

Energy and the Belgian economy

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Management summary

This note shows the importance of energy for the Belgian economy. The related problem of security of supply and the import dependence of Belgium with respect to primary fuel supply were the subject of an earlier note to the commission members.

First of all, the importance of energy for an economy stems from the presence of the energy sectors themselves. Indeed, they create value added and employment. This importance due to their own presence is qualified as their 'direct impact'. Belgian statistics contain information for two energy-related sectors, (1) "Manufacture of coke, refined petroleum products and nuclear fuel" and (2) "Electricity, gas, steam and hot water supply".

*The **direct impact** of the former (refinery) in terms of employment is around 830 people. The latter (mainly electricity) employs 18 000 workers in a direct way.*

*Besides their direct impact, these two sectors also have so-called indirect impacts. First there is an indirect impact through their purchases. Through these purchases they generate activity in the supplying sectors. This is called an indirect backward impact. The **indirect backward impact** represents additionally 18 000 workers for refinery and 20 000 for electricity and gas (for comparison; the indirect employment for the car manufacturing industry is over 50 000 persons). This includes the suppliers of the sector (level 1), but also the supplier's suppliers (level 2) etc. up to an infinite number of levels.*

Secondly, and probably the most important impact of the energy sectors is their downstream impact on the energy-consuming sectors and on households. This means that energy is a cost-component for all other economic agents. Some important economic sectors (chemical industry, paper industry and metal industry) are very dependent on the cost of energy (E.g. for the Belgian chemical industry the share of energy in total costs (10%) is almost as important as the share of salaries (14%)). Moreover these sectors act in a global and very competitive environment. As such, energy cost increases should preferably not be propagated to their own output prices. This implies that asymmetric energy price changes among international competitors might impact competitive power.

*The energy-using sectors (i.e. the **indirect forward impact** of the energy sectors) employ directly 64 000 workers in the case of the chemical industry (an additional number of 72 000 are 'backward dependent'). For the paper industry these numbers are 16 000 (plus 11 000 at the suppliers). There are 34 000 workers in the metal industry (plus 36 000 at its suppliers).*

*For completeness it is noted that the indicated indirect impacts are computed at an 'infinite' number of levels and that a 'disappearance' of an industry does **not** necessarily imply the disappearance of all indirect effects. E.g. for the indirect backward effects the impact will be the highest at the immediate (i.e. the level 1) suppliers. The indirect impacts are thus estimates of **potential** 'damage' due to events in the energy sectors.*

Introduction

Our contemporary welfare society heavily depends on energy; nearly all household appliances today use electric power, household heating uses fossil fuels or electrical power, a country's productive system is energy-based, ... The goal of this paper is to analyse the importance of energy from an economical point of view, concentrating on the Belgian case.

Statistical data splits up an economy into a number of industries (or 'sectors') based on their activity (defined by their NACE-code). Two energy producing sectors can be identified in Belgium i.e. "Manufacture of coke, refined petroleum products and nuclear fuel" (NACE code 23) and "Electricity, gas, steam and hot water supply" (NACE-code 40). Besides primary fuels these industries use materials purchased at other sectors. Their output (energy) is used in the productive processes of all other industries and by the households.

As such the economic importance of energy can be analysed along three axes:

1. The **direct impact** of the energy sectors, i.e. their employment and their value added.
2. The indirect impact that is generated through their purchases. This is called their **indirect backward impact**; by purchasing materials in other industries the energy sectors generate activity and thus employment and value added in these supplying sectors.
3. The indirect impact on the energy consuming sectors. The use of energy in the productive process of other sectors implies that energy is a cost-component for these client-sectors. As such, the energy-using sectors are (cost-) dependent on the price of energy. This is called the **indirect forward impact**. Remark that each of this client sectors has itself sectors that are backward dependent on it.

These effects can be analysed using the Belgian input-output table¹. The most recent table is the one for the year 2000².

1 Direct impact of the energy sectors

The "Manufacture of coke, refined petroleum products and nuclear fuel" has a value added of 844 million euro and employs 830 persons. It is a relatively small sector compared to the other energy providing sector "Electricity, gas, steam and hot water supply". The latter has a value added of 5 214 million euro and employs around 18 000 persons³.

Electricity represents around 85 pct. of total value added of "Electricity, gas, steam and hot water supply" and is thus by far the energy sector with the highest direct impact. The high value added of this sector is due to the specific characteristics of the 'electric commodity' as is argued in some of the NBB Working Papers⁴. These specificities - non-storability, volatile and inelastic demand - give rise to the necessity of important reserve capacities. This need for reserve capacity requires heterogeneous generation facilities consisting of generation plants with different costs. Production units with different production costs, running

¹ See Miller R.E., Blair P.D. (1985) for details on IO analysis.

² See Federal Planning Bureau (2004).

