

## **Gas market globalization: Perspectives and Limits**

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## Background and aims

Since the end of the 90s, we have observed an increasing trend towards global integration of gas markets with: i) increasing inter regional gas trade, especially for LNG which is the vector of this integration, ii) increasing trade flexibility both between gas sources and destination, and in transactions modalities iii) and to some extent increasing arbitrage opportunities between regional prices that contribute to connect these prices.

Today, the debate among experts is still intense on the sustainability of this trend over the long term and if it could drive to the globalization and structural integration of gas markets as it is the case for the oil markets

So, the last evolutions have brought some new elements to the global gas market. Indeed, recent developments in the North America, with the boom of unconventional gas reducing markedly the needs of LNG imports has reduced the gas dependence of this region, and widened the gap between Henry Hub and other reference prices. But on the other hand, the gas market has seen since 2010 a significant growth boosted by LNG demand from the Asian markets, including emerging markets and also Japan after the Fukushima catastrophe. Gas volumes are being increasingly oriented to the Pacific basin, which could tighten the supply / demand balance on the medium term, and contribute to reconnect spot prices in Asia and Europe,. Nevertheless, the surge in LNG shipping costs at the end of 2011 and beginning of 2012 has constrained these arbitrage opportunities and integration between Atlantic and Pacific basins.

With regards to these evolutions, this paper aims to analyse the prospects of the various factors contributing to globalize natural gas markets, and to highlight the limits to this process that make uncertain a global structural integration of gas markets, which is similar to that of the oil market.

In fact, since the 80s, the oil market has developed in a global commodity market, with worldwide competition for the supply, boosting trade between different regions. We have also seen the emergence of market based pricing mechanisms and the development of a strong trading activity on organized marketplaces. This has improved the liquidity of the oil markets, and provided tools to hedge against price risks. The reference prices formed on the markets are connected through the various arbitrages between regions.

Several factors contributed to this development, especially the relatively low cost of oil chain (cost of transport and storage), which facilitate trade and arbitrage between consumption areas. What does it mean for the gas that shows very different technical and economic characteristics than oil?

In this paper, we define the globalization of energy markets in general, as a structural integration between different regions through i) the intensification of trade in energy products and services, ii) the widening of markets supply chain, and iii) the development of competition between players acting on a global scale. So, main regions become strongly interrelated with price convergence dynamic. An event (or disequilibrium) occurred in one region would have a ripple effect on the other, through the various channels contributing to this globalization.

## Determinant factors for gas markets globalization

If we refer to the wide literature on the different drivers of globalization, it's possible to identify five groups<sup>1</sup>:

- **Technological drivers:** The innovation and technical progress, particularly in the transportation and telecommunication sectors, has enabled to strengthen the links between regions and to increase worldwide trades in goods and services.
- **Cost drivers:** Costs evolution and disparities along of the value chains are important drivers that encourage actors to trade and to adopt internationalization strategies, in order to benefit from comparative advantages and synergies between regions, and also to exploit potential economies of scale by expanding the share of international markets. The cost of transportation is very important factor that allows this expansion.
- **Market drivers:** These drivers are related to the situation of supply and demand in the different markets, which could lead actors to import or export goods and services, according to the supply / demand balances and to their market conditions, and thus contributing to increase international trade. This would be the case of an energy products buyer who looks for international supply because of the non-availability of domestic resources, or a seller searching international opportunities for growth because of the saturation of his traditional market.
- **Competitive drivers:** The needs for competitiveness encourage operators to seek profits and cost savings through internationalization strategies, thereby causing increased inter dependence between regions. Foreign Direct Investment (FDI) actions throughout the world are supporting this driver.
- **Political drivers:** including the market and trade policies that have helped to reduce barriers and enable access to markets for new operators, and thus have extended the opportunities of trades between regions. We can consider among these drivers, the ones that relate to the diversification policies aiming to achieve Energy Security of Supply,

If we look to the gas markets, we can note that their technical and economic specificities, particularly the high costs of gas supply chains, and also the security of supply issues, have led to the emergence of a traditional **regional configuration** which has been characterized by: i) the **lack of physical links between regions**, preventing the inter regional trade of significant gas volumes: and ii) the **predominance of Long Term oil indexed contracts** in international gas transactions that permit to achieve a balanced risk sharing mechanism between producers and consumers.

Considering these characteristics, the main drivers of globalization could be analyzed in the case of the gas markets, by distinguishing i) the factors that contribute to strengthen the links between different regions and to increase the share of inter-regional trade, particularly of LNG, in the total gas demand and ii) the factors helping to enhance the share of flexible gas trades that enable suppliers to direct their flexible volumes on the basis of the different market conditions and Netbacks.

In this context, the main globalization drivers that we have identified and that we analyse the prospects through this paper are illustrated in the table below:

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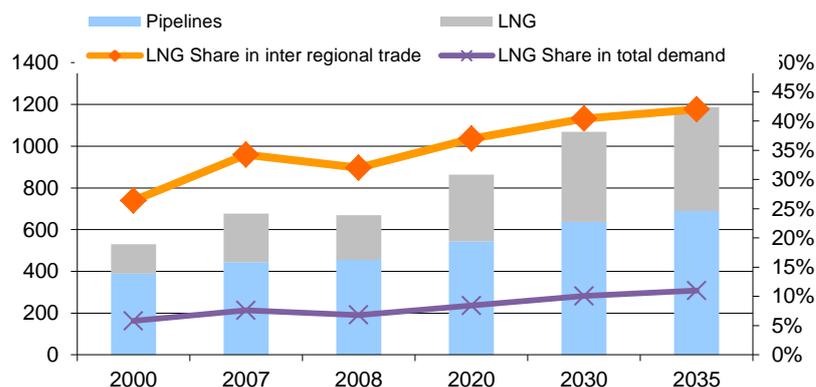
<sup>1</sup> Source: [M. Bauernfeind, 2005]

## Gas Markets Globalization Drivers

Gas Markets Globalization Drivers	Supply Side drivers (Suppliers)	Demand Side drivers (Consuming markets)
<b>I. Increasing links and LNG trade between regions</b>	<ul style="list-style-type: none"> <li>• Evolution of LNG Supply chain <b>costs</b></li> <li>• Increase of LNG Capacity &amp; Emergence of New sources (players)</li> <li>• LNG Shipping capacity Evolution</li> <li>• Internal Gas demand evolution in the producing countries (effect on gas exports)</li> <li>• Competition between LNG &amp; Pipeline</li> </ul>	<ul style="list-style-type: none"> <li>• Demand growth in the main consuming regions ( increasing needs for gas imports)</li> <li>• Domestic production development in some important consuming countries (ex: Us unconventional)</li> <li>• Market liberalization progress</li> <li>• Development of Regasification Capacities</li> <li>• Gas quality and inter-changeability</li> </ul>
<b>2) Developing flexible trade</b>	Availability of LNG flexible volume	Spot market development on the Regional, and on the Global scale

### I. Increasing links between regions

Improving the links between regions is manifested in the increase of inter-regional gas flows, and especially LNG that enables to connect distant producing and consuming areas. In fact, inter-regional trade amounted to 670 bcm in 2008 where the share of LNG is 32% (214 bcm). IEA projections show a sustainable growth of inter-regional trades over the long-term, that could amount to nearly 1200 bcm in 2035. It's expected also that LNG trade would grow faster than the trade by pipelines, and its share could well exceed 42% at the 2030 horizon.



#### Inter-regional gas trade Projections

Source: IEA

In addition, these projections show an increasing trend of the LNG trade share in the total gas demand that could reach about 11% in 2035.

In the following section, we analyse the prospects of major identified factors that contribute to increase links and LNG trade between regions, distinguishing the supply side drivers and the demand side ones in the major consuming markets.

