How can we reach the GHG emissions targets in the ESR sectors:

Decarbonization trajectories for Hungary, Italy, Poland, Romania and Spain

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1. Executive summary

This document describes two scenarios for reaching different levels of GHG emissions reductions in **Hungary**, **Italy**, **Poland**, **Romania** and **Spain** by 2030.

The first pathway corresponds to the target defined in the country's NECP, which is aligned to an overall GHG reduction of 40% in Europe compared to 1990 at the European level (ETS and ESR sectors). In the meantime, Europe has increased its ambition and is aiming for at least an overall 55% reduction in GHG emissions by 2030. The ESR sectors GHG reduction target is -7% between 2005 and 2030 in the ESR regulation.

More precisely for Italy, the ESR sectors GHG reduction target is -33% between 2005 and 2030 in the ESR regulation. They differ from the projected cuts in emissions that, according to the scenario highlighted in the document, Italy can achieve if all measures included in the NECP are implemented and they yield the expected results. In this scenario, Italy expects to reduce emissions by 34.6% in ESR sectors hence an overachievement of ESR regulation targets. On the other hand, Hungary projections of GHG emissions in the WAM scenario show a 19% reduction of these emissions, hence an overachievement of ESR regulation targets.

The second pathway details the requirements to reach an overall GHG reduction of -65% compared to 1990 (ETS and ESR sectors), which is often referred to as the only target compatible with Europe's commitments under the Paris Agreement.

The focus has been set on constructing a credible pathway for the NECP target, using information available in the NECP itself. The first overarching comment is that **the plans generally lack quantified and detailed policies to support the concrete decarbonization ambition.** Even though the sectoral trajectories included in the assessment of additional measures in the NECP (WAM) show progress in line with the GHG reduction targets, the plans fail to show a comprehensive and quantified set of measures indicating that such progress is credible between 2020 and 2030. This relates to both the qualitative aspect (i.e. policies covering transport, agriculture and buildings decarbonization in a comprehensive way) and the quantitative aspect (ambition level of the mentioned policies).

As a result of this, capturing only the measures explicitly detailed in the NECP document in the Pathways Explorer tool did not lead to the GHG reductions mentioned in the NECP for 2030 in the 3 sectors which are modelled. Hence, higher ambition for the levers mentioned in the plan, but also additional actions which were not leveraged, had to be implemented to reach the reduction objectives of the NECP. (As mentioned above, this document focuses on Buildings, Transport and Agriculture, and does not draw any conclusion on the other sectors which were not analysed.)

We note that the NECPs of **Hungary**, **Italy** and **Romania** cover a wide variety of decarbonization levers in qualitative terms. However, in the absence of quantification, we emphasize that it is important to leverage both technical and behavioural levers to use the full scope of options available to decarbonise the economy. The NECPs of **Poland** and **Spain** mostly focus on technical measures and therefore miss the opportunity to leverage the full scope of options available to decarbonise the economy.

It is worth highlighting that measures which focus on the demand side enable significant reductions in the amount of energy and material supply, which in turn ease the low carbon transition and enable to reduce other impacts beyond GHG emissions.

In particular, the following strengths and shortcomings can be pointed out in the various sectors.

Transport

For **Hungary**, it is shown that the decarbonization ambition is quite ambitious given the current increasing trend for the transport sector's emissions. However, this is not supported by a quantified set of measures. For **Italy,** it is shown that the decarbonization objectives are quite ambitious given the lead time required to significantly shift towards higher sales of electric vehicles, which is one of the key measures included with a target of up to 6 million full electric or hybrid vehicles. However, other levers lack a quantified set of measures. Hence, an ambitious and balanced trajectory is proposed to help support this ambition for both countries.

There is a clear intention to develop electromobility in **Poland** and **Spain**. However, no attention is given to the reduction of the transport activity nor the shift towards softer transportation modes, both for passenger and freight transport. However, these levers are key to reach the reduction target.

In **Romania**, there is a clear will to increase the modal share of rail for both freight and passenger transport. Nonetheless, it is shown that the passenger transport demand has been dramatically increasing for the last 15 years. Hence, besides modal shift, it is of paramount importance to be able to curb this increasing trend in the coming years.

Buildings

In the buildings sector in **Hungary**, **Italy, Poland** and **Spain**, policies are mentioned that aim at improving the building stock energy consumption as well as shifting towards low-carbon heating solutions. As shown in the analysis, the renovation rate and depth, and the switch from fossil fuels towards cleaner energy sources should be significant in order to reach the countries' ambitious target for the buildings sector in 2030. Acting on heating and cooling behaviour (for residential buildings, reducing the temperature regulation in winter and increase it in summer) can help to reach the reduction target. In **Romania**, the buildings sector represents an untapped potential for GHG reduction, with the current 2030 GHG target showing little or no change with respect to current trends.

Agriculture

Agriculture is given very little attention in the plan in **Hungary**, **Poland** and **Italy** and its emissions are foreseen to increase up to 2030. This represents an untapped potential for GHG reductions in the countries. Besides the measures acting on agricultural practices that are mentioned in **Spain's** NECP, the country should act on the food behaviour (diet), the land use and the bio-energy to be able to reach its reduction target.

2. Context

The PlanUp project

PlanUp tracks the development of National Energy and Climate Plans in five EU Member States: Spain, Italy, Hungary, Romania, and Poland. To support rapid decarbonisation in Europe the project promotes good practices in the transport, agriculture and building sectors and fosters dialogue on low-carbon policymaking between local, regional, and national authorities, civil society organisations and academia.

National Energy and Climate plans address the energy consumption and emissions of ESR sectors[1]. However, the focus of the PlanUp project lies on the three main sectors from the ESR: transport, buildings, and agriculture. Hence, waste, and non-ETS industry are not considered in the present analysis.

The Pathways Explorer model

The Pathways Explorer is an Energy and GHG emissions simulation model capturing insights on the trade-offs and implications of implementing ambitious low carbon transition scenarios. The tool, developed by Climact, is inspired by the EUCalc, the GlobalCalc and other existing calculator models. These tools allow investigating the full option space for climate mitigation, testing a wide range of potential measures, including emerging trends in preferences for mobility, housing or diets, as well as the full palette of technology options.

Here are some of the key features of The Pathways Explorer :

- It is a fully comprehensive energy system model, covering all energy sectors and GHG emissions, and capturing the dynamics of the energy system (e.g., the implications of the demand sectors on energy supply and on the demand for materials) ;
- It enables the development of energy transition scenarios based on realistic and transparent assumptions ;
- It is based on insights from >10 years of model developments, and captures a large amount of stakeholder engagements and expert consultations ;
- It is an easily accessible model, with a real-time online webtool for reach and use.

On the other hand, the Pathways Explorer does not cover the following aspects:

- Scenarios are in no-way forecasts, no specific likelihood is attached to them as all of them will depend on the societal and political ambition ;
- There is no cost-optimisation in the model. While cost optimisation can be useful in certain cases, avoiding it has the advantage of ensuring that all options can be explored, both the cost effective ones and the ones that are not yet cost-effective but ready for market deployment, and would be disregarded by cost-optimization models

[1] Effort Sharing Regulation: covers the non-ETS sectors, i.e. Transport, Buildings, Agriculture & Land-use, Waste and Non-ETS industry. See https://carbonmarketwatch.org/publications/understanding-the-climate-action-regulation/ and https://ec.europa.eu/clima/policies/effort/regulation_en

- Macro-economic analysis and co-benefits are not included in this model, but the results of the scenarios can be leveraged by other models which are developed for such complementary analysis.

The most defining feature of the calculator models are the so-called "ambition levers" (in short levers). These levers set the 2020-2050 trajectories[2] at the country-level for technology, lifestyles and specific sectoral practices (e.g., agricultural practices). The term ambition refers to whether a trajectory represents the continuation of current trends (level 1), medium to high ambition (level 2 and 3), or that associated with a transformational level (level 4), both in terms of societal change and technology deployment. Across all sectors, a large set of levers and trajectories are modelled (more than 100, e.g. transport demand per person; insulation level for refurbished houses; lifetime of certain products like cars, efficiency and type of steel production; offshore wind capacity installations) driving energy demand and supply projections. These levels have been defined over the course of many projects based on a large literature review and a series of workshops with sector experts.

Concretely, a scenario is then created by choosing a combination of effort (or ambition) levels for the full set of drivers available to the user. These are grouped by category of issues (e.g., lifestyle and technology) and sectors (e.g., buildings and transport). Those drivers can be described as either **'trajectories'** on which authorities have little or no influence (e.g., demographic trends, evolution of energy prices) in contrast to **'levers'** which can be directly influenced. Both of these types of drivers can be defined by the user to project the evolution of all the outputs of the model, including energy consumption, production, and cost implications. Higher ambition is always defined as having a stronger impact on reducing GHG emissions.

To reach a better understanding of how the tool works and how to create scenarios we strongly encourage the reader to read the following introductory document from the EUCalc project and to watch the introductory How-to video available on the intro page of the EUCalc model webtool.[3]

Disclaimer

Please note that the Pathways Explorer, at the date of publishing this document (30/06/2021) is still being improved and is not fixed. As a result of this, the graphs and figures related to the two scenarios presented in this document might not perfectly correspond to the results that can be found online when clicking on the scenario links.

[2] The Pathways Explorer input database contains historical data for these levers at least up to 2015. Depending on the data type and country, more recent lever data can exist in this database (up to 2019). If there is no historical data available for years between 2015 and 2020, the tool fills the missing years between the last available data point (e.g. 2017) and 2020 by making a projection between this last available year and 2050 using a level 1 ambition target for 2050 (corresponding to a conservative or 'Business-as-usual' trend). The results are kept only for missing years up to 2020. Then the real projection with the chosen ambition level for this particular lever is computed starting from 2020 up to 2050

[3] This video has been made for the EUCalc tool but the general layout of the interface is very similar to the Pathways Explorer webtool and the general using principles remain the same

3. Goals and methodology

This deliverable contains two decarbonization trajectories for the three main ESR[4] sectors in Hungary, Spain, Italy, Romania and Poland: transport, buildings and agriculture. The goal of these two scenarios is to show a credible pathway to reach GHG reduction targets in these sectors corresponding to two different decarbonization ambition levels:

- **NECP scenario**: this ambition level is directly derived from the target countries' NECP GHG reduction targets for 2030 and the details that were found in the NECP report on the specific Policies and Measures (PAMs) to be implemented in the short term to reach these targets. The scenario covers only the Effort Sharing Regulation sector (transport, buildings and agriculture) as they are the focus of the project.
- **-65% scenario**: this scenario corresponds to a 65% economy-wide GHG emission reduction target at EU level by 2030 and at least net zero emissions in 2050. The corresponding national 2030 GHG reduction targets for ESR sectors in the different countries are calculated based on numbers included in the ECF publication *Planning for net zero: assessing the draft national energy and climate plans* (May 2019)[5]

The methodology that was followed to specify the ESR sectors trajectories in the Pathways Explorer tool is illustrated on Figure 1 for the NECP level and can be summarized as follows:

- **STEP 1**: Map Policies and Measures (PAM) from the NECP to the Pathways Explorer levers
- **STEP 2**: Assess the level of the Pathways Explorer levers based on available information in the NECP. We are leveraging information available either directly in the text of the NECP or in tables in the appendices. If there is no quantified data that can be used or if a given lever is not mapped to PAM from the NECP, then a level of 2.5 is taken for this lever, corresponding to a moderate decarbonization ambition.
- **STEP 3**: Run the tool with the lever settings from STEP 2. The reduction of GHG emissions obtained in the three ESR sectors is compared to the targets for these sectors for the NECP level. If the targets are reached, then the trajectory is considered satisfactory for the NECP level. If not, iterate with higher ambition across all levers.

There is an iterative process between steps 2 and 3 by gradually increasing all levers from ESR sectors by the same increment and checking the results until a satisfactory trajectory is reached.

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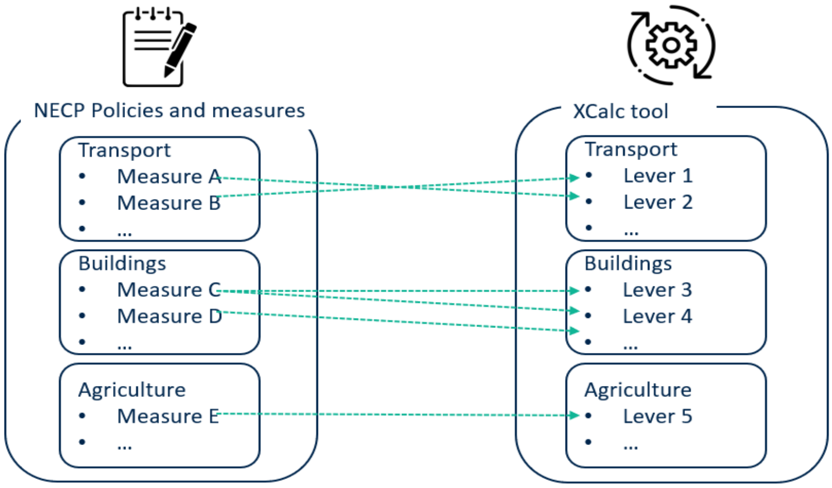
[4] Effort Sharing Regulation: covers the non-ETS sectors, i.e. Transport, Buildings, Agriculture & Land-use, Waste and Non-ETS industry. See https://carbonmarketwatch.org/publications/understanding-the-climate-action-regulation/ and https://ec.europa.eu/clima/policies/effort/regulation_en

[5] Available at https://europeanclimate.org/wp-content/uploads/2019/11/05-2019-planning-for-net-zero-assessing-the-draft-national-energy-and-climate-plans.pdf. See page 65 for figures (last column of the table, net zero (high range))

For the -65% scenario, the process is the same as above except that the sectoral GHG emissions reduction targets correspond to reaching -65% in 2030 (and at least Net zero by 2050), hence the level of levers should be further increased.

It is important to emphasize that the proposed trajectories only concern transport, buildings and agriculture sectors, which are within the scope of the PlanUp project. Energy Supply and Industry sectors are out of scope of this analysis. However, as the tool also displays results for these sectors that are not covered in the present analysis, there should be a certain consistency between these sectors and the ESR ones. For this reason, the levers for these sectors are arbitrarily set to a level of 2,5 corresponding to a moderate to ambitious decarbonization ambition.

STEP 1: MAPPING POLICIES AND MEASURES WITH XCALC LEVERS IN ESR SECTORS



STEP 2: ASSESS POSITIONS FOR XCALC LEVERS IN ESR SECTORS

LEVER TYPE	**Levers mapped with PAMs and quantified**	**Levers mapped with PAMs and not quantified**	**Levers not mapped with PAMs and not quantified**
EXAMPLE	The country plans to decrease the share of cars in urban transport to 42%	The country plans to decrease the share of cars in urban transport	The country does not mention modal shift in its NECP
ACTION	Lever “Mode of transport” set to level 2.8	Lever “Mode of transport” set to level 2.5	Lever “Mode of transport” set to level 2.5

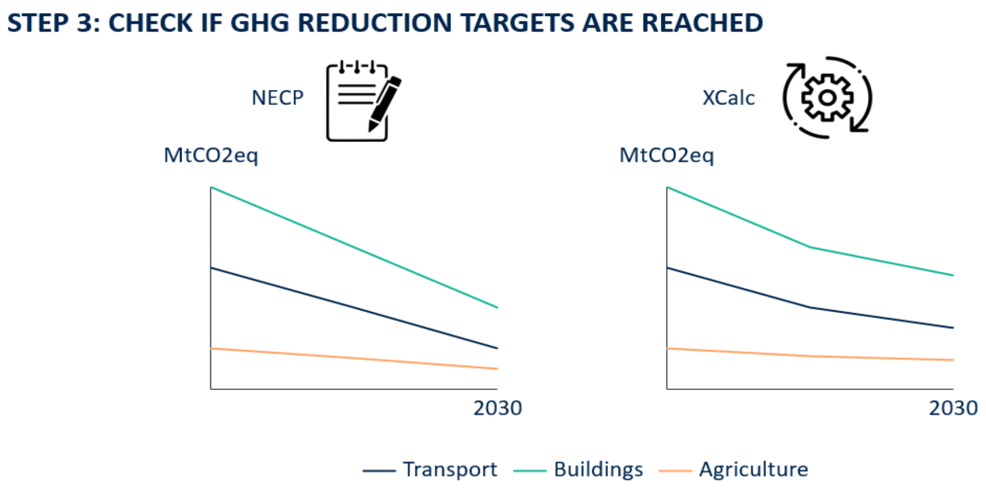


Figure 1 Methodology for NECP scenario creation

Decarbonization trajectories for Hungary

Results of the 2 scenarios (NECP and -65%)

What does the NECP scenario mean in Hungary

Overall results of the NECP scenario

The following section shows the analysis of the NECP measures and projections and the resulting scenario that is constructed in the Pathways Explorer model for Hungary. The main implications are detailed in the graphs and tables hereunder. However, the complete implications for the three analysed sectors can be investigated on the online webtool via this link (the procedure to navigate the webtool is described in Annex II).

The Hungarian NECP shows a reduction in emissions of 22.9% between 2005 and 2030 in transport, buildings and agriculture altogether. As mentioned in the executive summary, the GHG emissions reductions in the WAM trajectory for the ESR sectors in Hungary (-19% on the total ESR category, including transport, agriculture, buildings but also non-ETS industry and wastes) largely exceed the ESR target for this category (-7%).

Figure 2 shows the evolution of the GHG emissions for the three analysed sectors in the NECP scenario constructed for Hungary in The Pathways Explorer. It has to be noted that the sector emissions shown on Figure 2 do not match exactly the 2030 projections presented in the NECP. This is due to the fact that agriculture emissions are planned to slightly increase in the plan, which could not be reproduced in the Pathways Explorer tool, as well as a very slight scope difference between the tool and the reported figures in the NECP[6]. Given this slight difference, the choice is made to reproduce the GHG trajectory for the three sectors in terms of the relative variation corresponding to the NECP target rather than targeting the absolute figures. The specifics of each sector are described in the following sections.

[6] In The Pathways Explorer, historical emissions are calibrated with UNFCCC data in the NIR-CRF format

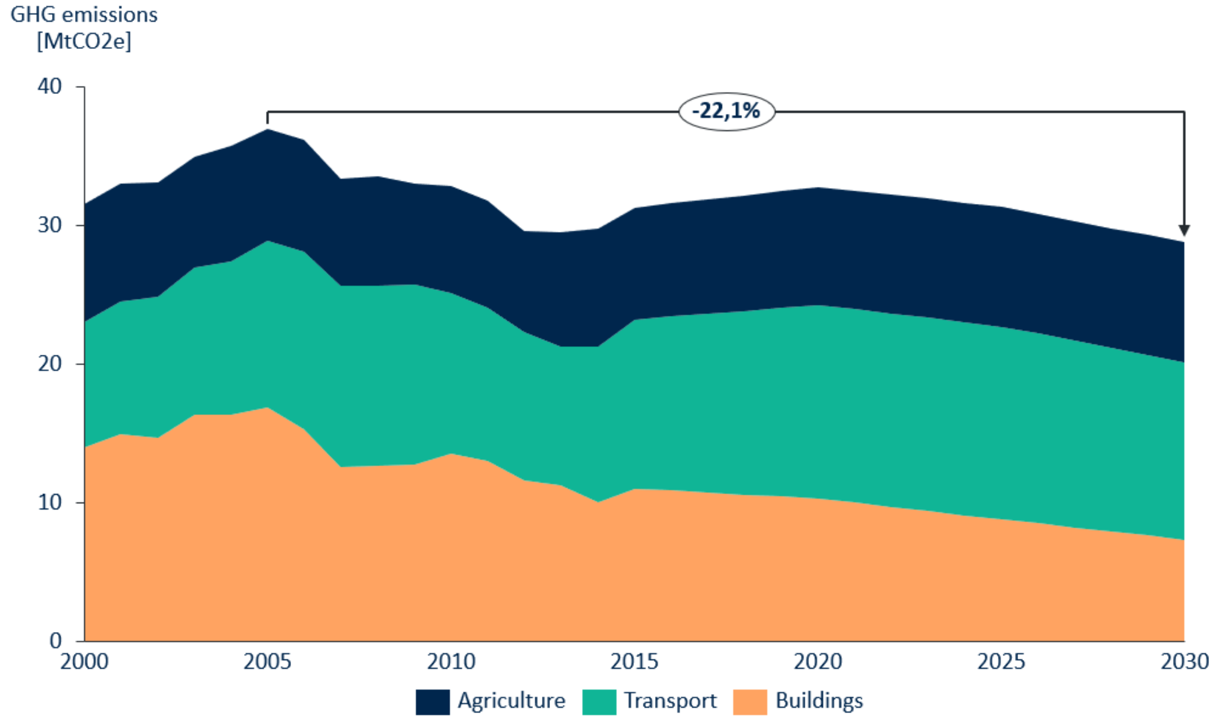


Figure 2 Evolution of the GHG emissions by sector [MtCO2e] for the three analysed sectors in the NECP scenario constructed in The Pathways Explorer

Transport sector

Table 1 below shows how PAMS and 2030 projections directly coming from the NECP document can be mapped and translated into ambition levels for the Pathways Explorer transport levers.

A first remark that can be made is that none of these policies and measures were quantified. Hence, the level of the levers that could be mapped with these policies had to be adjusted in order to reach the given GHG emission target for the transport sector in Hungary for 2030. It should also be noted that additional levers than the ones that could be mapped with NECP policies had to be used in order to reach this target, as can be seen when investigating this scenario on the webtool.

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Developing energy efficiency of vehicles and transport infrastructure, incentivising uptake of low emission fuel/electric vehicles and modal shift to	Transport>Passenger transport > Technology evolution>Technology share ZEV	3	Not quantified in the plan
	Transport>Passenger transport > Technology evolution>Technology share LEV	3	Not quantified in the plan

public transport or non-motorized transport			
	Key behaviours>Travel > Mode of transport	3	Not quantified in the plan
	Transport>Passenger transport > Energy efficiency	2	Not quantified in the plan
	Transport>Freight transport > Energy efficiency	2	Not quantified in the plan
Financing the green economy through the EU carbon market - energy efficiency of vehicles and electromobility	Transport>Passenger transport > Technology evolution>Technology share ZEV	3	Not quantified in the plan
	Transport>Freight transport > Energy efficiency	2	Not quantified in the plan
	Transport>Passenger transport > Energy efficiency	2	Not quantified in the plan
Promoting the use of public and non-motorised transport (walking and cycling), improving transport structure and supporting the expansion of rail and waterborne transport	Key behaviours>Travel > Mode of transport	3	Not quantified in the plan
	Transport>Freight transport > Freight mode	3	Not quantified in the plan
Tax reductions on electric (fully or plug-in hybrid) vehicles aiming at increasing the number of low emission and energy efficient vehicles on the roads. Annual car tax, company car tax and registration tax are all to be removed in these cases.	Transport>Passenger transport > Technology evolution>Technology share ZEV	3	Not quantified in the plan

Helping municipalities purchase 1,290 EURO6 / CNG / electric buses in 2020-2029 with the provision that from 2022 the newly purchased buses must be electric. The state subsidizes up to 20% of the total cost	Transport>Passenger transport > Technology evolution>Technology share ZEV	3	Not quantified in the plan
Indicator 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	
GHG emissions [MtCO2e] 12.8 (vs 12 in 2005)	/	/	/

Table 1. Mapping of the PAMs and 2030 indicators described in the NECP document with the specific transport levers in the Pathways Explorer and their ambition in the NECP scenario

Then, it can also be observed that the NECP decarbonization trajectory for the transport sector is rather ambitious. Indeed, GHG emissions have been increasing at a steady rate since 2013 in Hungary (see Figure 3). Not only should Hungary curb this trend but also reverse it in order to reach its own target for the sector. This ambition is reflected in the overall high level for the transport levers shown in Table 1.

