RECENT DEVELOPMENTS IN SPANISH RETAIL ELECTRICITY PRICES: THE ROLE PLAYED BY THE COST OF CO_2 EMISSION ALLOWANCES AND HIGHER GAS PRICES

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Abstract

Between December 2020 and June 2021, wholesale electricity market prices almost doubled in Spain. According to our estimates, a substantial portion of the observed increase – around 20% – would be due to the rise in CO_2 prices in the European ETS, which directly impacts the cost of generating electricity through fossil fuel technologies. Nevertheless, most of the increase – approximately half – would be attributable to the rise in natural gas prices, one of the inputs in combined cycle plants. Developments in wholesale electricity prices in other European markets have been similar to those in Spain. However, there are substantial differences regarding the pass-through to retail prices. In particular, the increase in the wholesale price of electricity would account for around one-third of the rise in the Harmonised Index of Consumer Prices (HICP) in Spain between December 2020 and June 2021, while its contribution to overall inflation in the main economies of the euro area has been significantly lower. Disparities in retail pricing schemes could be behind the observed differences.

Keywords: inflation, electricity market, European Emissions Trading System (EU ETS), pass-through.

JEL classification: E31, Q41, Q43, Q52.

Resumen

Entre diciembre de 2020 y junio de 2021, los precios mayoristas de la electricidad casi se duplicaron en España. De acuerdo con las estimaciones presentadas en este documento, una parte significativa de este aumento —alrededor del 20 %— vendría explicado por el encarecimiento observado, en el mismo período, en los precios de los derechos de emisión de CO_2, cuyo efecto repercute directamente en los costes de generación de la energía eléctrica a través de tecnologías que hacen uso de combustibles fósiles. No obstante, la mayor parte del incremento —aproximadamente la mitad— provendría del aumento de los precios del gas, materia prima empleada por las centrales de ciclo combinado. La evolución de los precios mayoristas de la electricidad en otros mercados europeos ha sido similar a la del caso español. Sin embargo, existen diferencias sustanciales en cuanto a la traslación a los precios minoristas. En particular, el encarecimiento de los precios de la electricidad en el mercado mayorista habría explicado cerca de una tercera parte del aumento de la tasa interanual del índice armonizado de precios de consumo en España entre diciembre de 2020 y junio de 2021, mientras que su contribución a la inflación general de las principales economías del área del euro habría sido muy inferior. Las discrepancias en los sistemas de fijación de precios minoristas de la electricidad podrían estar detrás de las diferencias encontradas.

Palabras clave: inflación, mercado eléctrico, régimen de comercio de derechos de emisión (RCDE), *pass-through.*

Códigos JEL: E31, Q41, Q43, Q52.

Contents

1 Introduction

Greenhouse gas emissions are responsible for climate changes globally that translate into extreme meteorological phenomena. The considerable consequences for human activity of these developments have positioned climate change as a first-order challenge for global well-being. And this must be tackled by means of an internationally coordinated and multi-faceted economic policy response.

First, measures must be adopted to adapt to the effects of climate change. This includes, for example, building infrastructures in an attempt to head off the fallout of, for instance, higher temperatures, diminishing rainfall in many regions and rising sea levels. Further, there is a need for mitigation measures that enable the transition from emissions-intensive activities to those that are not. One very important aspect of such actions involves the deployment of instruments that spur this transition, such as higher taxes on emissions and lower fossil fuel subsidies.

The emissions trading system (ETS) in force in the European Union (EU) since 2005 forms part of this setting. The EU ETS seeks to promote the reduction of greenhouse gas emissions by companies operating in the most polluting sectors of activity using a "cap and trade" mechanism. On one hand, the "cap" refers to the maximum amount of greenhouse gases which, annually, each of the plants and facilities considered by the ETS can emit. This "cap" diminishes over time, giving rise to a gradual fall in the aggregate amount of emissions. To comply with the cap, power plants have a specific volume of emission allowances, allocated free of charge, and they also have the possibility of acquiring additional allowances through auctions governed by the ETS regulations.[1]

On the other hand, the "trade" component refers to the fact that power plants can, in addition, buy and sell emission allowances on the market according to their needs. If the annual balance between emissions actually produced and emission allowances owned is positive, power plants would have to acquire on the market the allowances needed to make up the difference (were they not to do so they would be penalised with a sizeable fine). Conversely, if this balance is negative, they may either retain the surplus allowances for future use or sell them on the market.

In the EU in 2021, there has been a strong increase in the price of market-traded emission allowances, which is related to the greater ambition of the emission-reduction targets.[2] The sectors affected by the ETS are those whose productive processes involve high greenhouse gas emissions. Along with airlines and specific manufacturing sub-sectors, fossil fuel electricity generation is another major player that is responsible for almost half of all greenhouse gas emissions (see Chart 1.1).[3]

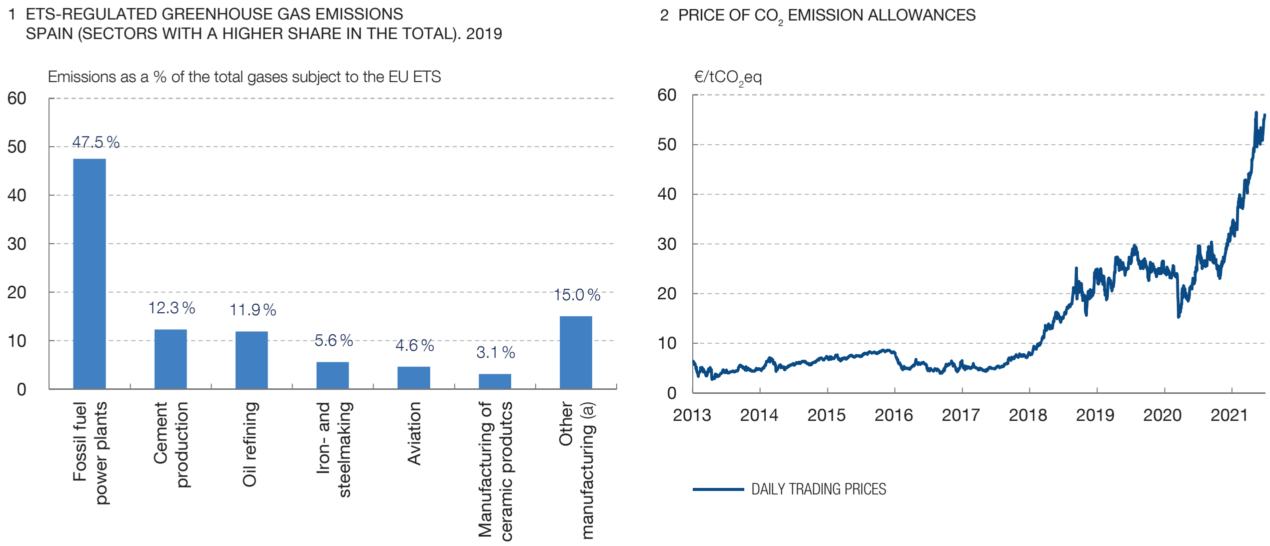
1 Until 2013, the bulk of allowances was assigned free of charge and only a small portion was purchased at auction. Thereafter, a gradual transition began towards a system in which most of the allowances are acquired at auction.

2 See European Commission (2020a and 2020b)

3 For a more detailed explanation of the rules and functioning of, and the manufacturing activities subject to, the ETS, see European Commission (2015).

Chart 1
RISING EMISSION ALLOWANCE PRICES STRONGLY AFFECT FOSSIL FUEL ELECTRICITY GENERATION

Fossil fuel electricity generation is responsible for almost half of greenhouse gas emissions subject to the ETS in Spain. It is, therefore, the industry most affected by the increase in emission allowance prices.



SOURCES: EEA and Sendeco2.

a "Other manufacturing" includes 17 additional manufacturing activities subject to the EU ETS, such as the production of primary and secondary aluminium, paper, ferrous and non-ferrous metals and the manufacture of glass.