³ P.m. for the Belgian economy the total value added equals 220.4 billion euro and employment equals 3.4 million persons.

simultaneously during certain periods, give rise to inframarginal rents (to be distinguished from market power rents)⁵. These rents have a positive impact on the value added of the electricity sector.

2 Indirect backward impact of the energy sectors

Through their intermediate purchases the energy sectors also generate activity at their supplying industries. This indirect backward impact can be quantified using input-output analysis' multipliers⁶.

Both energy sectors depend heavily on imports. The "Manufacture of coke, refined petroleum products and nuclear fuel" sector's total domestic purchases are 1.7 billion euro, its imports from abroad total 9.5 billion euro (imported crude oil accounts for 71% of these imports).

This has several important consequences from an economical point of view. Firstly, this implies that the sector's backward indirect effect (in the Belgian economy) is small. Most of this backward effect is generated in other economies and not in the national economy. Secondly the industry is heavily dependent on imports and on the prices of imported products. Important price increases in imported fuels (oil and gas) imply cost increases for the industry. As crude oil - the main imported product for this industry - is quoted in dollar, a strong euro has a mitigating impact on this imported inflation as can be seen from table 1 below:

Table 1: Crude oil prices and the mitigating impact of a strong euro

	2000	2005	annual growth
OPEC-oil (\$/b)	27.6	54.55	14.60%
\$ in €	1.085	0.804	-5.82%
OPEC-oil (€/b)	29.946	43.8582	7.93%

Source: FOD economie, KMO, Middenstand en energie.

Crude oil prices quoted in \$/b have almost doubled over the period 2000-2005. The strong performance of the euro compared to the US dollar has moderated the price increase for EMU-countries' economies, in particular for oil-intensive industries like refinery.

A similar reasoning holds for the electricity sector albeit to a lesser extent. The latter sector's total domestic purchases are 2.6 billion euro, its total imports equal 1.5 billion euro (mainly coal and gas). The backward effect is limited due to the high import dependence implying that a lot of (supplier) activity is generated outside the Belgian territory⁷. Generated employment in the supplying sectors (not including the direct employment) is 22 000 persons for the electricity sector and 18 000 persons for the refinery industry. Coal and gas (the imported inputs of the electricity sector) prices are also quoted in dollars. However the share of imported coal and gas in the purchases of the Belgian electricity industry is much lower than the share of oil in the refinery industry.

⁴ See Coppens F., Vivet D. (2004), See Coppens F., Vivet D. (2006).

⁵ See Coppens F. (2005).

⁶ The proportion of direct employment to total (direct and backward indirect) employment of an industry is given by the (net) Leontief employment multipliers.

⁷ This is to be compared to e.g. the construction industry with domestic purchases of 22.2 billion euro and imports of around 3.5 billion euro.

3 Indirect forward impact of the energy sectors

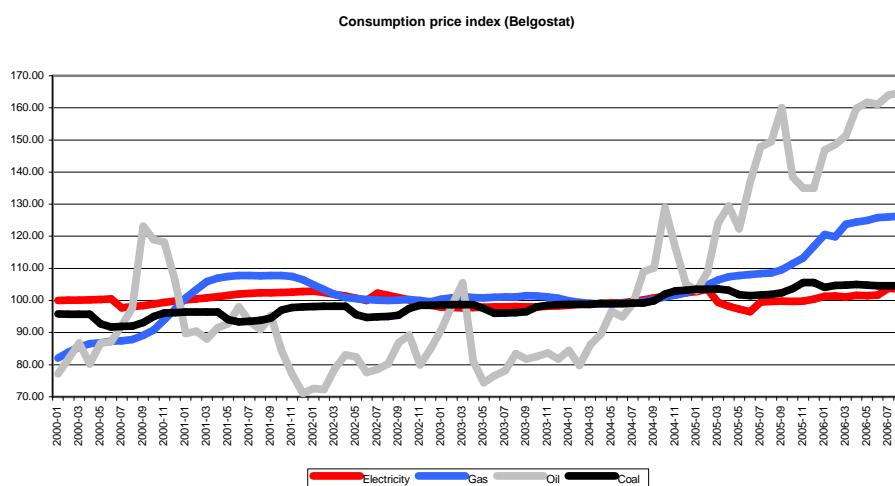
Through its use in all other industries the energy also has an important forward impact. This means that price-changes of their output - i.e. energy prices - have an impact on the costs of the using sectors.

A sector, using energy as an input, has several options to react to an increase in energy price.

- As a reaction to the cost-increase and in order to keep its margin at the desired level it might e.g. increase the prices of its outputs. As such it increases costs for all of its own clients, initiating a cascade effect with impact on the global price level (i.e. on inflation). In the Belgian context a 'second round' effect through the automatic indexation of salaries follows.
- It might decrease its margin
- It might save costs on other inputs and or factors of production like e.g. employment
- It might decrease its needs for energy, in other words increase its energy efficiency.

