The increased volatility of electricity prices for Belgian households

An analysis based on the specific characteristics of pricing by Belgian electricity suppliers

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Introduction

Every year there are various studies [1], notably the NBB Annual Report, that analyse Belgian inflation measured by the Harmonised Index of Consumer Prices (HICP). The contribution of energy products to inflation measured in that way is a constantly recurring theme. It is found that energy products are often not only the reason for the Belgian inflation gap in relation to the euro area, but are also largely accountable for the volatility of the Belgian index figure.

Until recently, only one energy source proved to be a factor here in most cases, namely oil (and its derivatives). Since the end of 2007, however, crude oil prices have ceased to be the only variable accounting for both the inflation gap and the volatility. Since then, the movement in consumer prices of natural gas and electricity has also played a significant role. A decade ago, both energy markets were still tightly regulated and virtually monopolistic. At the instigation of the European Commission, there has been a strong tendency towards deregulation not only in all European countries but also elsewhere, and that has naturally had an impact on pricing.

The timing of that deregulation varied. In Germany, it took place as early as 1998, in the Netherlands in 2004 and in France not until 2007. In France, household tariffs remained largely (over 95 p.c. [2]) regulated even after deregulation. In the Netherlands, though household electricity prices are more in line with the market, price changes are submitted to the regulator who checks whether they are "reasonable". This system, known as the "safety net method", stipulates that the suppliers must submit every tariff change to the regulator four weeks in advance of implementation. The regulator then assesses whether the tariff increase is fair in view of the costs incurred by the supplier. If the proposed tariff does not conform to the maximum limits set by the regulator, the supplier is given the opportunity to explain the increase. If, after completion of this procedure, the regulator judges the tariff to be unreasonable, then the supplier has a maximum tariff imposed on him. Different maximum tariffs may apply for green and grey electricity [3]. On the German and British markets, the competition authority and the regulator respectively conduct *ex post* checks to see whether tariff changes are "reasonable".

The (full) deregulation of the Belgian household energy markets took place at different times in the various regions. Flemish consumers were free to choose their supplier from July 2003; households in Wallonia and Brussels were able to do so from January 2007. Apart from market deregulation, Belgium also made methodological adjustments to the recording of the HICPs for natural gas and electricity between 2005 and 2007. According to recent

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(1) NBB (2008), NBB (2009), NBB (2010), NAI, Price Observatory (2009), Cornille D. (2009), ECB (2010).
(2) NAI, Price Observatory (2009), CRE (2010).
(3) Brattle Group (2009). For more information on the "safety net method", see http://www.energiekamer.nl/nederlands/gas/levering/tarieftoezicht.asp.

research, the change in the method of measuring the HICP is not the only reason for the high volatility: the primary cause is deregulated pricing. Above all, further investigation is needed into the factors which explain why fluctuations in energy commodity prices play such a significant role [1].

This study analyses pricing on the electricity market for private consumers. The first chapter outlines the issue, comparing electricity prices for households in Belgium, the Netherlands, Germany and France. The data used originate from Eurostat's data banks. The second chapter examines in greater depth the pricing mechanisms on electricity markets for private consumers. Suppliers apply fixed and variable tariffs which vary according to the consumption profile, while social tariffs are also a factor. The third and most important chapter of this study examines the underlying parameters which may account for the greater volatility of Belgian electricity prices, focusing in detail on the mechanisms used in variable-price contracts. The pricing method used in variable-price contracts appears to be very specific to the Belgian market and is the most likely reason for its atypical behaviour. The fourth chapter focuses briefly on whether such pricing mechanisms are also used in neighbouring countries. The fifth chapter sets out the conclusions.

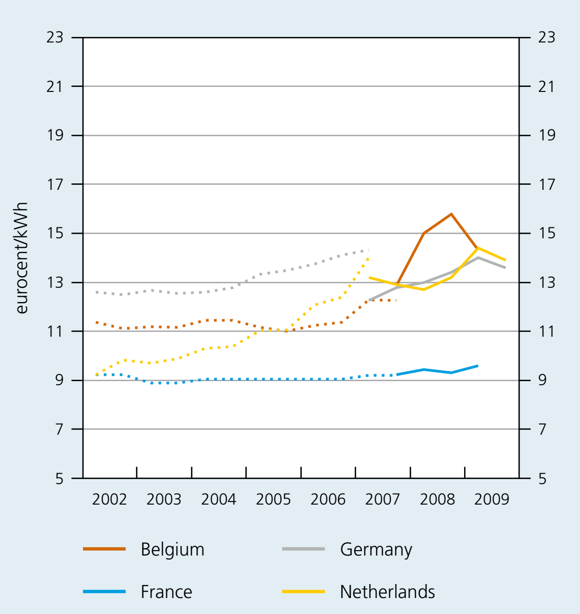
1. Electricity prices in Belgium and in neighbouring countries

1.1 Eurostat time series [2]

Eurostat collects data on the prices of electricity consumed by households in the various Member States. The households are divided into various consumption profile classes according to the number of kilowatt hours (kWh) consumed. The information is updated in the form of half-yearly time series [3]. In 2007 there were changes in the method of producing those time series. From the 2007 recording year onwards, the figure corresponds to the weighted [4] average over the half year; before that it was the value on the first day of the half year. Up to 2007, consumer class "Dc" was defined as the category with annual consumption of 3,500 kWh, including 1,300 kWh at the off-peak tariff. From 2007, class "Dc" covers households with annual electricity consumption between 2,500 and 5,000 kWh. These methodological changes imply that the pre-2007 figures are not comparable with the data compiled since 2007.

The time series for Belgium and for neighbouring countries are set out in the charts 1 and 3. Chart 1 shows the

CHART 1 ELECTRICITY PRICES FOR CONSUMER PROFILE DC, PRICES EXCLUDING TAX



Source: Eurostat.

prices excluding tax for class "Dc". The break in the series is indicated by the switch from a dotted line to a continuous line.

Up to 2007, prices in Belgium were between prices in France and those in Germany. In the Netherlands, electricity prices for private consumers were initially lower than those in Belgium, then higher from 2005 to 2007. After the break in the method that pattern changed. However, the break also coincided with deregulation of the sector, making it difficult to ascertain the exact reason for this altered pattern.

In France, the break is not expressed in the prices, but French private consumption of electricity is still largely determined by regulated tariffs. In Germany, prices for households fell significantly after the break; in the Netherlands, the difference is small, though prices did increase less strongly after the break. In Belgium, there was no serious impact on prices at the time of the break, but the profile of prices since the break is totally different from the previous picture. After the break, prices (excluding tax) were highest in Belgium until the end of 2008. In the first half of 2009, energy prices exhibited some convergence, except in France.

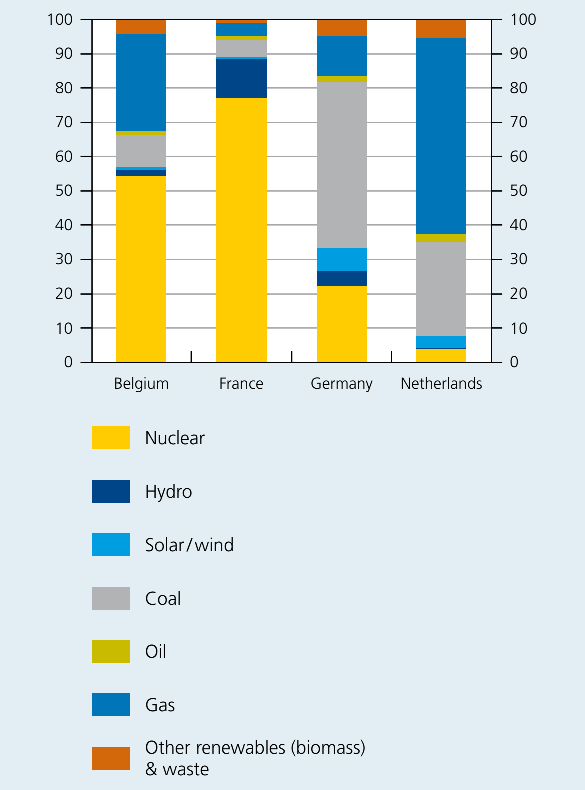
(1) Cornille D. (2009), NBB (2010), NAI, Price Observatory(2009), ECB (2010).
(2) http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/introduction.
(3) FPS Economy, SMEs, Self-employed and Energy (2010).
(4) The weighting takes account of consumption in each month and of the supplier's market share in that particular month.

Some studies [1] cite the varying mix of generating facilities and the steep increases in fossil fuel prices during the past decade as possible explanations for the divergent electricity prices in the different countries. Chart 2 shows the fuel mix for Belgium and neighbouring countries. That mix might account for the difference between prices in Belgium and those in France. However, Germany and the Netherlands use more fossil fuels than Belgium, so that the explanation must be sought elsewhere in those two cases.

Chart 3 shows electricity prices including tax.

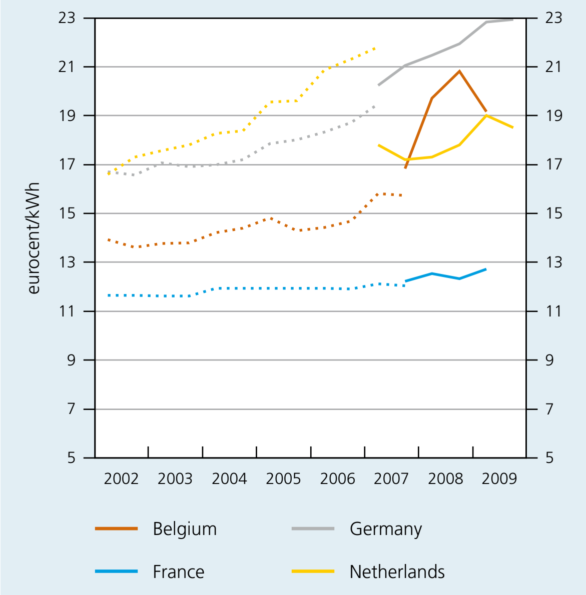
It should be noted that, after the break, as a result of levies, taxes and VAT, prices in Germany were again the highest. In 2007 and 2008, Belgium had the second highest prices including taxes, levies and VAT. In the first half of 2009, prices in Belgium subsided again to the level in the Netherlands. In the case of the Netherlands, there was a notable decline in levies, taxes and VAT after the break [2].

CHART 2 FUEL MIX IN BELGIUM AND IN NEIGHBOURING COUNTRIES (FIGURES BASED ON PRODUCTION IN 2007)



Source: IEA (2009).

CHART 3 ELECTRICITY PRICES FOR CONSUMER PROFILE DC, PRICES INCLUDING TAX



Source: Eurostat.

International price comparisons are a difficult exercise and the interpretations must be nuanced on account of the characteristics and regulations specific to the respective countries. Deregulation of the sector necessitated its unbundling into various segments: production, transmission, distribution and supply [3]. The prices recorded by Eurostat contain those four components. In Belgium, for example, the unbundling was much more radical than in Germany and France, and that is a potential source of tariff differences. The same applies to the public service obligations of the Belgian distribution system operators.

1.2 HICP for electricity

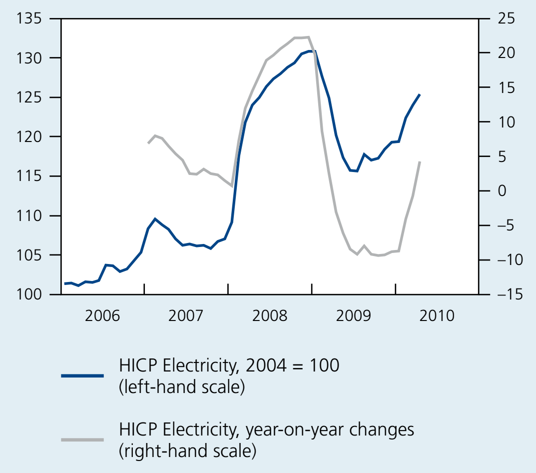
Charts 1 and 3 show price levels. Inflation figures – which were mentioned in the introduction – indicate price changes. To exclude seasonal influences, changes in one month are usually calculated with respect to the corresponding month in the previous year. Chart 4 shows the Belgian consumer price index for electricity supplied to households and the "year-on-year changes". The time series is issued monthly. There is a break in this time series, too, from 2005 for Flanders and from 2007 for Belgium.