Accordingly, the increase in the price of emission allowances has led, in particular, to a significant rise in the cost of electricity generation using fossil fuel-based technologies that emit more greenhouse gas emissions. The wholesale market for electricity in Europe operates under a margin system in which all generators receive the same price, corresponding to the market clearing price, which is related to the marginal generation costs of the most expensive technology. The underlying logic is to spur generation through non-polluting technologies, such as wind or solar power, whose marginal costs are very low; accordingly, they thus benefit from the return fixed on the basis of higher-cost technologies, which are the most polluting. At the same time, since the electricity price borne by end-consumers is set, in part, by wholesale market prices, the process described has pushed up the price of the household consumption basket.

Following this introduction, the next section analyses CO_2 emission allowance prices. The third section explains how the Spanish wholesale electricity market functions, and the fourth describes how emission allowance prices influence the prices set in this market. The fifth section quantifies the contribution of the recent increase in the prices of these allowances to higher electricity prices in wholesale markets, and the repercussions of the rise in gas prices observed since mid-2020 on the electricity generation costs of combined cycle power plants. In fact, the latter would explain most of the growth in electricity wholesale market prices since early 2021. The sixth section measures the effects of the increases in CO_2 emission allowance prices and gas prices on consumer prices in Spain. Lastly, the seventh section sets in context recent electricity price developments compared with selected European Union countries, while the eighth and final section draws conclusions.

2 Changes in the price of CO_2 emission allowances over time

Between 2013 and 2018, the price of CO_2 emission allowances held quite steady (see Chart 1.2). However, at the start of 2018, the revised regulatory framework approved by the 2015 Paris Agreement – the legally binding international treaty that called for greenhouse gas emissions in the European Union to be reduced by 40% compared with their 1990 levels by 2030 – came into force.[4]

The regulatory changes applied since early 2018 included, first, a gradual increase in the annual rate of reduction of the maximum emissions limit, from 1.74% to 2.2% from 2021. Second, emission allowances were redefined as financial instruments, meaning that, since then, market participants are no longer confined to firms that have surplus or insufficient emission allowances.

Third, and lastly, the market stability reserve was designed, to address possible shocks in the emission allowances market that could give rise to excessive supply/demand imbalances and, therefore, to overly sharp and intense price fluctuations. It was agreed that the reserve, which would become operational in January 2019, would be funded by the transfer of emission allowances worth €900 million that were originally planned to be auctioned between 2014 and 2016. These auctions were postponed at the time in a first attempt to address, in the period following the global financial crisis, the problem of a large build-up of surplus emission allowances that was driving down their price.[5] The creation of the reserve was accompanied by the decision to significantly increase, compared with the figures envisaged in 2014, the rate at which additional flows of emission allowances would be added to the reserve over the period 2019-2023, with the aim of reducing the surplus supply and tightening prices.[6]

Together these three measures drove up the price of emission allowances in 2018. Throughout 2019 and up to the onset of the COVID-19 crisis there was no clear price trend, but the global collapse in activity caused by the pandemic triggered a significant reduction in firms' demand for, and consequently in the price of, emission allowances.

However, since late 2020, the price of allowances has increased significantly, rising above €50 per tonne of CO_2 equivalent (tCO_2eq)[7] for the first time ever in May 2021 (see Chart 1.2). The price rise began in November 2020, when it was announced that the start of

4 This should allow global temperatures to rise by no more than 2ºC compared with pre-industrial levels.

5 According to the European Commission, the original source of this surplus lies in the fall in economic activity that followed the 2008 global financial crisis. As the recession caused a larger than expected reduction in emissions, many agents did not need to use their permits, saving them for future years (see the EU Emissions Trading System).

6 The 2018 regulatory changes established that, while total allowances in circulation exceeded 833 million, 24% of the surplus over that limit would be transferred to the market stability reserve each year (rather than 12% as initially envisaged). For more information on these regulatory changes, see https://ec.europa.eu/clima/news/ets-market-stability-reserve-will-start-reducing-auction-volume-almost-265-million-allowances_en.

7 Greenhouse gas emissions are measured in tonnes of CO_2 equivalent. This measure is used to convert emissions of the different greenhouse gases into their CO_2 equivalent. Along with carbon dioxide (CO_2), these gases include methane (CH_4), nitrous oxide (N_2O) and fluorinated gases.

the 2021 auctions would be delayed.[8] And it became more acute after the European Council approved, on 11 December, a binding increase in the greenhouse gas emission reduction target between 1990 and 2030, to 55% compared with 40% previously. The price surge (71% between December 2020 and June 2021) has been such that, according to some analysts, there could be a significant speculative component.

8 When this delay was announced, agents anticipated there could be changes to tighten up the emission regulations and this drove up the price (see European Commission, 2021).

3 The price formation mechanism in the Spanish wholesale electricity market

As in all other EU countries, in Spain the wholesale electricity market operates according to a system whereby each day's electricity demand is first met with supply from technologies with the lowest generation costs, which allows them to make lower bids to supply electricity. In practice, these are technologies – such as nuclear and renewables – that generate electricity that cannot be stored. If this supply is insufficient to meet total demand, the remainder is met by the technology that bids to supply electricity at the next lowest price, and so on until total demand is absorbed. The price set is the price of the supply that meets the last fraction of demand remaining; this is known as a margin system. This last price largely corresponds to the generation costs of the most expensive technology to enter the supply market. In consequence, in this price-setting system, all technologies are remunerated at the market clearing price. This is highly beneficial for low-cost generation technologies.

The Spanish market is a day-ahead market in which electricity generators indicate the price at which they are prepared to sell their electricity for each of the hours of the following day, and electricity retailers indicate the price at which they are prepared to buy electricity, based on their estimate of customer demand for each of those hours. Subsequently, for each hour of the day, all the sale bids are sorted in increasing order (from the lowest to the highest bid) and all the purchase bids in decreasing order, thus shaping the supply and demand curves, respectively.

The intersection of the expected demand and supply curves provides the market clearing prices for electricity, one price for each hour of the day.[9] These prices are determined, on the supply side, by physical limitations and by each generator's opportunity cost[10] (see Chart 2). The first generators to meet demand, i.e. those that make the lowest bids, are nuclear power, run-of-river hydropower, and wind and solar power facilities.[11] Storage hydropower and fossil-fuel facilities make higher bids and, therefore, meet the residual demand.[12]

9 The market clearing price is the price where the curves meet. This price determines which sale and which purchase bids become firm commitments to deliver energy.

10 Each generator's opportunity costs reflect, on the one hand, the costs they could avoid by deciding not to generate electricity (variable costs, start-up costs, etc.) and, on the other hand, the revenue they forgo when they decide to generate electricity. Energía y Sociedad (2019) has two clear examples of this last case: 1) if a fossil-fuel generator were able to resell on the market the fuel it uses to generate electricity, its opportunity cost would be the resale price, not the price it paid for the fuel; and 2) storage hydropower facilities have dams that enable them to store water, and hence an opportunity cost insofar as the water stored may be saved and used to generate electricity when the market price is higher.

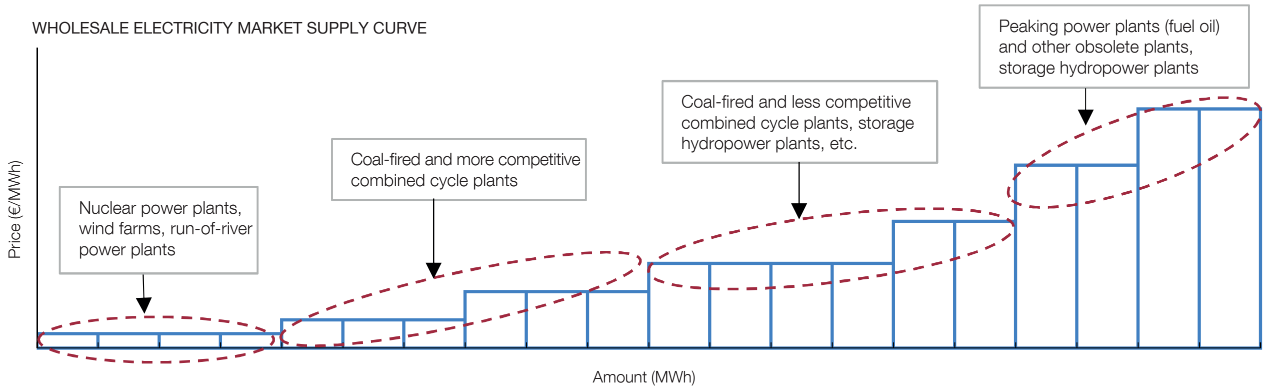
11 Nuclear power facilities have very low variable generation costs. Also, they need to generate energy continuously as their start/stoppage costs are very high. Accordingly, they make the lowest bids so as to ensure their market entry. Costs for wind and photovoltaic power generators are essentially maintenance costs, which are generally very low, given that the raw materials used (wind and sunlight) are free of charge (although, in exchange, they are not always available). For this reason, they also make low bids. Lastly, run-of-river hydropower facilities cannot store the water they use, to generate electricity at a later date, so there are no opportunity costs associated with the decision to generate electricity on a specific day.

