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THE COST OF ELECTRICITY FOR SPANISH FIRMS

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ABSTRACT

This article analyses the cost of electricity for Spanish firms. This cost is compared with other expenditure by Spanish industrial firms on goods and services and with their turnover, distinguishing by firm size and sector. Generally, in the industrial sector, the ratio of electricity expenditure to spending on goods and services increases as firm size diminishes, while the ratio of electricity expenditure to turnover is much higher for micro enterprises than for others. By sector, cement, lime and plaster manufacturing posts the highest ratios, followed by several extractive industries, some intermediate goods-producing basic metal industries and the energy, water and waste group.

Regarding the price of electricity, the article examines, in particular, the importance of the regulated cost component – paid through what are known as access charges – for medium-sized and large electricity consumers by sector. Owing to the design of the access charges, the highest average prices correspond to the lowest consumption bands. The average access charge by supply voltage has been stable since the last tariff review in 2014. In real terms, access charges decreased in the period 2014 to 2019.

Keywords: electricity prices, access charges, sector, firm size.

JEL classification: L00, M21, Q49.

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Introduction

As a result of globalisation, a large part of firms' purchases of productive inputs and sales are made at fixed prices on international markets, whereas energy and labour are two of the few factors that are paid at local prices. This, together with the outsourcing of certain services, has meant that energy price differences have become even more important when it comes to competing on international markets.

In Spain, firms' electricity bills account for more than half of their total expenditure on energy products. Accordingly, it is important to know what is the cost of electricity for Spanish firms. It must be borne in mind that a very large part of this cost is not strictly attributable to the generation, transmission, distribution and sale of electricity, but rather to a set of energy policies that are financed through the electricity bill.

Following this introduction, the next section describes in detail the components of the price of electricity in Spain. In the third section, the cost of electricity borne by Spanish industrial firms is set in context compared with other business variables, by firm size and sector. The last section analyses the prices that medium-sized and large Spanish firms pay for their electricity, together with the weight of the regulated component in these prices, again distinguishing by sector, also including in this case non-industrial sectors.

Costs included in non-household consumers' electricity supply

Consumers' electricity bills comprise three main components: energy, regulated costs and tax.[1]

The main item of the energy component is the cost of the electricity itself. This depends on the level of consumption and on the energy price during the relevant period, which is determined by the consumer's chosen supply strategy. Non-household consumers – especially large ones – can choose to purchase their energy:

1 Although this article concentrates on non-household consumers, this section also applies to household consumers, except for the energy purchase options, which for household consumers are generally limited to option (ii).

i) directly on the wholesale market, generally through a combination of purchases on the daily market and on forward markets;

ii) through a supply agreement with an electricity retailer in which the energy price is freely agreed between the parties;

iii) through a bilateral supply agreement;

iv) also through different levels of self-supply, through cogeneration[2] facilities or renewable self-supply.

The following variables also affect the energy component:

i) the cost of the ancillary services required to ensure safe operation of the electricity grid in real time;[3]

ii) other regulated prices, such as the cost of capacity payments[4] and of service interruptibility,[5] both related to regulatory mechanisms that help guarantee the electricity supply;

iii) the mark-up applied, where appropriate, by the electricity retailer.

The second component of the electricity bill are regulated costs, which cover the cost of certain electricity supply-related activities and are established by the regulators. In 2019, regulated costs funded through the electricity grid settlement system amounted to €17,627 million (see Chart 1). These costs comprise two components, according to the nature of the activities they fund, i.e. network charges and energy policy charges:[6]

i) The network charges are used to fund the cost associated with remuneration of the electricity transmission and distribution networks (€6,891 million, overall, in 2019, 39% of total regulated costs) that are needed to transport

2 Cogeneration is the simultaneous generation of electricity and heat in industrial processes that require both forms of energy. When surplus electricity is generated, it may be sold to the grid for a price.

3 Ancillary services are a set of processes managed by the Spanish grid operator – Red Eléctrica de España (REE) – that ensure that electricity generation meets demand at all times, ensuring the safe operation of the electricity system in real time. For more information see https://www.ree.es/en/activities/operation-of-the-electricity-system.

4 Capacity payments remunerate certain generating facilities for their availability to generate energy at times when the grid has a supply shortage.

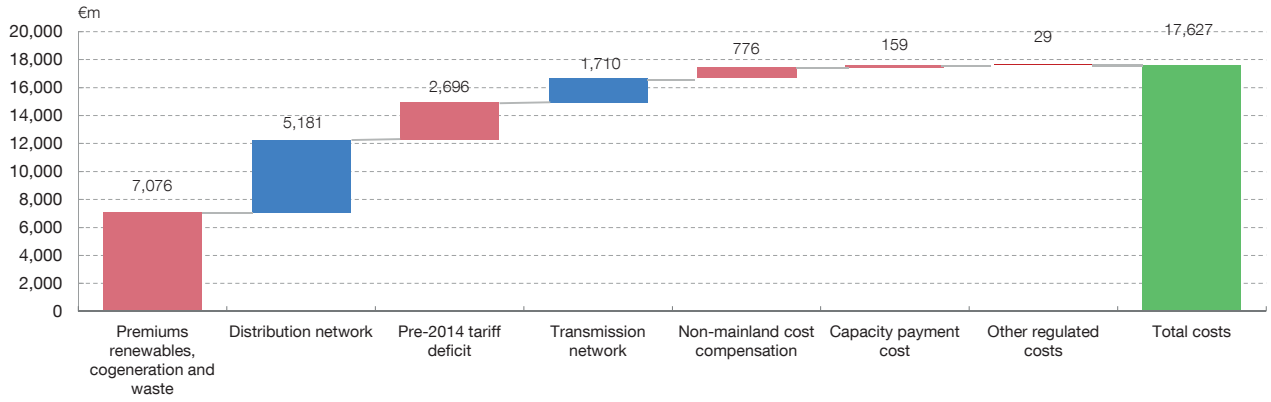
5 Service interruptibility is an economic compensation for industrial consumers that are prepared to reduce their demand at times when the electricity supply is insufficient to meet demand, thus preventing an indiscriminate power supply outage that would affect consumers overall.

