Impacts of policies on low-income households in the target countries

Study on the impacts of policies to decarbonize residential buildings on energy poverty in CEE/SEE and mitigation strategies
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<td>5.10.2</td>
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</tbody>
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1. SCOPE OF THE DOCUMENT

1.1 Introduction

This report presents the initial findings of Workstream 2, the quantification of three new policies, which are examined within the framework of the study. Based on data gathered from a variety of sources (primarily Eurostat, EU building codes and Household Budget Survey), the assessment is carried out, including the elaboration of chosen scenarios. The evaluation of effects from introduced policies to low-income households and the derived conclusions are part of the Workstream 3 (WS3) document.

The important prerequisite was to determine low-income groups of each country, which will be referred to by the modelling and measures at national level. The modelling itself, after data gathering and validation from the national expert group, included calculations of baseline final energy consumption of low-income households. Subsequently, the evolution of the introduction of three proposed policies was determined based on expert knowledge of national and EU level stakeholder groups. The policies referred to are:

- The EU Minimum Energy Performance Standards (MEPS)
- EU Emissions Trading System extension to fuel suppliers in buildings and transport sector
- Phasing out of fossil fuel boilers

The proposed policies’ introductions are calculated in relation to the business-as-usual (BaU) scenario(s) (the costs, investments and replacement rates) in five scenarios with different combinations of policies and the pace of introduction.

The results of Workstream 2 include the total costs of every introduced scenario, including energy expenditure and cost of investments and are accompanied by the presentation of comparison between scenarios in the joint graphs. These serve as inputs for WS3.

The results also include the calculation of the allocation of allowances that the obligatory parties from included Member States would receive as well as the distribution of other allowances. The revenues from the ETS2 will be used in WS3 for the financing of proposed measures.
1.2 Definition of low-income households

For the purpose of this evaluation, low-income households are considered those in the first income quintile. The absolute income depends on the Member State included.

The median disposable income per Member State is shown in Figure 1. When comparing the median income of MS included with average EU income, it is obvious that citizens of each MS already have lower median incomes than the average EU income.

Figure 1 Median income in the included Member States, source: Mean and median income by age and sex - EU-SILC and ECHP surveys, EUROSTAT

Figure 2 shows the percentage of citizens in the first quintile to which modelling and later introduced policies refer to. The distribution of income is in line with the EU average, with which some distributional conclusions could be also upscaled to other EU countries.

Figure 2 Percentage of the citizens in the first income quintile, source: Distribution of income by quantiles - EU-SILC and ECHP surveys, EUROSTAT
Number of low-income households per country

Based on income distribution per specific country, the number of households that have been used in the calculation are shown in Table 1. The importance of these numbers is that they primarily show how many households are being used for modelling purposes, but also indicate the number of households which measures are being developed for.

*Table 1 Number of low-income households per included Member State*

<table>
<thead>
<tr>
<th>Country</th>
<th>Bulgaria</th>
<th>Czechia</th>
<th>Greece</th>
<th>Hungary</th>
<th>Italy</th>
<th>Poland</th>
<th>Portugal</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of low-income HH</td>
<td>188,581</td>
<td>890,668</td>
<td>503,841</td>
<td>677,332</td>
<td>2,766,058</td>
<td>2,180,614</td>
<td>263,033</td>
<td>1,125,840</td>
<td>379,060</td>
<td>1,870,251</td>
</tr>
</tbody>
</table>
1.3 Data collection

The energy expenditure that was reported to the Households Budget Survey was the basis for determining the actual final energy consumption of low-income households in combination with additional data such as utilized fuels, the households’ size, the building’s area, and construction age of the building. If assumptions were used for the unavailable data, they are described in the country report. The module on how to distribute and evaluate the difference between the actual energy consumption of low-income households and the total population is described in the next chapter – modelling of baseline.

The final energy consumption of low-income households for different types of buildings (based on the energy performance and subsequently the building codes in each country) is calculated through the indicative dataset as presented in the table below:

<table>
<thead>
<tr>
<th>Input Parameters</th>
<th>Electricity</th>
<th>Heating oil</th>
<th>Natural gas</th>
<th>Biomass</th>
<th>District heating</th>
<th>Solar thermal</th>
<th>LPG</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (absolute) of low-income households (dwellings)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average income (€)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average number of occupants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average area (m2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average expenses for electricity (€)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average expenses for thermal energy (€)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of renovated buildings (%) (renovation rate)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of utilized fuels for thermal uses (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy prices (€/MWh) (with and without taxes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data collection included the following steps:

1: Finding results of the most recent Households Budget Survey conducted by the National Statistical Authority, for each country separately. Information about the Households Budget Survey is provided in the following table for the examined countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Bulgaria</th>
<th>Czechia</th>
<th>Greece</th>
<th>Hungary</th>
<th>Italy</th>
<th>Poland</th>
<th>Portugal</th>
<th>Romania</th>
<th>Slovakia</th>
<th>Spain</th>
</tr>
</thead>
</table>

2: Collecting information about electricity, gas and other fuels expenditures both for the total households and for the households that belong to the different income decile.

3: Accessing primary data of the Households Budget Survey to identify more disaggregated information.

To be able to build and calibrate the BaU scenario in the heating and cooling sector of the targeted countries, the following dataset was also needed:
### Table 4 Data needed for the BaU scenario

#### Space heating

<table>
<thead>
<tr>
<th>Modelling parameters</th>
<th>Heating degree days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed capacity of heating system (kW/building)</td>
<td></td>
</tr>
<tr>
<td>Utilization factor (%)</td>
<td></td>
</tr>
<tr>
<td>Useful energy for space heating (kWh/building)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of utilized fuels for space heating (%)</th>
<th>Heating oil</th>
<th>Natural gas</th>
<th>Biomass-Central system</th>
<th>Biomass-Individual system</th>
<th>District heating</th>
<th>Heat pumps-Conventional</th>
<th>Heat pumps-High efficient</th>
<th>Electricity</th>
<th>Other</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Calculations</th>
<th>Heating oil</th>
<th>Natural gas</th>
<th>Biomass</th>
<th>District heating</th>
<th>Electricity</th>
<th>Other</th>
</tr>
</thead>
</table>

#### Final energy consumption (GWh)

<table>
<thead>
<tr>
<th>Heating oil</th>
<th>Natural gas</th>
<th>Biomass</th>
<th>District heating</th>
<th>Electricity</th>
<th>Other</th>
</tr>
</thead>
</table>

#### Space Cooling

<table>
<thead>
<tr>
<th>Modelling parameters</th>
<th>Cooling degree days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilization factor (%)</td>
<td></td>
</tr>
<tr>
<td>Installed capacity of cooling system (kW/building)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of cooling systems (%)</th>
<th>Performance of cooling systems</th>
<th>Conventional systems</th>
<th>High-efficient systems</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Calculations</th>
<th>Electric</th>
<th>Natural gas</th>
<th>Heating oil</th>
<th>Solar thermal</th>
</tr>
</thead>
</table>

#### Domestic hot water (DHW)

<table>
<thead>
<tr>
<th>Modelling parameters</th>
<th>Consumption of DWH (lt/member &amp; day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful energy (kWh/building)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of utilized fuels for DHW (%)</th>
<th>Performance of DHW systems</th>
<th>Electricity</th>
<th>Natural gas</th>
<th>Heating oil</th>
<th>Solar thermal</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Calculations</th>
<th>Electricity</th>
<th>Natural gas</th>
<th>Heating oil</th>
<th>Solar thermal</th>
</tr>
</thead>
</table>

#### Cooking

<table>
<thead>
<tr>
<th>Modelling parameters</th>
<th>Demand for cooking (kWh/dwelling)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Percentage of utilized fuels for cooking (%)</th>
<th>Performance of cooking systems</th>
<th>Electricity</th>
<th>LPG</th>
<th>Natural gas</th>
<th>Biomass</th>
</tr>
</thead>
</table>

#### Lighting and appliances

<table>
<thead>
<tr>
<th>Modelling parameters</th>
<th>Demand for lighting (kWh/m2)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Percentage of lighting systems (%)</th>
<th>Percentage of electric appliances (%)</th>
<th>Performance of electric appliances (kWh/appliance)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Calculations</th>
<th>Electricity</th>
</tr>
</thead>
</table>

#### Final energy consumption (GWh) - Electricity

<table>
<thead>
<tr>
<th>Electricity</th>
<th>Other</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Other</th>
</tr>
</thead>
</table>


1.4 Development of the business-as-usual calculation

In this section, the methodological approach for the development of the BaU calculation is described using the “step” methodology.

**Figure 3 Step by step approach to BaU scenario development**

**Step 1:** Estimation of unitary final energy consumption for different end-uses of the average household according to data on the disaggregated final energy consumption of households (*data: Eurostat*).

**Step 2:** Calculation of reduced energy expenses of households belonging to the lowest income decile in comparison with energy expenses of the average household (*data: HBS*).

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for different end-uses taking into consideration reduced energy expenses as estimated in Step 2.

**Step 4:** Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration reduced energy expenses as estimated in Step 2.

**Step 5:** Identification of utilised means of heating and cooking for the case of households which belong to the lowest income decile (*data: HBS*).

**Step 6:** Modelling each different end-use separately for quantifying the consumed energy carriers.

**Step 7:** Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) as well as identified energy expenses (Step 2).
1.5 Resulting final energy consumption in BaU year

Detailed data is available in the per-country analysis. To compare the status of low-income households from the perspective of energy consumption in the baseline situation and baseline year (2019), the results are presented in the same graph:

![Figure 4 Energy consumption/low-income households](image)

Calculation details and distribution of fuels and uses of energy is shown in the country-specific documents. The baseline situation we evaluated based on the dataset is also shown, along with the comparison between the average household and the low-income household from the perspective of energy consumption. The results are shown for the year 2019.

![Figure 5 Comparison between average and low-income household energy consumption](image)
2. INTRODUCED POLICIES

The three targeted policies and how they are introduced to the modelling scenarios is described below.

2.1 General description of the introduced policies

The three policy proposals explored in this study are:

**Minimum Energy Performance Standards (MEPS)**

MEPS target existing buildings, aiming to encourage deep renovations that "meet a minimum performance standard by a given date or at a chosen trigger point in the building lifecycle".¹ The Energy Performance of Buildings directive includes the renovation of the worst performing buildings; those in Energy Performance Certificate (EPC) classes G or F. The G rating corresponds to the 15% worst performing buildings in each country, with the remaining buildings in the country distributed proportionately among the other classes between G and A which corresponds to zero-emission buildings. Residential buildings which are interesting for the study will have to be renovated from G to at least F by 2030, and to at least E by 2033.² Although evidence of the measured impacts of MEPS is limited, the Impact Assessment of the Energy Performance of Buildings Directive (EPBD) concluded that MEPS can support achieving final energy savings and energy expenditures reduction, as well as generate construction activity. The impact assessment did not isolate the impacts of MEPS on energy poverty, nor did it address specificities regarding the CEE and SEE regions.

**EU Emissions Trading System extension (ETS2)**

The EC has proposed a new emissions trading system (referred to in this document as ETS2), which will put a price on emissions from the building and the road transport sectors. This system is also cap and trade like ETS1 and it is regulated upstream, meaning it does not directly involve buildings or cars but suppliers of the directly distributed fuels. The new system is designed to start from 2026. These sectors will still be covered by the Effort Sharing Regulation, which means national policies will continue to contribute to reducing emissions in the sectors.³ Carbon pricing is considered to be the measure creating the market for innovative solutions, but it is dependent on the energy price elasticities (and cross-price elasticities) in each country as well as on the consumers’ responsiveness to price increases. The impacts of the ETS price in these sectors could however generate higher costs to households (hence leading to higher energy poverty) in Central and Eastern as well as Southern Europe.

**Phasing out of fossil fuel boilers**

To proceed with the decarbonization of heating and cooling in residential sectors, the installation or sale of new fossil boilers should be phased out by 2030 as boilers have a lifetime of around 20 years. There is, however, a potential of locking in poor households in using obsolete technologies, as heat pumps are more expensive in terms of their upfront investment.

while the running costs of heat pumps are likely to be lower than those of fossil boilers due to their higher efficiency. The only way for securing the minimization of such a lock-in is a stable and clear policy framework that can enable poor households to make the switch to renewable energy heating systems. There is an ongoing revision of the Ecodesign and energy labelling measures for space and water heaters that is likely going to lead to a downgrading of gas boilers to the lowest two energy labels and a discussion on the phase-out of the sale of inefficient fossil heating systems. Nevertheless, what is mostly remarked in the ten countries showcased in this study is that, in their decarbonization phase, they a) opt for natural gas as a new fuel for heating, enlarging their existing gas pipelines in the domestic sector, and b) still make use or introduce several subsidies for fossil fuel heating in natural gas boilers, under the umbrella of energy efficiency measures. The phasing out of fossil fuel boilers should therefore indicate a clear timeline to avoid further lock-ins and increase of costs for shifting natural gas boilers.

2.2 Introduction of policies to the model and scenario development

The policies are introduced to the modeling scenarios with an interactive process through the Stakeholder Board, involving most prominent experts in the area. Some of the scenarios include only one of the proposed policies, while others include a combination of policies which will be described in the following section.

2.2.1 Horizontal assumptions of the modelling scenarios

Baseline year

Within the modelling procedure, 2019 was used as the baseline year. The estimation of the final energy consumption of low-income households was performed through the implementation of an approach based on the collected data regarding the expenses of the households (including low-income ones), as described in the previous sections.

Changes in final energy consumption

The final energy consumption in the baseline case is evaluated on an annual basis in the period 2021-2030 according to the EU Reference Scenario 2020. It should be noted that no increase was considered for the period 2031-2050 due to the implementation of the various policies.
The assumptions for the evolution of the ETS1 (Figure 6) prices were derived from the EU Reference Scenario 2020.

Moreover, the carbon intensity of the electricity production sector in 2030, 2040 and 2050, according to the EU Reference Scenario 2020 for each MS, was taken into account for the calculation of the electricity price’s increase due to the ETS1 price.

ETS2

ETS2 prices are a result of the study, which Vivid Economics conducted for ECF. It should be noted that for the case of the ETS2 price, two different scenarios were explored to model the electricity price evolution until 2040. Scenario 1 was selected for the case of carbon pricing policy, while Scenario 2 was selected for combination of policies. Finally, it is assumed that after 2040 the ETS2 price will remain constant.
Figure 7 Scenario for the evolution of ETS2 price until 2040

Fossil fuels prices

An increase of fossil fuels prices was considered for the period of 2019-2050 according to the utilized forecasts within the framework of the EU Reference Scenario 2020 for the case of heating oil, natural gas, coal and LPG and was described per MS in the respective section.

Figure 8 Fossil fuel prices – reference
### 2.2.2 Descriptions of the introduced policies’ scenarios

Elasticities of demand for all the scenarios are determined in the per-country documents. Elasticities were only available on the average level of households.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline scenario</strong></td>
<td><strong>Assumptions</strong>: No implementation of additional policies. The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account. Scenario 1 was considered for the projection of the electricity price.</td>
</tr>
<tr>
<td><strong>Scenario 1</strong></td>
<td><strong>Assumptions</strong>: Scenario 1 was considered for the projection of ETS2 price. The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account in additional to the increase due to the carbon pricing. Scenario 1 was selected for the projection of the electricity price.</td>
</tr>
<tr>
<td><strong>Scenario 2</strong></td>
<td><strong>Assumptions</strong>: Mandatory phase-out of heating oil and solid fossil fuels in 2030 and natural gas (including LNG) in 2040. It was considered that the actual phase-out will have occurred after five years (heating oil and solid fossil fuels in 2035 and natural gas and LNG in 2045), and heat pumps will replace the existing heating systems. The installation cost of the heat pumps was assumed equal to €8,000.</td>
</tr>
<tr>
<td><strong>Scenario 3</strong></td>
<td><strong>Assumptions</strong>: Establishment of MEPS for achieving energy class E in 2035. 50% of the affected households (75% of the total low-income households) will renovate their buildings until 2030 and remaining buildings until 2035. Assumptions for buildings’ energy upgrade: Renovation cost: €10,000/dwelling and delivered final energy savings: 30%. In 2040 all the building will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: €5,000/dwelling and delivered final energy savings: 10%). It should be noted that the renovation costs for the case of Hungary was assumed to be slightly higher (€13,500/dwelling and €6,500/dwelling in 2035 and 2040 respectively).</td>
</tr>
<tr>
<td><strong>Scenario 4</strong></td>
<td><strong>Assumptions</strong>: Combination of Scenarios 2 and 3</td>
</tr>
<tr>
<td><strong>Scenario 5</strong></td>
<td><strong>Assumptions</strong>: Combination of Scenarios 1, 2 and 3.</td>
</tr>
</tbody>
</table>

The modelling of the policies occurred successively. Firstly, the impact of the ETS2 price was calculated, while the introduction of MEPS was considered in a second phase to estimate the reduction of the final energy consumption. Finally, the phasing out of the fossil fuels boilers was examined for the combined assessment of the examined policies. It should be highlighted that the energy efficiency principle was applied both in the introduction of MEPS and the phasing out of the fossil fuels boiler, as a meaningful reduction of energy consumption was assumed in the case of MEPS and the installation of heat pumps was considered for replacing the existing fossil fuel as it is the most energy efficient option.
3. CALCULATION OF THE AUCTION VOLUMES IN THE ETS2

As ETS2 has introduced adverse effects, but also revenues to help with the consequences on the low-income group, the objective of this work is to evaluate ETS2 auctions and to calculate revenues in WS3 and compare them with the needs deriving from the disposable income gap or low energy performance of buildings.

Based on the study prepared by Vivid Economics for T&E and ECF, the total number of auctions in the ETS2 will decrease as shown in Table 5.

<table>
<thead>
<tr>
<th>Year</th>
<th>Auctions prior to MSR adjustment</th>
<th>Auctions after MSR adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit: Million allowances</td>
<td>Unit: Million allowances</td>
</tr>
<tr>
<td></td>
<td>Scenario: Central case with MSR1</td>
<td>Scenario: Central case with MSR1</td>
</tr>
<tr>
<td>2026</td>
<td>1,289</td>
<td>1,289</td>
</tr>
<tr>
<td>2027</td>
<td>935</td>
<td>935</td>
</tr>
<tr>
<td>2028</td>
<td>779</td>
<td>745</td>
</tr>
<tr>
<td>2029</td>
<td>722</td>
<td>655</td>
</tr>
<tr>
<td>2030</td>
<td>665</td>
<td>665</td>
</tr>
<tr>
<td>2031</td>
<td>707</td>
<td>707</td>
</tr>
<tr>
<td>2032</td>
<td>650</td>
<td>650</td>
</tr>
<tr>
<td>2033</td>
<td>593</td>
<td>593</td>
</tr>
<tr>
<td>2034</td>
<td>536</td>
<td>536</td>
</tr>
<tr>
<td>2035</td>
<td>479</td>
<td>479</td>
</tr>
<tr>
<td>2036</td>
<td>422</td>
<td>422</td>
</tr>
<tr>
<td>2037</td>
<td>365</td>
<td>365</td>
</tr>
<tr>
<td>2038</td>
<td>308</td>
<td>308</td>
</tr>
<tr>
<td>2039</td>
<td>252</td>
<td>252</td>
</tr>
<tr>
<td>2040</td>
<td>195</td>
<td>195</td>
</tr>
</tbody>
</table>

The sharing of auctions is determined by the share of current emissions in the targeted sectors based on data collected under the Effort Sharing Regulation, as described in the introduction on the policy.

Auctioning

The Commission is proposing to apply emissions trading in new sectors where sharper reductions are needed to reach the 2030 target. Therefore, emissions from fuels used in road transport and buildings will be covered by a new, separate emissions trading system. It will become operational as of 2025, with a cap on emissions set from 2026, based on data collected under the Effort Sharing Regulation. During the first year, fuel suppliers will be required to hold a greenhouse gas emissions permit and to report their emissions for 2024 and 2025. The cap in the new ETS will be reduced annually to yield emissions reductions of 43% in 2030 compared
to 2005. The emission cap is allocated to fuel suppliers as described in the policy introduction.

- As both the building and road transport sectors are under no competitive pressure from outside the Union and are not exposed to a risk of carbon leakage, allowances for buildings and road transport will only be allocated via auctioning without there being any free allocation.\(^5\)
- The Innovation Fund, currently sourced from the existing ETS in 2021-2030, would include 150 million allowances from the ETS 2.
- The total volumes of the auctions described in the section above are distributed based on the emissions from “Fit for 55” Mix scenario data.\(^6\) The data has been evaluated.

Social Climate Fund

The Commission proposes to set up a new Social Climate Fund to address social impacts of emissions trading in road transport and buildings sectors on vulnerable households, micro-enterprises and transport users. Resources from this Fund should correspond to approximately 25% of the expected auction revenues from the new system in 2026-2032.

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\(^6\) [https://energy.ec.europa.eu/excel-files-mix-scenario_en#details](https://energy.ec.europa.eu/excel-files-mix-scenario_en#details)
Table 6 Allocation of ETS2 auctions

<table>
<thead>
<tr>
<th>Year</th>
<th>Auctions prior to MSR adjustment</th>
<th>Auctions after MSR adjustment</th>
<th>Allocation after Innovation fund</th>
<th>0.8%</th>
<th>2.3%</th>
<th>1.8%</th>
<th>8.8%</th>
<th>13.2%</th>
<th>1.9%</th>
<th>8.1%</th>
<th>1.5%</th>
<th>2.1%</th>
<th>0.9%</th>
<th>Central MSR1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2026</td>
<td>1,289</td>
<td>1,289</td>
<td>1,139</td>
<td>9.5</td>
<td>26.4</td>
<td>21.0</td>
<td>100.3</td>
<td>150.8</td>
<td>21.7</td>
<td>92.6</td>
<td>17.3</td>
<td>23.4</td>
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<td>74.2</td>
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<tr>
<td>2027</td>
<td>935</td>
<td>935</td>
<td>785</td>
<td>6.5</td>
<td>18.2</td>
<td>14.5</td>
<td>69.1</td>
<td>103.9</td>
<td>14.9</td>
<td>63.8</td>
<td>11.9</td>
<td>16.1</td>
<td>6.7</td>
<td>85.1</td>
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<td>2028</td>
<td>779</td>
<td>745</td>
<td>595</td>
<td>5.0</td>
<td>13.8</td>
<td>11.0</td>
<td>52.4</td>
<td>78.8</td>
<td>11.3</td>
<td>48.4</td>
<td>9.0</td>
<td>12.2</td>
<td>5.1</td>
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<tr>
<td>2029</td>
<td>722</td>
<td>655</td>
<td>505</td>
<td>4.2</td>
<td>11.7</td>
<td>9.3</td>
<td>44.4</td>
<td>66.9</td>
<td>9.6</td>
<td>41.1</td>
<td>7.7</td>
<td>10.4</td>
<td>4.3</td>
<td>106.0</td>
</tr>
<tr>
<td>2030</td>
<td>665</td>
<td>665</td>
<td>515</td>
<td>4.3</td>
<td>11.9</td>
<td>9.5</td>
<td>45.3</td>
<td>68.2</td>
<td>9.8</td>
<td>41.8</td>
<td>7.8</td>
<td>10.6</td>
<td>4.4</td>
<td>140.2</td>
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<td>152.2</td>
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<tr>
<td>2032</td>
<td>650</td>
<td>650</td>
<td>500</td>
<td>4.2</td>
<td>11.6</td>
<td>9.2</td>
<td>44.0</td>
<td>66.2</td>
<td>9.5</td>
<td>40.7</td>
<td>7.6</td>
<td>10.3</td>
<td>4.3</td>
<td>180.1</td>
</tr>
<tr>
<td>2033</td>
<td>593</td>
<td>593</td>
<td>443</td>
<td>3.7</td>
<td>10.3</td>
<td>8.2</td>
<td>39.0</td>
<td>58.7</td>
<td>8.4</td>
<td>36.0</td>
<td>6.7</td>
<td>9.1</td>
<td>3.8</td>
<td>199.9</td>
</tr>
<tr>
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<td>536</td>
<td>536</td>
<td>386</td>
<td>3.2</td>
<td>9.0</td>
<td>7.1</td>
<td>34.0</td>
<td>51.7</td>
<td>7.4</td>
<td>31.4</td>
<td>5.9</td>
<td>7.9</td>
<td>3.3</td>
<td>224.7</td>
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<tr>
<td>2035</td>
<td>479</td>
<td>479</td>
<td>329</td>
<td>2.7</td>
<td>7.6</td>
<td>6.1</td>
<td>29.0</td>
<td>43.6</td>
<td>6.3</td>
<td>26.8</td>
<td>5.0</td>
<td>6.8</td>
<td>2.8</td>
<td>254.3</td>
</tr>
<tr>
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<td>422</td>
<td>272</td>
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<td>5.0</td>
<td>24.0</td>
<td>36.1</td>
<td>5.2</td>
<td>22.1</td>
<td>4.1</td>
<td>5.6</td>
<td>2.3</td>
<td>278.2</td>
</tr>
<tr>
<td>2037</td>
<td>365</td>
<td>365</td>
<td>215</td>
<td>1.8</td>
<td>5.0</td>
<td>4.0</td>
<td>19.0</td>
<td>28.5</td>
<td>4.1</td>
<td>17.5</td>
<td>3.3</td>
<td>4.4</td>
<td>1.8</td>
<td>305.9</td>
</tr>
<tr>
<td>2038</td>
<td>308</td>
<td>308</td>
<td>158</td>
<td>1.3</td>
<td>3.7</td>
<td>2.9</td>
<td>13.9</td>
<td>21.0</td>
<td>3.0</td>
<td>12.9</td>
<td>2.4</td>
<td>3.2</td>
<td>1.4</td>
<td>337.3</td>
</tr>
<tr>
<td>2039</td>
<td>252</td>
<td>252</td>
<td>102</td>
<td>0.8</td>
<td>2.4</td>
<td>1.9</td>
<td>8.9</td>
<td>13.4</td>
<td>1.9</td>
<td>8.3</td>
<td>1.5</td>
<td>2.1</td>
<td>0.9</td>
<td>372.4</td>
</tr>
<tr>
<td>2040</td>
<td>195</td>
<td>195</td>
<td>45</td>
<td>0.4</td>
<td>1.0</td>
<td>0.8</td>
<td>3.9</td>
<td>5.9</td>
<td>0.8</td>
<td>3.6</td>
<td>0.7</td>
<td>0.9</td>
<td>0.4</td>
<td>344.3</td>
</tr>
</tbody>
</table>
4. RESULTS AND CONCLUSIONS

The energy costs for low-income groups in all countries which ban new fossil fuel boilers do not seem to change substantially and neither for the ETS2 as a standalone measure. Through the combination of measures, the relative energy costs (in comparison to the baseline) remain constant or decrease over time as a result of the combination of lower energy consumption and higher energy prices for these policy scenarios. However, it must be taken into consideration that this assumption is rather conservative for low-income households. The conclusion comes from the research on the specific price elasticities of low-income households.

