. Stakeholder management is essential as well as a proven track record that demonstrates that unconventional gas production does not harm the environment. If this is lacking, it will be difficult for politicians to support these developments over a long period.

Coalbed methane (CBM)

Successful development of CBM has so far been mainly limited to the US and Australia. In Australia the first CBM to LNG projects are being commissioned with over 25 mtpa (1,4 EJ) of CMB-based LNG capacity available by the end of 2015. This would double Australia's current LNG export capacity and make Australia the world's largest LNG exporter.

As with shale gas, the development of CBM requires perseverance. Australia started in the 1970s with exploration leading to the first commercial gas production in 1996.



Clearly successful CBM development requires a long lead-time, and some prerequisites needed to be fulfilled, among them a high market price for gas in Asia.

Australia has approved plans for an additional production capacity of 30 mtpa, but high labour costs in the gas sector in combination with pressure on Asian market prices due to the US increase in shale production, make these unfeasible for the time being.

In Indonesia and China efforts to develop CBM on a large scale have so far not been successful, but the aim to significantly increase CBM production in Asia remains strong, both to secure domestic energy production as well as to fight air pollution.

Gas hydrates

In the longer term, gas hydrates may also have a lot of potential. Research to recover natural gas from hydrates dates back to 1990, but a long horizon of R&D and testing is still needed before successful production methods can be found at reasonable costs. Nevertheless, gas hydrates may become another source of gas production which will contribute significantly to gas supply and a wider availability of gas around the world.

Visions from IGU wise persons on the long term Gas Market

Daniel Yergin:

A big shift towards natural gas

In any vision of the energy future, natural gas plays a larger role than would have been the case just a few years ago. After all, little more than half a decade ago, it seemed that the United States was gearing up to spend $100 billion a year importing liquefied natural gas (LNG) because of the increasingly high-cost and apparent scarcity of domestic gas.

Now the U.S., powered by the “shale gale”, will soon become an exporter of LNG, while European industry is migrating to the United States to take advantage of inexpensive natural gas. By early in the next decade, the United States could be one of the Big Three LNG exporters, along with Qatar and Australia. And new prospects for conventional and unconventional gas are being identified around the world.

And, so, what might the energy world look like twenty years from now? The most likely answer, from today’s perspective, is “bigger – but not too different”. The reasons are two. First, in the energy business, given the scale of existing infrastructure and the length of the investment lead times, twenty years is not very long. Second, virtually all growth in demand over the next twenty years will be in the emerging market countries, and they will largely tilt toward conventional energy.

In the IHS “Global Redesign” scenario, twenty years from now, even with greater efficiency, the world will be using between 35 and 40 percent more energy. That is the result of global economic growth and rising incomes in the developing world. Today, oil, natural gas and coal provide over 80 percent of world energy. Twenty years from now, they will probably be only slightly lower in terms of share – 70 to 80 percent. Renewables will bound ahead in absolute terms, growing 240 percent, but so will conventional energy, thus retaining its preponderant position.

There will, however, be a big shift in the mix among those conventional fuels – toward natural gas. In the 2030s, oil, natural gas, and coal will be running a neck-and-neck race for market share. By the end of that decade, in our scenarios, natural gas will likely pull ahead to become the world’s number one fuel.

Technology could change this picture. Wind is moving from the “alternative” category to the “conventional”. Solar costs have come down dramatically in the last few years.

Further declines in the costs of wind and solar would move them more rapidly into the marketplace. Breakthroughs in electricity storage would give a further boost to wind and solar by overcoming their present dependence on blowing wind and shining sun.

But policies, and their interaction with events, matter a lot. What kind of incentives and subsidies will be implemented to push renewables? Until recently, Germany saw itself as the world's model for the rapid introduction of renewables. But now it is becoming something of an anti-model, as the costs of the subsidies threatens a loss of global competitiveness, threatening, in the words of Germany's economics minister, "a dramatic de-industrialization". But a new push to accelerate renewables could be ignited by a combination of factors – several years of "extreme weather", which powers a much stronger consensus about the imminent risks of climate change; and a severe security crisis that disrupts the flow of oil worldwide or the flow of natural gas. Yet events could work in the other way, too. During the global recession, European governments peeled back generous subsidies for renewables. Another economic downturn would have a similar effect, meaning a big setback for the renewables industry.

What happens after the 2030s? Recent years have seen a "great bubbling" in scientific research and technological innovation around energy. The general lesson is that energy innovation takes a long time to reach the marketplace. In this wave of innovation, there will be many disappointments. But some share of these efforts will make their impact felt towards the end of the 2030s. But for the next couple of decades at least natural gas will be increasing its market share, driven both by more widely available supply and the demands of a growing world. And that could well take natural gas into the preeminent position in energy supply.