These price changes are not hypothetical as can be seen from graph 1. :

Graph 1: Consumption price index of energy products (1996=100)



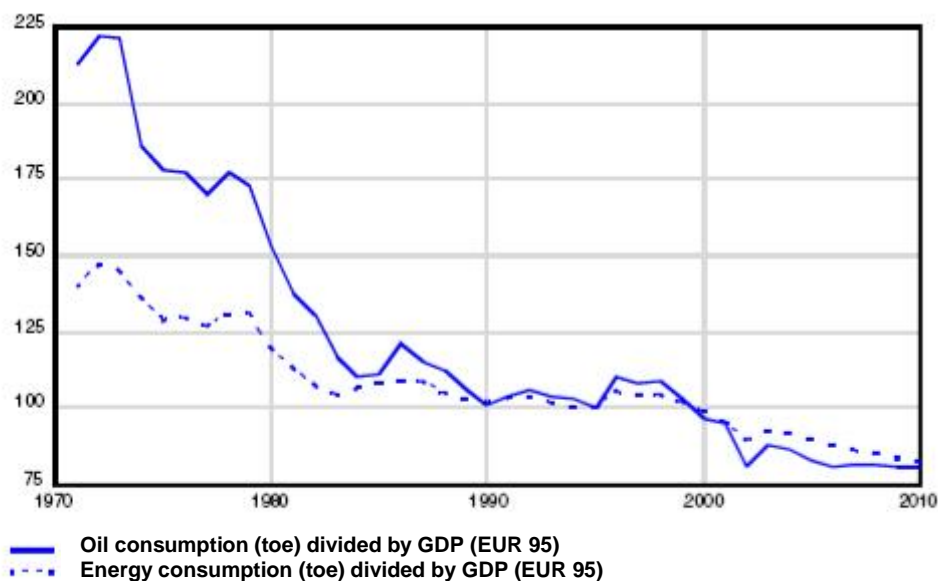
Source: Belgostat.

Since 1996 the crude oil price has more than doubled (index for dec-2005 is 227). Gas prices started to rise in 2000 and seem to follow crude oil prices with a certain time lag. Coal prices are more or less stable although a slight increase can be observed. The electricity (consumer) price is more or less stable but has slightly increased near the end of the period. This is probably due to increased gas prices. The large share of nuclear electricity generation probably has had a mitigating impact⁸.

⁸ As explained in Coppens F., Vivet D. (2006) there might be a trade off between this mitigating impact and a well-functioning competitive generation market.
See also CREG (2006) - De prijs van de elektriciteit per tariefcomponent - Presentation by Camps G. - 5/7/2006. On slide 7: "... de huidige wholesale prijzen zijn ontoereikend om de rentabiliteit van de toekomstige investeringen te verzekeren".

The effect of the oil crisis on oil-intensity (and on energy intensity in general) is illustrated in graph 2.

Graph 2: Evolution of oil-intensity and energy-intensity (toe/eur95) of the Belgian economy (1995=100)



Source: Federaal Planbureau (2005).

This graph shows the index of crude oil (and energy) intensity over the period 1970-2010. Crude oil intensity is defined as the crude oil (in tep) needed to produce one unit (eur95) of value added by the Belgian economy.

As energy-using industries depend on energy prices it is important to analyse the effect of changing energy prices on their costs. In IO analysis this can be quantified using the Ghosh-multipliers⁹. These show that:

1. The impact of the electricity sector on the costs of the other sectors is more important than the forward impact of the gas-sector.
2. The chemical industry is very sensitive to gas-prices as well as to electricity prices. The energy costs represent about 10% of total costs of this sector (p.m. salaries represent 14%).
3. The chemical industry has a relatively important share in Belgian GDP and employs 64 000 people (and an additional 72 200 at its suppliers).
4. Other energy intensive sectors are the metal industry and the paper industry. They each represent respectively 34 000 (plus 36 600 at suppliers) and 16 000 (plus 11 200 at suppliers) workers.

⁹ IO Analysis' Ghosh multipliers (and the Leontief multipliers) take into account the forward effect due to intermediate purchases of consumption goods (and thus not investment goods). The indirect forward impact of industries that produce investment goods (e.g. machines) will thus be underestimated. As such, the relatively high Ghosh multiplier of the Electricity industry might be due to the underestimation of the Ghosh multiplier of other industries, mainly of those that produce investment goods. To account for the forward impact of such industries, the investment flows should be incorporated in the intermediate consumption part of the IO-table. This is not possible because of data unavailability.