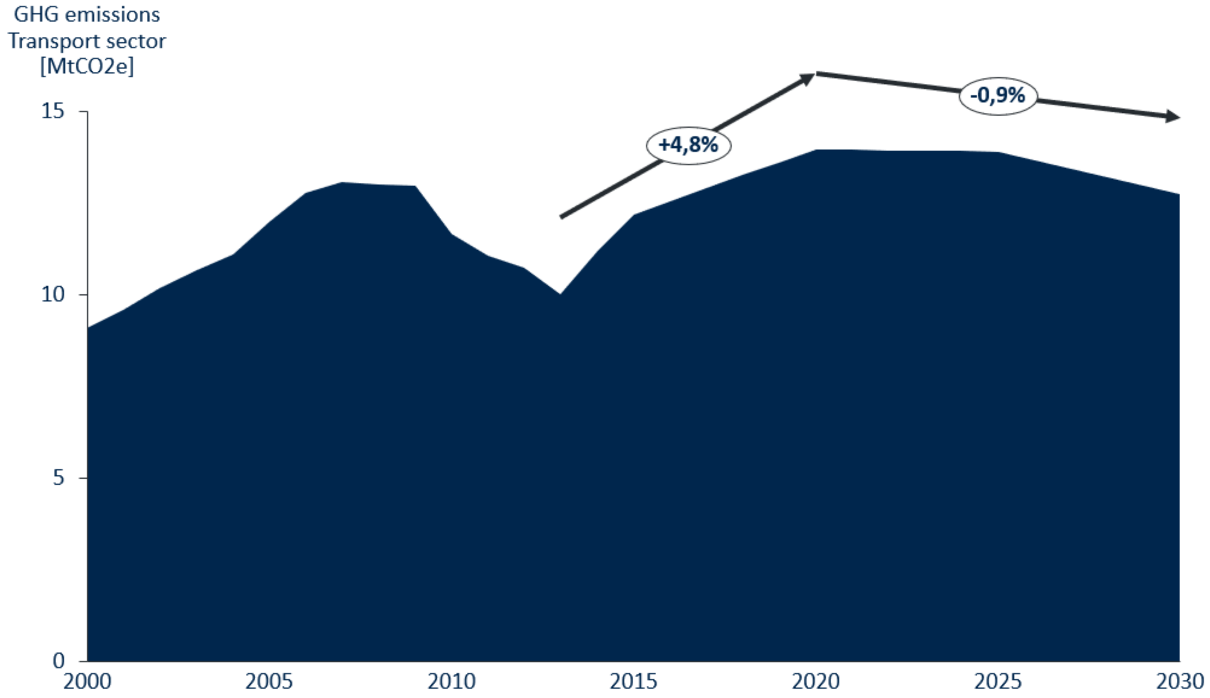


Figure 3 GHG emissions from the transport sector – with compound annual growth rates for periods 2013-2020 and 2020-2030 respectively

We detail further below the key outputs of the scenario based on these ambition levels.

Firstly, the passenger transport demand increase is contained to 4% and a moderate shift can be observed towards active modes and rail, the car modal share decreasing from 61% to 59% between 2020 and 2030 (Figure 4).

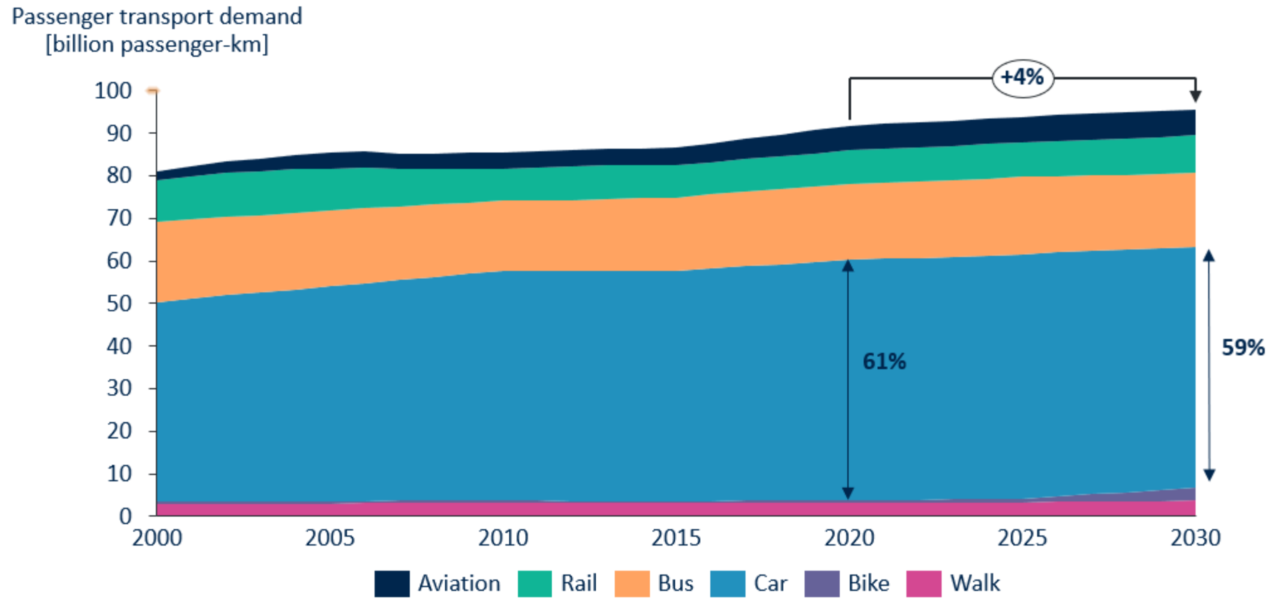


Figure 4 Evolution of the passenger transport demand

The evolution of the car fleet resulting from the lever settings presented in Table 1 is presented below (Figure 5). The modal shift and an increased occupancy rate allows to decrease the needed amount of cars in 2030 by 7% compared to 2020.

On the same figure, it can also be observed that Low- and Zero-emission vehicles do not represent a significant part of the fleet in 2030 (around 190k Battery-Electric Vehicles/BEV or Plug-in Hybrid/PHEV vehicles in 2030, ~5% of the total fleet). This is due to the fact that the needed vehicle fleet size decreases. Hence, new vehicle sales decrease as well. Furthermore, given the average 8.5 years lifetime of passenger cars in Hungary[7], a significant part of the existing fleet in 2020 (mainly based on fossil fuels) is still operational in 2030. This means that even with an increasing proportion of BEV/PHEV in new car sales (lever 'Technology-share new ZEV/LEV'), the absolute figures remain relatively low in at first. On a longer term however, the existing fossil-fuel cars need to be replaced when coming to their end of life, and BEV represent 43% of the car fleet in 2050 in the analyzed scenario when it is extended until 2050.

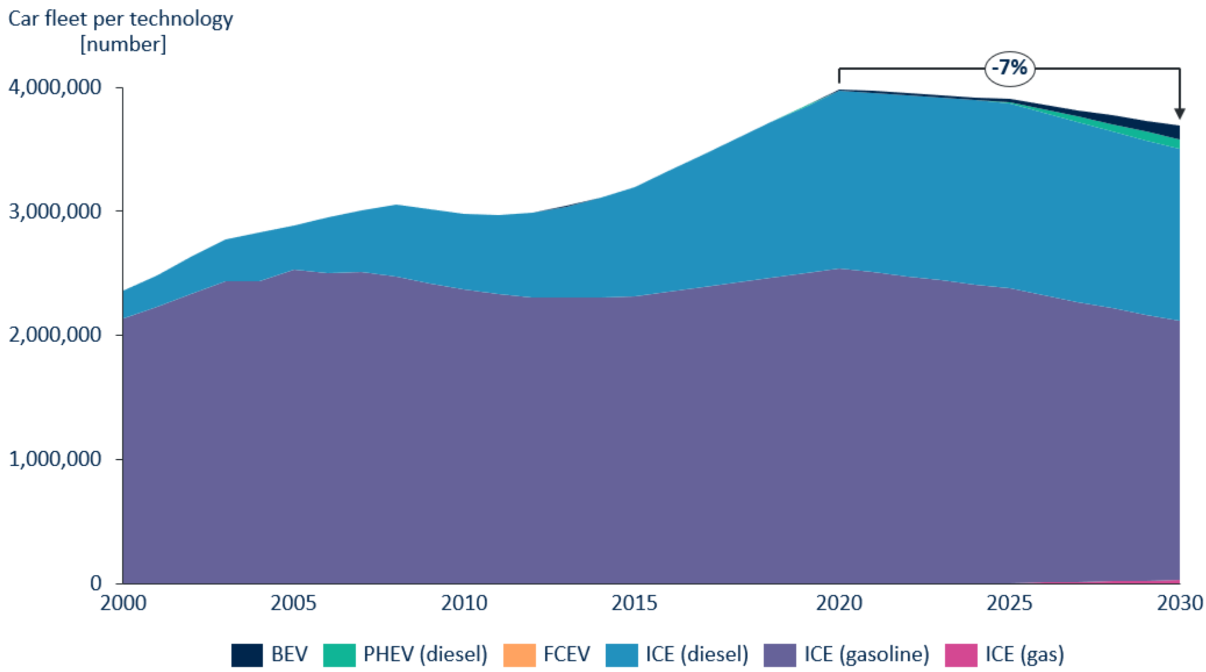


Figure 5 Composition of the car fleet by technology [million vehicles]. FCEV: fuel cell electric vehicle, BEV: Battery Electric Vehicle, PHEV: Plug-in Hybrid and Hybrid, ICE: Internal combustion engine

[7] EEA, 2016, https://www.eea.europa.eu/data-and-maps/daviz/average-age-of-road-vehicles-6#tab-chart_1

Buildings sector

Tables 3 and 4 below show how PAMS and 2030 projections respectively can be mapped and translated into ambition levels for the Pathways Explorer buildings levers.

Policies and Measures (PAMs)	Mapping with levers in the Pathways Explorer model	Level setting for the levers	Remark
Green District Heating Program	Buildings>Residential>Low-carbon heating solutions>District heating deployment	2	Not quantified
Indicator 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Population [number] 10,125,000	Demographic and long term> Population	B.8[8]	
Household size [number/household] 2.23	Demographic and long term> Household size	A.7[9]	
GHG emissions [MtCO2e] 8.0 (-55.9% vs 2005)			

Table 1: Mapping of the PAMs and 2030 indicators described in the NECP document with the specific buildings levers in the Pathways Explorer and their ambition in the NECP scenario

The buildings sector is expected to be the main contributor to GHG emissions cuts by 2030 in Hungary, reducing these by 56% in 2030 compared to 2005. However, there are very few quantified details about how to reach this ambitious decarbonization in the sector by 2030. Hence, a balanced setting of various levers is proposed to reach this sectoral target, by targeting both the improvement of the building envelope and the shift to low-carbon heating solutions. These categories of levers are set to a level of 2 for both tertiary and residential buildings. The concrete implications are shown below.

As shown on Figure 6 for residential buildings, this means that the renovated surface should be multiplied by 5 between 2020 and 2030. Besides the renovated

[8] Population and household size are not considered as 'levers' but rather as trajectories. Hence we do not consider that there is an ambition from 1 to 4, but rather 4 different trajectories defined for both indicators. The decimal figure (e.g. B.8) represents the fact that an hybrid trajectory is chosen, between two predefined ones (here B and C) and indicates the respective weight of both trajectories in the weighted sum (here it is 80% of trajectory C + 20% of trajectory B)

[9] Idem

surface, the renovation depth is of paramount importance: the average heating energy consumption of **renovated** buildings in 2030 (residential and non-residential) should be half the value (66 kWh/m²) of the current average heating energy consumption of the **total building stock** (122.8 kWh/m²). This should lead to a reduction of the total heating energy demand by 26% between 2020 and 2030 (Figure 7) (which amounts to a 49% reduction compared to 2005 level).

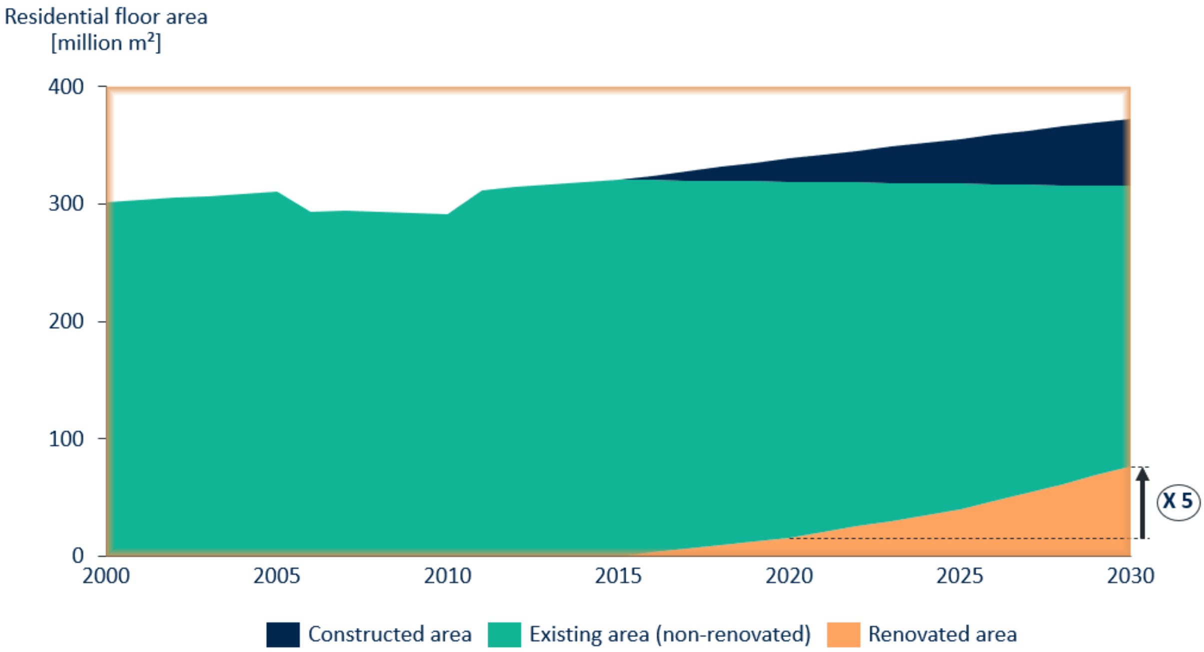


Figure 6 Evolution of the residential building stock

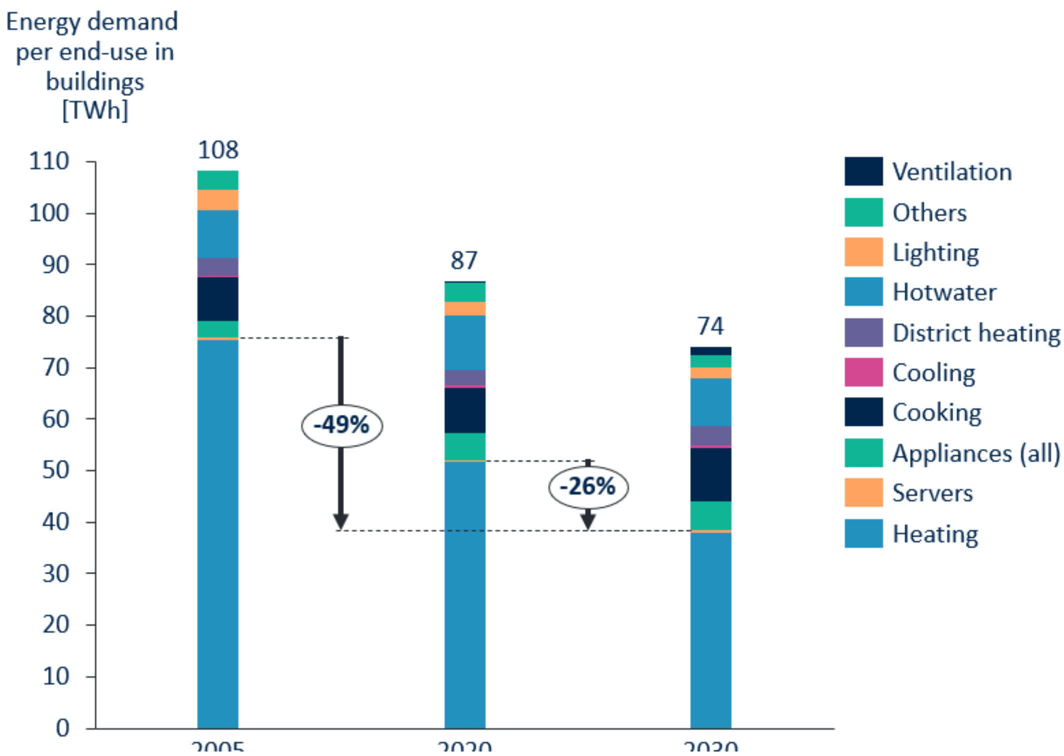


Figure 7 Evolution of the energy demand per end-use in the buildings sector

The ambition level for the low-carbon heating solutions lever is set to 2.3. This means that the share of fossil-fuel based heating bodies should decrease between 2020 and 2030. This translates into a 28% reduction in the demand for natural gas in the buildings energy consumption between 2020 and 2030 (Figure 8). It can also be seen from Figure 8 that the contribution of district heating and electricity to heating is increasing between 2020 and 2030, both in absolute and relative figures.

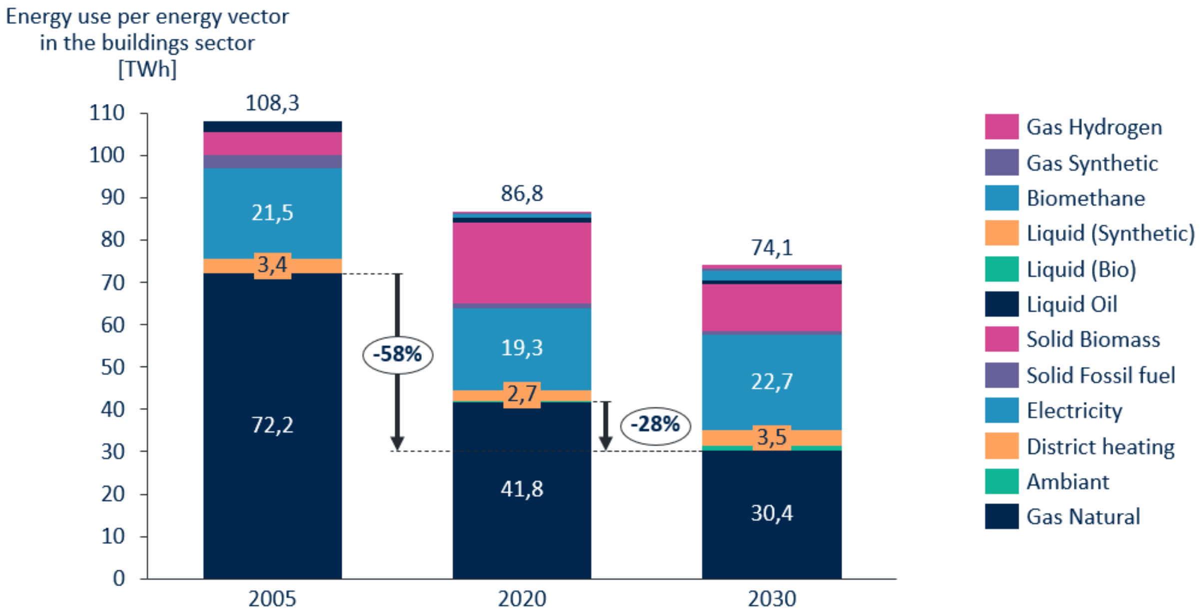


Figure 8 Evolution of the energy demand per energy vector in the buildings sector

Agriculture sector

The Hungarian NECP 2030 projections for agriculture foresee an increase of emissions (+17% on the 2005-2030 period). To reproduce this trend, the "Agriculture practices" lever group is set on 1.5. This corresponds to a moderate improvement with an increase of extensive agriculture, a lesser fertilizer use and more grazing for cattle.

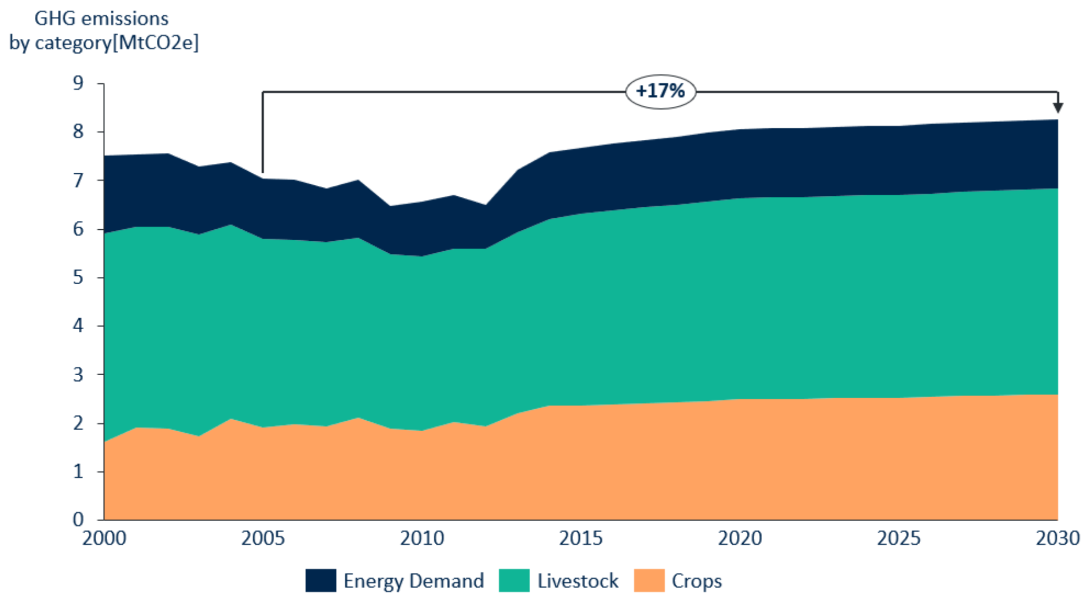


Figure 9 Evolution of GHG emissions by category [MtCO2e] in the agriculture sector in Hungary

Detailing what a -65% ambition for 2030 means

Overall results of the -65% scenario

As explained above, the GHG reduction target for ESR sectors in this scenario is calculated based on numbers included in the ECF publication *Planning for net zero: assessing the draft national energy and climate plans* (May 2019)[10].