*Daniel Yergin is vice chairman of IHS.
His most recent book is The Quest: Energy, Security, and the Remaking of the Modern World. He received the Pulitzer Prize for his book The Prize.*

2.3 Gas and renewables

The growth of intermittent renewable energy can have both positive and negative impacts on gas demand. Currently, the majority of renewable energy in the world is either biomass or hydro. However, in particular wind and solar are growing rapidly, as can be seen in figure 12. Both wind and solar are intermittent sources: they are predictable, but not controllable. Consequently, in order to provide reliable energy, back-up systems or storage need to be in place.

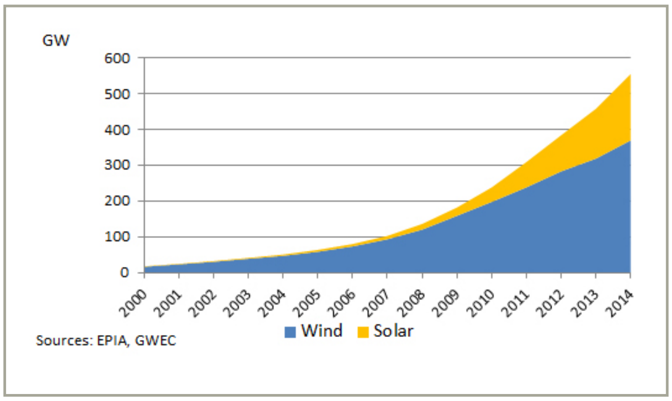


Figure 12: Development of Wind and Solar Energy.

Solar power

The growth of solar energy has been higher than most analysts predicted until recently. The continued expansion of solar power is boosted by subsidies (e.g. in Germany) and steadily decreasing costs. In its World Energy Outlook 2014, New Policies, the IEA assumes for 2040 an installed base of solar of 930 GW, representing 3% of total electricity production. The CAGR for solar PV between 2015 and 2040 would be about 7%.

Since the last WGC in Kuala Lumpur in 2012, the amount of solar globally installed has increased from 70 GW in 2011 to about 185 GW at the end of 2014, an increase of 170% in just three years (CAGR = 35%). Actually, the growth of solar has closely followed a graph presented by Jaap Hoogakker at the WGC of 2012 (figure 13), where he assumed solar to grow at a similar rate as the computer industry. Following this growth path until 2030 and assuming 10% growth per year afterwards would result in global solar production in 2050 equal to 25% of electricity demand.

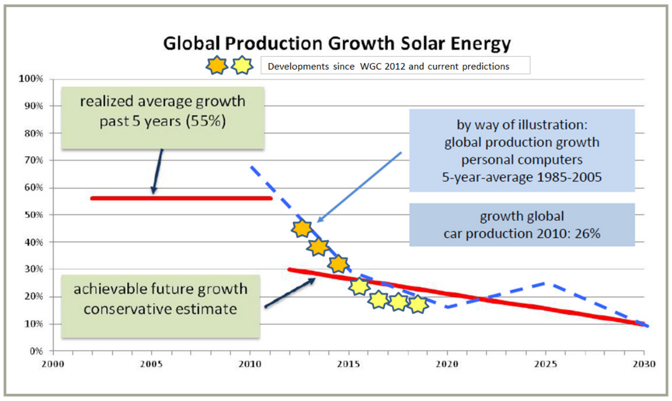


Figure 13: Global Production Growth Solar. Source: Jaap Hoogakker, WGC 2012.

For more than 30 years, costs of solar PV have decreased by 20% for every doubling of installed capacity. Experts expect this relation to be continued in the years to come. Currently, solar PV is, without subsidies, economical in certain niche markets and further price reductions would make solar attractive in more markets. In the not too distant future solar cost may become lower than the marginal cost of gas-fired power stations.

Wind power

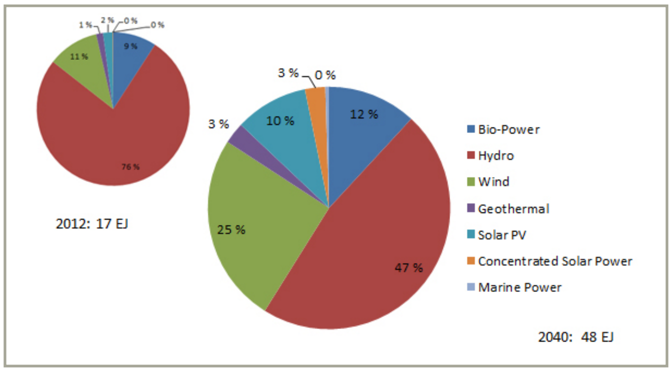


Figure 14: 2012-2040 Development of renewable Electricity Production. Source: IEA WEO 2014, New Policies Scenario.

