

Box 4

POTENTIAL SENSITIVITY OF NATURAL GAS AND ELECTRICITY CONSUMPTION IN SPAIN TO DIFFERENT WEATHER SCENARIOS IN WINTER 2022-2023

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This early-release box was published on 13 December

Winter 2021-2022 was the fourth warmest winter in Spain since 1961, according to the [Spanish Meteorological Agency](#) (AEMET, by its Spanish acronym). In particular, between 1 December 2021 and 28 February 2022 the average daily maximum temperature was 1.6 °C above the historical average (14.9%). By contrast, winter 2004-2005 was the fourth coldest winter since 1961, with the daily maximum temperature standing 1.3 °C below the historical average and 2.9 °C below that recorded in winter 2021-2022 (see Chart 1).

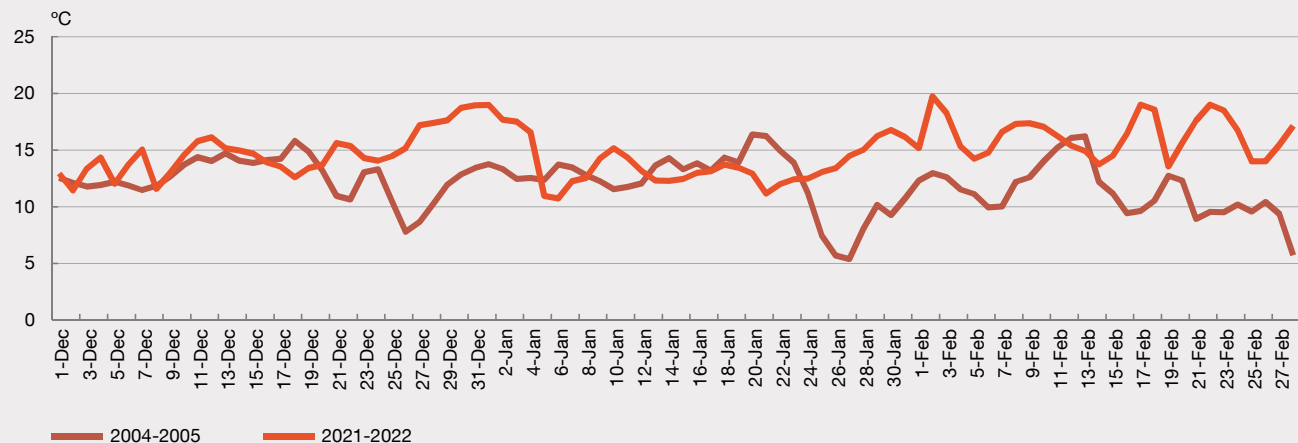
This box aims, first, to analyse the extent to which temperature fluctuation is a key driver of demand for energy in Spain. Second, against a backdrop in which international energy commodity markets are exposed to considerable volatility and there are doubts about the possibility of gas shortage problems arising in some European countries (mainly as a result of the Russian invasion of Ukraine),¹ this box tentatively considers Spanish households' and SMEs' energy consumption during winter 2022-2023 under different weather scenarios.

Charts 2 and 3 illustrate the relationship between Spanish household and SME demand for natural gas and electricity, respectively, and the daily maximum temperature. In light of this evidence, the sensitivity of demand for natural gas in Spain to temperature changes is clearly very different from that seen in the case of demand for electricity.

On one hand, the correlation between maximum temperature and natural gas consumption is very negative for low temperatures, but becomes non-significant for high temperatures (see Chart 2). In particular, for the same drop in temperature (for instance, of 1 °C), household and SME natural gas consumption increases appreciably when the daily maximum temperature is below approximately 20 °C, but barely changes when it is higher.

On the other, the correlation between electricity consumption² and maximum temperature has a U shape (see Chart 3). In other words, during the coldest months electricity consumption increases as the temperature drops (owing to the use of electric heating), whereas in

Chart 1
Maximum winter temperatures



SOURCE: AEMET.