For Hungary, this amounts to a -27.2% reduction of overall ESR emissions in 2030 compared to 2005. It can be noted that this target is not significantly higher than the -22.9% target from the NECP scenario. Indeed, it is shown in the section above that the WAM GHG trajectory largely exceeds the ESR target set for Hungary.

Hence, the -65% scenario (accessible through this link) does not present significant differences with the NECP scenario. Given that the buildings sector is already the major contributor to GHG cuts in the NECP scenario, the focus is on bringing additional GHG cuts from agriculture and transport sectors. That corresponds to an additional 1.9 MtCO2e reduction between 2005 and 2030 compared to the NECP scenario. The agriculture sector is the main contributor with a 1.1MtCO2e reduction compared to the NECP scenario. The transport sector contributed to the additional effort by 0.8 MtCO2e.

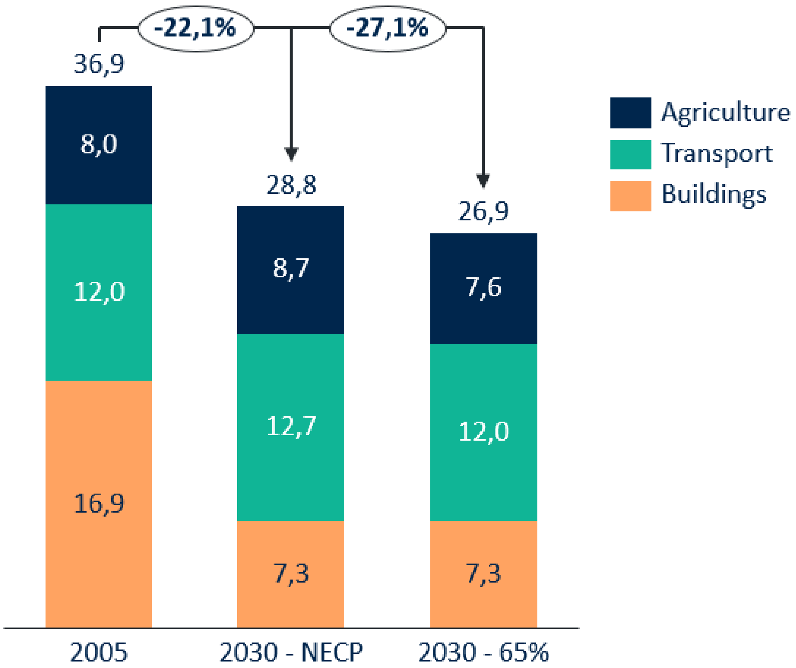


Figure 10 Comparison of GHG emissions [MtCO2e] in NECP and -65% scenarios

Transport sector

The additional effort in the transport sector compared to the NECP scenario (0.6 MtCO2e) comes from an increased lever setting (from level 2 to 3.1) for the

[10] Available at https://europeanclimate.org/wp-content/uploads/2019/11/05-2019-planning-for-net-zero-assessing-the-draft-national-energy-and-climate-plans.pdf. See page 65 for figures (last column of the table, net zero (high range))

occupancy lever. This implies that by 2030, the average of person per car increases to 1.8 (while being equal to 1.6 in 2016), which in turn decreases the amount of km run by cars for a same transport demand. This also results in a lesser need for cars.

This choice increases the share of the decarbonization effort brought by behavioural levers. Indeed, technical levers are not changed compared to the NECP scenario (average level of 1.5) but the average level of behavioural transport levers increases from 2 to 2.3.

Buildings sector

As indicated above, the additional GHG reduction effort for this scenario is placed on agriculture and transport sectors, hence nothing is changed compared to the NECP scenario for the buildings sector.

Agriculture sector

All agriculture levers were left on level 1 for the NECP scenario. In order to get a 1.1MtCO2e reduction compared to the NECP scenario for the agriculture sector, we implement two different actions. First, we set the "Type of diet" lever to level 2 which decreases the meat consumption by 13% between 2015 and 2030. Then, the "Climate Smart Crops Production System" lever is set on level 3, which is aligned with FAO sustainable agriculture scenario. This means a decrease of the intrants in the agricultural system, which in turn allows to lower the related emissions.

For the agriculture sector, it can be seen that both behavioural (average level of 1.5) and technical levers (average level of 2) are activated to increase the decarbonization effort.

Conclusions

This document shows two concrete pathways to reach two different levels of GHG reduction in Hungary by 2030.

From the analysis carried out for the NECP scenario, the following conclusions can be drawn:

Firstly, the plan lacks quantified measures. Indeed, while the plan mentions a wide variety of decarbonization levers, the policy description remains vague and without proper quantification.

Then, the ambition throughout the different sectors is quite unbalanced, with the buildings sector bearing the largest part of the decarbonization effort, while transport and agriculture do not see significant cuts in their GHG emissions.

Furthermore, in the buildings sector, it is shown that the ambitious GHG reduction target can only be met through significant efforts in terms of renovation rate, depth and shift from fossil fuels.

Finally, a more ambitious scenario in line with a -65% reduction of GHG emissions economy-wide in Europe is proposed. This scenario mainly focuses on increasing the use of behavioural decarbonization levers (occupancy of cars, meat consumption) in order to increase their contribution to the decarbonization effort alongside the technical levers.

Decarbonization trajectories for Italy

Results of the 2 scenarios (NECP and -65%)

What does the NECP scenario mean in Italy

Overall results of the NECP scenario

The following section shows the analysis of the NECP measures and projections and the resulting scenario that is constructed in the Pathways Explorer model for Italy. The main implications are detailed in the graphs and tables hereunder. However, the complete implications for the three analyzed sectors can be investigated on the online webtool via this link (the procedure to navigate the webtool is described in Annex II).

The Italian NECP shows a reduction in emissions of 32% between 2005 and 2030 in transport, buildings and agriculture altogether, which is very close to its overall reduction for the ESR sectors of 33% between 2005 and 2030 in the ESR regulation. This target is aligned to an overall GHG reduction of 40% in Europe compared to 1990 at the European level (ETS and ESR sectors). In the meantime, Europe has increased its ambition and is aiming for at least an overall 55% reduction in GHG emissions by 2030. The chosen targets differ from the projected cuts in emissions that, according to the scenario highlighted in the document, Italy can achieve if all measures included in the NECP are implemented and they yield the expected results. In this scenario, Italy expects to reduce emissions by 34.6% in ESR sectors hence an overachievement of ESR regulation targets.

Figure 2 shows the evolution of the GHG emissions for the three analysed sectors in the NECP scenario constructed for Italy in The Pathways Explorer. The reductions are mostly focused on the transport and buildings sectors, reducing by -36% and -39% respectively, when the agriculture sector barely reduces in the same time period.

The specifics of each sector are described in the following sections.

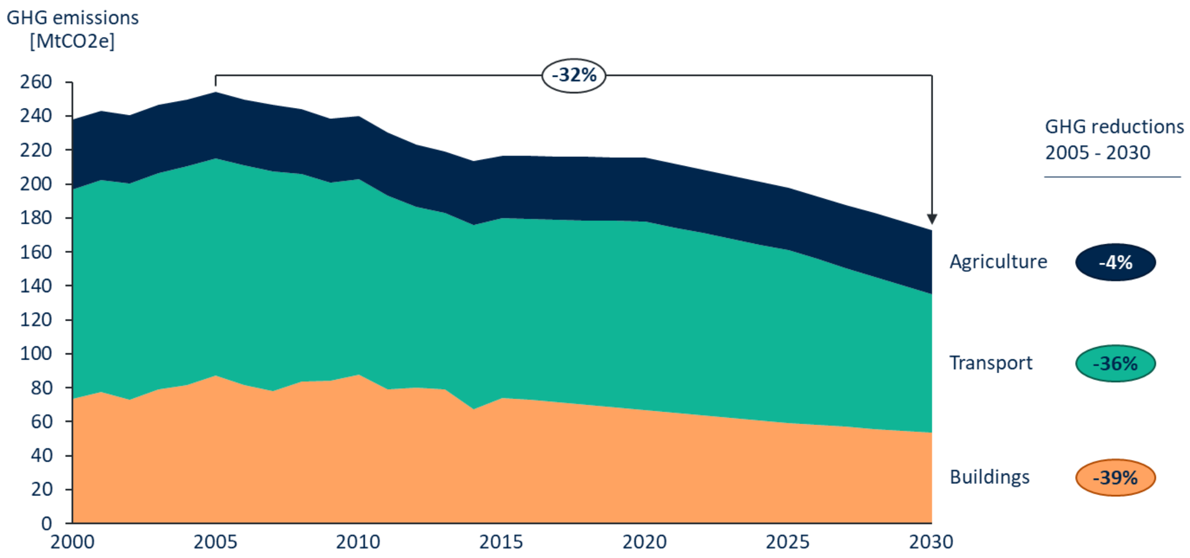


Figure 2 Evolution of the GHG emissions by sector [MtCO2e] for the three analysed sectors in the NECP scenario constructed in The Pathways Explorer

Transport sector

Table 1 below shows how PAMS and 2030 projections directly coming from the NECP document can be mapped and translated into ambition levels for the Pathways Explorer transport levers.

The NECP summarizes as follows the ambition: "in the transport sector, a 36% reduction in emissions due to the substantial electrification of car transport and, to a lesser extent, to the infiltration of biofuels".[11]

Measures	***Levers matched with measures***	***Final iteration***
Transport passengers - behavioral levers		
Increase in the uptake of shared mobility	***Key behaviours > Travel > Occupancy***	***3***
Transport decarbonisation		
Advanced fuels, which include advanced biofuels, renewable electricity, renewable fuels of non-biological origin, should count for at least 7% of the total energy consumed in transport.	***Several levers involved, some highlighted below***	

[11] Integrated national energy and climate plan for Italy, Ministry of Economic Development, Ministry of the Environment and Protection of Natural Resources and the Sea Ministry of Infrastructure and Transport, December 2019, p302

Uptake of six million electric vehicles and hybrid vehicles by 2030, four million of which fully electric	***Passenger transport > Technology evolution > Technology share ZEV*** ***Passenger transport > Technology evolution > Technology share LEV***	***level 4 : BEV reach 4.4 M in 2030*** ***level 4 : PHEV reach ~ 0.4 M in 2030***
In the final NECP, the use of first-generation biofuels is set to increase up to 0.71 Mtoe **(or 16.5 TWh)** (equal to 3% of RES-Transport) by 2030, in particular palm oil and derivatives, which are at high risk of indirect land use change (ILUC) and produce three times as much CO2 as diesel.	***Transport > Technology and fuels > Biofuel switch***	***level 1 leads to 16 TWh, in line with the 16.5 TWh mentioned in the NECP***
Transport freight		
Increase in the use of hydrogen in transport, in particular for direct application in cars, buses, heavy duty vehicles, trains (where electrification is not possible) and ships.	***Transport > Freight transport > Technology evolution > Share ZEV*** ***Transport > Freight transport > Technology evolution > Share ZEV mix***	***3.5*** ***1.5***
Shift from road to rail for freight transport	***Transport > Freight transport > Freight mode***	***2.5***
Transport: all other levers		***3***

Table 1. Mapping of the PAMs and 2030 indicators described in the NECP document with the specific transport levers in The Pathways Explorer and their ambition in the NECP scenario

A first remark that can be made is that few of these policies and measures were quantified. Hence, the level of the levers that could be mapped with these policies had to be adjusted in order to reach the given GHG emission target for the transport sector in Italy for 2030. It should also be noted that additional levers than the ones that could be mapped with NECP policies had to be used in order to reach this target, as can be noted with the level 3 ambition required for all other levers which were not highlighted in the NECP document.

Then, it can also be observed that the NECP decarbonization trajectory for the transport sector is rather ambitious. Indeed, GHG emissions have decreased between 2007 and 2013, but they have then stabilized, and would need a much higher rate of decrease in the next decade of about 3% year on year (see Figure 3). This ambition is reflected in the overall high level for the transport levers shown in Table 1, with the complexity of relying on Electric vehicles as the lifetime of vehicles is estimated to be around 10 years.

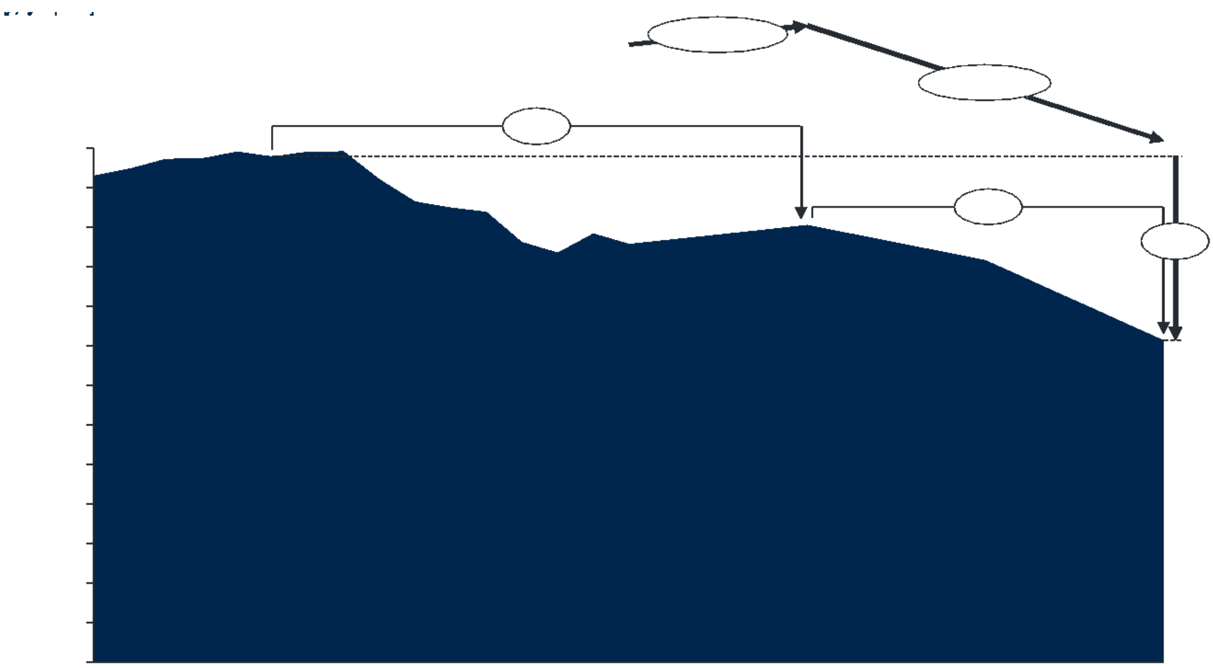


Figure 3. GHG emissions from the transport sector – with year-on-year (yoy) compounded annual growth rates for periods 2015-2020 and 2020-2030 and total percentage reductions for the other periods

We detail further below the key outputs of the scenario based on these ambition levels.

Firstly, the passenger transport demand increase is contained to 1.5% and a moderate shift can be observed towards active modes such as biking as well as public transport (rail and buses), the car modal share decreasing from 61% to 59% between 2020 and 2030 (Figure 4).

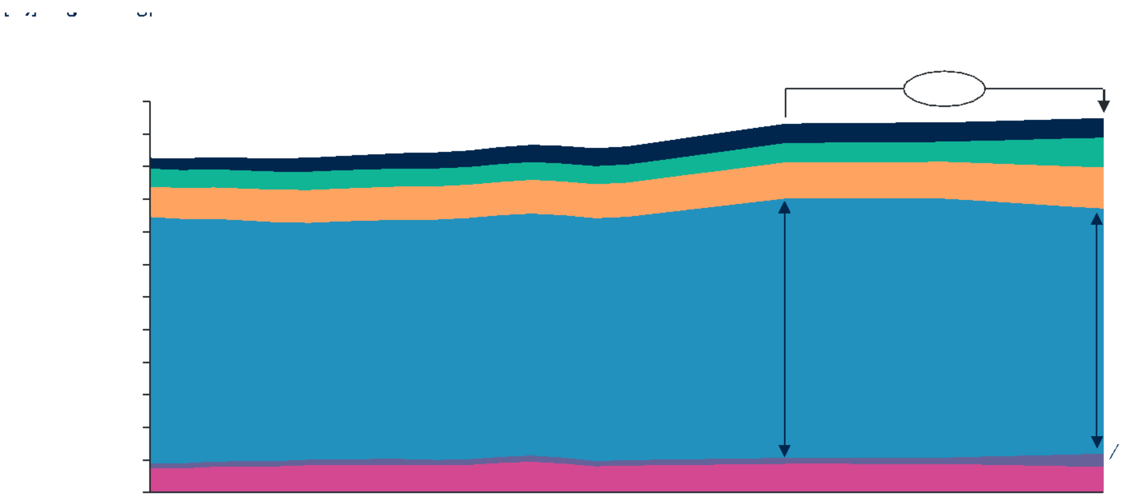


Figure 4. Evolution of the passenger transport demand

The evolution of the car fleet resulting from the lever settings presented in Table 1 is presented below (Figure 5). The modal shift and an increased occupancy rate have a significant impact on the fleet size, decreasing the needed amount of cars in 2030 by 17% compared to 2020.

On the same figure, it can also be observed that Low- and Zero-emission vehicles start increasing more significantly after 2025 to reach 12% of the fleet in 2030 (4.7 Mios Battery-Electric Vehicles (BEV) or Plug-in Hybrid Electric vehicles (PHEV) in 2030). This level is below the 6 Mios intended level mentioned in the NECP, this is due to the fact that the needed vehicle fleet size decreases. Hence, new vehicle sales decrease as well. Furthermore, given the average 7.5 years lifetime of passenger cars in Italy[12], a significant part of the existing fleet in 2020 (mainly based on fossil fuels) is still operational in 2030. This means that even with an increasing proportion of BEV/PHEV in new car sales (lever 'Technology-share new ZEV/LEV'), the absolute figures remain relatively low in at first. On a longer term however, the existing fossil-fuel cars need to be replaced when coming to their end of life, and BEV represent 61% of the car fleet in 2050 in the analyzed scenario when it is extended until 2050.

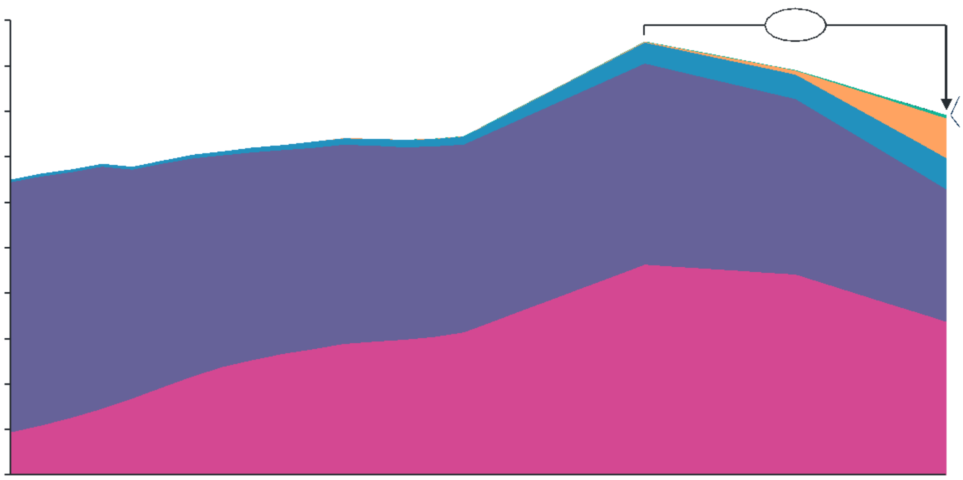


Figure 5 Composition of the car fleet by technology [million vehicles]. FCEV: fuel cell electric vehicle, BEV: Battery Electric Vehicle, PHEV: Plug-in Hybrid and Hybrid, ICE: Internal combustion engine

[12] EEA, 2016, https://www.eea.europa.eu/data-and-maps/daviz/average-age-of-road-vehicles-6#tab-chart_1

Buildings sector

According to the Italian NECP, the building sector is supposed to achieve an overall emission reduction of 35 MtCO2, decreasing from 87Mt today to 52Mt.

Table 2 below show how PAMS and 2030 projections respectively can be mapped and translated into ambition levels for the Buildings sector levers.

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**
This will be achieved mainly through deep renovations and requalification of buildings, the application of highly performing technologies and uptake of renewable energy sources (RES).	Buildings > Residential > Buildings envelope	1.5
the tertiary sector will contribute in particular through deep renovations and the installation of heat pumps and more efficient appliances.	Buildings>Services > Buildings envelope	1.5
Renewable energy sources in heating and cooling will play a major role and are planned to account for 33.9% of the 111Mteq of gross final energy consumption in the building sector.	Buildings>Residential-Services > Low-carbon heating solutions	1.5
Energy efficiency interventions and a phase-out of oil boilers are identified as priorities in the building sector.	Buildings>Residential-Services > Efficiency of technologies	1.5
	All other Buildings related levers	1.5

Indicator : 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**
Population [number] 63.3 Mios in 2030 (from 60.8 mios in 2015)	Demographic and long term> Population	B.2[13]

[13] Population and household size are not considered as 'levers' but rather as trajectories. Hence we do not consider that there is an ambition from 1 to 4, but rather 4 different trajectories defined for both indicators. The decimal figure (e.g. B.2) represents the fact that an hybrid trajectory is chosen, between two predefined ones (here B and C) and indicates the respective weight of both trajectories in the weighted sum (here it is 20% of trajectory C + 80% of trajectory B)

Household size [number/household] 2.3 persons per household in 2030 (from 2.36 in 2015)	Demographic and long term> Household size	A.9[14]
Buildings GHG emissions 53 MtCO2e (vs 74 MtCO2e in 2005 or -39%)		

Table 2: Mapping of the PAMs and 2030 indicators described in the NECP document with the specific Buildings sector levers in the Pathways Explorer and their ambition in the NECP scenario

The buildings sector is expected to reduce GHG emissions by 39% in 2030 compared to 2005. However, there are limited quantified details about how to reach this ambitious decarbonization in the sector by 2030. Some of the high level levers are mentioned, but a balanced setting of various levers is suggested as the most appropriate as a harmonized ambition level of 1.5 is sufficient to reach this sectoral target, by targeting both the improvement of the building envelope and the shift to low-carbon heating solutions. The levers are set to a level of 1.5 for both tertiary and residential buildings. The concrete implications are shown below.