Note however that the goal of forward impact measures is to analyse the impact of price changes. This analysis is only relevant for these industries for which (quality adjusted) price changes are likely. To come back to the example of machines, their prices may have risen but so has their performance (called their 'quality'), such that their 'price at equal quality' i.e. their 'quality adjusted price', can even have fallen (which is the case for e.g.

These sectors are global sectors, open to competition from abroad (the chemical industry exports around 60% of its output, the metal industry and the paper industry export more than 70% of their output). This means that asymmetric energy-price increases¹⁰ between international competitors can hardly be propagated to output price increases and that - in order to maintain their competitiveness - these cost increases will necessitate other cost-saving measures (increase energy efficiency, restructuring, ...).

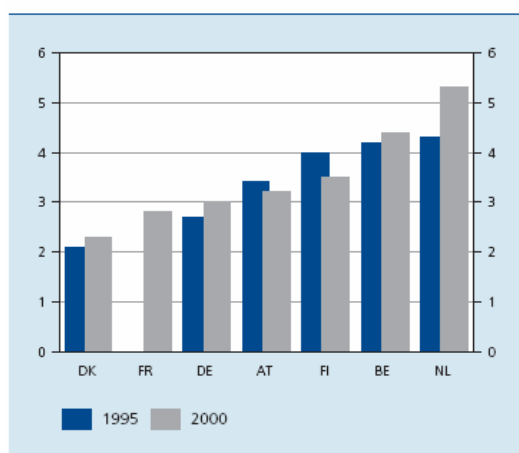
The energy-cost dependence of the industry is illustrated in graph 3. It seems that the Belgian and the Dutch industry have the highest share of energy in production costs.

The (increasing) difference between the Netherlands and Belgium can partly be explained by differences in industrial structure. As such it seems that the difference between the two countries is mainly due to the chemical industry's energy use whereby the Dutch chemical sector uses crude oil for non-energy purposes while in Belgium crude oil is mainly used in the refinery sector and its use in the chemical industry is almost absent.

The higher use of crude oil in the Dutch chemical sector and the increasing crude oil prices between 1995 and 2000 (see graph 1) can thus explain a large part of the difference in energy costs.

Graph 3: Share of energy products in the production cost in industry

CHART 16 SHARE OF ENERGY IN THE PRODUCTION COST IN INDUSTRY⁽¹⁾
(Percentages of total, 2000)



Sources: EC, NAI, NBB calculations.

(1) Figures taken from the calculation of cumulative costs based on the input-output tables. Here, industry and energy are defined according to the concept used for the analysis of these tables.

Energy is a particularly large component of intermediate production costs and is very sensitive to major price changes in the world's oil markets. Its share in the cumulative production cost of industry appears to be fairly high in Belgium: in 2000, intermediate consumption of products included in the energy branches (crude and refined petroleum products, production and distribution, etc.) accounted for 4.4 p.c. of the cost of industrial production in Belgium, compared with 3 to 3.5 p.c. for Germany, Austria and Finland and less than 3 p.c. in Denmark and France. However, it was even greater in the Netherlands, where it reached 5.3 p.c. Moreover, at almost two thirds the imported share of the energy cost was highest in the Netherlands and Belgium. In the majority of European countries, the importance of energy in the production process increased between 1995 and 2000 due to rising oil prices. Only Finnish and Austrian industry managed to reduce the relative size of their energy bill over this period.

Source: Nationale Bank van België (2005).

computers, phone equipment, faxes, cars, ...). This is different for energy prices which have risen (while the quality of the energy has remained the same).

¹⁰ Different rules regarding nuclear power are a potential cause for such asymmetric changes.

References

- Coppens F., Vivet D. (2004), "*Liberalisation of network industries: is electricity an exception to the rule?*", NBB Working paper 59, september 2004
- Coppens F. (2005), "*Divestiture or Virtual Power Plants - the solution to the problem of the dominant producer? - The case of Belgium*", Paper presented at the IAEE Conference in Bergen Norway.
- Coppens F., Vivet D. (2006), "*The single European electricity market: a long way to convergence*", NBB Working Paper 84, May 2006.
- CREG (2006), "*De prijs van de elektriciteit per tariefcomponent*", Presentation by Camps G. - 5/7/2006.
- Federaal Planbureau (2004), "*De input-outputtabellen van België voor 2000*", December 2004.
- Federaal Planbureau (2005), "*Les conséquences économiques du choc pétrolier sur l'économie belge*", WP 1-06.
- FOD Economie (2005), "*De energiemarkt in 2005*".
- Miller R.E., Blair P.D. (1985), "*Input-output Analysis - Foundations and extensions*", Prentice-Hall, New Jersey.
- Nationale Bank van België (2005), "*De industrie in België: vroegere ontwikkelingen en toekomstige uitdagingen*", Economisch Tijdschrift NBB, Q3-2005.
- OECD-IEA (2005), "*Energy Policies of IEA countries - Belgium*", 2005.