

CONTRIBUTION OF NATURAL GAS FOR SUSTAINABLE DEVELOPMENT IN PORTUGAL

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ABSTRACT

Portugal has strongly limited domestic energy resources, since imports almost 90% of its energy needs and its energy production is totally from renewable energy sources.

The addition of natural gas to the Portuguese energy mix in 1997 helped to diversify Portugal's energy sources and is a contribution to the mitigation of environmental problems. In 1997 also ceased the production and use of domestic coal.

In fact, Portugal is working to reduce the growth in energy use and CO₂ emissions, in order to follow the Kyoto Protocol.

This measure can be linked to environmental sustainability policies, creating the opportunity for new business to appear. Natural gas, in some applications, can substitute the electricity, implying a decrease in price.

Security of gas supply is an important issue, since Portugal depends mainly on a single supplier.

This paper aims at analysing the emerging gas market, (threats and opportunities), its evolution and comparison with other OECD countries.

Keywords: Energy consumption, Energy diversification, Environment, Sustainability, Industrial pollution, New business.

INTRODUCTION

In the industrialized world, among the major fuels, natural gas will have a large contribution to the expected increment of energy consumption. Due to its environmental and economic advantages, it

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is also increasingly becoming the fuel chosen for new power stations [International Energy Agency, 2002]. At the same time, in the developing countries, increments in the natural gas utilisation are expected to support both, power generation and industrial additional uses.

Over the past several decades, oil has been the world's foremost source of primary energy consumption, and it is expected to remain in that position until, at least, 2025. Oil's share of world energy, will drop only slightly in the forecast, from 39% in 2001 to 38% in 2025, despite expectations that countries, in many parts of the world, will be switching from oil to natural gas and other clean fuels for their electricity power generation [International Energy Outlook, 2003]. Growth in the transportation energy use, overwhelmingly fuelled by petroleum products, is expected to continue over the next 20 years. As a result, oil is projected to retain its predominance in the global energy mix.

Natural gas is projected to be the fastest growing source of primary energy. In the world, during the period 2001-2025, the consumption of natural gas will nearly double, to a value of 176 trillion cubic feet in 2025. Also, in the developing world, the natural gas growing will be strong, averaging 3.9% per year between 2003 and 2025. This reflects the growing popularity of the fuel and indicates that the natural gas markets, namely those of emerging countries, will develop quickly in the next years.

Natural gas is expected to surpass the coal use by 2005 (on a Btu basis) and by 2025 it is expected to exceed the use of coal by 31%, [International Energy Outlook, 2003].

The energy sector has been actively discussed in the past and recent years, for instance in the Rio (1992), Kyoto (1997) and Johannesburg (2002) Conferences. The present interest reflects various factors, and among them it can be mentioned the higher and more volatile energy prices, the vision of sustainable development, the growing of geopolitical concerns, the increase of instability and insecurity, and the implications of the terrorist attacks in New York on September 11th, 2001.

Security, sustainability and affordability of energy supplies remain a central objective of energy policies. Now studies and discussions have to be done, namely in the European Union, in order to examine how energy security can best be ensured in the context of liberalised markets and environmental constrains [European Commission, 2001].

The reform of the natural gas sector is well under way in OECD and UE countries, and is spreading to other parts of the world. It already brought to many customers an alternative choice of suppliers and services, although in some countries, until now, only a few customers have made use of the option. Natural gas prices, however, do not necessarily drop as a result of market reform, since prices are established under long-term contracts and are still predominantly pegged to the development in the prices of oil products. However, in the near future, it must be considered the fact that the natural gas known reserves have been increasing continually and they correspond today over seventy years of world present consumption. This estimate is higher than the oil reserves that round the fifty years of consumption.

Natural gas is the cleanest of all fossil energies and represents today the unique known energy fossil source that is able to conciliate the response to the energetic needs of the global economic world increase, with the necessary environmental sustainability.

