

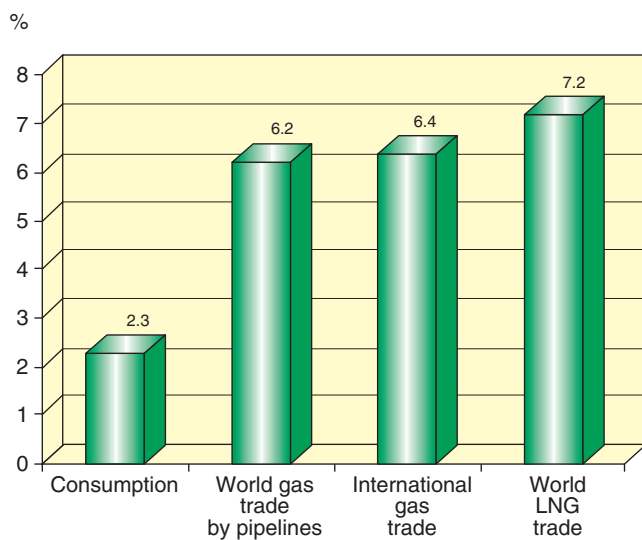
# LNG: A Commodity in the Making

*Although still far from being a commodity, LNG is undoubtedly emerging as an essential vector for world gas expansion. The flexibility it procures in terms of supply is of prime importance for future market equilibrium. Despite a number of uncertainties and constraints liable to thwart the realisation of the most optimistic growth prospects, the LNG trade remains wedded to rapid growth of about 7%/year by 2020, boosting its share of world gas trade to some 38% by that horizon.*

The earliest experiments in natural gas liquefaction date from 1934 in the USSR and 1940 in the United States, but only in 1961 was the Camel project initiated, the first LNG transport project in the world designed to export gas from Hassi R'Mel in Algeria. Since the plant started producing and making its first commercial deliveries to the British Canvey Island terminal in 1964, the LNG industry has made giant strides.

While its share of the total volume of gas marketed each year can be considered quite modest at just above 6%, the growth of world LNG trade has regularly outpaced that of international pipeline trade.

Fig. 1 Gas growth rate (1995-2005)

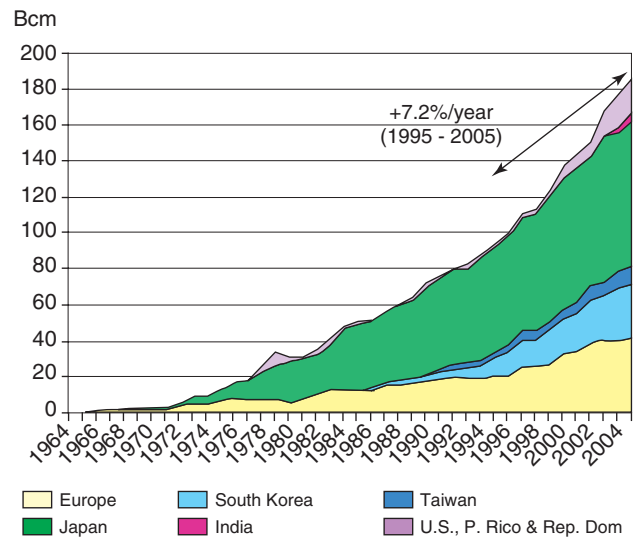


\* (not including intra-CIS trade).

Source: Cedigaz.

Over the last ten years, international LNG tanker trade has increased by 7.2%/year on average, reaching about 187 Bcm (138.5 Million tons) in 2005, according to preliminary Cedigaz estimates. Over this period, international gas trade by pipeline (not including intra-CIS flows) has grown by about 6%/year only.

Fig. 2 Evolution of international LNG trade



Source: Cedigaz.

Driven by many favourable fundamentals, there is a general consensus in the industry today in favour of steady future growth in LNG trade. With reasonably optimistic assumptions, it is conceivable that international flows by LNG tanker will grow rapidly to 196-232 Mt in 2010 and 310-375 Mt in 2020, rising about 6.9%/year on average over the next fifteen years.

With this powerful trend, faster than the growth of pipeline trade, the LNG share of world gas trade could reach about 38% by 2020, compared to 22% today.