Due to lack of data on low-income groups’ elasticities, we have used the average elasticities. However, research shows that there is “heterogeneity in households’ reactions to energy price fluctuations. ... Such high sensitivity, equivalent to the capacity of a household to handle problematic situations – such as an increase in prices – to satisfy its energy needs, is supported by high income level. We stress that, in our sample, the set of fuel-poor households that have higher elasticity do not necessarily correspond to low-income households, because only one-third of them are income-poor”.7 This research means that the energy poor have high elasticities only if they are not income poor, which is not the case for our analysed groups. Other streams of research also show that “increases in carbon taxes can increase... the existing level of poverty”.8 As such, the households living in inadequate conditions would respond very strongly to the price signal, unless they are in the low-income group, which is our case. This is supported by the research on investments which shows that the vulnerable households, use higher discount rate in comparison to the average households due to their use of the discounting gap, meaning that they prefer short term solutions. This also means that is very hard for vulnerable households to escape poverty because they do not always have the possibility to engage in actions that are sustainable in long term. 9

This would mean that the average response to price rise due to ETS2 introduction is a conservative assumption and does not include investments from the side of the household that would be needed to react to price changes such as fuel switches or increased energy efficiency. If savings in energy expenditure would not originate from the above-mentioned fuel switch and energy efficiency, they must come from lower energy consumption. Taking into consideration that the target group is low-income, although part of the energy savings could be a result of behavioural energy efficiency measures, most would be caused by simple reductions of energy consumption by reducing comfort,

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causing economic and social stress. This would shift more low-income households into a state of vulnerability, thus influencing arrears, lower comfortability levels (ability to keep warm) and consequentially resulting in reduced health and social statuses of the household. In other words, the response to the increase of the energy costs due to the ETS2 would not be a structural effect, but rather a short to medium-term response that cannot be considered an energy efficiency improvement. The main problem hindering a structural change (through energy upgrades of buildings or heating installations) is the difficulty in the upfront financing of costs for such systems by low-income groups, if proper compensation mechanisms are not present.

The introduction of MEPS and scenarios including MEPS with other policies shows a steep fall of energy consumption and positively influences the condition of the dwellings occupants live in. This is mostly the result of the establishment of MEPS achieving energy class E in existing buildings for 2035, most of the affected households belong to low-income groups, therefore most (75% in our assumption) would be targeted with the measure that results in energy savings.

When looking into results of policies for low-income households, the medium-long run expenditure side decreases, the comfort level improves, and higher disposable income results. This is of course the case if the introduced measure does not directly influence the energy costs of households, which is only possible if the policy instruments alleviate the cost increase that are introduced (this is further explored in WS3). As a basis, policies should aim at financing both the upfront costs for installing the heating equipment or upgrading the buildings, but also the increased energy costs in the form of social policies (similar to incumbent short-term measures for the increased costs during the current energy price crisis).

The analysis of auctions of ETS allowances shows the allocations aligned with the current ESR emissions of specific countries. Countries have different fuel mixes in their heating sector, signifying that the auctioned allowances introduced would proportionally assist them in targeting the energy transition in all sectors, including households. However, there is no relation between the heating energy mix and the level of energy poverty, therefore the methodology used in the Social Climate Fund to assist the countries with disproportionally high energy poverty levels is utterly important. Details of these allocations and how countries would use them are described in WS3.
5. ANNEX – RESULTS FOR MEMBER STATES

5.1 BULGARIA

5.1.1 Determination of baseline

**Step 1:** Estimation of the unitary final energy consumption for different end-uses of the average household in Bulgaria according to the data about the disaggregated final energy consumption of households (*data: Eurostat*).

*Table 7 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>9336</td>
</tr>
<tr>
<td>Space heating</td>
<td>4863</td>
</tr>
<tr>
<td>Space cooling</td>
<td>44</td>
</tr>
<tr>
<td>DHW</td>
<td>1695</td>
</tr>
<tr>
<td>Cooking</td>
<td>800</td>
</tr>
<tr>
<td>Other</td>
<td>1934</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of the reduced energy expenses of the households, which belong to the lowest income decile compared with the energy expenses of the average households (*data: HBS*).

*Table 8 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>18%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>100%</td>
</tr>
<tr>
<td>Oil</td>
<td>18%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>55%</td>
</tr>
<tr>
<td>District heat</td>
<td>84%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
<tr>
<td>Biomass</td>
<td>-5%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of the unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration the reduced energy expenses as estimated in Step 2.
**Step 4:** Calculation of the unitary final energy consumption of households, which belong to the lowest income decile, for the different consumed energy carriers taking into consideration the reduced energy expenses as estimated in the Step 2.

**Table 9 Energy consumption of low-income household**

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>7084</td>
</tr>
<tr>
<td>Space heating</td>
<td>3776</td>
</tr>
<tr>
<td>Space cooling</td>
<td>37</td>
</tr>
<tr>
<td>DHW</td>
<td>1020</td>
</tr>
<tr>
<td>Cooking</td>
<td>661</td>
</tr>
<tr>
<td>Other</td>
<td>1589</td>
</tr>
</tbody>
</table>

**Step 5:** Identification of the utilised means of heating and cooking for the case of households, which belong to the lowest income decile (*data: HBS*).

No change

**Step 6:** Modelling each different end-use separately for quantifying the consumed energy carriers.

Number of low-income households (dwellings): **188,581**

**Table 10 Energy consumption of low-income household distributed by fuels**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>7084</td>
</tr>
<tr>
<td>Electricity</td>
<td>3312</td>
</tr>
<tr>
<td>Natural gas</td>
<td>0</td>
</tr>
<tr>
<td>Oil</td>
<td>70</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>200</td>
</tr>
<tr>
<td>District heat</td>
<td>215</td>
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<tr>
<td>Solar thermal</td>
<td>47</td>
</tr>
<tr>
<td>Biomass</td>
<td>3239</td>
</tr>
</tbody>
</table>

**Table 11 Final energy consumption in low-income households**

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>625</td>
<td>71</td>
<td>7</td>
<td>153</td>
<td>93</td>
<td>300</td>
</tr>
<tr>
<td>Heating oil</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>LPG</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>611</td>
<td>579</td>
<td>13</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>District heating</td>
<td>41</td>
<td>24</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Final energy consumption (GWh)

<table>
<thead>
<tr>
<th>Energy Carrier</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal and other</td>
<td>38</td>
<td>37</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1336</td>
<td>712</td>
<td>7</td>
<td>192</td>
<td>125</td>
<td>300</td>
</tr>
</tbody>
</table>

**Step 7**: Validation and adjustment of the obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and the identified energy expenses (Step 2).

Cost deviation equal to **-13%** assuming the following prices:

*Table 12 Utilised energy prices in Bulgaria*

<table>
<thead>
<tr>
<th>Energy Carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
</tr>
<tr>
<td>Electricity</td>
<td>98</td>
</tr>
<tr>
<td>Natural gas</td>
<td>38</td>
</tr>
<tr>
<td>Biomass</td>
<td>28</td>
</tr>
<tr>
<td>District heating</td>
<td>51</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>160</td>
</tr>
<tr>
<td>Coal and other</td>
<td>50</td>
</tr>
</tbody>
</table>
5.1.2 Modelling the impacts of the examined policies in Bulgaria

Elasticities of demand
Electricity: -0.55 and heating: -0.50.

Baseline scenario

ASSUMPTIONS: No implementation of additional policies.
The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account.

Energy prices

Table 13 Energy prices in the baseline scenario for Bulgaria

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
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Final energy consumption (GWh)

Table 14 Final energy consumption in baseline scenario in Bulgaria

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<th>2025</th>
<th>2030</th>
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<td>1</td>
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<td><strong>197</strong></td>
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<td><strong>192</strong></td>
<td><strong>188</strong></td>
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</table>

**Total energy costs (million €)**

*Table 15 Total energy costs in baseline scenario in Bulgaria*

<table>
<thead>
<tr>
<th>Source of Energy</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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<th>2040</th>
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<tr>
<td>Heating oil</td>
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Scenario 1

ASSUMPTIONS: Scenario 1 was considered for the projection of ETS2 price.

Energy prices

Table 16 Energy prices in the Scenario 1 for Bulgaria

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<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
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Final energy consumption (GWh)

Table 17 Final energy consumption in Scenario 1 in Bulgaria

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<th>Space heating</th>
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<th>2030</th>
<th>2035</th>
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<tr>
<td>Ambient heat</td>
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<td>0</td>
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<td>0</td>
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<td>Coal and other</td>
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<th>2035</th>
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<td>0</td>
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<tr>
<td>Ambient heat</td>
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<td>0</td>
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</tr>
<tr>
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<th>Space heating, cooling and DHW</th>
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</table>
### Total energy costs (million €)

**Table 18 Total energy costs in Scenario 1 in Bulgaria**

<table>
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<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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</thead>
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<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Natural gas</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
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<td>610</td>
<td>610</td>
<td>610</td>
<td>610</td>
<td>610</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
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<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>District heating</td>
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<td>42</td>
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</tr>
<tr>
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<td>236</td>
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<td>229</td>
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<td>Coal and other</td>
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<td>894</td>
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Total energy costs in Scenario 1 in Bulgaria.
Scenario 2

ASSUMPTIONS: MANDATORY PHASE-OUT OF HEATING OIL AND SOLID FOSSIL FUELS IN 2030 AND NATURAL GAS (INCLUDING LNG) IN 2040.

IT WAS CONSIDERED THAT THE ACTUAL PHASE-OUT WILL HAVE OCCURRED AFTER FIVE YEARS (HEATING OIL AND SOLID FOSSIL FUELS IN 2035 AND NATURAL GAS AND LNG IN 2045), AND HEAT PUMPS WILL REPLACE THE EXISTING HEATING SYSTEMS.

Energy prices

Table 19 Energy prices in the Scenario 2 for Bulgaria

<table>
<thead>
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<th>2019</th>
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<th>2030</th>
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<th>2045</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
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<td>150</td>
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<td>Natural gas</td>
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</table>

Final energy consumption (GWh)

Table 20 Final energy consumption in Scenario 2 in Bulgaria

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<table>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>0</td>
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<td>0</td>
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### Table 21 Total energy costs in Scenario 2 in Bulgaria

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<th>Space heating, cooling and DHW</th>
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<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>Natural gas</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>LPG</td>
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<td>610</td>
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### Table 22 Investments foreseen in Scenario 2 in Bulgaria

<table>
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<tr>
<th>Investments (million €)</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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</table>
Scenario 3

ASSUMPTIONS: ESTABLISHMENT OF MEPS FOR ACHIEVING ENERGY CLASS C IN 2035.

50% OF AFFECTED HOUSEHOLDS (75% OF TOTAL LOW-INCOME HOUSEHOLDS) WILL RENOVATE THEIR BUILDINGS UNTIL 2030 (71 THOUSAND BUILDINGS) AND REMAIN UNTIL 2035 (71 THOUSAND BUILDINGS).

ASSUMPTIONS FOR BUILDINGS’ ENERGY UPGRADE: RENOVATION COST: 25 THOUSAND €/DWELLING AND DELIVERED FINAL ENERGY SAVINGS: 50%.

Energy prices

*Table 23 Energy prices in the Scenario 3 for Bulgaria*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>133</td>
<td>150</td>
<td>167</td>
<td>183</td>
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<tr>
<td>Natural gas</td>
<td>38</td>
<td>49</td>
<td>61</td>
<td>72</td>
<td>84</td>
<td>87</td>
<td>91</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>50</td>
<td>55</td>
<td>60</td>
<td>64</td>
<td>67</td>
<td>71</td>
<td>74</td>
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<tr>
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<td>99</td>
<td>100</td>
<td>103</td>
<td>106</td>
<td>110</td>
<td>114</td>
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<tr>
<td>LPG</td>
<td>160</td>
<td>187</td>
<td>213</td>
<td>240</td>
<td>267</td>
<td>293</td>
<td>320</td>
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</tbody>
</table>

Final energy consumption (GWh)

*Table 24 Final energy consumption in Scenario 3 in Bulgaria*

<table>
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<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<th>2045</th>
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</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
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<td>------</td>
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</tr>
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**Scenario 4**

**ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3**

**Energy prices**

*Table 27 Energy prices in the Scenario 4 for Bulgaria*

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<th>Energy prices (€/MWh)</th>
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<th>2035</th>
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<th>2045</th>
<th>2050</th>
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<td>72</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>67</td>
<td>71</td>
<td>74</td>
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**Final energy consumption (GWh)**

*Table 28 Final energy consumption in Scenario 4 in Bulgaria*

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### Total energy costs (million €)

**Table 29 Total energy costs in Scenario 4 in Bulgaria**

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### Investments foreseen in Scenario 4 in Bulgaria

**Table 30 Investments foreseen in Scenario 4 in Bulgaria**

<table>
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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

Table 31 Energy prices in the Scenario 5 for Bulgaria

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Final energy consumption (GWh)

Table 32 Final energy consumption in Scenario 5 in Bulgaria

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<tr>
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<td>597</td>
<td>485</td>
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<td>394</td>
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### Total energy costs (million €)

**Table 33 Total energy costs in Scenario 5 in Bulgaria**

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**Table 34 Investments foreseen in Scenario 5 in Bulgaria**

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<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
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<td>1768</td>
<td>1828</td>
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</table>
Synopsis

Comparison of final energy consumption

Figure 9 Comparison of final energy consumption between scenarios in Bulgaria

Comparison of investments in different scenarios

Figure 10 Investments in different scenarios in Bulgaria

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>2040</td>
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<td>Heat pumps</td>
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<tr>
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<td>1828</td>
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<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Investments (million €)</td>
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<td>2030</td>
<td>2035</td>
<td>2040</td>
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<td>2050</td>
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<tr>
<td></td>
<td>Heat pumps</td>
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<tr>
<td></td>
<td>Total</td>
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<td>1768</td>
<td>1828</td>
<td>0</td>
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</tr>
</tbody>
</table>
Comparison of the total energy costs

Figure 11 Comparison of final energy costs between scenarios in Bulgaria
5.2 CZECHIA

5.2.1 Determination of baseline

**Step 1:** Estimation of the unitary final energy consumption for different end-uses of the average household in Czechia according to the data about the disaggregated final energy consumption of households (data: Eurostat).

*Table 35 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>17138</td>
</tr>
<tr>
<td>Space heating</td>
<td>11814</td>
</tr>
<tr>
<td>Space cooling</td>
<td>14</td>
</tr>
<tr>
<td>DHW</td>
<td>2859</td>
</tr>
<tr>
<td>Cooking</td>
<td>1045</td>
</tr>
<tr>
<td>Other</td>
<td>1406</td>
</tr>
</tbody>
</table>

**Energy carrier**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>17138</td>
</tr>
<tr>
<td>Electricity</td>
<td>3163</td>
</tr>
<tr>
<td>Natural gas</td>
<td>4329</td>
</tr>
<tr>
<td>Oil</td>
<td>108</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>1907</td>
</tr>
<tr>
<td>District heat</td>
<td>2342</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>35</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>391</td>
</tr>
<tr>
<td>Biomass</td>
<td>4863</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of the reduced energy expenses of households, which belong to the lowest income decile compared with the energy expenses of the average households (data: HBS).

*Table 36 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>25%</td>
</tr>
<tr>
<td>Oil</td>
<td>80%</td>
</tr>
<tr>
<td>LPG</td>
<td>80%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>28%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
<tr>
<td>Biomass</td>
<td>26%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>25%</td>
</tr>
<tr>
<td>District heat</td>
<td>16%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>26%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of the unitary final energy consumption of the households, which belong to the lowest income group, for different end-uses taking into consideration the reduced energy expenses as estimated in Step 2.

*Table 37 Energy consumption of low-income households*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>12856</td>
</tr>
<tr>
<td>Space heating</td>
<td>8829</td>
</tr>
</tbody>
</table>
Step 4: Calculation of the unitary final energy consumption of the households, which belong to the lowest income decile, for the different consumed energy carriers taking into consideration the reduced energy expenses as estimated in Step 2.

Table 38 Energy consumption of low-income households distributed by fuels

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>12856</td>
</tr>
<tr>
<td>Electricity</td>
<td>2385</td>
</tr>
<tr>
<td>Natural gas</td>
<td>3138</td>
</tr>
<tr>
<td>Oil</td>
<td>22</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>1413</td>
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<tr>
<td>District heat</td>
<td>1966</td>
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<tr>
<td>Solar thermal</td>
<td>35</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>295</td>
</tr>
<tr>
<td>Biomass</td>
<td>3603</td>
</tr>
</tbody>
</table>

Step 5: Identification of the utilised means of heating and cooking for the case of households, which belong to the lowest income decile and assessment of additional data (data: HBS).

Adjustments have been made by the involved country expert.

Step 6: Modelling each different end-use separately for quantifying the consumed energy carriers.

Number of low-income households (dwellings): 890,668

Table 39 Final energy consumption in low-income households

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>2124</td>
<td>400</td>
<td>10</td>
<td>466</td>
<td>333</td>
<td>915</td>
</tr>
<tr>
<td>LPG</td>
<td>19</td>
<td>15</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>2795</td>
<td>1835</td>
<td>638</td>
<td>322</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar thermal</td>
<td>15</td>
<td>0</td>
<td>11</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>263</td>
<td>162</td>
<td>90</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>3209</td>
<td>3044</td>
<td>133</td>
<td>17</td>
<td>15</td>
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</tr>
<tr>
<td>District heating</td>
<td>1751</td>
<td>1181</td>
<td>570</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Coal and other</td>
<td>1259</td>
<td>1222</td>
<td>35</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11435</td>
<td>7859</td>
<td>1943</td>
<td>677</td>
<td>945</td>
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</tr>
</tbody>
</table>
**Step 7**: Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of the households for different end-uses (Step 3) and energy carriers (Step 4) and the identified energy expenses (Step 2).

Cost deviation equal to **+78%** assuming the following prices:

*Table 40 Utilised energy prices in Czechia*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>190</td>
</tr>
<tr>
<td>Natural gas</td>
<td>55</td>
</tr>
<tr>
<td>Biomass</td>
<td>40</td>
</tr>
<tr>
<td>District heating</td>
<td>64</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>150</td>
</tr>
<tr>
<td>Coal and other</td>
<td>10</td>
</tr>
</tbody>
</table>
5.2.2 Modelling the impacts of the examined policies in Czechia

Elasticities of demand
Electricity: -0.55 and heating: -0.50.

Baseline scenario

ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.
THE FORESEEN INCREASES OF ENERGY PRICES WITHIN THE FRAMEWORK OF THE EU REFERENCE SCENARIO 2020 WERE TAKEN INTO ACCOUNT.

Energy prices

Table 41 Energy prices in the baseline scenario for Czechia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>133</td>
<td>150</td>
<td>167</td>
<td>183</td>
<td>200</td>
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<tr>
<td>Natural gas</td>
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<td>72</td>
<td>88</td>
<td>105</td>
<td>121</td>
<td>127</td>
<td>132</td>
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<tr>
<td>Solid fossil fuels</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Electricity</td>
<td>190</td>
<td>191</td>
<td>192</td>
<td>197</td>
<td>203</td>
<td>214</td>
<td>225</td>
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<tr>
<td>LPG</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>225</td>
<td>250</td>
<td>275</td>
<td>300</td>
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</table>

Final energy consumption (GWh)

Table 42 Final energy consumption in baseline scenario in Czechia

<table>
<thead>
<tr>
<th>Space heating</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
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<td>0</td>
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<td>1078</td>
<td>1049</td>
<td>1023</td>
<td>999</td>
</tr>
<tr>
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<td>1108</td>
<td>1078</td>
<td>1049</td>
<td>1023</td>
<td>999</td>
</tr>
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<td>463</td>
<td>456</td>
<td>449</td>
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<td>435</td>
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</tr>
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<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>District heating</td>
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<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
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</tr>
<tr>
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<td>0</td>
<td>0</td>
</tr>
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<td>Biomass</td>
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<td>133</td>
<td>133</td>
<td>133</td>
<td>133</td>
<td>133</td>
</tr>
<tr>
<td>Coal and other</td>
<td>35</td>
<td>33</td>
<td>32</td>
<td>31</td>
<td>30</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>1943</td>
<td>1845</td>
<td>1779</td>
<td>1726</td>
<td>1684</td>
<td>1661</td>
<td>1640</td>
</tr>
<tr>
<td><strong>Space heating, cooling and DHW</strong></td>
<td><strong>2019</strong></td>
<td><strong>2025</strong></td>
<td><strong>2030</strong></td>
<td><strong>2035</strong></td>
<td><strong>2040</strong></td>
<td><strong>2045</strong></td>
<td><strong>2050</strong></td>
</tr>
<tr>
<td>Heating oil</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2473</td>
<td>2102</td>
<td>1860</td>
<td>1685</td>
<td>1552</td>
<td>1517</td>
<td>1484</td>
</tr>
<tr>
<td>LPG</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Biomass</td>
<td>3177</td>
<td>3177</td>
<td>3177</td>
<td>3177</td>
<td>3177</td>
<td>3177</td>
<td>3177</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>251</td>
<td>251</td>
<td>251</td>
<td>248</td>
<td>246</td>
<td>241</td>
<td>237</td>
</tr>
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**Total energy costs (million €)**

*Table 43 Total energy costs in baseline scenario in Czechia*
Scenario 1

ASSUMPTIONS: Scenario 1 was considered for the projection of ETS2 price.

