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IMPACT OF THE NEW EU EMISSIONS TRADING SYSTEM ON HOUSEHOLDS

Juan Carlos Roca Reina[1]*, Jonathan Volt[1], Agne Toleikyte[1], Johan Carlsson[1]

1: European Commission, Joint Research Centre, Directorate for Energy, Transport and Climate, P.O. Box 2, NL-1755 ZG Petten, Netherlands
e-mail: juan.roca-reina@ec.europa.eu

Abstract: *The heating of buildings is responsible for 40% of the European Union's final energy consumption and 36% of its total greenhouse gas emissions. Improving the energy efficiency of buildings and phasing out the use of fossil fuels for heating are, therefore, central pillars for achieving the climate goals of the European Green Deal. As part of the strategy to achieve these targets, a new emissions trading system (ETS 2) has been established, which will cover the CO_2 emissions stemming from fuel combustion in the building and transport sectors from 2027. This study analyses the impact of ETS 2 on households, including its influence on the cost-effectiveness of different renovation measures and clean heating solutions. The result provides new insights into how this new emissions trading system will influence the final consumer and investments in clean energy technologies over the next decade.*

Keywords: Energy, Efficiency, Buildings, Carbon, Emission Trading System.

1. INTRODUCTION

Heating of buildings is one of the largest sources of emissions in the EU. While efficiency standards of new buildings have steadily improved over the last two decades, improving the existing building stock has been more challenging. The problem is amplified with over 80 million dwellings relying on natural gas for heating, comprising over 40% of all households. A central reason is that fossil fuels have remained relatively inexpensive, which has hampered investments in energy renovations and renewable-based heating systems.

The EU ETS was initially launched in 2005 and functions as a cap-and-trade scheme[i], where emitters of greenhouse gases (GHG) have to bear an extra cost. Through its mechanism of pricing carbon([ii]), it has proven successful in mitigating emissions especially in the energy production and industrial sectors. The new EU Emission Trading System (ETS 2) has been introduced to also cover emissions from fuel combustion in buildings, transportation, as well as small-scale energy and industrial facilities. Until the implementation of ETS 2, households using heat pumps or district heating have indirectly paid higher costs for the electricity used, as power and heat generation plants fall under the original ETS, while households relying on individual gas or oil boilers have not. The ETS 2 will extend carbon pricing to cover the most emitting sectors, while fostering a more equitable competitive landscape.

The ETS 2 will complement other policies of the European Green Deal [1] to achieve the EU's climate goal of reducing EU emissions by at least 55% by 2030. The Fit for 55 [2] legal package also included the revision of several key climate and energy directives (e.g., Energy Efficiency Directive, Renewable Energy Directive, Energy Performance of Buildings Directive), as well as setting more ambitious targets. Furthermore, in response to Russia's invasion of Ukraine, the European Commission presented the REPowerEU Plan, which sets out a series of measures to phase out the dependence on Russian fossil fuels by 2030 [3]. This means the ETS 2 will be accompanied by a broad set of measures to improve energy efficiency in buildings and energy networks, and support the phase-out of fossil fuels.

The ETS 2 will become operational in 2027 and operate independently of the existing ETS, meaning the cost for one allowance might differ between the two systems[iii]. It covers emissions upstream, meaning fuel suppliers rather than households will be responsible for attaining allowances to cover their emissions. The ETS 2 cap is set to bring emissions down by 42% by 2030, compared to 2005 levels. The cost will depend on the demand, which in turn will be contingent on how successful the Member States and sectors have been in mitigating their emissions through other means. In other words, if other policies or innovations are effective and on track to achieve the 42% reduction, the ETS price will stay low, but if not, the price will be higher.

i A cap-and-trade scheme works by setting a cap on the total amount of carbon emissions allowed from a certain group of sources, such as fossil-fuelled boilers in buildings and fuel engines in vehicles. This cap is then divided into individual allowances, each representing a specific amount of emissions. Concerned companies are required to hold enough allowances to cover their emissions, and they can buy, sell, or trade these allowances with other companies. This creates a market, where the price of allowances is determined by supply and demand. As the cap is gradually lowered over time, the total amount of emissions allowed also decreases, encouraging companies to find ways to reduce their emissions. This market-based approach provides an economic incentive for companies to invest in cleaner technologies and practices, ultimately reducing overall carbon emissions.

ii The system also encompasses emissions resulting from the combustion of other greenhouse gases, namely methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride. Their emissions are being translated into carbon dioxide equivalents based on their global warming potential.

iii By 2031, the EU Commission will carry out a feasibility assessment of integrating the two systems into one.