12 As indicated above, the opportunity cost for storage hydropower facilities is the possibility of saving water to be used to generate electricity when market prices are higher (for example, the variable generation cost may possibly not vary intraday, but generating electricity at times when market demand is lower entails the cost of not selling that same electricity at a higher price when demand is higher). Fossil-fuel facilities have relatively low start-up costs, so they are able to begin generating electricity as and when required.

Chart 2

TECHNOLOGIES WITH HIGHER OPPORTUNITY COSTS TEND TO PUT UPWARD PRESSURE ON WHOLESALE ELECTRICITY PRICES

If total demand could be met by electricity generated using the technologies on the left-hand side of the supply curve, the wholesale electricity price would tend to be low. In general, however, despite the sharp increase in electricity generation using renewable sources, fossil fuel plants are still regularly needed to meet electricity demand. This means that fossil fuel generators generally exert a degree of upward pressure on the market clearing price.



SOURCE: Energía y Sociedad.

Subsequently, on the day the energy is generated and consumed, generators and retailers adjust positions in the intraday market. In general, this has no major impact on the average hourly electricity price.[13]

This description of how the market works reveals that the market clearing price for each level of demand is largely determined by the electricity generation structure.[14] If total demand could be met by electricity generated using the technologies on the left-hand side of the supply curve depicted in Chart 2, the wholesale electricity price would tend to be low. In general, however, despite the sharp increase in electricity generation using – cheaper – renewable sources over the last decade in Spain, fossil-fuel facilities are still regularly needed to meet electricity demand. This means that fossil-fuel generators generally exert a degree of upward pressure on the market clearing price.

13 For more details on how the wholesale electricity market works, see Energía y Sociedad (2019).

14 According to figures from Red Eléctrica de España, the Spanish grid operator, in 2019 the electricity generation structure in Spain was as follows: nuclear power, 21.4%; combined cycle, 21.2%; wind power, 20.8%; cogeneration, 11.3%; hydropower, 9.5%; and other technologies, 15%.

4 The relationship between CO_2 emission allowance prices and electricity prices on the wholesale market

Electricity producers that emit greenhouse gases tend to pass through the full change in emission allowance prices to their bid prices. When generating electricity, fossil fuel thermal power plants bear several costs, including those of the raw material (coal, gas or fuel) and of the CO_2 emission allowances needed for production. The latter cost tends to be very high, as they use a highly polluting technology, meaning that the volume of emission allowances they need to purchase is also large. In formulating their bid prices, these generators incorporate into their opportunity cost the revenues they forgo by not selling the emission allowances on the market, resulting in higher market clearing prices the higher the price of the allowances.[15]

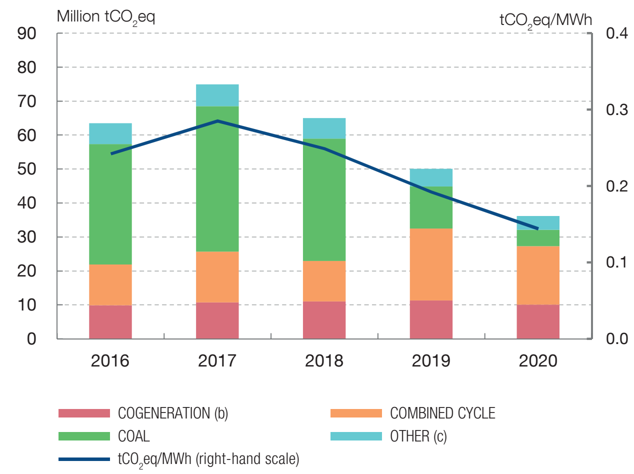
Incorporating CO_2 emission allowance prices into the bid price provides incentives for investing in cleaner technologies in the medium and long term. Since all bidders receive the market clearing price, an increase in this price linked to rising CO_2 emission allowance

Chart 3

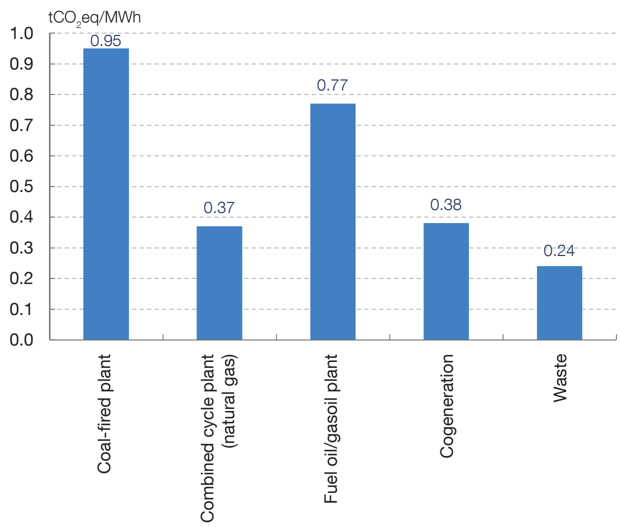
GREENHOUSE GAS EMISSIONS RELATED TO ELECTRICITY GENERATION HAVE DECLINED IN RECENT YEARS, OWING MAINLY TO THE MORE LIMITED USE OF COAL-FIRED PLANTS

Greenhouse gas emissions in the electricity sector have declined in recent years as a result of lower electricity generation by coal-fired plants, whose emissions are much higher than those of other technologies. This reduction is due chiefly to the gradual closure of such power plants and, to a lesser degree, to the incentives created by the CO_2 emission allowance markets.

1 VOLUME OF CO_2 EMISSIONS BY TECHNOLOGY AND EMISSION FACTOR IN TOTAL ELECTRICITY GENERATION (a)



2 CO_2 EMISSIONS LINKED TO ELECTRICITY GENERATION USING DIFFERENT TECHNOLOGIES (a)



SOURCE: Red Eléctrica de España.

a Greenhouse gas emissions are measured in tonnes of CO_2 equivalent. This measure is used to convert emissions of the different greenhouse gases into their CO_2 equivalent. Along with carbon dioxide (CO_2), these gases include methane (CH_4), nitrous oxide (N_2O) and fluorinated gases.

b Cogeneration is based on the principle of recovering and using the heat obtained in electricity generation through thermal technologies. It basically implies using otherwise wasted heat from electricity generation to produce useful thermal energy.

c Generation through fuel oil + gas, diesel engines, gas turbines, steam turbines and non-renewable waste.

15 Emission allowances may be accumulated over time. The allowances in a generator's portfolio can come from previously received free allocations, from allowances acquired through auctions and from purchases on the market.

costs generates revenue windfalls for cleaner generation sources. As long as these benefits persist over time , there will be incentives to invest in non-greenhouse gas-emitting electricity generation technologies, thus working towards the aim of making electricity generation emission-free in the future.[16]

As a result of the incentives created by CO_2 emission allowance markets and the gradual closure of coal-fired plants, greenhouse gas emissions in the electricity sector have declined in recent years (see Chart 3.1).[17] In particular, this reduction was 35% between 2017 and 2019,[18] mainly owing to lower electricity generation by coal-fired plants and, to a lesser extent, to the larger share of energy obtained through combined cycle power plants, with a volume of greenhouse gas emissions of approximately 50% compared with fuel oil and gasoil power plants, and of 40% compared with coal-fired plants (see Chart 3.2).[19]

16 This also entails windfall gains for clean electricity generators established prior to the CO_2 emission allowance scheme.

17 In Spain, the gradual closure of coal-fired plants began in 2010 as part of the initiatives to meet greenhouse gas reduction targets. Eight such plants were shut down in June 2020 and three more are scheduled to close in 2021.