## The Fundamentals of LNG Growth

### “Traditional” Factors

The uneven distribution of gas resources and their increasing remoteness from the main consuming regions, combined with the difficult — even impossible — rebalancing of gas markets by pipelines, make LNG the option of choice for:

## LNG: A Commodity in the Making

- Emerging or mature importing countries, seeking flexibility in gas supplies to better adjust supply to demand on their markets. The excellent modularity and progressiveness in building new regasification capacities meets this requirement adequately.
- Monetizing a large volume of “stranded” resources located in areas difficult to access by pipelines (Irian Jaya in Indonesia for instance). In the future, producing offshore medium-size fields with floating liquefaction plants could represent a further development option.
- Diversifying supply sources and routes to break away from related transit risks (security of supply issue).

### New Favourable Fundamentals

On top of these traditional factors giving LNG the advantage, are the fundamentals resulting from recent developments in the gas industry:

- Higher gas prices on some markets (North-America, and Europe) tend to favour the growth of LNG, which, despite cost cutting efforts, globally remains more expensive upon reception on the purchaser’s territory than piped gas.
- The stagnation of local production in the United States and the rather rapid decline of gas output in the British North Sea.
- The emergence of big new markets in Asia: India and China.
- The liberalization of energy markets which has shaken up traditional industrial structures, in the diversification of contractual terms (abandon of destination clauses) and in the proliferation of players and commercial flows, tend to favour the development of independent LNG import-export pools.

### Challenges and Constraints Moderate the Most Optimistic Forecasts

Whereas the Asian countries — Japan, South Korea, Taiwan — have, until now, driven worldwide LNG growth, the industry henceforth largely builds its expansion strategy on promising demand prospects from new markets: the United States and the United Kingdom in the Atlantic basin, China and India in the Pacific basin.

Although supply problems in these countries (stagnating domestic production in the United States and decline in the United Kingdom) and skyrocketing gas needs (India, China) could actually imply a major contribution from LNG, their demand growth potential remains beset by risks and uncertainties.

### High Gas Prices Militate Against Demand?

Since the turn of the century, constraints associated with American production capacity have driven gas prices on this market to record highs. The price at the Henry Hub, the reference for the US market, has gradually risen from \$1.5/MMBtu in the early Nineties to \$3.9/MMBtu on average in 2000 and \$8.5/MMBtu in 2005.

The persistence of high gas prices risks hobbling anticipated demand for LNG on the American market in particular because:

- it opens access to local gas reserves heretofore too expensive to develop, thereby slowing down the decline of domestic production;
- it revives plans to develop a pipeline from Alaska (negotiations are currently underway with the State Government of Alaska). According to the long-term energy demand analysis recently published by the Energy Information Administration (AEO2006), this pipeline could start operating as early as 2015;
- it prompts the largest industrial users to turn to alternative energies, as in the past, when they chose natural gas because of its low price;
- it encourages power companies to invest increasingly in new “clean coal” technologies and power generation from coal, and renews the debate on the comeback of nuclear energy.

Soaring gas prices, both on spot markets and in long-term gas purchase contracts indexed to oil prices, could also negatively impact the potential demand from new countries (India, China) whose gas industry is only in its infancy but where LNG is emerging as the privileged option.

In these countries, demand to price elasticity is potentially very high. Until now, the import companies, Petronet LNG in India and CNOOC in China, have negotiated special terms and LNG purchase prices far below the price generally applied in international sales contracts. Petronet LNG has secured from Qatar a fixed price of \$2.35 /MMBtu (fob) for imports over 5 years. CNOOC got a fixed price of \$2.2/MMBtu (fob) from Australia’s Woodside LNG and negotiated a price of \$2.4/MMBtu (fob) for its LNG purchases from the Tangguh project in Indonesia. Eager to work the most profitable markets to get the highest price for their gas resources, producers are unlikely to accept such contracts any more. The stumbling block of low prices demanded by Indian and Chinese companies against the high prices asked by producers may well, to some extent, deprive the LNG industry of these new markets.