Energy prices

Table 44 Energy prices in the Scenario 1 for Czechia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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Final energy consumption (GWh)

Table 45 Final energy consumption in Scenario 1 in Czechia

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<th>2030</th>
<th>2035</th>
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**Total energy costs (million €)**

*Table 46 Total energy costs in Scenario 1 in Czechia*
Scenario 2

Assumptions: Mandatory phase-out of heating oil and solid fossil fuels in 2030 and natural gas (including LNG) in 2040.
It was considered that the actual phase-out will have occurred after five years (heating oil and solid fossil fuels in 2035 and natural gas and LNG in 2045), and heat pumps will replace the existing heating systems.

Energy prices

Table 47 Energy prices in the Scenario 2 for Czechia

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<th>Energy prices (€/MWh)</th>
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<th>2040</th>
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<td>133</td>
<td>150</td>
<td>167</td>
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<td>225</td>
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Final energy consumption (GWh)

Table 48 Final energy consumption in Scenario 2 in Czechia

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<th>2030</th>
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### Table 49 Total energy costs in Scenario 2 in Czechia

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<td><strong>Total</strong></td>
<td>9812</td>
<td>9374</td>
<td>9074</td>
<td>8036</td>
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<td>7532</td>
<td>7463</td>
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</table>

### Table 50 Investments foreseen in Scenario 2 in Czechia

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
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<td>0</td>
<td>1079</td>
<td>0</td>
<td>1315</td>
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</tbody>
</table>
Scenario 3

Assumptions: Establishment of MEPS for achieving energy class E in 2035.

50% of the affected households (75% of the total low-income households) will renovate their buildings until 2030 (334 thousand buildings) and remain until 2035 (334 thousand buildings).

Assumptions for buildings’ energy upgrade: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all the building will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 51 Energy prices in the Scenario 3 for Czechia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>133</td>
<td>150</td>
<td>167</td>
<td>183</td>
<td>200</td>
</tr>
<tr>
<td>Natural gas</td>
<td>55</td>
<td>72</td>
<td>88</td>
<td>105</td>
<td>121</td>
<td>127</td>
<td>132</td>
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<tr>
<td>Solid fossil fuels</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Electricity</td>
<td>190</td>
<td>191</td>
<td>192</td>
<td>197</td>
<td>203</td>
<td>214</td>
<td>225</td>
</tr>
<tr>
<td>LPG</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>225</td>
<td>250</td>
<td>275</td>
<td>300</td>
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</table>

Final energy consumption (GWh)

Table 52 Final energy consumption in Scenario 3 in Czechia

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>1835</td>
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<td>1225</td>
<td>985</td>
<td>839</td>
<td>820</td>
<td>802</td>
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<tr>
<td>LPG</td>
<td>15</td>
<td>14</td>
<td>12</td>
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<td>3044</td>
<td>2702</td>
<td>2398</td>
<td>2218</td>
<td>2218</td>
<td>2218</td>
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<tr>
<td>Ambient heat</td>
<td>162</td>
<td>161</td>
<td>143</td>
<td>125</td>
<td>114</td>
<td>110</td>
<td>107</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>1181</td>
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<td>860</td>
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<td>273</td>
<td>265</td>
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<td>984</td>
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<td>7</td>
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<table>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>463</td>
<td>456</td>
<td>449</td>
<td>436</td>
<td>424</td>
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<td>542</td>
<td>480</td>
<td>435</td>
<td>400</td>
<td>391</td>
<td>383</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
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<tr>
<td></td>
<td>LPG</td>
<td>Biomass</td>
<td>Coal and other</td>
<td>Ambient heat</td>
<td>Solar thermal</td>
<td>Total</td>
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**Space heating cooling and DHW**

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<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>10</td>
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<td>8</td>
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<td>3177</td>
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<td>232</td>
<td>214</td>
<td>203</td>
<td>200</td>
<td>197</td>
</tr>
<tr>
<td>Solar thermal</td>
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<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
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<td>775</td>
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<td>6702</td>
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</table>

**Total energy costs (million €)**

*Table 53 Total energy costs in Scenario 3 in Czechia*

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>136</td>
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<td>150</td>
<td>148</td>
<td>150</td>
<td>153</td>
<td>156</td>
</tr>
<tr>
<td>LPG</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Biomass</td>
<td>127</td>
<td>127</td>
<td>113</td>
<td>101</td>
<td>94</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>103</td>
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<td>91</td>
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<td>167</td>
<td>158</td>
<td>152</td>
<td>150</td>
<td>153</td>
<td>156</td>
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<tr>
<td>Coal and other</td>
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<td>13</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
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<tr>
<td>Total</td>
<td>556</td>
<td>571</td>
<td>539</td>
<td>511</td>
<td>497</td>
<td>504</td>
<td>511</td>
</tr>
</tbody>
</table>

*Table 54 Investments foreseen in Scenario 3 in Czechia*

<table>
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<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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Scenario 4

ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3

Energy prices

Table 55 Energy prices in the Scenario 4 for Czechia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>133</td>
<td>150</td>
<td>167</td>
<td>183</td>
<td>200</td>
</tr>
<tr>
<td>Natural gas</td>
<td>55</td>
<td>72</td>
<td>88</td>
<td>105</td>
<td>121</td>
<td>127</td>
<td>132</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>15</td>
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<td>203</td>
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<td>225</td>
</tr>
<tr>
<td>LPG</td>
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<td>175</td>
<td>200</td>
<td>225</td>
<td>250</td>
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</table>

Final energy consumption (GWh)

Table 56 Final energy consumption in Scenario 4 in Czechia

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Natural gas</td>
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<td>LPG</td>
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<td>12</td>
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<td>7</td>
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<td>2030</td>
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<td>2040</td>
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<td>480</td>
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</tr>
<tr>
<td>Ambient heat</td>
<td>90</td>
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<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
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<tr>
<td>Solar thermal</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>1943</td>
<td>1845</td>
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<td>1663</td>
<td>1601</td>
<td>1579</td>
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<tr>
<td>Space heating, cooling and DHW</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
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<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2473</td>
<td>2102</td>
<td>1704</td>
<td>1420</td>
<td>1240</td>
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</table>
### Total energy costs (million €)

**Table 57 Total energy costs in Scenario 4 in Czechia**

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Natural gas</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<td>Biomass</td>
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<td>113</td>
<td>101</td>
<td>94</td>
<td>94</td>
<td>94</td>
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<td>Ambient heat</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>111</td>
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<td>103</td>
<td>95</td>
<td>91</td>
<td>91</td>
<td>91</td>
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<td>Electricity</td>
<td>166</td>
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<td>158</td>
<td>156</td>
<td>153</td>
<td>261</td>
<td>267</td>
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<tr>
<td>Coal and other</td>
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<td>13</td>
<td>12</td>
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<td>0</td>
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<tr>
<td><strong>Total</strong></td>
<td>556</td>
<td>571</td>
<td>539</td>
<td>503</td>
<td>490</td>
<td>446</td>
<td>452</td>
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</table>

**Table 58 Investments foreseen in Scenario 4 in Czechia**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
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<tr>
<td><strong>Total</strong></td>
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<td>4419</td>
<td>3340</td>
<td>1343</td>
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Scenario 5

Assumptions: Combination of Scenarios 1, 2 and 3.

Energy prices

Table 59 Energy prices in the Scenario 5 for Czechia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>139</td>
<td>164</td>
<td>189</td>
<td>230</td>
<td>271</td>
</tr>
<tr>
<td>Natural gas</td>
<td>55</td>
<td>72</td>
<td>92</td>
<td>115</td>
<td>138</td>
<td>162</td>
<td>186</td>
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<tr>
<td>Solid fossil fuels</td>
<td>10</td>
<td>11</td>
<td>19</td>
<td>32</td>
<td>44</td>
<td>78</td>
<td>111</td>
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<tr>
<td>Electricity</td>
<td>190</td>
<td>191</td>
<td>192</td>
<td>197</td>
<td>203</td>
<td>214</td>
<td>225</td>
</tr>
<tr>
<td>LPG</td>
<td>150</td>
<td>175</td>
<td>205</td>
<td>239</td>
<td>272</td>
<td>322</td>
<td>371</td>
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</table>

Final energy consumption (GWh)

Table 60 Final energy consumption in Scenario 5 in Czechia

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>1835</td>
<td>1560</td>
<td>1185</td>
<td>920</td>
<td>766</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>15</td>
<td>14</td>
<td>11</td>
<td>9</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>3044</td>
<td>3044</td>
<td>2702</td>
<td>2398</td>
<td>2218</td>
<td>2218</td>
<td>2218</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>162</td>
<td>161</td>
<td>143</td>
<td>165</td>
<td>150</td>
<td>546</td>
<td>531</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>1181</td>
<td>1181</td>
<td>1048</td>
<td>930</td>
<td>860</td>
<td>860</td>
<td>860</td>
</tr>
<tr>
<td>Electricity</td>
<td>400</td>
<td>399</td>
<td>353</td>
<td>221</td>
<td>202</td>
<td>322</td>
<td>313</td>
</tr>
<tr>
<td>Coal and other</td>
<td>1222</td>
<td>1161</td>
<td>644</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>7859</td>
<td>7520</td>
<td>6086</td>
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<td>4204</td>
<td>3946</td>
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</table>

<table>
<thead>
<tr>
<th>Space cooling</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
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<td>Total</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Domestic hot water (DHW)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
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<td>466</td>
<td>465</td>
<td>463</td>
<td>460</td>
<td>453</td>
<td>453</td>
<td>720</td>
</tr>
<tr>
<td>Natural gas</td>
<td>638</td>
<td>542</td>
<td>464</td>
<td>406</td>
<td>366</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
<td>570</td>
</tr>
<tr>
<td>LPG</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>133</td>
<td>133</td>
<td>133</td>
<td>133</td>
<td>133</td>
<td>133</td>
<td>133</td>
</tr>
<tr>
<td>Coal and other</td>
<td>35</td>
<td>33</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
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<td>90</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
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<td>1943</td>
<td>1845</td>
<td>1753</td>
<td>1671</td>
<td>1623</td>
<td>1545</td>
<td>1524</td>
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</table>

Space heating, cooling and DHW | 2019  | 2025  | 2030  | 2035  | 2040  | 2045  | 2050  |
<table>
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<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
</tbody>
</table>
### Total energy costs (million €)

**Table 61 Total energy costs in Scenario 5 in Czechia**

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2473</td>
<td>2102</td>
<td>1650</td>
<td>1327</td>
<td>1132</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>15</td>
<td>14</td>
<td>11</td>
<td>9</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
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<td>3177</td>
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<td>2531</td>
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<td>2351</td>
<td>2351</td>
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<tr>
<td>Ambient heat</td>
<td>251</td>
<td>251</td>
<td>232</td>
<td>254</td>
<td>240</td>
<td>636</td>
<td>621</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>11</td>
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<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
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<td>1431</td>
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<td>1195</td>
<td>665</td>
<td>0</td>
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<td>9374</td>
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<td>6322</td>
<td>5834</td>
<td>5498</td>
<td>5453</td>
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</tbody>
</table>

### Investments foreseen in Scenario 5 in Czechia

**Table 62 Investments foreseen in Scenario 5 in Czechia**

<table>
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<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>546</td>
<td>0</td>
<td>1221</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>3340</td>
<td>3340</td>
<td>3340</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>3340</td>
<td>3886</td>
<td>3340</td>
<td>1221</td>
<td>0</td>
</tr>
</tbody>
</table>
**Synopsis**

**Comparison of final energy consumption**

![Comparison of final energy consumption between scenarios in Czechia](image)

**Figure 12 Comparison of final energy consumption between scenarios in Czechia**

**Comparison of investments in different scenarios**

![Investments in different scenarios in Czechia in Czechia](image)

**Figure 13 Investments in different scenarios in Czechia in Czechia**

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1079</td>
<td>0</td>
<td>1315</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
<td></td>
</tr>
<tr>
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<td>0</td>
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<td>Investments (million €)</td>
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<td>2045</td>
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<td>0</td>
<td>1343</td>
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</tr>
<tr>
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<tr>
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<td>1221</td>
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</tr>
<tr>
<td>Building envelope</td>
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<td>3340</td>
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<td>0</td>
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<td>3886</td>
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<tr>
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<td>546</td>
<td>0</td>
<td>1221</td>
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</tr>
<tr>
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<td>3340</td>
<td>3340</td>
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</tr>
<tr>
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<td>3886</td>
<td>3340</td>
<td>1221</td>
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</tr>
</tbody>
</table>
Comparison of the total energy costs

Figure 14 Comparison of final energy costs between scenarios in Czechia
5.3 GREECE

5.3.1 Determination of baseline

**Step 1:** Estimation of unitary final energy consumption for different end-uses of the average household in Greece according to the data about the disaggregated final energy consumption of households (*data: Eurostat*).

*Table 63 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>10640</td>
</tr>
<tr>
<td>Space heating</td>
<td>5965</td>
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<tr>
<td>Space cooling</td>
<td>529</td>
</tr>
<tr>
<td>DHW</td>
<td>1428</td>
</tr>
<tr>
<td>Cooking</td>
<td>663</td>
</tr>
<tr>
<td>Other</td>
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</tr>
</tbody>
</table>

**Step 2:** Calculation of reduced energy expenses of the households, which belong to the lowest income decile compared with energy expenses of the average household (*data: HBS*).

*Table 64 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>26%</td>
</tr>
<tr>
<td>Oil</td>
<td>56%</td>
</tr>
<tr>
<td>LPG</td>
<td>56%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>57%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
<tr>
<td>Biomass</td>
<td>20%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>26%</td>
</tr>
<tr>
<td>District heat</td>
<td>53%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration the reduced energy expenses as estimated in Step 2.
**Table 65 Energy consumption of low-income households**

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>6913</td>
</tr>
<tr>
<td>Space heating</td>
<td>3312</td>
</tr>
<tr>
<td>Space cooling</td>
<td>393</td>
</tr>
<tr>
<td>DHW</td>
<td>1190</td>
</tr>
<tr>
<td>Cooking</td>
<td>489</td>
</tr>
<tr>
<td>Other</td>
<td>1528</td>
</tr>
</tbody>
</table>

**Step 4:** Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for the different consumed energy carriers taking into consideration the reduced energy expenses as estimated in Step 2.

**Table 66 Energy consumption of low-income households distributed by fuels**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>6913</td>
</tr>
<tr>
<td>Electricity</td>
<td>2903</td>
</tr>
<tr>
<td>Oil</td>
<td>1228</td>
</tr>
<tr>
<td>LPG</td>
<td>92</td>
</tr>
<tr>
<td>Natural gas</td>
<td>433</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>716</td>
</tr>
<tr>
<td>Biomass</td>
<td>1323</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>141</td>
</tr>
<tr>
<td>District heat</td>
<td>65</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>12</td>
</tr>
</tbody>
</table>

**Step 5:** Identification of utilised means of heating and cooking for the case of households which belong to the lowest income decile (*data: HBS*).

No change

**Step 6:** Modelling each different end-use separately for quantifying the consumed energy carriers.

Number of low-income households (dwellings): **503,841**

**Table 67 Final energy consumption in low-income households**

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>1463</td>
<td>70</td>
<td>198</td>
<td>218</td>
<td>207</td>
<td>770</td>
</tr>
<tr>
<td>Heating oil</td>
<td>619</td>
<td>592</td>
<td></td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>46</td>
<td>42</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>218</td>
<td>210</td>
<td></td>
<td>6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Solar thermal</td>
<td>361</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td>347</td>
</tr>
</tbody>
</table>
**Final energy consumption (GWh)**  

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>667</td>
<td>633</td>
<td></td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>71</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District heating</td>
<td>33</td>
<td>31</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal and other</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3483</td>
<td>1669</td>
<td>198</td>
<td>600</td>
<td>246</td>
<td>770</td>
</tr>
</tbody>
</table>

**Step 7**: Validation and adjustment of the obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and identified energy expenses (Step 2).

Cost deviation equal to **-4%** assuming the following prices:

*Table 68 Utilised energy prices in Greece*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>178</td>
</tr>
<tr>
<td>Heating oil</td>
<td>115</td>
</tr>
<tr>
<td>LPG</td>
<td>172</td>
</tr>
<tr>
<td>Natural gas</td>
<td>68</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>65</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>60</td>
</tr>
<tr>
<td>Coal and other</td>
<td>30</td>
</tr>
</tbody>
</table>
5.3.2 Modelling the impacts of the examined policies in Greece

Elasticities of demand
Electricity: -0.53 and heating: -0.51.

Baseline scenario

**Assumptions: No implementation of additional policies.**
The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account.

Energy prices

*Table 69 Energy prices in the baseline scenario for Greece*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>115</td>
<td>134</td>
<td>153</td>
<td>173</td>
<td>192</td>
<td>211</td>
<td>230</td>
</tr>
<tr>
<td>Natural gas</td>
<td>68</td>
<td>88</td>
<td>109</td>
<td>129</td>
<td>150</td>
<td>156</td>
<td>163</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Electricity</td>
<td>178</td>
<td>178</td>
<td>179</td>
<td>181</td>
<td>184</td>
<td>188</td>
<td>193</td>
</tr>
<tr>
<td>LPG</td>
<td>172</td>
<td>201</td>
<td>229</td>
<td>258</td>
<td>287</td>
<td>315</td>
<td>344</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

*Table 70 Final energy consumption in baseline scenario in Greece*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>592</td>
<td>566</td>
<td>525</td>
<td>491</td>
<td>463</td>
<td>440</td>
<td>419</td>
</tr>
<tr>
<td>Natural gas</td>
<td>210</td>
<td>186</td>
<td>164</td>
<td>148</td>
<td>136</td>
<td>133</td>
<td>130</td>
</tr>
<tr>
<td>LPG</td>
<td>42</td>
<td>40</td>
<td>37</td>
<td>35</td>
<td>33</td>
<td>31</td>
<td>29</td>
</tr>
<tr>
<td>Biomass</td>
<td>633</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>71</td>
<td>77</td>
<td>77</td>
<td>76</td>
<td>76</td>
<td>75</td>
<td>74</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>District heating</td>
<td>31</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Electricity</td>
<td>70</td>
<td>73</td>
<td>73</td>
<td>72</td>
<td>72</td>
<td>71</td>
<td>70</td>
</tr>
<tr>
<td>Coal and other</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>1669</td>
<td>1655</td>
<td>1589</td>
<td>1536</td>
<td>1493</td>
<td>1462</td>
<td>1436</td>
</tr>
<tr>
<td>Space cooling</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Electricity</td>
<td>198</td>
<td>207</td>
<td>207</td>
<td>205</td>
<td>203</td>
<td>201</td>
<td>198</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>207</td>
<td>207</td>
<td>205</td>
<td>203</td>
<td>201</td>
<td>198</td>
</tr>
<tr>
<td>Domestic hot water (DWH)</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Electricity</td>
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<td>227</td>
<td>227</td>
<td>225</td>
<td>224</td>
<td>221</td>
<td>218</td>
</tr>
<tr>
<td>Natural gas</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>4</td>
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<td>4</td>
</tr>
<tr>
<td>Heating oil</td>
<td>27</td>
<td>25</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td><strong>District heating</strong></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td><strong>Solar thermal</strong></td>
<td>347</td>
<td>362</td>
<td>362</td>
<td>362</td>
<td>362</td>
<td>362</td>
<td>362</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>600</td>
<td>623</td>
<td>620</td>
<td>616</td>
<td>613</td>
<td>609</td>
<td>605</td>
</tr>
<tr>
<td><strong>Space heating, cooling and DHW</strong></td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Heating oil</td>
<td>619</td>
<td>591</td>
<td>548</td>
<td>513</td>
<td>484</td>
<td>459</td>
<td>438</td>
</tr>
<tr>
<td>Natural gas</td>
<td>217</td>
<td>192</td>
<td>169</td>
<td>153</td>
<td>141</td>
<td>137</td>
<td>134</td>
</tr>
<tr>
<td>LPG</td>
<td>42</td>
<td>40</td>
<td>37</td>
<td>35</td>
<td>33</td>
<td>31</td>
<td>29</td>
</tr>
<tr>
<td>Biomass</td>
<td>633</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>71</td>
<td>77</td>
<td>77</td>
<td>76</td>
<td>76</td>
<td>75</td>
<td>74</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>361</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
<td>376</td>
</tr>
<tr>
<td>District heating</td>
<td>33</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Electricity</td>
<td>486</td>
<td>507</td>
<td>507</td>
<td>503</td>
<td>499</td>
<td>492</td>
<td>486</td>
</tr>
<tr>
<td>Coal and other</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2467</td>
<td>2485</td>
<td>2415</td>
<td>2357</td>
<td>2309</td>
<td>2272</td>
<td>2239</td>
</tr>
</tbody>
</table>

**Total energy costs (million €)**

*Table 71 Total energy costs in baseline scenario in Greece*

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>71</td>
<td>79</td>
<td>84</td>
<td>89</td>
<td>93</td>
<td>97</td>
<td>101</td>
</tr>
<tr>
<td>Natural gas</td>
<td>15</td>
<td>17</td>
<td>18</td>
<td>20</td>
<td>21</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>LPG</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Biomass</td>
<td>41</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Electricity</td>
<td>87</td>
<td>90</td>
<td>90</td>
<td>91</td>
<td>92</td>
<td>93</td>
<td>94</td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>223</td>
<td>240</td>
<td>247</td>
<td>254</td>
<td>260</td>
<td>266</td>
<td>272</td>
</tr>
</tbody>
</table>
Scenario 1

**ASSUMPTIONS:** Scenario 1 was considered for the projection of ETS2 price.

Energy prices

**Table 72 Energy prices in the Scenario 1 for Greece**

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>115</td>
<td>134</td>
<td>192</td>
<td>247</td>
<td>263</td>
<td>294</td>
<td>326</td>
</tr>
<tr>
<td>Natural gas</td>
<td>68</td>
<td>88</td>
<td>139</td>
<td>186</td>
<td>204</td>
<td>220</td>
<td>236</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>89</td>
<td>139</td>
<td>136</td>
<td>155</td>
<td>174</td>
</tr>
<tr>
<td>Electricity</td>
<td>178</td>
<td>178</td>
<td>179</td>
<td>181</td>
<td>184</td>
<td>188</td>
<td>193</td>
</tr>
<tr>
<td>LPG</td>
<td>172</td>
<td>201</td>
<td>268</td>
<td>333</td>
<td>358</td>
<td>399</td>
<td>440</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

**Table 73 Final energy consumption in Scenario 1 in Greece**

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>592</td>
<td>566</td>
<td>441</td>
<td>377</td>
<td>334</td>
<td>296</td>
<td>269</td>
</tr>
<tr>
<td>Natural gas</td>
<td>210</td>
<td>186</td>
<td>132</td>
<td>109</td>
<td>95</td>
<td>86</td>
<td>79</td>
</tr>
<tr>
<td>LPG</td>
<td>42</td>
<td>40</td>
<td>33</td>
<td>29</td>
<td>26</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Biomass</td>
<td>633</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
<td>661</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>71</td>
<td>77</td>
<td>77</td>
<td>76</td>
<td>76</td>
<td>75</td>
<td>74</td>
</tr>
<tr>
<td>Solar thermal</td>
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<td>661</td>
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</table>
Total energy costs (million €)

Table 74 Total energy costs in Scenario 1 in Greece

<table>
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<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>Ambient heat</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<td>94</td>
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<td>Coal and other</td>
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</table>
**Scenario 2**

**Assumptions:** Mandatory phase-out of heating oil and solid fossil fuels in 2030 and natural gas (including LNG) in 2040.

It was considered that the actual phase-out will have occurred after five years (heating oil and solid fossil fuels in 2035 and natural gas and LNG in 2045), and heat pumps will replace the existing heating systems.