As shown on Figure 6 for residential buildings, this means that the renovated surface should be multiplied by almost 3 between 2020 and 2030. Besides the renovated surface, the depth of these renovations is key, to sufficiently reduce the energy demand for heating, as it is a large share of the current energy demand (47% in 2020): the average heating energy consumption of **renovated** buildings in 2030 (residential and non-residential) should be half the value (66 kWh/m²) of the current average heating energy consumption of the **total building stock** (122.8 kWh/m²). This should lead to a reduction of the total cooling energy demand by 20% between 2020 and 2030 (Figure 7) (which amounts to a -35% reduction compared to 2005 level).

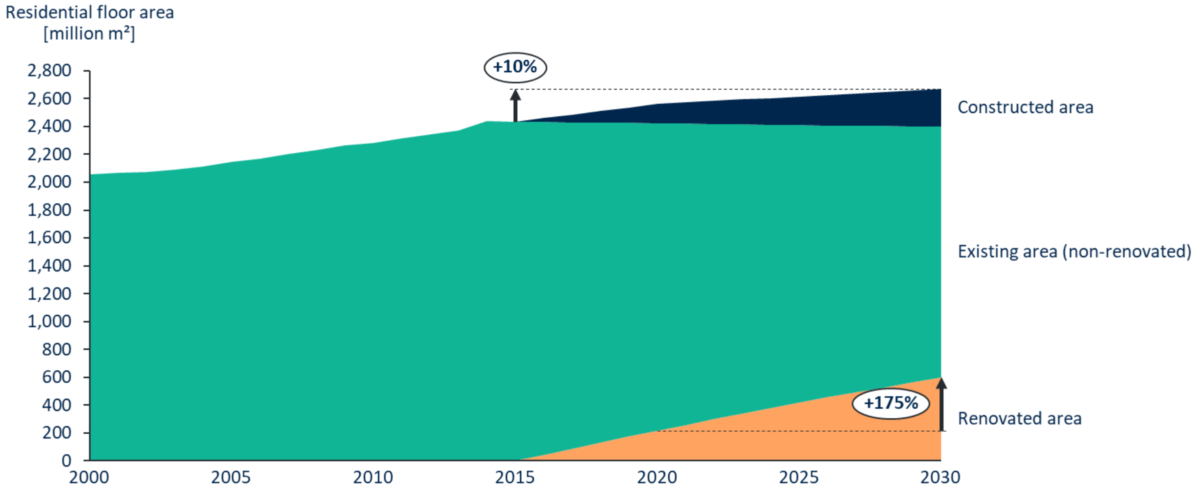


Figure 6 Evolution of the residential building stock

[14] Ibidem

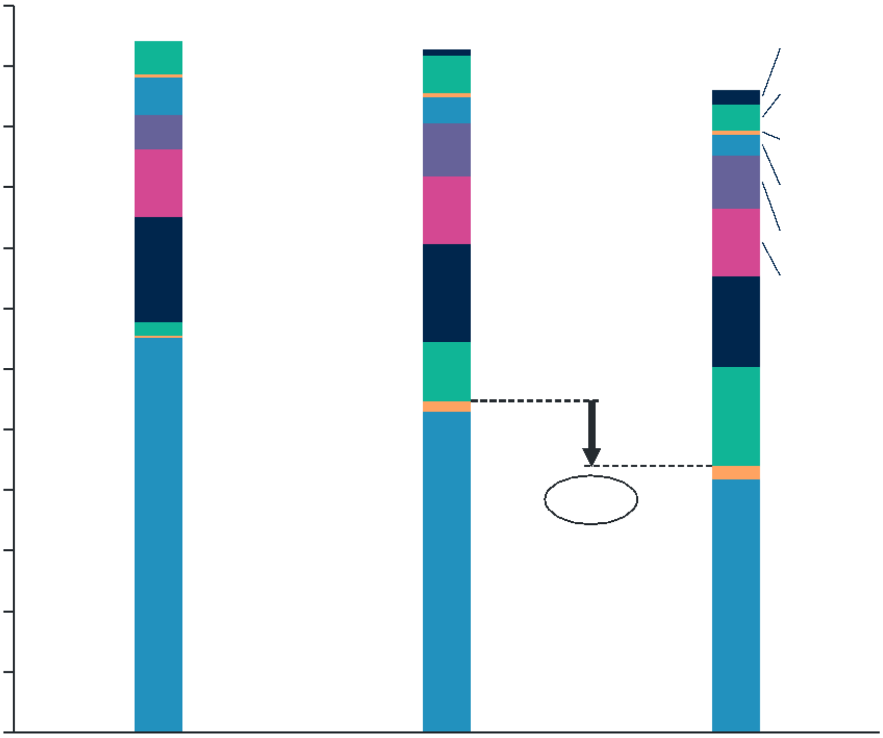


Figure 7 Evolution of the energy demand per end-use in the Buildings sector

The ambition level for the low-carbon heating solutions lever is set to 1.5. This means that the share of fossil-fuel based heating bodies should decrease between 2020 and 2030. This translates into a 29% reduction in the demand for natural gas in the building's energy consumption between 2020 and 2030 (Figure 8). It can also be seen from Figure 8 that the contribution of electricity to heating is increasing between 2020 and 2030, both in absolute and relative figures, which connects to the need to increase the rate of installation of heat pumps significantly.

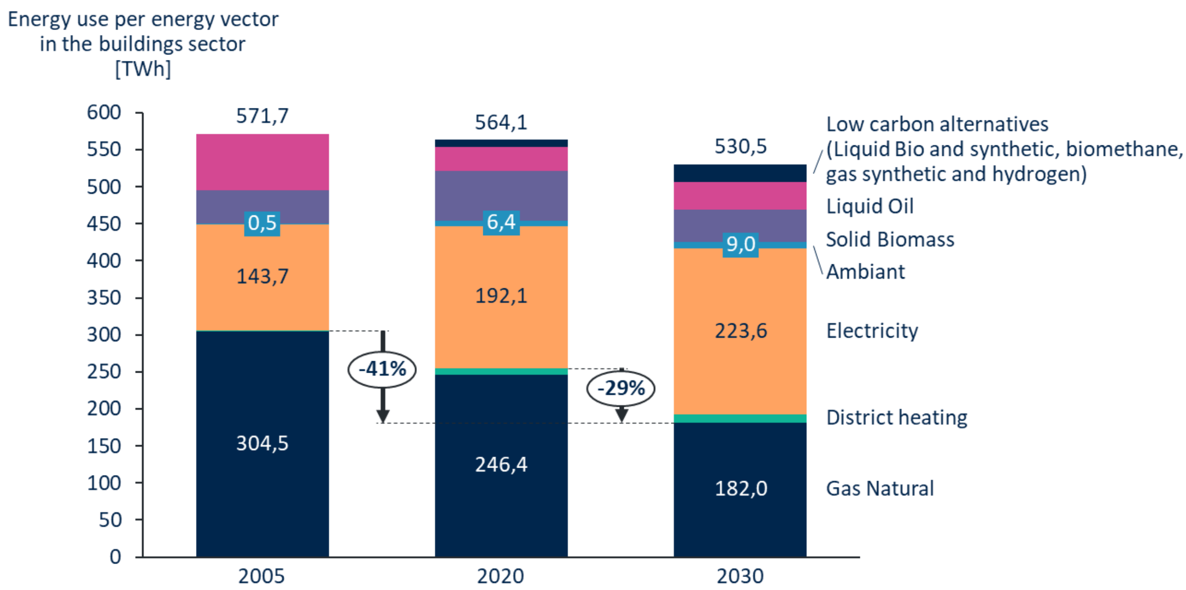


Figure 8 Evolution of the energy demand per energy vector in the buildings sector

Agriculture sector

The Italian NECP 2030 projections for agriculture foresee a stabilization of emissions (+3% on the 2015-2030 period, -7% compared to 2005). To try and reproduce this trend, all agriculture levers had to be set on 1 to represent the continuation of ongoing trends. However, even with this minimal ambition through all agriculture decarbonization levers, the emissions could only be stabilized (not increased by 3%) between 2015 and 2030, due to the continuation of certain ongoing trends (intensification of livestock production, improvement of energy efficiency) as well as the slight increase of the Italian population during this period, according to the Italian NECP 2030 projections.

This reflects well the lack of concrete measures in the Italian NECP concerning the agriculture sector.

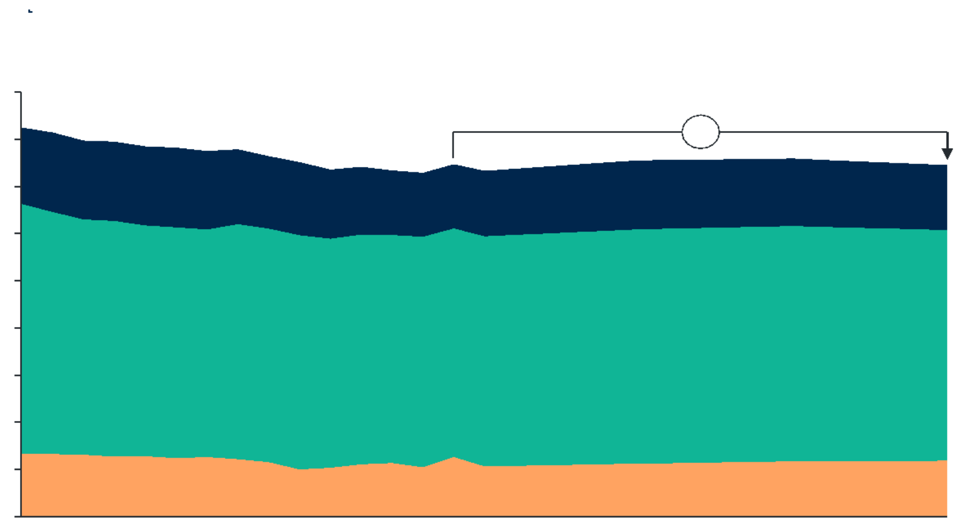


Figure 9 Evolution of GHG emissions by category [MtCO2e] in the agriculture sector in Italy

Detailing what a -65% ambition for 2030 means

Overall results of the -65% scenario

As explained above, the GHG reduction target for ESR sectors in this scenario is calculated based on numbers included in the ECF publication *Planning for net zero: assessing the draft national energy and climate plans* (May 2019)[15]. For Italy, this amounts to a -59.1% reduction of overall ESR emissions in 2030 compared to 2005. It can be noted that this target is significantly higher than the -33% target from the NECP scenario. Hence, the -65% scenario (accessible through this link) is significantly more ambitious than the NECP scenario.

The logic has been to reach a similar level in terms of ambition level of the levers in the scale from 1 to 4. Therefore, the buildings sector increases its contribution most as it reached the -39% reduction of the NECP with a relatively low level of ambition (level 1.5 out of 4 across most of its levers compared to level 2 on average for Transport), and this increases to -78% in the -65% scenario.

The agriculture sector also had a very low starting point with level 1 ambition on agricultural practices and diets, but it has the least potential in its reductions. The ambition is also increased to level 3.7, but the reductions remain below the ambition required (-29% in 2030 compared to 2005), and therefore Transport and Buildings sectors have to compensate with higher reductions.

Transport is the sector which reduces most in absolute emissions (-71 MtCO2e) as it is the largest contributor in 2005 with 128 MtCO2e.

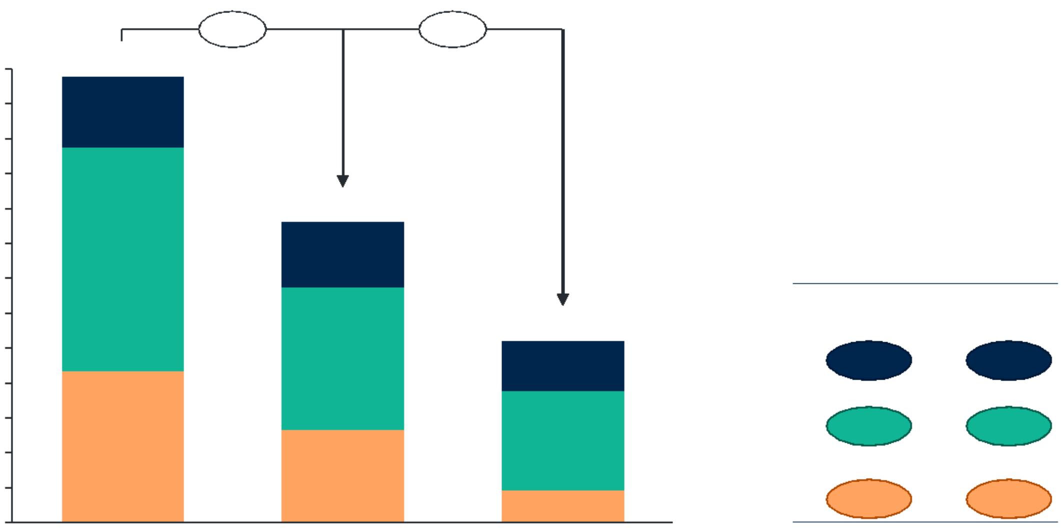


Figure 10 Comparison of GHG emissions [MtCO2e] in NECP and -65% scenarios

[15] Available at https://europeanclimate.org/wp-content/uploads/2019/11/05-2019-planning-for-net-zero-assessing-the-draft-national-energy-and-climate-plans.pdf. See page 65 for figures (last column of the table, net zero (high range))

Transport sector

As shown in Figure 11, the ambition level increases for all levers in the -65% scenario, to reach a similar ambition (except for the car own or hire which is kept at level 2 as it has strong implications on the fleet size, significantly reducing the amount of vehicles by 2030).

	NECP scenario	-65% scenario
Travel behaviour		
Passenger distance	3	3.7
Mode of transport	3	3.7
Occupancy	3	3.7
Car own or hire	1	2
Transport technical levers		
Passenger transport	2.5	3.7 (efficiency) & 4 (technology shift, but limited uptake due to smaller fleet)
Freight transport	2.4	3.7 (efficiency) & 4 (technology shift, but limited uptake due to smaller fleet)
Technology and fuels	1.3	2.5 for biofuels

Figure 11. Average ambition levels for these categories of levers in both scenarios for the Transport sector

This high ambition leads to significant GHG emissions reductions, but it requires a completely new way of looking at the transport sector: the vehicle fleet decreases, with much more focus on the shared economy (higher occupancy of cars and higher fleet management with less ownership of vehicles). The fleet size goes from 37 million passenger vehicles in 2015 to 23 million in 2030 (-38%).

As the vehicle fleet decreases, the opportunity decreases for shifting to electric vehicles (lower turnover ratio), and instead biofuels are coming in to complement this change in mobility.

Buildings sector

The buildings sector is pushed much further in all the available dimensions in the -65% scenario. This leads to much higher reductions in 2030 compared to 2005: -78%. Needless to say such an ambition requires activating all levers as quickly as it is technically feasible. It will lead to better buildings, more resilience and much lower energy consumption, but it is extremely challenging in terms of citizen involvement and financing.

	NECP scenario	-65% scenario
Buildings behaviour		
Living space per person (residential)	1.5	3.7
Rational use of non-residential floor area	1.5	3.7
Heating and cooling behaviours	1.5	3.7
Residential and Services		
Buildings envelope	1.5	3.7
Low carbon heating solutions	1.5	3.7
Appliances	1.5	3.7
Green gas / Green liquids	1	3.7
Energy efficiency of technologies	1.5	3.7

Figure 12. Average ambition levels for these categories of levers in both scenarios for the Buildings sector

Agriculture sector

As described in the section above, all agriculture levers were left on level 1 to reach the level of the NECP scenario. In the -65% scenario with align the ambition with the other sectors, at 3.7. This means the meat consumption decreases with more appropriate levels of calories consumption and diets. Then, the "Climate Smart Crops Production System" lever is set on level 3.7, which is slightly more ambitious than the FAO sustainable agriculture scenario (~level 3). This means a decrease of the intrants in the agricultural system, which in turn allows to lower the related emissions.

Altogether this turns around the historical stagnation in emissions to reduce emissions by -29% between 2005 and 2030.

	NECP scenario	-65% scenario
Diets		
Calories consumption	1	3.7
Type of diet	1	3.7
Technical levers		
Agriculture practices	1	3.7
Bioenergy	1	3.7

Figure 13. Average ambition levels for these categories of levers in both scenarios for the Agriculture sector

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We encourage the readers interested to better understand the scenarios to explore them further online at the following links:

- NECP scenario
- -65% scenario

Conclusions

This document shows two concrete pathways to reach two different levels of GHG reduction in Italy by 2030.

From the analysis carried out for the NECP scenario, the following conclusions can be drawn:

- Firstly, the plan lacks quantified measures. Indeed, while the plan mentions a wide variety of decarbonization levers, the policy description remains vague and without sufficient quantification.
- Then, the ambition throughout the different sectors is quite unbalanced, with the buildings sector bearing the largest part of the decarbonization effort, while transport and agriculture do not see significant cuts in their GHG emissions.
- Furthermore, in the buildings sector, it is shown that the ambitious GHG reduction target can only be met through significant efforts in terms of renovation rate, depth and shift from fossil fuels.

An ambitious scenario in line with a -65% reduction of GHG emissions economy-wide in Europe is proposed, requiring -59% reductions for the ESR sectors in Italy. To reach these levels, the behavioural decarbonization levers (travel mode shifts, higher occupancy of cars, lower meat consumption) are pushed much higher in order to increase their contribution to the decarbonization effort alongside the technical levers. The technical levers are particularly key in the Buildings sector where the behavioral ones do not lead to sufficient reductions. In this scenario this sector reaches a very ambitious -78% in emissions, requiring the massive and speedy deployment of renovation and of low carbon heating solutions.

Decarbonization trajectories for Poland

Results of the 2 scenarios (NECP and -65%)

What does the NECP scenario mean in Poland

Overall results of the NECP scenario

The following section shows the analysis of the NECP measures and projections and the resulting scenario that is constructed in the Pathways Explorer model for Poland. The main implications are detailed in the graphs and tables hereunder. However, the complete implications for the three analysed sectors can be investigated on the online webtool via this link (the procedure to navigate the webtool is described in Annex II).

The Polish NECP shows a reduction in emissions of 7% between 2005 and 2030 in ESR sectors, which is aligned with the ambition required in the context of the effort sharing for the current -40% EU target. However, this reduction target is not equally distributed between the various ESR sectors. Indeed, the overall variation of GHG emissions over the three analysed sectors is +5.4% between 2005 and 2030 while the waste and non-ETS industry sectors see an overall -33.6% reduction of their emissions in the same time.

Figure 2 shows the evolution of the GHG emissions for the three analysed sectors in the NECP scenario constructed for Poland in The Pathways Explorer. It has to be noted that the sector emissions shown on Figure 2 do not match exactly the 2030 projections presented in the NECP. Indeed, the overall emissions of the three analysed sectors only increase by 0.6% between 2005 and 2030 while this figure is 5.4% in Polish 2030 projections. The reasons for these deviations and the specifics of each sector are described in the following sections.

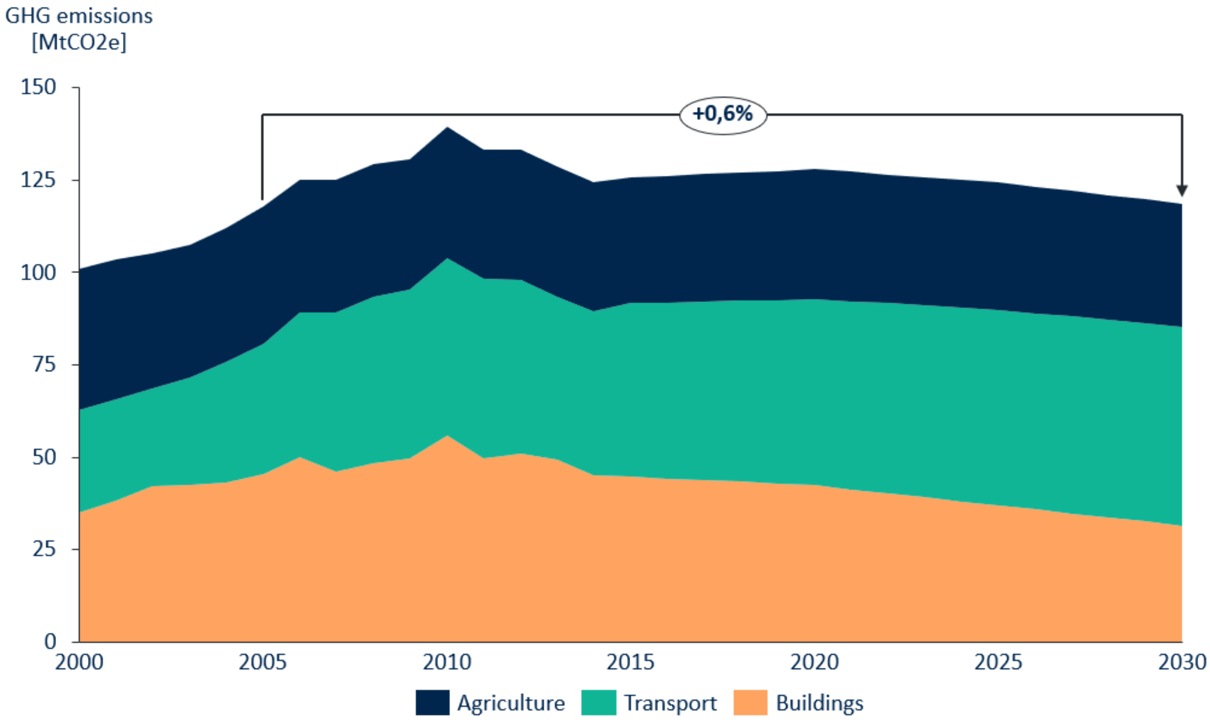

Figure 2 Evolution of the GHG emissions by sector [MtCO2e] for the three analysed sectors in the NECP scenario constructed in The Pathways Explorer

Transport sector

Table 1 below shows how PAMS and 2030 projections directly coming from the NECP document can be mapped and translated into ambition levels for the Pathways Explorer transport levers. This table illustrates the following elements:

1. The transport demand is steadily increasing from 2005 up to 2030, both for passenger and freight transport, in the absence of measures aiming at curbing the ongoing trend
2. There is no significant modal shift to softer transportation modes
3. The switch to clean powertrains is not significant enough to compensate for the increasing transport demand

As a result of these, the transport emissions are expected to significantly increase in 2030 projections compared to 2005 (+57.3%).