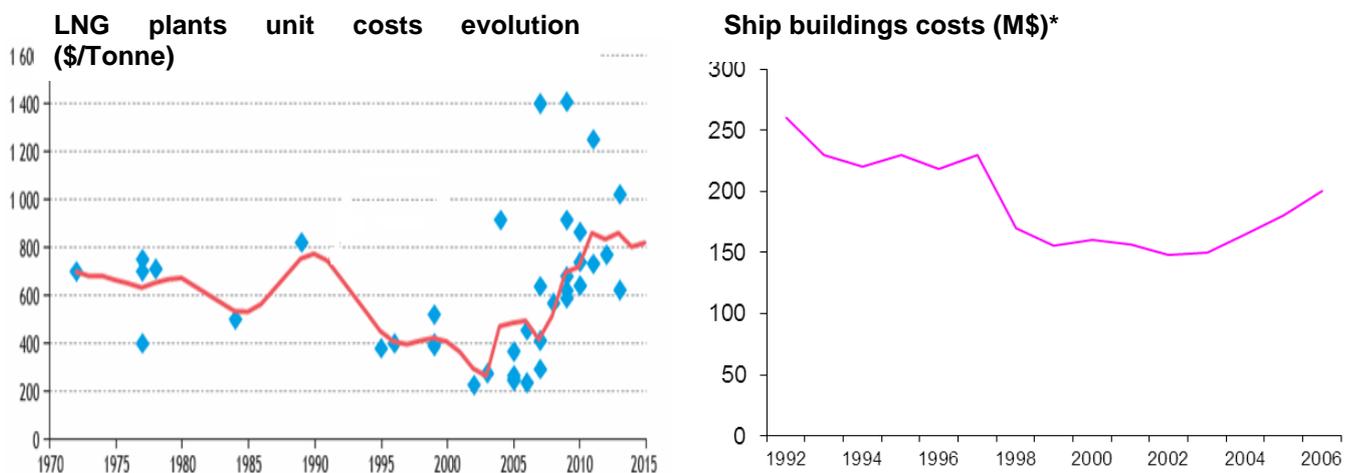
## I.1 Supply side drivers

### I.1.1 LNG supply cost evolution: still high costs that need visibility on demand

The unit cost of liquefaction plants experienced a downward trend until 2003 because of technical progress and economies of scale. This cost starts to increase after 2003, driven by the rise in oil prices and raw materials, as well as the anticipation of strong growth in LNG demand that has boosted orders for new plants and resulted in high tensions on the EPC, and skilled labour. The economic crisis has caused some costs stagnation, due to the slowdown in economic activity and LNG projects.

Today, many uncertainties are characterizing the prospects of liquefaction costs. We can consider on **the one hand bullish factors** such as: i) Lack of skilled labour, which is increasingly a structural issue in the oil and gas industries, ii) Increase in raw material costs, iii) increase in environmental constraints iv) Saturation of the potential of scale economies owing to the excess capacity and the development of LNG market flexibility and **on the other hand bearish factors** such as: i) LNG projects slowdown (few projects reaching FID recently) and ii) the possible development of Floating LNG that have lower cost than conventional plants.

For shipping by tankers, the cost evolution for this intermediate link in the LNG chain is driven by the regional supply / demand LNG balance that affect directly the development of LNG infrastructures and their utilization rates. However, we note that a downward trend for tankers building costs was observed until the mid-2000s, due mainly to the competition from Korean and Chinese shipyards. Since 2004, the buildings costs are on the rise but at a slower pace than that observed for liquefaction plants, driven particularly by the surge in tankers building orders in order to face the promising prospects for LNG inter-regional trade,



Source: IEA

Source: EIA, LNG Shipping Solution, Simon & company International

\* 125000 m3 entre 1992 et 2000, et 138000 m3 entre 2001 et 2006

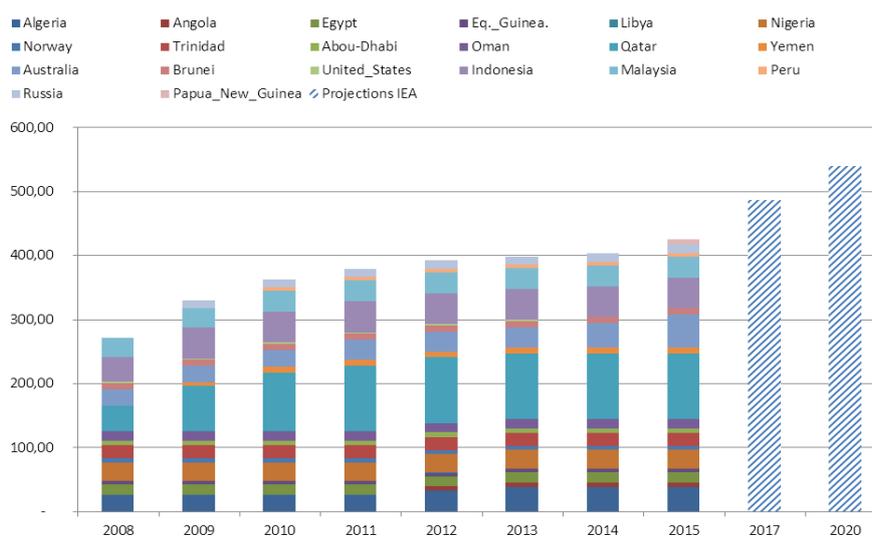
The outlook for shipping costs is uncertain and depends on the evolution of tankers fleet capacity and LNG trade, particularly the spot trade that provide indications for markets conditions. We note that LNG supply chain remains very capital intensive and thus requires demand visibility for ensuring its economic viability.

## I.1.2 Increase of liquefaction capacity: Market conditions delay the progress of many proposed projects

In recent years, the gas industry has seen a sharp increase in LNG capacity from 161 bcm in 2000 to 363 bcm in 2010<sup>2</sup>. This development has accelerated after 2005 with the commissioning of the Qatari trains. We have seen also the emergence of new players such as Russia, Yemen, Peru and Angola. We note that the period that follows economic crisis was very specific for LNG industry since the observed decline in demand coincides with the commissioning of over than 100 bcm of capacity.

For future prospects of LNG, the IEA estimates LNG projects under construction or having recently reached FID to more than 85 bcm between 2012 and 2017. These projects are mainly located in the Pacific basin. The total installed capacity could reach 487 bcm in 2017 and 540 bcm in 2020<sup>3</sup>

Other potential projects are announced, but have not yet obtained FID. The announced capacities are estimated at about 280 bcm, including proposed U.S. plants, but further than economic downturn effects, additional liquefaction projects are facing some structural constraints that hinder their progress mainly: i) Access to reserves for export projects, ii) persisting constraints on EPC and skilled labour, iii) increasing technical complexity and iv) the environmental issues.



### Liquefaction Capacity Evolution

Source: Cedigaz + IEA projections after 2017

## I.1.3 LNG shipping: an intermediate link that follows LNG market development

LNG shipping capacity has experienced strong growth driven by the growth in LNG flows between increased liquefaction and regasification capacities (Annual Average Rate estimated at over than 14% through the 2000-2010 period),

Indeed, the expectations of this significant growth in LNG demand has made the pace of LNG tankers new orders and consequently LNG shipping capacity, higher than the effectively traded volumes. This has led to shipping over-capacity in the market. In fact, the

<sup>2</sup> Source :Cedigaz

<sup>3</sup> IEA projections

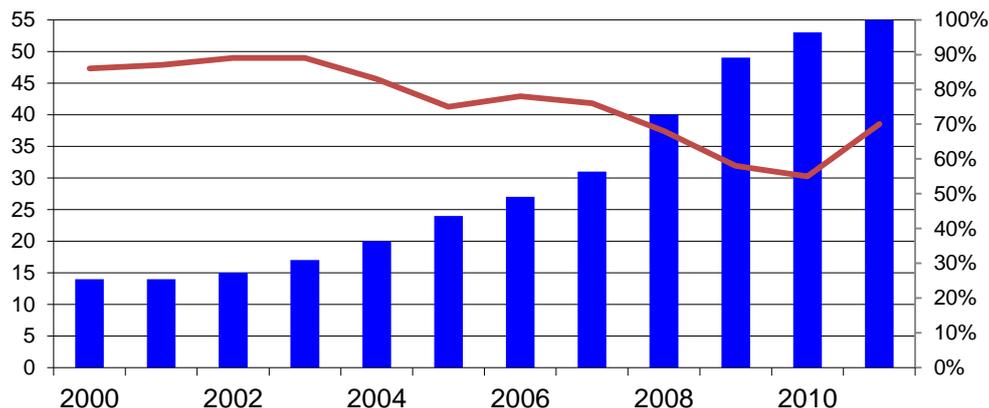
utilization rate of this capacity is estimated at about 68% in 2008 and less than 55% in 2010<sup>4</sup>. Similarly to what it did happen for liquefaction, many LNG shipping capacities came on the market in a period of declining demand in response to the economic downturn. Furthermore, this situation has been exacerbated by the increase in the LNG tankers unit size that aimed to take advantages from scale economies.