### Energy prices

*Table 75 Energy prices in the Scenario 2 for Greece*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
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<td>115</td>
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<td>192</td>
<td>211</td>
<td>230</td>
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<tr>
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<td>129</td>
<td>150</td>
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<tr>
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<td>42</td>
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<td>184</td>
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<td>193</td>
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<tr>
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<td>258</td>
<td>287</td>
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</table>

### Final energy consumption (GWh)

*Table 76 Final energy consumption in Scenario 2 in Greece*

<table>
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<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>661</td>
<td>661</td>
<td>661</td>
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<th>2035</th>
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</table>

**Total energy costs (million €)**

Table 77 Total energy costs in Scenario 2 in Greece

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<thead>
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<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<td>0</td>
<td>0</td>
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<td>113</td>
<td>122</td>
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<td>Coal and other</td>
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<td>0</td>
<td>0</td>
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<td>247</td>
<td>186</td>
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<td>167</td>
<td>168</td>
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</table>

**Table 78 Investments foreseen in Scenario 2 in Greece**

<table>
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<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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Scenario 3

ASSUMPTIONS: Establishment of MEPS for achieving energy class E in 2035.

50% of affected households (85% of the total low-income households) will renovate their buildings until 2030 (214 thousand buildings) and remain until 2035 (214 thousand buildings).

ASSUMPTIONS FOR BUILDINGS’ ENERGY UPGRADE: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all buildings will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 79 Energy prices in the Scenario 3 for Greece

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
<td>Natural gas</td>
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<td>88</td>
<td>109</td>
<td>129</td>
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<td>163</td>
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<tr>
<td>Solid fossil fuels</td>
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Final energy consumption (GWh)

Table 80 Final energy consumption in Scenario 3 in Greece

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### Total Energy Costs (million €)

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<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>461</td>
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### Investments Foreseen in Scenario 3 in Greece

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## Scenario 4

**ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3**

### Energy prices

**Table 83 Energy prices in the Scenario 4 for Greece**

<table>
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<th>Energy prices (€/MWh)</th>
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<th>2030</th>
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### Final energy consumption (GWh)

**Table 84 Final energy consumption in Scenario 4 in Greece**

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<th>Domestic hot water (DWH)</th>
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### Total energy costs (million €)

Table 85 Total energy costs in Scenario 4 in Greece

<table>
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<th>Space heating, cooling and DHW</th>
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<th>2035</th>
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### Investments foreseen in Scenario 4 in Greece

Table 86 Investments foreseen in Scenario 4 in Greece

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<th>2045</th>
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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

Table 87 Energy prices in the Scenario 5 for Greece

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<th>2019</th>
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<th>2045</th>
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<tr>
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<td>158</td>
<td>185</td>
<td>211</td>
<td>252</td>
<td>292</td>
</tr>
<tr>
<td>Natural gas</td>
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<td>112</td>
<td>138</td>
<td>165</td>
<td>188</td>
<td>211</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
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<td>67</td>
<td>98</td>
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Final energy consumption (GWh)

Table 88 Final energy consumption in Scenario 5 in Greece

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<th>2035</th>
<th>2040</th>
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<tbody>
<tr>
<td>Heating oil</td>
<td>592</td>
<td>566</td>
<td>449</td>
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<td>0</td>
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<td>210</td>
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<tr>
<td>Biomass</td>
<td>633</td>
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<td>577</td>
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<td>461</td>
<td>461</td>
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<tr>
<td>Ambient heat</td>
<td>71</td>
<td>77</td>
<td>67</td>
<td>193</td>
<td>175</td>
<td>231</td>
<td>228</td>
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<tr>
<td>Solar thermal</td>
<td>14</td>
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<td>198</td>
<td>196</td>
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<td>Coal and other</td>
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<td>6</td>
<td>4</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Total</td>
<td>1669</td>
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<td>1004</td>
<td>906</td>
<td>923</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Space cooling</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2050</th>
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<tbody>
<tr>
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<td>180</td>
<td>156</td>
<td>142</td>
<td>140</td>
<td>138</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>207</td>
<td>180</td>
<td>156</td>
<td>142</td>
<td>140</td>
<td>138</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Domestic hot water (DHW)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>218</td>
<td>227</td>
<td>227</td>
<td>242</td>
<td>240</td>
<td>240</td>
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<td>0</td>
</tr>
<tr>
<td>Heating oil</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
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<td>2</td>
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<td>2</td>
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<tr>
<td>Solar thermal</td>
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<td>362</td>
<td>362</td>
<td>362</td>
<td>362</td>
<td>362</td>
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<td>623</td>
<td>619</td>
<td>611</td>
<td>609</td>
<td>605</td>
<td>602</td>
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</table>

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>619</td>
<td>591</td>
<td>472</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Natural gas</td>
<td>217</td>
<td>192</td>
<td>145</td>
<td>112</td>
<td>93</td>
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<td>0</td>
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<tr>
<td>LPG</td>
<td>42</td>
<td>40</td>
<td>32</td>
<td>26</td>
<td>22</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>633</td>
<td>661</td>
<td>577</td>
<td>504</td>
<td>461</td>
<td>461</td>
<td>461</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>71</td>
<td>77</td>
<td>67</td>
<td>193</td>
<td>175</td>
<td>231</td>
<td>228</td>
</tr>
</tbody>
</table>
### Solar thermal

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>361</td>
<td>376</td>
<td>375</td>
<td>373</td>
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<td>372</td>
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</table>

### District heating

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>33</td>
<td>34</td>
<td>30</td>
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</tbody>
</table>

### Electricity

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>486</td>
<td>507</td>
<td>471</td>
<td>538</td>
<td>509</td>
<td>579</td>
<td>571</td>
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</table>

### Coal and other

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
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<td>6</td>
<td>4</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

### Total

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2467</td>
<td>2485</td>
<td>2173</td>
<td>1771</td>
<td>1656</td>
<td>1667</td>
<td>1657</td>
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</tbody>
</table>

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**Total energy costs (million €)**

**Table 89 Total energy costs in Scenario 5 in Greece**

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>71</td>
<td>79</td>
<td>75</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>15</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
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<td>7</td>
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<td>0</td>
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<td>33</td>
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<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
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<td>2</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>84</td>
<td>97</td>
<td>94</td>
<td>109</td>
<td>110</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>Total</td>
<td>223</td>
<td>240</td>
<td>222</td>
<td>154</td>
<td>147</td>
<td>140</td>
<td>142</td>
</tr>
</tbody>
</table>

**Table 90 Investments foreseen in Scenario 5 in Greece**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>1270</td>
<td>0</td>
<td>463</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
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<td>2137</td>
<td>2137</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>2137</td>
<td>3407</td>
<td>2137</td>
<td>463</td>
<td>0</td>
</tr>
</tbody>
</table>
**Synopsis**

Comparison of final energy consumption

![Comparison of final energy consumption between scenarios in Greece](image)

**Figure 15 Comparison of final energy consumption between scenarios in Greece**

Comparison of investments in different scenarios

![Investments in different scenarios in Greece](image)

**Figure 16 Investments in different scenarios in Greece**

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1303</td>
<td>0</td>
<td>488</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>2137</td>
<td>2137</td>
<td>2137</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1303</td>
<td>0</td>
<td>505</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>2137</td>
<td>2137</td>
<td>2137</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>2137</td>
<td>3440</td>
<td>2137</td>
<td>505</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Heat pumps</td>
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<td>1270</td>
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<td>3407</td>
<td>2137</td>
<td>463</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Comparison of the total energy costs

Figure 17 Comparison of final energy costs between scenarios in Greece
5.4 HUNGARY

5.4.1 Determination of baseline

**Step 1:** Estimation of unitary final energy consumption for different end-uses of the average household in Hungary according to the data about the disaggregated final energy consumption of households (data: Eurostat).

*Table 91 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>16008</td>
</tr>
<tr>
<td>Space heating</td>
<td>11316</td>
</tr>
<tr>
<td>Space cooling</td>
<td>38</td>
</tr>
<tr>
<td>DHW</td>
<td>2103</td>
</tr>
<tr>
<td>Cooking</td>
<td>798</td>
</tr>
<tr>
<td>Other</td>
<td>1753</td>
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</tbody>
</table>

**Energy carrier**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>16008</td>
</tr>
<tr>
<td>Electricity</td>
<td>2817</td>
</tr>
<tr>
<td>Natural gas</td>
<td>7876</td>
</tr>
<tr>
<td>Oil</td>
<td>208</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>199</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>26</td>
</tr>
<tr>
<td>District heat</td>
<td>1283</td>
</tr>
<tr>
<td>Biomass</td>
<td>3562</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>37</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of reduced energy expenses of households, which belong to the lowest income decile compared with the energy expenses of the average household (data: HBS).

*Table 92 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>17%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>53%</td>
</tr>
<tr>
<td>Oil</td>
<td>-107%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>-3%</td>
</tr>
<tr>
<td>District heat</td>
<td>59%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>17%</td>
</tr>
<tr>
<td>Biomass</td>
<td>-22%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration the reduced energy expenses as estimated in Step 2.

*Table 93 Energy consumption of low-income households*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11606</td>
</tr>
<tr>
<td>Space heating</td>
<td>8084</td>
</tr>
</tbody>
</table>
Step 4: Calculation of unitary final energy consumption of the households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration the reduced energy expenses as estimated in the Step 2.

Table 94 Energy consumption of low-income households distributed by fuels

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11606</td>
</tr>
<tr>
<td>Electricity</td>
<td>2338</td>
</tr>
<tr>
<td>Natural gas</td>
<td>3702</td>
</tr>
<tr>
<td>Oil</td>
<td>431</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>205</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>22</td>
</tr>
<tr>
<td>District heat</td>
<td>526</td>
</tr>
<tr>
<td>Biomass</td>
<td>4346</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>37</td>
</tr>
</tbody>
</table>

Step 5: Identification of utilised means of heating and cooking for the case of the households, which belong to the lowest income decile and assessment of additional data (data: HBS).

Adjustments have been made by the involved country expert.

Step 6: Modelling each different end-use separately for quantifying the consumed energy carriers.

Number of low-income households (dwellings): 677,332

Table 95 Final energy consumption in the low-income households

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>1566</td>
<td>53</td>
<td>4</td>
<td>468</td>
<td>56</td>
<td>985</td>
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<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>292</td>
<td>37</td>
<td></td>
<td>41</td>
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<td></td>
</tr>
<tr>
<td>Natural gas</td>
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<td>2076</td>
<td></td>
<td>257</td>
<td>173</td>
<td></td>
</tr>
<tr>
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<td></td>
<td>25</td>
<td></td>
<td></td>
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<tr>
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<td>15</td>
<td>15</td>
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<td></td>
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</tr>
<tr>
<td>District heating</td>
<td>356</td>
<td>263</td>
<td></td>
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<tr>
<td>Coal and other</td>
<td>139</td>
<td>139</td>
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<td>4</td>
<td>935</td>
<td>444</td>
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Step 7: Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and the identified energy expenses (Step 2).

Cost deviation equal to +89% assuming the following prices:

*Table 96 Utilised energy prices in Hungary*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>113</td>
</tr>
<tr>
<td>Electricity</td>
<td>113</td>
</tr>
<tr>
<td>Natural gas</td>
<td>34</td>
</tr>
<tr>
<td>Biomass</td>
<td>15</td>
</tr>
<tr>
<td>District heating</td>
<td>30</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
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<td>LPG</td>
<td>150</td>
</tr>
<tr>
<td>Coal and other</td>
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</table>
5.4.2 Modelling the impacts of the examined policies in Hungary

Elasticities of demand
Electricity: -0.10 and heating: -0.50.

Baseline scenario

**ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.**

The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account.

Energy prices

*Table 97 Energy prices in the baseline scenario for Hungary*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>113</td>
<td>132</td>
<td>151</td>
<td>170</td>
<td>188</td>
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<tr>
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<td>65</td>
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<td>Solid fossil fuels</td>
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<td>20</td>
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<td>22</td>
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<td>128</td>
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<td>250</td>
<td>275</td>
<td>300</td>
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Final energy consumption (GWh)

*Table 98 Final energy consumption in baseline scenario in Hungary*

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<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>2915</td>
<td>2915</td>
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</tr>
<tr>
<td>Ambient heat</td>
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<td>15</td>
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<td>15</td>
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<tr>
<td>Domestic hot water (DWH)</td>
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<td>2030</td>
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<td>2040</td>
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</tr>
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<td>94</td>
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<td>51</td>
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<td>Ambient heat</td>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
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<td></td>
<td></td>
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<td>529</td>
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<td>526</td>
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</tr>
<tr>
<td>Coal and other</td>
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</table>

**Total energy costs (million €)**

*Table 99 Total energy costs in baseline scenario in Hungary*
Scenario 1

ASSUMPTIONS: Scenario 1 was considered for the projection of ETS2 price.

Energy prices

Table 100 Energy prices in the Scenario 1 for Hungary

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
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<td>113</td>
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<td>273</td>
<td>307</td>
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<td>133</td>
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<td>Solid fossil fuels</td>
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<td>140</td>
<td>135</td>
<td>157</td>
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<td>117</td>
<td>121</td>
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<tr>
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<td>314</td>
<td>335</td>
<td>375</td>
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</table>

Final energy consumption (GWh)

Table 101 Final energy consumption in Scenario 1 in Hungary

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>0</td>
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<tr>
<td>Natural gas</td>
<td>2076</td>
<td>1779</td>
<td>855</td>
<td>653</td>
<td>548</td>
<td>474</td>
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<td>27</td>
<td>24</td>
<td>21</td>
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<td>15</td>
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<td>15</td>
<td>15</td>
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</tr>
<tr>
<td>Solar thermal</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
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<tr>
<td>Coal and other</td>
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<td>2030</td>
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<td>0</td>
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<td>2035</td>
<td>2040</td>
<td>2045</td>
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</table>
### Total energy costs (million €)

**Table 102 Total energy costs in Scenario 1 in Hungary**

<table>
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<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>0</td>
<td>0</td>
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<td>0</td>
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Scenario 2

Assumptions: Mandatory phase-out of heating oil and solid fossil fuels in 2030 and natural gas (including LNG) in 2040.

It was considered that the actual phase-out will have occurred after five years (heating oil and solid fossil fuels in 2035 and natural gas and LNG in 2045), and heat pumps will replace the existing heating systems.

Energy prices

Table 103 Energy prices in the Scenario 2 for Hungary

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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<th>2040</th>
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Final energy consumption (GWh)

Table 104 Final energy consumption in Scenario 2 in Hungary

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<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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### Total energy costs (million €)

**Table 105 Total energy costs in Scenario 2 in Hungary**

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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### Investments foreseen in Scenario 2 in Hungary

**Table 106 Investments foreseen in Scenario 2 in Hungary**

<table>
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<tr>
<th>Investments (million €)</th>
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Scenario 3

Assumptions: Establishment of MEPS for achieving energy class E in 2035.

50% of the affected households (75% of the total low-income households) will renovate their buildings until 2030 (254 thousand buildings) and remain until 2035 (254 thousand buildings).

Assumptions for buildings’ energy upgrade: Renovation cost: 13.5 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all the building will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 6.5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 107 Energy prices in the Scenario 3 for Hungary

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
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<td>132</td>
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<td>207</td>
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<td>65</td>
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<tr>
<td>Solid fossil fuels</td>
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<tr>
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<td>200</td>
<td>225</td>
<td>250</td>
<td>275</td>
<td>300</td>
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</table>

Final energy consumption (GWh)

Table 108 Final energy consumption in Scenario 3 in Hungary

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>915</td>
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**Space heating, cooling and DHW**

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**Total energy costs (million €)**

**Table 109 Total energy costs in Scenario 3 in Hungary**

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<th>2019</th>
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<th>2030</th>
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<tr>
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<td>0</td>
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</tr>
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**Table 110 Investments foreseen in Scenario 3 in Hungary**

<table>
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<th>Investments (million €)</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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Scenario 4

ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3

Energy prices

Table 111 Energy prices in the Scenario 4 for Hungary

<table>
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<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
<tr>
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<tr>
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<tr>
<td>Solid fossil fuels</td>
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<td>18</td>
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<td>20</td>
<td>21</td>
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<td>114</td>
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<td>121</td>
<td>128</td>
<td>134</td>
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<tr>
<td>LPG</td>
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<td>175</td>
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<td>225</td>
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Final energy consumption (GWh)

Table 112 Final energy consumption in Scenario 4 in Hungary

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<th>Space heating</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2050</th>
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<td>0</td>
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<td>957</td>
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<td>2915</td>
<td>2587</td>
<td>2296</td>
<td>2124</td>
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<td>2124</td>
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<td>13</td>
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<td>561</td>
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<td>0</td>
<td>0</td>
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<tr>
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<td>235</td>
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<td>193</td>
<td>193</td>
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<td>31</td>
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<th>2040</th>
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<table>
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<tr>
<th>Domestic hot water (DWH)</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>0</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
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<td>94</td>
<td>94</td>
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<td>94</td>
<td>94</td>
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<tr>
<td>LPG</td>
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<tr>
<td>Biomass</td>
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<td>51</td>
<td>51</td>
<td>51</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
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<td>0</td>
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<table>
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<th>2035</th>
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### Total energy costs (million €)

#### Table 113 Total energy costs in Scenario 4 in Hungary

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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</tr>
<tr>
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<td>40</td>
<td>35</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Ambient heat</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>64</td>
<td>119</td>
<td>124</td>
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<td>0</td>
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<tr>
<td><strong>Total</strong></td>
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<td>218</td>
<td>210</td>
<td>204</td>
<td>202</td>
<td>160</td>
<td>166</td>
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</table>

#### Table 114 Investments foreseen in Scenario 4 in Hungary

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<th>Investments (million €)</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>3302</td>
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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

*Table 115 Energy prices in the Scenario 5 for Hungary*

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<tr>
<th>Energy prices (€/MWh)</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>59</td>
<td>76</td>
<td>93</td>
<td>116</td>
<td>139</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>26</td>
<td>39</td>
<td>52</td>
<td>88</td>
<td>123</td>
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<td>114</td>
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</table>

Final energy consumption (GWh)

*Table 116 Final energy consumption in Scenario 5 in Hungary*

<table>
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<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1002</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>LPG</td>
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<td>28</td>
<td>23</td>
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</tr>
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<td>2915</td>
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<td>2296</td>
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<td>2124</td>
<td>2124</td>
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<td>13</td>
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<td>17</td>
<td>435</td>
<td>433</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>263</td>
<td>265</td>
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<td>193</td>
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<td>23</td>
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<table>
<thead>
<tr>
<th>Domestic hot water (DWH)</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
<td>District heating</td>
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<td>94</td>
<td>94</td>
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</tr>
<tr>
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<td>35</td>
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<td>51</td>
<td>51</td>
<td>51</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
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<td>0</td>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Total Energy Costs (million €)

*Table 117 Total energy costs in Scenario 5 in Hungary*

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td>2334</td>
<td>2000</td>
<td>1505</td>
<td>1159</td>
<td>962</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>79</td>
<td>73</td>
<td>63</td>
<td>55</td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>2942</td>
<td>2966</td>
<td>2638</td>
<td>2347</td>
<td>2175</td>
<td>2175</td>
<td>2175</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>15</td>
<td>15</td>
<td>13</td>
<td>19</td>
<td>17</td>
<td>435</td>
<td>433</td>
</tr>
<tr>
<td>District heating</td>
<td>356</td>
<td>359</td>
<td>329</td>
<td>303</td>
<td>287</td>
<td>287</td>
<td>287</td>
</tr>
<tr>
<td>Electricity</td>
<td>525</td>
<td>529</td>
<td>523</td>
<td>527</td>
<td>523</td>
<td>833</td>
<td>829</td>
</tr>
<tr>
<td>Coal and other</td>
<td>139</td>
<td>133</td>
<td>85</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6415</td>
<td>6100</td>
<td>5181</td>
<td>4434</td>
<td>4038</td>
<td>3756</td>
<td>3749</td>
</tr>
</tbody>
</table>

### Investments Foreseen in Scenario 5 in Hungary

*Table 118 Investments foreseen in Scenario 5 in Hungary*

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>84</td>
<td>0</td>
<td>1292</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>3429</td>
<td>3429</td>
<td>3302</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>3429</td>
<td>3513</td>
<td>3302</td>
<td>1292</td>
<td>0</td>
</tr>
</tbody>
</table>
Synopsis

Comparison of final energy consumption

Figure 18 Comparison of final energy consumption between scenarios in Hungary

Comparison of investments in different scenarios

Figure 19 Investments in different scenarios in Hungary

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 2</td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>138</td>
<td>0</td>
<td>1547</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Investments (million €)</td>
<td>0</td>
<td>3429</td>
<td>3429</td>
<td>3302</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Building envelope</td>
<td>0</td>
<td>3429</td>
<td>3429</td>
<td>3302</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Investments (million €)</td>
<td>0</td>
<td>3429</td>
<td>3567</td>
<td>3302</td>
<td>1556</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>138</td>
<td>0</td>
<td>1556</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Building envelope</td>
<td>0</td>
<td>3429</td>
<td>3429</td>
<td>3302</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0</td>
<td>3429</td>
<td>3513</td>
<td>3302</td>
<td>1292</td>
<td>0</td>
</tr>
</tbody>
</table>
Comparison of the total energy costs

Figure 20 Comparison of final energy costs between scenarios in Hungary
5.5 ITALY

5.5.1 Determination of baseline

Step 1: Estimation of unitary final energy consumption for different end-uses of average household in Italy according to data about disaggregated final energy consumption of households (data: Eurostat).

*Table 119 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>13915</td>
</tr>
<tr>
<td>Space heating</td>
<td>9240</td>
</tr>
<tr>
<td>Space cooling</td>
<td>118</td>
</tr>
<tr>
<td>DHW</td>
<td>1678</td>
</tr>
<tr>
<td>Cooking</td>
<td>891</td>
</tr>
<tr>
<td>Other</td>
<td>1988</td>
</tr>
</tbody>
</table>

*Energy carrier | Average household (kWh/HH) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>13915</td>
</tr>
<tr>
<td>Electricity</td>
<td>2523</td>
</tr>
<tr>
<td>Natural gas</td>
<td>7216</td>
</tr>
<tr>
<td>Oil</td>
<td>387</td>
</tr>
<tr>
<td>LPG</td>
<td>500</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>0</td>
</tr>
<tr>
<td>District heat</td>
<td>397</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>75</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>43</td>
</tr>
<tr>
<td>Biomass</td>
<td>2772</td>
</tr>
</tbody>
</table>

Step 2: Calculation of reduced energy expenses of households, which belong to the lowest income decile compared with energy expenses of average households (data: HBS).

*Table 120 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>6%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>25%</td>
</tr>
<tr>
<td>Oil</td>
<td>49%</td>
</tr>
<tr>
<td>LPG</td>
<td>33%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>74%</td>
</tr>
<tr>
<td>District heat</td>
<td>49%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>49%</td>
</tr>
<tr>
<td>Biomass</td>
<td>2%</td>
</tr>
</tbody>
</table>

Step 3: Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration the reduced energy expenses as estimated in Step 2.

*Table 121 Energy consumption of low-income households*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11366</td>
</tr>
<tr>
<td>Space heating</td>
<td>7369</td>
</tr>
</tbody>
</table>
**Step 4:** Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration the reduced energy expenses as estimated in the Step 2.

**Table 122 Energy consumption of low-income households distributed by fuels**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>11366</td>
</tr>
<tr>
<td>Electricity</td>
<td>2374</td>
</tr>
<tr>
<td>Natural gas</td>
<td>5444</td>
</tr>
<tr>
<td>Oil</td>
<td>199</td>
</tr>
<tr>
<td>LPG</td>
<td>333</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>0</td>
</tr>
<tr>
<td>District heat</td>
<td>202</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>75</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>22</td>
</tr>
<tr>
<td>Biomass</td>
<td>2716</td>
</tr>
</tbody>
</table>

**Step 5:** Identification of utilised means of heating and cooking for the case of households, which belong to the lowest income decile (data: HBS).

No change

**Step 6:** Modelling each different end-use separately for quantifying the consumed energy carriers.

Number of low-income households (dwellings): **2,766,058**

**Table 123 Final energy consumption in the low-income households**

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>6566</td>
<td>102</td>
<td>307</td>
<td>611</td>
<td>374</td>
<td>5172</td>
</tr>
<tr>
<td>Heating oil</td>
<td>551</td>
<td>493</td>
<td></td>
<td>58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>922</td>
<td>584</td>
<td></td>
<td>161</td>
<td>177</td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>15058</td>
<td>11465</td>
<td></td>
<td>2282</td>
<td>1312</td>
<td></td>
</tr>
<tr>
<td>Solar thermal</td>
<td>209</td>
<td>12</td>
<td></td>
<td>196</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>60</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>7513</td>
<td>7180</td>
<td></td>
<td>273</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>District heating</td>
<td>558</td>
<td>487</td>
<td></td>
<td>71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Step 7: Validation and adjustment of the obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and identified energy expenses (Step 2).