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Clean transportation - 1 million EV by 2025	• Transport>Passenger transport > Technology evolution>Technology share ZEV	3.2	Not mentioned in the analysis of the final NECP
Zero emission public transport (eBus project)	• Transport>Passenger transport > Technology	3.2	

25% of buses are EV by 2030	evolution>Technology share ZEV		
Polish Electromobility Plan's requirement for zero-emission cars in municipal fleets Difficult to quantify regarding the total fleet size as figures relate to municipal fleets	• Transport>Passenger transport > Technology evolution>Technology share ZEV	3.2	
Modal shift	• Key behaviours>Travel > Mode of transport	1	
Indicator **2030 projections**	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	
Passenger activity per mode [billion pkm]	• Key behaviours>Travel > Passenger distance • Key behaviours>Travel > Mode of transport		
Cars 432		1	The Polish 2030 projections do not match historical figures in the tool. Hence, only the relative evolution of figures is considered, not the absolute values.
Buses 38		1	
Rail 47		1	
Freight activity per mode [billion tkm]	• Key behaviours>Consumption > Freight distance • Transport>Freight transport > Freight mode		
Road 322		1	The Polish 2030 projections do not match historical figures in the tool. Hence, only the relative evolution of figures is considered, not the absolute values.
Rail 109		1	
Internal waterways 1.9		1	
Biofuels consumption [TWh] 16.5	• Transport>Technology and fuels > Biofuel switch	1	
Electricity consumption [TWh] 3.4	• Transport>Passenger transport > Technology	1	

	evolution>Technology share ZEV		
GHG emissions [MtCO2e] 57.0			

Table 1. Mapping of the PAMs and 2030 indicators described in the NECP document with the specific transport levers in The Pathways Explorer and their ambition in the NECP scenario

We detail further below the key outputs of the scenario based on these ambition levels.

Firstly, the passenger transport demand is increasing by 45% between 2005 and 2030, with no significant shift from individual cars to public transportation and active modes (Figure 3).

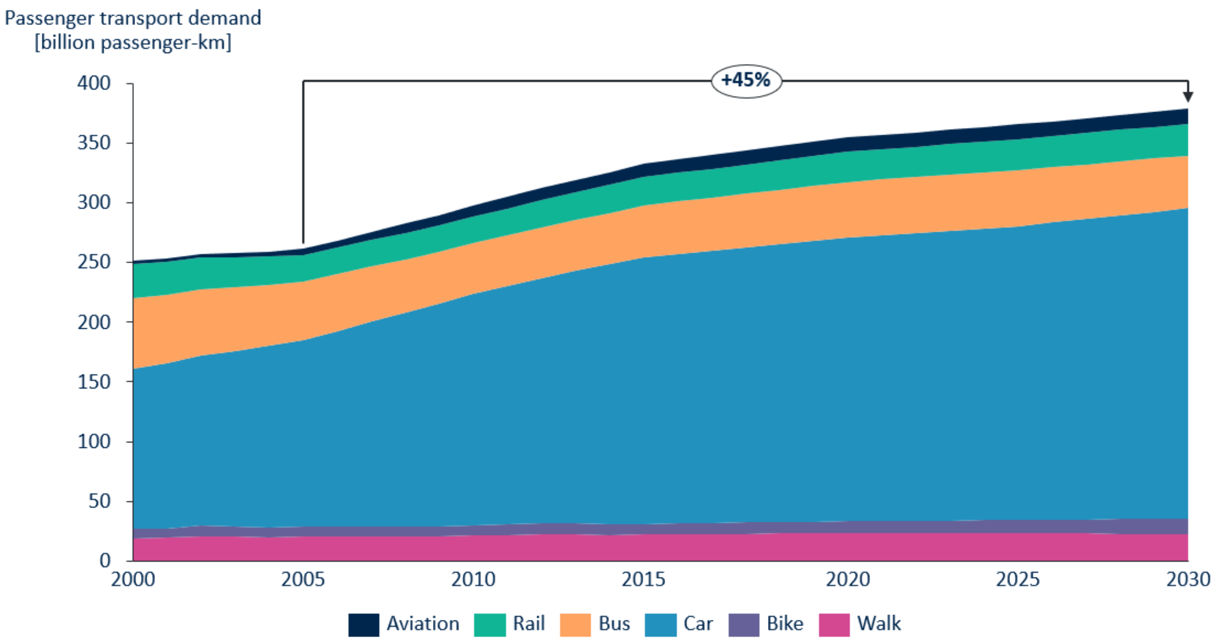

Figure 3 Evolution of the passenger transport demand

Then, there is an even larger increase in freight transport demand. It increases by 75% between 2005 and 2030, as shown on Figure 4, with no shift from road transport to rail or internal waterways.

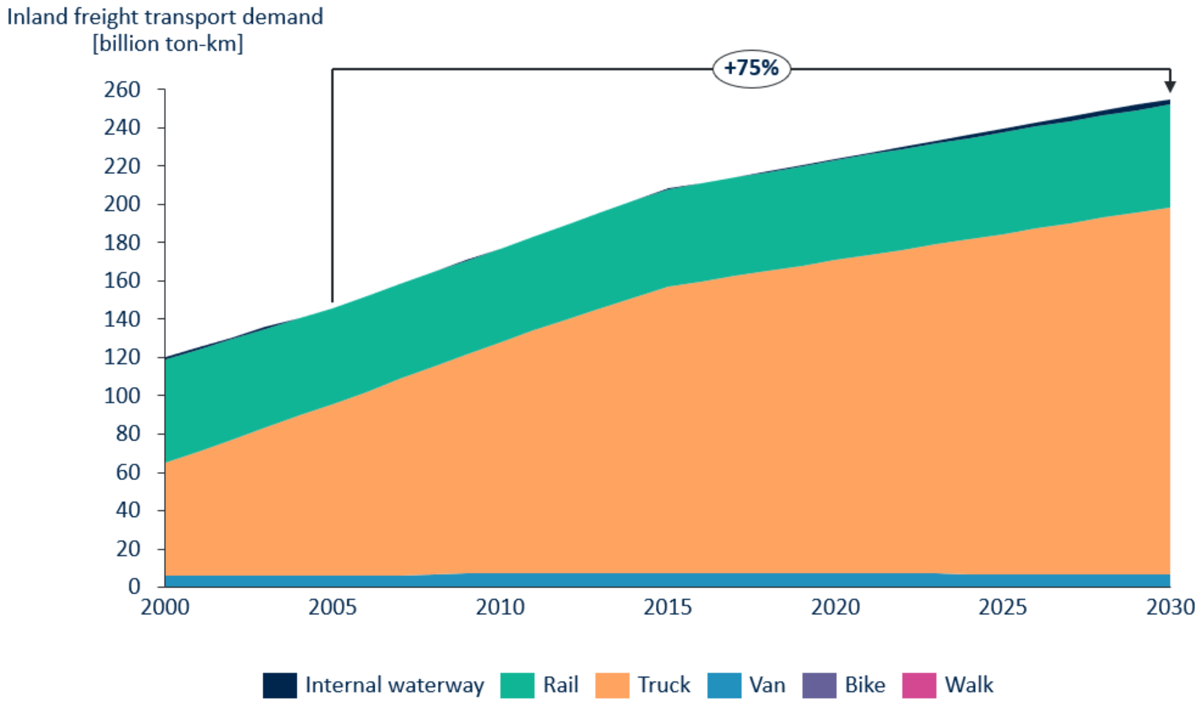

Figure 4 Evolution of the freight transport demand

In terms of the vehicle fleet evolution, the choice was made to mimic a policy presented in the draft NECP but not in the final one: the uptake of clean vehicles, leading to one million Battery Electric Vehicles in the fleet by 2030, as shown on Figure 5. It should be noted that this only represents about 6% of the expected car fleet by 2030 . As this measure was not included in the final plan, including it lowers the transport sector emissions (54 MtCO2e) compared to the 2030 projections (57 MtCO2e). Nonetheless, even with this small deviation from 2030 projections, transport emissions still increase by 52% between 2005 and 2030.

This shows that

- The transport demand should first be curbed, then shifted from polluting modes (car, truck) to softer and cleaner modes such as bus or rail.
- The decarbonization of the vehicle fleet should be more ambitious in order to slow the current growing trend in transport GHG emissions.

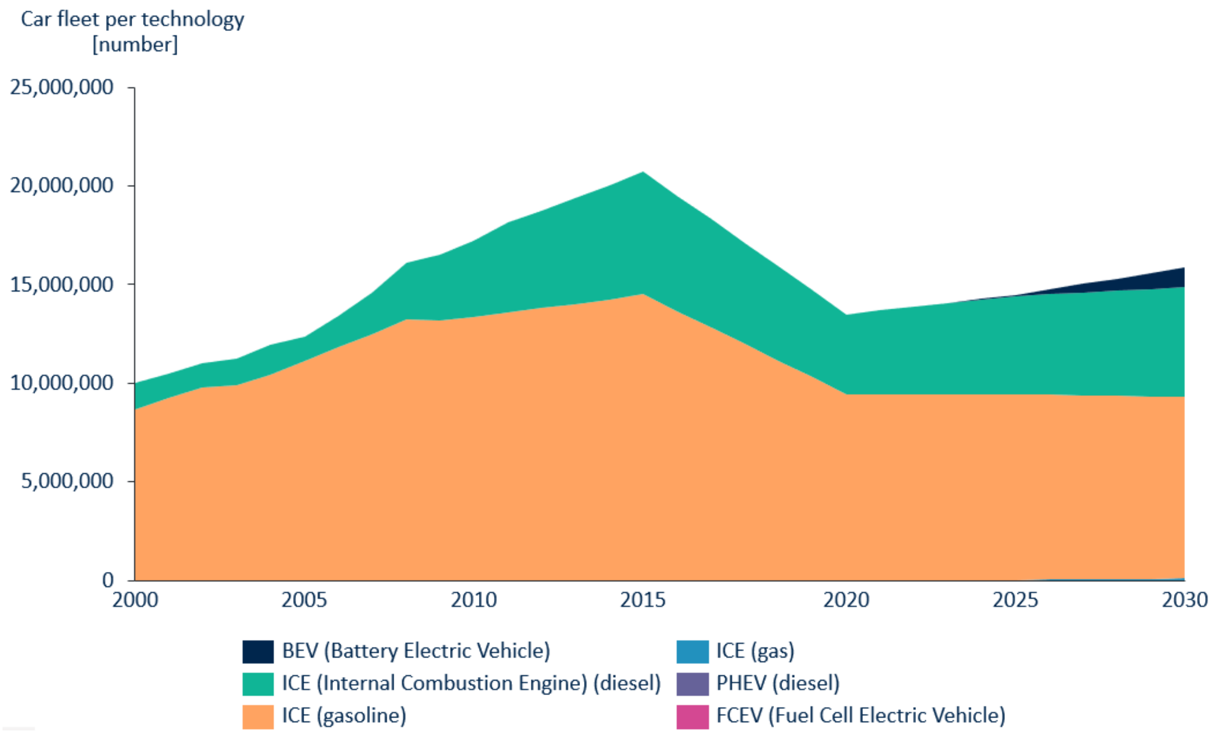

Figure 5 Composition of the car fleet by technology [million vehicles]. FCEV: fuel cell electric vehicle, BEV: Battery Electric Vehicle, PHEV: Plug-in Hybrid and Hybrid, ICE: Internal combustion engine

It is therefore logical that the amount of GHG emissions is only stabilized by 2030, and even if the measures are extended, while it reduces after 2030 it does not reach zero emissions by 2050.

Buildings sector

Tables 3 and 4 below show how PAMS and 2030 projections respectively can be mapped and translated into ambition levels for the Pathways Explorer buildings levers.

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Annual renovation target 3%	• Buildings>Services/Residential > Buildings envelope	2.2	Not mentioned in the analysis of the final NECP
Energy performance standards		2.2	No proper quantification in the NECP
The Clean Air programme	Buildings>Services/Residential > Low carbon heating solutions	2.2	No proper quantification in the NECP
Indicator 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Population [number] 37,500,000	Demographic and long term> Population	C[16]	
Household size [number/household] 2.3	Demographic and long term> Household size	C	
GHG emissions [MtCO2e] 31.3			

Table 1: Mapping of the PAMs and 2030 indicators described in the NECP document with the specific buildings levers in The Pathways Explorer and their ambition in the NECP scenario

The buildings sector is expected to be the main contributor to GHG emissions cuts by 2030 in Poland, reducing these by 31.4% in 2030 compared to 2005. The two main buildings-related policies in the Polish NECP are (i) increased energy performance standards and (ii) clean air programme. These two can be mapped to

[16] Population and household size are not considered as 'levers' but rather as trajectories. Hence we do not consider that there is an ambition from 1 to 4, but rather 4 different trajectories defined for both indicators. The decimal figure (e.g. B.8) represents the fact that an hybrid trajectory is chosen, between two predefined ones (here B and C) and indicates the respective weight of both trajectories in the weighted sum (here it is 80% of trajectory C + 20% of trajectory B)

the Pathways Explorer levers controlling the renovation rate and depth (i) and low carbon heating solutions (ii). However, these policies are not properly quantified in the plan. Hence, the abovementioned The Pathways Explorer levers have been set to reach the 2030 decarbonization target for this sector.

The ambition level for the renovation rate and depth lever is set to 2.2. As shown on Figure 6, this means that the renovated surface should be quadrupled between 2020 and 2030. Besides the renovated surface, the renovation depth is of paramount importance: the average heating energy consumption of all buildings in 2030 (residential and non-residential) should be 24% lower (98 kWh/m²) than the current average heating energy consumption of the (129kWh/m²). This should lead to a reduction of the total heating energy demand (district and individual heating) by 14% between 2020 and 2030 (Figure 7).

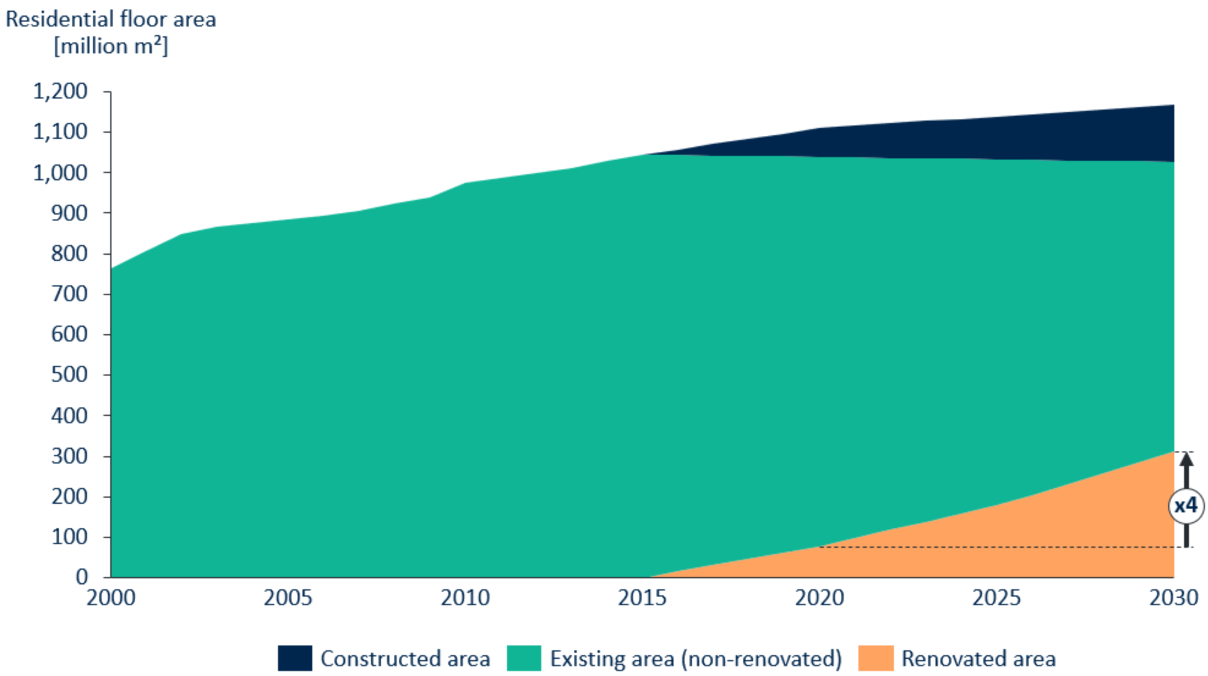

Figure 6 Evolution of the residential building stock

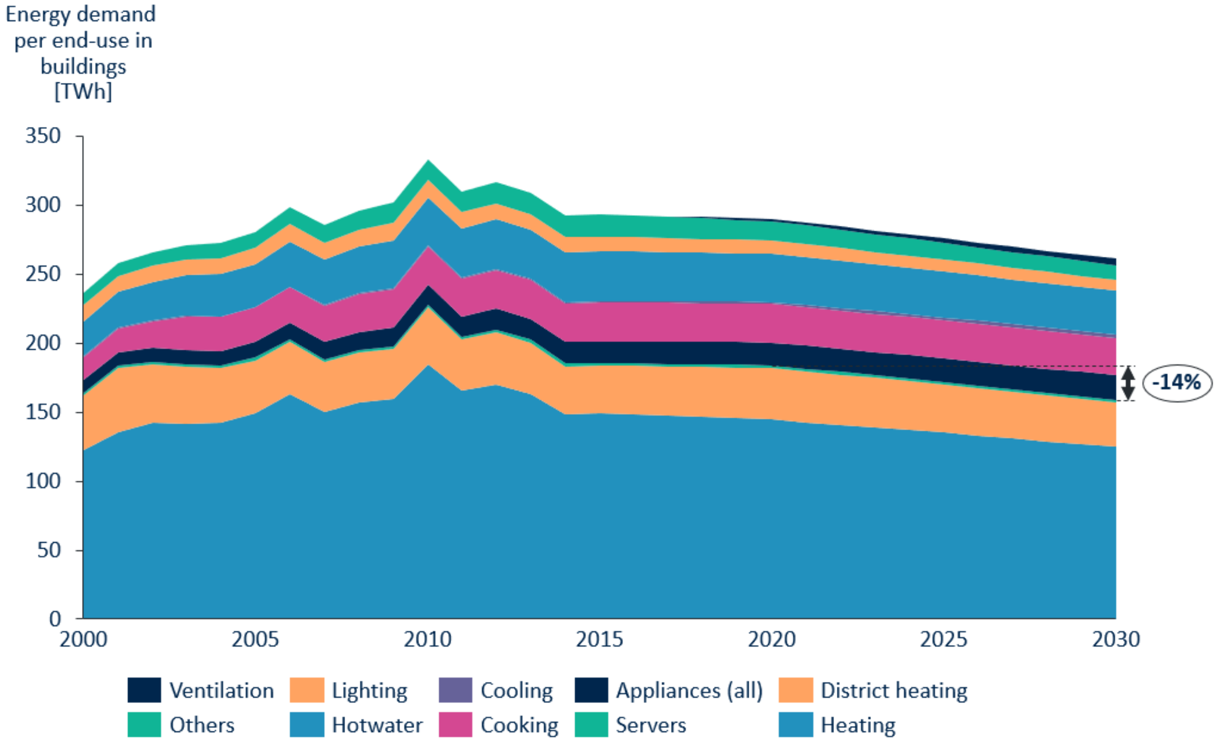

Figure 7 Evolution of the energy demand per end-use in the buildings sector

The ambition level for the low-carbon heating solutions lever is set to 2.2. This means that the share of fossil-fuel based heating bodies should significantly decrease between 2020 and 2030. This translates into a 39% reduction in the demand for coal in the buildings energy consumption (Figure 8)

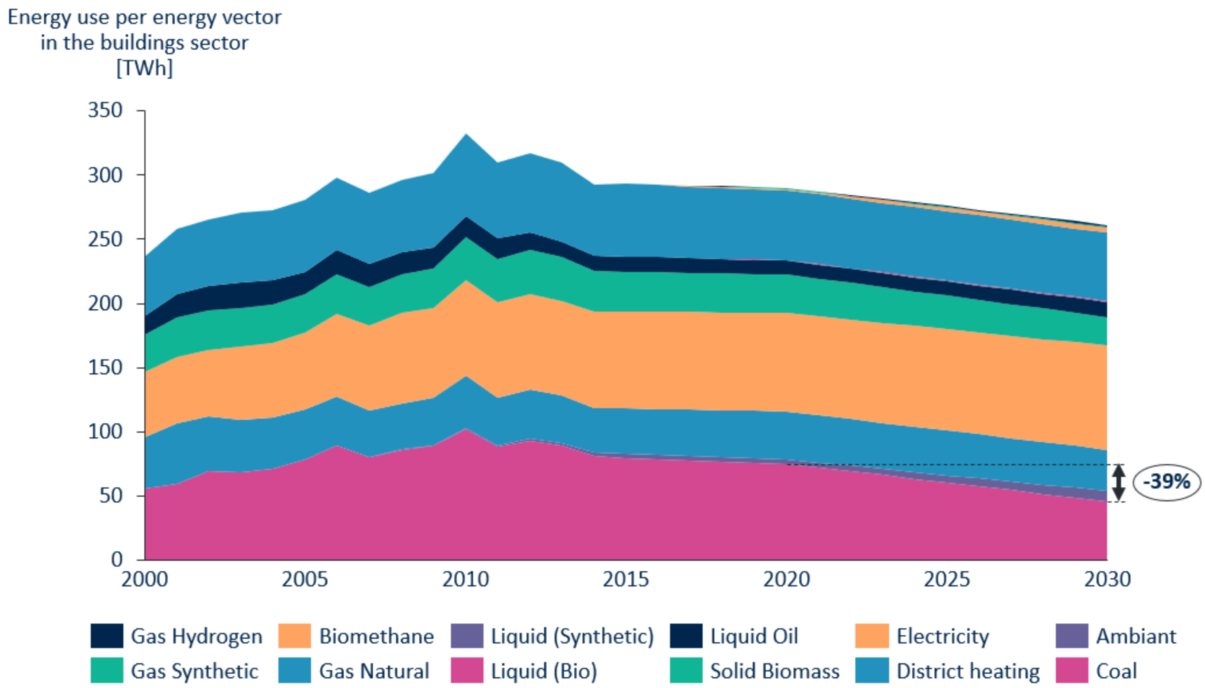

Figure 8 Evolution of the energy demand per energy vector in the buildings sector

Agriculture sector

The Polish NECP 2030 projections for agriculture foresee a status quo with 2005 GHG emissions (+0.3% on the 2005-2030 period). To try and reproduce this trend, all agriculture levers were set on 1 to represent the continuation of ongoing trends. However, even with this minimal ambition through all agriculture decarbonization levers, the emissions decrease by 9% between 2005 and 2030, due to the continuation of ongoing trends (intensification of livestock production, improvement of energy efficiency) as well as the slight decrease of the Polish population during this period, according to the Polish NECP 2030 projections.