(1) ECB (2010).
(2) This is confirmed in NAI, Price Observatory (2009).
(3) See Coppens F. and D. Vivet (2004).

Before 2005 (Flanders) and before 2007 (Wallonia and Brussels) the HICP index was based on annual bills (this was called the "payment approach"); from 2005/2007 it was produced on the basis of monthly tariff calculations requested from the regional regulators (the "acquisition approach")[1]. As a result, before 2007 prices were an average of the preceding twelve months, and since 2007 it is "instantaneous" prices that have been used[2]. Switching from annual averages to "instantaneous" monthly prices normally heightens volatility[3].

The HICP series calculated is an average of all consumption profiles; it therefore does not only reflect the pattern for "Dc". The HICP for Belgium is recorded inclusive of taxes. The index already begins to rise slightly by the end of 2007; at the beginning of 2008 it increases very sharply. However, it is not until the beginning of 2008 that the year-on-year changes become greater. This indicates that in the final months of the year the index figure is generally already higher as a result of a seasonal effect. That effect is eliminated in the year-on-year changes which are always measured in relation to the same month in the previous year.

CHART 4 INDEX OF BELGIAN ELECTRICITY PRICES FOR PRIVATE CONSUMERS



Source: Belgostat.

A quick comparison of charts 2, 3 and 4 reveals that in both the Eurostat time series of electricity prices and the HICP time series the pattern from the end of 2007 is very different from that prevailing previously. Cornille D. (2009) shows that the greater volatility compared to the euro area is due not only to the change in the recording method but also to the pricing mechanisms applied on the deregulated markets, particularly in the rapid transmission to consumer prices of changes in the primary fuel prices.

The next chapter goes into more detail on the electricity market pricing mechanisms.

2. Pricing mechanisms on the belgian electricity market (for households)

2.1 Prices in a deregulated electricity sector

Deregulation of the Belgian electricity sector took place at different times in the respective regions. However, the new structure is the same in Flanders, Wallonia and the Brussels Capital Region. The sector was divided into four segments: production, transmission, distribution and supply. Production and supply have been deregulated; transmission and distribution remain as strictly regulated monopolies after the break-up. This brief summary is confined to household supply (for a fuller account of deregulation, see Coppens F. and D. Vivet (2004)). On the deregulated Belgian electricity market, individuals can conclude a contract with the supplier of their choice who then supplies the household with electricity in return for payment. The supplier buys in the electricity from a chosen producer. The energy purchased is then transported via the transmission network (high voltage and network structure) and the distribution network (low voltage and radial structure).

At the end of a given period (usually one year) the supplier invoices an amount to the customer ("household price" in figure 1). The supplier uses the amount collected to cover his expenses: (a) the "energy price" to the producer, (b) the transport charges to the transmission system operator and the distribution system operator, and (c) the levies, taxes and VAT to various entities (the government, the regulator, the ombudsman, nuclear liabilities, etc.). After paying all those expenses and levies, the supplier is still left with a margin which he uses to pay his own operating and investment costs and other expenses (e.g. the public service obligations[4]). The components of the invoiced price are shown in figure 1.

(1) The payment method considers the price at the time of payment for the goods; the acquisition method takes the price at the time of purchase (acquisition).
(2) See also Cornille D. (2009).
(3) In statistics, it is a well-known fact that the standard deviation of the arithmetical average $\bar{x}$ is smaller than that of the variable itself. For an arithmetical average of "n" terms:
$$s_{\bar{x}} = \frac{s_x}{\sqrt{n}}.$$
Calculation of an annual average therefore reduces the standard deviation (a measure of volatility) by a factor of roughly 3.5.
(4) Including the costs of purchasing compulsory green certificates.

When analysing price movements, it is therefore necessary to clarify the price in question, i.e. whether it is only the price of the electricity (the energy price) or the energy price plus the supplier's margin, or the price including both the supplier's margin and transport costs, or the total price including levies, taxes and VAT.

In the case of household supplies, it is not possible to distinguish between the energy price and the supplier's margin as it is not known how much the supplier pays to the producer for the energy. Transport costs (transmission and distribution charges) are regulated and are published on websites of the regulator (CREG) and the distribution system operators [1]. The levies, taxes and VAT are also known.

The Eurostat time series comprise the energy price, the supplier's margin and the transport costs. There is a series including taxes, levies and VAT, and a series which excludes them.

The Belgian HICP-EL is based on an all-in tariff. The prices therefore reflect not only changes in energy prices and the supplier's margin but also changes in transport charges and levies, taxes and VAT.

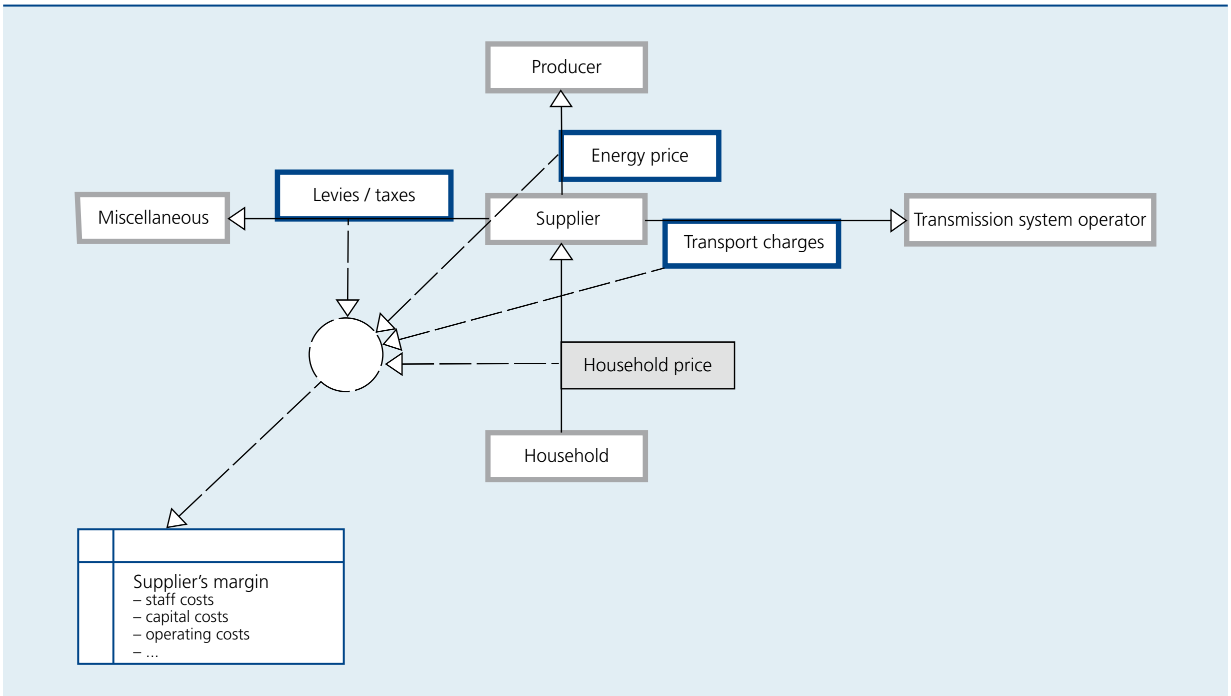
(1) http://www.creg.be/nl/transporte_nl.html.
(2) CREG (2007), p. 37, CREG (2009c).

The sections which follow analyse part of the price that suppliers invoice to households. The part that is analysed concerns the energy price and the supplier's margin, i.e. excluding transport charges and levies, taxes and VAT. The prices used to calculate the consumer price index also include transport charges, levies, taxes and VAT. Since the transport costs (principally the distribution charges [2]) have risen steeply during the period under consideration, the index is adjusted for changes in distribution tariffs.

2.2 Indexation of prices in variable contracts; the "Ne-Nc index" and the "Ne-Iem index"

Most Belgian household supply contracts are based on a variable price. This means that the price is adjusted monthly in line with an index (in just the same way that rents are adjusted annually in line with the health index). The aim of that indexation is that the supplier's income is adjusted as his own expenses increase, enabling him to maintain a "normal" margin during the term of the contract (see figure 1). Such adjustment of prices in line with market developments is also found in other markets. For example, on the banking market, in the case of variable-rate contracts, mortgage interest rates are adjusted periodically in line with market rates.

FIGURE 1 COMPONENTS OF THE PRICE CHARGED TO HOUSEHOLDS



Source: NBB.

In contrast, fixed-price contracts stipulate a price which is fixed for one or two years, but it will usually be slightly higher because the supplier charges an extra margin to cover the uncertainty over future prices. Here, too, it is possible to draw an analogy with mortgage interest rates: the interest rate on fixed-rate contracts is slightly higher than on contracts with variable interest rate formulas.

Most contracts for the supply of electricity to Belgian households are variable-price contracts, though the percentage has been declining, especially since the end of 2008. In 2007, variable-price contracts represented a 94 p.c. share; in 2008 that fell slightly to 93 p.c., and in the first ten months of 2009 it dropped to 86 p.c.[1]

The supplier is free to decide the indexation mechanism. In most cases, however, the chosen method is indexation based on two parameters. Table 1 sets out the leading suppliers and the indexation parameters which they use. The parameter Ne reflects the movement in wage and material costs, while parameters Nc and Iem reflect changes in fuel costs. The market shares of the suppliers are calculated on the basis of the number of access points which they served on the Belgian market in 2009 figures. The number of access points is the most relevant criterion for the private market[2].

The parameters Ne and Nc already existed before deregulation (but the method of calculating Nc was modified in 2004[3]). Both parameters are composed of partial indices. The parameter Ne consists of an index that reflects the movement in labour costs (in the metalworking industry) and an index that tracks the cost of materials. The parameter Nc reflects the cost of fuel (oil, coal and natural gas), but also the costs associated with the nuclear capacity utilisation rate. For the exact formulas, see annex 1. The monthly figures for Nc and Ne are published on CREG's website.

Supply contracts with variable prices indexed on the basis of Nc and Ne state the price of the power supplied as a function of Nc and Ne. In most cases, the price consists of several tariffs specified on the supplier's tariff schedule (they also vary from one supplier to another, hence the exponent "l" in formulas (1) and (2)). For a given consumption profile (e.g. 3,500 kWh per annum, including 1,500 kWh at the off-peak rate), it is possible to calculate the total coefficient of Nc and Ne (for more details, see annex 2). For the "Ne-Nc index" in eurocent/KWh, the formula is as follows:

$$\mathrm{Ne} - \mathrm{Nc} - \text{index price}^{l} = a^{l}_{\mathrm{Ne}}.\mathrm{Ne} + a^{l}_{\mathrm{Nc}}.\mathrm{Nc} \qquad (1)$$

The coefficient a_{Ne} and a_{Nc} can be calculated on the basis of a supplier's tariff schedule (see annex 2). If the monthly values of the parameters Nc and Ne are substituted in the formula (1), it is possible to calculate the "Ne-Nc index" for that consumption profile.

TABLE 1 PARAMETERS USED AND MARKET SHARE HELD BY THE VARIOUS SUPPLIERS ON THE BELGIAN HOUSEHOLD ELECTRICITY MARKET

Supplier	Market share (p.c. of access points)	Parameters used
Electrabel Customer Services	66.5	Ne, Nc
SPE/Luminus	19.5	Ne, Iem
Nuon	5.3	Ne, Nc
Essent	3.1	Ne, Nc
Distribution system operator	2.2	mixed form
Lampiris	2.1	fixed only
Others	1.3	–
Total	**100.0**	

Sources: CREG, CWAPE, VREG, BRUGEL (2010).