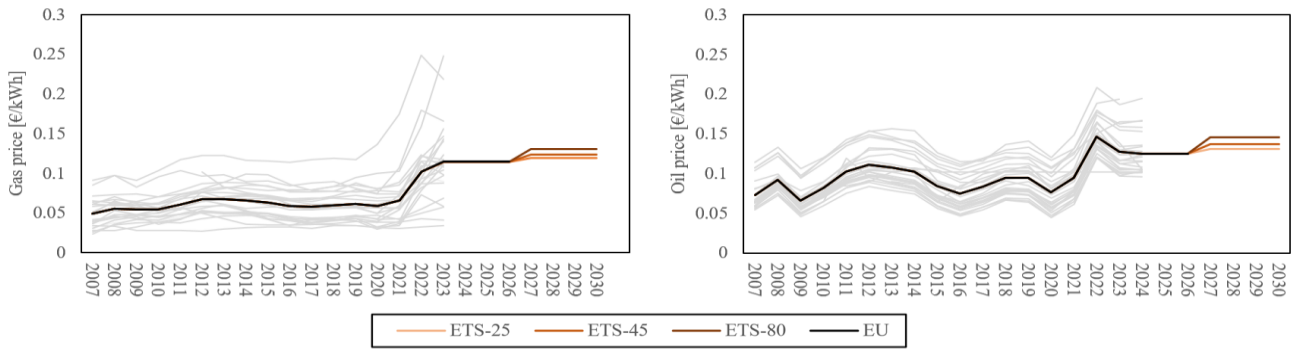

Figure 1. Different ETS 2 prices impact on gas and oil prices

Figure 1 illustrates the impact of ETS 2 on households heating with gas and oil, given three different price levels: 25, 45 and 80 €/ton, respectively. Furthermore, gas and oil prices are represented with grey lines, being EU the average of them. Additional allowances will be released from the ETS 2 market stability reserve, if the price of allowances exceeds 45 €/ton (in 2020 prices), during the first three years of its operation. The impact is slightly higher for houses using oil as the carbon emission intensity of oil is larger.

2. HOUSEHOLDS DESCRIPTION

The higher cost of using fossil fuels for heating will also lead to higher costs for people who already struggle financially. The share of households unable to keep home adequately warm varies greatly across the EU, from a couple percentages in the Nordic countries to around 24% of households in Bulgaria. Regarding the Iberian Peninsula, Portugal and Spain are above average with shares between 18-21%. The reasons are primarily a relatively high share of households with lower incomes but also less efficient buildings.

The ETS 2 price will indirectly be paid by households using fossil fuels for heating purposes. Gas is the most common fuel, and Figure 2 shows that 45% of the households in the EU use gas for heating. In Netherlands, Hungary and Italy more than 68% of the households use a gas boiler for their heating needs. 21% of Spanish households use gas for heating.