Before 2011, the availability, or even the surplus of shipping capacity since 2006, has supported the development of the Spot/Short Term Market, which has strengthened the links between distant locations (the distance travelled by spot cargos is on the average 30% higher than those covered under the LT contracts)<sup>5</sup>, and retroactively, the development of Spot LNG Market has encouraged the purchase of tankers not dedicated to LT contracts, leading to increase in LNG transport capacity, and particularly in flexible ones<sup>6</sup>.

So, what future prospects of LNG shipping capacity? Indeed, excess capacity has led to a sharp slowdown in new orders and commissioning of vessels, resulting in a sharp moderation in the growth of the total transport capacity. The decommissioning of old vessels could also reduce the capacity and therefore requires their replacement.

On the other hand, growth in LNG demand in 2011 and its medium term outlook, particularly in the Pacific Basin, has greatly increased the capacity utilization rate, estimated at around 68% in 2011, and which could exceed 75% in 2013<sup>7</sup>.

This has increased tensions on shipping prices in 2011 that could be sustained on the medium term.



#### Evolution of LNG shipping capacity (Bcm) and its utilization rate (%)

Source: P&P, MOL

### I.1.4 Gas demand in the producing countries: Growing needs but high resource potential to satisfy both internal and international demand

In the recent years, we have seen a sustained growth of internal consumption at the most of producing countries, driven by increasing economic and social needs. Indeed, natural gas is an important development factor. Do these trends sustainable on the long term? Do they have an impact on gas exports?

The prospects for industrialization in the major producing countries, and the present context of depressed international gas markets, would encourage government to give priority to local development. This policy could undermine the development of new exporting capacities, but

<sup>4</sup> Source: [M P. Rowley, MOL, 2011]

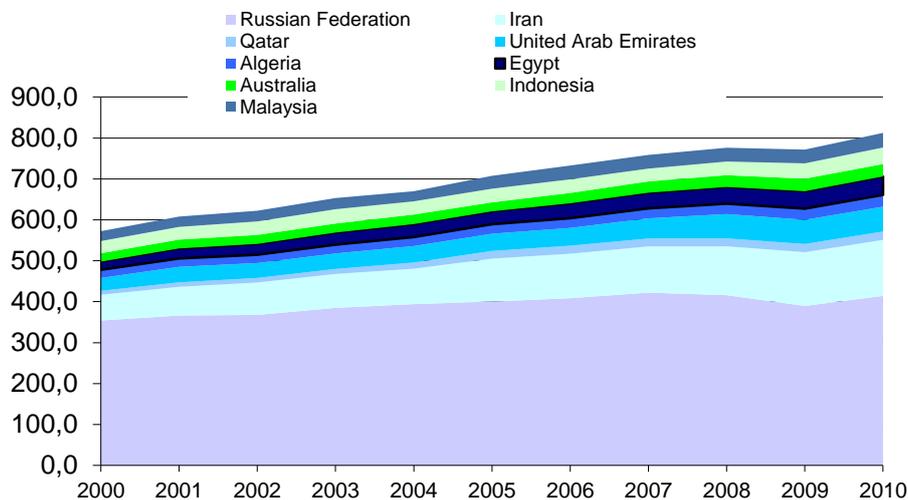
<sup>5</sup> Source: [Energy Charter, 2008]; [Energy Charter, 2009]

<sup>6</sup> Often, LNG tankers are second hand purchased, following the end of expiration of their charter in the framework of the LT contract.

<sup>7</sup> [M P. Rowley, MOL, 2011]

the need for revenues and attractiveness of the hydrocarbon sector to foreign investors may put some constraints on its implementation.

Note that gas exporting countries have significant resources, often under explored, and they are making significant efforts to increase their reserves in order to satisfy both internal and international market's needs. However, the evolution of international markets conditions is key determinants for the development of additional exports capacities.



#### Demand Growth in main producing countries

Source: BP statistical review

### I.1.5 Competition LNG / Pipeline: Many pipeline projects that could slow LNG progress

Although the projections show a faster growth for LNG trade than pipelines over the long term, the development of LNG supply capacities can be challenged by the pipeline alternative that offers a number of advantages: i) less costly than LNG option, ii) reliability of supply; iii) provides a quality that's compatible with markets requirements; iv) allows for regional integration by connecting several countries and regions

We note that LNG trade has grown faster than pipelines in recent years, but it's likely that pipelines rebound and recover their share in gas trades. Firm commitments required for the development of important pipeline projects could cause a significant under-utilization of regasification capacity. For Europe, for example, proposed long-term pipeline capacities are estimated at 351 bcm by the European Union<sup>8</sup>, including the various corridors of supply in the context of EU policy.

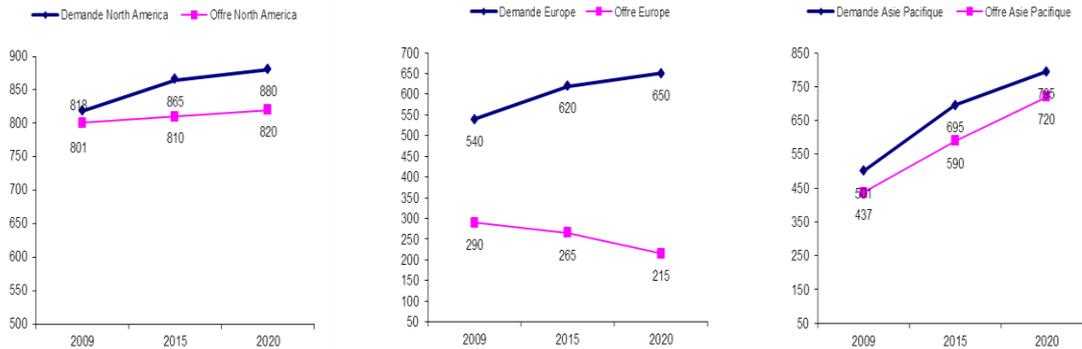
However, we note on one side that the development of pipeline projects is subject to various geopolitical constraints, and few projects are today under construction around the world. On the other side, the development of mega projects could therefore strengthen the connection between distant producing and consuming regions, but on a less flexible basis than that would be by LNG.

<sup>8</sup> Source:[TEN E, 2008]

## I.2 Demand side drivers

### I.2.1 Natural gas demand growth in main consuming areas: a large demand uncertainty that affect the import needs

The Long term growth of supply / demand imbalances on the three main consuming regions (North America, Europe and Asia Pacific) increases the need of imported gas from outside the region. These imbalances are linked to the differences between the rate of growth of demand and of intra-regional supply



#### Outlook of regional Supply Demand balance (Bcm)

Source: CEDIGAZ 2011

However large uncertainties characterize the import needs owing to uncertainties on the demand growth and on the development of supply in the consuming regions, especially non-conventional gas supply.

Uncertainty on long term demand growth is in our opinion the most important factor influencing the evolution of regional deficits and corollary import requirements, because the demand anticipation will directly impact the supply, particularly intra-regional supply. Indeed, poor anticipation of demand may widen the gap if not followed by investment needed to develop this supply.

