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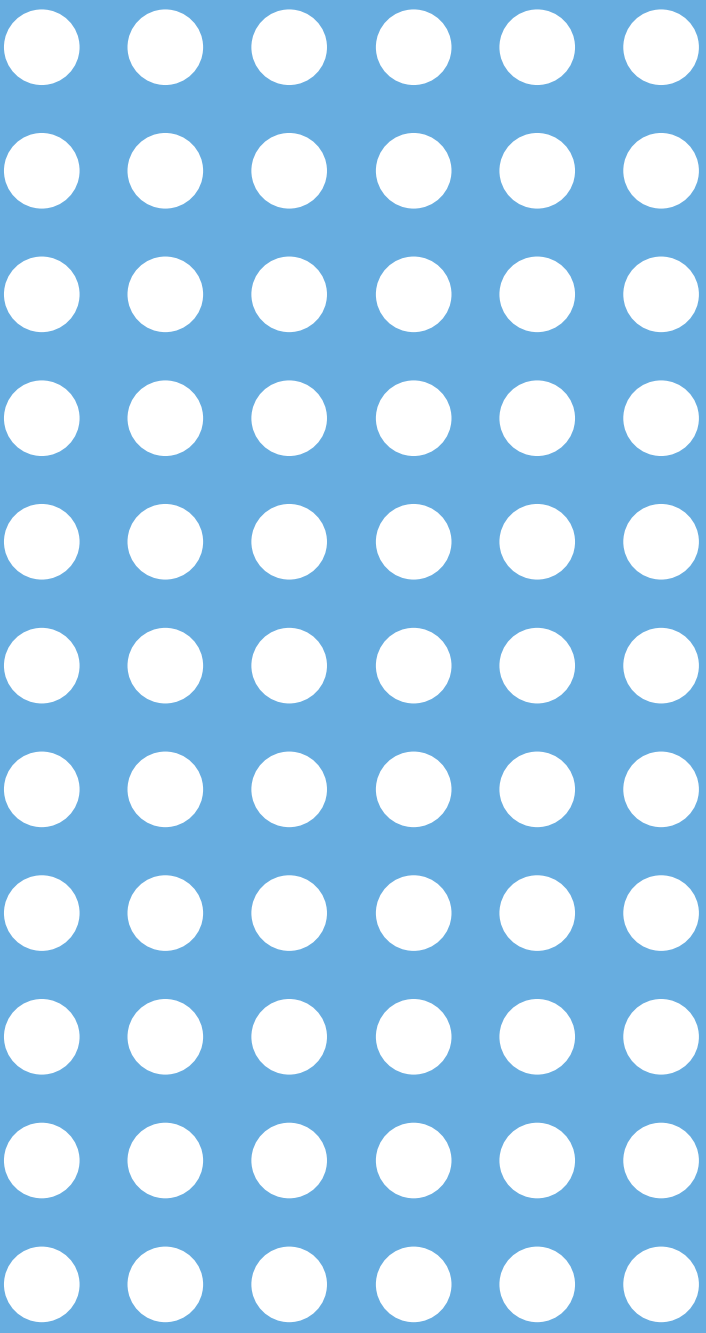
THE TRILOGY OF SPECIAL PROJECTS

Gas to Power – Global Outlook

'Still the Driver for Growth?'



In preparation of the 2006 World Gas Conference, IGU launched three special projects: Gas to Power, Sustainability and Regulation. For all three, the aim was to engage governments, industry and other stakeholders in a dialogue on gas-related issues to achieve the best solutions for society at large.

The Gas to Power Project was set up in view of the pivotal role that power is likely to play in the development of gas markets and the realisation that it will take enormous effort to achieve the projected growth. Its aims were to assess the realistic prospects for future gas-fired power generation, to identify possible obstacles and to address these jointly between the gas industry, the power industry and governments.

Under this project surveys and studies were conducted on the prospects of gas use in the power sector for North America, South America, Europe, Russia, Africa and the Asian Pacific region. In a number of places workshops were held to discuss the outcomes of the studies with the relevant stakeholder groups.