Table 1 shows that most players on the private market use such a formula in their variable price contracts. SPE/Luminus uses a formula of this type, but replaces the parameter Nc with another parameter Iem (see annex 3). The formula for that supplier is therefore:[4]

$$\mathrm{Nc} - \mathrm{Iem} - \text{index price}^{l} = a^{l}_{\mathrm{Ne}}.\mathrm{Ne} + a^{l}_{\mathrm{Iem}}.\mathrm{Iem} \qquad (2)$$

The parameter "Iem" reflects the movement in gas prices at Zeebrugge, the movement in electricity prices on the Belpex power exchange, and the movement in coal prices[5].

Table 1 shows that some suppliers only offer fixed-price contracts. The network operators use a mixed structure. The distribution system operators (DSOs) are the supplier of last resort; if a customer is unable to pay his bills, there is a very strict procedure permitting the supplier is to terminate that customer's contract. The customer is then assigned to the DSO for his region. The DSO must supply the customer with electricity at a price not exceeding the

(1) Source: CREG.
(2) Calculation of the market shares on the basis of the energy supplied accords too much weight to large consumers other than households.
(3) CREG (2008a).CREG (2009a). Moniteur belge/Belgisch Staatblad (2001), Moniteur belge/Belgisch Staatsblad (2004).
(4) That is also true of "Ebem", which is a smaller supplier having the municipality of Merksplas as its sole shareholder.
(5) For completeness, it should be noted that, in some contracts, SPE/Luminus also uses another parameter (Iec) which is even more closely linked to the movement in Belpex prices. See annex 2.

TABLE 2 PRICE COMPONENTS INCLUDED IN THE VARIOUS TIME SERIES

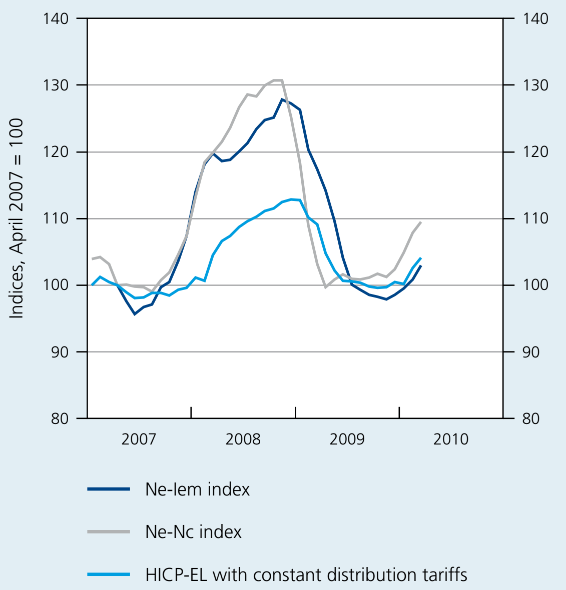
	Eurostat	IPCH-EL	HICP-EL with constant distribution charges	Index price
Energy price	X	X	X	X
Supplier's margin	X	X	X	X
Transmission costs	X	X	X	
Distribution costs	X	X	constant	
Levies, taxes and VAT	– or X	X	X	

Source: NBB.

weighted average price charged by suppliers active in the DSO's region [1].

The Ne-Nc index price was calculated for a number of tariff schedules. Chart 5 shows one example, together with the HICP index for electricity. It also shows the movement in the Ne-Iem index price. The Ne-Iem index has only been used since October 2008. It was calculated retroactively from April 2007.

CHART 5 THE ADJUSTED HICP-EL (WITH CONSTANT DISTRIBUTION TARIFFS), THE NE-NC INDEX AND THE NE-IEM INDEX



Source: Cornille D. (2009) for the HICP-EL with constant distribution tariffs, own calculations for the Ne-Nc index and for the Ne-Iem index.

The "Ne-Nc index price" and the "Ne-Iem index price" reflect the energy price and the supplier's margin; the transmission and distribution costs are not included, nor are the taxes. The HICP for electricity was therefore adjusted for the change in the distribution tariffs [2]. Thus, chart 5 shows an HICP-EL with constant distribution costs. When comparing electricity prices it is necessary to take account of the components included (see table 2).

It should be noted that the Eurostat price (in charts 1 and 3) contains more components than the index price analysed in detail later in this article. That explains why the Eurostat price is higher, and unless there is a negative correlation between the components, that will also tend to enhance the volatility. [3]

Chart 6 shows on the right-hand scale the year-on-year changes in the adjusted HICP-EL and on the left-hand scale the annual changes in the Ne-Nc and the Ne-Iem indices.

It therefore seems that, especially in the case of the year-on-year changes, the adjusted HICP-EL and the Ne-Nc and Ne-Iem indices follow a very similar pattern (except for one scale factor, as the units on the axes are different). The Ne-Nc index for a given month was calculated here on the basis of the values of Ne and Nc for that same month. However, in the contracts the suppliers apply a formula which takes account of the values of the parameters for the preceding month, which explains why the HICP curve lags behind the Ne-Nc index curve.

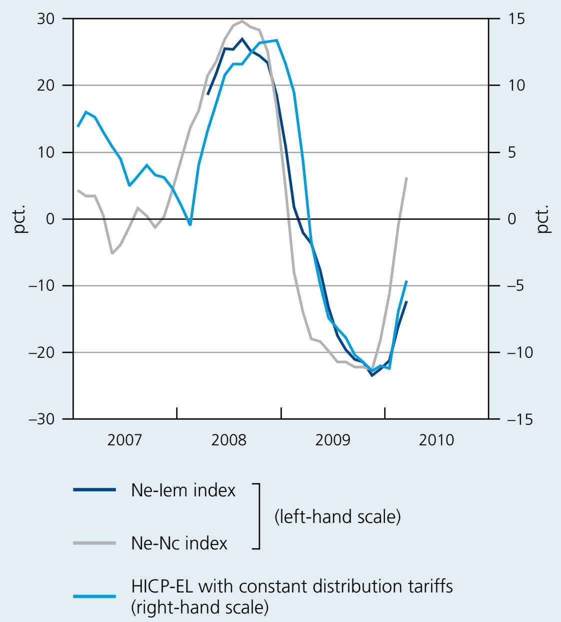
It should be noted that perfect similarity cannot be expected either for the Ne-Nc index or for the Ne-Iem index, as the adjusted HICP is an average market price. Table 1 shows that many suppliers index on the basis of Ne and Nc, which may explain why the HICP for electricity and the Ne-Nc index display a similar pattern. The deviations are due to the use of different weighting coefficients for Ne and Nc by different suppliers and for different consumption profiles, since there are some contracts which are not indexed on the basis of Ne and Nc (fixed price contracts or indexation based on other parameters).

In regard to the HICP with constant distribution tariffs, it must also be borne in mind that, while adjustments were made for the changes in the distribution tariffs, that does not apply to the distribution tariffs themselves, or to the transmission tariffs, and that also tends to even out

(1) CREG (2010a).
(2) CREG (2007), p. 37, CREG (2009c).
(3) That follows from the sum formula for the standard deviations;
$s^2_{x+y} = s^2_x + s^2_y + 2.r_{xy}.s_x.s_y$, where s^2_x is the variance of the variable x and r_{xy} is the correlation between the variables x and y.

CHART 6 ADJUSTED HICP INDEX AND THE NE-NC AND NE-IEM INDICES

(year-on-year changes)



Source: Own calculations on the basis of tariff schedules and Cornille D. (2009) for the HICP with constant distribution tariffs.

the relative changes in the index. Relative changes in the price level include, in the denominator, the price level at the start of the period, and that is higher if the (constant) distribution tariffs are included.

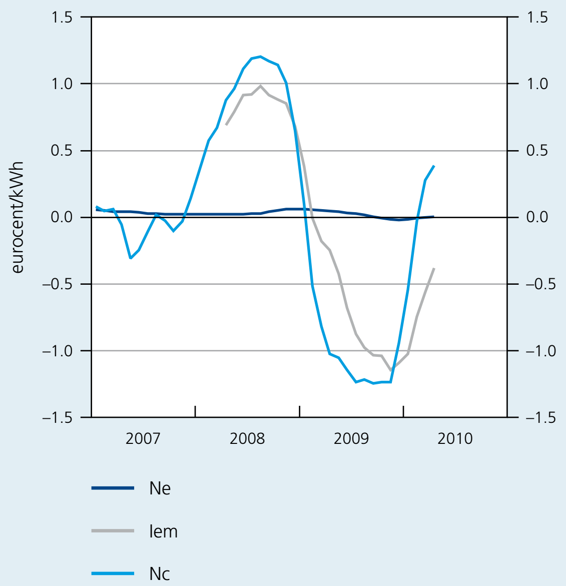
2.3 Influence of the chosen tariff schedule on the movement in the Ne-Nc and Ne-Iem indices.

The Ne-Nc/Ne-Iem index price calculations and charts in this study were based on a typical tariff schedule of one supplier. These tariff schedules show the supplier's values for the coefficients of Nc/Iem and Ne. Calculations were also done on the basis of other examples, but that had no significant impact on the conclusions.

For all tariff schedules, the ratio between the weights of Nc or Iem and Ne is much smaller than the ratio between the amplitudes of the variation in Ne (Nc). That is why the tariff schedule chosen does not really matter in the context of the year-on-year changes.

The amplitude of the change in Nc and Iem is up to 30 times greater than for Ne. Since the index price is a weighted sum of Nc/Iem and Ne (see formulas (1) and (2)),

CHART 7 YEAR-ON-YEAR CHANGES IN NC, IEM AND NE



Source: Own calculations.

so long as the weight of Ne is not too great in relation to that of Nc/Iem, the year-on-year changes in the Ne-Nc index price are dictated mainly by the changes in Nc/Iem.

2.4 Frequency of price adjustments: rapid transmission and lack of information and transparency

The indexation parameters Ne, Nc and Iem are calculated monthly, which also implies that the electricity price in variable-price contracts changes every month. The data which the regional regulators submit for the calculation of the HICP are based on those monthly price changes.

Since private customers are invoiced annually, they do not notice these monthly changes. However, their invoices are based on a price which is adjusted monthly. For that purpose, their annual consumption which is noted once a year is divided among the months of the preceding year on the basis of "synthetic load profiles" (SLP) validated by the regulator. An SLP indicates the distribution of consumption for each quarter of one year for a typical consumer. On the basis of that (statistically estimated) distribution it is therefore possible to separate the typical user's consumption into peak and off-peak usage. In other words, the SLP can be used to convert the total annual consumption into an (estimated) monthly consumption, and break that down into peak and off-peak consumption. The monthly consumption figure thus calculated is then multiplied by the index for the month in question.

The invoice price paid by a household with a variable-price contract is therefore a weighted average of the monthly index prices. The weighting is based on a load profile which is considered to indicate that household's consumption. Most consumers are unaware of the monthly price changes, and are given little information about the price which they pay in a particular month; they only find out the prices ex post, when receiving the invoice (1). An obligation to give prior notice would perhaps lead to less frequent price changes in view of the menu costs involved (2). That information obligation could also enhance transparency and, furthermore, provide the incentives required to modify consumption. However, it is necessary to ensure that the menu costs do indeed lead to less frequent price changes, and are not just added on to the invoice.