18 In 2020, CO_2 emissions linked to power generation declined even further, but it is difficult to determine to what extent this was a consequence of the pandemic or of the incentives created by emission allowance markets. The comparison is thus distorted.

19 Specifically, producing one megawatt-hour (MWh) of electricity entails emissions of 0.37, 0.77 and 0.95 metric tonnes (mT) of CO_2 equivalent in a combined cycle, fuel oil/gasoil and carbon-fired power plant, respectively.

5 The impact of emission allowance prices on wholesale electricity prices in Spain

Notwithstanding its characteristically high volatility, the wholesale price of electricity trended downwards throughout 2019 and early 2020, partly due to increased electricity generation using renewable energy sources and partly to lower gas prices (see Chart 4.1). The unfolding of the pandemic temporarily led to further price declines, although prices rebounded quickly, possibly owing to the relatively low impact of the crisis on electricity-intensive industrial sectors. At the beginning of 2021, adverse weather conditions briefly pushed wholesale electricity prices to very high levels. This was followed by a swift turnaround in February, as a consequence of high hydroelectric power generation and the prevalence of weather spurring wind farm electricity generation.

However, compared with historical patterns, the average price of electricity between April and June 2021 has been unusually high. Electricity tends to become cheaper in the spring, as a result of a combination of several factors. On the supply side, the output of hydroelectric plants is greater at that time of the year, as the volume of water stored in reservoirs is also higher. In addition, demand tends to decrease during this period for seasonal reasons.[20]

Against this backdrop, this spring's unusually high electricity prices stem largely from the upward pressure exerted by combined cycle technology on daily clearing prices. This is due, first, to the considerable increase in the price of gas (used by these plants for power generation) (see Chart 4.2), which would be partly related to increased demand for this hydrocarbon in Asia.[21] But also, as mentioned above, the increase in the price of greenhouse gas emission allowances that comes with combined cycle power generation has significantly impacted producer prices using this technology.

In this regard, Box 1 shows that the minimum prices required in many of the bids made by combined cycle power plants in the wholesale electricity market have risen sharply between the end of 2020 and April 2021.[22] It also evidences that, in recent times, the power output of these technologies has been low. This suggests that these types of power plants have faced difficulties covering their production costs, despite the high market clearing prices on the wholesale market. As mentioned above, much of this higher cost stems from the increase in the price of natural gas. Taking as a reference the Iberian gas market, the attendant price index rose from an average of 18.2 €/MWh in December

20 Compared with spring and autumn, demand for electricity tends to be higher in winter and summer as a consequence of the more extreme temperatures.

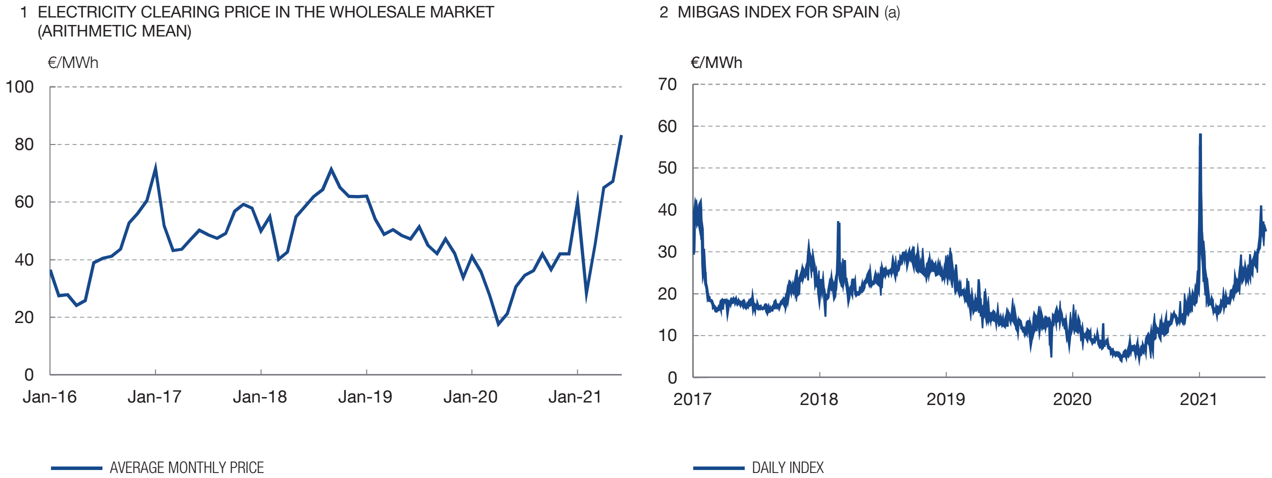
21 Added to the soaring demand for liquefied natural gas in several Asian economies were the supply problems caused by maintenance work on infrastructures in Norway and Russia (the main bidders in the European market) and last winter's high demand as a result of the low temperatures. The sum of these factors prompted gas inventories in June 2020 to be 20% below the usual level for this time of year (see https://www.bloomberg.com/news/articles/2021-06-21/eu-gas-stokes-inflation-fears-with-prices-near-13-year-high).

22 More recent information on wholesale electricity market bids is not available due to a three-month confidentiality period from the operating day of the day-ahead market.

Chart 4

HIGHER GAS AND EMISSION ALLOWANCE PRICES HAVE CONTRIBUTED TO THE SHARP RISE IN ELECTRICITY PRICES IN THE SPANISH WHOLESALE MARKET SINCE THE BEGINNING OF THE YEAR

This spring's unusually high electricity prices stem largely from the upward pressure exerted by combined cycle technology on daily market clearing prices. Generation costs for this technology have risen due, first, to the considerable increase in the price of gas; and, second, to the increase in the price of greenhouse gas emission allowances.



SOURCES: OMIE and MIBGAS.

a The MIBGAS index is the weighted average price of all the gas trades executed for the same day in all of Spain's trading sessions.

2020 to an average of 28.7 €/MWh in June 2021 (see Chart 4.2). According to different studies, the thermal efficiency of gas in combined cycle power plants is approximately 50%, which means that two MWh of gas are needed to produce one MWh of electricity.[23] On this basis, the rise in gas prices would have led to an increase of around 20.9 €/MWh in the wholesale price of electricity between December and June.

Moreover, average emission allowance prices rose from €30.9 per tonne of CO_2 equivalent in December to €52.8 in June. Bearing in mind that the combined cycle technology emits approximately 0.37 tCO_2eq per MWh, the increase in emission allowance prices would have added around 8.1 €/MWh to the wholesale price of electricity (see Chart 5.1). The price per MWh in the wholesale electricity market increased from 42 €/MWh to 83.3 €/MWh between December 2020 and June 2021, up 98.5%. Consequently, higher CO_2 allowance prices would explain one-fifth of that increase (19.6 pp), while higher gas prices would account for half of it (50.3 pp). Additionally, companies tend to pass through, to a greater or lesser extent, the tax on electricity generation (7% of the value of the output of all power plants) to the wholesale market bid price. Thus, on account of the

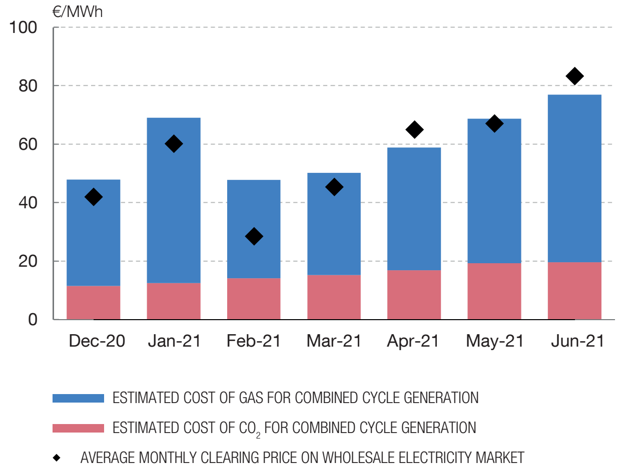
23 According to Storm (2020), the thermal efficiency of combined cycle power plants ranges from 45% to 57%.