Basically environmental sustainability represents a responsibility for the present generation, linking the environmental protection, economic development and welfare of today and tomorrow. The excessive consumption of today's natural resources should be analysed and stopped, allowing their continuation for the consumption needs of future generations. Environmental sustainable development creates several business opportunities, including new business processes with reduced external impacts, improved financial performance, and enhanced reputation among communities,

customers and stakeholders. A clever management approach allows companies to increase pollution prevention and recycling that are techniques used to translate policy objectives into practice.

Next section introduces the environmental sustainability and sections 3 and 4 analyse the international and national markets of natural gas, respectively. The natural gas opportunities and treats are introduced in section 5 and the paper ends with some conclusions.

ABOUT ENVIRONMENTAL SUSTAINABILITY

Natural gas represents the cleaner fossil source of energy that better preserves environmental sustainability.

The concept of sustainable development was introduced by the first time in the Brundtland Commission [World Commission on Environment and Development, 1987]. Basically it was presented as a responsibility for the present generation, in order to avoid a large consumption of today's natural resources, allowing their continuation for the consumption needs of future generations.

The sustainable development can be focuses as the linkage of environmental protection, economic development and welfare of today and tomorrow's generations [European Commission, 2000a, b]. It should be an approach centred on investment, including the rate of return, and on equity issues, within and between generations [Duarte, Sarmiento and Durão, 2003].

Companies' sustainable development [Brockhoff, Chakrabarti and Kirchgeorg, 1999] means that companies must adopt strategies and activities that meet today needs of customers and stakeholders while protecting, sustaining and enhancing the human and natural resources that will be needed in the future.

At the present, the concept of sustainability can be applied not only to natural resource utilisation, but also to successful business enterprises, communities and ecosystems.

The way to sustainable development also depends on [Sarmiento and Duarte, 2001; Sarmiento, Duarte and Durão, 2003]:

- how government gets involved in this objective;
- how the commercial investment and banking responds;
- new commitments via international agreements;
- modification of individual consumption patterns;
- new and clear community strategies on sustainability.

THE INTERNATIONAL MARKET OF NATURAL GAS

Figure 1 presents the main world export countries in 2000 [Direcção Geral da Energia, 2002a,b]. It shows that the countries with larger natural gas export ratios are Russia and Canada, but other countries with significant exports are Netherlands and Norway in Europe, Algeria in Africa, and Indonesia in the Pacific region.

Figure 1. Main world natural gas export countries in 2000.

Figure 2. Regional distribution of natural gas production market in 2000.

Figure 2 shows the regional distribution of the natural gas production market in 2000. On other hand, as shown in Figure 3, in 2000, the countries with larger import ratios are the United States of America, Japan and Germany, Italy, France and Belgium in Europe [Direcção Geral da Energia, 2002a, b].

Figure 3. Main natural gas import countries in 2000.

Figure 4 presents the regional distribution of the natural gas consumption in 2000.

Figure 4. Regional distribution of natural gas consumption, in 2000.

Tables 1 and 2 show respectively the predicted evolutions of the natural gas production and natural gas net imports, until 2020 [International Energy Agency, 2002; International Energy Outlook, 2003].

Table 1. Natural gas production.

Table 2. Natural gas net imports.

Yet, it is still possible an increase of natural gas reserves, as a result of new discoveries and/or of new technologies that can allow known reserves, now considered uneconomic, to be brought into production. All three OECD regions are projected to experience a downturn in gas production, during the second decade of the 21st century, however the precise timing is uncertain, mainly because estimates of gas reserves, and gas demand growth, are unknown.

Table 3. Energy Consumption in EU Countries, in 2000.

Table 3 presents the sources of all energy consumed in European Union countries, in 2000 [International Energy Outlook, 2003]. The percentage of the total energy consumption corresponding to the use of petroleum, natural gas, nuclear, coal, hydro and other renewable sources of energy, were, in 2000, 43%, 23%, 14%, 13%, 5% and 1% respectively. The EU countries with larger percentile consumption of natural gas, are, Netherlands, United Kingdom, Italy, Ireland, Belgium, Denmark, and Germany, i.e., 39%, 36%,

32%, 26%, 23%, 23% and 22% respectively. Natural gas imports into Europe are likely to continue to flow mainly by pipeline from Russia and North Africa. The natural gas imported into Japan and some other Asian countries already arrive as LNG (liquid natural gas).