6 To date, this distinction between network charges and energy policy charges has not been explicitly made in consumers' bills; instead, the two concepts are paid under a single regulated cost (the access charges). From June 2021 two regulated prices are to be applied: a network charge set by the National Commission on Markets and Competition (CNMC) and an energy policy charge set by the Ministry for the Ecological Transition and the Demographic Challenge.

Chart 1

REGULATED COSTS (2019) (a)

Regulated costs amounted to €17,627 million in 2019. Subsidies for renewable energy facilities were the main regulated cost (40% of the total), followed by remuneration of distribution (29%), payment of past tariff deficits (15%) and remuneration of transmission (10%).



SOURCE: CNMC (2020).

a Total regulated costs (green column) broken down between network charges (blue columns) and energy policy charges (red columns).

electricity from the place of generation to the place of use. The transmission networks are the higher voltage lines (over 220 kV in mainland Spain)[7] that transmit large amounts of energy over long distances, while the main function of the distribution networks is to carry energy to end consumers that have mainly medium and low-voltage connections.[8]

ii) The energy policy charges are used to fund cost items that, according to energy policy decisions, are funded through the electricity bill[9] (€10,736 million in 2019, 61% of total regulated costs in that year). In Spain the three main such cost items are:

— the extra cost deriving from the incentives for renewable technologies, cogeneration and waste treatment;[10]

7 The international interconnections and non-mainland systems include elements that belong to the transmission network, but they have lower voltage levels.

8 Except for industrial customers with higher electricity use, which are generally directly connected to the transmission network.

9 In addition to the charges paid by consumers in their bills, these costs are also funded by other means, notably including the taxes and charges established by Law 15/2012 and revenues from auctions of CO2 emission rights. These other revenue sources amounted to €2,450 million in 2019.

10 In December 2020, the Government approved the draft bill for the creation of the National Fund for Electricity Grid Sustainability. The aim is to transfer the cost of this item, which is currently funded entirely through the electricity grid, to energy (liquid hydrocarbon, natural gas and electricity) consumers overall. Under the Government's proposal, this mechanism would be phased in from 2021, meaning that this item would disappear completely from the regulated costs included in the electricity bill in 2025.

— the annual cost of paying down the debt taken on by the electricity sector up to 2013 (the "tariff deficit");[11]

— 50% of the higher cost of electricity supply in the non-mainland systems (more expensive than on the mainland for reasons of geography).

The regulated costs are borne by each firm through regulated prices, some in the form of network charges and others in the form of energy policy charges. Essentially this depends on firms' voltage connection and, in some cases, on their contracted power, with different tariffs defined in the regulations according to these variables. In addition, each tariff includes different prices for network charges and energy policy charges, depending on time of use (the so-called time-of-use periods). These unit prices have a binomial structure, with:

i) a unit price for network charges and another for energy policy charges, both defined in terms of the consumer's contracted power (€/kW/year);

ii) a unit price for network charges and another for energy policy charges, both defined in terms of the energy used (€/kWh).[12]

The higher the supply voltage,[13] the lower the unit prices both of the network charges and the energy policy charges in the different tariffs. In addition, in each tariff the network charges and energy policy charges are lower at off-peak times when electricity demand is lower, and vice versa (see Chart 2). In consequence, total regulated costs are not fixed according to the contracted power supply, because they also depend on the amount of energy taken from the grid and on the time of use.

As regards the third component, the electricity bill includes tax on the use of electricity in the form of an excise duty (5.1%) and VAT (21%, the standard rate). However, unlike household consumers, firms are not subject to this VAT and, in the case of the excise duty, large consumers enjoy an 85% exemption.

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11 See Matea (2013) on the tariff deficit.

12 The tariff structure is defined in Royal Decree 1164/2001 of 26 October 2001 establishing network charges for electricity transmission and distribution networks. This structure will change after June 2021, in accordance with the network charges methodology defined by the CNMC in its Circular 3/2020 of 15 January 2020. The new structure will, however, be defined on the basis of the same variables (voltage and contracted power).