This is a summary of the findings of IGU's Project 'Gas to Power'. On 6 June, the 23rd World Gas Conference will focus on Gas to Power and the issues surrounding its future position.

I would like to thank all those who participated in the project and its surveys, in particular the International Energy Agency (IEA) with whom we enjoyed close cooperation during the course of this project, and hope that it adds to the dialogue and cooperation between the stakeholders in governments, the gas and the power generation industries and supporting institutions.

George H.B. Verberg
President International Gas Union 2003 - 2006

Power, still the driver for growth?

The general feeling at the 22nd World Gas Conference in Tokyo in 2003 with respect to the development of gas demand was one of optimism and high expectations. Over the past three years, perceptions of future demand for natural gas have changed.

The IEA, in the reference scenario of its 2005 World Energy Outlook (WEO), indicates a demand for gas for gas-fired generation of some 1800 bcm/a by 2020, down from 1950 bcm/a in its 2002 Outlook.

Nevertheless the growth projections remain impressive:

- The global power sector is expected to require an additional **800 bcm** in 2020, nearly double the consumption in 2003.
- With a total projected growth in gas demand of 1350 bcm for all market sectors, gas to power amounts to **60%** of total growth of natural gas consumption.
- For the power sector the projected contribution of gas-fired generation is equally impressive: at **45%** of total new capacity (**55%** outside China) it is expected to make by far the biggest contribution to growth in generating capacity.
- This outlook of growth in gas for power is the same across all regions, for developed and developing markets. In developing markets power generation has an added anchor role: the growth in other markets depends directly on the success of the power development.

The main drivers supporting this significantly growing role of gas in power generation remain:

- The combined cycle technology gives gas a major advantage in efficiency over other fossil fuels, reflected in both economic and environmental performance.
- The assumption that gas prices offer longer term competitiveness of gas-fired generation.
- The low capital intensity and the possibility of 'modular' tracking of demand growth, features of particular importance in a liberalized energy market.

Projected growth of gas use for power generation in different markets, bcm

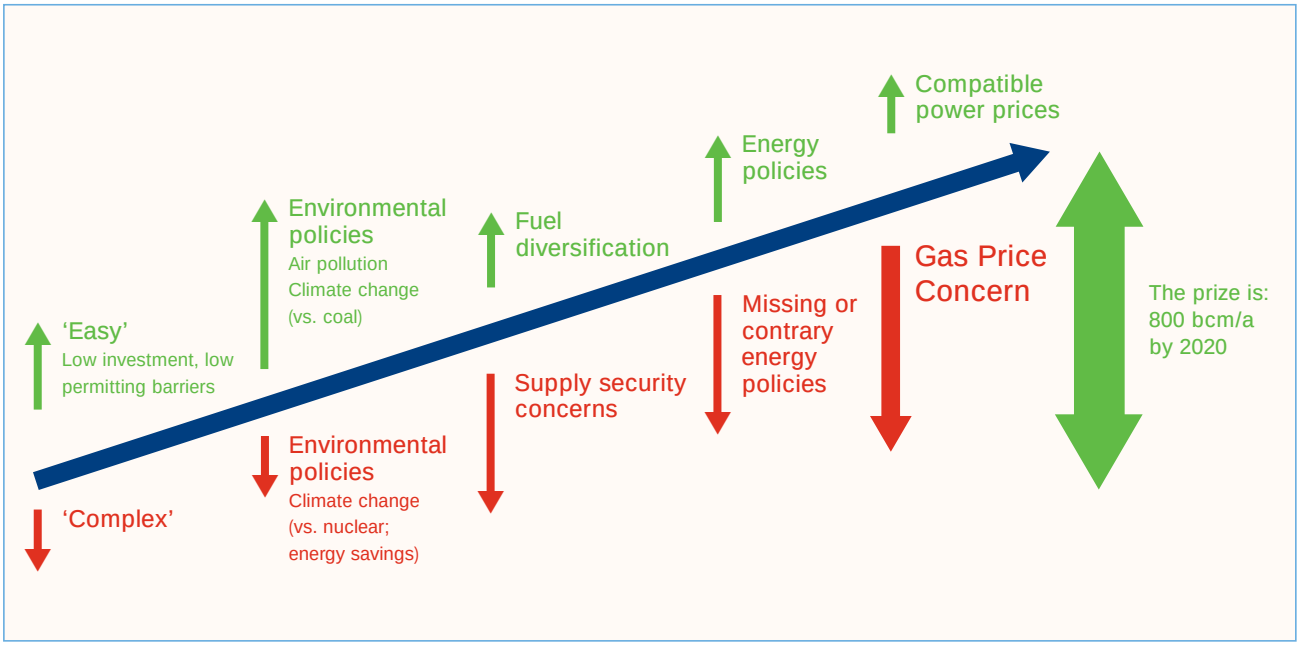
	2003	2020	Growth 2003 - 2020
World	990	1775	785
North America	205	345	140
South America	30	100	70
Europe	145	270	125
AsiaPacific	175	360	185
China	5	40	35
India	15	45	30
Japan	50	70	20
Africa	30	100	70
Middle East	80	180	100
Russia	250	290	40