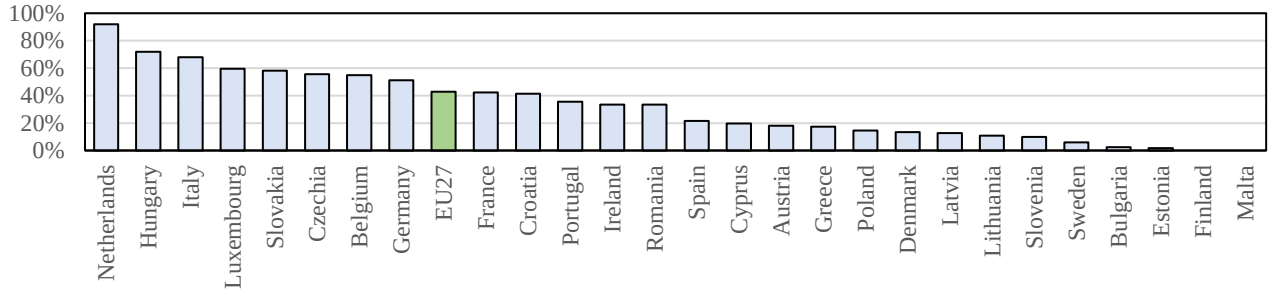

Figure 2. Households share with natural gas heating. *JRC Compilation based on national sources (2024)*

The use of gas is spread somewhat evenly across all different income levels. In this study, we have considered five income levels: level 1, the one with the lowest income, and level 5, the one with the highest. Gas boilers are even more common among the higher income levels.

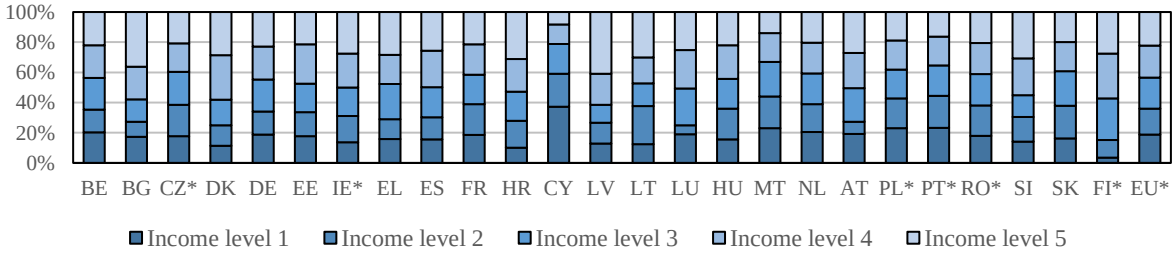

Figure 3. Households with gas heating by income group. *JRC analysis based on HBS data from 2020. The data is from 2015 for MS with an asterisk (*).*

All the data exposed through the chapter highlight the importance of increasing the price of fossil fuels for several households throughout the EU. In this work, we focus more on the impact of the ETS 2 levy in two different cities in Spain, which are Madrid and Elche.

3. BUILDINGS AND CLIMATE DESCRIPTION

The building type selected for the analysis is a single-family house archetype from the TABULA project database [4]. This database provides information about buildings from different Member States, providing a picture of the most typical buildings in the EU. This information comprises building envelope surfaces, U-values, ventilation rates, heated floor area, building coefficient of inertia, etc. Table 1 shows the information about the geometry and envelope of the building selected, a single-family house from the 1970s.

Table 1. Building information.

	Surface	**U**
Envelope parts	**m^2**	**$W/m^2 \cdot K$**
Walls	312	1.33
Roof	63	4.17
Floor	90	0.85
Windows	12.6	4.59
Heated floor area	170	-

The heating demand for the house has been calculated for different climate conditions, namely Madrid and Elche. The climate conditions are based on a typical meteorological year information from the PVGIS database [5]. The interior temperature is defined as 20°C which is assumed to be constant during the day. We have considered a base temperature of 15ºC in the simulation, which represents the minimum outdoor temperature at which, potentially, there is no heating demand.

The heating demand calculation follows a methodology based on UNE-EN ISO 52016-1:2017[iv]. We adjust the results obtained from this methodology by using an utilisation factor proposed by the TABULA project [1]. This value has no units of measurement and represents the link between the theoretical heating demand obtained from the methodology and the potential actual heating demand the building has. The utilisation factor is applied because the theoretical assumptions have shown to be persistently too high. According to the TABULA methodology, the utilisation factor decreases when the energy use of the building increases, following a linear relation. For this reason, the overestimation tends to be higher for lower-performing buildings.