Most of the basic energy scenarios foresee that wind power will be five to ten times as big in 2050 as now. In its World Energy Outlook 2014, the IEA projects that wind power could increase to 1320 GW in 2040. When this growth figure is extrapolated to 2050, wind production would reach 20 EJ or 15% of global electricity consumption. According to the IEA, wind energy will still have to be subsidised by 2040.

Organizations like the European Wind Energy Association (EWEA) and Greenpeace project a larger growth in wind power and estimate that it could reach between 30 and 50

EJ in 2050. Still, in the long term global growth of wind energy will probably be more limited than of solar energy. This is because of lack of space (and lack of wind) in many places. Offshore there is more space, but offshore wind power is expensive.

Back-up power

Increasing amounts of intermittent power initially have a negative effect on gas-fired power, since in a portfolio with gas, coal and nuclear, gas power plants tend to be the first to be switched off when renewables come online. On the other hand, the increasing need for backup power could also give natural gas a decisive advantage against nuclear and coal-fired power stations, due to the lower investment costs for gas-fired power stations compared to their alternatives.

Providing back-up power is not necessarily an insignificant activity. After all, even in the sunniest parts of the world the sun does not shine more than 50% of the time and wind is not always available either. However, a breakthrough in electricity storage technology could jeopardise this outlook for gas. Currently storage costs for electricity are very high, typically €100 per kWh of stored amount of energy or more, and batteries have a limited life, but all over the world research is being conducted to improve batteries. Whether these efforts will be successful is not clear yet.

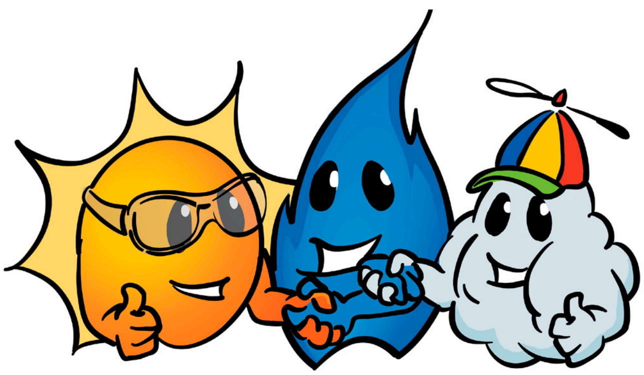
Combinations

Gas can work well together with renewables in other ways too. A back-up function is not only needed on the macro-level (for electricity generation) but also on the micro-level (for heating buildings). In large parts of the world most of the energy used is for heating, not for electricity. Combinations of solar panels, gas heat pumps and condensing boilers can form very efficient ways to heat and power buildings. Back-up provided by battery storage can be much more expensive. Demand response solutions in combination with 'smart grids' can help to adjust energy use, but require substantial investment as well as significant behavioural change, and will have limited value to solve the intermittency challenge of solar and wind energies.

One Shell executive (Dick Benschop, in a publication by the Dutch Gas Association: "A new life for gas") has offered the intriguing idea that gas will ultimately become the 'system fuel' of the future, one that makes the entire low-carbon energy system function efficiently and cost-effectively. This is because gas is highly flexible: it can be deployed at any level within the energy system (small and large) and it can be transformed into any other fuel at any level and on any scale – from large gas-fired power stations to condensed boilers and fuel cells.

This is without saying that in Europe, gas is currently often seen as just one of the fossil fuels. In countries like Germany, gas has recently lost market share, while the market share of coal has grown. Today, the flexibility of modern coal fired power stations as a secure, abundant and affordable ally for intermittent renewable energy sources is loudly advocated in Europe. The gas industry has to work hard to compete and demonstrate its superior qualities in order to become the position it deserves.

WORKING TOGETHER TO CREATE A BETTER WORLD



2.4 Gas for transport

The use of natural gas as a transportation fuel has gone through a major transformation in recent years. It has slowly emerged to become an important alternative to the use of oil-based liquid fuels.

This represents an enormous opportunity for gas as the transport sector is one of the main consumers of energy. Moreover, despite the development of more efficient vehicles, the demand of energy by the transport sector is expected to increase significantly in the coming decades.

Natural gas is currently making inroads in the transportation sector because it offers several advantages:, lower emissions of pollutants, near zero emissions of fine particulates, sometimes lower costs and 20-25% lower greenhouse gas emissions.

Significantly, gas as transport fuel is no longer confined to the use of light duty vehicles running on CNG (compressed natural gas), which have long had a place in the market, e.g. in Argentina, Iran, India and Italy. Today, thanks to the development of small-scale LNG, natural gas can also be used in ships, trucks, buses, rail and off-road applications.

Small-scale LNG refers to the direct use of LNG for 'small' end uses like heavy road transport, bunkering and small industrial processes. The use of LNG in transport has been boosted by a number of technological innovations. For example, through the use of cryogenic pumps in LNG storage tanks, natural gas can be injected at high pressure into the engine, resulting in 'diesel like' operation. This breakthrough, called High Pressure Direct Injection, allows large engines to run on natural gas at high power.