### Competition with the Gasline Option

Exacerbated by the potentially destructive effect of lasting high prices on gas and LNG demand (including in Europe), is

# LNG: A Commodity in the Making

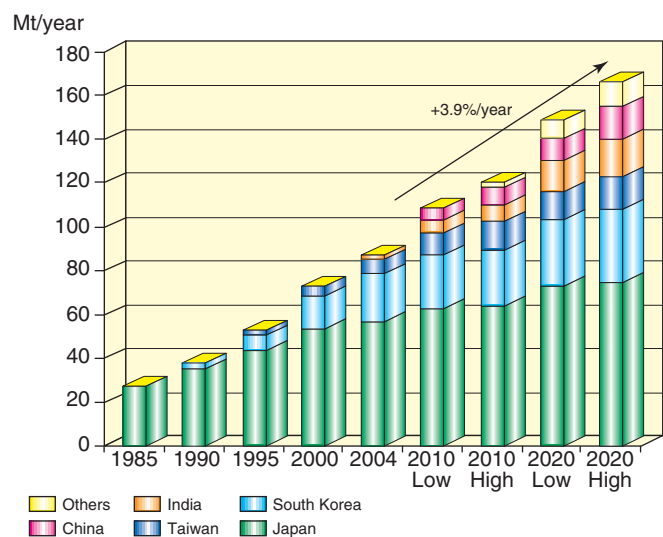
fierce gas-gas competition. The European market is certainly the most representative example. Besides intra-European production (including Norway) which accounts for 59%, a major share of outside gas supplies are currently piped from Russia, Algeria and Libya, with only 7.8% for LNG imports by tanker.

Although the need to diversify supply sources remains a major concern, and tends to favour LNG, traditional pipeline suppliers are slated to satisfy a major share of additional gas demand in Europe. New export corridors (Langeled from Norway, Medgaz and Galsi from Algeria, NEGP from Russia, Nabucco from Central Asia) are under construction and planned. In the medium-term (2010-2013), additional capacity of about a hundred billion cubic meters/year could be operational, delivering large gas volumes at a competitive price compared to LNG.

## Markets East and West of Suez: Contrasting Growth Rates

Cedigaz forecasts that world LNG demand could increase by about 6.9%/year over the next 15 years, approaching 375 Mt/year (506 Bcm) in 2020. The growth rates of markets East and West of Suez should, however, display glaring contrast.

Fig. 3 LNG demand prospects East of Suez



Source: Cedigaz.

**East of Suez**, LNG demand could account for about 45% of the world total in 2020, posting an increase of about 4%/year over the period. At least in the short- to medium-term, Japan is likely to provide a significant impetus to LNG tanker trade in the region. The “S-curve” price formula that limits the impact of high oil price increase for the buyer, makes LNG

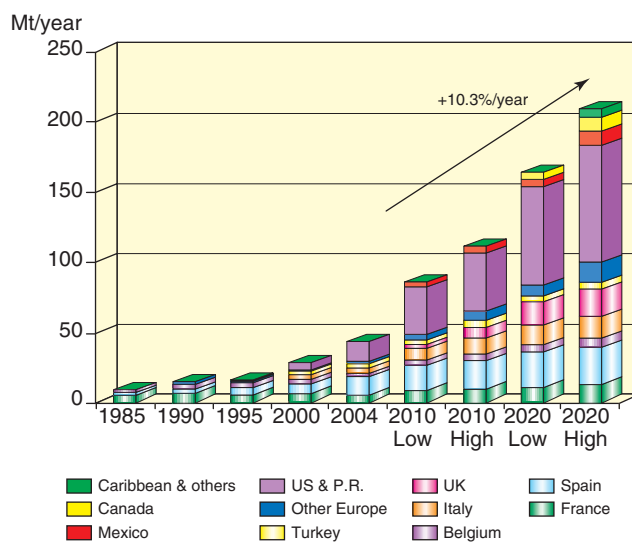
more competitive. In South Korea, sales to city-gas are increasing steadily, while demand from the power sector is more volatile, in line with price fluctuations. This sector is now open to competition. Posco and SKPower have their own import capacities.

Although many new LNG receiving terminal projects had initially been announced in India and in China, most of them have been cancelled due to rising prices and a willingness to rationalise the construction of infrastructures. In India, where a “moderate” LNG price is probably the key to its expansion, at least in the medium-term because local prices are heavily subsidized, only the capacity extension of the Dahej terminal (Petronet LNG) to 10 Mt/year seems realistic by 2010-2011. Since cargoes received at Hazira terminal (Shell/Total) remained unsold because local customers were asked to pay too high prices, the capacity of the facility is barely exploited. In China, two terminals (Guangdong and Fujian) will receive their first cubic meters of LNG in 2006 and 2008/09 respectively. The likelihood of another terminal being built by 2010 is rather slight. The construction of new facilities is contingent on the LNG price that importing companies will be able to get. In Indonesia, the planned construction of two receiving terminals in Java responds to the government strategy to prioritise the supply of the domestic market.