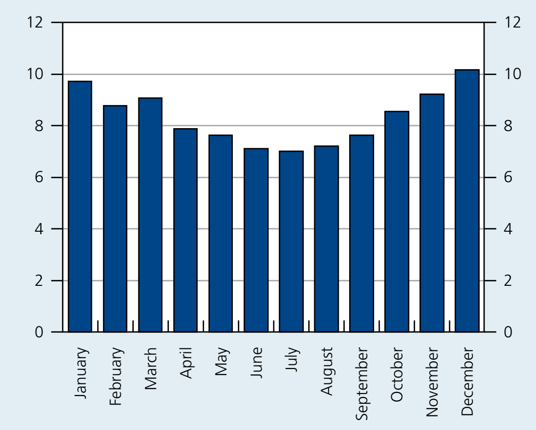
Menu costs may be among the reasons for the existence of indexation formulas. Prices under existing contracts can only be increased subject to very stringent conditions, because consumers must be given the opportunity to change their supplier, and that implies that they must be notified of price rises. That entails menu costs and deters suppliers from making frequent formula adjustments. Provided the indexation mechanism is explicitly described in the contract, however, the law does allow price increases on the basis of indexation formulas (3).

For completeness, it should be noted that even if consumers modify their behaviour, that will only influence their total annual consumption and therefore only have an indirect impact on the cost of consumption in a particular month. The load profiles are determined by the regulator, and in the case of a fixed load profile the allocation of the annual consumption among the various months will take no account of a household's modified behaviour. To rectify this, it would be necessary to take monthly consumption readings. That is a possible application for "smart meters" (4).

By way of illustration, chart 8 shows a simplified SLP (monthly instead of quarterly). During the summer months, consumption is clearly assumed to be lower. On the basis of the SLP depicted, the difference between the acquisition price (i.e. the price which changes every month) and the invoiced price is shown in chart 9.

(1) Most suppliers publish prices monthly on their websites, so price-conscious consumers can find that information if they want to.
(2) Menu costs are the costs associated with changing prices, e.g. the alteration and replacement of price lists or menus in restaurants.
(3) See the Law on market practices and consumer protection of 6 April 2010.
(4) "Smart meters" are meters equipped with computer hardware. They offer many possibilities: they can be read remotely, they can measure consumption continuously, and they can measure and record the individual consumer's load profile, etc.

CHART 8 A SIMPLIFIED LOAD PROFILE
(percentage of annual consumption)

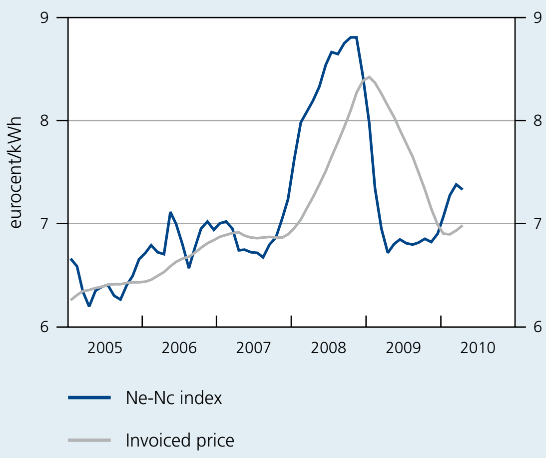


Source: Own calculations based on a VREG load profile.

Chart 9 shows the Ne-Nc index price changing month by month. For each month, it also shows how much a household invoiced in that month would pay for its consumption during the preceding twelve months. This is therefore the weighted average Ne-Nc index and the price which the private consumer "sees".

The less volatile invoiced price is a direct consequence of averaging. That also applies to the delayed effect: the price change is recorded later. However, a steep upward trend is also evident in the invoiced price.

CHART 9 DIFFERENCE BETWEEN NE-NC INDEX AND THE (AVERAGE) INVOICED PRICE



Source: Own calculations based on a VREG load profile.

The chapters which follow will examine the underlying characteristics of pricing on the electricity market for private consumers.

3. Analysis of the components of the electricity price for households

3.1 Analysis of the components of the calculated Ne-Nc index

3.1.1 Breakdown into components of the Ne-Nc index

The above analogy between the Ne-Nc index and the HICP for electricity merits more detailed analysis. For that purpose, the parameters Nc and Ne are broken down into their sub-indices and the contribution of each sub-index to the total Ne-Nc index is then examined. Formula (1) can therefore be broken down further by using the definitions of the parameters Ne and Nc (see annex 1). Chart 10 breaks down the Ne-Nc index into its components. The parameter Ne consists of a constant (Ne-cst), labour costs (Ne-s) and material costs (Ne-Mx). The height of the three bars shows the trend in Ne (see formula (3)). In addition, there are the contributions made by the parameter Nc (see formula (4)). One sub-component of Nc remains constant (Nc-cst); another sub-component depends on the nuclear capacity utilisation rate (Nc-fnu) and a third depends on the movement in the coal price (Nc-coal); there is also a contribution that depends on the movement in oil prices (Nc-oil), and finally, a component reflecting the movement in gas prices (Nc-gas). This factor also depends on the use of nuclear facilities: in the case of a high capacity utilisation rate, it may generate negative values for Nc-gas [1].

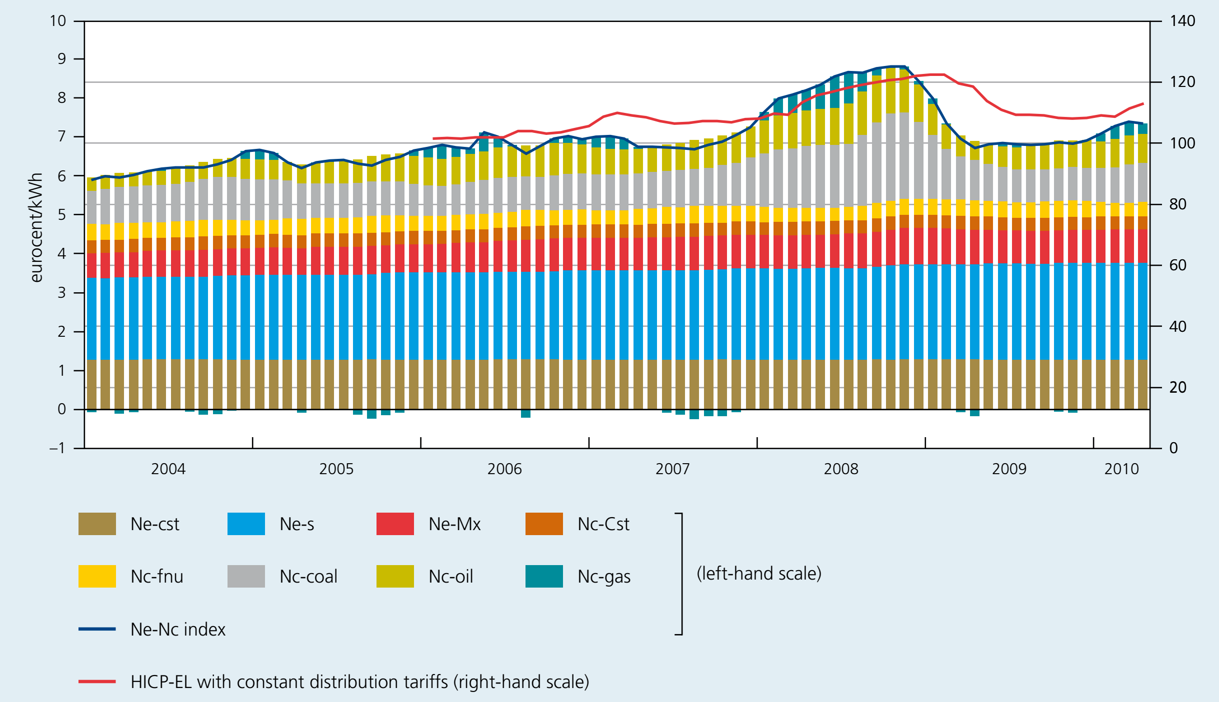
$$a_{Ne}.Ne = Ne\_cst + Ne\_s + Ne\_Mx \quad (3)$$

$$a_{Nc}.Nc = Nc\_cst + Nc\_fnu + Nc\_coal + Nc\_oil + Nc\_gas \quad (4)$$

The blue line in chart 10 shows the movement in the Ne-Nc index price (including all positive and possibly negative contributions); the adjusted HICP was also included (on the right-hand scale).

(1) For an example, see annex 1 and/or CREG (2008a).

CHART 10 COMPONENTS OF THE NE-NC INDEX FOR SETTING TARIFFS



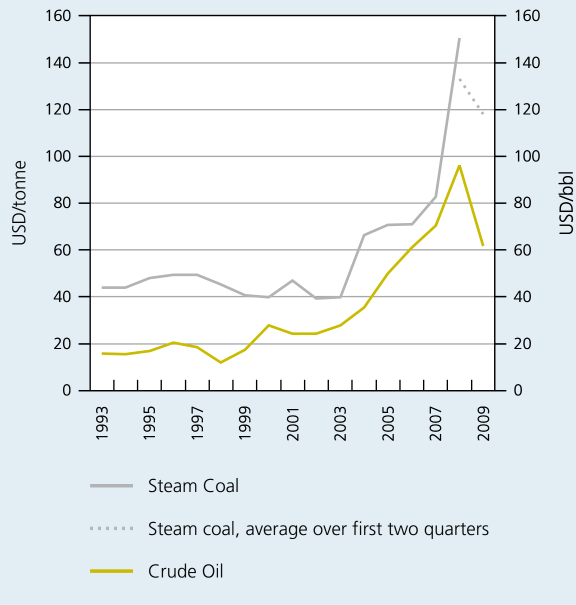
Sources: CREG, own calculations.

The contribution from parameter Ne is only rising slowly, with little volatility. The largest fraction of the total price depends on the contributions of this parameter Ne. Parameter Nc therefore appears to be the cause of the volatility. Its influence is significant throughout the period, but increased sharply in 2008; in the second half of that year the contribution of the Nc parameter almost equalled that of the Ne parameter.

In addition, coal prices clearly had a particularly large impact in the period from late 2008 to early 2009. During that period, Belgian import prices for coal increased sharply, as is evident from chart 11. Since the 2009 data were not yet available, the average of the first two quarters is also shown. The trend in that average gives some idea of how prices may have moved between 2008 and 2009. Up to 2003, coal import prices were relatively flat; after that, an initial price rise in 2004 was followed by a strong increase in 2008, resulting from the surge in demand for coal. Apart from coal prices, transport costs – which are included in import prices – also increased sharply in that period as a result of higher demand for transport capacity.[1] At the end of 2008, prices declined

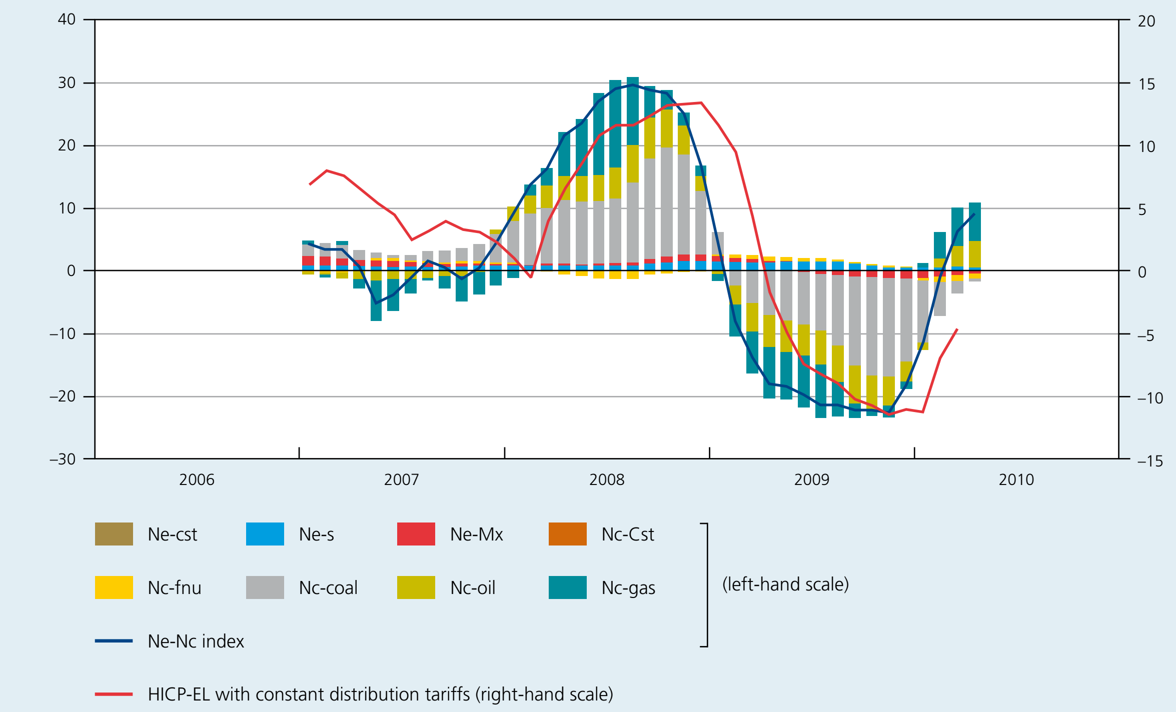
(1) OECD/IEA (2010).