DRIVING INTO A GREENER FUTURE ON GAS

CLEANER HEAVY DUTY TRANSPORT ON LNG

Growth in small-scale LNG will depend on a number of economic and regulatory factors. Economic factors include the fuel price differential with oil, availability of LNG and a sufficiently developed LNG distribution chain. Regulatory factors include environmental and safety regulations, e.g. new emission regulations in marine transport in parts of Europe and the US and in air quality in China. LNG use sharply reduces emissions of sulphur and nitrogen oxides and particulate matter.

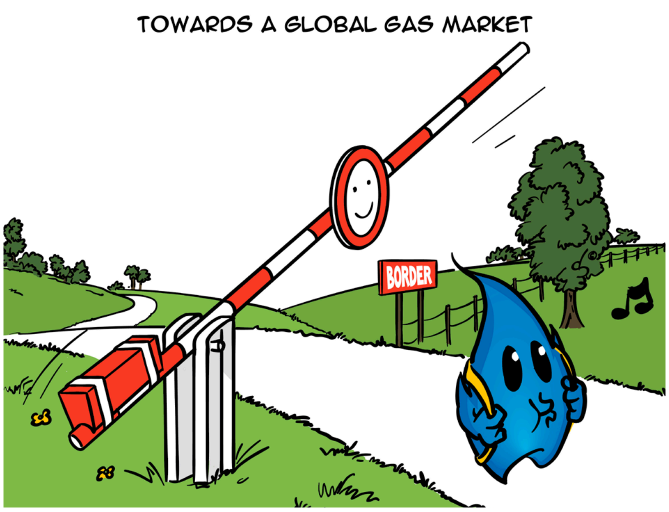
The growth potential of gas in transport is significant. Between 2000 and 2015, the natural gas vehicle fleet in the world grew from less than 2 million to 15-20 million vehicles. Analysts of NGV Global predict a global Compound Annual Growth Rate (CAGR) of 7% for natural gas vehicles (NGV's). That would increase the use of natural gas in the global transport sector to 400-500 bcm (15-20 EJ) in 2050. The IEA assumes in its recent WEO 2014 growth to 190 bcm (7 EJ) in 2040, corresponding to a CAGR of about 5%.

The main challenges for natural gas to grow in the transport sector are threefold. First, there is the chicken and egg problem: developing the industry requires investment in infrastructure, but the lack of infrastructure makes the demand for natural gas uncertain and brings an element of risk for the project investors. Secondly, the economics of gas to transport are challenging since the sector has to compete with mature oil infrastructure. Thirdly, uncertainties in economic and regulatory factors bring additional challenges for market players.

Chapter 3 Key policy developments

3.1 Energy security

Concerns over security of supply and demand have always been present in the gas market, but they seem to have grown in recent years. This is perhaps a bit ironical, as diversification of both supply and demand has actually increased globally. These concerns have been however supported by the perception by many players of market instability. Gas suppliers have expressed in many occasion their worry about certain implemented measures and policies adopted in some markets, having a potential effect on gas market stability, and putting at risk investments in new capital intensive gas projects.



There is no doubt that global gas resources are large enough to cover any conceivable demand for a long time to come. This indeed is one of the most important strengths of gas: there is no discussion over 'peak gas' as there is over 'peak oil'. According to the BP Statistical Review of Energy, proven reserves of gas are enough to cover over 50 years of current demand. Total remaining technically recoverable resources are much higher – according to the IEA, equivalent to 235 years of current production.

The (expected) growth in unconventional gas production across the world will not only lead to more gas being available, but resources will also be spread more evenly across the globe. This will have a positive impact on security of supply. The evolution of a globalized commodity market, due to the increase of LNG trade, may be expected to reduce geopolitical tensions, by allowing diversification of supply and demand. Nevertheless, this LNG trade expansion and more generally gas chain development need to be supported by fair prices, and by relevant and reliable risk sharing mechanisms between resource holders, gas projects' developers and financers and gas consumers, in order to provide frameworks and conditions for a sustainable gas development.

Dialogue, understanding and cooperation between various stakeholders in the gas industry should be an important lever to use in order to enhance security of supply and demand. There have been – and continue to be – many successful long-term international collaborations in the gas chain, e.g. Nord Stream, the gas agreements between Russia and China and various LNG projects. These collaborative ventures also increase trust and lead to win-win results for stakeholders. Thus, there are many reasons why we may expect the risks of geopolitical tensions in the international gas market to be reduced.

Nevertheless, policymakers and the larger public tend to have a more negative perception of these risks, which is a serious concern. Even as the industry has a good track record, the gas industry has to assure the public and policy makers that gas is not only an abundant fuel, but also a secure fuel.