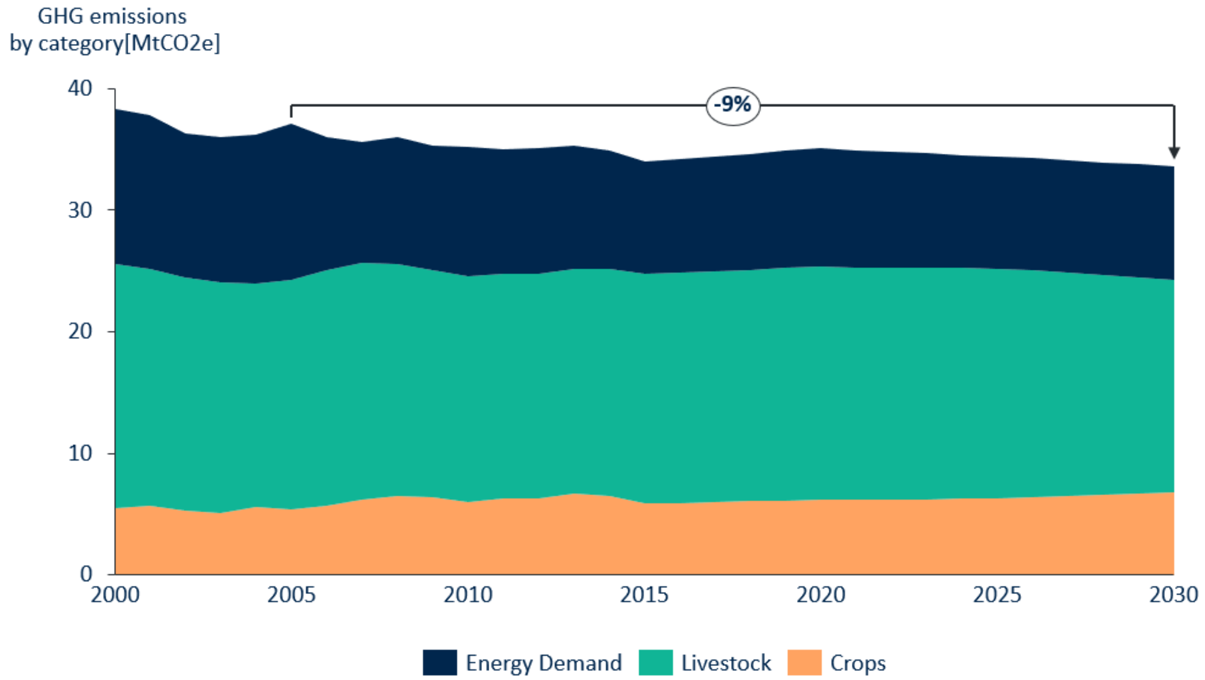

Figure 8 Evoluton of GHG emissions by category [MtCO2e] in the agriculture sector in Poland

Detailing what a -65% ambition for 2030 means

Overall results of the -65% scenario

As explained above, the GHG reduction target for ESR sectors in this scenario is calculated based on numbers included in the ECF publication *Planning for net zero: assessing the draft national energy and climate plans* (May 2019)[17].

For Poland, this amounts to a -28.5% reduction of overall ESR emissions in 2030 compared to 2005. As stated before, ESR emissions also include waste and non-ETS industry besides transport, agriculture and buildings. Hence, when

[17] Available at https://europeanclimate.org/wp-content/uploads/2019/11/05-2019-planning-for-net-zero-assessing-the-draft-national-energy-and-climate-plans.pdf. See page 65 for figures (last column of the table, net zero (high range))

disaggregating this overall target over the various sectors, it could be argued that the ambition over transport, buildings and agriculture could be lower than this 28.5% reduction figure as long as the non-ETS industry bears the majority of the decarbonization effort. Nonetheless, this target should represent a pathway for Poland that is compatible with net-zero emissions at EU level by 2050, which represents an ambitious decarbonization. We thus believe that it is important to distribute this effort evenly over the different sectors to construct a credible pathway. Hence, we make the choice to keep the same 28.5% reduction target for the three agriculture, buildings and transport sectors taken as a whole.

Given the steady increase of transport emissions between 2005 and 2020 (Figure 6), this overall reduction target for the three sectors is challenging. It requires a high ambition on numerous levers in the concerned sectors. The scenario and its complete implications can be consulted here. Some of the major implications for the tree sectors are detailed in the sections below.

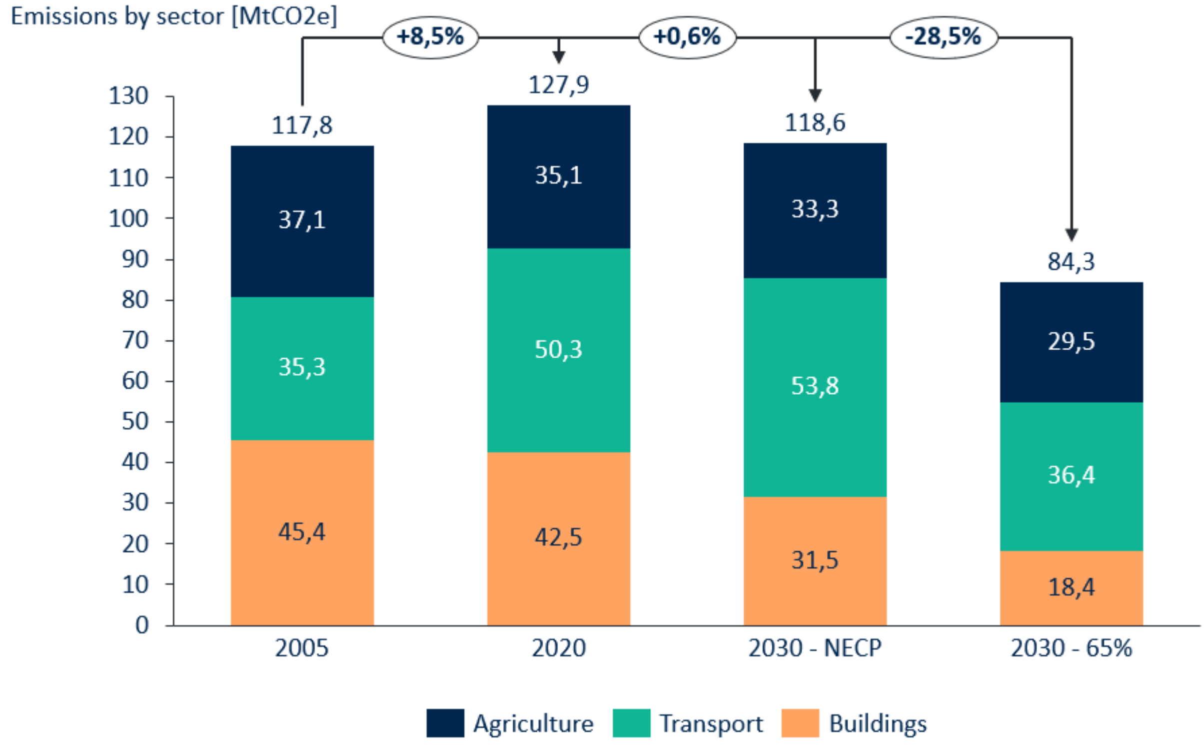

Figure 9 Evolution of GHG emissions by sector in the NECP and -65% scenario

Transport sector

As it can be seen on Figure 6, the decarbonization ambition for the transport sector is much higher in the -65% scenario than in the NECP scenario.

In the present case, the -65% scenario for transport in Poland in 2030 nearly corresponds to getting back to 2005 emission levels for this sector, while the passenger transport demand has jumped by 36% between the years 2005 and 2015 alone. This means that we should not only focus on decarbonizing the transport demand by shifting away from car transport and Internal Combustion Engines (ICE) in general, but also on reducing the transport demand itself. Hence, behavioural and technical levers should both be activated for this pathway. We detail hereunder some of the most important developments.

Both passenger and freight transport demand levers are set near to their maximum level (3.5), which implies a reduction of 5% and 7% of the freight activity ([tkm]) and passenger activity ([pkm]) respectively between 2020 and 2030.

Then, the modal shift levers are also set near to their maximum setting for both freight and passenger (3.5) , which corresponds to a significant reduction of the car modal share from 70% in 2020 to 59% in 2030.

Finally, the levers representing the improvement of vehicles energy efficiency are set to level 3.5.

Buildings sector

As shown on Figure 6, the buildings sector is set to cut its emissions by 60% between 2005 and 2030 in the proposed scenario. This is significantly more ambitious than the target proposed for the NECP scenario. This is also achieved by activating behavioural and technical levers.

This implies to significantly curb the increase of residential and tertiary buildings surface between 2020 and 2030, to decrease the heating temperature and hot water consumption to increase the renovation rate and depth and to increase the uptake of low-carbon heating solutions.

The average level of buildings levers is 3.1 while it is 1.6 in the NECP scenario, which shows the difference in ambition in both scenarios.

Agriculture sector

The decarbonization effort is also significant in the agriculture sector with a 20% reduction between 2005 and 2030. This reduction is achieved thanks to a combination of the “Food waste” lever set on 3.5, which allows to reduce food waste in Poland (hence to reduce the needed food production for a same useful food consumption) and an improvement in agricultural practices (this lever being set on level 3.3). This encompasses manure management, alternative protein sources for cattle and reduced use of fertilizers.

Conclusions

This document shows two concrete pathways to reach two different levels of GHG reduction in Poland by 2030.

From the analysis carried out for the NECP scenario, the following conclusions can be drawn:

Firstly, the plan lacks diversified measures. Indeed, the plan mostly addresses one or two decarbonization levers throughout the various sectors, not reaping the full potential of behavioural and technical changes.

Then, the ambition throughout the different sectors is quite unbalanced, with the buildings sector bearing the largest part of the decarbonization effort, while transport and agriculture do not see significant cuts in their GHG emissions.

Finally, in the buildings sector, it has been shown that the ambitious GHG reduction target can only be met through significant efforts in terms of renovation rate, depth and shift from fossil fuels.

Decarbonization trajectories for Romania

Results of the 2 scenarios (NECP and -65%)

What does the NECP scenario mean in Romania

<u>Overall results of the NECP scenario</u>

The following section shows the analysis of the NECP measures and projections and the resulting scenario that is constructed in the Pathways Explorer model for Romania. The main implications are detailed in the graphs and tables hereunder. However, the complete implications for the three analysed sectors can be investigated on the online webtool via this link (the procedure to navigate the webtool is described in Annex II).

The Romanian foresees an overall 2% GHG emissions reduction between 2005 and 2030 on Effort Sharing Regulation (ESR) sectors (agriculture, transport, buildings, waste and non-ETS industry), as recommended by the EU ESR regulation. However, no further quantification is given in the Romanian NECP about how this reduction is split between the different ESR sectors. Hence, the sectoral targets used for this analysis are taken from European Environment Agency's database about member states GHG projections under the WAM scenario[18]. These are shown in Table 1 hereunder, where both the Common Reporting Format and the Pathways Explorer sectors categories are matched.

<table>
<tr><th>the Pathways Explorer</th><th>CRF category</th><th colspan="2">2005 values [MtCO2e] [19]</th><th>2030 WAM projections [MtCO2e][20]</th></tr>
<tr><td>Transport</td><td>1.A.3 Transport</td><td colspan="2">12.58</td><td>19.85</td></tr>
<tr><td>Buildings (residential)</td><td>1.A.4.a Commercial/Institutional</td><td>8.26</td><td rowspan="3">11.28</td><td rowspan="3">12.07</td></tr>
<tr><td>Buildings (services)</td><td>1.A.4.b Residential</td><td>2.52</td></tr>
<tr><td>Agriculture (energy)</td><td>1.A.4.c Agriculture/Forestry/Fishing</td><td>0.5</td></tr>
<tr><td>Agriculture (processes)</td><td>3. Agriculture</td><td colspan="2">21.14</td><td>19.86</td></tr>
</table>

[18] https://www.eea.europa.eu/data-and-maps/data/greenhouse-gas-emission-projections-for-7

[19] UNFCCC GHG data, https://di.unfccc.int/detailed_data_by_party

[20] https://www.eea.europa.eu/data-and-maps/data/greenhouse-gas-emission-projections-for-7

Table 1 2030 projections for the analysed sectors in CRF granularity and comparison with the Pathways Explorer granularity

As it can be seen in Table 1 the overall emissions from CRF sector 1.A.4 are foreseen to increase between 2005 and 2030. Yet, the granularity in which these projections are given does not allow to distinguish between the variations in the different subcategories (residential, services and energy for agriculture). Hence, we have to make assumptions in order to attribute these variations to the different Pathways Explorer sectors.

First, the PlanUp analysis of the Romanian NECP [21] indicates that the buildings sector is the one contributing the most to decarbonization of ESR sectors, and that the decarbonization ambition in the agriculture sector is very low (energy + processes). Then, the Romanian population is foreseen to decrease by 15.3% in 2030 compared to 2005 in the NECP. Besides, if we consider that (i) the buildings specific energy consumption (kWh/m²) is going to stagnate at worse and more probably going to decrease and (ii) that the fuel mix is probably going to rely less and less on heavily-emitting fossil fuels, then it seems logical to assume decreasing emissions for the buildings sectors in 2030 compared to 2005 (CRF 1.A.4.a + CRF 1.A.4.b). This is also indicated by the current trend (buildings emissions decrease from 12.3 to 9.4 MtCO2e between 2005 and 2015).

This means that the overall increase of 1.A.4 emissions would be entirely due to the energy use in agriculture. Even if emissions from the buildings sector (1.A.4.a + 1.A.4.b) remained at their 2005 level in 2030, then it would mean that the 1.A.4.c emissions should be nearly tripled (increase from 0.5 to 1,29 MtCO2e) between 2005 and 2030. This cannot be reproduced in the Pathways Explorer webtool, even with the lowest settings for agriculture levers.

Given the considerations above, the GHG projections for sector 1.A.4 seem unrealistic. We propose the alternative targets shown in Table 2 based on the following:

- For the agriculture sector, as mentioned above, the NECP decarbonization ambition is very low. We thus consider as a target for CRF sectors 3 + 1A.4.c the maximum figure we can get in the tool, leaving all agriculture levers on the lowest possible setting, 1. This corresponds to 17.68 MtCO2e.
- For the buildings sector, we consider a 8.88 MtCO2e target, corresponding to a slight increase in buildings renovation and low-carbon heating solutions between 2020 and 2030. The rationale behind this choice is detailed in the buildings section hereunder.

the Pathways Explorer	CRF category	2030 adapted targets [MtCO2e]
Transport	1.A.3 Transport	19.85

[21] LIFE PlanUp (2020) *Progress Check: Romania's final energy and climate plan under review*

Buildings (residential)	1.A.4.a Commercial/Institutional	**8.88**
Buildings (services)	1.A.4.b Residential	
Agriculture (energy)	1.A.4.c Agriculture/Forestry/Fishing	**17.68**
Agriculture (processes)	3. Agriculture	

Table 2 Adapted 2030 targets for the NECP scenario in Romania

These targets are illustrated on Figure 2 hereunder. As shown on this figure, the adapted targets for this scenario correspond to a 7% increase of emissions between 2005 and 2030 in the three analysed sectors.

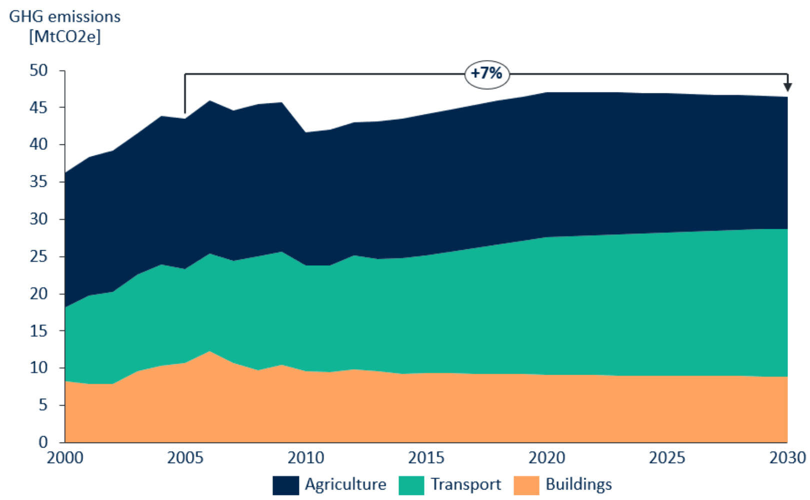

Figure 2 Evolution of the GHG emissions by sector [MtCO2e] for the three analysed sectors in the NECP scenario constructed in the Pathways Explorer

Transport sector

Table 1 below shows how PAMS and 2030 projections directly coming from the NECP document can be mapped and translated into ambition levels for the Pathways Explorer transport levers. As it can be seen from the table, the "decarbonization" ambition for the transport sector is very low given that the population is foreseen to decrease by 15.3% between 2005 and 2030 while transport emissions are seeing a 58% increase within the same timeframe. This is mainly due to a significant increase in the individual transport demand up to 2030 (continuing the current increasing trend: 70% increase between 2005 and 2015[22]).

A first remark that can be made is that none of these policies and measures were quantified. Hence, the level of the levers that could be mapped with these policies had to be adjusted in order to reach the given GHG emission target for the transport sector in Romania for 2030.

[22] EU Statistical Pocketbook

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Increasing railway transport	Key behaviours>Travel > Mode of transport	2.2	Not quantified in the plan
	Transport>Freight transport > Freight mode	2.2	Not quantified in the plan
Fostering electromobility	Transport>Passenger transport > Technology evolution>Technology share ZEV	2.2	Not quantified in the plan
Indicator 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	
GHG emissions [MtCO2e] 19.85 (vs 12.57 in 2005, corresponding to a 58% increase)	/	/	/

Table 3 Mapping of the PAMS and 2030 indicators described in the NECP document with the specific transport levers in the Pathways Explorer and their ambition in the NECP scenario

We detail further below the key outputs of the scenario based on these ambition levels.

Firstly, the passenger transport demand nearly stagnates (-0.6% between 2020 and 2030), due to two opposite trends: (i) the increase in the individual transport demand following past trends (measured in [pkm/cap]) and (ii) a decreasing population in the Romanian projections. Then, due to a relatively low setting of the "modal shift" lever, the modal share of cars only sees a light decrease (around 1%) between 2020 and 2030, corresponding to an equivalent transfer to rail transport (see Figure 3).

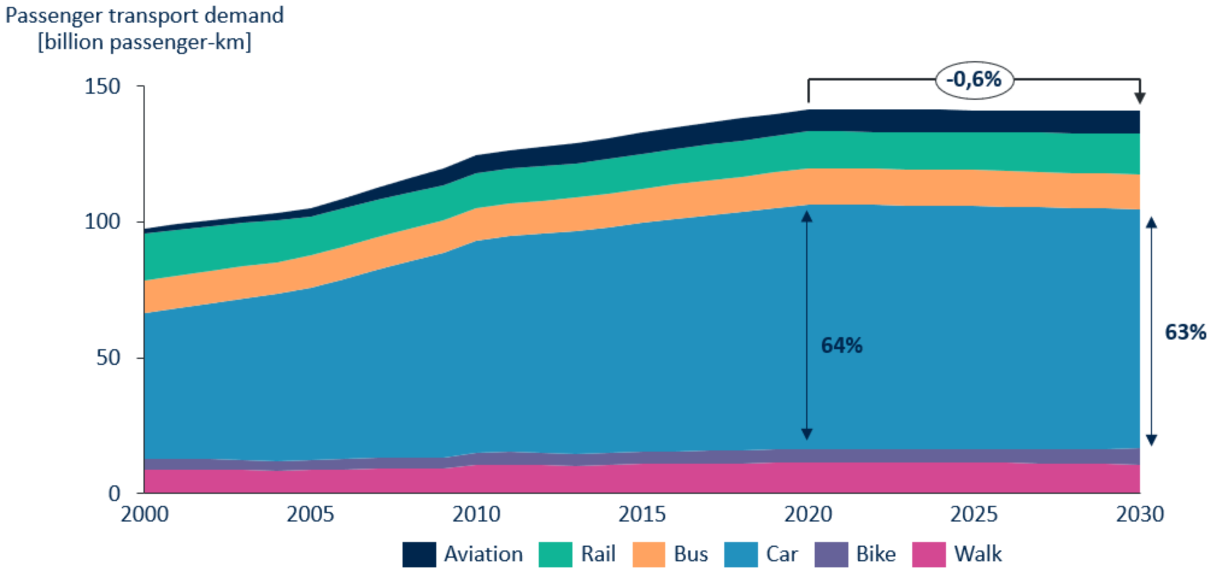

Figure 4 Evolution of the passenger transport demand

The lever influencing the uptake of zero-emission vehicles (ZEV) is also activated to account for the electromobility policy from the Romanian NECP. Due to the low setting for this lever and the average 7.7 years lifetime of passenger cars in Romania[23], a significant part of the existing fleet in 2020 (mainly based on fossil fuels) is still operational in 2030. This means that even with an increasing proportion of BEV/PHEV in new car sales (lever 'Technology-share new ZEV/LEV'), the absolute figures remain relatively low in at first, with about 1% of Battery Electric vehicles (BEV) in the car fleet by 2030 (see Figure 4). Nonetheless, BEV represents 16% of the car fleet in 2050 when this scenario is extended up to that year.

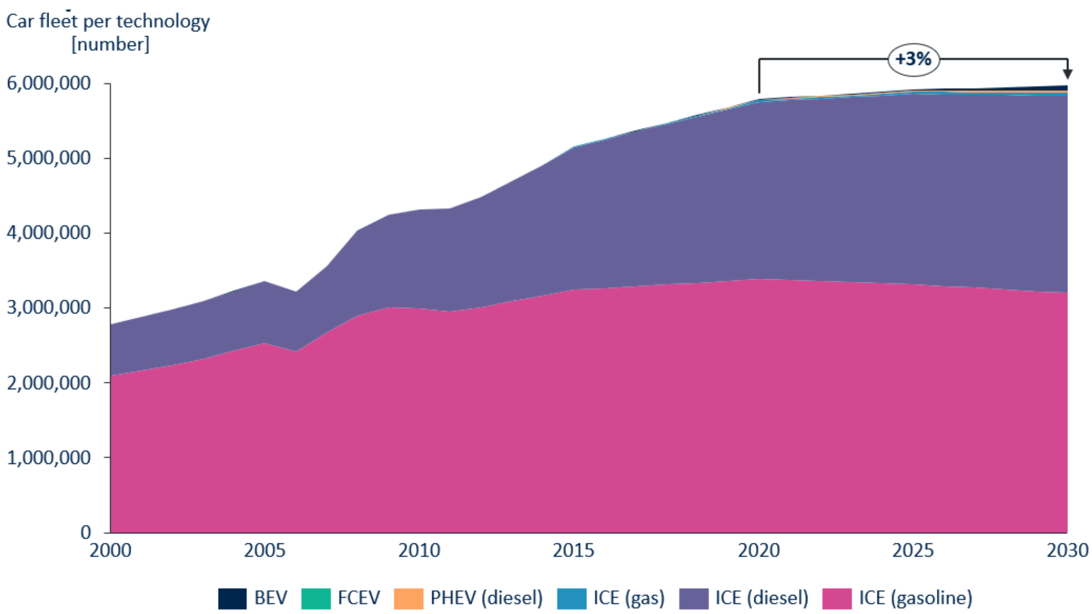

Figure 3 Evolution of the car fleet in Romania in the NECP scenario

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23 EEA, 2016, https://www.eea.europa.eu/data-and-maps/daviz/average-age-of-road-vehicles-6#tab-chart_1

Buildings sector

Tables 3 and 4 below show how PAMS and 2030 projections respectively can be mapped and translated into ambition levels for the Pathways Explorer buildings levers.