Source: Based upon IEA WEO 2005, 2004, IGU

However, not all stakeholders are equally convinced of these long-term prospects and of the wisdom of making major commitments to gas-fired generation. Others may not be aware of the effort required to realise this prospect or are facing conflicting demands. For all, the challenge is to agree on the desired role of gas in power generation and then deal, jointly, with any issues that could affect the realisation of this potential. Failure to address these issues effectively will not only effect the potential development of the gas industry but could also compromise the realisation of environmental and economic benefits that gas for power generation can offer.

Factors influencing the growth prospects

Drivers for gas to power and concerns vary between regions, although there are commonalities across the world. Generally they fall in the categories shown in the diagram below:



Price is the main concern

Not surprisingly, the surveys and reports have confirmed the impact of today's high gas prices as the main factor, which currently limits the growth perspective for gas in the power sector. The leading institutions have modified their long-term gas price outlook: they still expect prices to return to lower levels than today, albeit significantly higher than the 2002/3 outlook, at and above **$ 5/MMBtu** (2004 terms) post 2010 for wholesale prices. This has led in a number of recent projections of demand to lower expectations, but at $ 5/MMBtu gas-fired generation is still regarded a competitive option in most energy systems. However, not all generators and observers share the views that:

a) gas-fired power generation is competitive at these price levels and
b) that prices will return to such levels.

IEA's price expectations in the World Energy Outlook 2005 (in year-2004-US-$ per MMBtu)

	2010	Change from WEO 2002	2020	Change from WEO 2002	2030	Change from WEO 2002
US imports	5.80	+94%	5.90	+57%	6.20	+40%
European imports	5.00	+62%	5.20	+43%	5.60	+33%
Japan LNG imports	6.00	+39%	6.10	+25%	6.20	+17%

Source: IEA 2005, 2002; US Bureau of Labor Statistics 2006

Policies and politics create the second biggest family of issues

Energy policies: more minuses than pluses

In most regions the absence of clear energy policies articulating the role of gas or the uncertainties around policy developments is hampering the prospects for gas-fired generation. In a limited number of countries government energy policies clearly recognise positions for gas and offer supporting regulatory frameworks.

Environmental policies offer more pluses than minuses

In almost all regions examined in the surveys natural gas-fired power generation is seen as an excellent means to mitigate local environmental problems. In Europe, the carbon dioxide **emission-trading** scheme principally increases the benefits gas can offer to power generators. In most other places environmental benefits do not translate into an economic advantage.