Visions from IGU wise persons on the long term Gas Market

Coby van der Linde:

Government policies are key

The position of natural gas in the energy mix is not subject to a single (economic) driver, not now and not in the coming years, but will to a large extent depend on government policies (security of supply, security of demand and environment). These government policies differ widely among the main natural gas markets. The availability of domestic supplies, even if a country is a net-importer, helps to raise the level of comfort with imported natural gas supplies.

Increasingly, the license to export depends on facilitating a healthy domestic market to develop as well (East Africa), in addition to developing LNG export capacities. The level of internationalization of the market (liquidity) also matters providing importing countries/companies with the ability to secure supplies in the short and longer term. A last impact to consider is the price of natural gas in the various consumer markets.

With more LNG coming on the market, the short to medium term outlook is positive, but the wide variety in production costs and the prices prevailing in some markets (oil index or perhaps another security-of-supply surcharge) will continue to influence flows and perhaps limit the level of integration at the international level.

One factor that could have a significant impact on natural gas supply and demand of in the coming years is the decision of China to reduce coal generated electricity in urban areas (air pollution) and replace it with gas-fired generation capacities. The Russian-Chinese natural gas contract is an important development, in terms of the price formula and the diversification of supplies that China is trying to organise. The role of natural gas in China could grow when domestic supplies can be increased. Here the shale potential will play an important role, although the availability of water could be important to determine the extent and speed of exploitation. If significant volumes of natural gas can be produced domestically, transportation/mobility demand could also come within reach. China has a natural gas plan, earmarking natural gas for certain sectors. With more gas available, this list could be extended to include more types of gas consumption than in the current planning period (i.e. electricity generation). From a climate change perspective, China could be pressured to move up the energy ladder faster or begin to employ CCS to remedy its contribution to CO2 emissions.

In the Middle East demand for natural gas is growing, but markets are not integrating, suggesting that LNG imports will continue to grow rather than pipeline gas. Much will depend on the (regional) geopolitics in the Middle East and in particular the impact on Iraqi oil and natural gas production and the potential return of Iran to international markets.

In Europe, domestic supply of natural gas is still declining and the contribution of shale supplies uncertain. With the introduction of substantial capacities of renewables in the EU market, demand for natural gas may change. Already gas is hardly functioning as a base load supplier anymore. Coal-generation has proven to be able to fluctuate with renewables too, evidenced by the German market. The implication could be that gas will be traded in smaller 'parcels' and demand will be more unpredictable; to supplement (perhaps at local-ized/distributional level) solar, wind and more flexible coal. This could impact gas trade, storage and gas transportation capacities. Another complication here could be geopolitical barriers to gas trade, increasing the cost of natural gas in Europe, and re-defining the role of gas. However, if carbon policy becomes more robust, the role of natural gas, also in power generation, could be much larger. To secure gas demand, a greater role for gas in mobility, shipping and heavy trucks shifting to LNG could help the gas market stabilize.

In the North American market ample gas supplies will lead the way to the future energy mix, although also here, natural gas must accommodate the increasing share of renewables. New markets for natural gas will be developed when government policy emphasis on more energy per carbon emitted becomes more emphasized.

Coby van der Linde has been director of the Clingendael International Energy Programme (CIEP) since 2001.

3.2. Environmental policies

Environmental policies are mostly aimed at reducing air pollution and other harmful emissions. Such policies will usually have a positive effect on gas demand, as gas combustion leads to relatively low emissions.

Gas versus oil

The potential of natural gas in the transport sector, replacing oil has been discussed in paragraph 2.4. Regulations of emissions from trucks and shipping may substantially benefit natural gas. This is because the use of natural gas eliminates fine particles and sulphur oxides, and reduces emissions of nitrous oxides considerably.

For example, from 1 January 2015, the maximum sulphur content of fuel oil used in coastal areas – so-called emission control areas – in Europe, the US and Canada is reduced from 1.0% to 0.1% Consequently, ships have to switch to more expensive types of oil or install equipment like scrubbers to clean the exhaust gases. Additional emission limits may be introduced in 2020 for the use of fuel oil outside the emission control areas. The plan is to reduce the maximum sulphur content here from 3.5% to 0.5%

These emission standards benefit the use of natural gas over fuel oil. They may lead shippers to switch to gas. The introduction of environmental measures may even be speeded up if natural gas is seen to be widely available as clean alternative to fuel oil.

Gas versus coal

Emissions of pollutants such as NOx, SOx, particulates and mercury are significantly reduced when power plants switch from coal to gas. The mining of coal is also associated with relatively heavy pollution as well as high safety risks.

Nevertheless, despite the disadvantages of coal, power production from coal has doubled globally since 1990. In 2012 coal contributed to 41% of global power production and gas to 22%. A further increase in coal utilisation for power production is expected by many analysts if no additional measures are taken to link the use of coal and its incidence on climate change. The main reason for producers to prefer coal to gas in electricity generation is the cost advantage it usually offers. Coal is also preferred sometimes for security of supply reasons, if it is domestically produced or imported from countries that are deemed to be stable.