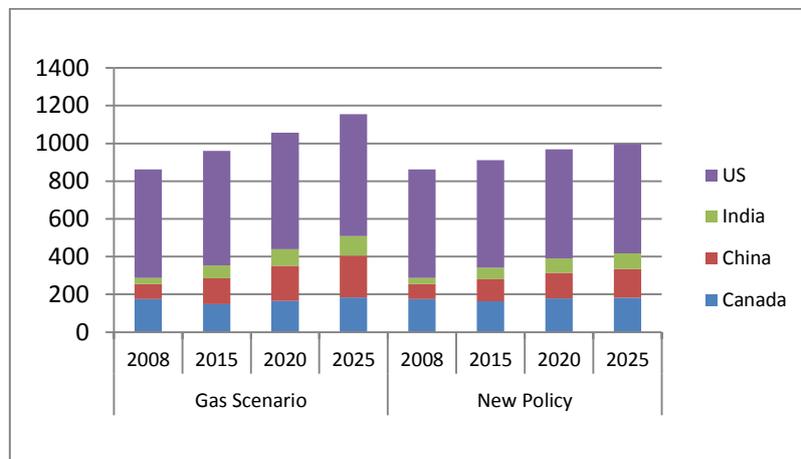
The major uncertainties on the demand for long-term gas are related to:

- Growth driven by the power sector that remains very sensitive to prices and to competition from alternative sources
- Effect of environmental policies on gas: not very clear if it's favours the penetration of gas as a clean energy source, or otherwise compel its development.
- Effect of Liberalisation policies and their evolution in some important consuming markets;
- Uncertainty about the development of nuclear energy (Fukushima effect; Germany nuclear decommissioning)
- The effect of renewable energy.

### I.2.2 Domestic production evolution, in particular of unconventional gas: a slowing factor for gas imports

Domestic production in the main consuming areas, especially of unconventional gas, could significantly reduce the imports requirements. Indeed, the growth of domestic production in North America has reduced gas dependency of this region from the rest of the world. China and India could also experience strong growth of domestic production. However, the development of regional production in Europe is more uncertain, although there is significant potential for unconventional gas in Poland and France.

The two scenarios of the IEA (New Policy & Gas Scenario)<sup>9</sup> show an increasing trend of production in North America, China and India. Nevertheless these projections are characterized by great uncertainties, where the gap between the two scenarios could reach 160 bcm in 2025. Production in China has the greatest uncertainty.



### Outlook for gas production in countries with high potential reserves (bcm)

Source: IEA

The boom in unconventional gas and its effect on the global supply has surprised the gas industry, including even the United States where the players expected a sharp increase in imports evidenced by a significant development of regasification capacities, which are largely under-utilized. Will unconventional gas supply be sustainable on the long term? Can the American experience be duplicated in other consuming markets?

For the United States, It is likely that the effect of non-conventional production persist given the resources, and also the experience gained by operators. However, several constraints could slow this development, or even reverse it very quickly: i) the economic viability of projects in the context of low levels of gas prices. This viability is often supported by the production of gas liquids, which could focus future investment on the gas liquids rich areas, ii) environmental constraints, where moratorium is imposed in some states<sup>10</sup> in order to assess the impact of hydraulic fracturing.

For China, Resources of Shale Gas and CBM are very important, and government policy is encouraging the development of these resources, particularly CBM, in order to increase the gas share in the energy mix. However, the domestic price level and the competitiveness of unconventional gas remain main issues in China.

The development of unconventional gas in Europe is more complex facing several constraints: geological (more complex and deep reservoirs), strong environmental regulations, land accessibility with regards to the strong urbanization, hostile populations. These constraints have a direct effect on costs, where the cost of drilling in Europe is estimated 2 to 3 times higher than the United States<sup>11</sup>. The future of unconventional gas in Europe depends on technological and regulation progress. However, it may be noted that Shale Gas exploration in Poland has attracted a lot of interests, and it's not clear whether the constraints above can be passed on.

<sup>9</sup> Source [IEA Special Report Golden age of Gas; 2011]

<sup>10</sup> State of New York and Maryland

<sup>11</sup> Source: [Florence Geny, 2010]

### I.2.3 Market liberalization: Disparities in progress and security of supply issues

Progress of liberalization has been uneven across consumer countries, where we can distinguish between liberalized markets in North America and UK, markets that are implementing liberalization policy in Continental Europe and the emerging markets such as China, which are in the early stages of development and are highly regulated.

#### Liberalization in Europe

The liberalization process in Europe has been slow and uncertain, although some progress made in recent years, particularly in the North West Europe<sup>12</sup>. The objective of the European Union to achieve an integrated and competitive single market seems to be distant and several barriers to this process do exist<sup>13</sup>:

- Heterogeneity of the European markets in terms of supply structure, and configuration. It appears difficult to harmonize the operating rules in markets where the level of development, concentration and also security of supply issues are quite different.
- Lack of access to markets and networks for new operators, due to certain regulatory barriers as well as the market power of incumbents<sup>14</sup>.
- Difficulty to effectively regulate access to cross border transport networks
- Divergence of views between the European and national energy policies. Some member countries showed resistance to the fragmentation and weakening of the bargaining power of European operators.
- Position of the main gas suppliers who don't want to sell or to index large contractual volumes on spot basis.

The European Union seeks to reduce these constraints, through the adoption of the 3rd legislative package<sup>15</sup>. However, two important issues could hinder the progress of the liberalization in Europe:

1. **Security of supply:** The need of reliable supply could be a major constraint to the liberalization. In fact, the increasing gas dependence could force Europe to look for additional importing volumes, and to compete for this supply on a global scale, particularly with Asian markets that are still dependant on Long Term Contracts, and could pay more than Europe for gas. We have to note that securing important volumes on a spot basis remain a difficult task for European buyers facing supplier resistance and their preference for oil indexed contracts.

2. **The Future of the Euro zone** with the debt crisis and its impact on the development of national policies. It is conceivable that the predominance of national interests and the establishment of protectionist policies can reduce the accessibility of new entrants to markets.

Consequently, the specificities of Europe and challenges of security of supply make very low the probability to duplicate American or English model.

#### Liberalization in Asia

For the Asian markets, **the most developed and mature markets (Japan, Korea)**, have initiated liberalization efforts in the mid-90s, but these efforts did not permit to increase the competition against the dominant position of incumbents. It should be noted that this process was found largely hampered by security of supply issues.

<sup>12</sup> Ref. Paragraph III.1

<sup>13</sup> Sources: [N. Haase; 2008]; [A. Gilardoni, 2008]; [Gazprom M&T,2011).

<sup>14</sup> It should be noted that many national regulators have not yet reached the degree of independence that allows them to ensure non-discriminatory access to markets

<sup>15</sup> See Paragraph II.2.1

The high prices of indexed contracts and the LNG supply surplus has raised pressures to advance liberalization and enhance competition, but this excess conditions would be a temporary situation and dependence on gas imports puts the issue of security of supply at the heart of concerns. Note that the Asian buyers who have not secured Long Term supply from 2006 to 2008 have been obliged to purchase spot cargos at high prices. This includes especially the Korean buyers who have experienced the failure of the liberalization process in their country.

**For emerging markets (China and India),** the gas sector is in its early stages of development, where domestic production plays an important role and where the market prices are regulated. However, the prospects of increasing imports expose both countries to international market prices. China has recently allowed a significant increase in prices, and India has initiated reforms aimed at opening up the market and encouraging new operators to invest in infrastructure and expand domestic production. What are the prospects of liberalization in these countries?

Price reforms in China and India are characterized by strong uncertainties:

- Despite a willingness of the Chinese government to deregulate prices and make them compatible with increased supply costs, high inflation that characterizes the economic environment and lack of maturity of the gas market make the process slow and uncertain
- For India, the low domestic price does not encourage investment in infrastructure. The increase in imports would exert upward pressures on prices, but the effect of deregulation of prices in this developing market is uncertain.