Chart 5

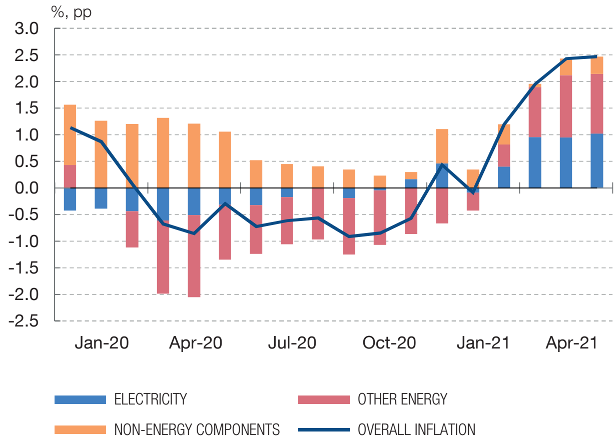
HIGHER ELECTRICITY PRICES IN THE WHOLESALE MARKET HAVE PUT UPWARD PRESSURE ON CONSUMER PRICES

Between December 2020 and June 2021, wholesale market prices rose by 98.5%. Higher CO_2 allowance prices would account for one-fifth of that increase and higher gas prices for almost half. This appears to have affected retail market prices. Thus, higher electricity prices in the first half of the year would have contributed almost 30% to the observed 3 pp increase in overall inflation.

1 PRICE OF ELECTRICITY ON THE WHOLESALE MARKET AND ESTIMATED GENERATION COSTS FOR COMBINED CYCLE POWER PLANTS



2 CONTRIBUTION OF THE PRICE OF ELECTRICITY TO INFLATION



SOURCES: OMIE, INE and Banco de España.

higher tax base, up to 6.9 pp of the increase observed could be due to the impact of this tax on the market clearing price.[24]

24 In light of the wholesale price increase observed in the first half of 2021, the Spanish government decided to suspend the collection of the tax on electricity generation between July and September 2021 (see Royal Decree-Law (RDL) 12/2021 of 24 June 2021).

6 The contribution of electricity prices to recent HICP developments

The electricity price paid by each individual domestic consumer depends on whether consumers have decided to opt for the regulated tariff system – known as the Voluntary Price for the Small Consumer (VPSC) – or whether, on the contrary, they have opted to engage the services of an electricity retailer on the free market. Approximately 40% of consumers have opted for the first of these two possibilities.[25]

For a regulated-tariff consumer, the final amount of the bill is the outcome of a set of highly diverse items. One of these, which accounts on average for approximately 48% of the final amount, is given by the so-called "energy" item. This, in turn, comprises: first, the amount of electricity actually consumed multiplied by a unit price, which is set on the wholesale markets; and second, network charges (encompassing transport and distribution costs).[26] Specifically, under the regulated tariff, the retail unit price changes hourly depending on changes in the wholesale market price (known as "dynamic pricing").[27] The remaining items – all of which regulated – include "power" (a fixed cost contracted by the household which determines the maximum volume of electricity that may be consumed at each point in time), energy policy charges (which cover all other regulated costs, including the tariff deficit and the financing of renewables) and various taxes, among which the excise duty on electricity (5.1% of the power and energy items) and VAT (21% of the total amount of the bill).[28]

The increase in the wholesale market price between December 2020 and June 2021 led to a 46% rise in the energy item (which, as indicated, includes network charges). Since this item accounts on average for approximately 48% of the amount of the bill, the increase in the price paid by the average regulated-tariff consumer is estimated to have been 22.3%. Further, given that electricity accounts, according to the weighting of this item in the harmonised index of consumer prices (HICP), for 3.5% of total household spending on goods and services, higher wholesale market prices in the first six months of the year are estimated to have contributed at most 0.8 pp to the 3 pp rise in overall inflation (see Chart 5.2).[29] Consequently, using the calculations set out in the previous section, it could be concluded that the increase in the CO_2 emission allowance price has mechanistically contributed some 0.2 pp to the rise in the inflation rate, measured by the overall HICP, in the first six months of this year, while the contribution of the increase in gas prices is estimated

25 Specifically, 10.7 million of the 26.8 million domestic consumers have opted for the VPSC, with the remaining 16.1 million adopting the free market tariff (see Comisión Nacional de los Mercados y la Competencia (CNMC), 2021a).

26 Energy and network charges account, respectively, for around 27.7% and 20.5% of the bill of time-of-use consumers (see CNMC, 2021b).

27 EU Directive 2019/944 of 5 June 2019 on common rules for the internal market for electricity defines dynamic electricity price contracts as "an electricity supply contract between a supplier and a final customer that reflects the price variation in the spot markets, including in the day-ahead and intraday markets, at intervals at least equal to the market settlement frequency".

28 On 24 June 2021 the Spanish government reduced VAT on the electricity bill from 21% to 10% for the period running from the entry into force of the RDL until 31 December 2021 (see RDL 12/2021 of 24 June 2021).

29 The 0.8 pp involve assuming that all consumers are equally affected by the increase in the energy item, although around 40% of them are under the VPSC. However, the remaining consumers also face, with differing frequencies, tariff revisions that will include wholesale market price changes.

to be 0.4 pp.[30] Lastly, up to 0.1 pp of the 0.8 pp is estimated to have been contributed by the tax on electricity generation which, as previously indicated, generators usually pass through, to differing degrees, to wholesale market bid prices.[31]

However, the effects of higher CO_2 emission allowance prices on HICP developments extend beyond their direct impact through the price of electricity as household final consumption. Two additional channels must be added. The first, which also has a direct impact, occurs through the effect of the increase in the emission allowance price on producer prices of industries subject to the ETS.[32] As Chart 1.1 shows, the activities that most contribute to CO_2 emissions, aside from fossil fuel electricity generation, are cement, steel and iron, and ceramics production, along with oil refining and air transport. In any event, the fact that a productive sector is responsible for a high proportion of greenhouse gas emissions does not automatically mean that its costs will be affected by the higher cost of emission permits, since that will depend on the sign of the net balance between its actual emissions and allocated allowances.

The second channel, in this case of indirect effects, on the HICP is the share of inputs from ETS-regulated activities in the cost structure of the various sectors of the economy that supply final goods and services to households (most particularly, the use of electricity in productive processes, the intensity of which obviously differs greatly across processes). Indeed, according to Matea Rosa et al. (2021), the sectors evidencing a greater share of electricity in 2018 in their total purchases were the manufacture of cement, lime and plaster, the mining of non-ferrous metal ores and the extractive industries.

In any event, measuring the effects on the HICP of higher emission allowance prices via these two additional channels is an extremely complex matter that hinges, among other factors, on the degree of pass-through of generation cost increases (whether directly or through inputs) to the final consumer. One specific instance in which the pass-through is presumably high is that of airline tickets, although the impact on the HICP would be limited, given their scant weight in the household consumption basket.

30 From early June, this impact was partly countered by the entry into force of amendments to the regulated components of the electricity bill affecting all consumers.

31 As also previously indicated, in 2021 Q3 the tax on electricity generation will be suspended (see RDL 12/2021 of 24 June 2021).

32 As in the case of electricity, other ETS-regulated industries also face the opportunity cost arising, on taking the decision to produce, from those revenues they forgo by not selling their emission allowances on the market.

7 The effects of the increase in emission allowance prices on consumer prices: a European comparison

The impact of the increase in gas and emission allowance prices on the wholesale market electricity price is not a phenomenon exclusive to the Spanish market. As Chart 6 shows, the main euro area economies have been experiencing very similar price rises in these markets since early 2021. This is due, as mentioned, to the fact that the wholesale markets for electricity in Europe share the concept of marginal price-setting.