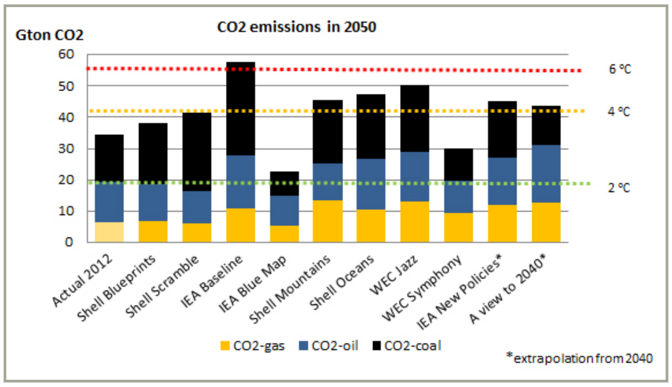
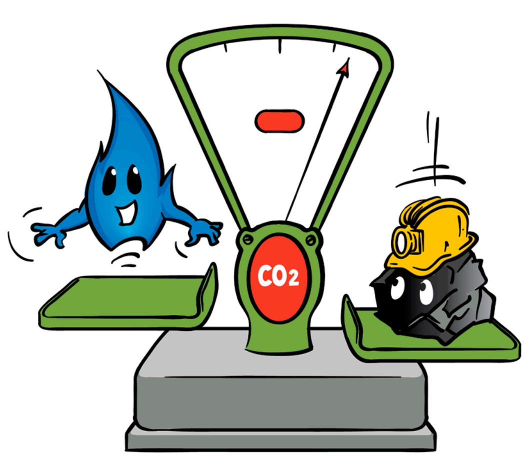


Figure 15: CO2 emissions in 2050 per scenario

In several parts of the world, including China, the US and the EU, governments are taking measures to reduce coal-fired power generation. These can take the form of emission performance standards (as in the US) or the closing of old, heavily polluting coal plants (as in China and The Netherlands). Additionally, coal use may be discouraged through carbon pricing or the obligation to install CCS (UK).

Experts agree that replacement of coal by gas in power generation is one of the most efficient and effective ways to substantially reduce greenhouse gas (CO2) emissions. Coal-fired power generates, per kWh produced, twice as much CO2 as gas-fired power. The availability of natural gas at a reasonable price may encourage governments to decide on measures that stimulate this replacement (figure 15).

TIPPING THE BALANCE TOWARDS GAS



3.3 Climate policies

Climate policies are steering the global energy system in the direction of decarbonisation. There are reasons why gas may gain from strengthening climate policies. Firstly, gas can play a positive role by replacing alternatives that are more carbon-intensive. Secondly, the flexibility of natural gas and the relatively low costs of gas infrastructure may give gas a preferred position as back-up fuel next to a growing amount of intermittent renewable energies. Thirdly, natural gas could also be a zero-carbon energy source if it is combined with carbon capture and storage (CCS). However, since natural gas is a fossil fuel, climate policies forcing reduction of CO2 emissions may also have a negative impact on the future demand for gas.

With respect to international (global) climate policy efforts, the official (though not legally binding) goal under the Copenhagen Accord (2009) is to limit global warming to an average of 2 ^{o}C. This same goal will be at the centre of the upcoming UN climate negotiations in Paris in December 2015 where world leaders are expected to sign an agreement which will take effect from 2020 on. Countries are expected to submit national action plans ("nationally determined contributions") by the first quarter of 2015. These will form the basis of the negotiations for an international agreement. The outcome of the process is still very uncertain at this stage.

There are many different forms climate policy may take: carbon pricing, the introduction of emission performance standards, actions to negate emissions (e.g. planting new forests) or prohibition of harmful activities.

At this moment carbon pricing (either through emission trading schemes or through carbon taxes) is one of the preferred measures in many countries. The World Bank has collected a lot of data on carbon pricing and is also coordinating private and public sector support for carbon pricing schemes. In September 2014, the World Bank announced that 73 countries and over 1,000 businesses support carbon pricing in one form or another. According to the World Bank, almost 40 countries and more than 20 cities, states and provinces already use carbon pricing mechanisms or are planning to implement them. These jurisdictions are responsible for some 22 % of global emissions. Others are developing or considering systems that will put a price on carbon in the future. These actions "will encompass almost half of global CO2 emissions."