Furthermore, it is worth noting that the future of domestic production in China and India has an important effect on the reforms, since the supply structure determines the cost of supply and the price required for it.<sup>16</sup>

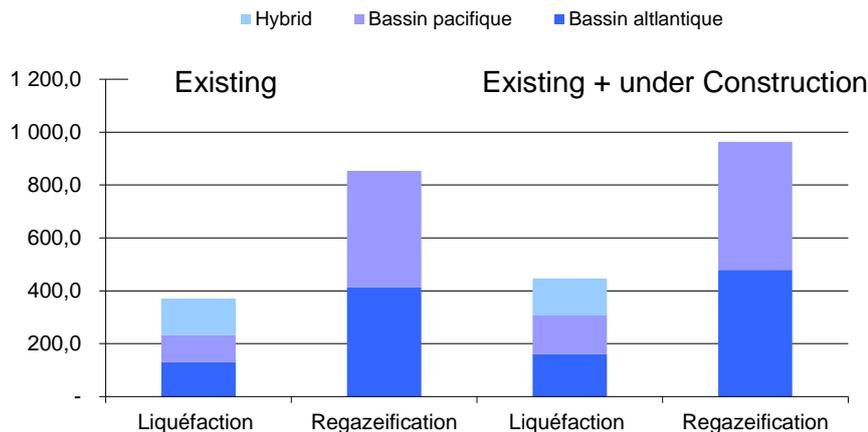
#### **I.2.4 Regasification capacities: exceeding largely LNG available volumes**

The regasification capacity has experienced very strong growth in recent years, driven in particular by: i) lower costs than other parts of the LNG chain, ii) development of new markets, iii) suppliers strategy to get access to markets; iv) emergence of LNG floating terminals characterized by lower costs and construction lead-times v) markets liberalization in consuming countries and their willingness to diversify supply sources, and finally vi) search of flexibility by portfolio gas suppliers.

However these capacities have reached about 850 bcm, more than doubling the available liquefaction capacity, and could grow further, leading to significant under-utilization rate. (under construction capacities estimated at around 110 bcm and planned ones are estimated at around 700 bcm)<sup>17</sup>, In this context, one may question the sustainability of the long-term capacity surpluses and the viability of regasification projects, such as the ones being built in United States, where imported volumes are been significantly reduced.

<sup>16</sup> Sources : [J. Jensens, 2011]; [Yanrui WU, 2011] [Rajeev Mahrotra, 2009]; [Peter Hughes, 2011]

<sup>17</sup> Source: [IEA MT Oil & Gas; 2011]



### Existing and Under Construction Capacities

Source: IEA

## 1.2.5 Gas Quality and inter-changeability: a constraint on the diversification of LNG sources

Differences in quality required by the gas markets are important constraints to LNG inter-changeability and gas trade in general. Indeed, combustion appliances in different markets cannot accommodate the various qualities of Gas. On this basis, we can identify three types of qualities required by markets: i) Traditional buyers in the Atlantic basin (mainly in United States and Uk) prefer Gas with low calorific value and low Wobbe Index<sup>18</sup>; ii) LNG Pacific Buyers who require high calorific Gas; iii) Buyers in the EU developing gas markets that are tacking part of the European gas quality standardization policy, aiming to set specifications to accommodate various Gas qualities (EASEE standards in Europe).

One can ask about the possibilities of extending the European standards required by the gas combustion devices to other consuming markets. So, given the technical and economical limits, and the specificities of the different regional markets; this would remain uncertain

For LNG, it should be noted that regasification terminals can to some extent adapt the quality of gas, either by injection of nitrogen or extraction of liquids to reduce its gas calorific value, or by the injection of heavier products such as LPG to enhance calorific value. However, great part of these terminals (particularly in Europe and Asia) is inadequate to accommodate various gas qualities. The adaptation of regasification terminals could result in additional costs and reduce the competitiveness of LNG. Thus, this remains an obstacle to the markets integration.

## II. Developing flexible trade

The development of LNG trade has significantly contributed to connect regional markets, but the fact that much of these LNG volumes are traded under long-term contracts, indexed to various price references, does limit the flexibility of supplying the markets throughout the world according to their needs, and this could reduce the potential for **structural markets integration**. Many flexibilities have been developed, including contractual flexibilities, which

<sup>18</sup> Wobbe Index (WI). The WI is a measure of the degree to which the combustion properties of one gas resemble those of another gas. The WI is defined as follows:  $WI = HHV / (Rd)^{0.5}$ , where Rd is the density of gas relative to the density of air. If two gases have the same WI then the energy input to the flame of a burner is identical, for a given pressure. The WI is expressed, like the HHV, in MJ/m<sup>3</sup> [Source: UIG PGCD Study Group]

allowed the availability of flexible gas, and the trade of this gas depending on the market needs either in the contract framework<sup>19</sup>, or often on a spot / short term basis.

Two drivers will be then discussed in order to understand the development of flexible trade in the global gas market: i) on the supply side, the prospects of flexible gas volumes availability and ii) on the demand side, the development perspectives of spot markets on the regional and on the global scale.

## II.1 Availability of LNG flexible volumes

In recent years, the flexible LNG volumes potentially available to the market have increased significantly and have supported the high growth of short term and spot LNG trade, which rose from 5 million tonnes in 2000 to 47 Mt in 2010<sup>20</sup>

### II.1.1 Driving factors for flexible LNG

In the past, flexible volumes were primarily related to volumes in excess of contractual commitments LT, which were available after the liquefaction capacity debottlenecking, or during the transitional period at the beginning of the life of LNG project (Ramp Up period)<sup>21</sup>. Indeed, differences could exist between the volumes produced and contractually delivered before reaching the level of contractual commitment<sup>22</sup>.

Often, these excess volumes are integrated into the LT contracts, and sold under the same conditions to LNG project clients. The placement of these volumes on spot markets has been boosted since 2000, with the development of this market.

Today, the sources of flexible volumes are diversified and are often left deliberately by the LNG project partners, to take advantage from spot market opportunities. We can identify three types of flexible volumes sources: Spare or uncontracted capacities, Long Term Contractual flexibilities and Portfolio gas suppliers' strategies;

#### a) LNG Spare Capacity

The excess capacity with regards to the contractual commitments may be related to the reasons above:

- Development of new LNG projects or expansion of existing capacities without firm commitment to full capacity. LNG plants debottlenecking can also be included in this way;
- Expiration of long-term contracts: These contracts could be renewed partially or not, depending on the conditions of supply and demand for LNG project partners.
- Imbalance between market demand and existing LNG capacities. Indeed, a decline in demand in the market may lead to renegotiate lower contract volumes, thereby releasing free capacity that can be directed to the spot market.
- Ramp Up Period for LNG projects to allow buyers to expand their volumes' take until reaching contractual commitments

<sup>19</sup> Operational flexibilities do exist in LT contracts, particularly in pipelines contracts which allow buyer to adjust its gas take depending on its market fluctuations and seasonality.

<sup>20</sup> [IGU LNG report, 2010]

<sup>21</sup> [J. Jensen, 2004]

<sup>22</sup> This period could last for years if buyers cannot absorb in a short time all the volumes produced from the new LNG trains.

## b) The contractual flexibilities

Flexible volumes could be released from long term contracts, having flexibility parameters that enable partners to adjust the volumes according to markets fluctuations or to divert gas to spot markets. These parameters include mainly.

- **The take or pay clauses:** Volumes beyond the minimum Take or Pay can be adjusted to the markets needs and seasonality or directed to spot markets. Note that these minimum Take or Pay level can be renegotiated depending on the conditions prevailing in the market targeted by the long-term contract. To do so, a renegotiation clause terms are often included in the LT contracts.
- **Destination flexibility:** the Atlantic basin LT contracts, particularly certain contracts with European countries<sup>23</sup>, often incorporate elements of destination flexibility, which permit to divert volumes to the spot market. Also, some FOB contracts, such as those established for LNG train in Trinidad & Tobago, give the buyers the opportunity to divert volumes toward attractive markets.

## c) Gas suppliers Portfolio Strategy

The worldwide development of the LNG industry has enabled the development of an arbitrage activity between markets having different prices and features. This activity was particularly intense in the Atlantic basin between open markets in North America and UK, and this has occurred before the unconventional boom reducing significantly US LNG imports.

The increase in arbitrage opportunities and market risks following markets liberalization have fostered the development of portfolio strategies by some gas suppliers, that was able to build a large portfolio of supplying sources and markets, and optimize their flows based on existing opportunities. So, this portfolio optimization requires great flexibility in volumes and access to transport and regasification capacities.