Policies and Measures (PAMs)	Mapping with levers in the Pathways Explorer model	Level setting for the levers	Remark
Long Term Renovation Strategy (SRTL)	Buildings>Residential/Services> Buildings envelope	1.3	Not quantified in the plan
Casa Verde – The Green House	Buildings>Residential/Services>Low-carbon heating solutions>District heating deployment	1.3	Not quantified
Indicator 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Population [number] 18,000,000	Demographic and long term> Population	D[24]	
Household size [number/household] 2.46	Demographic and long term> Household size	B[25]	
GHG emissions [MtCO2e] 8.88 (-17% vs 2005)			

Table 5: Mapping of the PAMs and 2030 indicators described in the NECP document with the specific buildings levers in the Pathways Explorer and their ambition in the NECP scenario

As explained above, emissions in the buildings sector should decrease between 2005 and 2030 (continuing the trend observed between 2005 and today) given Romanian evolutions, both technical (fuel mix) and demographic. To propose an alternative target, we consider the two following elements. First, this target should be "high" enough (in absolute MtCO2e figures) not to significantly diverge from the overall -2% ESR target for GHG reduction in Romania. Then, we want to be able to

[24] Population and household size are not considered as 'levers' but rather as trajectories. Hence we do not consider that there is an ambition from 1 to 4, but rather 4 different trajectories defined for both indicators. The decimal figure (e.g. B.8) represents the fact that an hybrid trajectory is chosen, between two predefined ones (here B and C) and indicates the respective weight of both trajectories in the weighted sum (here it is 80% of trajectory C + 20% of trajectory B)

[25] Idem

"activate" the levers mapped with Casa Verde and LTRS policies Hence, an adapted 8.88 MtCO2e is proposed. This corresponds to a very low setting (1.3) for the levers mapped with the aforementioned policies. As shown on Figure 5, the combination of these trends corresponds to a 10% decrease of the final energy demand for heating between 2020 and 2030 (equivalent to the decrease observed between 2005 and 2020).

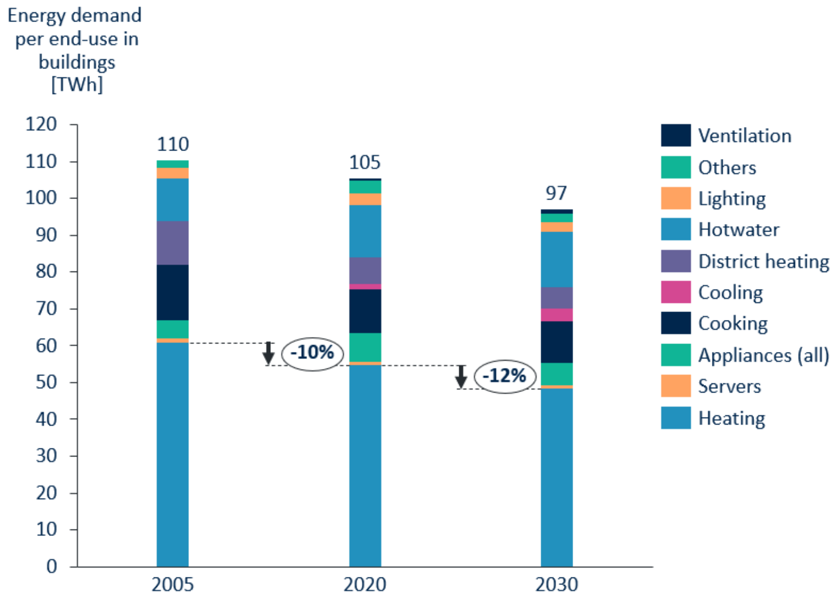

Figure 4 Evolution of the energy consumption per end use in the NECP scenario

Agriculture sector

As explained above, the adapted target for the agriculture sector (17.68 MtCO2e in 2030) corresponds to the maximum figure that is observed when all agriculture levers are set on 1 (minimal decarbonization ambition, continuation of ongoing trends), accounting for the decreasing population up to 2030. This evolution corresponds to a 13% decrease between 2005 and 2030, as shown on Figure 5.

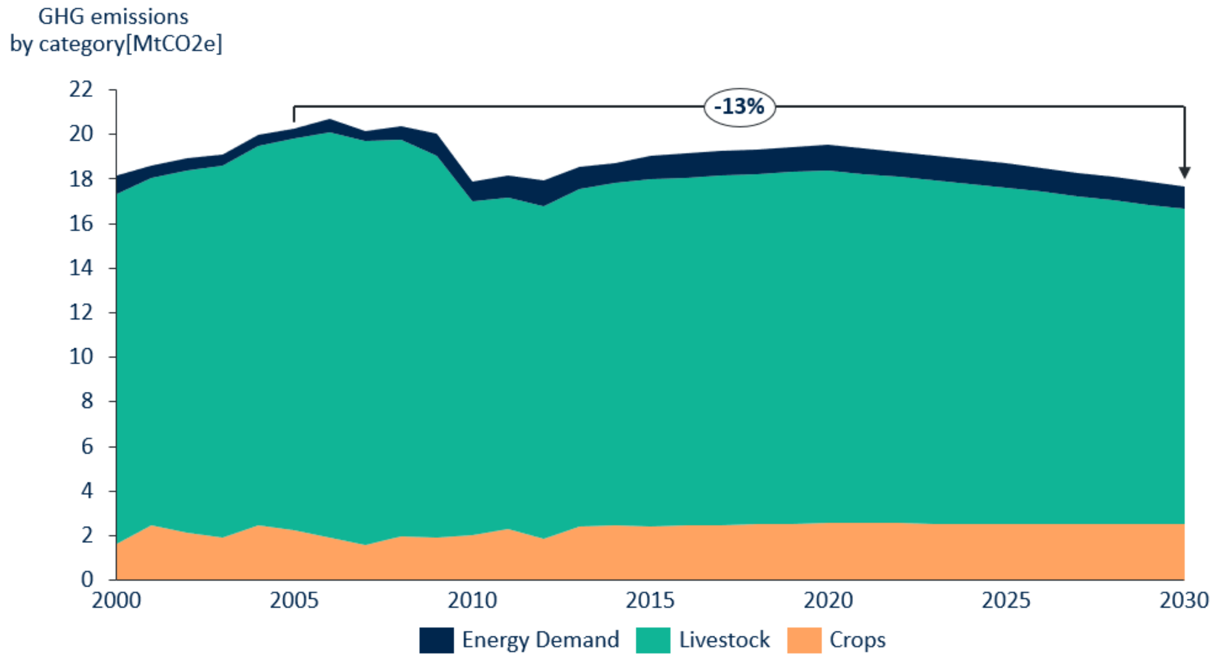

Figure 5 Evolution of GHG emissions by category [MtCO2e] in the agriculture sector in Romania

Detailing what a -65% ambition for 2030 means

Overall results of the -65% scenario

As explained above, the GHG reduction target for ESR sectors in this scenario is calculated based on numbers included in the ECF publication *Planning for net zero: assessing the draft national energy and climate plans* (May 2019)[26].

For Romania, this amounts to a -22.5% reduction of overall ESR emissions in 2030 compared to 2005. As stated before, ESR emissions also include waste and non-ETS industry besides transport, agriculture and buildings. Hence, when disaggregating this overall target over the various sectors, it could be argued that the ambition over transport, buildings and agriculture could be lower than this 22.5% reduction figure as long as the non-ETS industry bears the majority of the decarbonization effort. Nonetheless, this target should represent a pathway for Romania that is compatible with net-zero emissions at EU level by 2050, which represents an ambitious decarbonization. We thus believe that it is important to distribute this effort evenly over the different sectors to construct a credible pathway. Hence, we make the choice to keep the same 22.5% reduction target for the three agriculture, buildings and transport sectors taken as a whole.

Given the steady increase of transport emissions between 2005 and 2020 (Figure 6), this overall reduction target for the three sectors is challenging. It requires a high ambition on numerous levers in the concerned sectors. The scenario and its complete implications can be consulted here. Some of the major implications for the tree sectors are detailed in the sections below.

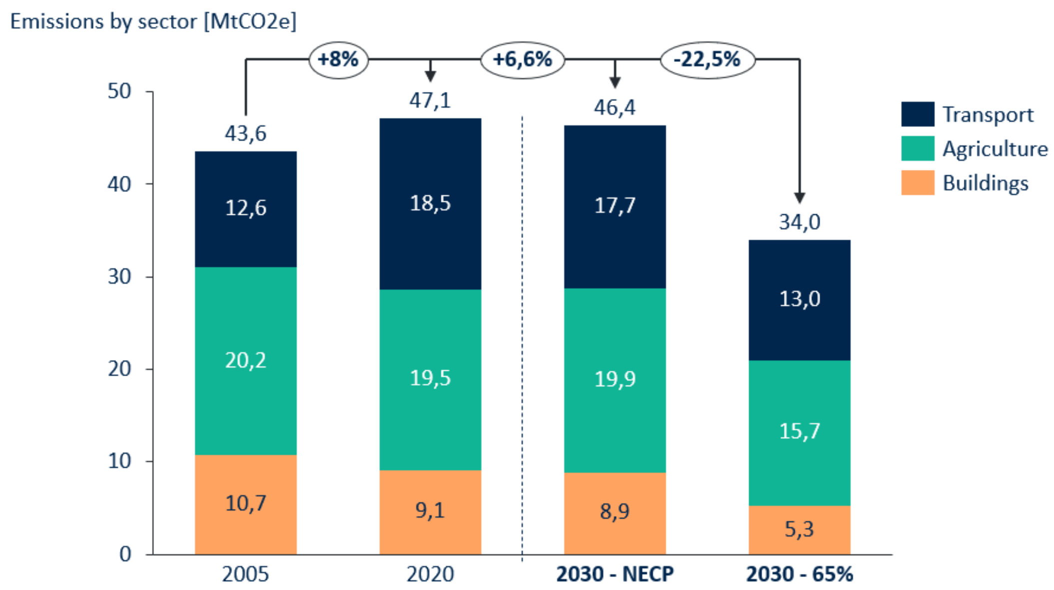

Figure 6 Evolution of GHG emissions by sector in the NECP and -65% scenario

[26] Available at https://europeanclimate.org/wp-content/uploads/2019/11/05-2019-planning-for-net-zero-assessing-the-draft-national-energy-and-climate-plans.pdf. See page 65 for figures (last column of the table, net zero (high range))

Transport sector

As it can be seen on Figure 6, the decarbonization ambition for the transport sector is much higher in the -65% scenario than in the NECP scenario. In the latter, only two levers were activated, representing a moderate modal shift from cars to trains and a slight increase of BEV in the Romanian car fleet respectively.

In the present case, the -65% scenario for transport in Romania in 2030 corresponds to getting back to 2005 emission levels for this sector, while the individual passenger transport demand has jumped by 70% between the years 2005 and 2015 alone. This means that we should not only focus on decarbonizing the transport demand by shifting away from car transport and Internal Combustion Engines (ICE) in general, but also on reducing the transport demand itself. Hence, behavioural and technical levers should both be activated for this pathway. We detail hereunder some of the most important developments.

Both passenger and freight transport demand levers are set to their maximum level, which implies a reduction of 9% and 14% of the freight activity ([tkm]) and passenger activity ([pkm]) respectively between 2020 and 2030.

Then, the modal shift levers are also set to their maximum setting for both freight and passenger, which corresponds to a significant reduction of the car modal share from 68% in 2020 to 52% in 2030.

Finally, the levers representing the improvement of vehicles energy efficiency are set to level 3, which leads to a 14% and 13% reduction of cars and trucks specific energy consumption respectively between 2020 and 2030.

Buildings sector

As shown on Figure 6, the buildings sector is set to cut its emissions by 2 between 2005 and 2030 in the proposed scenario. This is significantly more ambitious than the target proposed for the NECP scenario. This is also achieved by activating behavioural and technical levers.

This implies to significantly curb the increase of residential and tertiary buildings surface between 2020 and 2030, to decrease the heating temperature and hot water consumption to increase the renovation rate and depth and to increase the uptake of low-carbon heating solutions.

The average level of buildings levers is 2.8 while it is 1.1 in the NECP scenario, which shows the difference in ambition in both scenarios.

Agriculture sector

The decarbonization effort is also significant in the agriculture sector with a 22% reduction between 2005 and 2030. This reduction is achieved thanks to a combination of the “Diet” lever set on 2, which allows to stabilize the meat consumption per capita in Romania, and an improvement in agricultural practices (this lever being set on level 3). This encompasses manure management, alternative protein sources for cattle and reduced use of fertilizers.

Conclusions

This document shows two concrete pathways to reach two different levels of GHG reduction in Romania by 2030.

From the analysis carried out for the NECP scenario, the following conclusions can be drawn:

Firstly, it has been shown that the GHG reduction target in the buildings sector for 2030 seems unrealistically low given the decreasing population foreseen in the plan.

Then, the plan lacks quantified measures. Indeed, while the plan mentions a wide variety of decarbonization levers, the policy description remains vague and without proper quantification.

Finally, a more ambitious scenario in line with a -65% reduction of GHG emissions economy-wide in Europe is proposed. Compared to the NECP scenario, it presents an ambitious decarbonization pathway where numerous decarbonization levers have to be activated in the three analysed sectors.

Decarbonization trajectories for Spain

Results of the 2 scenarios (NECP and -65%)

What does the NECP scenario mean in SPAIN

Overall results of the NECP scenario

The following section shows the analysis of the NECP measures and projections and the resulting scenario that is constructed in the Pathways Explorer model for Spain. The main implications are detailed in the graphs and tables hereunder. However, the complete implications for the three analyzed sectors can be investigated on the online webtool via this link (the procedure to navigate the webtool is described in Annex II).

According to the Spanish NECP, the following reduction targets are expected between 2005 and 2030.

- Agriculture: -18%
- Transport: -41%
- Buildings: -41%
- Total for these 3 sectors: -36%

Figure 2 shows the evolution of the GHG emissions for the three analysed sectors in the NECP scenario constructed for Spain in the Pathways Explorer.

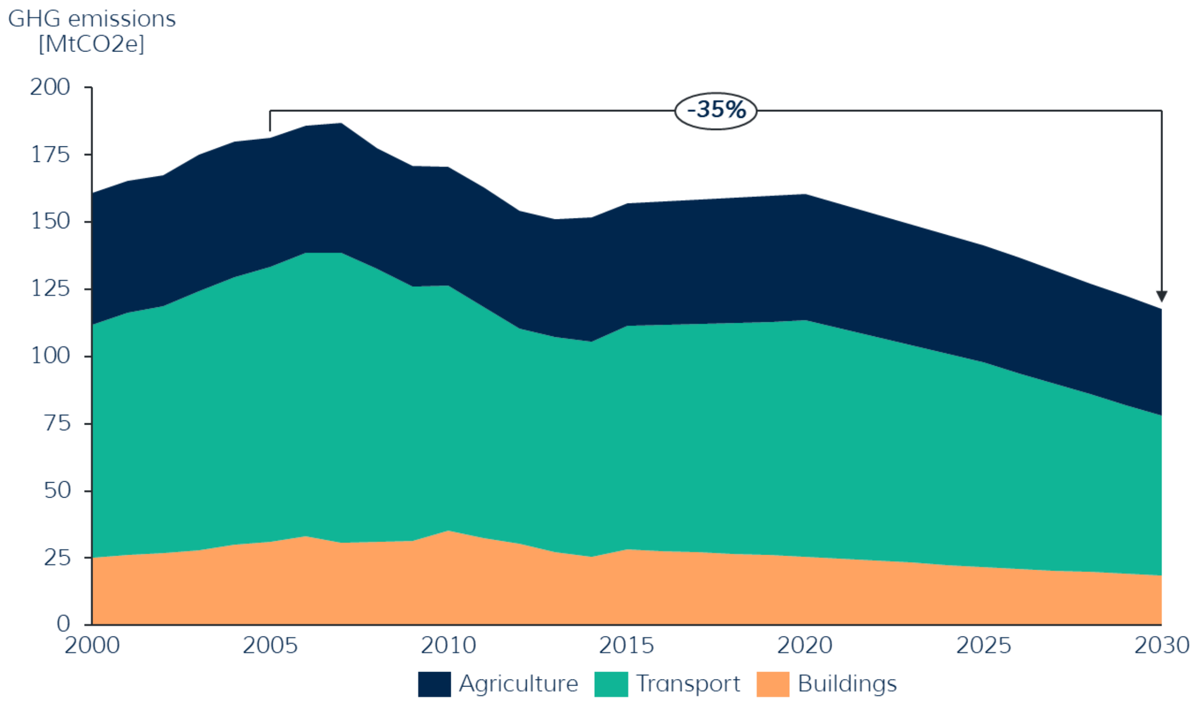

Figure 2 Evolution of the GHG emissions by sector [MtCO2e] for the three analysed sectors in the NECP scenario constructed in the Pathways Explorer

Transport sector

Table 1 below shows how PAMS and 2030 projections directly coming from the NECP document can be mapped and translated into ambition levels for the Pathways Explorer transport levers. Three measures mention the decarbonisation of vehicles, through the encouragement of electric vehicles (EV). The third one mentions a quantified target (5 million EV in 2030), this measure is therefore chosen to set the lever.

This table illustrates the following elements:

1. Transport demand is expected to grow, for passenger and for freight;
2. The indicators show no consequent modal shift (passenger transport and freight);
3. The NECP document is more ambition on technological aspects: evolution of EV and biofuel consumption.

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Promotion of low-emission zones for cities with more than 50,000 inhabitants (starting from 2023) and e-mobility	Passenger transport > Technology evolution > Technology share ZEV / LEV	-	No quantification mentioned

Efficient and Sustainable Mobility Incentives Program (MOVES) : encouraging (through financial support) the purchase of alternative vehicles, installing infrastructures for charging electric vehicles and creating incentives to implement electric bicycle loan systems	Passenger transport > Technology evolution > Technology share ZEV / LEV	-	No quantification mentioned
Transport decarbonisation: Number of electric vehicles by 2030: 5 million units, including cars, vans, motorcycles and buses	Passenger transport > Technology evolution > Technology share ZEV / LEV	4	Leading to 4.34 M EV in 2030 (level 4 being the maximum lever of the Pathways Explorer)
Indicator 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	
Passenger activity per mode [% 2030 vs 2015]	Key behaviours>Travel > Passenger distance	1	Increase of total passenger demand
Cars + 15%			
Buses + 15%	Key behaviours>Travel > Mode of transport	1	Stabilisation of the car proportion
Rail + 16%			
Motorcycles +25%			
Freight activity per mode [% 2030 vs 2015]	Key behaviours>Consumption > Freight distance	1	Increase of the freight demand
Road +23%	Transport>Freight transport > Freight mode	1	The rail proportion decreases
Rail +20%			
Biofuels consumption [TWh] +120%	Transport>Technology and fuels > Biofuel switch > Road	1.3	2030 value communicated in the NECP

			used to match the lever

Table 1. Mapping of the PAMs and 2030 indicators described in the NECP document with the specific transport levers in the Pathways Explorer and their ambition in the NECP scenario

With these settings, the results from the Pathways Explorer model only show a 25% GHG emissions reduction for the transport sector in 2030 (vs 2005), which is largely behind the target reduction of 41%, mentioned in the NECP. We pushed further several levers to get this 41% reduction. Table 2 shows the new settings.

Levers in the Pathways Explorer model	**Final level setting for the levers**	**Remark**
Passenger transport > Technology evolution > Technology share ZEV / LEV	4	Lever not adapted since the target was clearly quantified in the NECP.
Key behaviours>Travel > Passenger distance	3.1	Lever adapted to 1 (minimal level to 3.1) to reach the NECP transport target.
Key behaviours>Travel > Mode of transport	3.1	
Key behaviours>Travel > Occupancy	3.1	
Transport > Passenger transport > energy efficiency	3.1	
Key behaviours>Consumption > Freight distance	3.1	
Transport>Freight transport > Freight mode	3.1	
Transport>Freight transport > Energy efficiency	3.1	
Transport>Technology and fuels > Biofuel switch	1.3	Lever not adapted since the target was clearly

		quantified in the NECP

Table 2. Final level set for the levers in transport to reach the reduction target mentioned in the NECP for transport

We detail further below the key outputs of the scenario based on these ambition levels.

Firstly, the passenger transport demand is increasing by 6% between 2005 and 2030, with a shift from individual cars to public transportation and active modes (Figure 3). This evolution results from two trends: the historical trend that have seen the transport demand increasing and the 2020 – 2030 trends which should be different. The passenger transport demand decreases by 6% between 2020 and 2030, the car transport by 13%.

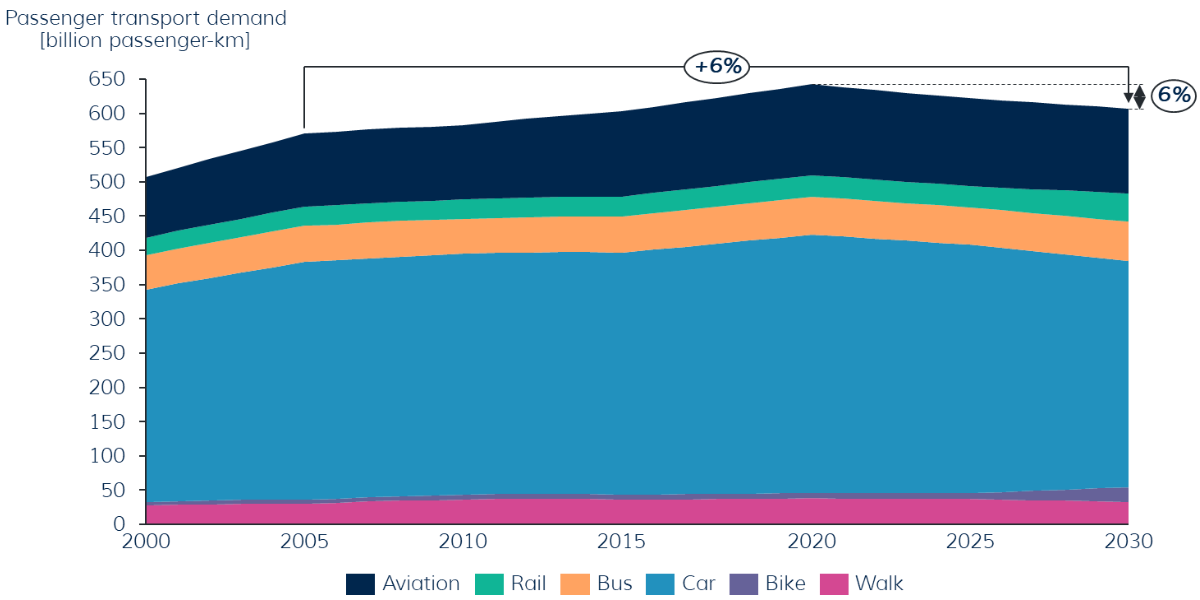

Figure 3 Evolution of the passenger transport demand

Then, there is a decrease in freight transport demand. It decreases by 7% between 2005 and 2030, as shown on Figure 4. The decrease between 2020 and 2030 is slower (-1%) but we observe a shift from road transport to rail or internal waterways (-11% for trucks).