Cost deviation equal to 12% assuming the following prices:

Table 124 Utilised energy prices in Italy

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (£/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>113</td>
</tr>
<tr>
<td>Electricity</td>
<td>248</td>
</tr>
<tr>
<td>Natural gas</td>
<td>80</td>
</tr>
<tr>
<td>Biomass</td>
<td>40</td>
</tr>
<tr>
<td>District heating</td>
<td>115</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
</tr>
<tr>
<td>Coal and other</td>
<td>30</td>
</tr>
</tbody>
</table>
5.5.2 Modelling the impacts of the examined policies in Italy

Elasticities of demand
Electricity: -0.55 and heating: -0.50.

Baseline scenario

**ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.**

**The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account.**

Energy prices

*Table 125 Energy prices in the baseline scenario for Italy*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>113</td>
<td>132</td>
<td>151</td>
<td>170</td>
<td>188</td>
<td>207</td>
<td>226</td>
</tr>
<tr>
<td>Natural gas</td>
<td>80</td>
<td>104</td>
<td>128</td>
<td>152</td>
<td>176</td>
<td>184</td>
<td>192</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Electricity</td>
<td>248</td>
<td>249</td>
<td>249</td>
<td>253</td>
<td>256</td>
<td>263</td>
<td>270</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>227</td>
<td>255</td>
<td>283</td>
<td>312</td>
<td>340</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

*Table 126 Final energy consumption in baseline scenario in Italy*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>493</td>
<td>452</td>
<td>420</td>
<td>394</td>
<td>372</td>
<td>353</td>
<td>337</td>
</tr>
<tr>
<td>Natural gas</td>
<td>11465</td>
<td>9745</td>
<td>8620</td>
<td>7812</td>
<td>7196</td>
<td>7032</td>
<td>6879</td>
</tr>
<tr>
<td>LPG</td>
<td>584</td>
<td>535</td>
<td>497</td>
<td>466</td>
<td>440</td>
<td>418</td>
<td>399</td>
</tr>
<tr>
<td>Biomass</td>
<td>7180</td>
<td>7180</td>
<td>7180</td>
<td>7180</td>
<td>7180</td>
<td>7180</td>
<td>7180</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>59</td>
<td>59</td>
<td>58</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>District heating</td>
<td>487</td>
<td>487</td>
<td>487</td>
<td>487</td>
<td>487</td>
<td>487</td>
<td>487</td>
</tr>
<tr>
<td>Electricity</td>
<td>102</td>
<td>102</td>
<td>102</td>
<td>101</td>
<td>100</td>
<td>99</td>
<td>97</td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20384</td>
<td>18575</td>
<td>17380</td>
<td>16513</td>
<td>15847</td>
<td>15641</td>
<td>15450</td>
</tr>
<tr>
<td>Space cooling</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Electricity</td>
<td>307</td>
<td>307</td>
<td>306</td>
<td>304</td>
<td>301</td>
<td>297</td>
<td>293</td>
</tr>
<tr>
<td>Total</td>
<td>307</td>
<td>307</td>
<td>306</td>
<td>304</td>
<td>301</td>
<td>297</td>
<td>293</td>
</tr>
<tr>
<td>Domestic hot water (DWH)</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Electricity</td>
<td>611</td>
<td>611</td>
<td>610</td>
<td>605</td>
<td>600</td>
<td>592</td>
<td>584</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2282</td>
<td>1939</td>
<td>1716</td>
<td>1555</td>
<td>1432</td>
<td>1399</td>
<td>1369</td>
</tr>
<tr>
<td>Energy Source</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Heating oil</td>
<td>58</td>
<td>53</td>
<td>49</td>
<td>46</td>
<td>43</td>
<td>41</td>
<td>39</td>
</tr>
<tr>
<td>District heating</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>LPG</td>
<td>161</td>
<td>147</td>
<td>137</td>
<td>128</td>
<td>121</td>
<td>115</td>
<td>110</td>
</tr>
<tr>
<td>Biomass</td>
<td>273</td>
<td>273</td>
<td>273</td>
<td>273</td>
<td>273</td>
<td>273</td>
<td>273</td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3652</td>
<td>3291</td>
<td>3052</td>
<td>2874</td>
<td>2737</td>
<td>2688</td>
<td>2643</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>551</td>
<td>505</td>
<td>469</td>
<td>440</td>
<td>415</td>
<td>395</td>
<td>377</td>
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**Total energy costs (million €)**

*Table 127 Total energy costs in baseline scenario in Italy*
Scenario 1

ASSUMPTIONS: SCENARIO 1 WAS CONSIDERED FOR THE PROJECTION OF ETS2 PRICE.

Energy prices

Table 128 Energy prices in the Scenario 1 for Italy

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
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<th>2035</th>
<th>2040</th>
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Final energy consumption (GWh)

Table 129 Final energy consumption in Scenario 1 in Italy

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<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>2045</td>
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### Total energy costs (million €)

*Table 130 Total energy costs in Scenario 1 in Italy*

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<th>Space heating, cooling and DHW</th>
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<th>2025</th>
<th>2030</th>
<th>2035</th>
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Scenario 2

Assumptions: Mandatory phase-out of heating oil and solid fossil fuels in 2030 and natural gas (including LNG) in 2040.

It was considered that the actual phase-out will have occurred after five years (heating oil and solid fossil fuels in 2035 and natural gas and LNG in 2045), and heat pumps will replace the existing heating systems.

Energy prices

Table 131 Energy prices in the Scenario 2 for Italy

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
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<td>151</td>
<td>170</td>
<td>188</td>
<td>207</td>
<td>226</td>
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<td>128</td>
<td>152</td>
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Final energy consumption (GWh)

Table 132 Final energy consumption in Scenario 2 in Italy

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<th>2030</th>
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## Total energy costs (million €)

**Table 133 Total energy costs in Scenario 2 in Italy**

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<tr>
<th>Space heating, cooling and DHW</th>
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<th>2030</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>District heating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal and other</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>24343</td>
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<td>16948</td>
<td>16829</td>
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</table>

## Investments foreseen in Scenario 2 in Italy

**Table 134 Investments foreseen in Scenario 2 in Italy**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td></td>
<td></td>
<td>528</td>
<td></td>
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<td>10596</td>
</tr>
</tbody>
</table>

---

98
Scenario 3

Assumptions: Establishment of MEPS for achieving energy class E in 2035.

50% of affected households (75% of total low-income households) will renovate their buildings until 2030 (1.04 million buildings) and remain until 2035 (1.04 million buildings).

Assumptions for buildings’ energy upgrade: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all buildings will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 135 Energy prices in the Scenario 3 for Italy

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>113</td>
<td>132</td>
<td>151</td>
<td>170</td>
<td>188</td>
<td>207</td>
<td>226</td>
</tr>
<tr>
<td>Natural gas</td>
<td>80</td>
<td>104</td>
<td>128</td>
<td>152</td>
<td>176</td>
<td>184</td>
<td>192</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Electricity</td>
<td>248</td>
<td>249</td>
<td>249</td>
<td>253</td>
<td>256</td>
<td>263</td>
<td>270</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>227</td>
<td>255</td>
<td>283</td>
<td>312</td>
<td>340</td>
</tr>
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</table>

Final energy consumption (GWh)

Table 136 Final energy consumption in Scenario 3 in Italy

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>493</td>
<td>452</td>
<td>373</td>
<td>310</td>
<td>271</td>
<td>257</td>
<td>246</td>
<td>246</td>
</tr>
<tr>
<td>Natural gas</td>
<td>11465</td>
<td>9745</td>
<td>7651</td>
<td>6153</td>
<td>5243</td>
<td>5123</td>
<td>5012</td>
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<tr>
<td>LPG</td>
<td>584</td>
<td>535</td>
<td>441</td>
<td>367</td>
<td>321</td>
<td>305</td>
<td>291</td>
<td>291</td>
</tr>
<tr>
<td>Biomass</td>
<td>7180</td>
<td>7180</td>
<td>6373</td>
<td>5656</td>
<td>5231</td>
<td>5231</td>
<td>5231</td>
<td>5231</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>60</td>
<td>60</td>
<td>54</td>
<td>47</td>
<td>43</td>
<td>43</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>District heating</td>
<td>487</td>
<td>487</td>
<td>432</td>
<td>384</td>
<td>355</td>
<td>355</td>
<td>355</td>
<td>355</td>
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<tr>
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<td>102</td>
<td>102</td>
<td>90</td>
<td>79</td>
<td>73</td>
<td>72</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>18575</td>
<td>15424</td>
<td>13006</td>
<td>11546</td>
<td>11395</td>
<td>11257</td>
<td>11257</td>
</tr>
</tbody>
</table>

Space cooling

| Electricity           | 307  | 307  | 272  | 239  | 220  | 217  | 214  | 214  |
| Total                 | 307  | 307  | 272  | 239  | 220  | 217  | 214  | 214  |

Domestic hot water (DWH)

| Electricity           | 611  | 611  | 610  | 605  | 600  | 592  | 584  | 584  |
| Natural gas           | 2282 | 1939 | 1716 | 1555 | 1432 | 1399 | 1369 | 1369 |
| Heating oil           | 58   | 53   | 49   | 46   | 43   | 41   | 39   | 39   |
| District heating      | 71   | 71   | 71   | 71   | 71   | 71   | 71   | 71   |
### Total energy costs (million €)

**Table 137 Total energy costs in Scenario 3 in Italy**

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating, cooling and DHW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating oil</td>
<td>62</td>
<td>67</td>
<td>64</td>
<td>60</td>
<td>59</td>
<td>62</td>
<td>64</td>
</tr>
<tr>
<td>Natural gas</td>
<td>1100</td>
<td>1215</td>
<td>1199</td>
<td>1172</td>
<td>1175</td>
<td>1200</td>
<td>1225</td>
</tr>
<tr>
<td>LPG</td>
<td>127</td>
<td>135</td>
<td>131</td>
<td>126</td>
<td>125</td>
<td>131</td>
<td>136</td>
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<tr>
<td>Biomass</td>
<td>298</td>
<td>298</td>
<td>266</td>
<td>237</td>
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<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>District heating</td>
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<td>49</td>
</tr>
<tr>
<td>Electricity</td>
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<td>253</td>
<td>242</td>
<td>233</td>
<td>229</td>
<td>231</td>
<td>234</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<tr>
<td><strong>Total</strong></td>
<td>1904</td>
<td>2033</td>
<td>1959</td>
<td>1881</td>
<td>1857</td>
<td>1893</td>
<td>1929</td>
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</table>

**Table 138 Investments foreseen in Scenario 3 in Italy**

<table>
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<tr>
<th></th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Investments (million €)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
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<td>10373</td>
<td>10373</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>
Scenario 4

ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3

Energy prices

Table 139 Energy prices in the Scenario 4 for Italy

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>113</td>
<td>132</td>
<td>151</td>
<td>170</td>
<td>188</td>
<td>207</td>
<td>226</td>
</tr>
<tr>
<td>Natural gas</td>
<td>80</td>
<td>104</td>
<td>128</td>
<td>152</td>
<td>176</td>
<td>184</td>
<td>192</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Electricity</td>
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<td>249</td>
<td>249</td>
<td>253</td>
<td>256</td>
<td>263</td>
<td>270</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>227</td>
<td>255</td>
<td>283</td>
<td>312</td>
<td>340</td>
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</table>

Final energy consumption (GWh)

Table 140 Final energy consumption in Scenario 4 in Italy

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>493</td>
<td>452</td>
<td>373</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>11465</td>
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<td>7561</td>
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<td>5231</td>
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<td>535</td>
<td>441</td>
<td>367</td>
<td>321</td>
<td>0</td>
<td>0</td>
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<td>6730</td>
<td>6373</td>
<td>5656</td>
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<td>5231</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>60</td>
<td>60</td>
<td>54</td>
<td>169</td>
<td>155</td>
<td>3229</td>
<td>3185</td>
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<tr>
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<td>11</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>District heating</td>
<td>487</td>
<td>487</td>
<td>432</td>
<td>384</td>
<td>355</td>
<td>355</td>
<td>355</td>
</tr>
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<td>102</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>12856</td>
<td>11422</td>
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<table>
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<tr>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
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<tr>
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<td>307</td>
<td>272</td>
<td>239</td>
<td>220</td>
<td>217</td>
<td>214</td>
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<tr>
<td>Total</td>
<td>307</td>
<td>307</td>
<td>272</td>
<td>239</td>
<td>220</td>
<td>217</td>
<td>214</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
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<td>610</td>
<td>757</td>
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<td>1716</td>
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<td>1432</td>
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<tr>
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<td>49</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
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<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>LPG</td>
<td>161</td>
<td>147</td>
<td>137</td>
<td>128</td>
<td>121</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Biomass</td>
<td>273</td>
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<td>273</td>
<td>273</td>
<td>273</td>
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<td>273</td>
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<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
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<td>196</td>
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<td>196</td>
<td>196</td>
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<td>2981</td>
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<td>2644</td>
<td>2616</td>
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</table>

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
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<td>9366</td>
<td>7708</td>
<td>6674</td>
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</tbody>
</table>
### Total energy costs (million €)

**Table 141 Total energy costs in Scenario 4 in Italy**

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
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<td>578</td>
<td>495</td>
<td>442</td>
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<tr>
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<td>7454</td>
<td>6646</td>
<td>5929</td>
<td>5505</td>
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<td>5505</td>
</tr>
<tr>
<td>Ambient heat</td>
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<td>60</td>
<td>54</td>
<td>169</td>
<td>155</td>
<td>3229</td>
<td>3185</td>
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<tr>
<td>Solar thermal</td>
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<td>209</td>
<td>207</td>
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<td>205</td>
<td>205</td>
<td>205</td>
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<tr>
<td>District heating</td>
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<td>426</td>
<td>426</td>
<td>426</td>
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<td>1079</td>
<td>3830</td>
<td>3778</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>22172</td>
<td>18748</td>
<td>16076</td>
<td>14486</td>
<td>13195</td>
<td>13099</td>
</tr>
</tbody>
</table>

### Investments foreseen in Scenario 4 in Italy

**Table 142 Investments foreseen in Scenario 4 in Italy**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>528</td>
<td>0</td>
<td>10646</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>10373</td>
<td>10373</td>
<td>10373</td>
<td>0</td>
<td>0</td>
</tr>
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<td><strong>Total</strong></td>
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<td>10373</td>
<td>10900</td>
<td>10373</td>
<td>10646</td>
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</tr>
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</table>
**Scenario 5**

**ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.**

**Energy prices**

*Table 143 Energy prices in the Scenario 5 for Italy*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>113</td>
<td>132</td>
<td>156</td>
<td>182</td>
<td>209</td>
<td>250</td>
<td>291</td>
</tr>
<tr>
<td>Natural gas</td>
<td>80</td>
<td>104</td>
<td>132</td>
<td>162</td>
<td>192</td>
<td>216</td>
<td>241</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>43</td>
<td>55</td>
<td>68</td>
<td>100</td>
<td>132</td>
</tr>
<tr>
<td>Electricity</td>
<td>248</td>
<td>249</td>
<td>249</td>
<td>253</td>
<td>256</td>
<td>263</td>
<td>270</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>232</td>
<td>268</td>
<td>304</td>
<td>354</td>
<td>405</td>
</tr>
</tbody>
</table>

**Final energy consumption (GWh)**

*Table 144 Final energy consumption in Scenario 5 in Italy*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>493</td>
<td>452</td>
<td>365</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>11465</td>
<td>9745</td>
<td>7497</td>
<td>5897</td>
<td>4950</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>584</td>
<td>535</td>
<td>435</td>
<td>356</td>
<td>307</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>7180</td>
<td>7180</td>
<td>6373</td>
<td>5656</td>
<td>5231</td>
<td>5231</td>
<td>5231</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>60</td>
<td>60</td>
<td>54</td>
<td>163</td>
<td>150</td>
<td>2930</td>
<td>2890</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>District heating</td>
<td>487</td>
<td>487</td>
<td>432</td>
<td>384</td>
<td>355</td>
<td>355</td>
<td>355</td>
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<tr>
<td>Electricity</td>
<td>102</td>
<td>102</td>
<td>90</td>
<td>115</td>
<td>105</td>
<td>1375</td>
<td>1357</td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20384</td>
<td>18575</td>
<td>15257</td>
<td>12581</td>
<td>11108</td>
<td>9901</td>
<td>9842</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Space cooling</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>307</td>
<td>307</td>
<td>272</td>
<td>239</td>
<td>220</td>
<td>217</td>
<td>214</td>
</tr>
<tr>
<td>Total</td>
<td>307</td>
<td>307</td>
<td>272</td>
<td>239</td>
<td>220</td>
<td>217</td>
<td>214</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>611</td>
<td>611</td>
<td>610</td>
<td>752</td>
<td>746</td>
<td>1969</td>
<td>1942</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2282</td>
<td>1939</td>
<td>1681</td>
<td>1490</td>
<td>1352</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Heating oil</td>
<td>58</td>
<td>53</td>
<td>48</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>LPG</td>
<td>161</td>
<td>147</td>
<td>135</td>
<td>124</td>
<td>116</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>273</td>
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<td>273</td>
<td>273</td>
<td>273</td>
<td>273</td>
<td>273</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
<td>196</td>
</tr>
<tr>
<td>Total</td>
<td>3652</td>
<td>3291</td>
<td>3015</td>
<td>2907</td>
<td>2755</td>
<td>2510</td>
<td>2483</td>
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</table>

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
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<tr>
<td></td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>-------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Heating oil</td>
<td>551</td>
<td>505</td>
<td>413</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Natural gas</td>
<td>13746</td>
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<td>9178</td>
<td>7387</td>
<td>6302</td>
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<tr>
<td>LPG</td>
<td>745</td>
<td>683</td>
<td>570</td>
<td>481</td>
<td>423</td>
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<td>0</td>
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<tr>
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<td>7454</td>
<td>6646</td>
<td>5929</td>
<td>5505</td>
<td>5505</td>
<td>5505</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>60</td>
<td>60</td>
<td>54</td>
<td>163</td>
<td>150</td>
<td>2930</td>
<td>2890</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>209</td>
<td>209</td>
<td>207</td>
<td>206</td>
<td>205</td>
<td>205</td>
<td>205</td>
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<tr>
<td>District heating</td>
<td>558</td>
<td>558</td>
<td>503</td>
<td>455</td>
<td>426</td>
<td>426</td>
<td>426</td>
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<tr>
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<td>1019</td>
<td>972</td>
<td>1106</td>
<td>1071</td>
<td>3561</td>
<td>3512</td>
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<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>24343</td>
<td>22172</td>
<td>18544</td>
<td>15727</td>
<td>14082</td>
<td>12627</td>
<td>12539</td>
</tr>
</tbody>
</table>

**Table 145 Total energy costs in Scenario 5 in Italy**

<table>
<thead>
<tr>
<th></th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>516</td>
<td>0</td>
<td>10101</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>10373</td>
<td>10373</td>
<td>10373</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>10373</td>
<td>10888</td>
<td>10373</td>
<td>10101</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 146 Investments foreseen in Scenario 5 in Italy**
Synopsis

Comparison of final energy consumption

![Graph showing comparison of final energy consumption between scenarios in Italy.](image)

*Figure 21 Comparison of final energy consumption between scenarios in Italy*

Comparison of investments in different scenarios

*Figure 22 Investments in different scenarios in Italy*

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>528</td>
<td>0</td>
<td>10596</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Building envelope</td>
<td>0</td>
<td>10373</td>
<td>10373</td>
<td>10373</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>528</td>
<td>0</td>
<td>10646</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Building envelope</td>
<td>0</td>
<td>10373</td>
<td>10373</td>
<td>10373</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>516</td>
<td>0</td>
<td>10101</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Building envelope</td>
<td>0</td>
<td>10373</td>
<td>10373</td>
<td>10373</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>Total</td>
<td>0</td>
<td>10373</td>
<td>10888</td>
<td>10373</td>
<td>10101</td>
<td>0</td>
</tr>
</tbody>
</table>
Comparison of the total energy costs

**Figure 23** Comparison of final energy costs between scenarios in Italy
5.6 POLAND

5.6.1 Determination of baseline

**Step 1:** Estimation of unitary final energy consumption for different end-uses of the average household in Poland according to data on the disaggregated final energy consumption of households (*data: Eurostat*).

*Table 147 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>14417</td>
</tr>
<tr>
<td>Space heating</td>
<td>9105</td>
</tr>
<tr>
<td>Space cooling</td>
<td>0</td>
</tr>
<tr>
<td>DHW</td>
<td>2485</td>
</tr>
<tr>
<td>Cooking</td>
<td>1293</td>
</tr>
<tr>
<td>Other</td>
<td>1534</td>
</tr>
</tbody>
</table>

**Energy carrier**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>14417</td>
</tr>
<tr>
<td>Electricity</td>
<td>1979</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2849</td>
</tr>
<tr>
<td>Heating oil</td>
<td>55</td>
</tr>
<tr>
<td>LNG</td>
<td>456</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>4080</td>
</tr>
<tr>
<td>District heat</td>
<td>2843</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>52</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>185</td>
</tr>
<tr>
<td>Biomass</td>
<td>1919</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of reduced energy expenses of households, which belong to the lowest income decile compared with energy expenses of the average household (*data: HBS*).

*Table 148 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>35%</td>
</tr>
<tr>
<td>LPG</td>
<td>35%</td>
</tr>
<tr>
<td>Heating oil</td>
<td>35%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>35%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
<tr>
<td>Biomass</td>
<td>35%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>35%</td>
</tr>
<tr>
<td>District heat</td>
<td>35%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>35%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration reduced energy expenses as estimated in Step 2.

*Table 149 Energy consumption of low-income households*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>9399</td>
</tr>
<tr>
<td>Space heating</td>
<td>5925</td>
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</tbody>
</table>
Step 4: Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration reduced energy expenses as estimated in the Step 2.

Table 150 Energy consumption of low-income households distributed by fuels

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>9399</td>
</tr>
<tr>
<td>Electricity</td>
<td>1288</td>
</tr>
<tr>
<td>Natural gas</td>
<td>1854</td>
</tr>
<tr>
<td>Heating oil</td>
<td>36</td>
</tr>
<tr>
<td>LNG</td>
<td>297</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>2654</td>
</tr>
<tr>
<td>District heat</td>
<td>1850</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>52</td>
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<tr>
<td>Ambient heat</td>
<td>121</td>
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<tr>
<td>Biomass</td>
<td>1248</td>
</tr>
</tbody>
</table>

Step 5: Identification of utilised means of heating and cooking for the case of households, which belong to the lowest income decile (data: HBS).

No change

Step 6: Modelling each different end-use separately for quantifying consumed energy carriers.

Number of low-income households (dwellings): 2,180,614

Table 151 Final energy consumption in low-income households

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>2808</td>
<td>125</td>
<td>0</td>
<td>203</td>
<td>304</td>
<td>2176</td>
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<tr>
<td>Heating oil</td>
<td>78</td>
<td>69</td>
<td></td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>647</td>
<td>26</td>
<td></td>
<td>31</td>
<td>591</td>
<td></td>
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<tr>
<td>Natural gas</td>
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<td>2160</td>
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<td>1071</td>
<td>811</td>
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<tr>
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<td>107</td>
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<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>263</td>
<td>184</td>
<td></td>
<td>79</td>
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<td></td>
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<tr>
<td>Biomass</td>
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<td>1320</td>
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<tr>
<td>Coal and other</td>
<td>5788</td>
<td>5199</td>
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<td>517</td>
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</table>
Step 7: Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and identified energy expenses (Step 2).