In order to have these flexible volumes, gas suppliers, participating in LNG liquefaction projects, have used the self-contracting strategies to contract volumes with marketing subsidiaries they own. The subsidiary could optimize its sales by selling directly to end customers, or direct the volumes toward markets offering higher Net Back, basing on the supplier portfolio. Indeed, volumes from the Self Contracting are integrated in the global supplier portfolio, and can be considered as flexible volumes.

These strategies have allowed the emergence of global players with a large portfolio of assets on the LNG supply chain (liquefaction, Tankers and Terminals), and combining their positions upstream and downstream gas to capture the opportunities for arbitration when and where possible. However, the very high cost of assets acquisition and of building flexible portfolio could compel these strategies and reserve them to some large players.

### II.1.2 Outlook for flexible LNG volumes

LNG flexible volume is very difficult to assess, because of difficulties to appreciate the various flexibilities, particularly contractual flexibilities.

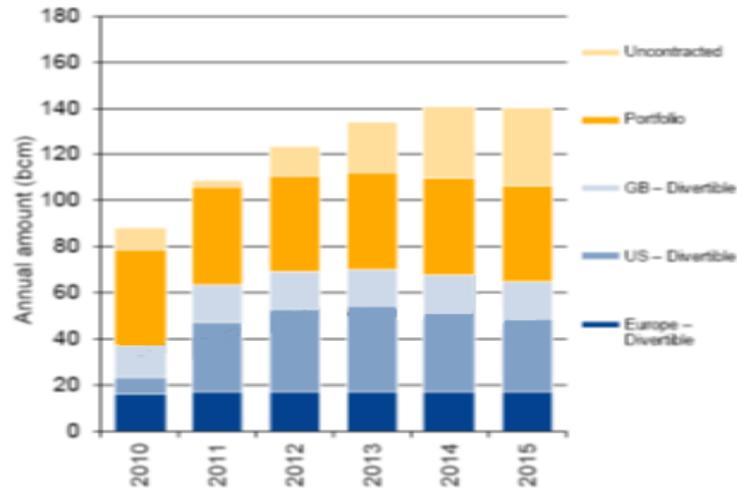
However, we can refer for indication to the PÖYRY estimates<sup>24</sup>, that amount the level of flexible LNG volumes potentially available on the market to about 84 bcm in 2010<sup>25</sup> (see chart below). These flexible volumes are broken down as follows:

<sup>23</sup>The clause has been disputed by the EU under its competition laws.

<sup>24</sup> Source : [PÖYRY, 2010]

<sup>25</sup> These volumes do not include those of the Pacific basin, estimated at around 5 bcm (Energy Charter, 2009); these flexible volumes are primarily related to some spare capacity due to uncommitted supply. However, flexibility in Pacific Basin remains low.

- Uncontracted volumes representing 8% of flexible volumes, are related to excess LNG capacity with regards to the contractual commitments (includes expiring contracts)
- Gas suppliers' portfolio representing 48% of total flexible volumes
- Divertible Volumes issued from the various contractual flexibilities of the Atlantic basin contracts, which represent 44% of flexible volumes.



Flexible Volumes Evolution  
Source: POYRY

Significant growth was observed in 2011, particularly because of the commissioning of new trains in Qatar which include much of the volumes contracted for the U.S. market, and potentially divertible to other markets.

The projections of these flexible volumes show a strong trend upward, reaching 140 bcm in 2015. This growth is particularly driven by the not yet contracted LNG capacities including new capacities and those released after the expiration of old contracts.

Consequently, the evolution of flexible volumes could be significantly slowed if the LT contracts continue to dominate the gas markets. Furthermore, markets conditions could also influence the delivery of these flexible volumes, if they are available, to the customers. In this regards, the pricing strategy of gas suppliers and markets conditions are fundamental conditions for the availability of flexible volumes and their delivery to the markets.

## II.2 The development of spot markets: Issues and Perspectives

Spot market<sup>26</sup> development, is an essential condition for the development of competition in gas markets. In theory, the spot prices reflect the supply / demand balances, and can transmit on that basis the price signals that are the market reference prices. Note that the confidence of the operators to these price signals in their deals, depends on the spot market liquidity and transparency.

Despite the growing trend of spot volumes traded, many uncertainties remain about the future development of these markets, their liquidity and price transparency

In order to appreciate the future prospects of Spot markets, we first examine the factors contributing to the development of these markets in the major consuming regions (regional scale), and then we will consider the factors affecting the development of LNG Spot trade on a global scale.

<sup>26</sup> Spot markets do not necessarily have trading floors. The term 'spot market' applies to all spot transactions concluded in an area where strong trading activities take place. [Energy Charter, 2007]

## II.2.1 Spot market development in the main consuming markets

### a. North America and the United Kingdom

Although there are differences between these two markets related to the size, development level and depth, and also to the structure of supply and demand, we can distinguish some common characteristics:

- Mature and liberalized markets with a large share of spot and short term transactions.
- Availability of domestic production, which facilitated the progress of reforms, by reducing the constraints on security of supply.
- Development of liquid Spot Markets at the gas hubs (eg HH and NBP), and predominance of price market mechanisms.
- Sophistication of these markets through the development of several trading products and financial instruments to hedge against risks.

Market Pricing mechanisms are strongly established in North America and the United Kingdom, and most of the volumes are based on spot prices. Consequently, a reversal from the Spot market development and their role is unlikely in these areas.

Despite the potential growth of spot traded volumes, owing to the possible increase of flexible Gas and arbitrage between NBP and HH, some issues do exist, mainly those related to i) the volatility of spot prices, and ii) the security of supply issues over the Long Term..

#### i) The price volatility

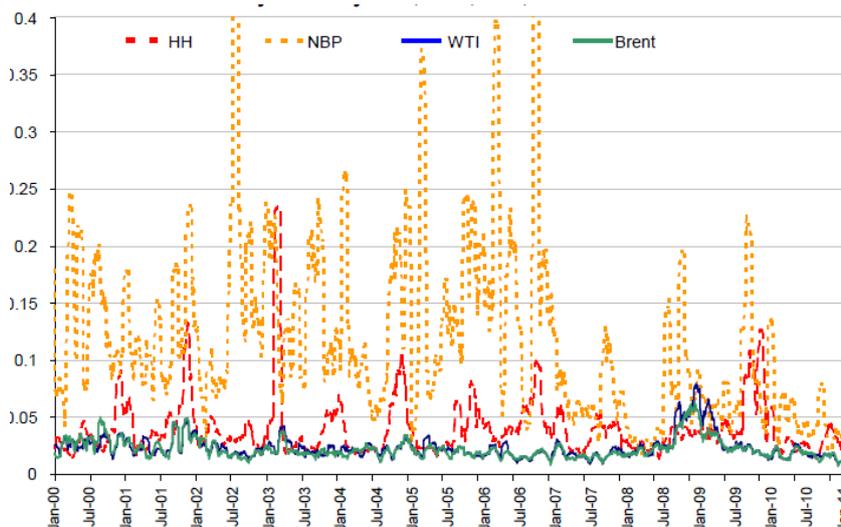
The spot prices volatility continues to be a topic of debate among gas actors, regulators and policy makers, in order to set up mechanisms to reduce its effects on the economy<sup>27</sup>. For US, one can wonder about the reasons of the volatility in this market characterized by a flexible and diversified supply base (including an important local supply) and a dense infrastructure of transport and storage. This should allow a supply response to the various changes. Indeed, many observers associate the volatility to the importance of speculation<sup>28</sup> in the price formation and to the strong market reaction to the frequent flows of information that characterize the energy and particularly the gas industry in US<sup>29</sup>.

The UK NBP spot prices have been characterized by higher volatility than the HH price, which is often attributed to the lower supply response to seasonal and variable demand. The decline of UK production, its high dependence on short-term supply and lack of storage capacity would expose the country to market fluctuations.

<sup>27</sup> [F. Whitman, M.J. Bradley & Associates, 2011]

<sup>28</sup> The use of financial instruments to hedge against price risks can mitigate the effect of volatility, but it might also have an amplifying effect, since it could lead to increase transaction costs which encourage speculation for increasing prices beyond the fundamentals.