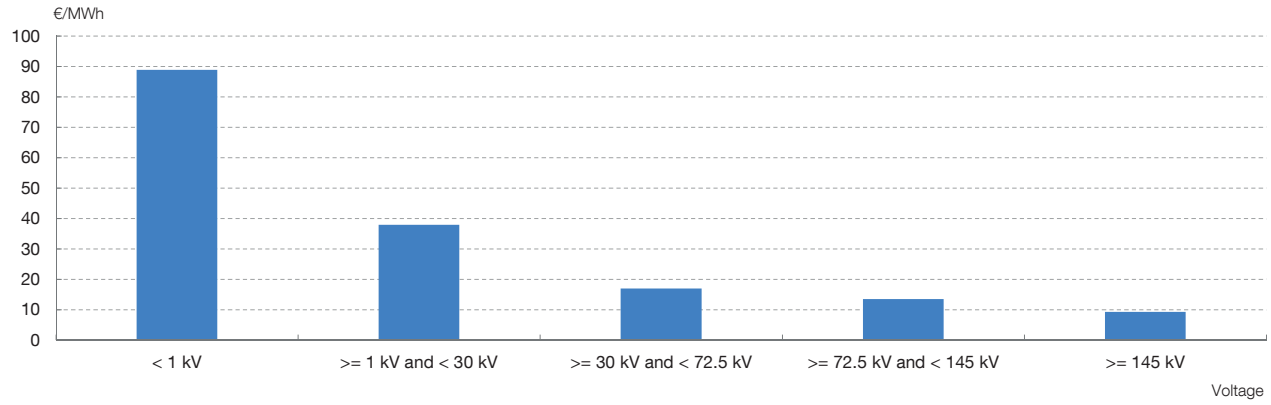
13 In simplified terms, in the case of the network charges this is because the higher the voltage at which consumers connect to the grid, the lower their need of the networks. For example, consumers that are connected to the transmission network do not bear the cost of the distribution network, as they do not use it.

In the case of the energy policy charges where, conversely to network charges, there is no clear cost factor to determine how they should be assigned to the different consumer types, the cost allocation according to the tariff level is inversely proportional to the consumers' price-to-demand elasticity, which is higher for industrial consumers with high-voltage connections. This approach is related to the Ramsey rule, based on the fact that this is the allocation strategy that least distorts consumers' decisions compared with a situation in which there are no charges, thus entailing the least loss of well-being for consumers overall and, therefore, greater economic efficiency.

Chart 2

AVERAGE ACCESS CHARGE BILLED BY SUPPLY VOLTAGE (2019) (a)

Access charges decrease as supply voltage increases. This is especially noticeable when going from low voltage (under 1 kV) to high voltage (over 1 kV).



SOURCE: CNMC (2020).

a Under 1 kV is low voltage; over 1 kV is high voltage.

Industrial firms' electricity expenditure

Drawing on INE (National Statistics Institute) data, "Structural Business Statistics: Industrial Sector",[14] the importance of electricity expenditure may be analysed according to certain business ratios, drawing a distinction by sector and firm size. For this purpose, disaggregated 3-digit CNAE (National Classification of Economic Activities) data were used and three large groups were considered according to firm size: micro enterprises (up to 9 employees), small enterprises (between 10 and 49 employees) and medium-sized and large enterprises (50 or more employees).

On average, electricity expenditure accounts for somewhat less than two-thirds of Spanish firms' expenditure on energy products, reflecting the importance of electricity as a factor of production. This will presumably become more acute in the future as the productive system comes to depend more on electricity in response to climate change.

14 In this section, homogeneous series for the period 2016-18 provided by INE are used, in which each legal unit (identified by its tax identification number) is a firm. The 2018 data are slightly different from the INE series, because no account has been taken here of the methodological change introduced in that year, according to which a firm becomes: a) an independent legal unit that is not part of a business group, it being assumed, therefore, that it enjoys autonomy of decision; b) a business group comprising one or more legal units; or c) a subset of one or more legal units of a business group. As per INE (2020), this change only affects legal units that are part of business groups, which account for 3.1% of the total. In addition, lignite extractive industries (data available only for 2018) have been excluded from the analysis. Although the number of firms is very small and their electricity use is very low, their turnover is so small that the ratio of electricity expenditure to turnover is abnormally high (47%).

The disaggregation by firm size shows that electricity as a percentage of total average expenditure on energy products is lower among micro enterprises (58%) than among the other two categories (63%) (see Chart 3.1). However, as Chart 3.2 shows, there is a high degree of heterogeneity, especially among micro enterprises, owing to the great diversity of their activities.

For 84% of firms with more than ten employees, electricity expenditure accounts for more than 50% of their total energy bill (see Chart 3.2), whereas this is the case for just 68% of firms with fewer than ten employees.

If firms' electricity bills as a proportion of total expenditure on goods and services are analysed, micro enterprises have the highest proportion of electricity expenditure. Moreover, in the period 2016-18 this proportion increased for micro enterprises, whereas it declined for all other firms (see Chart 3.3). For most firms, irrespective of size, electricity accounts for between 1% and 2% of all their purchases of goods and services (see Chart 3.4). Yet for 44% of those with fewer than ten employees, electricity expenditure accounts for more than 2% of their total purchases of goods and services, whereas this is the case for just 30% of the larger enterprises.

Similarly, the ratio of electricity expenditure to turnover is also higher for micro enterprises than for small, medium-sized and large ones. Between 2016 and 2018 this ratio rose for micro enterprises, whereas it fell for medium-sized and large ones (see Chart 3.5). Also in keeping with the pattern in terms of total expenditure, for 44% of firms with fewer than ten employees, electricity expenditure accounts for more than 1.5% of their total income, whereas this is the case for just 28% of large enterprises (see Chart 3.6).