4. THE NATURAL GAS IN PORTUGAL

The Portuguese energy programme was adopted by the Portuguese Parliament in July 1994 and planned to improve energy efficiency, diversify energy sources and promote renewable sources. Domestic coal production ceased in 1997, but at the same time the natural gas started to be used.

Since Portugal is not a natural gas producer, it was in 1997 that the importation of natural gas was initiated from Algeria, through the Europe-Magreb pipeline, Algeria, Morocco and Spain.

4.1. Energy Consumption

Figure 5 presents the evolution of the volume of consumption and sales of natural gas in Portugal since 1998 [Galp Energia, 1998, 1999, 2000 and 2001]. Figure 6 introduces the installed net for the same period. These figures show that during the three years period, the mentioned parameters had a very large increase.

Figure 5. Consumption and sales of natural gas.

Figure 6. Installed net of natural gas.

4.2. Energy Diversification and Efficiency

The successful introduction of natural gas has been a key factor for the diversification of Portugal's energy sources and mitigation of environmental problems. Natural gas was first used in electrical power generation, allowing electricity to be supplied at a competitive price.

The Portuguese natural gas sector is young and it is growing rapidly. As Portugal is an emergent natural gas market, the European legislation allowed the market competition to be delayed and the opening market will start only ten years after the beginning of natural gas supplies, i.e. 2008. In January 1999, the government and the major energy consumers agreed to establish a regulator for the natural gas market. A clear schedule for the implementation of competition and an early decision on its modalities would allow suppliers and consumers to become prepared for the liberalised natural gas market.

Improving energy efficiency has been an important policy objective in order to avoid the increase of consumption resulting from the growth of energy demand and also to lower the pernicious effects of the greenhouse emissions. The percentile increase of natural gas utilisation, avoids the increase and promotes the decrease of the usually energy associated CO₂ emissions, making the system to move towards the Kyoto target. At the same time it helps the Portuguese industries to be more competitive.

Portugal's energy imports are expected to increase as the country has little potential for energy production from domestic resources.

All of domestic's energy production is in renewable energies, however Portugal still imports almost 90% of its own needs.

The renewable energies produced in Portugal are of different kinds and the more important ones that should be mentioned are:

- Hydro electricity, which is the main energy source;
- Electricity production from bio-mass and wastes, that is increasing with small plants in the north and centre of the country;
- Wind power capacity, that is starting to be considered in different locations for electricity generation;
- Geothermal power, from two geothermal plants in Azores, on S. Miguel and Pico islands and that supply a significant portion of the electricity needs of the islands.

5. NATURAL GAS OPPORTUNITIES AND THREATS

The natural gas industries developed in a short and fast period of quick and deep changes. Some of the main factors of those changes are:

- The constitution of global energy companies, through the integration of vertical and horizontal processes, involving merges, acquisitions and partnerships;
- The convergence of natural gas and electricity companies motivated mainly by the need of expansion of electrical power production through thermodynamically modified cycles;
- The increase attention paid by the gas companies on the market of total services that they can provide to clients, regarding their global energetic needs, in stead of the simple sell of primary merchandise;
- The expansion of companies to the foreign market, especially with joint utilities of electricity and natural gas and considering the help of the privatisation processes.

These organisational and operational modifications on the natural gas companies have been accomplished with important regulator changes, essentially based on the separation of infrastructures construction and operating activities, from the other different activities as, for example, production, commercialisation and storage.

It was in this phase of deep evolution changes on the international issues and markets, that the natural gas was introduced in Portugal.

On the other hand, the natural gas utilisation has other opportunities that can be divided into two groups: (1) resulting from the natural gas general characteristics, and (2) resulting from particular and specific reasons.