CHART 11 BELGIUM'S ANNUAL AVERAGE IMPORT COSTS (INCLUDING INSURANCE AND TRANSPORT) FOR COAL AND OIL



Sources: OECD/IEA (2010).

CHART 12 SUB-INDICES OF THE NE-NC INDEX FOR SETTING TARIFFS
(year-on-year changes)



Sources: CREG, own calculations.

owing to the global economic crisis. Crude oil prices are shown on the right-hand scale. In 2008 they increased more moderately than coal prices. The trend in oil prices also represents a smaller weight in the Nc parameter (see annex 1). The large coal price increase and the heavier weight of coal in the Nc account for the importance of that component in chart 10.

The prices in chart 10 include only energy and supply costs (see table 2), i.e. no transmission and distribution costs and no taxes and VAT either. In July 2009 the energy price accounted for roughly 55 p.c. of the total price excluding VAT (see VREG (2010), p. 43), so that a price of 8.8 eurocent/kWh corresponds to a total price excl. VAT of 16 eurocent/kWh. If the VAT is also taken into account, then this price is consistent with chart 3.

The varying contributions to the year-on-year changes are shown in chart 12.

Since the end of 2007, the Ne-Nc index has been rising year-on-year. At first, that was due mainly to the rise in coal prices. At the beginning of 2008 that effect was reinforced by rising oil prices. Shortly after that came a third increase attributable to the natural gas price, whether or not combined with the nuclear capacity utilisation rate (see annex 1). At the end of 2008, the effect of the gas price and the nuclear capacity utilisation rate disappeared, but prices continued to rise steadily as a result of the increase in coal prices. In 2009, there was a "mirror" effect in which the falls in the Ne-Nc index were triggered by the combination of falling gas prices and changes in the nuclear capacity utilisation rate ; later they were reinforced by reductions in the prices of coal, in particular, but also oil.

Fluctuations in coal and oil prices need not mean that the electricity is produced from coal or oil, as in some long-term natural gas contracts the price is linked to movements in coal or oil prices.

The fact that changes in the Ne-Nc index and the HICP follow much the same pattern strongly suggests that the volatility is due to the use of the parameter Nc, especially owing to its coal price component. The combination of the gas price and the nuclear capacity utilisation rate is also a contributory factor.

3.1.2 Nuclear capacity utilisation rate and the impact of changes in natural gas prices

The coefficient of changes in the price of natural gas in the formula for Nc is not constant, as it depends on the nuclear capacity utilisation rate (see annex 1). The change in this "natural gas component" is therefore due to both changes in the natural gas price index and changes in that coefficient. However, that change can be broken down into a component that depends on the nuclear capacity utilisation rate and a component that depends on the movement in the price of natural gas. There is also a component consisting of the interaction between the two changes. This breakdown is explained in annex 4 and depicted in chart 13. The chart data are expressed in eurocent/kWh, which is different from the unit used in chart 12 (percentages). Chart 13 therefore also shows the year-on-year change in the Ne-Nc index in eurocent/kWh.

The chart shows the changes in the term "Nc-Ispotgas" from chart 12 broken down into three elements (see annex 4) :

- "nuclear contribution" indicates what the change would have been if the gas price index had remained constant, i.e. if it is only the nuclear capacity utilisation rate that has changed
- "natural gas contribution" similarly indicates what the change would have been if the nuclear capacity utilisation rate had remained constant, i.e. if it is only the gas index figure that has changed
- the preceding two situations are hypothetical, as in practice, both the gas price index figure and the nuclear capacity utilisation rate are variable ; there is therefore also a third component called the "dual contribution".

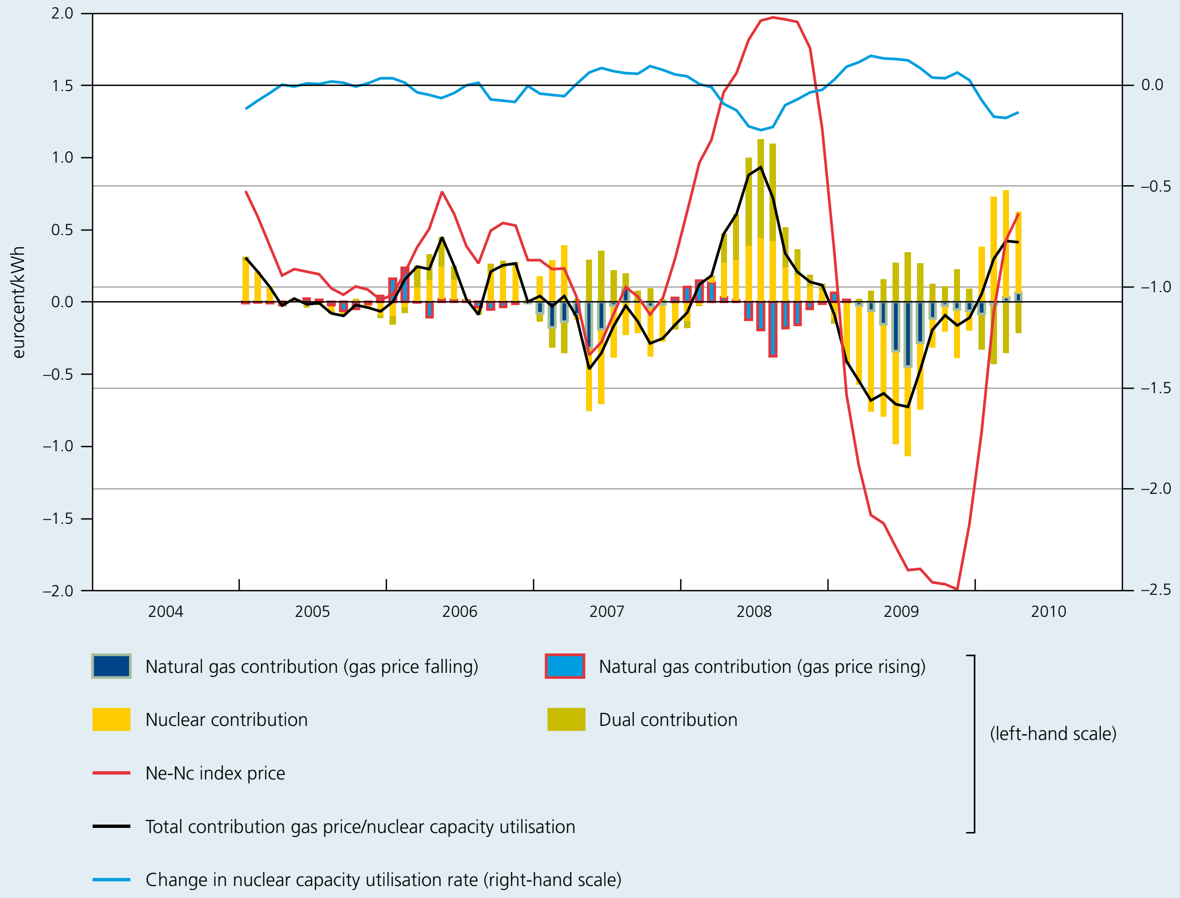
The sum of those contributions is equal to the total (year-on-year) change in the Nc-Ispotgas component. It is stated as the "total contribution of gas price/nuclear capacity utilisation".

Since the coefficient (1 – Ifnu) may have a negative value, that contribution may be negative even if the gas price increases. The blocks indicating the "gas contribution" are therefore outlined in red for the periods in which the gas price is rising and in green if it is declining.

Chart 13 shows that in mid 2008 the contributions of the combined natural gas price/nuclear capacity utilisation rate to the total parameter were due primarily to changes in the nuclear capacity utilisation rate. That lower utilisation rate was due to maintenance work and/or other problems (particularly the replacement of steam generators for Doel 4 and Tihange 3 and the reloading of fuel in Doel 2, 3 and 4 and in Tihange 2 and 3). In the second half of 2008, the gas price increased but that exerted downward pressure on the price. At the beginning of 2009, the improvement in the nuclear capacity utilisation rate exerted downward pressure on the Ne-Nc index. That effect was augmented by a decline in the gas price index.

CHART 13 ANALYSIS OF THE CONTRIBUTION OF CHANGES IN THE NATURAL GAS PRICE

(year-on-year changes)



Sources: CREG, own calculations.

Chart 14 simulates the impact of the nuclear capacity utilisation rate. It shows what the Ne-Nc index would have been if the nuclear capacity utilisation rate had remained constant since January 2004. In comparison with chart 10, which depicts the real situation, it appears that the price of natural gas would then have had far less influence; in these hypothetical circumstances, the steep price increases would then have occurred somewhat later (around mid 2008).

3.2 Analysis of the components of the Ne-Iem index

3.2.1 Breakdown of the Ne-Iem index

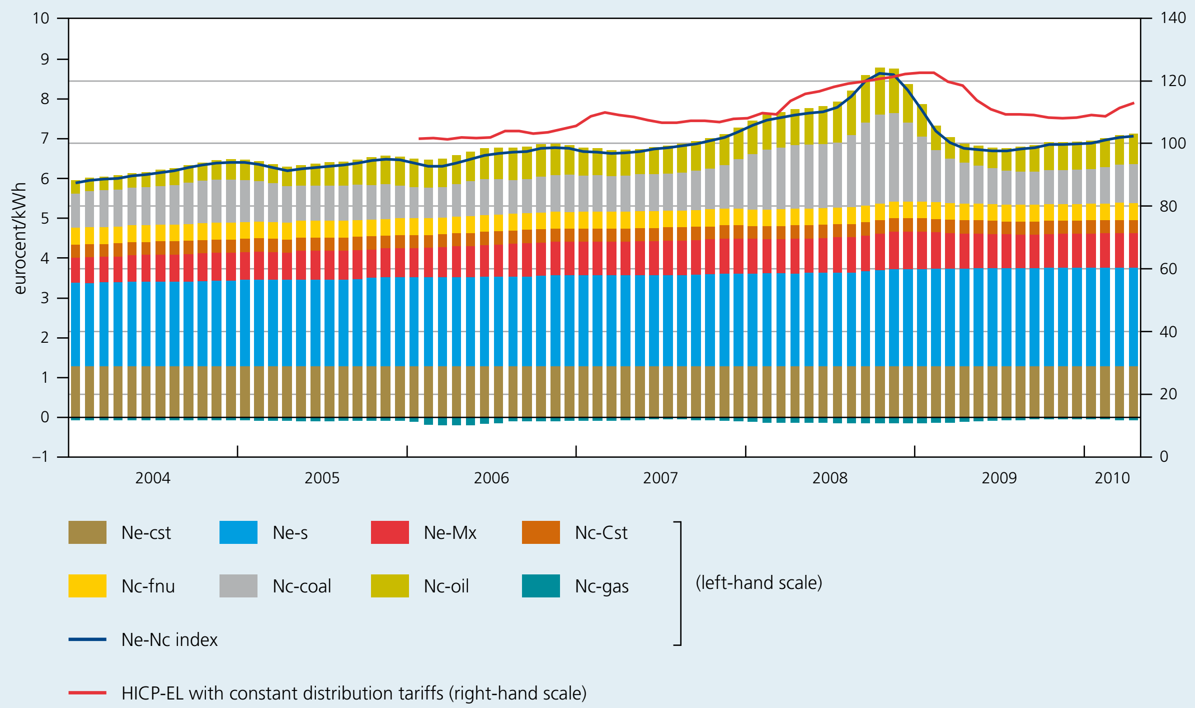
A similar analysis of the separate components can also be conducted for the Ne-Iem index. That index, like the Ne-Nc index ,is made up as follows (see also formula (2) and annex 3):

$$a_{Ne}.Ne = Ne\_cst + Ne\_s + Ne\_Mx \qquad (5)$$

$$a_{Iem}.Iem = Iem\_cst + Iem\_dah311 + Iem\_coal311 + Iem\_Belpex311 \qquad (6)$$