Security of Supply: back on many agenda's

In all importing regions the growing import dependence coincides with growing concerns of governments regarding the increasing influence of **geopolitics** in the international energy arena. Where this leads to policies of fuel diversification away from oil, this supports the prospects for gas but these instances are limited. More frequently, it relates to concerns of over-dependence on natural gas imports, in some cases supported by political incidents, which were seen to jeopardise supplies. Promotion of coal and even nuclear power could be the result.

Diversification is not only the domain of government policies, also large power generators choose to diversify fuel dependence, particularly in the light of the major uncertainty over the future of gas prices. The perceived higher supply security, often from indigenous sources, and predictability of prices create a predilection for coal with many large power generators.

Gas is ‘easy’ and ‘complex’

Gas remains a highly valued fuel for power generation. For established, ‘mature’ markets it offers short lead times for new developments, relatively easy permitting processes and fewer NIMBY issues than other fuels: sometimes there is even no realistic alternative. Power generators value the flexibility and the low capital requirements that CCGT’s power plants offer. Balanced against that is the complexity of developing economic gas supply lines and the associated costs of infrastructure, notably for developing markets, which shies off potential users.

It takes three to tango

Obviously, the prospects of gas for power depend essentially on the considerations of the power industry with regards to the choice of fuel for new investments and its views on the future role of gas for power generation. Power generators need to have confidence that the gas industry can deliver natural gas reliably at a price, compatible with the power markets they are active in over the life of their investment. The gas industry, in turn, relies on the participation of governments, both active and passive. Gas, more than other fossil fuels, is dependent on government policies that recognise and support the necessary development of international supply arrangements and the associated infrastructure. This is not limited to the creation of appropriate framework policies and regulation. The establishment or expansion of these international gas supply lines requires active participation of governments through the entire supply chain. Furthermore, international stability – the responsibility of nation states – is more than for any other fossil a pre-requisite for the continuity of natural gas deliveries. Close co-operation between the three stakeholders, the power industry, the gas industry and governments therefore is essential.

In summary

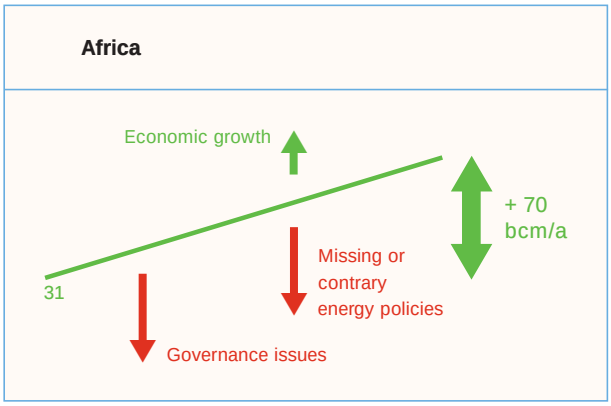
With a total projected volume of 1800 bcm in 2020, nearly double the consumption of recent years, the prospects for Gas to Power remain impressive. The realisation of this growth can only be achieved through close cooperation between the gas industry, the power industry and governments, notably by addressing issues summarised as:

- World-wide concern over the longer term outlook for natural **gas prices** and natural gas **availability**.
- **Energy policies** in many regions are absent or unclear in relation to the role of gas-fired generation and the development of the associated contractual and physical infrastructure.
- Growing concerns around **Security of Supply** and the influence of **(geo)politics**.

The regions

Africa

A general shortage of electricity supply, the desire to monetize indigenous gas reserves combined with the need to reduce gas flaring, at least in some countries, offer significant scope for the extension of gas-fired power generation.