In the first group it should be identified those opportunities that are alike for all countries all over the world:

- The physical characteristics of the natural gas reduce the fuel consumption, meaning that, in reality, the total fuel amount used will reduce;

- The reserves of natural gas are presently estimated to be equivalent to 1.9 trillion barrels of oil, similar in magnitude to the lower end of the range of the reserves estimates for conventional oil. Although the world demand for natural gas is growing faster than that for oil, (around 3% per annum, compared with 1.8% per annum) it does so from a much lower base. World natural gas production is not expected to peak until beyond 2020;
- Natural gas is the cleanest of all fossil energy sources, so its use is good for the environment;
- Natural gas is, at the present time, the only known energy source that is able to conciliate the response capacity for energetic needs due to the global economic world increase, with environmental sustainability resulting from that increase.

The second group includes all those opportunities that are linked to the specific fact of having natural gas in Portugal:

- The natural gas started to reduce Portugal's high dependence on imported oil and contributes to diversify the energy supply;
- The electricity produced with natural gas can be more competitive regarding energy prices;
- The use of natural gas contributes to reduce the CO₂ emissions and to achieve the Kyoto Protocol target. That Protocol was ratified by Portugal in 2002;
- With the use of natural gas the Portuguese environment is improved and it would give a better quality of life.

The main threat of the use of natural gas in Portugal results from the fact that Portugal should have more sources of natural gas suppliers. Having only one supplier, Algeria, is not secure since it is a country located within an instability region. So it should be found, for instance, a European country as another supplier source. Also it should be considered the possibility of importing natural gas by sea and/or by boat.

Among the opportunities that can result from the use of natural gas, it should be mentioned those linked to environmental sustainability. Environmental sustainable development strategies uncover several business opportunities in issues that might be regarded as costs to be borne or risks to be mitigated. Results include new business processes with reduced external impacts, improved financial performance, and enhanced reputation among communities, customers and stakeholders.

To improve the control of the environmental performance, some companies conduct environmental health and safety assessments, develop environmental management policies, and implement environmental management systems [Henriques and Sadorsky, 1996; Eaty and Porter, 1998]. Pollution prevention and recycling are techniques used to translate policy objectives into practice.

A clever management approach allows companies to save money by anticipating and avoiding expenditures arising from environmental damage, and by minimizing the cost of complying with future legislation [Prakash, 2001; Klassen and McLaughlin, 1996]. In addition, operating cost can be reduced through waste minimization, pollution prevention and the elimination of health and safety hazards [Porter and Linde, 1995].

6. CONCLUSIONS

The present paper analyses the international and national energy markets regarding the future utilisation of natural gas in Portugal. Our country has a high dependency on oil as fuel, and the use of natural gas allows diversifying. The diversification should be extended to the natural gas suppliers, and it should be set a clear schedule for the introduction of competition in the gas market and take an early decision on its modalities so that suppliers and consumers could have a firm basis to adapt to the new market offers.

The paper also studies the new opportunities resulting from this new sector. As natural gas is the cleanest fossil energy source, a link is made to environmental sustainability. A new line of business is opening attracting new business processes with low external impacts and enhanced reputation among customers, stakeholders and communities.

Natural gas is a good way to move accordingly to the Kyoto Protocol, which recommends, to the more industrialised and polluting countries around the world, a reduction of emissions of pernicious gases and particles.

So the introduction of natural gas is a good solution for the Portuguese energy sector and the associated eventual potential problems can be solved if the studies and the corresponding solutions are applied on time. Complementary, as Portugal is not a natural gas producer, it should continue to give attention to the development of renewable energies processes.

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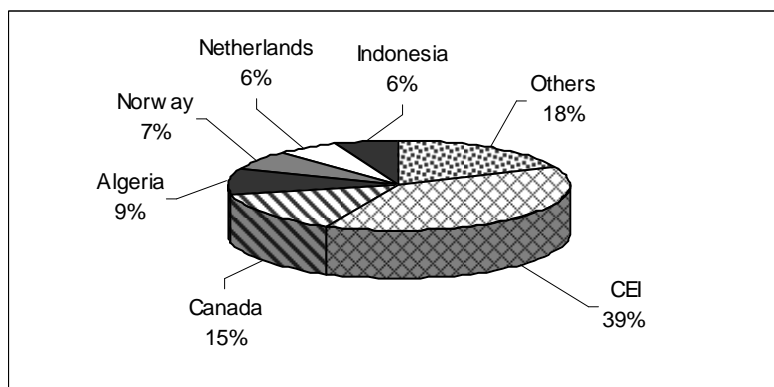


Figure 1. Main world natural gas export countries in 2000. Source: *Energy Portugal 2001*, DGE, 2002.