Following this approach, it is estimated that the analysed house has a yearly heating demand of 95 kWh/m^2 in Elche and 170 kWh/m^2 in Madrid. According to the energy label of the existing building stock document of IDAE[v], the yearly heating demand for the reference building is 149.8 kWh/m^2 and 76.9 kWh/m^2 in Madrid and Elche (Alicante) respectively. This means that the results obtained are in line with the potential heating demand that a building could have in these regions.

4. RESULTS

The analysis carried out in the study aims to show the impact of ETS 2 in buildings. First, an energy balance of the building is carried out to determine its heating demand and the CO_2 emissions of using different heating systems. This is accompanied by an economic analysis of the gas or electricity costs needed to supply this heating demand. The cost is compared with the level of income of households and with the level of increase due to the ETS 2.

[iv] https://www.une.org/encuentra-tu-norma/busca-tu-norma/norma/?c=norma-une-en-iso-52016-1-2017-n0059143

[v] https://www.idae.es/uploads/documentos/documentos_11261_EscalaCalifEnerg_EdifExistentes_2011_accesible_c762988d.pdf

In order to know the level of CO_2 emissions of the heating systems, we have applied different CO_2 factors: 202 g/kWh for gas, 267 g/kWh for oil and 177 g/kWh for electricity for both geographical locations. The factors are linked to the energy use of the building. We calculate the energy use taking into account the energy demand and the efficiency of the heating systems applied. Five different heating systems are applied to the same house in two different climate regions. Figure 4 shows the results of this approach:

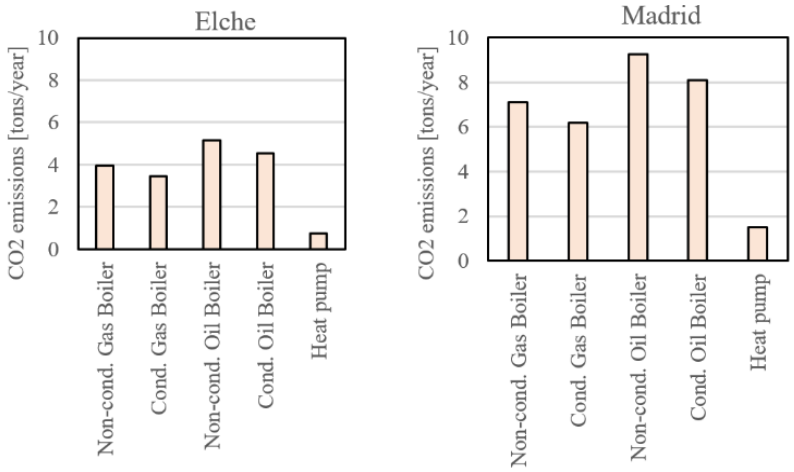

Figure 4. CO_2 of different heating systems in two climate regions of Spain

We apply different ETS 2 price scenarios for the CO_2 emissions of different heating systems. In order to determine the impact of the ETS 2 price, we estimate the energy use costs for different heating systems. The prices used are 0.12 €/kWh for gas, 0.08 €/kWh for oil and 0.27 €/kWh for electricity. Applying these costs to the energy use of the heating system selected and adding the ETS 2 cost allows us to estimate the energy price increase if this levy is applied. Furthermore, the income level of households is needed to understand the impact on the final user. The income levels shown in Figures 5 and 6 account for the average income level of couples with children in Spain.