<sup>29</sup> According to the estimates of the Natural Gas Supply Association, the U.S. production, transmission, and retailing markets include 160 pipeline companies, 123 storage companies, 260 marketing companies, and 1,200 local distribution companies,



### Volatility\* of HH, NBP, WTI, Brent

Source: Poten & Partners

\* Standard deviation of spot prices Log

Many tools are being used by the Gas actors in order to hedge against volatility, including on the one side physical tools like developing storage capacities and operating flexibilities, locking fixed price delivery contracts, or on the other side financial tools, such as futures and swaps or other derivatives like options. However, the specificities of gas market, the high volatility, and also the technical and economic rigidities of gas chains often make these mitigating tools more costly and risky comparing to the oil markets.

### ii) Security of supply issue over the Long Term

Indexing MT / LT contracts on volatile spot prices which dominate North American and UK markets is often considered as an unattractive option by gas suppliers that could prefer to supply these markets when prices are good and avoid them when not.

So, securing long term contracts may be a difficult task for buyers. Indeed, we can note that a large part of supply in these markets is based on domestic production and spot / short term transactions. In this Context, lack of contracts over the medium or long term periods could raise the security of supply issues, especially for UK where the main projections show a downward trend of its domestic production and also of contractual pipeline supplies.

### b. Continental Europe

The debate is intense among experts on the future of market mechanisms in Continental Europe. Several scenarios are considered including the establishment of an integrated and competitive market, promoted by the European Union, and the maintaining of existing mechanisms based on LT indexed contracts, which are defended by the main gas suppliers, and it should be noted, **have permitted the great development of the gas industry.**

The development of market mechanisms is conditioned by the evolution of spot markets, which depends on a number of factors including mainly: i) liquidity, ii) Price transparency, iii) Volatility iv) Security of long term supply and attractiveness of the European market; v) Gas supplier's strategy

## i) The liquidity

This is the major challenge for the development of spot and market based mechanisms in continental Europe and it depends on accessibility to markets and infrastructures, and the development of trading activity on the gas hubs

Despite the increase in volume trades on all of these hubs, they have not reached the level of liquidity required to establish relevant reference prices. The liquidity indicator most commonly used by analysts is the Churn Index<sup>30</sup>; this index fluctuates between 10 and 15 for the NBP, a level that recognizes the liquidity of this spot market.

The table below shows the levels of liquidity represented by the Churn index, and it may be noted that the most active gas hub outside NBP (Zeebrugge) remains well below the required level of liquidity.

	NBP	Zeebrugge	TTF	NCG	PSV	PEG	GASPOOL	CEGH
2003	11,64	3,78	1,77					
2004	10,37	3,88	2,70		1,10	1,50		
2005	9,31	4,96	3,05		1,30	1,48	1,33	1,14
2006	10,15	5,24	3,24	2,00	1,48	1,84	1,50	1,89
2007	13,51	5,09	3,69	1,61	1,69	2,18	2,18	2,57
2008	14,43	4,99	3,22	1,76	2,03	2,50	2,20	2,87
2009	13,62	5,03	3,04	2,24	2,14	2,85	2,22	3,00
2010	11,59	5,05	3,40	2,69	2,00	3,20	1,10	3,13

Churn index for the Europe continental hubs

Source: IEA

**What are the prospects of market liquidity?** : We can identify three areas, permitting to apprehend the future liquidity of spot markets in Continental Europe: i) market conditions (Over supply), ii) the role of hubs and their attractiveness for gas operators, and iii) the implementation of the 3rd Legislative Package.

**=> Market conditions (Over Supply) favourable to the development of trading in the context of the economic crisis, but these conditions are likely to change in the medium term**

The gas over supply has encouraged buyers to use spot purchases, and has increased trading activity at the hubs. However, the gas market is not immune from a turnaround, and many experts predict the absorption of over-supply beyond 2014<sup>31</sup>. The major gas suppliers recognize the temporary situation of this over supply market condition, such as Gazprom which has agreed to index some of its exported volumes to Germany on spot prices, for a limited period.

**=> Progress realized at the gas hubs, mainly in the North West Europe TTF, NCG and Zeebrugge, but the attractiveness and the prospects of liquidity remain uncertain.**

The seven continental hubs have experienced significant progress in both traded and physical volumes<sup>32</sup>, mainly for TTF, Zeebrugge and NCG, that represent in 2010 about 2/3 of the total volumes traded on all the continental hubs,

However, it should be noted that the progress of trading activity<sup>33</sup> and also the liquidity of these hubs would be related to prevailing market conditions in Europe following the economic crisis. The future of this activity remains uncertain, since it is conditioned by the

<sup>30</sup> which is the ratio of volume trades on the physical volumes traded,

<sup>31</sup> [A. Lecarpentier; Cedigaz; 2011]

<sup>32</sup> Source: [IEA MT Oil & Gas; 2011]

<sup>33</sup> Volumes almost doubled between 2008 and 2010

evolution of the market situation, the availability of flexible gas, and by the attractiveness of the hubs for gas operators. We can observe in this way that Zeebrugge, considered as the most liquid gas hub according to the Churn indicator in continental Europe is experiencing a relative stagnation with an index that is around 5 for several years<sup>34</sup>.

We can note also that the most important liquidity index (Churn index) has shown a non-stable behavior of the gas hubs liquidity, even for the NBP that is recognized as the most liquid hubs in Europe (see table above).

Another feature in Continental Europe hubs is the lack of trading products such as futures contracts that allow to hedge against risk. The development of these trading products could be compelled by the possible future regulation of financial markets.

**=> The liberalization reforms in the 3rd legislative package aims to promote accessibility and facilitate the trading, but heterogeneity of markets, and difficulties in implementing these reforms could compel their progress<sup>35</sup>.**

The adoption of the 3rd Legislative package in 2009 by the EU marked a new phase in the reform process of the gas sector in Europe. This legislative package is based on some principles and mechanisms aiming to accelerate the development of a competitive market including mainly: i) Accessibility to gas infrastructure; ii) Long-term investment for the development of new cross-border capacities; iii) Consistency in the functioning of markets and neighbouring networks (Regional Consistency, Market coupling); iv) Strengthening the coordination of regulation between countries (the creation of a European regulatory agency); v) The reduction of market concentration and market power of large operators, by establishing the Ownership unbundling,

Beyond these principles, the difficulty remains in the details of implementation, and some uncertainties do still exist such as<sup>36</sup>:

- The European economic crisis could bring back national protectionism, reducing access to markets to new operators<sup>37</sup>.
- The reliability of capacity allocation, and access regimes for storage and LNG capacity.
- The risks in investment decision process for the creation of additional infrastructures
- The cost of reforms in the context of economic crisis.

## ii) The price transparency

Transparency in the functioning of spot markets is an important factor that permits to competing operators, a non-discriminatory access to markets, and thus enhances the liquidity and enables the development of trading activity (physically and also financially).

Transparency Improvement is based on effective regulation and communication that reduces barriers and asymmetric information. However, it remains heavily influenced by the degree of maturity and market concentration.

<sup>34</sup> In addition, the merger of the markets in Germany, reducing stress and transit accessibility, and also the limitations introduced by the regulator on the long-term relationships linking suppliers (Wholesalers) and customers, have increased the trading activity, particularly in the NCG, which became the largest gas market place in Germany, but the future of this trading activity is particularly dependent on the flexible volumes available for this market dominated by the Russian gas. [Peter Hughes, 2011]

<sup>35</sup> Source: [N. Haase; 2008]; [C. Lyle, EFET, 2011].

<sup>36</sup> Sources: [C. Lyle, EFET, 2010]. [A. Williamson, Gazprom M&T, 2011] ; [A.Siri, EFET, 2011]

<sup>37</sup> It may be noted that some resistance were often displayed by countries that have expressed a preference for the emergence of champion's gas rather than fragmentation which could weaken the bargaining power of European operators.

### **iii) The volatility and lack of development of hedging mechanisms**

Volatility is often cited as a normal part of the development of market mechanisms. It is the result of the need to balance supply and demand, but the magnitude of this volatility can be very important in under-developed organized markets, lacking maturity and liquidity.