Figure 2. Regional distribution of natural gas production market in 2000. Source: *Energy Portugal 2001*, DGE, 2002.

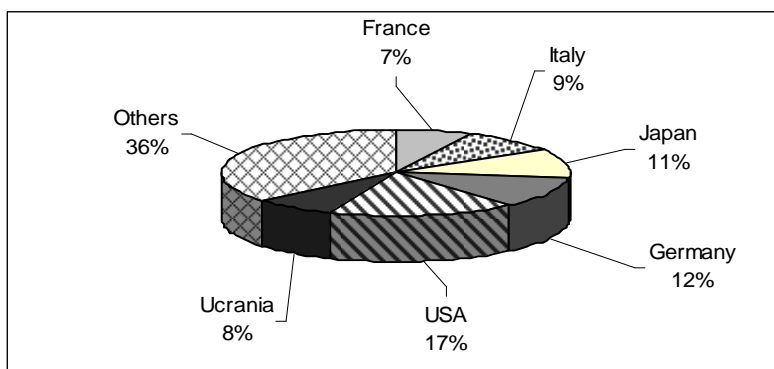


Figure 3. Main natural gas import countries in 2000. Source: *Energy Portugal 2001*, DGE, 2002.

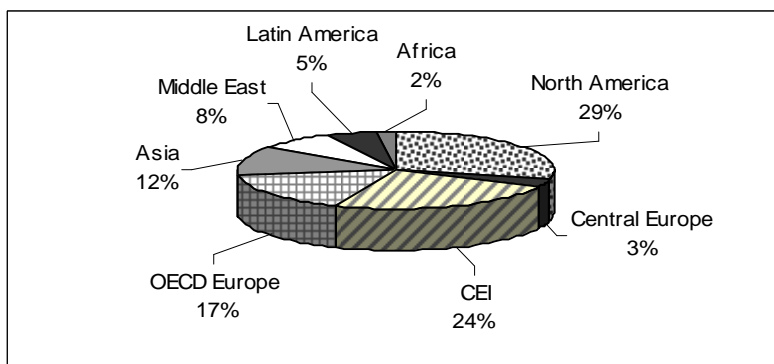


Figure 4. Regional distribution of natural gas consumption, in 2000. Source: *Energy Portugal 2001*, DGE, 2002.

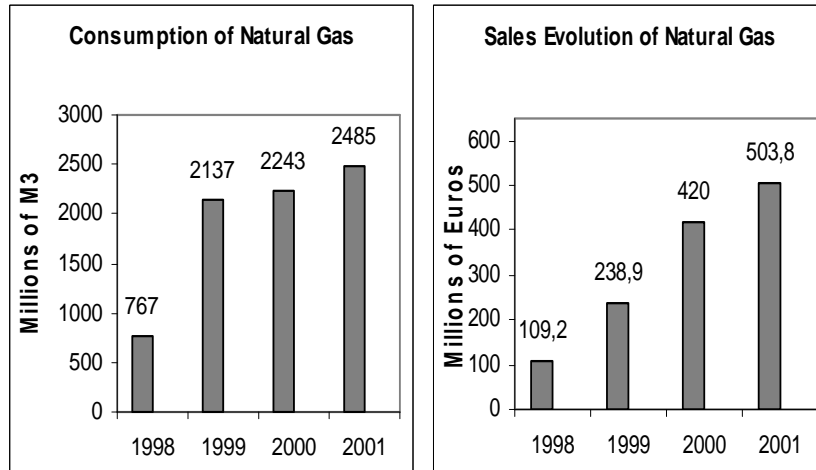


Figure 5. Consumption and sales of natural gas. Source: *Reports of Activities and Accounts*, Galp, 2001.