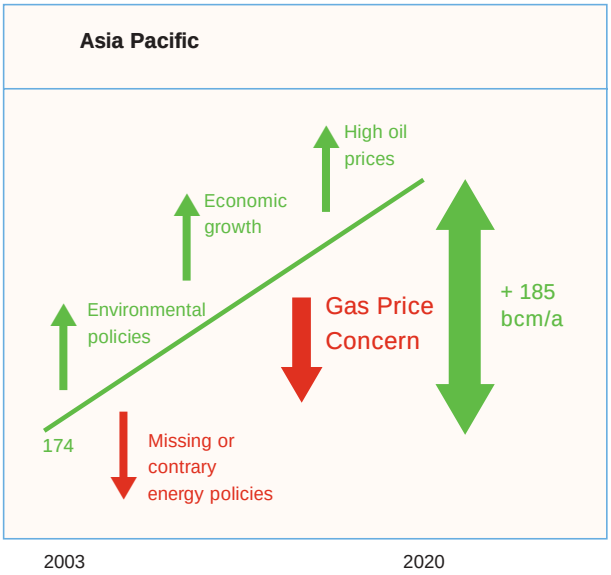
However, the realisation of new gas-fired power development faces major obstacles, including:

- Lack of or inappropriate regulatory/policy framework.
- Lack of institutional and human resource capacity to administer the sector.
- Governance issues; illegal connections to power supply, limited trust that potential customers will be able to pay their power bills.
- Lack of locally developed gas markets and appropriate infrastructure.

Asia Pacific

The Asia Pacific region is geographically the largest and from a gas perspective the least integrated of all regions. Point-to-point LNG supplies dominate the gas business. New international pipeline systems are under consideration and, once realised, will give the gas industry another shot in the arm.

The IEA outlook for the region is significant with projections of an additional 185 bcm/a gas for power generation by 2020 whereas other studies are more optimistic and hint at additional demand in excess of 200 bcm/a by then.



What the countries have in common is concern about the future availability of sufficient gas at prices which make it competitive for gas-fired generation. But otherwise the prospects and the obstacles vary significantly between countries. The Asian market is very diverse with huge differences in purchasing power between countries and whether a country has access to its own gas reserves or cheap indigenous coal or hydro.

The **Chinese** government recognises the benefits of natural gas-fired power plants for reducing local air pollution and appreciates the role of the power sector as a demand anchor for the development of the domestic gas market. China's power markets are also in need of flexible power plants for load balancing. The potential for gas-fired generation is considerable at 40 - 60 bcm/a by 2020. High oil prices trigger displacement of oil products by natural gas in power generation where feasible. However, relatively high gas prices in combination with rather low electricity prices and the absence of a policy framework recognising the need for secure gas use for power in firm supply chains, coupled with inconsistent enforcement of existing emission regulations make it hard for gas to compete with coal.

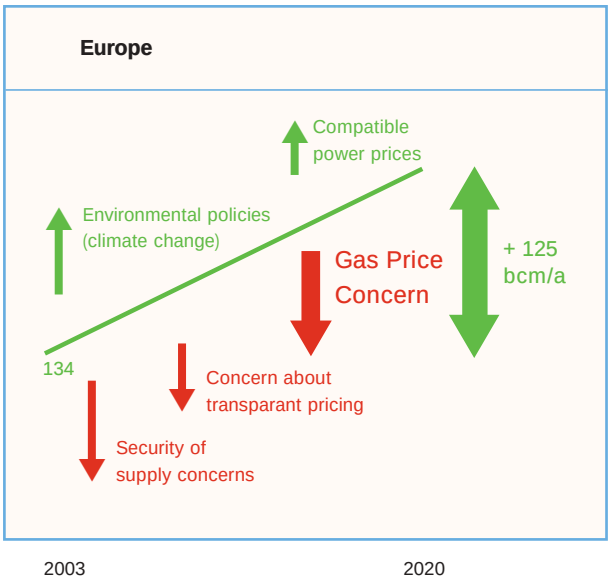
Similarly, **India** needs new power generation capacity to support its growing economy; local air pollution makes gas a wanted fuel for power generation. However, the government vision and a policy framework for future gas to power are still unclear. The administered pricing system is also becoming a serious bottleneck: it tends to paralyse the necessary efforts to import gas and makes market value difficult to grasp. Geopolitics frustrates the large potential for India to import gas by pipeline. However, the Indian government is making some progress in managing gas price expectations upwards and has a stated objective of increasingly decontrolling gas prices to stimulate the development of the market. A growing numbers of buyers are able to pay market rates.