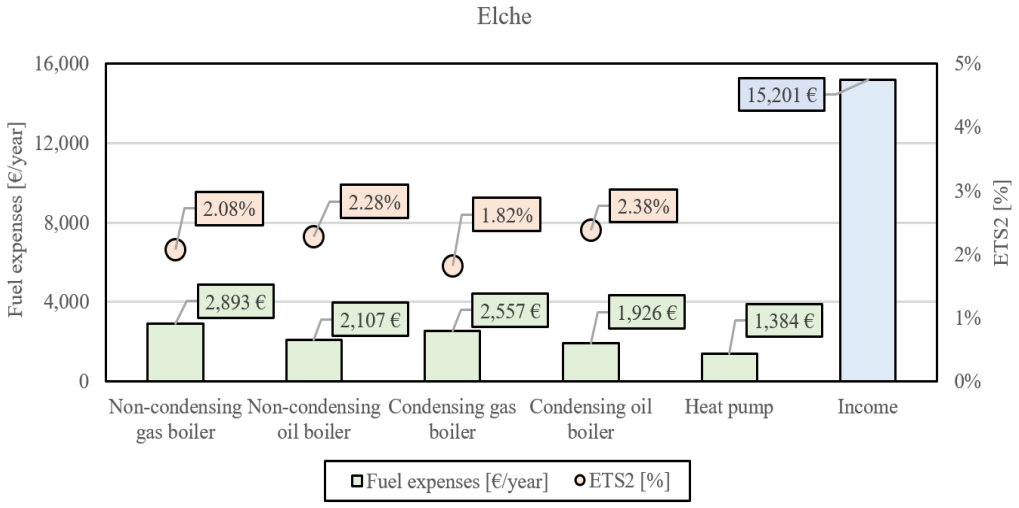

Figure 5. ETS 2 impact on different heating systems in Elche

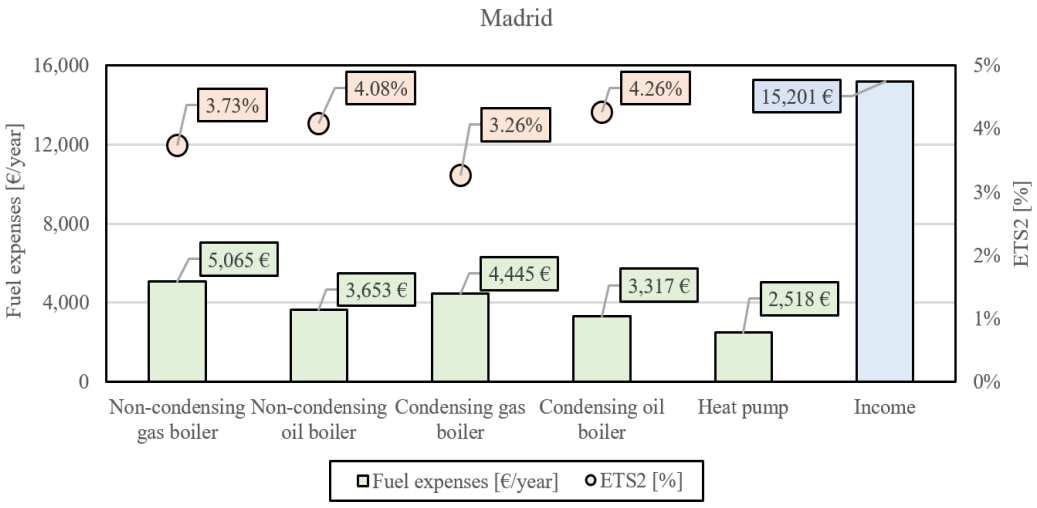

Figure 6. ETS 2 impact on different heating systems in Madrid

The income level considered is the same for Elche and Madrid. The reason is that the database used takes into account the national level; there is no discretisation among cities. The price scenario used for the ETS 2 is 80 €/ton CO_2, which is a worst-case scenario. The impact of ETS 2 is higher in Madrid than in Elche, due to the higher level of heating demand to deliver. In both cases, the ETS 2 level reaches 2-4% of the income level of households. The impact is null on heat pumps, as the ETS 2 levy only applies to fossil fuel-based heating systems.

5. CONCLUSIONS

ETS 2 will have a financial impact on households. The impact is, however, heavily linked to income level, climate region, the heating system used and heating demand. For an average-income couple with children in Spain, this impact could reach 4% of household income if the heating system selected consumes fossil fuel and the house has a heating demand of around 170 kWh/m^2. The ETS 2 price creates an incentive to decarbonise EU building stock by installing renewable energy sources and phasing out fossil fuels. However, more incentives and subsidies are needed for low-income households to ensure that they can also afford to participate in the low-carbon transition.

6. REFERENCES

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