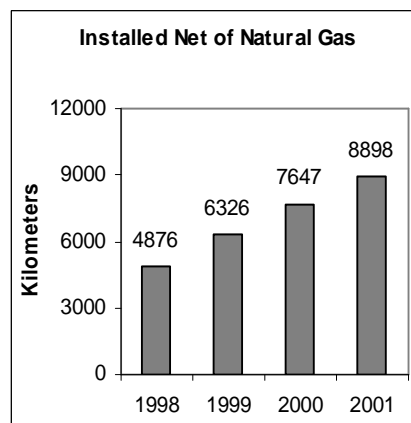


Figure 6. Installed net of natural gas. Source: *Reports of Activities and Accounts*, Galp, 2001.

Table 1. Natural gas production. Source: International Energy Agency, 2002.

| Production (MTOE) | 2000 | 2010 | 2020 |
|-----------------------------|-------------|-------------|-------------|
| OECD North America + Mexico | 674 | 799 | 478 |
| OECD Europe | 222 | 276 | 238 |
| OECD Pacific | 54 | 87 | 68 |
| Transition Economies | 631 | 882 | 1316 |
| China | 30 | 57 | 78 |
| Rest of world | 486 | 795 | 1630 |
| World Total | 2098 | 2895 | 3807 |

Table 2. Natural gas net imports. Source: International Energy Agency, 2002.

| Net Imports (MTOE) | 2000 | 2010 | 2020 |
|-----------------------------|-------------|-------------|-------------|
| OECD North America + Mexico | -2 | 61 | 526 |
| OCDE Europe | 153 | 232 | 386 |
| OECD Pacific | 42 | 42 | 74 |
| Transition Economies | -108 | -173 | -363 |
| China | 0 | 0 | 0 |
| Rest of world | -91 | -168 | -629 |
| World Total | -6 | -6 | -6 |

Table 3. Energy Consumption in EU Countries, in 2000. Source: International Energy Agency, 2002.

| Countries | Total (Quadril ion Btu) | Petro- leum | Natu- ral Gas | Coal | Nuclear | Hydro- electricity | Other Renewables Electricity | Net Electricity Imports |
|------------------|--|------------------------|------------------------------|-------------|----------------|-------------------------------|---|--|
| Austria | 1.41 | 39% | 20% | 10% | 0% | 31% | 1% | -1% |
| Belgium | 2.75 | 45% | 23% | 12% | 17% | 0.2% | 0.4% | 1.6% |
| Denmark | 0.88 | 51% | 23% | 19% | 0% | 0.03% | 7% | 1% |
| Finland | 1.30 | 32% | 12% | 11% | 17% | 12% | 7% | 9% |
| France | 10.41 | 40% | 15% | 6% | 39% | 7% | 0.4% | -7% |
| Germany | 13.98 | 41% | 22% | 23% | 12% | 1% | 1% | 0.1% |
| Greece | 1.33 | 63% | 6% | 28% | 0% | 3% | 0.7% | 0.0% |
| Ireland | 0.59 | 60% | 26% | 13% | 0% | 1% | 0.5% | 0.2% |
| Italy | 7.96 | 49% | 32% | 6% | 0% | 6% | 2% | 6% |
| Luxembourg | 0.19 | 50% | 15% | 3% | 0% | 1% | 0.4% | 31% |
| Netherlands | 3.91 | 45% | 39% | 8% | 1% | 0.04% | 1% | 5% |
| Portugal | 1.08 | 64% | 8% | 14% | 0% | 11% | 2% | 1% |
| Spain | 5.40 | 57% | 12% | 14% | 11% | 5% | 1% | 1% |
| Sweden | 2.25 | 30% | 1% | 4% | 24% | 36% | 2% | 2% |
| U Kingdom | 9.88 | 35% | 36% | 15% | 10% | 1% | 1% | 1% |
| Total | 63.32 | 43% | 23% | 13% | 14% | 5% | 1% | 0.7% |

Note: percentages may not add to 100% due to independent rounding.