Japan is a market in which security of gas supply is of paramount importance with environmental issues now a growing concern. Private gas companies are active in the development of gas-fired power generation. Nuclear is planned to play an increasingly important role for base-load power production in Japan and if such plans are delivered, nuclear will have a large influence on gas demand for power generation. Thus, the scope for increase in gas use in power will remain moderate, in particular where a stabilisation of demand for power is expected during the vision period.

Economic growth and the reduction of local air pollution in urban areas are important drivers for gas to power in **South East Asia and East Asia**. Governments in many countries of the region can very directly influence the fuel mix as they own or control power and gas companies. Government concerns about nuclear safety as well as the stance towards coal vary across countries and offer varying scope for increases in gas-fired power generation from substantial (Taiwan) to limited (Korea). Gas producing countries such as Indonesia and Malaysia are reviewing the future role of gas for power generation under the considerations of enhancing domestic use of the resource. Administered pricing systems in some countries in the region pose problems for further development of gas-fired generation capacity, with prices at the moment being too low to attract sufficient gas supplies and the concern that future (deregulated) prices may be too high to make gas an affordable option for power generation. However, gas demand is currently supported by the fact that oil and oil products are even higher priced than natural gas, and where possible, natural gas substitutes oil products in power generation.

Europe and Russia

Generators and governments in the **European Union** appear divided over the role of gas-fired generation. For Southern Europe and the UK there seem to be few alternatives to gas for power generation, among other reasons due to limits set by the national CO_2-emission budgets. With gas plants setting the price, power prices in that regions might enable investment in gas-fired capacity. France is still committed to nuclear energy and a number of countries in North West Europe appear to have a preference for coal. The CO_2 Emission Trading Scheme will further improve the competitiveness of gas-fired power generation versus coal-fired plant. Leading analysts expect gas to make a major contribution to future power generation. The IEA 2005 projection is for an additional 125 bcm/a by 2020.



However there is discomfort in the power industry and scepticism among observers:

- Uncertainty regarding the future gas price level: today's gas prices make other generation plant look more attractive.
- The power industry in continental Europe, as opposed to the situation in the UK market, is uncomfortable with what it regards as insufficient competition and transparency in continental gas markets and with the prevailing indexation of gas prices to oil product prices.
- Furthermore, energy security concerns in recent months have led to renewed interest by various governments in nuclear options.

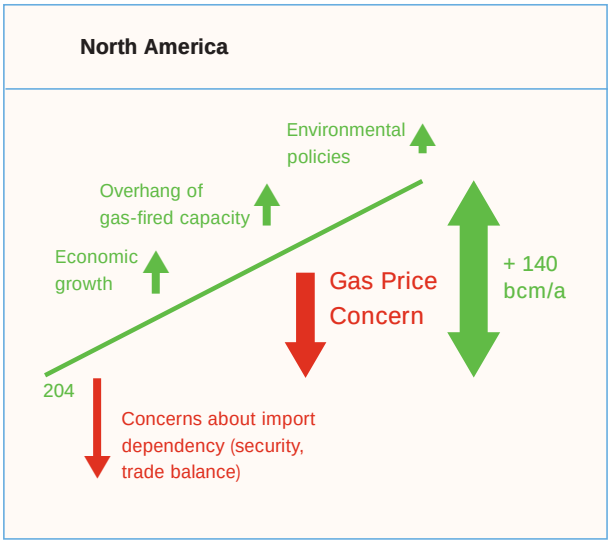
In **Russia** economic growth is the driver for additional power generation needs. Gas-fired power plays a role in controlling local air pollution. However, the very low administered natural gas prices will be gradually increased and consequently the share of coal and nuclear in power generation is set to rise. Existing power plants will be retrofitted, which will keep them competitive and will reduce the gas intensity. Demand for gas will shift from base load to mid-merit. Altogether the outlook is for gas demand for power generation to increase only modestly over the review period to 2020.