Other terminals, planned in Chile and on the Pacific coast, could have a future impact on the development of flows and prices in the Pacific basin.

**West of Suez**, the Atlantic basin could experience faster growth of about 10%/year and account for about 55% of world LNG demand by 2020.

Fig. 4 Potential LNG demand West of Suez



Source: Cedigaz.

# LNG: A Commodity in the Making

In the Atlantic basin, which already has receiving capacity of about 80 Mt/year, some fifty regasification terminals are being built or planned. Although most of them are extremely unlikely to materialize, these projects attest to the dynamism and the optimistic vision for LNG that the companies demonstrate on these markets.

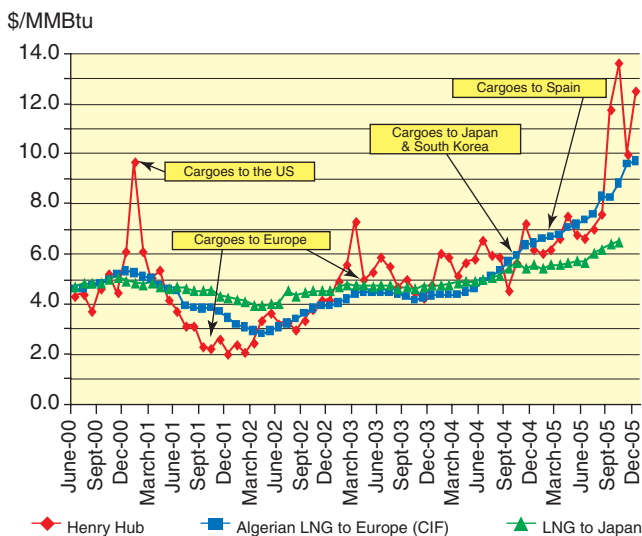
Table 1  
LNG receiving capacities in the Atlantic Basin  
(Mt/year)

	Existing capacity	Under construction & approved	Planned	Total (existing & potential)
North America	33.8	+ 172	+ 280	<b>485.8</b>
Europe	46.4	+ 42	+ 90	<b>178.4</b>
<b>Total</b>	<b>80.2</b>	<b>+ 214</b>	<b>+ 370</b>	<b>664.2</b>

Source: FERC and data compiled by Cedigaz.

Even if the scale of the demand growth rate is still uncertain, LNG will very likely have a major and increasing role in the Atlantic. The main uncertainty surrounds the impact which price arbitrage could have on the distribution of volumes between the two markets, American and European.

Fig. 5 Price arbitrage develops among markets



Source: MITI, WGI.

The high gas price on the American market is already significantly affecting LNG sales in the Atlantic. It is becoming the “benchmark” already determining the final destination “spot” LNG in particular, as producers and importers shuttle their cargoes to the most lucrative market. In the future, a massive

shift of LNG volumes to North America could force European terminals to operate well under capacity.

## Supply is Highly Concentrated

The growth potential of LNG demand, combined with the discovery of large gas resources in new areas (Egypt, Peru, Barents Sea) is encouraging national and international companies to invest massively in liquefaction plants. Shared among thirteen countries, current world liquefaction capacity of 176 Mt/year (238 Bcm) is therefore slated to increase sharply.

Many projects representing additional capacity of about 220 Mt/year, are under construction or planned to meet future requirements. Should demand grow as anticipated, all the new capacity (some of it difficult to develop) will be needed. Besides, to secure a safety margin (about 20%) to contend with unforeseen interruptions and serious incidents on certain plants, several new projects will have to be implemented, in addition to those already announced by 2020.

### Atlantic Basin Producers

Five Atlantic basin countries currently have liquefaction capacity of 62 Mt/year. New plants under construction in Norway (Snøhvit LNG) and Equatorial Guinea (EGLNG), and new trains and debottleneckings on existing plants, will add about 20 Mt/year capacity by 2010. Beyond 2010, new projects in Angola, Russia (Shtokman, Ust-Luga) and Nigeria (Brass LNG, Olokola LNG), as well as further extensions to existing plants, could boost total production capacity in the Basin to about 150 Mt/year by 2020.

### Pacific Basin Producers

Although its share has decreased significantly in recent years, Asia still hosts 40% of the world’s liquefaction capacity. However, Indonesia will relinquish its leadership as early as 2007, when Qatar’s capacity reaches 30 Mt/year.