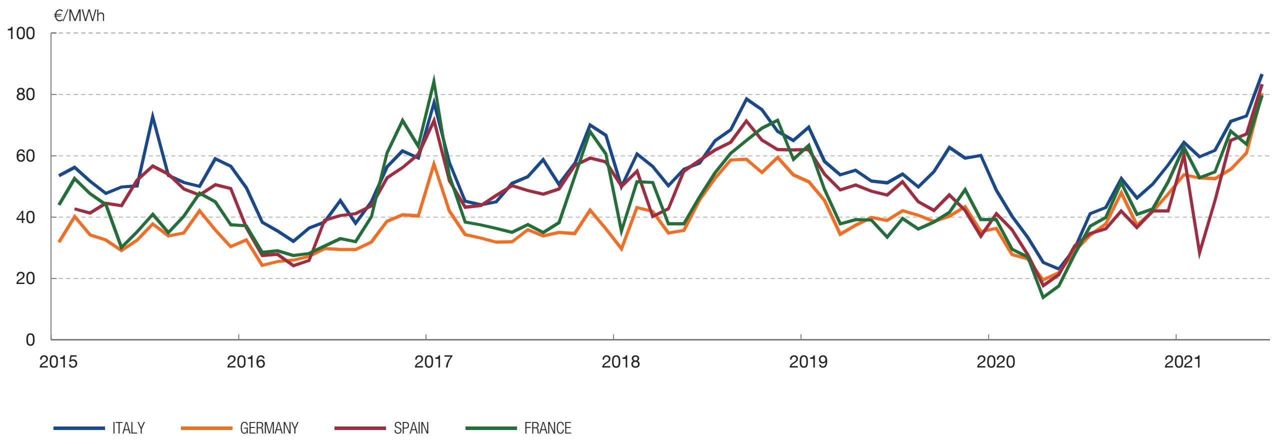
Nonetheless, the impact of wholesale market electricity price movements on consumer prices shows notable cross-country heterogeneity. Specifically, the final electricity price borne by domestic consumers is substantially more volatile in Spain than in the main euro area economies, unlike the case of non-electrical energy, where cross-country price developments show a greater degree of homogeneity (see Chart 7).

To explain the differences in the pass-through of changes in European wholesale market electricity prices to retail markets it is necessary to analyse the particular characteristics of the price-setting mechanism in the latter. As explained in the previous section, around 40% of households in Spain opt for a dynamic pricing system (VPSC). This system is characterised by the high frequency of price revision, which explains why the pass-through of wholesale market price movements to the prices paid by the final consumer is greater and swifter. Indeed, this feature is likewise observed in other

Chart 6
THE RECENT INCREASES IN WHOLESALE ELECTRICITIY PRICES ARE A COMMON PHENOMENON IN EU COUNTRIES

The pass-through of increases in the prices of gas and emission allowances to wholesale market electricity prices is a phenomenon common to the main euro area economies, which have been experiencing similar price rises since early 2021.

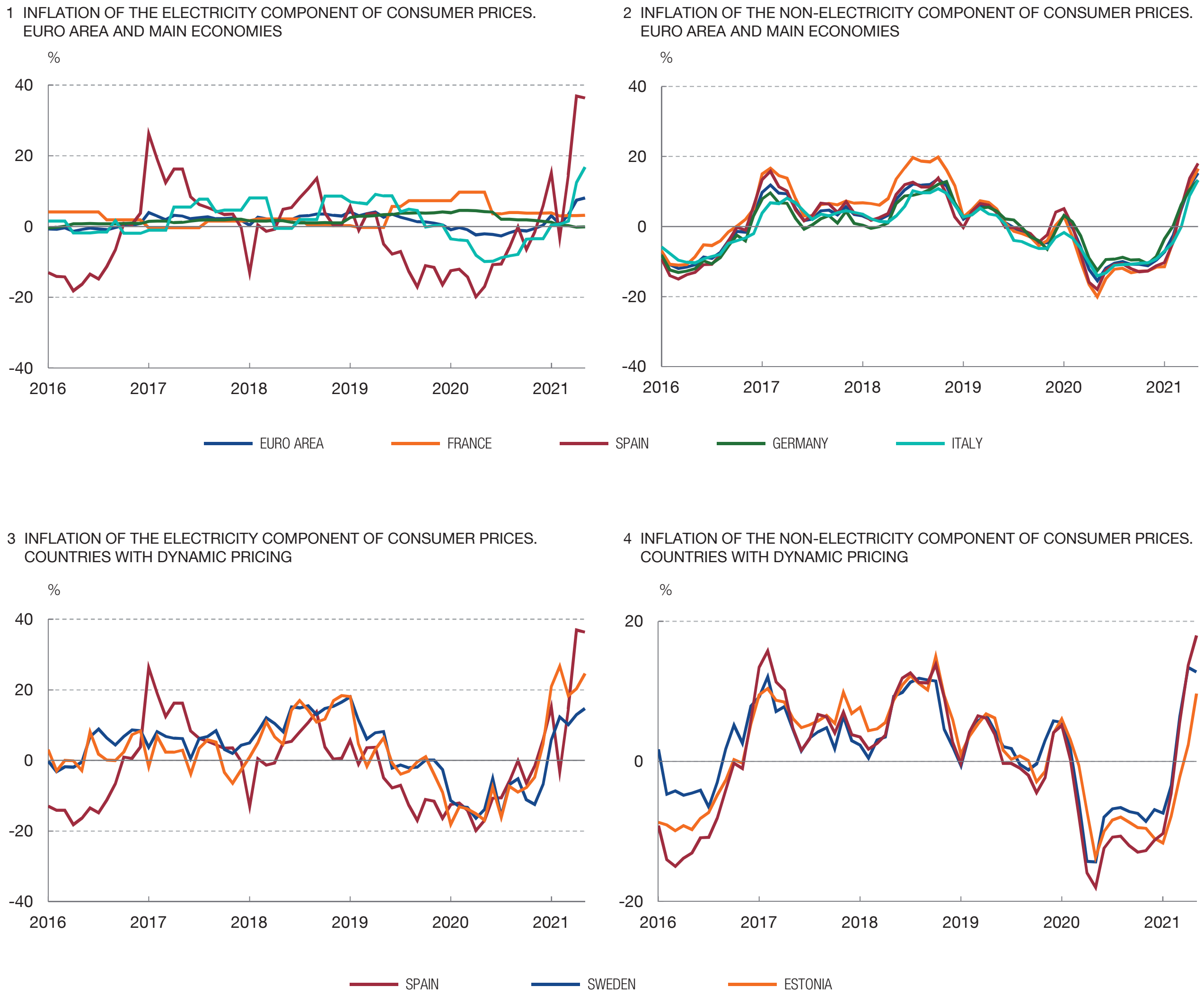
PRICE OF ELECTRICITY IN SELECTED EUROPEAN WHOLESALE MARKETS



SOURCES: OMIE and Refinitiv.

Chart 7
ELECTRICITY CONSUMER PRICES SHOW GREATER VOLATILITY IN COUNTRIES WITH DYNAMIC PRICING SYSTEMS

The final electricity price borne by domestic consumers is substantially more volatile in Spain than in the main euro area economies. As in other countries, such as Sweden or Estonia, the greater volatility seems to be due largely to the high proportion of consumers with dynamic pricing contracts.



SOURCE: Eurostat.

European markets, such as Sweden and Estonia, where there is also a high proportion of consumers under systems based on dynamic pricing contracts (see Chart 7).[33]

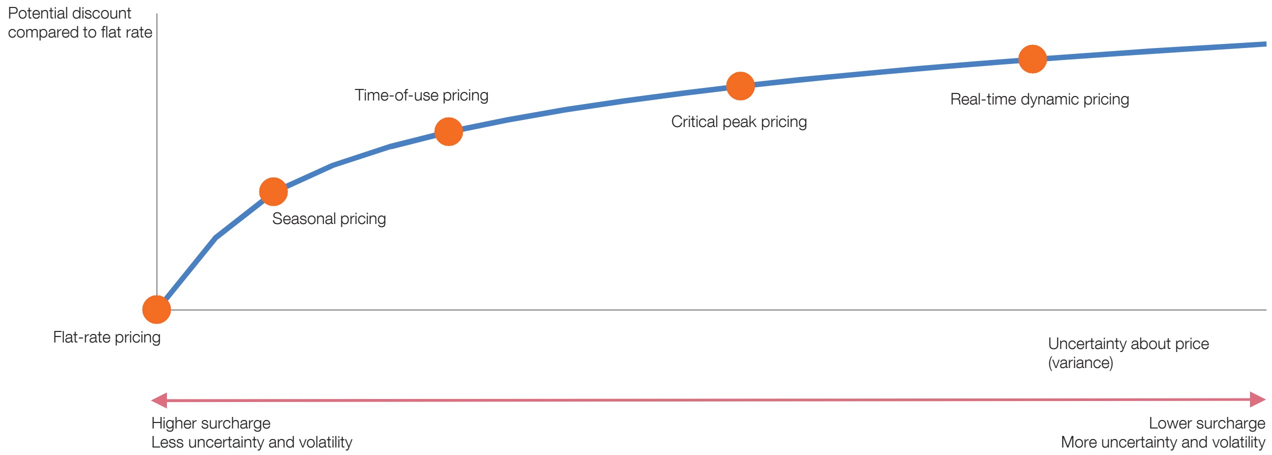
Under retail price-setting systems for electricity there is something of a trade-off in terms of consumer well-being between the level of prices borne and uncertainty

33 For greater details on existing dynamic pricing arrangements and on the countries which, on different scales, have implemented such systems, see the recent report by the International Renewable Energy Agency (IRENA, 2019).