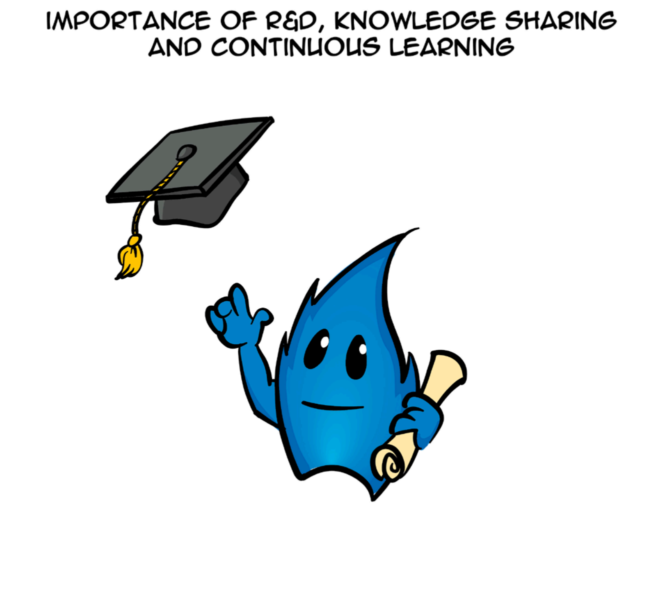
Carbon pricing can have different effects on gas demand. First of all, it induces switching from coal or oil to gas. This occurs both at the power station level (marginal costs) and when investment decisions have to be taken (full costs). At what price level gas demand will be negatively affected depends, among other things, on the price differential between gas and coal. Secondly, since natural gas emits CO2 as well, demand for gas may be affected. The introduction of CCS might reduce the effect, but at a cost.

Methane emissions

The risk of methane emissions deserves special mention. Methane is a severe greenhouse gas which may escape during fossil fuel production, transport, distribution and usage. If escape rates of methane are not sufficiently controlled, methane emissions will contribute to a significant fraction of total global warming.

Consequently, fossil fuels do not only compete with regard to their relative CO2 emissions, but also with their methane emissions. Scientists and engineers have established that there are ample technologies available to find and limit methane leaks in the gas chain. In 2009, the IGU Working Group 3 has issued a report listing best practices. From this report it may be deduced that greenhouse gas emissions from flaring and methane leakages may be as much as 25% of the emissions due to gas combustion.

Thus, methane emissions may increase the footprint of natural gas considerably. Therefore constant attention for reduction of emissions by means of R&D, innovation, sharing of knowledge and implementation of best practices makes gas a more attractive fuel to use.



Vision from the Gas Exporting Countries Forum

Seyed Mohammad Hossein Adeli:

Clean Energy for Green Economy

During the last two decades, Natural Gas gained market share in the energy mix as it was the fastest growing fossil fuel, due to its numerous advantages, of which: environmental cleanliness, abundance and affordability. Therefore, Natural gas grew by an average of 3% per year, and its share in global energy mix jumped from 19% to more than 21% in twenty years' time.

Most of the energy experts and analysts agree that this is not the end of the Natural Gas boom, and that the future might be even brighter for Natural Gas as its potential is not yet exhausted.

At the Gas Exporting Countries Forum, our studies indicate that Natural Gas has the potential to continue to grow substantially and to reach a share of at least 25% in the global energy mix by 2035. This growth is necessary not only to fuel and support the global industries and economic activities, but also to secure the shift to a lower carbon content global economy and to ensure the security of the energy supply.

Natural Gas Demand is growing and will be competing with other fuels in some sectors such as the power sector. Thus, Natural Gas demand not only depends on economic growth but also on energy policies that can be the key to the future of Natural Gas. As the world is increasingly becoming more conscious of the importance of climate change challenges and ready to reduce its greenhouse gas (GHG) emissions, the role of energy policies and their environmental impact becomes more important as well. Therefore, energy policies, that do not lead to displacing high carbon emission fuels through a move towards a fair carbon price as well as reduction of GHG emissions, are inconsistent and not focused on environment preservation. It is ironic to envisage energy policies that will support renewables and high carbon emission fuels simultaneously when there is abundance of Natural Gas as the perfect and cleanest fossil fuel to back up the development of any renewables.

The development of Natural Gas cannot be guaranteed without a proper and secure investment climate, especially in the upstream sector. Natural Gas industry is capital intensive and requires stable revenues to ensure its survival and replacement, consequently the security of supply cannot be envisaged in a volatile environment where the investors may see their assets at threat anytime. Long-term agreements and reasonable natural gas prices are key in maintaining this security of gas supply that is essential not only for gas suppliers but also for gas consumers.

In the course of Natural Gas development, two major trends will be paramount to the gas industry, which are the development of unconventional resources and the increase of LNG projects and trade. Whereas, the success of unconventional gas outside the United States is unlikely in the coming ten years, its worldwide development in the long term is expected.

The LNG trade growth not only will allow the multiplicity of gas suppliers, but will also increase the flexibility of gas supply in general, as in the case for instance of emergencies like the Fukushima disaster where the LNG was the main fuel to replace the lost nuclear capacity, and had more than proven its reliability and contribution to the global energy security.