From a sectoral standpoint, Chart 4 shows that extractive industry firms have by far the highest ratios of electricity expenditure to total purchases of goods and services (4.8%) and to turnover (3.4%). They are followed by intermediate goods manufacturing firms (3.1% and 2.3%, respectively) and, in third place, by consumer goods manufacturing firms (1.8% and 1.3%, respectively). At the other end of the scale are capital goods manufacturing firms and the energy, water and waste sector (with lower ratios than the other industrial firms).

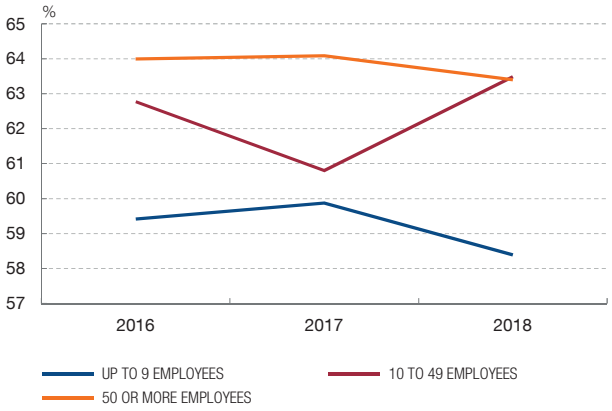
Charts 5 and 6 present more detailed 3-digit CNAE sectoral data, depicting the sectors that have the highest ratios of electricity expenditure to purchases of goods and services and to turnover, respectively. A high level of coincidence is observed between the sectors that appear in both charts: the cement, lime and plaster manufacturing sector has the highest ratios (12% to purchases of goods and services and 10% to turnover), followed by several extractive industries, some intermediate goods-producing basic metal industries and the energy, water and waste group.

Chart 3

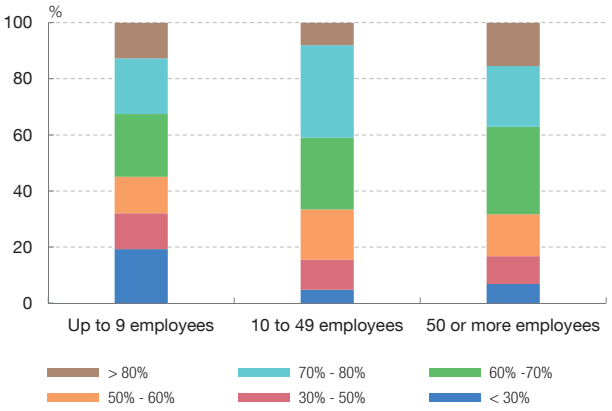
RATIOS OF ELECTRICITY EXPENDITURE TO CERTAIN BUSINESS VARIABLES, BY FIRM SIZE

Electricity is Spanish firms' main energy input. By firm size, micro enterprises have the lowest ratio of electricity expenditure to total expenditure on energy products, but the highest ratio to total purchases of goods and services and to turnover.

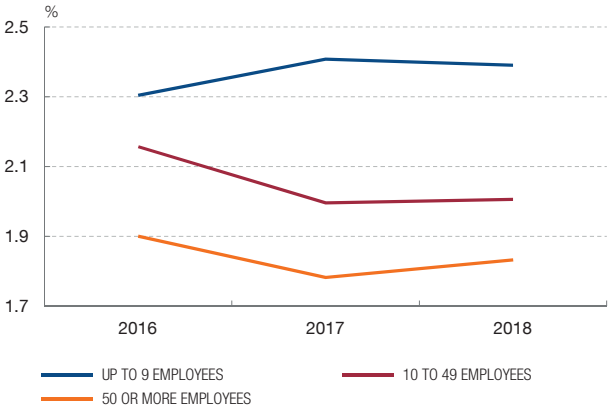
1 RATIO OF ELECTRICITY EXPENDITURE TO TOTAL EXPENDITURE ON ENERGY PRODUCTS (a)



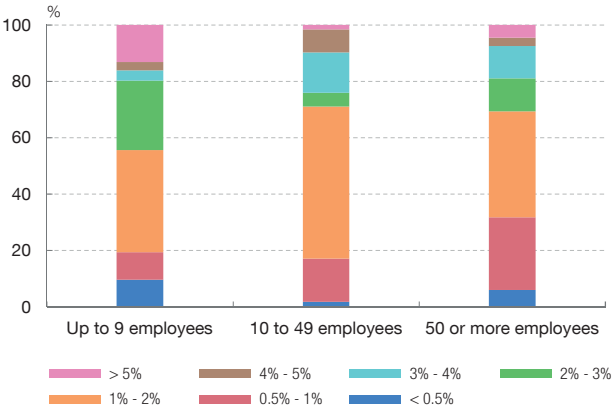
2 PERCENTAGE OF FIRMS ACCORDING TO RATIO OF ELECTRICITY EXPENDITURE TO TOTAL EXPENDITURE ON ENERGY PRODUCTS IN 2018