Cost deviation equal to 34% assuming the following prices:

Table 152 Utilised energy prices in Poland

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>125</td>
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<tr>
<td>Heating oil</td>
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<tr>
<td>LPG</td>
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<tr>
<td>Natural gas</td>
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<tr>
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<tr>
<td>District heating</td>
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</tr>
<tr>
<td>Coal and other</td>
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</table>
Modelling the impacts of the examined policies in Poland

Elasticities of demand
Electricity: -0.55 and heating: -0.50.

Baseline scenario

ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.
THE FORESEEN INCREASES OF ENERGY PRICES WITHIN THE FRAMEWORK OF THE EU REFERENCE SCENARIO 2020 WERE TAKEN INTO ACCOUNT.

Energy prices

Table 153 Energy prices in the baseline scenario for Poland

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
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<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>147</td>
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Final energy consumption (GWh)

Table 154 Final energy consumption in baseline scenario in Poland

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<th>2030</th>
<th>2035</th>
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</table>

**Table 155 Total energy costs in baseline scenario in Poland**
Scenario 1

ASSUMPTIONS: Scenario 1 was considered for the projection of ETS2 price.

Energy prices

Table 156 Energy prices in the Scenario 1 for Poland

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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<th>2040</th>
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</table>

Final energy consumption (GWh)

Table 157 Final energy consumption in Scenario 1 in Poland

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<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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<th>2040</th>
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<tbody>
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</table>

**Total energy costs (million €)**

*Table 158 Total energy costs in Scenario 1 in Poland*

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<tr>
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<td>53</td>
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<td>483</td>
<td>507</td>
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Scenario 2

ASSUMPTIONS: MANDATORY PHASE-OUT OF HEATING OIL AND SOLID FOSSIL FUELS IN 2030 AND NATURAL GAS (INCLUDING LNG) IN 2040.

IT WAS CONSIDERED THAT THE ACTUAL PHASE-OUT WILL HAVE OCCURRED AFTER FIVE YEARS (HEATING OIL AND SOLID FOSSIL FUELS IN 2035 AND NATURAL GAS AND LNG IN 2045), AND HEAT PUMPS WILL REPLACE THE EXISTING HEATING SYSTEMS.

Energy prices

<table>
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<tr>
<th>Energy prices (€/MWh)</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>72</td>
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Final energy consumption (GWh)

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<table>
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<tr>
<th>Domestic hot water (DWH)</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>730</td>
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<td>0</td>
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### Total energy costs (million €)

**Table 161 Total energy costs in Scenario 2 in Poland**

<table>
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<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
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<th>2030</th>
<th>2035</th>
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<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<tr>
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<td>202</td>
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<td>42</td>
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<td>117</td>
<td>266</td>
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<tr>
<td>Coal and other</td>
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<td>0</td>
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<tr>
<td>Total</td>
<td>567</td>
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<td>609</td>
<td>563</td>
<td>579</td>
<td>521</td>
<td>529</td>
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</table>

### Investments foreseen in Scenario 2 in Poland

**Table 162 Investments foreseen in Scenario 2 in Poland**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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</table>
Scenario 3

Assumptions: Establishment of MEPS for achieving energy class E in 2035.

50% of affected households (75% of total low-income households) will renovate their buildings until 2030 (818 thousand buildings) and remain until 2035 (818 thousand buildings).

Assumptions for buildings’ energy upgrade: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all buildings will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 163 Energy prices in the Scenario 3 for Poland

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
<td>Heating oil</td>
<td>90</td>
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<td>120</td>
<td>135</td>
<td>150</td>
<td>165</td>
<td>180</td>
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<tr>
<td>Natural gas</td>
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<td>72</td>
<td>86</td>
<td>99</td>
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<tr>
<td>Solid fossil fuels</td>
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</tr>
<tr>
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<tr>
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<td>80</td>
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<td>107</td>
<td>120</td>
<td>133</td>
<td>147</td>
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</tbody>
</table>

Final energy consumption (GWh)

Table 164 Final energy consumption in Scenario 3 in Poland

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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</thead>
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**Total energy costs (million €)**

Table 165 Total energy costs in Scenario 3 in Poland

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Table 166 Investments foreseen in Scenario 3 in Poland

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Scenario 4

Assumptions: Combination of Scenarios 2 and 3

Energy prices

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Final energy consumption (GWh)

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### Total energy costs (million €)

**Table 169 Total energy costs in Scenario 4 in Poland**

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<th>Space heating, cooling and DHW</th>
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**Table 170 Investments foreseen in Scenario 4 in Poland**

<table>
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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

Table 171 Energy prices in the Scenario 5 for Poland

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Final energy consumption (GWh)

Table 172 Final energy consumption in Scenario 5 in Poland

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<td>Coal and other</td>
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<td>491</td>
<td>386</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>107</td>
<td>107</td>
<td>107</td>
<td>107</td>
<td>107</td>
<td>107</td>
<td>107</td>
</tr>
<tr>
<td>Total</td>
<td>3563</td>
<td>3372</td>
<td>3125</td>
<td>2736</td>
<td>2654</td>
<td>2522</td>
<td>2489</td>
</tr>
</tbody>
</table>

Space heating, cooling and DHW

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>78</td>
<td>72</td>
<td>58</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Space heating, cooling and DHW</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Heating oil</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>145</td>
<td>161</td>
<td>164</td>
<td>167</td>
<td>173</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>53</td>
<td>53</td>
<td>48</td>
<td>43</td>
<td>40</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>202</td>
<td>202</td>
<td>186</td>
<td>173</td>
<td>165</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>Electricity</td>
<td>41</td>
<td>41</td>
<td>40</td>
<td>134</td>
<td>131</td>
<td>226</td>
<td>233</td>
</tr>
<tr>
<td>Coal and other</td>
<td>114</td>
<td>119</td>
<td>120</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>567</td>
<td>589</td>
<td>571</td>
<td>523</td>
<td>514</td>
<td>431</td>
<td>438</td>
</tr>
</tbody>
</table>

**Total energy costs (million €)**

*Table 173 Total energy costs in Scenario 5 in Poland*

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>5479</td>
<td>0</td>
<td>2523</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>8177</td>
<td>8177</td>
<td>8177</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>8177</td>
<td>13657</td>
<td>8177</td>
<td>2523</td>
<td>0</td>
</tr>
</tbody>
</table>

*Table 174 Investments foreseen in Scenario 5 in Poland*
Synopsis

Comparison of final energy consumption

Figure 24 Comparison of final energy consumption between scenarios in Poland

Comparison of investments in different scenarios

Figure 25 Investments in different scenarios in Poland

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td></td>
<td>0</td>
<td>0</td>
<td>6987</td>
<td>0</td>
<td>2958</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Building envelope</td>
<td></td>
<td>0</td>
<td>8177</td>
<td>8177</td>
<td>8177</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Heat pumps</td>
<td></td>
<td>0</td>
<td>0</td>
<td>6987</td>
<td>0</td>
<td>2793</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td></td>
<td>0</td>
<td>8177</td>
<td>8177</td>
<td>8177</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0</td>
<td>8177</td>
<td>15164</td>
<td>8177</td>
<td>2793</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Heat pumps</td>
<td></td>
<td>0</td>
<td>0</td>
<td>5479</td>
<td>0</td>
<td>2523</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td></td>
<td>0</td>
<td>8177</td>
<td>8177</td>
<td>8177</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0</td>
<td>8177</td>
<td>13657</td>
<td>8177</td>
<td>2523</td>
<td>0</td>
</tr>
</tbody>
</table>
Comparison of the total energy costs

Figure 26 Comparison of final energy costs between scenarios in Poland
5.7 PORTUGAL

5.7.1 Determination of baseline

**Step 1:** Estimation of unitary final energy consumption for different end-uses of the average household in Portugal according to data about disaggregated final energy consumption of households (*data: Eurostat*).

*Table 175 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>8081</td>
</tr>
<tr>
<td>Space heating</td>
<td>2207</td>
</tr>
<tr>
<td>Space cooling</td>
<td>51</td>
</tr>
<tr>
<td>DHW</td>
<td>1425</td>
</tr>
<tr>
<td>Cooking</td>
<td>2919</td>
</tr>
<tr>
<td>Other</td>
<td>1480</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of reduced energy expenses of households, which belong to the lowest income decile compared with energy expenses of the average household (*data: HBS*).

*Table 176 Comparison of expenses between average and low-income household*  

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>45%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>30%</td>
</tr>
<tr>
<td>Oil</td>
<td>43%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>100%</td>
</tr>
<tr>
<td>District heat</td>
<td>100%</td>
</tr>
<tr>
<td>Biomass</td>
<td>67%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>45%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration reduced energy expenses as estimated in Step 2.

*Table 177 Energy consumption of low-income households*  

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Space heating</td>
<td></td>
</tr>
<tr>
<td>Space cooling</td>
<td></td>
</tr>
<tr>
<td>DHW</td>
<td></td>
</tr>
<tr>
<td>Cooking</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>
### Step 4: Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration reduced energy expenses as estimated in the Step 2.

**Table 178 Energy consumption of low-income households distributed by fuels**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4184</td>
</tr>
<tr>
<td>Electricity</td>
<td>1750</td>
</tr>
<tr>
<td>Natural gas</td>
<td>559</td>
</tr>
<tr>
<td>Oil</td>
<td>648</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>0</td>
</tr>
<tr>
<td>District heat</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>692</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>162</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>372</td>
</tr>
</tbody>
</table>

### Step 5: Identification of utilised means of heating and cooking for the case of households, which belong to the lowest income decile \textit{(data: HBS)}.

No change

### Step 6: Modelling each different end-use separately for quantifying consumed energy carriers.

Number of low-income households (dwellings): \textbf{263,033}

**Table 179 Final energy consumption in low-income households**

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>460</td>
<td>42</td>
<td>7</td>
<td>11</td>
<td>187</td>
<td>214</td>
</tr>
<tr>
<td>Heating oil</td>
<td>21</td>
<td>13</td>
<td>6</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>150</td>
<td>4</td>
<td>8</td>
<td>80</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>147</td>
<td>5</td>
<td>91</td>
<td>91</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Solar thermal</td>
<td>43</td>
<td>3</td>
<td>39</td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>182</td>
<td>94</td>
<td>11</td>
<td>78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>98</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>District heating</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Step 7: Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and identified energy expenses (Step 2).

Cost deviation equal to -13% assuming the following prices:

Table 180 Utilised energy prices in Portugal

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>135</td>
</tr>
<tr>
<td>Electricity</td>
<td>240</td>
</tr>
<tr>
<td>Natural gas</td>
<td>94</td>
</tr>
<tr>
<td>Biomass</td>
<td>91</td>
</tr>
<tr>
<td>District heating</td>
<td>50</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>156</td>
</tr>
<tr>
<td>Coal and other</td>
<td>30</td>
</tr>
</tbody>
</table>
5.7.2 Modelling the impacts of the examined policies in Portugal

Elasticities of demand
Electricity: -0.616 and heating: -0.353.

Baseline scenario

ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.
THE FORESEEN INCREASES OF ENERGY PRICES WITHIN THE FRAMEWORK OF THE EU REFERENCE SCENARIO 2020 WERE TAKEN INTO ACCOUNT.

Energy prices

*Table 181 Energy prices in the baseline scenario for Portugal*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>135</td>
<td>158</td>
<td>180</td>
<td>203</td>
<td>225</td>
<td>248</td>
<td>270</td>
</tr>
<tr>
<td>Natural gas</td>
<td>94</td>
<td>122</td>
<td>150</td>
<td>179</td>
<td>207</td>
<td>216</td>
<td>226</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Electricity</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>241</td>
<td>241</td>
<td>242</td>
<td>242</td>
</tr>
<tr>
<td>LPG</td>
<td>156</td>
<td>182</td>
<td>207</td>
<td>233</td>
<td>259</td>
<td>285</td>
<td>311</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

*Table 182 Final energy consumption in baseline scenario in Portugal*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>13</td>
<td>12</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Natural gas</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>LPG</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Biomass</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>98</td>
<td>98</td>
<td>98</td>
<td>98</td>
<td>98</td>
<td>98</td>
<td>97</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>District heating</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Electricity</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>41</td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>258</td>
<td>257</td>
<td>255</td>
<td>254</td>
<td>253</td>
<td>253</td>
<td>252</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Space cooling</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
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<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Natural gas</td>
<td>91</td>
<td>81</td>
<td>75</td>
<td>70</td>
<td>66</td>
<td>65</td>
<td>64</td>
</tr>
<tr>
<td>Heating oil</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
### Total energy costs (million €)

*Table 183 Total energy costs in baseline scenario in Portugal*

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>504</td>
<td>488</td>
<td>476</td>
<td>467</td>
<td>459</td>
<td>455</td>
<td>451</td>
</tr>
<tr>
<td>Natural gas</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>14</td>
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Scenario 1

ASSUMPTIONS: SCENARIO 1 WAS CONSIDERED FOR THE PROJECTION OF ETS2 PRICE.

Energy prices

Table 184 Energy prices in the Scenario 1 for Portugal

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
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<tr>
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<td>Solid fossil fuels</td>
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Final energy consumption (GWh)

Table 185 Final energy consumption in Scenario 1 in Portugal

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<th>2025</th>
<th>2030</th>
<th>2035</th>
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<td>94</td>
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<th>2035</th>
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<td>11</td>
<td>11</td>
<td>11</td>
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<td>Natural gas</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
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<tr>
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<td>488</td>
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<td>443</td>
<td>431</td>
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</table>

**Total energy costs (million €)**

*Table 186 Total energy costs in Scenario 1 in Portugal*

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<tr>
<th>Source of energy</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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</tr>
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<td>14</td>
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<td>63</td>
<td>68</td>
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<td>78</td>
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Scenario 2

ASSUMPTIONS: MANDATORY PHASE-OUT OF HEATING OIL AND SOLID FOSSIL FUELS IN 2030 AND
NATURAL GAS (INCLUDING LNG) IN 2040.

IT WAS CONSIDERED THAT THE ACTUAL PHASE-OUT WILL HAVE OCCURRED AFTER FIVE YEARS (HEATING
OIL AND SOLID FOSSIL FUELS IN 2035 AND NATURAL GAS AND LNG IN 2045), AND HEAT PUMPS WILL
REPLACE THE EXISTING HEATING SYSTEMS.

Energy prices

Table 187 Energy prices in the Scenario 2 for Portugal

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
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<td>158</td>
<td>180</td>
<td>203</td>
<td>225</td>
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<tr>
<td>Natural gas</td>
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<td>122</td>
<td>150</td>
<td>179</td>
<td>207</td>
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<td>226</td>
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<td>Solid fossil fuels</td>
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<td>207</td>
<td>233</td>
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<td>285</td>
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Final energy consumption (GWh)

Table 188 Final energy consumption in Scenario 2 in Portugal

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<th>2030</th>
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<table>
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<th>Domestic hot water (DWH)</th>
<th>2019</th>
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<th>2035</th>
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<td>77</td>
<td>77</td>
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<tr>
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<td>11</td>
<td>11</td>
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<tr>
<td>Coal and other</td>
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<td>0</td>
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<td>0</td>
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</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>39</td>
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</tbody>
</table>
### Total energy costs (million €)

**Table 189 Total energy costs in Scenario 2 in Portugal**

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>21</td>
<td>19</td>
<td>18</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Natural gas</td>
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<td>78</td>
<td>73</td>
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<tr>
<td>LPG</td>
<td>83</td>
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<tr>
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<td>105</td>
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<td>105</td>
<td>105</td>
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<td>Solar thermal</td>
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<tr>
<td>District heating</td>
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<td>0</td>
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<tr>
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<td>60</td>
<td>60</td>
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<td>Coal and other</td>
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<td>0</td>
<td>0</td>
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<td><strong>Total</strong></td>
<td>504</td>
<td>488</td>
<td>476</td>
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### Investments foreseen in Scenario 2 in Portugal

**Table 190 Investments foreseen in Scenario 2 in Portugal**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
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<td>52</td>
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Scenario 3

Assumptions: Establishment of MEPS for achieving energy class E in 2035.

50% of affected households (75% of total low-income households) will renovate their buildings until 2030 (99 thousand buildings) and remain until 2035 (99 thousand buildings).

Assumptions for buildings’ energy upgrade: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all buildings will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 191 Energy prices in the Scenario 3 for Portugal

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>135</td>
<td>158</td>
<td>180</td>
<td>203</td>
<td>225</td>
<td>248</td>
<td>270</td>
</tr>
<tr>
<td>Natural gas</td>
<td>94</td>
<td>122</td>
<td>150</td>
<td>179</td>
<td>207</td>
<td>216</td>
<td>226</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
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<td>38</td>
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<tr>
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<td>240</td>
<td>241</td>
<td>241</td>
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<tr>
<td>LPG</td>
<td>156</td>
<td>182</td>
<td>207</td>
<td>233</td>
<td>259</td>
<td>285</td>
<td>311</td>
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Final energy consumption (GWh)

Table 192 Final energy consumption in Scenario 3 in Portugal

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
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<tr>
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<tr>
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</tr>
<tr>
<td>Biomass</td>
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<td>94</td>
<td>83</td>
<td>74</td>
<td>68</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>98</td>
<td>98</td>
<td>87</td>
<td>77</td>
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<td>71</td>
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<tr>
<td>Solar thermal</td>
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<td>3</td>
</tr>
<tr>
<td>District heating</td>
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<tr>
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<td>33</td>
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<th>2040</th>
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<td>5</td>
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<table>
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<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>------</td>
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</tr>
<tr>
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<td>65</td>
<td>63</td>
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<tr>
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<td>85</td>
<td>79</td>
<td>79</td>
<td>79</td>
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<tr>
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<td>87</td>
<td>77</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Total</td>
<td>504</td>
<td>488</td>
<td>447</td>
<td>411</td>
<td>388</td>
<td>384</td>
<td>380</td>
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</table>

**Total energy costs (million €)**

*Table 193 Total energy costs in Scenario 3 in Portugal*

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>Natural gas</td>
<td>9</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>LPG</td>
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<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>19</td>
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<tr>
<td>Biomass</td>
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<td>9</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
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<td>District heating</td>
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<td>0</td>
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<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>52</td>
<td>53</td>
<td>55</td>
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</table>

*Table 194 Investments foreseen in Scenario 3 in Portugal*
Scenario 4

ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3

Energy prices

*Table 195 Energy prices in the Scenario 4 for Portugal*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>135</td>
<td>158</td>
<td>180</td>
<td>203</td>
<td>225</td>
<td>248</td>
<td>270</td>
</tr>
<tr>
<td>Natural gas</td>
<td>94</td>
<td>122</td>
<td>150</td>
<td>179</td>
<td>207</td>
<td>216</td>
<td>226</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
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<td>240</td>
<td>241</td>
<td>241</td>
<td>242</td>
<td>242</td>
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<tr>
<td>LPG</td>
<td>156</td>
<td>182</td>
<td>207</td>
<td>233</td>
<td>259</td>
<td>285</td>
<td>311</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

*Table 196 Final energy consumption in Scenario 4 in Portugal*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>5</td>
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<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>94</td>
<td>94</td>
<td>83</td>
<td>74</td>
<td>68</td>
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<td>68</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>98</td>
<td>98</td>
<td>87</td>
<td>68</td>
<td>62</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Solar thermal</td>
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<tr>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>Electricity</td>
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<td>37</td>
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<td>64</td>
<td>63</td>
</tr>
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<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
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<td>258</td>
<td>257</td>
<td>227</td>
<td>238</td>
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<td>199</td>
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<table>
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<tr>
<th>Space cooling</th>
<th>2019</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>6</td>
<td>5</td>
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<td>Total</td>
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<td>7</td>
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<td>6</td>
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<td>5</td>
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</table>

<table>
<thead>
<tr>
<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tbody>
<tr>
<td>Electricity</td>
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<td>77</td>
<td>77</td>
<td>192</td>
<td>192</td>
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<tr>
<td>Natural gas</td>
<td>91</td>
<td>81</td>
<td>75</td>
<td>70</td>
<td>66</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Heating oil</td>
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<td>7</td>
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<td>Biomass</td>
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<td>11</td>
<td>11</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>39</td>
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<th>Space heating, cooling and DWH</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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### Total energy costs (million €)

**Table 197 Total energy costs in Scenario 4 in Portugal**

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Ambient heat</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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**Table 198 Investments foreseen in Scenario 4 in Portugal**

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<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

Table 199 Energy prices in the Scenario 5 for Portugal

<table>
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<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>135</td>
<td>158</td>
<td>185</td>
<td>217</td>
<td>248</td>
<td>295</td>
<td>342</td>
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<tr>
<td>Natural gas</td>
<td>94</td>
<td>122</td>
<td>155</td>
<td>189</td>
<td>224</td>
<td>252</td>
<td>281</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>57</td>
<td>71</td>
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<td>241</td>
<td>242</td>
<td>242</td>
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<tr>
<td>LPG</td>
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<td>248</td>
<td>282</td>
<td>333</td>
<td>384</td>
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Final energy consumption (GWh)

Table 200 Final energy consumption in Scenario 5 in Portugal

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<th>Space heating</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2050</th>
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</thead>
<tbody>
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<td>13</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>3</td>
<td>3</td>
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<td>LPG</td>
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<td>3</td>
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<td>0</td>
</tr>
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<td>94</td>
<td>94</td>
<td>83</td>
<td>74</td>
<td>68</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>98</td>
<td>98</td>
<td>87</td>
<td>68</td>
<td>62</td>
<td>65</td>
<td>65</td>
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<td>3</td>
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<td>District heating</td>
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<td>0</td>
<td>0</td>
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<td>37</td>
<td>89</td>
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<td>63</td>
<td>63</td>
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<td>Coal and other</td>
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<tr>
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<th>2035</th>
<th>2040</th>
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<table>
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<th>Domestic hot water (DWH)</th>
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<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2050</th>
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</thead>
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<td>76</td>
<td>76</td>
<td>183</td>
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<td>74</td>
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<tr>
<td>District heating</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>80</td>
<td>75</td>
<td>70</td>
<td>66</td>
<td>63</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Solar thermal</td>
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<td>39</td>
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<tr>
<td>Total</td>
<td>239</td>
<td>224</td>
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<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
<tr>
<td>Heating oil</td>
<td>21</td>
<td>19</td>
<td>17</td>
<td>0</td>
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</table>
Natural gas  |  95  |  85  |  77  |  70  |  66  |  0   |  0   
LPG         |  83  |  78  |  73  |  69  |  65  |  0   |  0   
Biomass     | 105  | 105  |  94  |  85  |  79  |  79  |  79  
Ambient heat|  98  |  98  |  87  |  68  |  62  |  65  |  65  
Solar thermal|  43  |  43  |  42  |  42  |  42  |  42  |  42  
District heating|  0  |  0   |  0   |  0   |  0   |  0   |  0   
Electricity |  60  |  60  |  55  | 170  | 163  | 252  | 251  
Coal and other|  0   |  0   |  0   |  0   |  0   |  0   |  0   
Total       | 504  | 488  | 444  | 503  | 477  | 437  | 437  

**Total energy costs (million €)**

*Table 201 Total energy costs in Scenario 5 in Portugal*

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>0</td>
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<td>8</td>
<td>7</td>
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<td>7</td>
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<td>Ambient heat</td>
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*Table 202 Investments foreseen in Scenario 5 in Portugal*

<table>
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<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<tbody>
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Synopsis

Comparison of final energy consumption

![Comparison of final energy consumption between scenarios in Portugal](image)

Comparison of investments in different scenarios

![Investments in different scenarios in Portugal](image)

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Investments (million €)</th>
<th>2025</th>
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<th>2050</th>
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</tr>
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<td>43</td>
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</tr>
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</table>
Comparison of total energy costs

Figure 29 Comparison of final energy costs between scenarios in Portugal
5.8 ROMANIA

5.8.1 Determination of baseline

**Step 1:** Estimation of the unitary final energy consumption for different end-uses of the average household in Romania according to data on disaggregated final energy consumption of households (*data: Eurostat*).

<table>
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<th>Average household (kWh/HH)</th>
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<td>Cooking</td>
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<tr>
<td>Other</td>
<td>1642</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of reduced energy expenses of households, which belong to the lowest income decile compared with energy expenses of the average household (*data: HBS*).