Chart 8

DYNAMIC AND FLAT-RATE ELECTRICITY PRICING SYSTEMS

There is a trade-off between the price level borne by consumers and the uncertainty regarding the volatility of that price. Specifically, flat-rate pricing eliminates the uncertainty over possible changes in prices, but includes a premium for elimination of the risk, resulting in higher prices. Dynamic pricing offers lower prices in exchange for passing on to consumers the volatility in the final price.



SOURCE: Boeve et al. (2021).

over price volatility (see Chart 8).[34] On one hand, in the extreme case of being subject to a fixed-price tariff contract, the uncertainty over possible changes in prices would be eliminated; conversely, however, there is a "premium" for elimination of the risk reflected in higher prices. On the other hand, dynamic pricing tariffs offer lower average prices, but in exchange, consumers have to face price volatility and, therefore, greater uncertainty over their energy expenditure.[35]

Both the greater share of electricity in the Spanish household consumption basket (3.5% compared with 2.9% in the euro area on average)[36] and the greater pass-through of wholesale market price rises (as a result of the dynamic pricing system) explain why higher electricity prices have made a greater contribution to the rise in overall inflation in Spain than in the euro area as a whole and in its main economies (see Charts 5.2 and 9). This contribution has been particularly low in the cases of Germany and France, where the wholesale market price rise has not yet passed through to retail markets. As earlier discussed, this would have

34 See, for instance, Boeve et al. (2021).

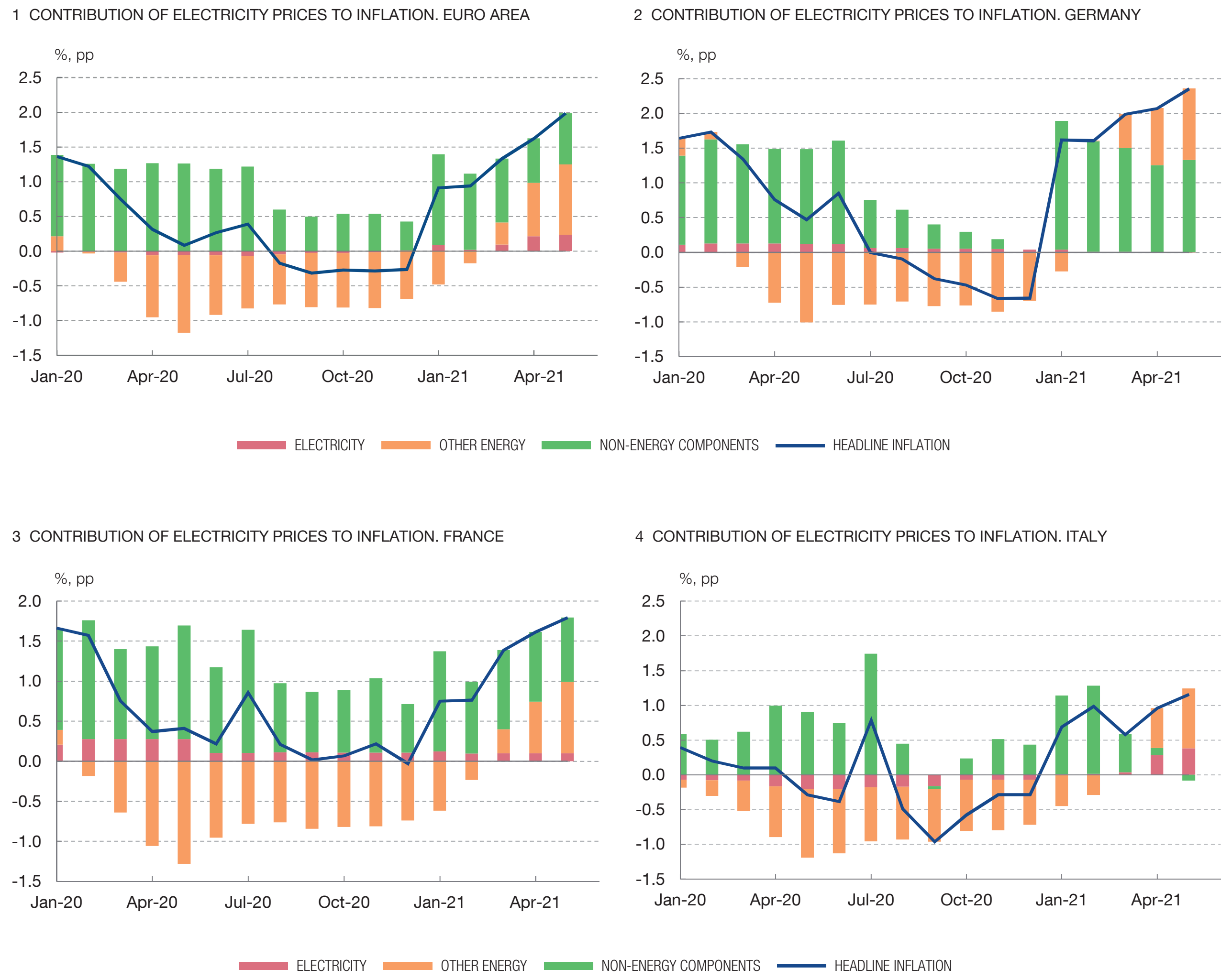
35 Despite the greater volatility generated by dynamic pricing contracts, they have been recommended by certain agencies, such as the Council of European Energy Regulators (CEER) to which the CNMC belongs (Council of European Energy Regulators, 2020), and in various studies by the European Commission (Boeve et al., 2021; European Commission, 2019) based on the fact that they offer specific advantages. Firstly, they allow consumers to interiorise price signals to a greater extent, duly adapting their consumption patterns. Secondly, because they tend to make the market more transparent and provide for a more efficient management of demand.

36 Among the largest euro area economies, the weightings for Germany, France and Italy are, respectively, 3%, 3.2% and 2.3%.

Chart 9

IN THE MAIN EURO AREA ECONOMIES, HIGHER WHOLESALE MARKET ELECTRICITY PRICES HAVE NOT YET PASSED THROUGH TO CONSUMER PRICES AS THEY HAVE IN SPAIN

In recent months, electricity prices have made a more modest contribution to headline inflation in the main euro area economies than in Spain, most likely as a result of the regulatory differences and the retail price-setting systems used.



SOURCE: Eurostat.

to do with how frequently prices derived from regulatory differences are updated and which are the most habitual contracts in the retail electricity market.[37]

37 In the absence of regulated prices, as in Germany, consumers opt for the tariff they prefer in a free market evidencing widely differing characteristics. Even in those countries with regulated tariffs, such as France, only a portion of consumers have adopted this type of contract. Accordingly, it is difficult to obtain statistics on the coverage of the different types of pricing contracts (e.g. fixed-price tariffs, critical peak pricing, etc.) in each of the European retail markets. However, it is known that only seven Member States have dynamic pricing systems (European Commission, 2019), and that only in Estonia, Sweden and Spain does their coverage appear to be high (Boeve et al., 2021). Spain's case is unique in that it has regulated dynamic pricing.

8 Conclusions

In the period from December 2020 to June 2021, wholesale market electricity prices rose sharply. On our estimates in this paper, one-fifth of this increase would be due to higher CO_2 emission allowance prices, in turn attributable to the recent changes in the reduction targets for greenhouse gas emissions in Europe. Set against this factor, approximately half of the increase in prices in the electricity generation market would be the consequence of the higher price of gas.