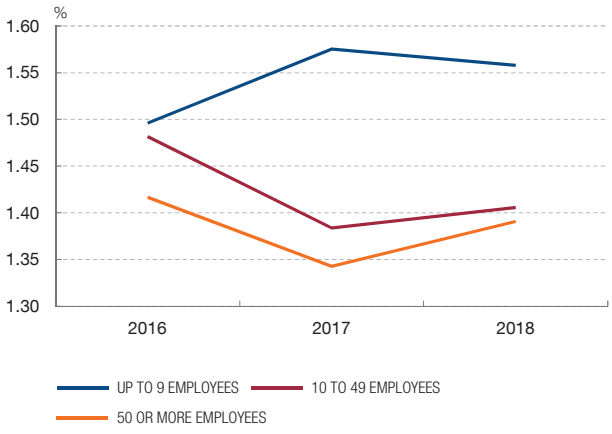
3 RATIO OF ELECTRICITY EXPENDITURE TO TOTAL PURCHASES OF GOODS AND SERVICES (a)



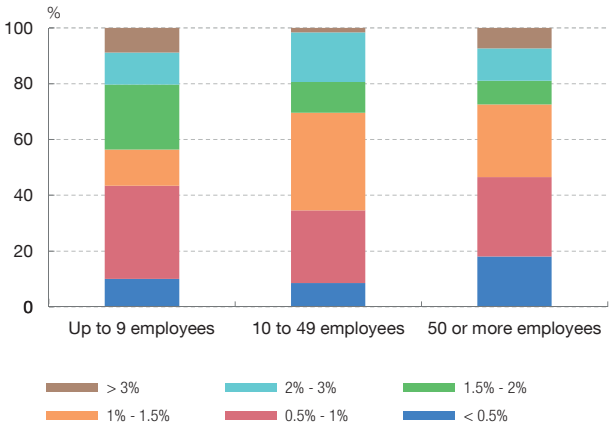
4 PERCENTAGE OF FIRMS ACCORDING TO RATIO OF ELECTRICITY EXPENDITURE TO TOTAL PURCHASES OF GOODS AND SERVICES IN 2018



5 RATIO OF ELECTRICITY EXPENDITURE TO TURNOVER (a)



6 PERCENTAGE OF FIRMS ACCORDING TO RATIO OF ELECTRICITY EXPENDITURE TO TURNOVER IN 2018



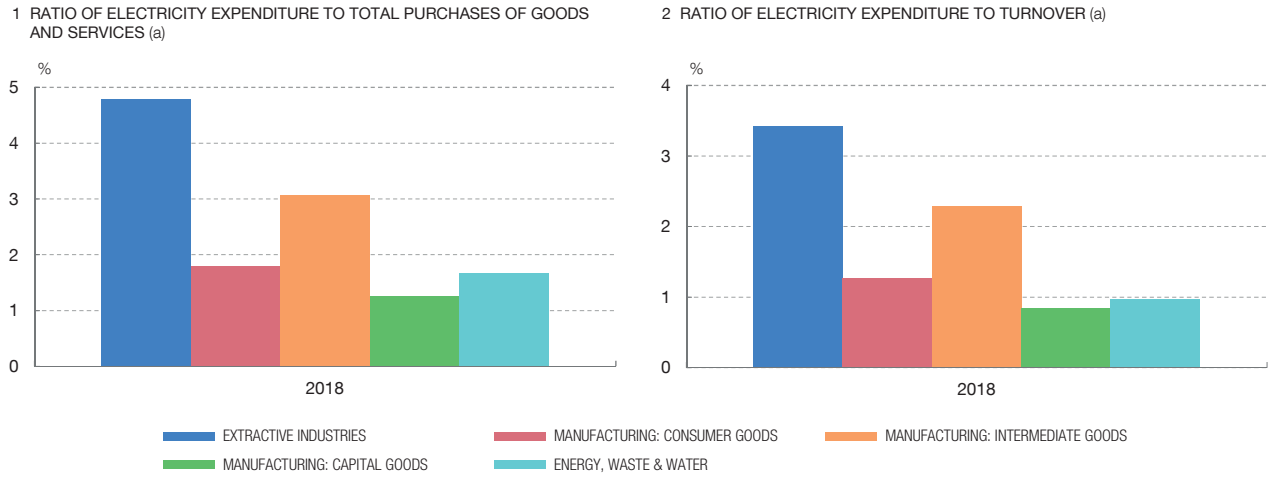
SOURCE: INE.

a Weighted by number of firms.

Chart 4

ELECTRICITY EXPENDITURE AS A PERCENTAGE OF OTHER BUSINESS VARIABLES, BY INDUSTRY GROUPS (2018)

Extractive industry firms are by far the most electricity-intensive, comparing electricity expenditure to total purchases of goods and services and to turnover. They are followed by intermediate goods manufacturing firms.