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>6%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>9%</td>
</tr>
<tr>
<td>Oil</td>
<td>7%</td>
</tr>
<tr>
<td>LPG</td>
<td>7%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>7%</td>
</tr>
<tr>
<td>District heat</td>
<td>7%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>6%</td>
</tr>
<tr>
<td>Biomass</td>
<td>7%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration reduced energy expenses as estimated in Step 2.
Table 205 Energy consumption of low-income households

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11074</td>
</tr>
<tr>
<td>Space heating</td>
<td>6887</td>
</tr>
<tr>
<td>Space cooling</td>
<td>37</td>
</tr>
<tr>
<td>DHW</td>
<td>1503</td>
</tr>
<tr>
<td>Cooking</td>
<td>1105</td>
</tr>
<tr>
<td>Other</td>
<td>1542</td>
</tr>
</tbody>
</table>

Step 4: Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration reduced energy expenses as estimated in the Step 2.

Table 206 Energy consumption of low-income households distributed by fuels

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11074</td>
</tr>
<tr>
<td>Electricity</td>
<td>1625</td>
</tr>
<tr>
<td>Natural gas</td>
<td>3513</td>
</tr>
<tr>
<td>Oil</td>
<td>59</td>
</tr>
<tr>
<td>LPG</td>
<td>413</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>59</td>
</tr>
<tr>
<td>District heat</td>
<td>1016</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>4389</td>
</tr>
</tbody>
</table>

Step 5: Identification of the utilised means of heating and cooking for the case of households, which belong to the lowest income decile (data: HBS).

No change

Step 6: Modelling each different end-use separately for quantifying consumed energy carriers.

Number of low-income households (dwellings): 1,125,840

Table 207 Final energy consumption in low-income households

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>1830</td>
<td>16</td>
<td>42</td>
<td>35</td>
<td>1</td>
<td>1736</td>
</tr>
<tr>
<td>Heating oil</td>
<td>67</td>
<td>0</td>
<td>0</td>
<td>14</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>465</td>
<td>1</td>
<td>0</td>
<td>97</td>
<td>367</td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>3955</td>
<td>2315</td>
<td>899</td>
<td>740</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Final energy consumption (GWh)</td>
<td>Total</td>
<td>Heating</td>
<td>Cooling</td>
<td>DHW</td>
<td>Cooking</td>
<td>Electric appliances &amp; Lighting</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------</td>
<td>---------</td>
<td>---------</td>
<td>-----</td>
<td>---------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>4942</td>
<td>4232</td>
<td>632</td>
<td>78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>District heating</td>
<td>1144</td>
<td>1144</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal and other</td>
<td>66</td>
<td>46</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>12467</td>
<td>7753</td>
<td>42</td>
<td>1692</td>
<td>1244</td>
<td>1736</td>
</tr>
</tbody>
</table>

**Step 7**: Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and identified energy expenses (Step 2).

Cost deviation equal to 3% assuming the following prices:

*Table 208 Utilised energy prices in Romania*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>80</td>
</tr>
<tr>
<td>Electricity</td>
<td>135</td>
</tr>
<tr>
<td>Natural gas</td>
<td>40</td>
</tr>
<tr>
<td>Biomass</td>
<td>20</td>
</tr>
<tr>
<td>District heating</td>
<td>50</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
</tr>
<tr>
<td>Coal and other</td>
<td>10</td>
</tr>
</tbody>
</table>
5.8.2 Modelling the impacts of the examined policies in Romania

Elasticities of demand
Electricity: -0.55 and heating: -0.50.

Baseline scenario

**ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.**

The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account.

Energy prices

*Table 209 Energy prices in the baseline scenario for Romania*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>80</td>
<td>93</td>
<td>107</td>
<td>120</td>
<td>133</td>
<td>147</td>
<td>160</td>
</tr>
<tr>
<td>Natural gas</td>
<td>40</td>
<td>52</td>
<td>64</td>
<td>76</td>
<td>88</td>
<td>92</td>
<td>96</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Electricity</td>
<td>135</td>
<td>135</td>
<td>136</td>
<td>139</td>
<td>142</td>
<td>147</td>
<td>152</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>227</td>
<td>255</td>
<td>283</td>
<td>312</td>
<td>340</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

*Table 210 Final energy consumption in baseline scenario in Romania*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2315</td>
<td>2116</td>
<td>2020</td>
<td>1979</td>
<td>1823</td>
<td>1781</td>
<td>1743</td>
</tr>
<tr>
<td>LPG</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>1144</td>
<td>953</td>
<td>762</td>
<td>572</td>
<td>572</td>
<td>572</td>
<td>572</td>
</tr>
<tr>
<td>Electricity</td>
<td>16</td>
<td>73</td>
<td>130</td>
<td>186</td>
<td>183</td>
<td>180</td>
<td>177</td>
</tr>
<tr>
<td>Coal and other</td>
<td>46</td>
<td>43</td>
<td>41</td>
<td>40</td>
<td>39</td>
<td>38</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>7753</td>
<td>7418</td>
<td>7187</td>
<td>7009</td>
<td>6850</td>
<td>6804</td>
<td>6761</td>
</tr>
<tr>
<td>Space cooling</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Electricity</td>
<td>42</td>
<td>41</td>
<td>41</td>
<td>41</td>
<td>40</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>41</td>
<td>41</td>
<td>41</td>
<td>40</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>Domestic hot water (DWH)</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Electricity</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>34</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>Natural gas</td>
<td>899</td>
<td>765</td>
<td>676</td>
<td>613</td>
<td>565</td>
<td>552</td>
<td>540</td>
</tr>
<tr>
<td>Heating oil</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>District heating</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>97</td>
<td>89</td>
<td>82</td>
<td>77</td>
<td>73</td>
<td>69</td>
<td>66</td>
</tr>
<tr>
<td>Biomass</td>
<td>632</td>
<td>632</td>
<td>632</td>
<td>632</td>
<td>632</td>
<td>632</td>
<td>632</td>
</tr>
<tr>
<td>Coal and other</td>
<td>15</td>
<td>14</td>
<td>14</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1692</td>
<td>1547</td>
<td>1451</td>
<td>1381</td>
<td>1327</td>
<td>1309</td>
<td>1293</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating, cooling and DHW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating oil</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Natural gas</td>
<td>3215</td>
<td>2881</td>
<td>2697</td>
<td>2592</td>
<td>2387</td>
<td>2333</td>
<td>2282</td>
</tr>
<tr>
<td>LPG</td>
<td>97</td>
<td>89</td>
<td>83</td>
<td>78</td>
<td>73</td>
<td>70</td>
<td>67</td>
</tr>
<tr>
<td>Biomass</td>
<td>4864</td>
<td>4864</td>
<td>4864</td>
<td>4864</td>
<td>4864</td>
<td>4864</td>
<td>4864</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>1144</td>
<td>953</td>
<td>762</td>
<td>572</td>
<td>572</td>
<td>572</td>
<td>572</td>
</tr>
<tr>
<td>Electricity</td>
<td>92</td>
<td>149</td>
<td>206</td>
<td>261</td>
<td>258</td>
<td>253</td>
<td>249</td>
</tr>
<tr>
<td>Coal and other</td>
<td>61</td>
<td>58</td>
<td>55</td>
<td>53</td>
<td>52</td>
<td>51</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9487</td>
<td>9007</td>
<td>8679</td>
<td>8431</td>
<td>8217</td>
<td>8153</td>
<td>8093</td>
</tr>
</tbody>
</table>

**Total energy costs (million €)**

*Table 211 Total energy costs in baseline scenario in Romania*
Scenario 1

ASSUMPTIONS: SCENARIO 1 WAS CONSIDERED FOR THE PROJECTION OF ETS2 PRICE.

Energy prices

Table 212 Energy prices in the Scenario 1 for Romania

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>80</td>
<td>93</td>
<td>151</td>
<td>204</td>
<td>213</td>
<td>240</td>
<td>268</td>
</tr>
<tr>
<td>Natural gas</td>
<td>40</td>
<td>52</td>
<td>97</td>
<td>140</td>
<td>149</td>
<td>163</td>
<td>178</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>10</td>
<td>11</td>
<td>72</td>
<td>126</td>
<td>121</td>
<td>141</td>
<td>161</td>
</tr>
<tr>
<td>Electricity</td>
<td>135</td>
<td>135</td>
<td>136</td>
<td>139</td>
<td>142</td>
<td>147</td>
<td>152</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>271</td>
<td>339</td>
<td>363</td>
<td>405</td>
<td>448</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

Table 213 Final energy consumption in Scenario 1 in Romania

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>2315</td>
<td>2116</td>
<td>1339</td>
<td>1196</td>
<td>1015</td>
<td>890</td>
<td>801</td>
</tr>
<tr>
<td>LPG</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
<td>4232</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>1144</td>
<td>953</td>
<td>762</td>
<td>572</td>
<td>572</td>
<td>572</td>
<td>572</td>
</tr>
<tr>
<td>Electricity</td>
<td>16</td>
<td>73</td>
<td>130</td>
<td>186</td>
<td>183</td>
<td>180</td>
<td>177</td>
</tr>
<tr>
<td>Coal and other</td>
<td>46</td>
<td>43</td>
<td>0</td>
<td>0</td>
<td>0</td>
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Space heating, cooling and DHW | 2019 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
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<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
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### Total energy costs (million €)

**Table 214 Total energy costs in Scenario 1 in Romania**

<table>
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<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td></td>
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<td>District heating</td>
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<td>357</td>
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<td>425</td>
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Scenario 2

ASSUMPTIONS: MANDATORY PHASE-OUT OF HEATING OIL AND SOLID FOSSIL FUELS IN 2030 AND NATURAL GAS (INCLUDING LNG) IN 2040.

IT WAS CONSIDERED THAT THE ACTUAL PHASE-OUT WILL HAVE OCCURRED AFTER FIVE YEARS (HEATING OIL AND SOLID FOSSIL FUELS IN 2035 AND NATURAL GAS AND LNG IN 2045), AND HEAT PUMPS WILL REPLACE THE EXISTING HEATING SYSTEMS.

Energy prices

Table 215 Energy prices in the Scenario 2 for Romania

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
<tr>
<td>Heating oil</td>
<td>80</td>
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<td>107</td>
<td>120</td>
<td>133</td>
<td>147</td>
<td>160</td>
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<td>Natural gas</td>
<td>40</td>
<td>52</td>
<td>64</td>
<td>76</td>
<td>88</td>
<td>92</td>
<td>96</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>255</td>
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Final energy consumption (GWh)

Table 216 Final energy consumption in Scenario 2 in Romania

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<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<tr>
<td>District heating</td>
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<td>953</td>
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**Total energy costs (million €)**

*Table 217 Total energy costs in Scenario 2 in Romania*

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<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>97</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
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<td>29</td>
<td>29</td>
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<td>28</td>
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<td>0</td>
<td>0</td>
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<td>391</td>
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<td>319</td>
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</table>

*Table 218 Investments foreseen in Scenario 2 in Romania*

<table>
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<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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</table>
Scenario 3

Assumptions: Establishment of MEPS for achieving energy class E in 2035.

50% of affected households (75% of total low-income households) will renovate their buildings until 2030 (422 thousand buildings) and remain until 2035 (422 thousand buildings).

Assumptions for buildings’ energy upgrade: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all buildings will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 219 Energy prices in the Scenario 3 for Romania

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
<tr>
<td>Heating oil</td>
<td>80</td>
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<tr>
<td>Natural gas</td>
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<td>64</td>
<td>76</td>
<td>88</td>
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<tr>
<td>Solid fossil fuels</td>
<td>10</td>
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</table>

Final energy consumption (GWh)

Table 220 Final energy consumption in Scenario 3 in Romania

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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<td>0</td>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<table>
<thead>
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<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>Natural gas</td>
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<td>765</td>
<td>676</td>
<td>613</td>
<td>565</td>
<td>552</td>
<td>540</td>
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<tr>
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### Total energy costs (million €)

Table 221 Total energy costs in Scenario 3 in Romania

<table>
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<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
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<td>22</td>
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<td>79</td>
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<td>0</td>
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Table 222 Investments foreseen in Scenario 3 in Romania

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<th>2025</th>
<th>2030</th>
<th>2035</th>
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Scenario 4

ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3

Energy prices

Table 223 Energy prices in the Scenario 4 for Romania

<table>
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<th>Energy prices (€/MWh)</th>
<th>2019</th>
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<th>2035</th>
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<th>2045</th>
<th>2050</th>
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<td>227</td>
<td>255</td>
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Final energy consumption (GWh)

Table 224 Final energy consumption in Scenario 4 in Romania

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<thead>
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<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<td>3084</td>
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<td>0</td>
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<td>District heating</td>
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<td>953</td>
<td>677</td>
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<td>32</td>
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<table>
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<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<th>2045</th>
<th>2050</th>
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<td>0</td>
</tr>
<tr>
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<td>0</td>
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</tr>
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<th>2030</th>
<th>2035</th>
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## Table 225 Total energy costs in Scenario 4 in Romania

<table>
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<th>2035</th>
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<td>19</td>
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<td>Biomass</td>
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<td>74</td>
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<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Solar thermal</td>
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<td>0</td>
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<tr>
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<td>0</td>
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<td><strong>Total</strong></td>
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<td>327</td>
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<td>251</td>
<td>254</td>
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</table>

## Table 226 Investments foreseen in Scenario 4 in Romania

<table>
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<tr>
<th>Investments (million €)</th>
<th>2025</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

Table 227 Energy prices in the Scenario 5 for Romania

<table>
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<th>2019</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
<td>Heating oil</td>
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<td>93</td>
<td>112</td>
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<tr>
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<td>127</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>19</td>
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Final energy consumption (GWh)

Table 228 Final energy consumption in Scenario 5 in Romania

<table>
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<tr>
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<th>2025</th>
<th>2030</th>
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</tbody>
</table>

**Total energy costs (million €)**

*Table 229 Total energy costs in Scenario 5 in Romania*

<table>
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<tr>
<th></th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
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<td>337</td>
<td>226</td>
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</table>

*Table 230 Investments foreseen in Scenario 5 in Romania*

<table>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
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<td>0</td>
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<td>0</td>
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</tr>
<tr>
<td>Building envelope</td>
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<td>0</td>
</tr>
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</tbody>
</table>
Synopsis

Comparison of final energy consumption

![Comparison of final energy consumption between scenarios in Romania](figure30.png)

Comparison of investments in different scenarios

![Investments in different scenarios in Romania](figure31.png)

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Investments (million €)</th>
<th>2025</th>
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<th>2035</th>
<th>2040</th>
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<th>2050</th>
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<td>2368</td>
<td>0</td>
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</tbody>
</table>

<table>
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<tr>
<th>Scenario 3</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
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<th>Investments (million €)</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
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<td>4222</td>
<td>4222</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<table>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td></td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>0</td>
<td>2229</td>
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</tr>
</tbody>
</table>

<table>
<thead>
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<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
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<td>4222</td>
<td>4222</td>
<td>4222</td>
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<td></td>
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<td>4222</td>
<td>4246</td>
<td>4222</td>
<td>2229</td>
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</tr>
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</table>
Comparison of total energy costs

Figure 32 Comparison of final energy costs between scenarios in Romania
5.9 SLOVAKIA

5.9.1 Determination of baseline

**Step 1:** Estimation of unitary final energy consumption for different end-uses of the average household in Slovakia according to data about disaggregated final energy consumption of households (*data: Eurostat*).

*Table 231 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>16212</td>
</tr>
<tr>
<td>Space heating</td>
<td>11803</td>
</tr>
<tr>
<td>Space cooling</td>
<td>20</td>
</tr>
<tr>
<td>DHW</td>
<td>2037</td>
</tr>
<tr>
<td>Cooking</td>
<td>700</td>
</tr>
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<td>Other</td>
<td>1652</td>
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</table>

**Energy carrier**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>16212</td>
</tr>
<tr>
<td>Electricity</td>
<td>2877</td>
</tr>
<tr>
<td>Natural gas</td>
<td>6873</td>
</tr>
<tr>
<td>LPG</td>
<td>47</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>164</td>
</tr>
<tr>
<td>District heat</td>
<td>2479</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>42</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>172</td>
</tr>
<tr>
<td>Biomass</td>
<td>3559</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of reduced energy expenses of households, which belong to the lowest income decile compared with energy expenses of the average household (*data: HBS*).

*Table 232 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
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<tbody>
<tr>
<td>Electricity</td>
<td>28%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>28%</td>
</tr>
<tr>
<td>Oil</td>
<td>28%</td>
</tr>
<tr>
<td>LNG</td>
<td>28%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>28%</td>
</tr>
<tr>
<td>District heat</td>
<td>28%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>100%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>28%</td>
</tr>
<tr>
<td>Biomass</td>
<td>28%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration reduced energy expenses as estimated in Step 2.

*Table 233 Energy consumption of low-income households*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11715</td>
</tr>
</tbody>
</table>
### Step 4: Calculation of unitary final energy consumption of households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration reduced energy expenses as estimated in the Step 2.

**Table 234 Energy consumption of low-income households distributed by fuels**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>11715</td>
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<tr>
<td>Electricity</td>
<td>2079</td>
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<tr>
<td>Natural gas</td>
<td>4966</td>
</tr>
<tr>
<td>LPG</td>
<td>34</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>119</td>
</tr>
<tr>
<td>District heat</td>
<td>1791</td>
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<tr>
<td>Solar thermal</td>
<td>30</td>
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<td>124</td>
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<tr>
<td>Biomass</td>
<td>2571</td>
</tr>
</tbody>
</table>

### Step 5: Identification of utilised means of heating and cooking for the case of households, which belong to the lowest income decile (data: HBS).

No change

### Step 6: Modelling each different end-use separately for quantifying consumed energy carriers.

Number of low-income households (dwellings): **379,060**

**Table 235 Final energy consumption in low-income households**

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
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<tbody>
<tr>
<td>Electricity</td>
<td>788</td>
<td>178</td>
<td>5</td>
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<tr>
<td>LPG</td>
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<td>1520</td>
<td></td>
<td>230</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>Solar thermal</td>
<td>11</td>
<td>1</td>
<td></td>
<td>10</td>
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<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>47</td>
<td>47</td>
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<td>81</td>
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<tr>
<td>District heating</td>
<td>679</td>
<td>561</td>
<td></td>
<td>118</td>
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<td></td>
</tr>
<tr>
<td>Coal and other</td>
<td>45</td>
<td>27</td>
<td></td>
<td>12</td>
<td>6</td>
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</tr>
</tbody>
</table>
Step 7: Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and identified energy expenses (Step 2).

Cost deviation equal to -55% assuming the following prices:

Table 236 Validation numbers

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
</tr>
<tr>
<td>Electricity</td>
<td>185</td>
</tr>
<tr>
<td>Natural gas</td>
<td>45</td>
</tr>
<tr>
<td>Biomass</td>
<td>40</td>
</tr>
<tr>
<td>District heating</td>
<td>80</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
</tr>
<tr>
<td>Coal and other</td>
<td>30</td>
</tr>
</tbody>
</table>

Total | 4441 | 3233 | 5  | 558 | 192 | 453 |
5.9.2 Modelling the impacts of the examined policies in Slovakia

Elasticities of demand
Electricity: -0.55 and heating: -0.50.

Baseline scenario

ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.

THE FORESEEN INCREASES OF ENERGY PRICES WITHIN THE FRAMEWORK OF THE EU REFERENCE SCENARIO 2020 WERE TAKEN INTO ACCOUNT.

Energy prices

Table 237 Energy prices in the baseline scenario for Slovakia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>133</td>
<td>150</td>
<td>167</td>
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<td>200</td>
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<tr>
<td>Natural gas</td>
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<td>59</td>
<td>72</td>
<td>86</td>
<td>99</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>36</td>
<td>38</td>
<td>40</td>
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<td>44</td>
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<td>185</td>
<td>188</td>
<td>190</td>
<td>194</td>
<td>197</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>227</td>
<td>255</td>
<td>283</td>
<td>312</td>
<td>340</td>
</tr>
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</table>

Final energy consumption (GWh)

Table 238 Final energy consumption in baseline scenario in Slovakia

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>1036</td>
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<td>5</td>
</tr>
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<td>891</td>
<td>891</td>
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<td>891</td>
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<td>46</td>
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<tr>
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<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
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<td>561</td>
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<td>178</td>
<td>178</td>
<td>178</td>
<td>175</td>
<td>174</td>
<td>172</td>
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<td>Coal and other</td>
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<td>24</td>
<td>23</td>
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<td>2633</td>
<td>2610</td>
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<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
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<tr>
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<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Domestic hot water (DWH)</td>
<td>2019</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
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<tr>
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<td>104</td>
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<td>101</td>
<td>100</td>
</tr>
<tr>
<td>Natural gas</td>
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<td>196</td>
<td>173</td>
<td>157</td>
<td>144</td>
<td>141</td>
<td>138</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
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<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>District heating</td>
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<td>118</td>
<td>118</td>
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<tr>
<td>LPG</td>
<td>4</td>
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<td>3</td>
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</tr>
<tr>
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<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>Ambient heat</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>558</td>
<td>522</td>
<td>499</td>
<td>482</td>
<td>468</td>
<td>464</td>
<td>459</td>
</tr>
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</table>

**Table 239 Total energy costs in baseline scenario in Slovakia**

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>1488</td>
<td>1316</td>
<td>1193</td>
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<td>1073</td>
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<td>LPG</td>
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<td>9</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>8</td>
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<td>Biomass</td>
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<td>47</td>
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<td>46</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
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<td>11</td>
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<tr>
<td>District heating</td>
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<td>679</td>
<td>679</td>
<td>679</td>
<td>679</td>
<td>679</td>
<td>679</td>
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<tr>
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<td>287</td>
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<td>283</td>
<td>280</td>
<td>278</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>37</td>
<td>35</td>
<td>34</td>
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<tr>
<td><strong>Total</strong></td>
<td>3796</td>
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<td>3356</td>
<td>3229</td>
<td>3131</td>
<td>3102</td>
<td>3074</td>
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</tbody>
</table>
Scenario 1

**ASSUMPTIONS:** SCENARIO 1 WAS CONSIDERED FOR THE PROJECTION OF ETS2 PRICE.

Energy prices

*Table 240 Energy prices in the Scenario 1 for Slovakia*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>178</td>
<td>234</td>
<td>247</td>
<td>278</td>
<td>309</td>
</tr>
<tr>
<td>Natural gas</td>
<td>45</td>
<td>59</td>
<td>106</td>
<td>150</td>
<td>160</td>
<td>176</td>
<td>191</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>96</td>
<td>153</td>
<td>149</td>
<td>170</td>
<td>192</td>
</tr>
<tr>
<td>Electricity</td>
<td>185</td>
<td>185</td>
<td>185</td>
<td>188</td>
<td>190</td>
<td>194</td>
<td>197</td>
</tr>
<tr>
<td>LPG</td>
<td>170</td>
<td>198</td>
<td>271</td>
<td>339</td>
<td>364</td>
<td>406</td>
<td>449</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

*Table 241 Final energy consumption in Scenario 1 in Slovakia*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1520</td>
<td>1292</td>
<td>770</td>
<td>610</td>
<td>520</td>
<td>458</td>
<td>414</td>
</tr>
<tr>
<td>LPG</td>
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<td>6</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Biomass</td>
<td>891</td>
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<td>891</td>
<td>891</td>
<td>891</td>
<td>891</td>
<td>891</td>
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<tr>
<td>Ambient heat</td>
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<td>47</td>
<td>47</td>
<td>46</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Solar thermal</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>District heating</td>
<td>561</td>
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<td>561</td>
</tr>
<tr>
<td>Electricity</td>
<td>178</td>
<td>178</td>
<td>178</td>
<td>177</td>
<td>175</td>
<td>174</td>
<td>172</td>
</tr>
<tr>
<td>Coal and other</td>
<td>27</td>
<td>26</td>
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<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
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<td>2455</td>
<td>2292</td>
<td>2200</td>
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<table>
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<tr>
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<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
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<td>5</td>
<td>5</td>
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</table>

<table>
<thead>
<tr>
<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tbody>
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<td>104</td>
<td>103</td>
<td>102</td>
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<td>100</td>
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<tr>
<td>Natural gas</td>
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<td>196</td>
<td>117</td>
<td>92</td>
<td>79</td>
<td>69</td>
<td>63</td>
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<tr>
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<td>0</td>
</tr>
<tr>
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<td>118</td>
</tr>
<tr>
<td>LPG</td>
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<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Biomass</td>
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<td>81</td>
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<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
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<tr>
<td><strong>Total</strong></td>
<td>558</td>
<td>522</td>
<td>432</td>
<td>407</td>
<td>392</td>
<td>382</td>
<td>374</td>
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</table>

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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</tbody>
</table>
### Total energy costs (million €)

*Table 242 Total energy costs in Scenario 1 in Slovakia*

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>79</td>
<td>87</td>
<td>94</td>
<td>105</td>
<td>116</td>
<td>127</td>
<td>136</td>
</tr>
<tr>
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<tr>
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<td>255</td>
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</table>
Scenario 2

Assumptions: Mandatory phase-out of heating oil and solid fossil fuels in 2030 and natural gas (including LNG) in 2040.