- 1 See Box 2 of this Report for more details.
- 2 To estimate electricity consumption by households and SMEs consuming less than 10 kW, Red Eléctrica ESIOS data on the operating hourly programme (P48) relating to regulated rate retailers (CUR, by their Spanish abbreviation) are used. The series can be affected not only by changes in consumption by point of supply –which is the subject of this box–, but also by changes in the number of households and SMEs with regulated rates. For this reason, regulated rate retailer consumption is divided by the number of supply points (monthly data provided by the Spanish National Securities Market Commission (CNMV, by its Spanish abbreviation) between January 2015 and August 2022) and is multiplied by the total number of supply points.

Box 4

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the warmest months, temperature rises are what lead to greater consumption (owing to the use of air conditioning).

In any event, a comparison of Charts 2 and 3 shows that in the coldest months of the year, natural gas consumption is more sensitive than electricity consumption to temperature changes. This means that a drop in temperature causes a greater relative increase in natural gas consumption than in electricity consumption.

In the second part of this box, a model based on the methodology of [Bover et al \(2022\)](#) is considered in an attempt to estimate how the consumption of natural gas and electricity in Spain might change over the 2022-2023 winter in the face of different weather scenarios. Specifically, daily data on Spanish households' and SMEs' consumption of natural gas (between March 2019 and November 2022) and electricity (between January 2015 and August 2022) are used to estimate a logarithmic correlation between the levels of consumption of each of these energy inputs, the daily maximum temperature and its square root, and different configurations of calendar effects (year, month, day of the week and public holidays).

Once these models have been estimated, two alternative scenarios are envisaged in terms of possible temperature patterns over the 2022-2023 winter. First, a "warm winter" is considered, in which the temperature behaves much as it did in the 2021-2022 winter. Second, the temperatures recorded in the 2004-2005 winter are used by way of a "cold winter".

The results of this exercise suggest that, in a cold winter, the consumption of natural gas and electricity would be 32% and 7% higher, respectively, than would be the case in a warm winter. In other words, leaving to one side any other non-temperature-related factors that may have arisen over the past year, if the 2022-2023 winter is as cold as the 2004-2005 winter, Spanish households' and SMEs' consumption of natural gas and electricity could rise year-on-year by 32% and 7%, respectively.

In any event, when extrapolating these results to the 2022-2023 winter, regard should also be had to the potential impact on households' and SMEs' energy consumption decisions of both the Heating Energy Saving

Chart 2
Household and SME demand for natural gas and daily maximum temperature (a)

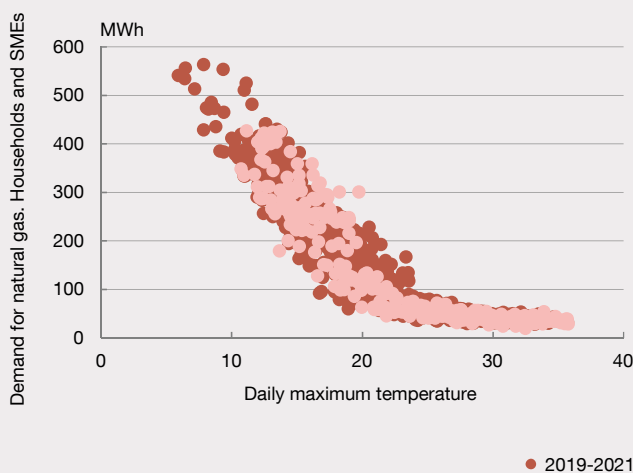
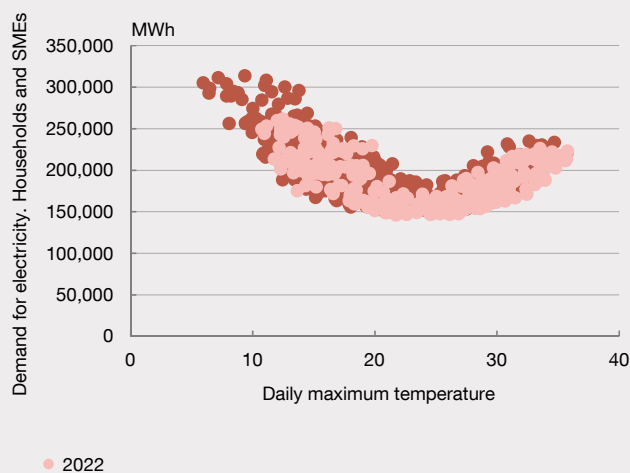