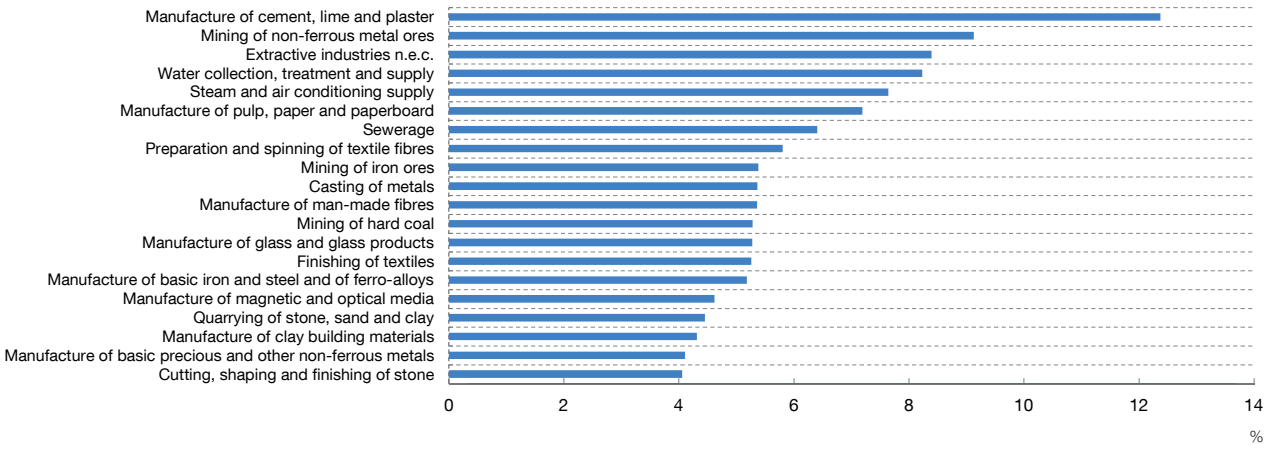
SOURCE: INE.

a Weighted by number of firms.

Chart 5

INDUSTRIES WITH A RATIO OF ELECTRICITY EXPENDITURE TO PURCHASES OF GOODS AND SERVICES OVER 4% IN 2018

The cement, lime and plaster manufacturing industry is that in which electricity accounts for the highest proportion (somewhat more than 12%) of all purchases of the goods and services essential for its production process. It is followed by several extractive industries.

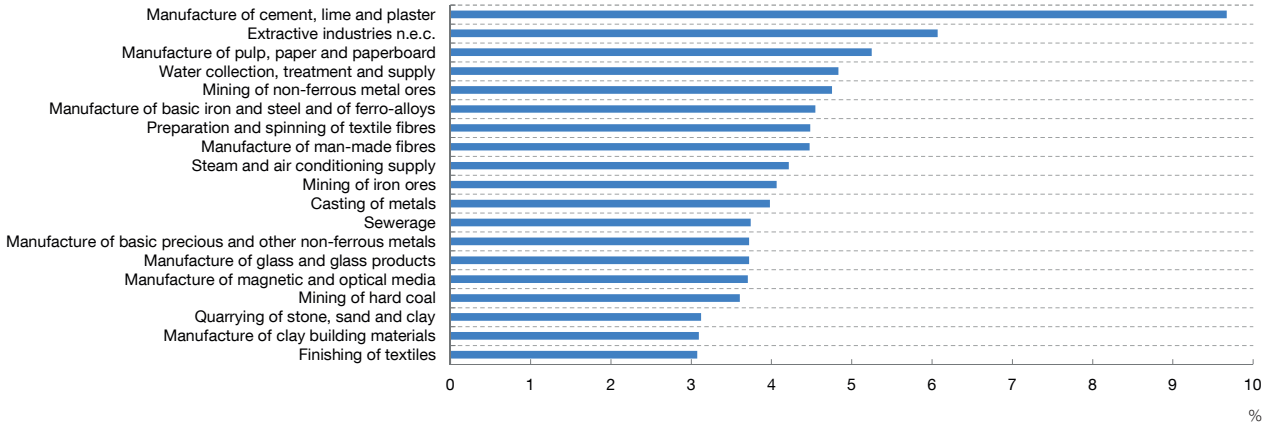


SOURCE: INE.

Chart 6

SECTORS WITH A RATIO OF ELECTRICITY EXPENDITURE TO TURNOVER OVER 3% IN 2018 (a)

Cement, lime and plaster manufacturing had the highest ratio of electricity expenditure to turnover (9.7%) in 2018, followed by other extractive industries and pulp, paper and paperboard manufacturing, both with figures over 5%.



SOURCE: INE.

a Excluding mining of lignite, which records an abnormally high figure (47%).

The price of electricity for medium-sized and large enterprises in Spain

Having analysed firms' electricity expenditure, the next step would be to ascertain how it breaks down in terms of the amount of electricity used and its price (and price components). This would permit analysis of the technologies of scale available to different-sized firms in the same sector and the price differences they face. A future study could analyse how the ratio of actual electricity consumption to sales varies according to firms' characteristics, as this entails matching firm-level electricity use and sales data which are not currently available. In this respect, for purposes of illustration, Cagno, Trianni, Spallina and Marchesani (2017), for example, find that firm size and more or less intensive energy use are aspects to be taken into account to analyse energy efficiency at Italian manufacturing firms, which is lower at less-energy-intensive small firms. Similarly, Kostka, Moslener and Andreas (2013) compile data on how SMEs in China face multiple difficulties applying energy-saving measures, while Solnørdal and Thyholdt (2017) also conclude, with information on Norwegian manufacturing firms, that there is a positive correlation between firm size and energy efficiency.