Spot price volatility on the Continental Europe markets could see a growing trend due to the low and uncertain process of reforms maturation, and also to the uncertainties characterizing the global economy and in particular the economies of major European countries. We note that this volatile and risky environment does not encourage heavy and expensive gas supply chain investment.

In addition, gas hubs in continental Europe do not offer enough trading products for hedging against price risks.

### **iv) Security of long-term supply (attractiveness of the European market)**

The increase of the energy dependence in Europe raises the problem of security of supply at the heart of concerns. Indeed, additional gas imports are needed from new sources in the supplier countries, but Europe has to compete in the global market, to attract this additional supply, especially with the Asian markets that remain largely dependent on long-term indexed contracts.

In addition, price fluctuations on the spot markets in Europe, is an important risk for the long term investment decisions, and it could bring some difficulties to secure adequate funding for projects (problem of projects bankability), leading to under-investment, or to the orientation of these investments toward destinations that could provide better security.

A number of long-term contracts will expire on the medium term, and renewal of these contracts on a spot basis would be uncertain, as the exporters are not very keen to link significant gas volume on spot volatile and unpredictable prices.

Consequently, supply security issue remains a real obstacle to the development of European spot market mechanisms

### **v) Gas supplier's strategy**

The pricing strategy of external suppliers to Europe is an important parameter. The main gas exporting countries that are members of GECF continue to defend the oil indexed LT contracts, They aim, as we can see in their official declaration<sup>38</sup>, to maintain gas to oil/oil products indexation with the objective of an oil and gas price convergence, with regards to the advantages of gas both in terms of energy efficiency and environmental premium.

In addition, GECF countries consider the need of Long Term Contracts in order to achieve a balanced risk sharing mechanism between producers and consumers.

### **c) Asia Pacific**

Spot and Short term LNG transactions in the Asian markets are based on bilateral relationships between buyers and sellers, and are more driven by seasonal or unpredictable events than by the development of gas competition through a liberalization process. In fact, the liberalization reforms that were launched in some countries in the region have been slowed because of security of supply challenges.

So there are no gas hubs that permit to organize a trading activity; the latter responds to short term arbitrage opportunities for providing complementary volumes to the long-term indexed contracts.

In order to analyse the prospects for the spot market in Asia, we consider three factors that

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<sup>38</sup> Doha Declaration; The First Gas Summit of The Heads of State and Government Of GECF Member Countries; 15 November 2011 , DOHA, QATAR

influence this development: i) Security of supply, ii) the influence of developments seen in the Atlantic basin, and iii) the potential emergence of indexing references other than oil price.

### **i) Security of supply**

Faced with an almost total dependency on imported LNG, and limited competition on the gas markets, Major Asian LNG Buyers have a great sensitivity to the issue of security of supply, and favours a portfolio dominated by a stable and reliable supply, The emergence of new importers such as China and India, with large and growing needs, could influence the gas balance in the region. These actors have managed to secure some LNG contracts with relatively low prices), that led to some downward pressure exerted by other importers on their suppliers, but the supply problems from Indonesia, and particularly nuclear recurring incidents in the region brings back the challenge of security of supply to the heart of the regional concerns.

### **ii) Implications of developments in the Atlantic Basin**

We have seen recently increasing arbitrage opportunities between excess markets in Europe and North America, and growing import markets in Asia. Thus, Increasing volumes have been directed to the Pacific basin on a spot basis. So, is it possible that this evolution encourage the development of organized and liquid spot markets in Asia, supporting trading activities and providing relevant price references to gas operators? Market structure and slower liberalization process constraint the development of organized spot markets and competitive pricing mechanisms. To date, the Asian LNG spot prices are based on Border Prices collected from the main bilateral transactions that lack of transparency and liquidity. It's likely that the spot volume remain a complementary volume to the long term contracts in Asia, responding to short term opportunities.

### **iii) Indexing reference alternatives to oil prices**

Asian contracts are dominated by the JCC as an indexing reference, it is uncertain that the other alternatives such as LNG spot prices or Atlantic basin references (HH, NBP), that are volatile and reflect different equilibrium conditions than those of the Asian markets, can develop with regards to the stability and reliability requirements in Asia. In addition, the value of natural gas is still connected to the petroleum products, since they remain the alternatives sources in other than power generation sectors in Asia. Note that these sectors have a dominant share in the natural gas consumption with a growth potential in emerging markets especially China and India.

### ***II.2.2 Spot LNG development on a global scale***

Following section tries to identify the main drivers of spot LNG growth on the global scale. So, spot and Short-term LNG trades have traditionally been used to meet the needs to balance short term supply and demand, and it represented a small share of the global gas trade, because of technical, economic and contractual rigidities characterizing the LNG activity. However, in recent years, these Spot volumes have experienced significant growth. Although much of these volumes are driven by unpredictable events, structural factors have also emerged and become determinant to the future developments of Spot LNG market, namely: i) The increasing connection of regions and markets that permit to increase the opportunities for trade between diverse sources and destinations; and ii) Development of flexibilities providing free gas volumes that could be directed to the spot market. This point is discussed paragraph II1.

In general we can say that the LNG spot market is driven both by short-term factors, and by structural medium / long term factors. Despite the observed growth trend, the spot market is not immune to go down on the short-term because of reducing opportunities (-18% of

decline in 2008 comparing to 2009)<sup>39</sup>, or also on the medium / long term because of the following reason:

- Changes in the supply / demand balance (US unconventional gas, Strong demand growth causing a return to tight market conditions).
- Consuming markets supply structure (importing countries strategy, security of supply issues, Pipeline / LNG competition)
- Slowdown of the liberalization process impeding the development of the spot at the gas hubs and reducing operators accessibility
- Pricing strategies of gas suppliers

Spot LNG market could therefore be subject to wide fluctuations in response to unpredictable events, and its development is subject to great uncertainty. This makes very uncertain the emergence of a global reference price of LNG.

## Conclusion

This paper aims to analyse the prospects of the various factors contributing to the globalization of the natural gas market, and to highlight its limits. In this regard, we have analysed in the first step the main drivers that enable to improve links and gas trade between regions, especially LNG trade considered as the vector of the globalization process, and in the second step the drivers that permit to develop the trade of flexible gas.

Our analysis points out that the large uncertainties on the globalization driving forces do not support the trend towards this globalization.

So, despite the outlook of increasing inter regional gas trades, and in particular LNG trade that would experience, according to the main projections, faster growth than pipelines and thus contribute to connect distant gas producing and consuming areas; many uncertainties are characterizing these projections. Indeed, the uncertain evolution of regional Supply / Demand Balances could affect directly and reduce the needs to import gas volumes from other regions. This situation has already been seen in North America with the boom of unconventional.

We note that although the gas markets are moving towards more geographical and contractual flexibilities, the outlook for flexible gas trade remains uncertain and driven by short-term opportunities. The strategy of the actors and their risk aversion is an important determinant in the development of flexible gas trade.

The development of liquid and transparent spot markets in continental Europe and Asia are also characterized by a lot of uncertainties. Despite an observed increase in traded volumes in the main Continental Europe Gas Hubs, particularly in the North West, this progress is mainly driven by gas over supply conditions that could not persist over the medium and long term. In addition, the liquidity is still an issue for these hubs; we can note that the most important liquidity index (Churn index) has shown a non-stable behavior of the gas hubs liquidity, even for the NBP that is recognized as the most liquid hubs in Europe.

Security of supply in Europe and Asia remains the major challenge and could significantly slow the process of liberalization as already observed in Asia Pacific. So, Long Term and Medium term contracts would continue to play a major role, since they offer better visibility, security of supply and of demand, cash flows sustainability for the gas chain that remains highly capital intensive. In this regards, the main gas exporting countries continue to defend Long Term oil indexed contracts, since they permit to achieve a balanced risk sharing mechanism between producers and consumers and to take account of the gas advantages and its environmental premium.

Consequently, technical and economic rigidities that characterize natural gas chains, particularly the high costs, would make duplication of the current oil market model unlikely.

<sup>39</sup> Source : IEA WEO 2009

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