This breakdown is also illustrated in chart 15. Here, too, the parameter Ne is the most significant and the most stable component. Comparison of charts 10 and 15 shows that the weight of Ne is roughly the same in formulas (3) and (5). In chart 10, the parameter Nc was responsible for the volatility; here it is the parameter Iem. The comparison of charts 10 and 15 also reveals that the constant element in Iem is greater than in chart 10. Both Iem and Nc reflect the movement in fuel costs, so that this constant term reflects the part of the fuel costs that changes little (if at all). That applies, for instance, to

CHART 14 SIMULATION – HIGH NUCLEAR CAPACITY UTILISATION RATE



Sources: CREG, own calculations.

the cost of nuclear power stations, HEP stations, wind turbines etc. That constant term reduces the volatility but not the level.

Chart 16 shows the year-on-year changes in the weighted Iem components. The year-on-year increases in 2008 seem to be due mainly to the rising prices of natural gas (Iem-dah311) rather than the price increases on Belpex. Coal prices played only a minor role in 2008. In 2009 there were similar changes but in the opposite direction.

Indexation on the basis of the Ne-Iem index seems to make sense for suppliers whose intermediate costs depend on the gas price, electricity exchange prices and coal prices. That does not necessarily mean that they buy from coal producers. For example, it is possible that long-term contracts for buying natural gas are indexed to the movement in coal prices. However, indexation on the basis of a production mix is justified only if the purchase production mix is relatively constant. In practice that is hard to verify because – as already mentioned – suppliers can buy from any chosen producer. The production mix therefore has to be derived indirectly from the purchase mix. Use of the Belpex index may be sensible if shortfalls are only rectified by buying on Belpex or if some of the supplier's purchase contracts are linked to that exchange index.

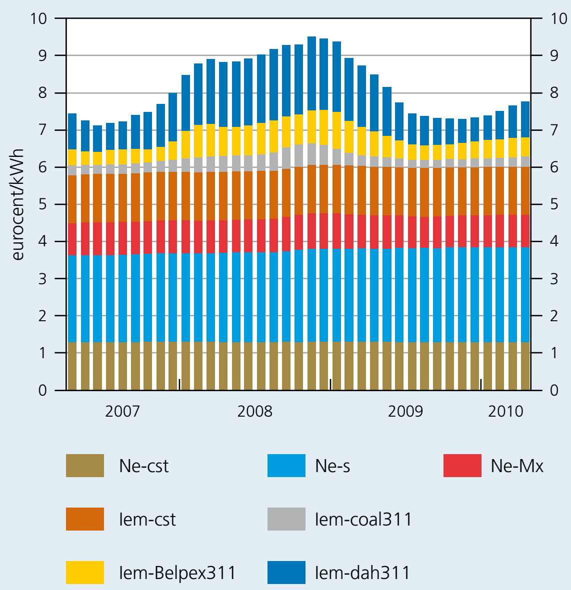
3.2.2 Comparison of the changes in the Ne-Nc index and THe Ne-Iem index

Chart 17 compares the changes in the Iem index with those in the Nc index. The year-on-year changes in the Iem component of the Ne-Iem index are due mainly to fluctuations in natural gas prices and, to a lesser extent, electricity prices on Belpex and coal prices.

The changes in Nc are due to fluctuations in coal and oil prices and changes in the natural gas component (remember that that component comprises two elements, namely the nuclear capacity utilisation rate and the index of natural gas prices).The gas component of Nc is broken down further in chart 17c. This shows that the movement in that component is determined mainly by the changes in the nuclear capacity utilisation rate.

It is also evident that the movement in gas prices in Iem differs from the index reflecting the gas price changes in Nc.

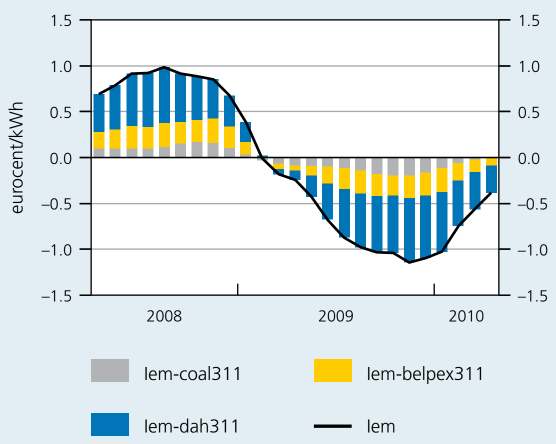
CHART 15 COMPONENTS OF THE CALCULATED NE-IEM INDEX FOR TARIFF SETTING



Source : Own calculations.

Nc and Iem both show the movement in fuel costs. The varying composition of these two parameters Nc and Iem is therefore due to differences in the supplier purchase structure. Suppliers who use Nc assume a mix of purchases from producers who generate electricity on the basis of nuclear energy, oil, natural gas and goal, where natural gas is a substitute for nuclear energy in cases where less use is made of nuclear power station capacity. Since the formula for Nc gives those fuels a fixed weight, it is implicitly assumed here that all suppliers who use Nc also have the same purchase mix in regard to primary fuels. Suppliers who use the parameter Iem consider that the costs of their purchase mix depend on the gas price, electricity exchange prices and coal prices.

CHART 16 COMPONENTS OF THE IEM INDEX FOR TARIFF SETTING
(year-on-year changes)



Source : Own calculations.

Both fuel index figures contain a constant term. That term is relatively more significant for the Iem index.

There is no component relating to CO_2 emissions, nor to the costs of the public service obligations (particularly the purchase of the green electricity certificates which have to be submitted annually).

3.3 Suppliers' costs and indexation of selling prices

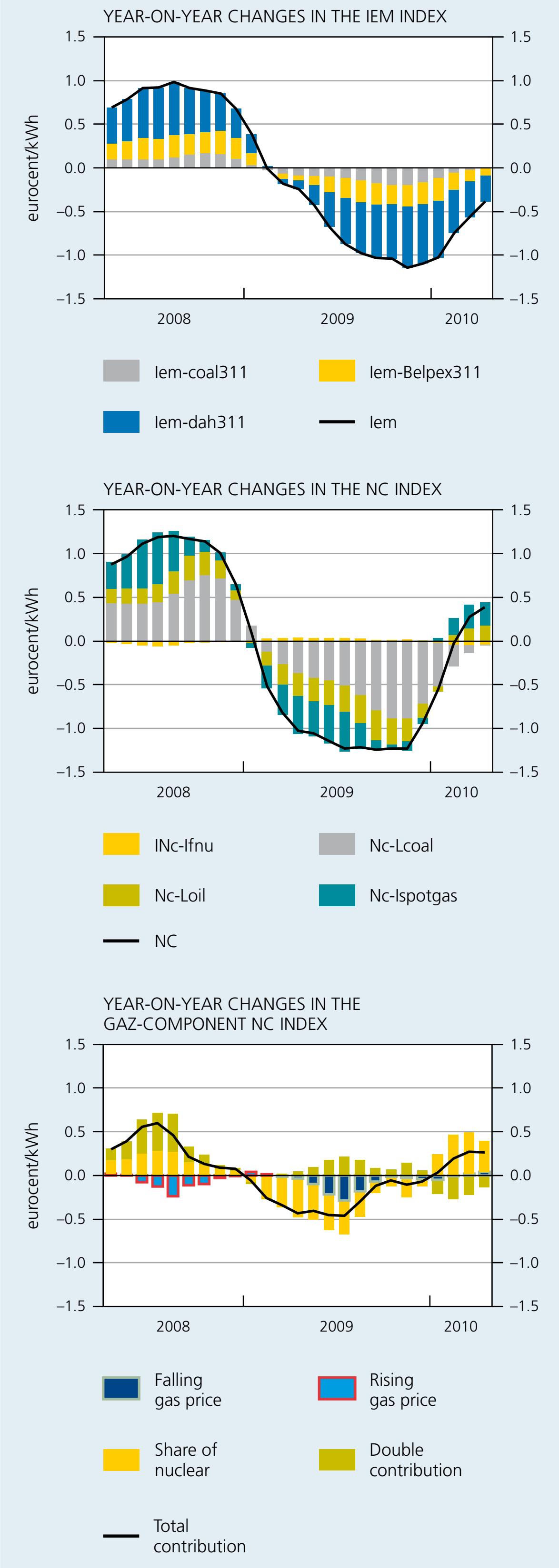
It is clear from the foregoing that the volatility of the HICP for electricity is almost certainly due to the indexation mechanisms used in the variable-price contracts. That indexation of selling prices is justified by the variability of the costs of suppliers' purchases. As a result, the supplier has to adjust his selling prices in line with his purchase costs in order to maintain the level of his margin.

The Ne and Nc indices were already in use before 2007. However, the definition of the parameter Nc was adjusted in 2004 (see the new definition in annex 1 [(1)]) because the old definition was based on confidential data [(2)]. After deregulation, it was therefore no longer possible to use the old formula. The pre-2004 Nc formula refers explicitly to the composition of the fuel mix used in the production of electricity [(3)]. It defined Nc on the basis of the monthly expenditure on the various fuels, and therefore took implicit account of monthly changes in the mix. The new formula no longer does that ; it therefore implicitly assumes a constant fuel cost mix. For more information on the old definition of Nc, see annex 5.

The parameter Iem came into use in 2008. However, that parameter cannot in itself explain the greater volatility in the HICP for electricity because it only applies to a small share of the market. The Iem index was introduced because the parameter Nc inadequately reflected the costs of the supplier in question.

(1) Moniteur belge (2004).
(2) CREG (2003).
(3) Moniteur belge (2001).

CHART 17



Source : Own calculations.