In the absence of these data, this section focuses on calculating a theoretical electricity bill for different consumer types. This exercise draws on information from Red Eléctrica de España (REE), the Spanish grid operator, on firms' electricity demand by sector and access charge. Contracted power supply hypotheses were

made, drawing on hourly use figures, plus estimates of all other cost components.[15] The excise duty on electricity and VAT were then added to the resulting amounts, to give an annual electricity bill for the period 2011-19. A sectoral database is thus obtained, containing data on the amount and the theoretical prices of the electricity used, along with a breakdown of the different price components.

Owing to data restrictions, these calculations are limited to medium-sized and large consumers[16] in all economic sectors, with a 3-digit CNAE sectoral disaggregation. At this point it is important to note that as these are medium-sized and large consumers with a high-voltage access charge, the results obtained cannot be extrapolated to small firms.

The consumers included in this analysis accounted for 43% of end consumption in 2019; the manufacturing industry with contracted power over 450 kW accounted for slightly more than one quarter of the total.

Drawing on the estimates made for medium-sized and large firms, and taking into account the number of consumers and their total consumption, an average end price charged has been calculated for each sector (see Chart 7.1). The average end price estimated is between 8.0 and 31.2 euro cents per kWh, with an average of 12.1 euro cents per kWh. The highest average prices are found in the lowest consumption bands, which in general correspond to lower voltage tariffs, owing (as shown in the second section) to the tariff design. Tax pressure[17] has no effect, as excise duty and VAT rates are the same, irrespective of the level of consumption.

As for the different cost components analysed in the second section, the specific proportion of the electricity bill for which they account changes every year. This is due, in particular, to the year-on-year change in the price of electricity, which essentially depends on the price of fuel and CO2 emission rights on the international markets, on demand and on generation of renewables, especially hydropower. Accordingly, in years in which the price of electricity is lower, the energy component will account for a smaller proportion of the bill, and vice versa.

Nevertheless, Chart 7.2 shows that in 2019, on average, as the average end price for consumers rose the proportion of the regulated component – or access charges – rose, fluctuating between 8% and 20% in most cases. In 2019 it even reached 60% for the smallest consumers, while at the other end of the scale, for firms with very high electricity consumption, the access charge accounted for just 8% of the total, owing to the higher proportion of the energy component in their bills.

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15 Not including possible surcharges (such as for surplus capacity) or rebates (such as for service interruptibility).

16 Firms with contracted power over 450 kW. The consumer demand data are taken from the SIMEL database (more information at https://www.ree.es/es/actividades/operacion-del-sistema-electrico/medidas-electricas (Spanish version only)).

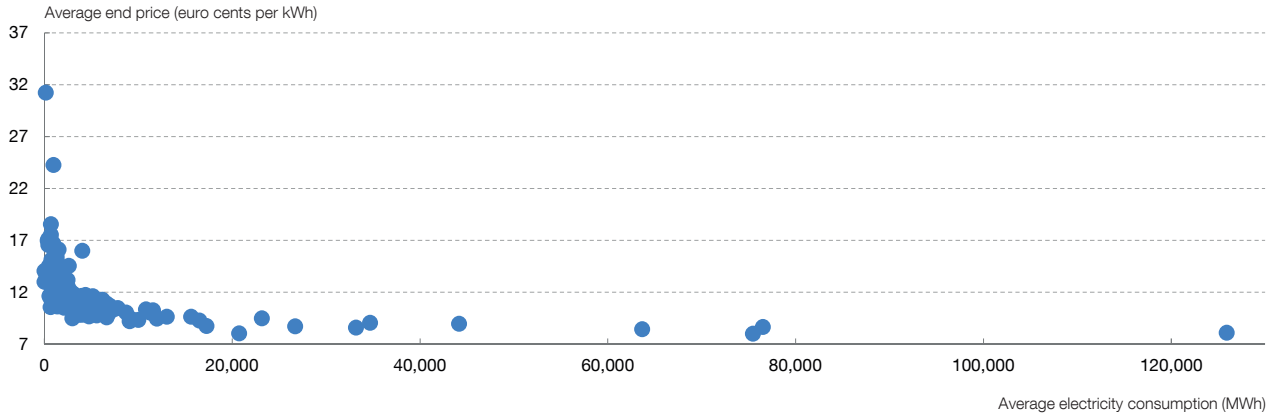
17 Except for certain electro-intensive consumers that enjoy an 85% exemption from the excise duty.

Chart 7

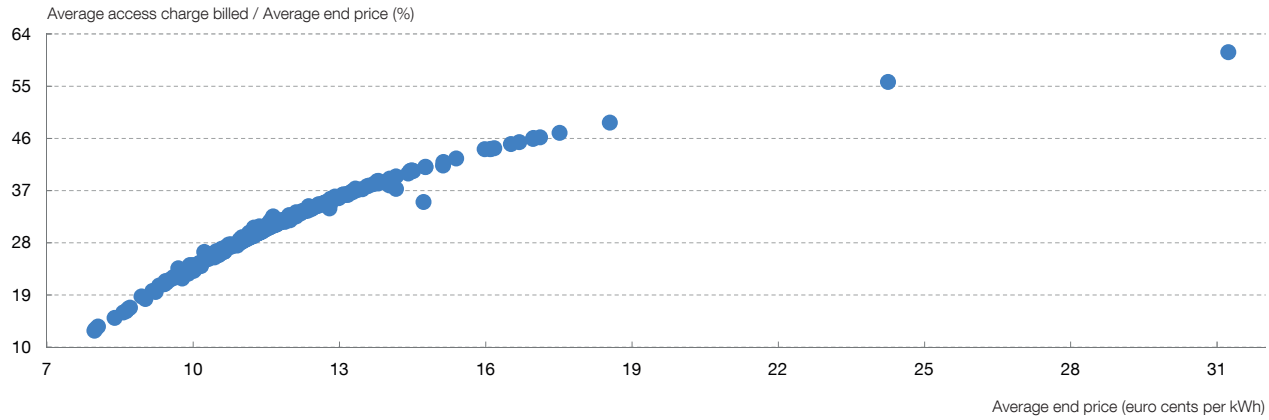
AVERAGE ELECTRICITY CONSUMPTION AND AVERAGE PRICE (a)