Liquefaction capacity in the Atlantic basin, currently amounting to 72 Mt/year and mainly shared among four countries (Australia, Brunei, Indonesia and Malaysia), will continue to grow to reach 96 to 98 Mt/year by 2010, or even 120 to 125 Mt/year in 2020.

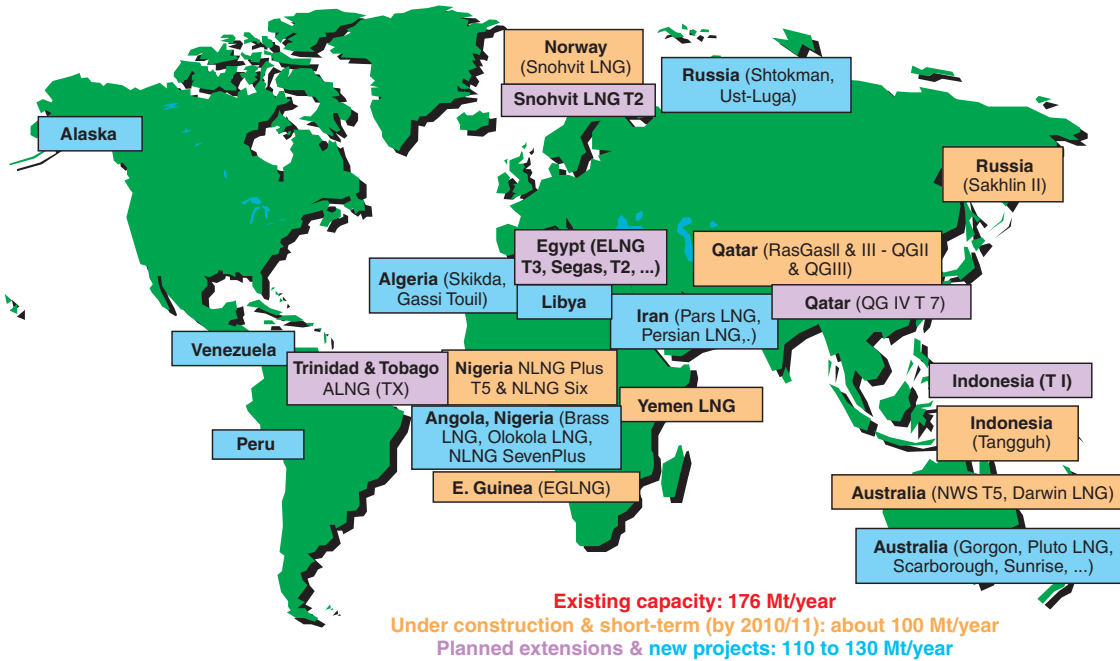
However, apart from Australia, new capacity will primarily be built in new producing areas (Sakhalin, Peru). Although Indonesia is still number one in terms of liquefaction capacity (28.8 Mt/year), it currently faces substantial problems that jeopardize its future LNG exports:

- the decline of reserves on fields which supply the Arun liquefaction facilities and which has already caused the shutdown of two of the plant’s trains;

# LNG: A Commodity in the Making

Fig. 6

Liquefaction projects worldwide



Source: Cedigaz.

- difficulties in producing some of the fields supplying Bontang;
- the government's clear determination to supply its domestic market (fertilizer industry in particular) and limit LNG exports. In 2006, LNG purchases by Asian buyers will be reduced by about 60 cargoes.

## The Middle-East, Supplier to all Markets

With about 34% of worldwide proven reserves, the Middle-East countries currently producing LNG (Abu-Dhabi, Oman and Qatar) and future suppliers (Yemen and Iran) are bound to become a major supply source for Atlantic and Pacific markets. Existing capacity of 42 Mt/year should have doubled by 2010 to about 93 Mt/year, with the coming onstream of new trains in Qatar — Qatargas II, III & IV, RasGas II T5 and RasGas III will boost the country's capacity to 77 Mt/year — and the Yemen LNG plant.

New installations, planned in Iran in particular, could subsequently raise capacity in the region to about 120 Mt/year.