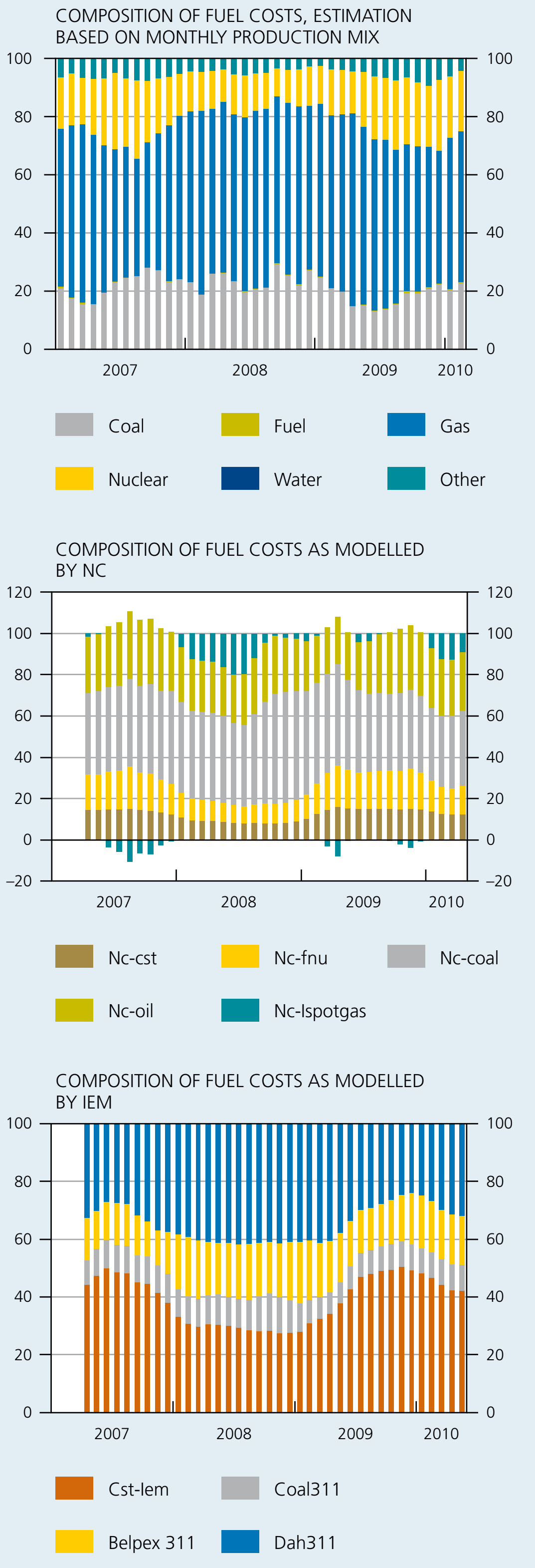
On a liberalised market, suppliers are free to determine their indexation formulas. Ideally, that indexation formula should reflect the supplier's costs. In theory, the use of different formulas by the various suppliers should lead to price differences and hence to shifts in demand in favour of the producers offering the cheapest production mix. However, these theoretical conclusions are based on a number of fundamental assumptions. For example, it need not be that households are perfectly and fully informed. The preceding chapters have shown that the use of different indices (Ne, Nc, Iem, etc.) and different, variable weights for each index increases the complexity and reduces transparency. The difference in frequency between price adjustments and invoicing also implies that the private user only knows *ex post* what price he is paying. The price which changes every month is often published on the website. The search for the cheapest supplier (inherent in the efficient operation of a free market) assumes that every household makes the effort to compare that information again on the internet every month, and furthermore is capable of estimating the effect on the invoiced price for the months ahead. That entails knowledge of the underlying calculation algorithms.

The supplier's costs are determined by his purchase mix; the underlying production mix can only be calculated or estimated indirectly; furthermore, it may vary. The question is therefore whether the volatility of fuel costs and the variability of the purchase mix (and hence of the fuel costs) should be passed on to households.

The indexation formula used should reflect the supplier's cost structure. If the components are wrong, if the required components are absent or if the weightings are incorrect, the price charged to households will have no connection with the real costs. Free competition between the various suppliers ought to correct that. On the deregulated market, Nc and Iem should therefore reflect the movement in fuel costs for the entire Belgian production capacity, or at least for that part of the capacity that supplies households with electricity on the regulated market. However, it is difficult to separate the part of the capacity used to supply households; for that reason, an attempt is made to break down the monthly costs of the entire capacity into the costs of the fuels used.

The ELIA website gives monthly injection data per technology, distinguishing between coal, oil, gas, nuclear, HEP and other power stations. On the basis of that monthly production mix in a given period it is possible to calculate average fuel costs for production during that period (for more details, see annex 6). For that purpose, production costs per technology are estimated. On the basis of the indices for the fuels (I-spotgas, I-oil, I-Coal) and assuming that the fuels for nuclear, HEP and other power stations

CHART 18 RELATIVE CONTRIBUTION TO FUEL COSTS – COMPARISON



Sources: Own calculations.

remain unchanged over the period, it is possible to estimate the year-on-year changes in the average fuel costs for the entire capacity on the basis of an initial price. Those fuel costs can easily be broken down by type of fuel (see annex 6) to give the relative fuel cost structure (see chart 18). This chart shows that over the period considered, gas was the principal fuel cost component, followed by coal. Chart 18 compares those relative contributions with the relative contributions of the various components of Nc and Iem.

The composition of fuel costs in chart 18 differs from the structure of the indices Nc and Iem, though the latter should reflect the suppliers' fuel costs. That does not necessarily imply that the parameters Nc and Iem ought to be identical with the fuel costs for the entire Belgian production capacity, because every supplier is free to purchase from any chosen producer. The market share of the suppliers who use Iem is small (see table 1). The fuel mix of those suppliers may therefore deviate from that of the Belgian capacity as a whole, which could explain the differences between the first and third parts of chart 18.

In view of the large share of suppliers using Nc, however, one could expect some similarity, but that is not the case. This need not mean that Nc is a poor reflection of the fuel cost pattern, because other explanations are possible: long-term purchase contracts for gas may be indexed to the price of coal, or the part of the production capacity used to supply households may differ in its composition from the capacity as a whole.

It is also worth mentioning that the share of the fuel costs that hardly ever changes (the constant) is greater in the Iem index. Once again, this does not mean that the cost pattern is misrepresented, because the costs depend on the supplier's fuel mix.

However, it is surprising that the formulas for Nc and Iem are clearly based on a fuel mix which remains constant over time. Yet on a liberalised market suppliers are free to modify their buying, there may be changes in the producers' production facilities, and the fuel mix may also be modified in the event of changes in relative fuel prices. For completeness, it should be noted that price increases under existing contracts are very strictly regulated by the consumer protection law. However, indexation formulas are permitted so long as the indexation mechanism is explicitly spelt out in the contract [1].

Note that no account is taken of the costs of emission rights or public service obligations.

(1) See the law of 6 April 2010 on market practices and consumer protection.

4. Fuel costs and pricing in neighbouring countries

This article has shown that the Belgian HICP for electricity exhibits a very close correlation with the Ne-Nc index and the Ne-Iem index, and is therefore most likely to reflect the method of indexation in the variable-price contracts of Belgian households. As a result of that indexation mechanism, changes in the parameters are very quickly reflected in the prices charged to private consumers. The question is whether such price index formulas are also used in other countries. On the basis of information available to the public it is not easy to check how selling prices elsewhere are adjusted in line with fluctuations in costs, particularly the direct or indirect fuel costs incurred by electricity suppliers.

In some neighbouring countries, households are still in most cases supplied with electricity at regulated tariffs (that is so in France, where over 95 p.c. of prices are still regulated)(1), or mechanisms have been incorporated to limit the frequency of price changes and/or to assess whether the price changes are reasonable (that is the case in the Netherlands where the NMa Energiekamer checks whether price changes are fair)(2). On the German and British markets, the competition authority and the regulator respectively conduct ex post checks to see whether tariff adjustments are reasonable.

To find out whether domestic electricity prices are also aligned with production costs in other countries, this chapter examines whether there is any correlation between the movement in fuel costs (expressed by the indices I-coal, I-spotgas and I-oil used in the parameter Nc) and the HICP index for electricity in Belgium and in neighbouring countries. The correlations calculated are set out in table 3.

The correlations were calculated for the period January 2007 to March 2010. It should first be pointed out that the HICPs are calculated on the basis of an all-in tariff (see table 2) and that they therefore include components other than the energy price. The Belgian HICP seems to show a positive correlation with all sub-indices. The French and German HICPs have a (slight) negative correlation with the fuel indices. The Dutch index tracks the movement in the gas price. However, the correlation with the oil and coal indices tends to be negative.

TABLE 3 CORRELATION BETWEEN HICP-EL AND THE VARIOUS COMPONENTS OF NC

	Coal	Oil	Spotgas
Belgium	0.685	0.513	0.682
Germany	–0.057	–0.163	–0.025
France	–0.075	–0.079	–0.167
Netherlands	–0.057	–0.349	0.114

Sources: Own calculations based on Eurostat (HICP) and CREG (sub-indices).

Nevertheless, it should be noted that the findings in table 3 must be interpreted with due caution, especially as the various fuel indices have a strong mutual correlation. That is undoubtedly attributable to an underlying common factor, namely developments in the emerging economies which caused a surge in demand for energy in the period considered. Table 3 thus presents total correlations. For example: owing to the strong correlation between the coal index and the oil index, the link between coal and the HICP includes a component connected with fluctuations in oil prices.

The correlations calculated show that, over the period considered, the HICP came under upward pressure as a result of an increase in any of the fuel indices, whereas neighbouring countries experienced multiple effects which partly cancelled one another out. Yet on the basis of this table, it seems rather unlikely that, in neighbouring countries, changes in fuel costs were passed on to households via automatic, monthly adjustment.

Conclusions

Sources of energy (oil, gas and electricity) have already formed the subject of analysis in various studies on the Belgian harmonised index of consumer prices. Before 2007 the movement in the oil price (and prices of derivatives) was a significant explanatory variable in the pattern of inflation. Since 2007, natural gas and electricity have also made a major contribution to the divergence between the Belgian HICP and the European average.

This article took a closer look at the method of pricing electricity. It shows that there is a very close correlation between the HICP for electricity and the indexation mechanisms which electricity suppliers use in their variable-price contracts. That indexation is based on certain parameters, the commonest being Ne, Nc and Iem. The Ne index reflects changes in labour and material costs. The current definition of the Nc index has applied since

(1) NAI, Price Observatory (2009), CRE (2010).
(2) Brattle Group (2009). For more information on the "safety net method", see http://www.energiekamer.nl/nederlands/gas/levering/tarieftoezicht.asp.

2004, and that parameter reflects the movement in the cost of the fuels which producers use. Most producers use the Nc index. The Iem index is different from Nc, but also tracks the movement in fuel costs.

The parameter Ne is relatively stable. The Nc index is more volatile because its constituent components – the prices of coal, oil and gas, and the nuclear capacity utilisation rate – have become more volatile. The Iem index is also more volatile, mainly because of major changes in the price of its natural gas component.

In a totally free market, prices should in theory reflect the costs of efficient producers. Sufficient transparency and competition are also required to ensure that the market mechanism can be fully effective. If these conditions are not entirely fulfilled, corrective measures can be applied by means of greater regulation.

On the Belgian deregulated market, electricity suppliers are free to choose their indexation parameters. In principle, the indexation formulas used should reflect the costs of efficient production. It is not possible to confirm that theoretical assertion on the basis of a rough estimate of fuel costs and analysis of the formulas.

Prices charged to households are adjusted monthly on the basis of the said indexation formulas. However, invoicing takes place annually. The annual consumption is converted to a monthly figure on the basis of pre-defined (and therefore approximate) load profiles. Annual invoicing implies that users are unaware of the volatility, but it also means that they do not know in advance what price they are paying. That is not conducive to transparency, yet the free market must be transparent in order to operate efficiently. Transparency is further reduced by the use of different indices, all with their own variable weightings.

Compulsory advance notice might reduce the frequency of price adjustments in view of the associated menu costs. That information obligation could also enhance transparency, as well as encouraging people to modify their consumption. However, it would be essential to ensure that the menu costs lead to less frequent price changes, and are not passed on in higher bills while the frequency of changes remains the same. A periodic but less frequent adjustment in line with market prices, by analogy with the variable interest rates on mortgage loans, is another approach worth investigating.

The more rapid transmission of changes in the parameters does provide an explanation for the greater volatility of Belgian electricity prices, though the question is whether the parameters actually reflect the suppliers' costs. On a free market, the free choice of the indexation formula and parameters used should lead to prices which reflect the suppliers' costs. That could not be demonstrated on the basis of a rough estimate of the production costs of the production capacity as a whole. A rough estimate of the average fuel costs of the Belgian production facilities reveals that the cost structure differs from the indexation formulas. There are various factors which could account for that: suppliers can purchase electricity from the producer of their choice, so that the mix may differ from the mix of Belgian production capacity. Strictly speaking, it is necessary to consider the mix of that part of the capacity which is used to supply households with electricity, but that is difficult to isolate.