There is a negative correlation between firms' average electricity consumption and the price they pay for their electricity: the higher the average end price, the higher the proportion of the access charge in the final tariff.

1 AVERAGE ELECTRICITY CONSUMPTION (b) AND AVERAGE END PRICE (c) in 2019



2 AVERAGE END PRICE AND AVERAGE ACCESS CHARGE AS A PROPORTION OF AVERAGE END PRICE IN 2019 (c)



SOURCE: Own calculations, drawing on CNMC and REE data.

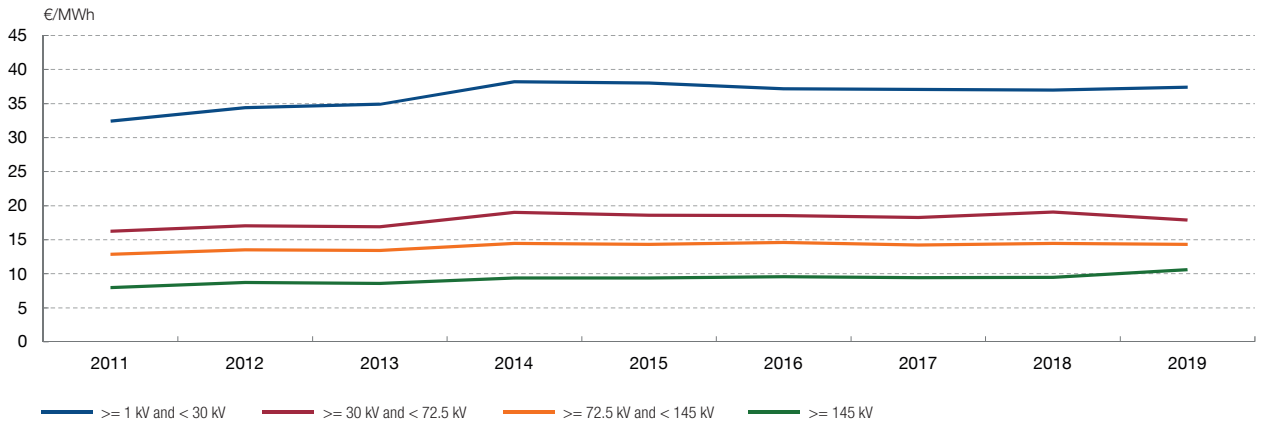
a Provisional 2019 data. Firms with installed power over 450 kW and with meter measurements during the year.
b Average consumption of each 3-digit economic sector.
c Estimated average prices for each 3-digit economic sector. Economic sectors that have at least one firm in all the years in the period 2014-19. Prices estimated considering the same contracted power for all times of use and equivalent to annual maximum hourly consumption. Not including the retailer mark-up, supplements for surplus capacity or reactive energy, or possible changes in contracted power in the year.

This different proportion by level of consumption means that fluctuations in the unit price of energy have a greater impact at large firms than at small ones, because at large firms it accounts for a larger proportion of the end price. Chart 8 shows the change in the unit price of the access charges in the period 2011 to 2019. In particular, the unit price rose sharply in 2014, when prices were modified with the aim of increasing revenues to mitigate the problem of the tariff deficit. As the chart shows, although this was a widespread increase, the regulatory reform had a more pronounced impact on firms with a lower level of consumption. Since 2014, the

Chart 8

AVERAGE ACCESS CHARGE BY SUPPLY VOLTAGE

In 2014 there was a systematic increase in all high-voltage tariffs as a result of the reform of the tariff structure.



SOURCE: Own calculations, drawing on CNMC and REE data.

"power" and "energy" items included in the access charges have been frozen. In consequence, it may be surprising to learn that the unit price of the access charges changed between 2014 and 2019. Indeed, as Chart 8 shows, they rose by approximately 1% in the period. This increase occurred even though the prices were frozen and may be explained by a combination of the following factors:

i) a change in use of the contracted power (resulting in a different amount of energy being used, giving rise to different unit prices);

ii) a change in the consumption distribution between different time-of-use periods.

For instance, if a consumer has reduced the use of its power (lower consumption, maintaining the same contracted power) and/or has increased the proportion of energy that it consumes in peak time-of-use periods, the unit price of its access charge would increase, and vice versa.

To conclude, the empirical evidence analysed shows that the cost of electricity is significant for competitiveness and that the regulated components of the tariff may account for a significant portion of the electricity bill, having a different impact on the end price by sector and firm size.

9.3.2021.

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