Chart 3
Estimated household and SME demand for electricity and daily maximum temperature (b)



SOURCES: AEMET, Enagas, CNMV, Red Eléctrica ESIOS.

a Household, commercial and SME daily natural gas.

b Data obtained from the result of the operating hourly programme (P48) relating to regulated rate retailers (CUR) of Red Eléctrica ESIOS. These data are multiplied by the monthly data on supply points provided by the CNMC according to the formula $CUR \times (1 + \text{free market supply points} / \text{regulated market supply points})$ to take into consideration possible changes in the number of households with different rates. Thus, it is assumed that regulated rate and free market consumers are consuming the same daily number of MWh.

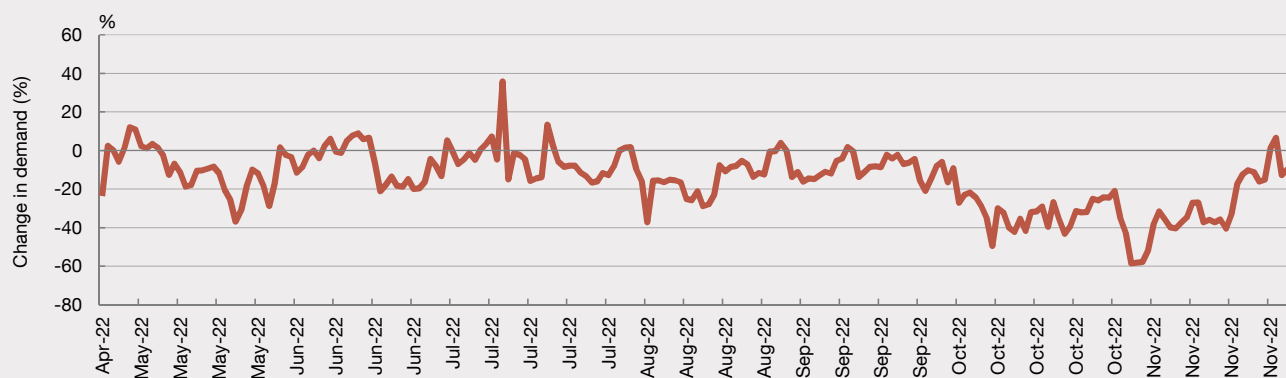
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and Management Emergency Action Plan approved in August³ and the sharp rise in energy prices observed over the course of 2022. Indeed, compared with 2019-2021, the demand for natural gas⁴ on the part of Spanish households and SMEs fell substantially during much of October and November 2022, a state of affairs that cannot be explained by the factors included in the model (see Chart 4)⁵.

If this recent change in energy consumption patterns persists, the consumption of natural gas in Spain could be reduced by 10% year-on-year over the 2022-2023 winter if the temperatures are the same as last winter. However, even if these recent changes in consumption patterns are factored in, the natural gas consumed in Spain could rise by around 25% on the preceding year if the 2022-2023 winter is as cold as the 2004-2005 winter.

Chart 4
Estimated change in households' and SMEs' demand for natural gas (a)



SOURCE: Banco de España, drawing on data from AEMET and Enagas.

a Estimated daily household, commercial and SME consumption of natural gas as a percentage of the consumption observed between 2019 and 2021 and until 30 November, taking into account days of the week, months, years, public holidays and maximum temperatures. For further details, see [Bover et al. \(2022\)](#).

- 3 This plan sets out energy-saving recommendations and measures in different areas that are mandatory for some SMEs in certain sectors. For more details, see [Royal Decree-Law 14/2022](#).
- 4 This exercise did not include demand for electricity given the lack of information on changes in supply points in the most recent months with which to estimate households' and SMEs' consumption.
- 5 This chart shows the difference between the natural gas consumption observed in 2022 and the consumption forecast by a model correlating households' and SMEs' demand for gas with temperature patterns and various calendar effects over the period 2019-2021. Thus, by excluding the data on 2022 from this estimate, the role that some of the most recent developments (not included in the model) may have played in gas consumption in Spain can be approximated.