Middle East

It is not surprising that the **Middle East** countries with their vast hydrocarbon resources turn to natural gas to meet their growing demand for power. There appear to be few or no obstacles to the realisation of new gas-fired plants, and few alternatives apart from only modest additions of oil-fired generation. The IEA WEO 2005 projects growth of gas to power for the region by an additional 100 bcm/a by 2020.

North America

Power generators in **North America**, particularly Independent Power Producers (IPP's), appreciate the low capital requirements of gas-fired power plants, the short lead times and the advantages with regards to permitting procedures and meeting environmental obligations. But it is also the IPP's who have been hit hardest in recent years. Canada aims at replacing coal-fired generation by natural gas-fired plants in order to meet obligations under the Kyoto protocol. Uncertainty around gas price and government policy have led the EIA to lower its projections of future demand of gas for power in the US, but it remains considerable at 230 bcm/a by 2020.

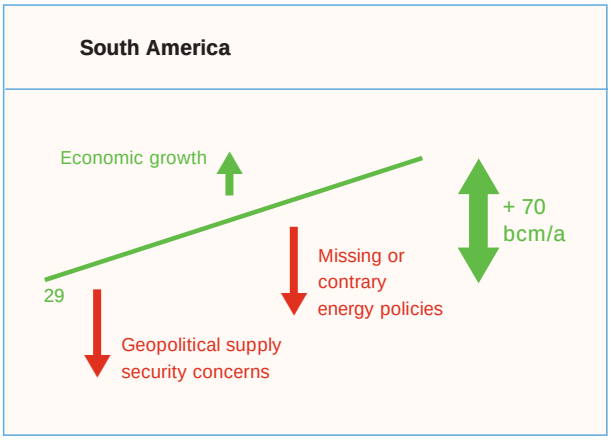


The main uncertainties of future demand revolve around:

- The concern that current gas price levels are here to stay as a result of a continuing tight market. This outlook seems supported by the expectation of only limited additional supplies from Mexico's resource potential, high costs of and uncertainties over new US gas developments and strong demand for natural gas in Canada's unconventional oil development areas.
- The future role of IPP's and merchant plants vis-à-vis the position of regulated utilities.
- Government concerns of becoming overly dependent on gas imports have renewed interest in nuclear energy and clean coal technologies.

South America

South America's economic growth brings along the need for major new investments in power generation. The continent has adequate gas reserves to meet any demand for many years to come.
The potential for additional gas-fired generation by 2020 is not inconsiderable: 70 bcm.



Yet, projections have been reduced over recent years due to a number of perceived and real obstacles, mainly based on politics and (the absence of) integrated energy policies:

- In hydro-dominated markets, gas-fired power plants can be a cost-effective solution to increase supply security. However, without off-take assurances, uncertainties about returns for the gas-fired plants are very high. Policies are not in place to deal with these requirements.
- Geopolitical issues frustrate the international gas business in a number of countries.
- Government interventions in the downstream gas sector and in the power sector reduce the confidence of the gas industry.

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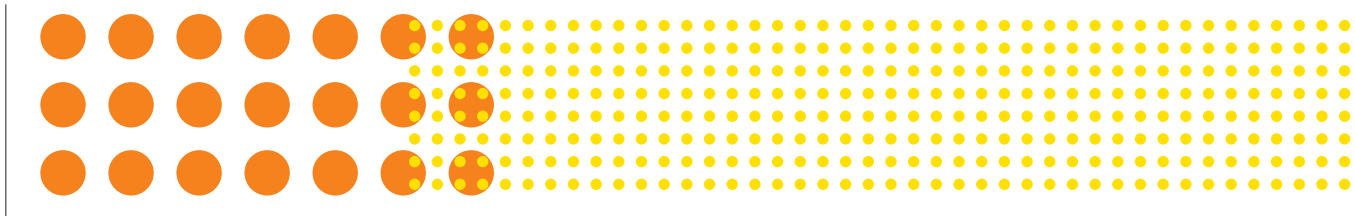

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