It was considered that the actual phase-out will have occurred after five years (heating oil and solid fossil fuels in 2035 and natural gas and LNG in 2045), and heat pumps will replace the existing heating systems.

Energy prices

Table 243 Energy prices in the Scenario 2 for Slovakia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<td>227</td>
<td>255</td>
<td>283</td>
<td>312</td>
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</table>

Final energy consumption (GWh)

Table 244 Final energy consumption in Scenario 2 in Slovakia

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<td>891</td>
<td>891</td>
<td>891</td>
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**Total energy costs (million €)**

Table 245 Total energy costs in Scenario 2 in Slovakia

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<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
<tr>
<td>Heating oil</td>
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<td>0</td>
<td>0</td>
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<td>39</td>
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<td>39</td>
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<tr>
<td>Ambient heat</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>54</td>
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<td>122</td>
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<tr>
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<td>1</td>
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<td>0</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td>228</td>
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<td>245</td>
<td>252</td>
<td>260</td>
<td>215</td>
<td>216</td>
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</tbody>
</table>

Table 246 Investments foreseen in Scenario 2 in Slovakia

<table>
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<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2050</th>
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</table>
**Scenario 3**

**Assumptions: Establishment of MEPS for achieving energy class E in 2035.**

50% of affected households (75% of total low-income households) will renovate their buildings until 2030 (334 thousand buildings) and remain until 2035 (334 thousand buildings).

**Assumptions for buildings’ energy upgrade: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all buildings will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

**Energy prices**

*Table 247 Energy prices in the Scenario 3 for Slovakia*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>133</td>
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<td>167</td>
<td>183</td>
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</tr>
<tr>
<td>Natural gas</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>33</td>
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<td>227</td>
<td>255</td>
<td>283</td>
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</table>

**Final energy consumption (GWh)**

*Table 248 Final energy consumption in Scenario 3 in Slovakia*

<table>
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<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
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<tr>
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</tr>
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<td>0</td>
<td>0</td>
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<td>0</td>
<td>0</td>
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<td>10</td>
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<td><strong>Total</strong></td>
<td>558</td>
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<td>2025</td>
<td>2030</td>
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</tr>
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<td>Solar thermal</td>
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<td>11</td>
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<tr>
<td>District heating</td>
<td>679</td>
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<td>266</td>
<td>246</td>
<td>234</td>
<td>232</td>
<td>229</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>37</td>
<td>33</td>
<td>29</td>
<td>27</td>
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<td><strong>Total</strong></td>
<td>3796</td>
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<td>3035</td>
<td>2646</td>
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</table>

**Total energy costs (million €)**

Table 249 Total energy costs in Scenario 3 in Slovakia

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>79</td>
<td>87</td>
<td>85</td>
<td>83</td>
<td>83</td>
<td>85</td>
<td>87</td>
</tr>
<tr>
<td>LPG</td>
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<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Biomass</td>
<td>39</td>
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<tr>
<td>Ambient heat</td>
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<td>0</td>
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<td>0</td>
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<td>42</td>
</tr>
<tr>
<td>Electricity</td>
<td>53</td>
<td>53</td>
<td>49</td>
<td>46</td>
<td>45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>237</td>
<td>222</td>
<td>209</td>
<td>202</td>
<td>204</td>
<td>206</td>
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</table>

**Table 250 Investments foreseen in Scenario 3 in Slovakia**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building envelope</td>
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Scenario 4

ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3

Energy prices

Table 251 Energy prices in the Scenario 4 for Slovakia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>133</td>
<td>150</td>
<td>167</td>
<td>183</td>
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</tr>
<tr>
<td>Natural gas</td>
<td>45</td>
<td>59</td>
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<td>86</td>
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<td>104</td>
<td>108</td>
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<tr>
<td>Solid fossil fuels</td>
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<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
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<tr>
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<td>185</td>
<td>185</td>
<td>188</td>
<td>190</td>
<td>194</td>
<td>197</td>
</tr>
<tr>
<td>LPG</td>
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<td>227</td>
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<td>283</td>
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<td>340</td>
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Final energy consumption (GWh)

Table 252 Final energy consumption in Scenario 4 in Slovakia

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tr>
<td>Heating oil</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1520</td>
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<td>1014</td>
<td>816</td>
<td>695</td>
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<tr>
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<td>0</td>
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<td>200</td>
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<tr>
<td>Coal and other</td>
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<td>0</td>
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<table>
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<tr>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2050</th>
</tr>
</thead>
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<tr>
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<table>
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<th>Domestic hot water (DWH)</th>
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<th>2030</th>
<th>2035</th>
<th>2040</th>
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<th>2050</th>
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</thead>
<tbody>
<tr>
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<td>108</td>
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<td>108</td>
<td>236</td>
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<td>173</td>
<td>157</td>
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</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
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<tr>
<td>LPG</td>
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<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<tr>
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<td>522</td>
<td>499</td>
<td>477</td>
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Space heating, cooling and DHW

<table>
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<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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</thead>
<tbody>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>1488</td>
<td>1187</td>
<td>973</td>
<td>839</td>
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</tr>
</tbody>
</table>
### Total energy costs (million €)

**Table 253 Total energy costs in Scenario 4 in Slovakia**

<table>
<thead>
<tr>
<th>Space heating, cooling and DHW</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>79</td>
<td>87</td>
<td>85</td>
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<td>83</td>
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</tr>
<tr>
<td>LPG</td>
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<td>2</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
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<td>35</td>
<td>31</td>
<td>29</td>
<td>29</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>District heating</td>
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<td>45</td>
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<td>42</td>
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<td>49</td>
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<td>29</td>
<td>85</td>
<td>86</td>
</tr>
<tr>
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<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td>222</td>
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<td>186</td>
<td>157</td>
<td>157</td>
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</tbody>
</table>

### Investments foreseen in Scenario 4 in Slovakia

**Table 254 Investments foreseen in Scenario 4 in Slovakia**

<table>
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<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
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<td>1142</td>
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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

Table 255 Energy prices in the Scenario 5 for Slovakia

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>100</td>
<td>117</td>
<td>139</td>
<td>164</td>
<td>189</td>
<td>230</td>
<td>271</td>
</tr>
<tr>
<td>Natural gas</td>
<td>45</td>
<td>59</td>
<td>76</td>
<td>96</td>
<td>116</td>
<td>139</td>
<td>162</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>43</td>
<td>57</td>
<td>70</td>
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<td>140</td>
</tr>
<tr>
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<td>185</td>
<td>185</td>
<td>185</td>
<td>188</td>
<td>190</td>
<td>194</td>
<td>197</td>
</tr>
<tr>
<td>LPG</td>
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<td>232</td>
<td>269</td>
<td>306</td>
<td>358</td>
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</table>

Final energy consumption (GWh)

Table 256 Final energy consumption in Scenario 5 in Slovakia

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
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<tbody>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
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<td>1520</td>
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<td>751</td>
<td>623</td>
<td>0</td>
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</tr>
<tr>
<td>LPG</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>891</td>
<td>891</td>
<td>791</td>
<td>702</td>
<td>649</td>
<td>649</td>
<td>649</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>47</td>
<td>47</td>
<td>42</td>
<td>33</td>
<td>30</td>
<td>350</td>
<td>347</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>561</td>
<td>561</td>
<td>498</td>
<td>442</td>
<td>409</td>
<td>409</td>
<td>409</td>
</tr>
<tr>
<td>Electricity</td>
<td>178</td>
<td>178</td>
<td>158</td>
<td>45</td>
<td>41</td>
<td>171</td>
<td>170</td>
</tr>
<tr>
<td>Coal and other</td>
<td>27</td>
<td>26</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>3233</td>
<td>3003</td>
<td>2489</td>
<td>1978</td>
<td>1756</td>
<td>1580</td>
<td>1575</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Space cooling</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Total</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Domestic hot water (DWH)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>104</td>
<td>104</td>
<td>104</td>
<td>108</td>
<td>107</td>
<td>213</td>
<td>211</td>
</tr>
<tr>
<td>Natural gas</td>
<td>230</td>
<td>196</td>
<td>166</td>
<td>144</td>
<td>129</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
</tr>
<tr>
<td>LPG</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Coal and other</td>
<td>12</td>
<td>11</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>558</td>
<td>522</td>
<td>491</td>
<td>464</td>
<td>448</td>
<td>422</td>
<td>420</td>
</tr>
</tbody>
</table>

Space heating, cooling and DHW

<table>
<thead>
<tr>
<th>Heating oil</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Total energy costs (million €)

**Table 257 Total energy costs in Scenario 5 in Slovakia**

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Space heating, cooling and DHW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating oil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>79</td>
<td>87</td>
<td>87</td>
<td>86</td>
<td>87</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>39</td>
<td>39</td>
<td>35</td>
<td>31</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>54</td>
<td>54</td>
<td>49</td>
<td>45</td>
<td>42</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Electricity</td>
<td>53</td>
<td>53</td>
<td>49</td>
<td>29</td>
<td>29</td>
<td>75</td>
<td>76</td>
</tr>
<tr>
<td>Coal and other</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>228</td>
<td>237</td>
<td>224</td>
<td>193</td>
<td>189</td>
<td>146</td>
<td>147</td>
</tr>
</tbody>
</table>

**Table 258 Investments foreseen in Scenario 5 in Slovakia**

<table>
<thead>
<tr>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>1011</td>
<td>0</td>
</tr>
<tr>
<td>Building envelope</td>
<td>0</td>
<td>1421</td>
<td>1421</td>
<td>1421</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>1421</td>
<td>1443</td>
<td>1421</td>
<td>1011</td>
<td>0</td>
</tr>
</tbody>
</table>
Synopsis

Comparison of final energy consumption

![Comparison of final energy consumption between scenarios in Slovakia](image)

**Figure 33 Comparison of final energy consumption between scenarios in Slovakia**

Comparison of investments in different scenarios

**Figure 34 Investments in different scenarios in Slovakia**

<table>
<thead>
<tr>
<th>Scenario 2</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>0</td>
<td>1087</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Building envelope</td>
<td>0</td>
<td>1421</td>
<td>1421</td>
<td>1421</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>0</td>
<td>1142</td>
<td>0</td>
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<td>0</td>
<td>1421</td>
<td>1421</td>
<td>1421</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>0</td>
<td>1421</td>
<td>1448</td>
<td>1421</td>
<td>1142</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>0</td>
<td>1011</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Building envelope</td>
<td>0</td>
<td>1421</td>
<td>1421</td>
<td>1421</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>0</td>
<td>1421</td>
<td>1443</td>
<td>1421</td>
<td>1011</td>
<td>0</td>
</tr>
</tbody>
</table>
Comparison of total energy costs

Figure 35 Comparison of final energy costs between scenarios in Slovakia
5.10 SPAIN

5.10.1 Determination of baseline

**Step 1:** Estimation of unitary final energy consumption for different end-uses of the average household in Spain according to data about disaggregated final energy consumption of households (*data: Eurostat*).

*Table 259 Energy consumption in average household*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Average household (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>9145</td>
</tr>
<tr>
<td>Space heating</td>
<td>3851</td>
</tr>
<tr>
<td>Space cooling</td>
<td>91</td>
</tr>
<tr>
<td>DHW</td>
<td>1641</td>
</tr>
<tr>
<td>Cooking</td>
<td>688</td>
</tr>
<tr>
<td>Other</td>
<td>2874</td>
</tr>
</tbody>
</table>

**Step 2:** Calculation of reduced energy expenses of households, which belong to the lowest income decile compared with energy expenses of average households (*data: HBS*).

*Table 260 Comparison of expenses between average and low-income household*

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>21%</td>
</tr>
<tr>
<td>Natural gas</td>
<td>59%</td>
</tr>
<tr>
<td>Oil</td>
<td>58%</td>
</tr>
<tr>
<td>LNG</td>
<td>-73%</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>87%</td>
</tr>
<tr>
<td>District heat</td>
<td>100%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>100%</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>21%</td>
</tr>
<tr>
<td>Biomass</td>
<td>28%</td>
</tr>
</tbody>
</table>

**Step 3:** Calculation of unitary final energy consumption of households, which belong to the lowest income group, for different end-uses taking into consideration reduced energy expenses as estimated in Step 2.

*Table 261 Energy consumption of low-income households*

<table>
<thead>
<tr>
<th>End uses</th>
<th>Low-income HH (kWh/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>6587</td>
</tr>
</tbody>
</table>
**Step 4:** Calculation of final energy consumption of households, which belong to the lowest income decile, for different consumed energy carriers taking into consideration reduced energy expenses as estimated in the Step 2.

**Table 262 Energy consumption of low-income households distributed by fuels**

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Low-income HH (kWb/HH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>6587</td>
</tr>
<tr>
<td>Electricity</td>
<td>3084</td>
</tr>
<tr>
<td>Natural gas</td>
<td>758</td>
</tr>
<tr>
<td>Oil</td>
<td>389</td>
</tr>
<tr>
<td>LNG</td>
<td>968</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>5</td>
</tr>
<tr>
<td>District heat</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>172</td>
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<tr>
<td>Ambient heat</td>
<td>78</td>
</tr>
<tr>
<td>Biomass</td>
<td>1133</td>
</tr>
</tbody>
</table>

**Step 5:** Identification of utilised means of heating and cooking for the case of households, which belong to the lowest income decile and assessment of additional data (*data: HBS*).

Adjustments have been made by the involved country expert.

**Step 6:** Modelling each different end-use separately for quantifying consumed energy carriers.

Number of low-income households (dwellings): **1,870,251**

**Table 263 Final energy consumption in low-income households**

<table>
<thead>
<tr>
<th>Final energy consumption (GWh)</th>
<th>Total</th>
<th>Heating</th>
<th>Cooling</th>
<th>DHW</th>
<th>Cooking</th>
<th>Electric appliances &amp; Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>5528</td>
<td>166</td>
<td>135</td>
<td>430</td>
<td>556</td>
<td>4242</td>
</tr>
<tr>
<td>Heating oil</td>
<td>1290</td>
<td>1161</td>
<td>126</td>
<td>415</td>
<td>173</td>
<td>3</td>
</tr>
<tr>
<td>LPG</td>
<td>877</td>
<td>290</td>
<td>415</td>
<td>173</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>2260</td>
<td>936</td>
<td>1047</td>
<td>277</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar thermal</td>
<td>231</td>
<td>14</td>
<td>216</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient heat</td>
<td>187</td>
<td>185</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>1890</td>
<td>1819</td>
<td>46</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>District heating</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Step 7: Validation and adjustment of obtained results, which were derived by the applied modelling approach in Step 6, in conjunction with both the unitary final energy consumption of households for different end-uses (Step 3) and energy carriers (Step 4) and identified energy expenses (Step 2).

Cost deviation equal to 13% assuming the following prices:

Table 264 Utilised energy prices in Spain

<table>
<thead>
<tr>
<th>Energy carrier</th>
<th>Energy price (€/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>71</td>
</tr>
<tr>
<td>Electricity</td>
<td>240</td>
</tr>
<tr>
<td>Natural gas</td>
<td>88</td>
</tr>
<tr>
<td>Biomass</td>
<td>54</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>83</td>
</tr>
<tr>
<td>Coal and other</td>
<td>30</td>
</tr>
</tbody>
</table>
5.10.2 Modelling the impacts of the examined policies in Spain

Elasticities of demand
Electricity: -0.705, natural gas: 0.987, heating oil: -0.606 and other fuels: -0.865

Baseline scenario

ASSUMPTIONS: NO IMPLEMENTATION OF ADDITIONAL POLICIES.
The foreseen increases of energy prices within the framework of the EU Reference Scenario 2020 were taken into account.

Energy prices

Table 265 Energy prices in the baseline scenario for Spain

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>71</td>
<td>83</td>
<td>95</td>
<td>107</td>
<td>119</td>
<td>131</td>
<td>143</td>
</tr>
<tr>
<td>Natural gas</td>
<td>88</td>
<td>114</td>
<td>141</td>
<td>167</td>
<td>193</td>
<td>202</td>
<td>211</td>
</tr>
<tr>
<td>Solid fossil fuels</td>
<td>30</td>
<td>33</td>
<td>36</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Electricity</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>241</td>
<td>242</td>
<td>244</td>
<td>246</td>
</tr>
<tr>
<td>LPG</td>
<td>83</td>
<td>96</td>
<td>110</td>
<td>124</td>
<td>138</td>
<td>151</td>
<td>165</td>
</tr>
</tbody>
</table>

Final energy consumption (GWh)

Table 266 Final energy consumption in baseline scenario in Spain

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>1161</td>
<td>1044</td>
<td>953</td>
<td>881</td>
<td>822</td>
<td>772</td>
<td>729</td>
</tr>
<tr>
<td>Natural gas</td>
<td>936</td>
<td>684</td>
<td>543</td>
<td>451</td>
<td>388</td>
<td>372</td>
<td>357</td>
</tr>
<tr>
<td>LPG</td>
<td>290</td>
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**Total energy costs (million €)**

*Table 267 Total energy costs in baseline scenario in Spain*
Scenario 1

**ASSUMPTIONS: SCENARIO 1 WAS CONSIDERED FOR THE PROJECTION OF ETS2 PRICE.**

Energy prices

*Table 268 Energy prices in the Scenario 1 for Spain*

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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Final energy consumption (GWh)

*Table 269 Final energy consumption in Scenario 1 in Spain*

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<tr>
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<td>185</td>
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Space heating, cooling and DHW | 2019 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
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**Total energy costs (million €)**

*Table 270 Total energy costs in Scenario 1 in Spain*
**Scenario 2**

**Assumptions: Mandatory phase-out of heating oil and solid fossil fuels in 2030 and natural gas (including LNG) in 2040.**

It was considered that the actual phase-out will have occurred after five years (heating oil and solid fossil fuels in 2035 and natural gas and LNG in 2045), and heat pumps will replace the existing heating systems.

**Energy prices**

*Table 271 Energy prices in the Scenario 2 for Spain*

<table>
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<th>Energy prices (€/MWh)</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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**Final energy consumption (GWh)**

*Table 272 Final energy consumption in Scenario 2 in Spain*

<table>
<thead>
<tr>
<th>Space heating</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
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### Total energy costs (million €)

**Table 273 Total energy costs in Scenario 2 in Spain**

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<th>Space heating, cooling and DHW</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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### Investments foreseen in Scenario 2 in Spain

**Table 274 Investments foreseen in Scenario 2 in Spain**

<table>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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Scenario 3

Assumptions: Establishment of MEPS for achieving energy class E in 2035.

50% of affected households (75% of total low-income households) will renovate their buildings until 2030 (701 thousand buildings) and remain until 2035 (701 thousand buildings).

Assumptions for buildings’ energy upgrade: Renovation cost: 10 thousand €/dwelling and delivered final energy savings: 30%.

In 2040 all buildings will be upgraded to energy class D (Assumptions for buildings’ energy upgrade: Renovation cost: 5 thousand €/dwelling and delivered final energy savings: 10%).

Energy prices

Table 275 Energy prices in the Scenario 3 for Spain

<table>
<thead>
<tr>
<th>Energy prices (€/MWh)</th>
<th>2019</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
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<tr>
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<td>167</td>
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<td>110</td>
<td>124</td>
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Final energy consumption (GWh)

Table 276 Final energy consumption in Scenario 3 in Spain

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<th>2030</th>
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**Total energy costs (million €)**

*Table 277 Total energy costs in Scenario 3 in Spain*

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*Table 278 Investments foreseen in Scenario 3 in Spain*

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<th>Investments (million €)</th>
<th>2025</th>
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<th>2035</th>
<th>2040</th>
<th>2045</th>
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Scenario 4

ASSUMPTIONS: COMBINATION OF SCENARIOS 2 AND 3

Energy prices

Table 279 Energy prices in the Scenario 4 for Spain

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Final energy consumption (GWh)

Table 280 Final energy consumption in Scenario 4 in Spain

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Total energy costs (million €)

Table 281 Total energy costs in Scenario 4 in Spain

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Table 282 Investments foreseen in Scenario 4 in Spain

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Scenario 5

ASSUMPTIONS: COMBINATION OF SCENARIOS 1, 2 AND 3.

Energy prices

Table 283 Energy prices in Scenario 5 for Spain

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Final energy consumption (GWh)

Table 284 Final energy consumption in Scenario 5 in Spain

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<td>District heating</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Electricity</td>
<td>731</td>
<td>730</td>
<td>696</td>
<td>1119</td>
<td>1086</td>
<td>1697</td>
<td>1688</td>
</tr>
<tr>
<td>Coal and other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6989</td>
<td>6223</td>
<td>5183</td>
<td>4382</td>
<td>3997</td>
<td>3825</td>
<td>3813</td>
</tr>
</tbody>
</table>

**Total energy costs (million €)**

*Table 285 Total energy costs in Scenario 5 in Spain*

<table>
<thead>
<tr>
<th>Source of Energy</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating oil</td>
<td>92</td>
<td>96</td>
<td>92</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>174</td>
<td>166</td>
<td>151</td>
<td>140</td>
<td>134</td>
<td>0</td>
</tr>
<tr>
<td>LPG</td>
<td>58</td>
<td>58</td>
<td>55</td>
<td>52</td>
<td>51</td>
<td>0</td>
</tr>
<tr>
<td>Biomass</td>
<td>100</td>
<td>100</td>
<td>89</td>
<td>79</td>
<td>73</td>
<td>73</td>
</tr>
<tr>
<td>Ambient heat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>District heating</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Electricity</td>
<td>175</td>
<td>175</td>
<td>167</td>
<td>270</td>
<td>263</td>
<td>414</td>
</tr>
<tr>
<td>Coal and other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>600</td>
<td>595</td>
<td>554</td>
<td>541</td>
<td>521</td>
<td>487</td>
</tr>
</tbody>
</table>

*Table 286 Investments foreseen in Scenario 5 in Spain*
**Synopsis**

**Comparison of final energy consumption**

![Graph showing comparison of final energy consumption between scenarios in Spain.](image)

*Figure 36 Comparison of final energy consumption between scenarios in Spain*

**Comparison of investments in different scenarios**

![Table showing investments in different scenarios in Spain.](image)

*Figure 37 Investments in different scenarios in Spain*

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Investments (million €)</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>2045</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 2</td>
<td>Heat pumps</td>
<td>0</td>
<td>0</td>
<td>3554</td>
<td>0</td>
<td>2391</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Building envelope</td>
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<td>7013</td>
<td>7013</td>
<td>7013</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Heat pumps</td>
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<td>0</td>
<td>3554</td>
<td>0</td>
<td>2433</td>
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</tr>
<tr>
<td>Scenario 4</td>
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<td>7013</td>
<td>7013</td>
<td>0</td>
<td>0</td>
</tr>
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<td>7013</td>
<td>10568</td>
<td>7013</td>
<td>2433</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Investments (million €)</td>
<td>2025</td>
<td>2030</td>
<td>2035</td>
<td>2040</td>
<td>2045</td>
<td>2050</td>
</tr>
<tr>
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<td>3355</td>
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<td>2031</td>
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<tr>
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<td>7013</td>
<td>7013</td>
<td>7013</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Total</td>
<td>0</td>
<td>7013</td>
<td>10369</td>
<td>7013</td>
<td>2031</td>
<td>0</td>
</tr>
</tbody>
</table>
Comparison of total energy costs

Figure 38 Comparison of final energy costs between scenarios in Spain