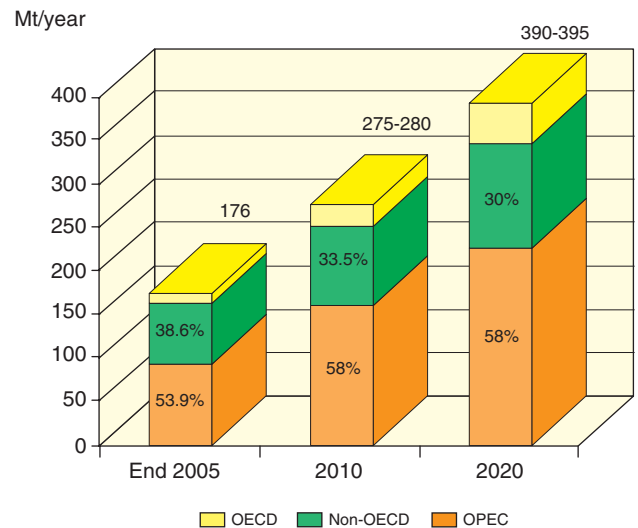
Despite the long distances from Atlantic markets (United States in particular) and Pacific markets (with exception of India), the Middle East stands at the supply crossroads. Adding its huge potential reserves, this area is destined to play a crucial role in world LNG supply.

## OPEC Countries Dominate

Most LNG projects due for development in the next 20 years will be located in non-OECD countries, the main exceptions being Australia and Norway. The OPEC countries, where gas reserves account for 50% of the world total, exported 77 Mt (104 Bcm) of LNG in 2004 (58.5% of world LNG trade).

Fig. 7

World potential supply of LNG



Source: Cedigaz.

# LNG: A Commodity in the Making

By 2020, their exports could reach about 225 Mt, boosting their share of the world gas trade to about 60%. Combined with other non-OECD countries, some 88% of international LNG flows will come from these two areas.

Although this dependence may fuel concerns in terms of security of supply, mirroring the oil situation, recent developments in company strategies are tending to allay these concerns. The increasingly tangled inter-relationships and mutual holdings of the players all along the gas chain will mitigate the risk of actor impinging on prices and production capacity.

## LNG: The Locomotive of the World Gas Market

Gas markets, hitherto regional, are now opening to the world, as interactions intensify with the development of new supply routes.

Although transportation costs remain a major factor somewhat governing the final destination of traded volumes, the flexibility offered by the maritime option makes LNG the means of choice for the creation of a global gas market. "Spot and short-term" transactions in particular should grow very significantly from the current 10% to probably 30% of world trade within the next ten years or so.

Nevertheless, this rapid growth of LNG faces many challenges and cannot be expected to proceed without some aches and pains.

### Colossal Investments

While rising gas prices increase their feasibility, colossal investments, often spread over rather short periods, are needed to build infrastructures, estimated by the International Energy Agency in its *World Energy Outlook 2003* at

250 billion dollars over the period 2000-2030. And the vigorous economy drives that largely contributed to give LNG a new impetus are probably due to slacken, at least in the medium term. Although the industry aims to expand liquefaction trains and tankers capacity to improve project economics by the effect of scale, the abundance of orders placed with contractors building liquefaction plants and shipyards for LNG tankers will erase the profits, in most cases, anticipated from these developments and push up costs. As an example, the price of a standard-size LNG tanker (145,000 m<sup>3</sup>) is currently about 200 million dollars, compared to 155 million dollars in 2002/03. By the end of this decade, the LNG tanker fleet will number 320 ships, compared to 191 in December 2005.

These trends also imply many constraints, stemming from the limited availability of crews to run the fleet and the significant increase in maritime activity in some transit routes such as the Suez Canal.

## Conclusion

Greater flexibility, fluidity and diversification of sources and supply routes. These are the watchwords the gas industry will have to heed as it moves toward more globalisation.

Despite the many obstacles that the operators will have to overcome, particularly to deliver to the market, at the right time, the volumes needed to satisfy demand, LNG remains the privileged option to secure an harmonious development of the gas expansion.

*Marie-Françoise Chabrelié, Cedigaz  
m-francoise.chabrelié@ifp.fr*

*Final text received on January 17, 2006*



### IFP (Headquarters)

1 et 4, avenue de Bois-Préau - 92852 Rueil-Malmaison Cedex - France  
Tel.: +33 1 47 52 60 00 - Fax: +33 1 47 52 70 00

### IFP-Lyon

BP 3 - 69390 Vernaison - France  
Tel.: +33 4 78 02 20 20 - Fax: +33 4 78 02 20 15