Conversely, it is true that the formulas for both Nc and Iem assume a fixed fuel mix. Nevertheless, that mix is not constant: there may be changes in the production capacity, variations in relative fuel prices influence the mix, etc.

Some components affecting the price of electricity are not included in the formulas. Examples are the costs of emission rights and public service obligations.

In practice, it is not feasible to take constant account of these factors, as that would lead to frequent adjustments and substantial menu costs. The "safety net" method used in the Netherlands could offer a solution here. This method stipulates that the suppliers must submit every tariff change to the regulator four weeks in advance of implementation. The regulator then assesses whether the tariff increase is fair in view of the costs incurred by the supplier. If the proposed tariff does not conform to the maximum limits set by the regulator, the supplier is given the opportunity to explain the increase. If, after completion of this procedure, the regulator judges the tariff to be unreasonable, then the supplier has a maximum tariff imposed on him. Different maximum tariffs may apply for green and grey electricity (1).

As a result of this method, the problem of the complex structure of suppliers' costs, in which fuel costs are only one element, is transferred from the consumer to the regulator. Furthermore, the regulator has access to the supplier's internal operating data. That is absolutely essential in order to assess whether the tariffs correspond to the costs.

In an efficient market, there would be no need for the "safety net" method if consumers could readily compare the various suppliers' tariffs and if they could also readily switch their supplier.

(1) For more information on the "safety net method", see http://www.energiekamer.nl/nederlands/gas/levering/tarieftoezicht.asp.

In neighbouring countries, the consumer price indices are less volatile than in Belgium. It was not possible to establish any link between the HICP-EL of neighbouring countries and the indices used in Belgium in variable-price contracts. That suggests that those other countries may apply a different method of adjusting selling prices in line with the suppliers' costs. Moreover, electricity prices are often still regulated in neighbouring countries (France) or prices are adjusted far less frequently ("safety net" method in the Netherlands).

The indexation formulas used in Belgium imply that all changes in primary fuel prices are passed on quickly and virtually in full in consumer prices: that is not the case in neighbouring countries.

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Annex 1 : Definition of the parameters Nc and Ne

This annex (based on the document CREG (2008a)) explains the parameters Nc and Ne. The values of these parameters are published on CREG's website in the form of monthly time series calculated as follows:

The parameter Ne reflects the movement in labour and material costs and is defined as:

$$\mathrm{Ne} = 0{,}425 + 0{,}390 \frac{\mathrm{s}}{8{,}88131} + 0{,}185 \frac{\mathrm{Mx}}{141{,}51}$$

where s gives the change in wages in the metalworking industry and Mx tracks the cost of materials.

The parameter Nc reflects the prices of primary fuels and is defined as:

$$Nc = 0{,}214 + 0{,}260.I_{fnu} + 0{,}375.I_{coal} + 0{,}240.I_{oil} + 1{,}195.(1 - I_{fnu}).I_{spotgas}$$

I_{fnu} is an index which indicates the nuclear capacity utilisation rate, measured against an initial value. This figure may therefore be greater than one.

I_{coal}, I_{oil}, $I_{spotgas}$ respectively give the changes in prices of coal, oil and natural gas. They are also indices measured in relation to a base period.

Annex 2 : Calculation of the coefficients of nc and ne on the basis of one supplier's tariff schedule

A typical supplier's tariff schedule contains the following (considering only the energy price and a supplier's margin):

– a fixed tariff component expressed in eurocents per annum. This fixed component is a multiple of the parameter Ne published by the CREG.

Thus $T_{fix} = c_f.Ne$

– a peak rate tariff which combines the parameters Ne and Nc. It is expressed in eurocents per kWh.

Thus $T_{peak} = c_{p,e}.Ne + c_{p,c}.Nc$

– an off-peak tariff which combines the parameters Ne and Nc. It is expressed in eurocents per kWh.

Thus $T_{low} = c_{l,e}.Ne + c_{l,c}.Nc$

– possibly a night-time tariff which combines the parameters Ne and Nc. It is expressed in eurocents per kWh.

Thus $T_{night} = c_{n,e}.Ne + c_{n,c}.Nc$

On the basis of this information combined with a particular consumption profile, it is possible to determine an index that summarises everything in one formula comprising only Ne and Nc. By definition, a consumption profile determines consumption per type of tariff. The profile therefore comprises three types of consumption (a quantity consumed at peak rates, a quantity consumed at off-peak rates and a quantity consumed at night-time rates), all expressed in kWh. The respective types of consumption are represented as (q_p, q_l, q_n). For example, for the consumption profile "3,500kWh per annum, including 1,500 at the off-peak rate", this becomes (2000 kWh, 1500 kWh, 0 kWh).

The formula is fairly simple to derive.

For consumption of $(q_p + q_l + q_n)$ the annual bill comes to

$$T_{fix} + q_p.T_{peak} + q_l.T_{low} + q_n.T_{night}$$

If the formulas for the different types of tariff are substituted, we get

$$c_f.Ne + q_p.(c_{p,e}.Ne + c_{p,c}.Nc) + q_l.(c_{l,e}.Ne + c_{l,c}.Nc) + q_n.(c_{n,e}.Ne + c_{n,c}.Nc)$$

If we work out and restate the formula, we get

$$(c_f + q_p.c_{p,e} + q_l.c_{l,e} + q_n.c_{n,e}).Ne + (q_p.c_{p,c} + q_l.c_{l,c} + q_n.c_{n,c}).Nc$$

This is the consumption paid for $(q_p + q_l + q_n)$

Per kWh that gives us the following formula

$$\frac{(c_f + q_p.c_{p,e} + q_l.c_{l,e} + q_n.c_{n,e})}{(q_p + q_l + q_n)}.Ne + \frac{(q_p.c_{p,c} + q_l.c_{l,c} + q_n.c_{n,c})}{(q_p + q_l + q_n)}.Nc$$

This is a formula that gives total consumption according to the parameters Nc and Ne.

Annex 3 : Definition of the parameters Iem and Iec USED BY LUMINUS

Since May 2008, the electricity supplier Luminus has stopped using the parameter Nc and switched to an alternative parameter of which two variants were defined, namely Iem and Iec. The parameter Iec is more closely linked to daily prices on the Belpex exchange.

The two parameters were defined as follows :

$$\text{Iem} = 0{,}684633 + 0{,}03856 . \text{DAH311} + 0{,}006321 . \text{Belpex 311} + 0{,}002479 . \text{Coal 311}$$

$$\text{Iec} = 0{,}3423165 + 0{,}01928 . \text{DAH311} + 0{,}003161 . \text{Belpex 311} + 0{,}00124 . \text{Coal 311} + 0{,}034555 . \text{Belpex}$$

The coefficients of Iec are therefore half those of Iem and the term “Belpex” was added.

The suffix 311 indicates that the index figure is a quarterly average of the prices. In the case of DAH that is a quarterly average of the gas price at the Zeebrugge Hub. Belpex311 is the (quarterly) average price on the Belpex electricity exchange, and Coal 311 is the average coal price taken over three months. The Belpex variable with no suffix is the average price on Belpex over the past month.

Note that the coefficient of Coal 311 is expressed in a different unit (tonne/€). The coefficients of DAH311, Belpex311 and Belpex are in MHh/€.

Annex 4: Analysis of the contribution of changes in the gas price

The coefficient of the gas price index in the formula for Nc depends on the nuclear capacity utilisation rate. However, the total contributions of the last term in the formula for Nc can be broken down as follows:

If the last term is written as $c_{gas}.I_{gas}$, then the change in that term between two periods "1" and "2" is equal to $c_{gas}^{(2)}.I_{gas}^{(2)} - c_{gas}^{(1)}.I_{gas}^{(1)}$.

This can be rewritten as:

$$\begin{aligned} c_{gas}^{(2)}.I_{gas}^{(2)} - c_{gas}^{(1)}.I_{gas}^{(1)} &= c_{gas}^{(2)}.I_{gas}^{(2)} - c_{gas}^{(1)}.I_{gas}^{(1)} + c_{gas}^{(2)}.I_{gas}^{(1)} - c_{gas}^{(2)}.I_{gas}^{(1)} \\ &= c_{gas}^{(2)}.\Delta I_{gas} + \Delta c_{gas}.I_{gas}^{(1)} \end{aligned}$$

The term in $c_{gas}^{(2)}$ implicitly depends on the change Δc_{gas} and should therefore be rewritten as $c_{gas}^{(2)} = c_{gas}^{(1)} + \Delta c_{gas}$, ultimately giving us

$$c_{gas}^{(2)}.I_{gas}^{(2)} - c_{gas}^{(1)}.I_{gas}^{(1)} = c_{gas}^{(1)}.\Delta I_{gas} + \Delta c_{gas}.I_{gas}^{(1)} + \Delta c_{gas}.\Delta I_{gas}$$

Annex 5 : Old definition of the parameter Nc

For a detailed definition of the parameter Nc, before it was revised in 2004, see the 12 December 2001 issue of the Moniteur belge. This annex contains a simplified version to describe the differences between the old and new definitions, as those differences explain why the old definition offered a better reflection of the costs.

It should also be noted that the old formula was devised before deregulation, in a period when suppliers and producers were still vertically integrated. In that context, suppliers have a better idea of the cost of the fuel used.

On the deregulated market it was no longer possible to use the old formula because it was based on internal corporate data which ceased to be in the public domain after deregulation.

In the Moniteur belge/Belgisch Staatsblad (2001), Nc is defined for a given month "m" as $Nc^m = \frac{Ce^m}{Ce_{reference}}$, where Ce^m represents the average fuel costs in that month. Ce^m is defined in more detail in the text of the law. Ce^m is calculated monthly. In simple terms, it can be said that Ce^m is the weighted average of the cost of the fuel used, namely the costs of nuclear fuel and fossil fuels. The weighting is based on the percentage of the fuels in the mix during the month in question.

$$Ce^m = \frac{1}{3}\sum_{i=2}^{4}\left[s_{nuke}^{y}.C_{nuke}^{m-i} + \left(1 - s_{nuke}^{y}\right).C_{other}^{m-i}\right] + EC^m$$

where

- Ce^m is the value of Ce for month m
- s_{nuke}^{y} is the percentage of nuclear production in year y
- C_{nuke}^{m-i} is the nuclear energy production costs in month (m-i), in €/kWh
- C_{other}^{m-i} is the average cost of fossil fuels and imports in month (m-i), in €/kWh
- EC^m is an adjustment term. The first part of the formula uses the annual percentage of nuclear energy. That figure may vary from month to month, and the EC-term adjusts for that.

The formula for Ce is very different from that for Nc in annex 1. The latter assumes that there are fixed ratios for coal and oil, and that gas and nuclear are complementary. In contrast, the formula for Ce is based on the costs incurred in the month in question.

Annex 6: Average fuel costs for a given production mix

It is possible to calculate the average fuel costs for a given production mix in a given period.

Example: month m in which, for technology t, the quantity produced (in MWh) is represented by $q_t^{(m)}$ and the fuel costs (in €/MWh) by $fc_t^{(m)}$. The total fuel costs in that month are obtained by adding together the various technologies:

$$FC^{(m)} = \sum_t q_t^{(m)}.fc_t^{(m)}$$

The average fuel costs are obtained after division by the total quantity produced. The contributions of the various technologies in the mix can be identified as follows:

$$\overline{fc}^{(m)} = \sum_t \frac{q_t^{(m)}}{q^{(m)}}.fc_t^{(m)}$$

where $q^{(m)}$ is the total production in the month in question.