Seyed Mohammad Hossein Adeli has been Secretary General of the Gas Exporting Countries Forum since January 2014.

Chapter 4 Reflections and recommendations

4.1 Reflections

As an industry we can say with confidence that gas is truly a wonderful energy source. It is a reliable, versatile, efficient, cost-effective and abundant source of energy that can greatly enhance people's lives and well-being.

We also know that the world needs energy. Population growth and economic developments cannot be fully offset by improvements in energy efficiency. Most analysts forecast a 50% growth in global energy demand in 2050 compared to today. Consequently, for natural gas, with all of its advantages, there is ample opportunity for growth.

Yet the fact that there is an opportunity does not automatically guarantee success. There have been many great products and inventions that did not conquer the world for one reason or another. After all, there are alternatives for gas, even without considering conventional usage of coal and oil:

- in electricity production there are renewables, coal-with-CCS and nuclear power;
- in transport there are biofuels and electric vehicles;
- in the built environment, heating can be produced with electricity or underground thermal energy storage.

Choices in the global energy market are made by private and public actors based on a combination of three main considerations: security of supply (and demand), economic costs and benefits, and environmental impact. Adequately addressing these three factors by the gas industry will significantly contribute to the gas industry's licence to grow for the benefit of the planet.

4.2 Recommendations

Based on the above considerations, what should be the strategy to make a bright future of gas a reality up to 2050?

We would like to make five broad recommendations. As gas industry we need to:

Continue to bring down costs. In the coming decades, gas will remain in competition with coal and oil. For environmental reasons, gas is the preferred fuel, but this is not enough if price differences between gas and these alternative fuels are too large. Continued cost efficiency improvements in the gas chain, in particular in LNG, are crucial to effectively compete with coal and oil.

Continue to reduce the environmental impact of natural gas. Gas is the cleanest fossil fuel. Yet there is no guarantee that it will stay the cleanest. Producers of other fossil resources are aware that they need to work on sustainability. The environmental risks carried by gas production, transport and distribution are certainly manageable, but always need to be addressed adequately with attention for continuous improvement and sufficient investment in R&D.

Embrace innovation and renewables. Natural gas and renewable energy are natural allies in the transition to a cleaner energy future. Still, the specific roles, values, and merits of natural gas and renewable energy in relation to long-term goals of energy security and climate change mitigation continue to be debated. Unfortunately, discussions all too often consider each in isolation or concentrate on the competitive impacts of one on the other. Renewable energy will stay and increase significantly in the coming decades. The natural gas sector should explore synergies with renewables in power, heating and transportation. This will require constant innovation and investment in R&D.

Reduce interdependencies. Although the gas industry has always managed ‘to keep the gas flowing’, too large dependency on a single supplier and/or single buyers is perceived by decision-makers to carry risks and may thus be ultimately detrimental to the position of gas in the energy mix. The perception of these risks can make gas less attractive and complicate the undertaking of new projects. A global gas market in which consumers and producers have multiple options to buy and sell gas could be beneficial to tackle this problem, although this does not preclude the continued existence of long-term partnerships.

Demonstrate and advocate. Perceptions matter. This is true both in markets and in politics. Gas needs to be advocated, it does not sell itself, as is shown by the absence of natural gas as integral part of decarbonisation policies. Its benefits with respect to competing fuels have to be demonstrated. The industry has to work hard to cooperate, be transparent and prepared to explain and demonstrate the benefits of gas to ensure that gas is appreciated for the contribution that it can make to a decarbonised energy future. IGU can play a key role as spokesperson of the gas industry advocating for gas, stimulating innovation and R&D, facilitating transfer of technology and know-how and bringing together industry and stakeholders.

In conclusion: gas has ample opportunity to become the world’s most important energy source by 2050. However, we should not take this bright future for granted. As a major energy source, natural gas will get significant public attention. To bring gas to pole position, the gas industry has to engage with stakeholders and demonstrate to the world that it is continuously improving itself and is ready for the Golden Age of Gas.

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IGU

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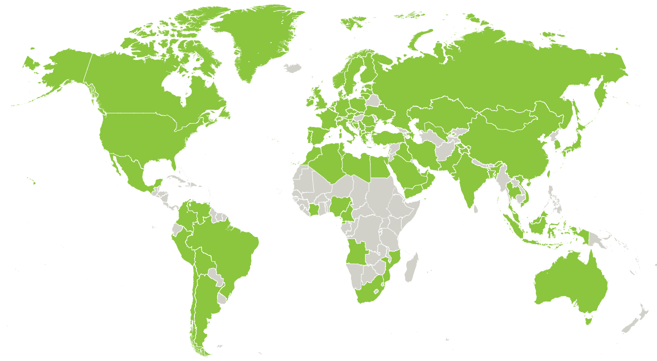

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