Against this background, the behaviour of prices in the wholesale electricity markets in the main euro area countries has been similar to that observed in Spain. However, the pass-through to retail prices has been uneven across countries, owing to the difference in certain characteristics of the respective markets, in particular regarding their regulation and price-setting arrangements. Specifically, in Spain's case, the pass-through has been particularly high. Our estimates indicate that the increase in wholesale market electricity prices would be responsible for one-third of the rise in the HICP observed in Spain in the first half of 2021. Conversely, the impact is estimated to have been notably lower both in the euro area as a whole and in its three main economies.

Box 1

A PROXY OF THE GENERATION COSTS OF COMBINED CYCLE PLANTS THROUGH THE MINIMUM PRICES REQUIRED IN THEIR WHOLESALE MARKET BIDS

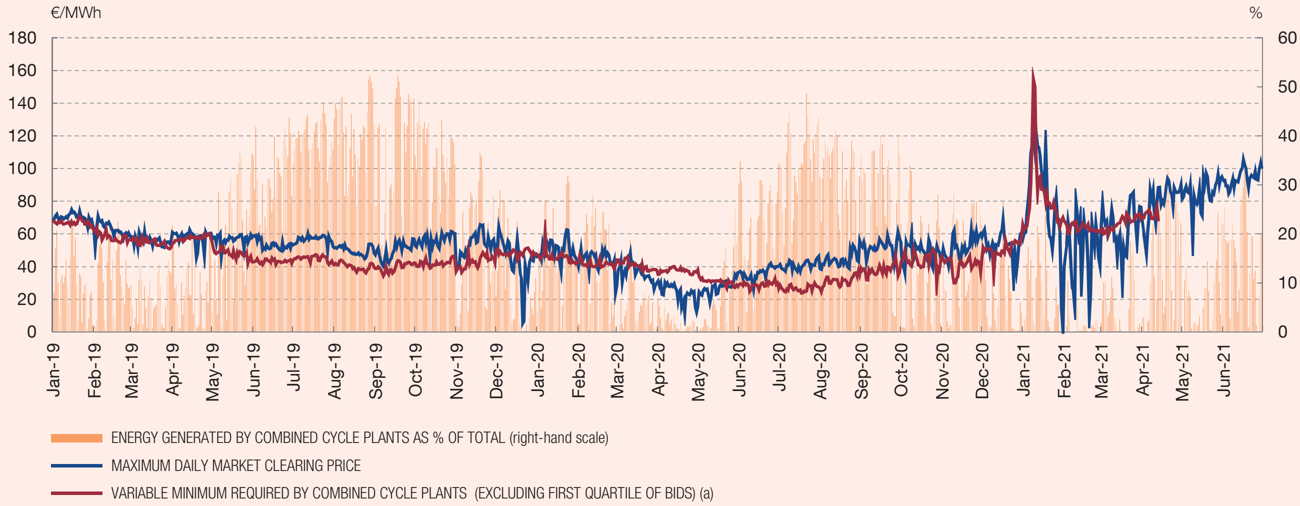
Combined cycle plants' bid prices on the wholesale market can be used to proxy the increase in their electricity generation costs. Given that for each one of these plants, bids vary for each hour and each day, and that bids may be made by generation tranches,[1] it is difficult to obtain a clear view of the costs from these prices. However, a large percentage of the bids made are conditional on each plant obtaining a minimum daily revenue; if that revenue is not obtained, the bids are not considered valid for clearing. The revenue threshold may be formulated in terms of a fixed amount, a variable amount (a minimum price per megawatt-hour (MWh) sold) or a combination of the two. Drawing on the bids conditional on variable minimum revenue being obtained, it is possible to proxy the generation costs of combined cycle technology.

Chart 1 presents daily frequency data on the wholesale electricity market since January 2019. Specifically, it shows, from among the bids made by combined cycle plants that stipulated a variable minimum revenue requirement, the lowest level of revenue required excluding the first quartile of the distribution (red line).[2] The chart also shows the maximum market clearing price for each day (blue line)[3] and the daily percentage of energy generated by combined cycle plants as a proportion of the total energy in the Iberian electricity market (orange bars).

As the chart shows, when the maximum market clearing price is higher than the variable minimum revenue requirement, combined cycle generation increases, whereas when the opposite is the case it decreases significantly. Between December 2020 and mid-April 2021, the variable minimum revenue requirement rose sharply (probably as a consequence of higher prices of gas and emission allowances), tending to lie above the maximum clearing price. This led to a situation in which combined cycle plants had a relatively low share of electricity generation.[4]

Chart 1
MAXIMUM ELECTRICITY MARKET CLEARING PRICE, VARIABLE MINIMUM BID PRICE AND PERCENTAGE OF ENERGY GENERATED BY COMBINED CYCLE PLANTS

Between December 2020 and mid-April 2021, the variable minimum revenue required in electricity supply bids made by combined cycle plants rose sharply. More recently, combined cycle plants have accounted for only a small portion of energy generation. This suggests that they have had difficulties meeting their generation costs, despite the high clearing prices on the wholsesale electricity market.



SOURCES: OMIE and Banco de España.

a The variable minimum revenue required in the lowest bid, excluding the first quartile of the distribution.

1 For each hour, each plant can bid its entire available capacity divided into up to 25 tranches, each with a different price. Thus, for example, a 300 MWh capacity plant could bid 100 MWh at €0, 100 MWh at €10 and the last 100 MWh at €20.

2 The first quartile of the distribution is excluded because that allows us to rule out all bids where the variable revenue requirement is equal to 0. When that is the case, only market bids ultimately determine whether the bidding power plants will take part in electricity generation for a specific hour of the day.

3 The maximum price from among the 24 market clearing prices for each hour of the day is taken. The top rather than the average price is taken because if combined cycle plants manage to enter the market, they do so when prices are highest: if they cannot cover their costs at the highest prices, they will be less able to do so at lower prices.

4 As a result, the share of other technologies, such as storage hydropower, increased to satisfy the part of the demand not met by either renewables or combined cycle plants.

Box 1

A PROXY OF THE GENERATION COSTS OF COMBINED CYCLE PLANTS THROUGH THE MINIMUM PRICES REQUIRED IN THEIR WHOLESALE MARKET BIDS (cont.)

There are no data available on variable minimum revenue required after 15 April, as the bids are not made publicly available until three months after the day on which they were made. However, as the chart shows, the proportion of electricity generated by combined cycle plants remained relatively low between mid-April and end-June. This suggests that the variable minimum revenue requirement in that period continued to be higher than the maximum market clearing price and, therefore, that the cost of electricity generation using combined cycle technology remained high.

REFERENCES

Boeve, S., J. Cherkasky, H. Schult and M. Bons (2021). *ASSET study on dynamic retail electricity prices,* European Commission.

Comisión Nacional de los Mercados y la Competencia (2021a). *Boletín de Indicadores Eléctricos de abril de 2021,* May.

Comisión Nacional de los Mercados y la Competencia (2021b). *La nueva factura de la luz. Nociones básicas.*

Council of European Energy Regulators (2020). *Recommendations on Dynamic Price Implementation.*

Energía y Sociedad (2019). *Manual de la energía. Electricidad,* available at: https://www.energiaysociedad.es/pdf/documentos/manuales-energia/manual-electricidad.docx

European Commission. (2015). *EU ETS Handbook.*

European Commission (2019). *COMMISSION STAFF WORKING DOCUMENT Accompanying the document REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. Energy prices and costs in Europe.*

European Commission (2020a). "State of the Union: Commission raises climate ambition and proposes 55% cut in emissions by 2030", Press release, 17 September.

European Commission (2020b). "European Council meeting (10 and 11 December 2020) - Conclusions", 11 December.

European Commission (2021). *Quarterly Report on European Electricity Markets — market observatory for energy,* 13 (4), Oct-Dec 2020.

IRENA (2019). *Innovation landscape brief: Time-of-use tariffs,* International Renewable Energy Agency, Abu Dhabi.

Matea Rosa, M. L., F. Martínez Casares and S. Vázquez Martínez (2021). "The cost of electricity for Spanish firms", Analytical Article, *Economic Bulletin* 1/2021, Banco de España.

Storm, K. (2020). "Combined cycle power plant (1×1) labor estimate", *Industrial Construction Estimating Manual,* Gulf Professional Publishing, Ch. 6, pp. 95-159.

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