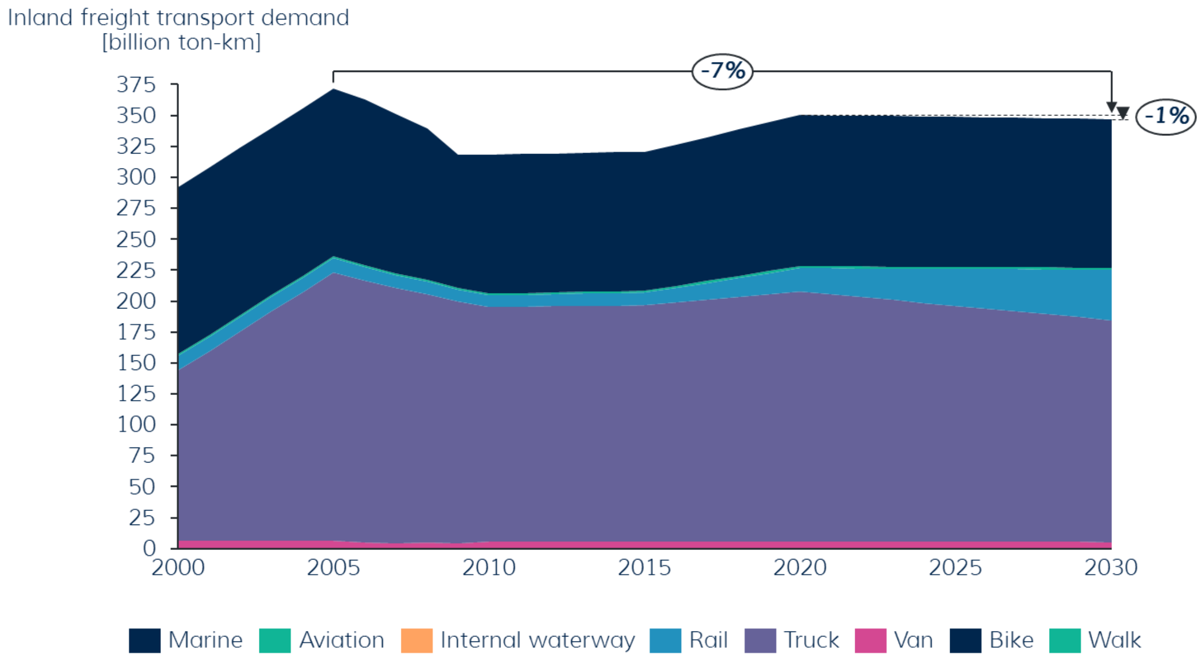

Figure 4 Evolution of the freight transport demand

The level of the lever corresponding to the electrification of the car fleet was kept at the maximal level: 4. After having revised up the levers corresponding to the behaviour of transport (transport demand, mode of transport, car occupancy), the needed number of cars in the fleet is significantly decreased as shown in Figure 5 (-32% between 2015 and 2030). Therefore, the level 4 now corresponds to 1.46 M in 2030 (instead of 4.34M in the first iteration, with no behavioural changes). In other words, trying to get the reduction target through the electrification of the car fleet without acting on transport behaviour is not sufficient. It is necessary to address the transport behaviour to reach the reduction target. Reducing transport needs (in pkm) and accelerating the modal shift results in a lesser need for cars. That explains the small number of EV in 2030 in this scenario.

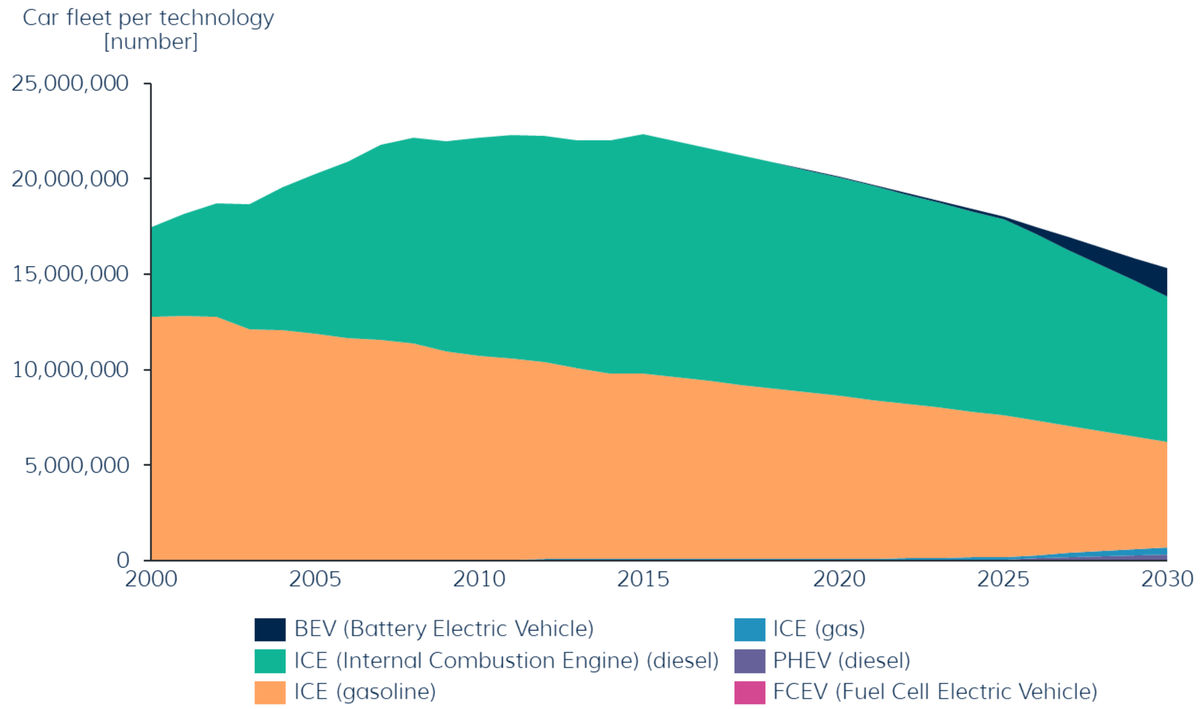

Figure 5 Composition of the car fleet by technology. FCEV: fuel cell electric vehicle, BEV: Battery Electric Vehicle, PHEV: Plug-in Hybrid and Hybrid, ICE: Internal combustion engine

Buildings sector

Table 3 below shows how PAMS and 2030 projections respectively can be mapped and translated into ambition levels for the Pathways Explorer buildings levers.

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
National Housing Plan: governmental funding mechanism that aims to support rental housing, urban rehabilitation and renovation.	Buildings> Residential > Buildings envelope	2.5	No quantification mentioned
PAREER programme aims to help finance retrofitting (through subsidies and loans) to reduce both the demand (actions on thermal envelope) and energy consumption (on the installations) of buildings		2.5	No quantification mentioned
The CTE-DB HE regulates the energy use and demand of buildings, both for new construction and retrofitting. Recent updates to the DB-HE have introduced the requirement of building (or retrofitting) near-zero-energy buildings	Buildings>Services/Residential > Buildings envelope	2.5	No quantification mentioned
Indicator 2030 projections	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Population [% 2030 vs 2015] +1.5%	Demographic and long term> Population	C.6	On a A-D scale (A corresponding to 1 and D, to 4)
Household size [number/household, % 2030 vs 2015]	Demographic and long term> Household size	A.6	On a A-D scale (A corresponding to 1 and D, to 4)

-6%			

Table 3: Mapping of the PAMs and 2030 indicators described in the NECP document with the specific buildings levers in the Pathways Explorer and their ambition in the NECP scenario

These settings give a 29% reduction in 2030 vs 2005 for the building emissions, which is under the 41% reduction target mentioned in the NECP. To fill the gap, we activated a complementary lever to the renovation of building envelope: the deployment of low carbon heating solutions. That includes the deployment of district heating, the contribution of solid biomass, the electrification of space, water heating and cooking.

Lever	**Level**
Buildings>Services/Residential > Buildings envelope	2.5
Buildings>Services/Residential > Low carbon heating solutions	2

Table 4: Levers' level in the Pathways Explorer to match NECP's ambition for the building sector

The ambition level for the renovation rate and depth lever is set to 2.5. As shown on Figure 6, this means that the renovated surface should be tripled between 2020 and 2030. Besides the renovated surface, the renovation depth is of paramount importance: the average heating energy consumption of **renovated** buildings in 2030 (residential and non-residential) should be less than half the value (65 kWh/m²) of the current average heating energy consumption of the **total building stock** (150 kWh/m²). This should lead to a reduction of the total heating energy demand by 31% between 2020 and 2030 (-9% in the total energy demand, Figure 7).

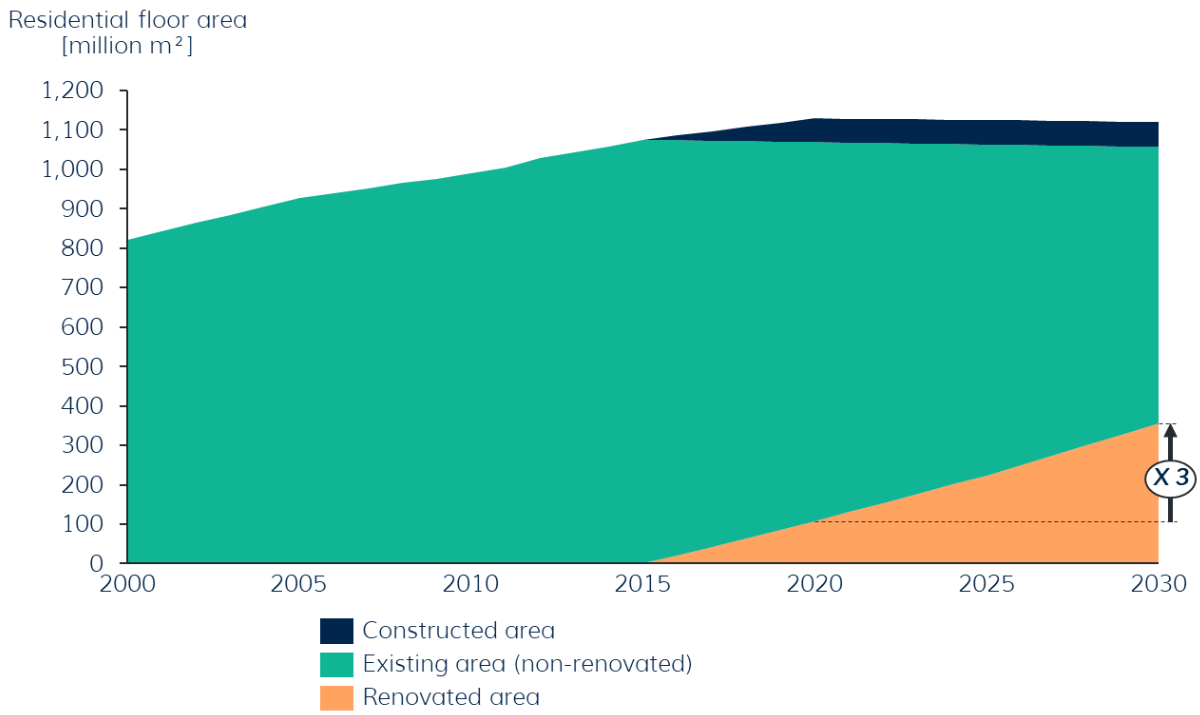

Figure 6 Evolution of the residential building stock

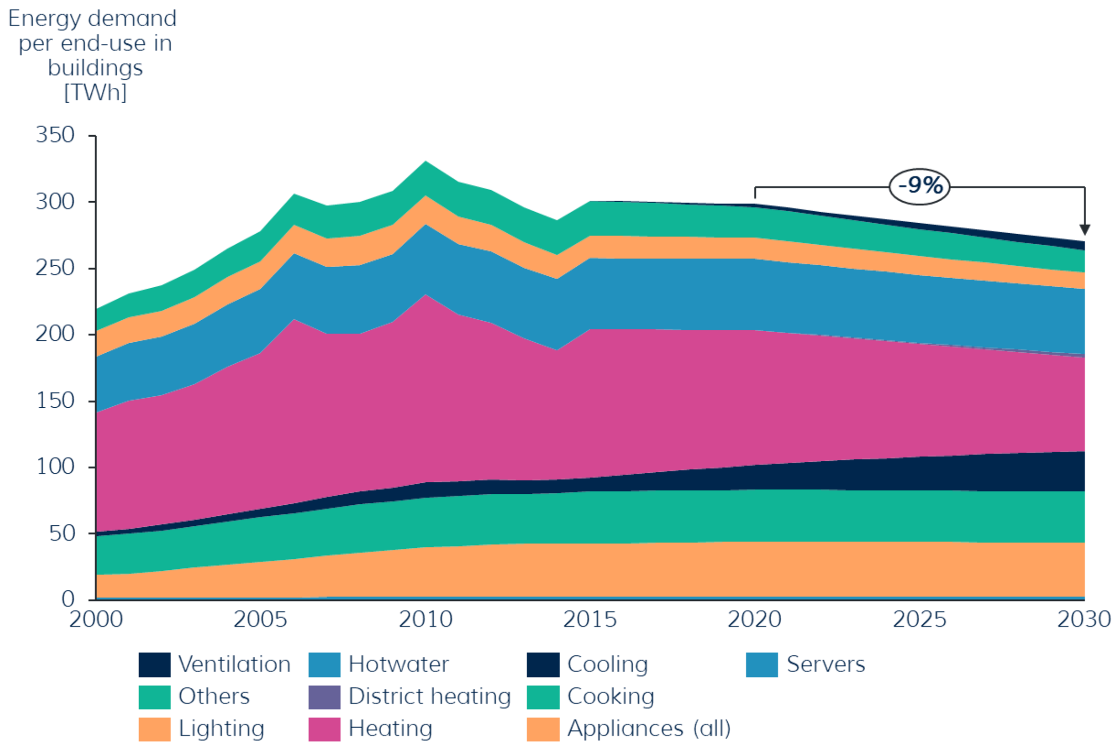

Figure 7 Evolution of the energy demand per end-use in the buildings sector

The ambition level for the low-carbon heating solutions lever is set to 2. This means that the share of fossil-fuel based heating bodies should significantly decrease between 2020 and 2030. This translates into a 37% reduction in the demand for liquid oil in the buildings energy consumption and -18% for the natural gas (Figure 8).

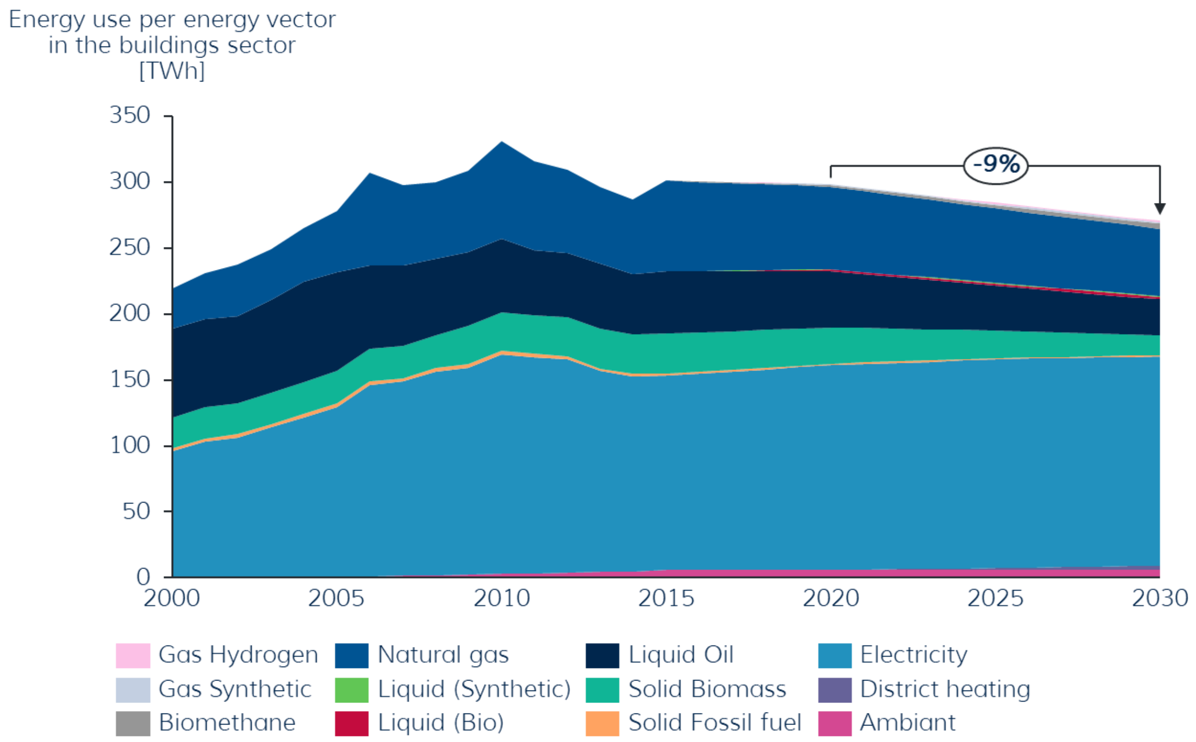

Figure 8 Evolution of the energy demand per energy vector in the buildings sector

Agriculture sector

Table 5 below shows how PAMS and 2030 projections respectively can be mapped and translated into ambition levels for the Pathways Explorer buildings levers.

Policies and Measures (PAMs)	**Mapping with levers in the Pathways Explorer model**	**Level setting for the levers**	**Remark**
Agricultural Contract for the Biosphere Reserve (CARB) in Menorca: aims to ensure the sustainability and viability of the agricultural sector in Menorca by generating positive impacts such as the reduction of GHG and CO2 emissions.	Agriculture, forestry and land use (AFOLU)> Agriculture practices	2.5	No quantification mentioned
Support for organic farming	Agriculture, forestry and land use (AFOLU)> Agriculture practices > Climate Smart Crop Production Systems	2.5	No quantification mentioned
Action Plan for the Development of Organic Production in the Canary Islands	Agriculture, forestry and land use (AFOLU)> Agriculture practices > Climate Smart Crop Production Systems	2.5	No quantification mentioned

Table 5: Mapping of the PAMs described in the NECP document with the specific agriculture levers in the Pathways Explorer and their ambition in the NECP scenario

These settings result in a 13% reduction of emissions due to agriculture in 2030 vs 2005, instead of the 18% reduction target mentioned in the NECP.

To fill the gap, we revised up additional levers, concerning the food behaviour (diet), the bioenergy and the land use.

	Initial lever	Final lever	Signification[27]
Key behaviours > Diet > Calories consumption	1	1.8	-4% of calories consumed in 2030 (2.61 instead of 2.72 kcal/cap/day in 2015)
Key behaviours > Diet > Type of diet	1	1.8	-26% of meat and dairy products consumption in 2030 vs 2015
Agriculture, forestry and land use (AFOLU)> Land-use	1	2	Surplus land is equally allocated between

[27] To understand further each lever, visit the webtool via this link.

			afforestation (33%), natural prairies (33%) and non-food cropland (33%)
Agriculture, forestry and land use (AFOLU)> Bio-energy	1	2	More domestic bioenergy produced from low-value residues and co-products and less biofuels imported from other countries

Table 6: Levers' level in the Pathways Explorer to match NECP's ambition for the agriculture sector

Acting on these two additional levers allows Spain to reach its reduction target for agriculture (Figure 9).

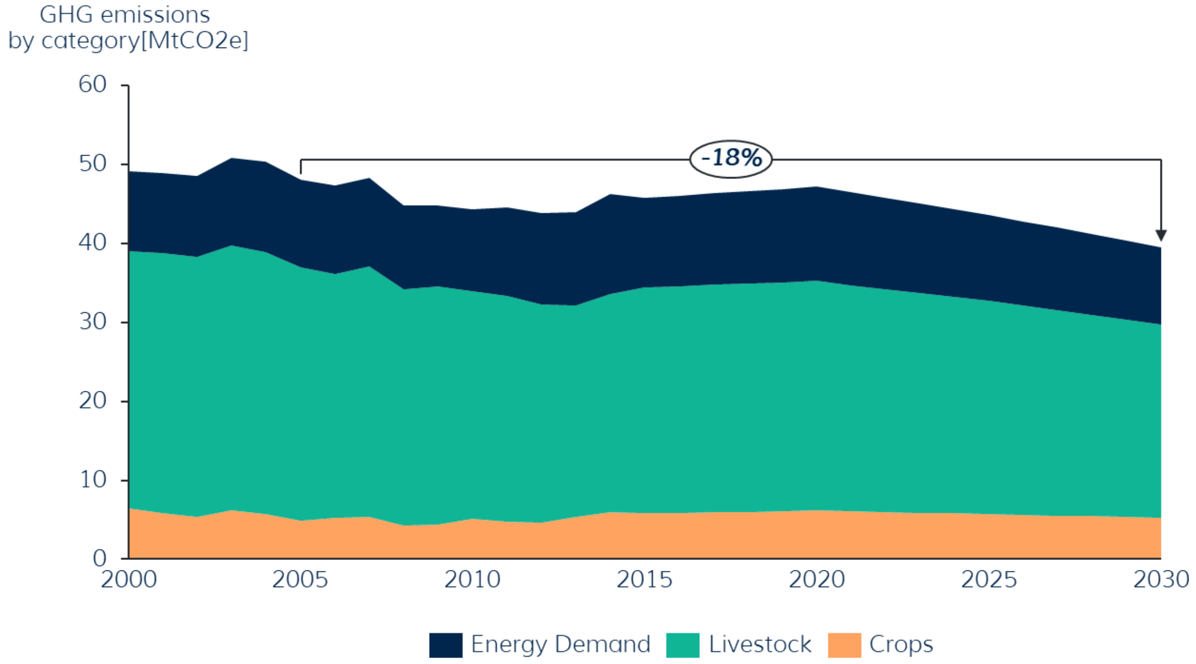

Figure 9 Evolution of GHG emissions by category [MtCO2e] in the agriculture sector in Spain

Detailing what a -65% ambition for 2030 means

Overall results of the -65% scenario

An ambitious scenario leading to -65% emissions at European level is also modelled for Spain. In this scenario, the ESR target for Spain is -52% by 2030 (vs 2005).

The major result of this scenario is that it is not possible to reach -52% emissions in 2030 for the sector of agriculture, even when pushing all levers to 4 (maximal level). It is therefore necessary to allocate a greater reduction target for the two other sectors modelled here (transport and buildings).

The target reduction for each sector is then the following (2030 vs 2005):

- Transport: -58%
- Buildings: -58%
- Agriculture: -35%
- Total for these 3 sectors: -52%

This scenario (Figure 10) can be viewed on the webtool via this link.

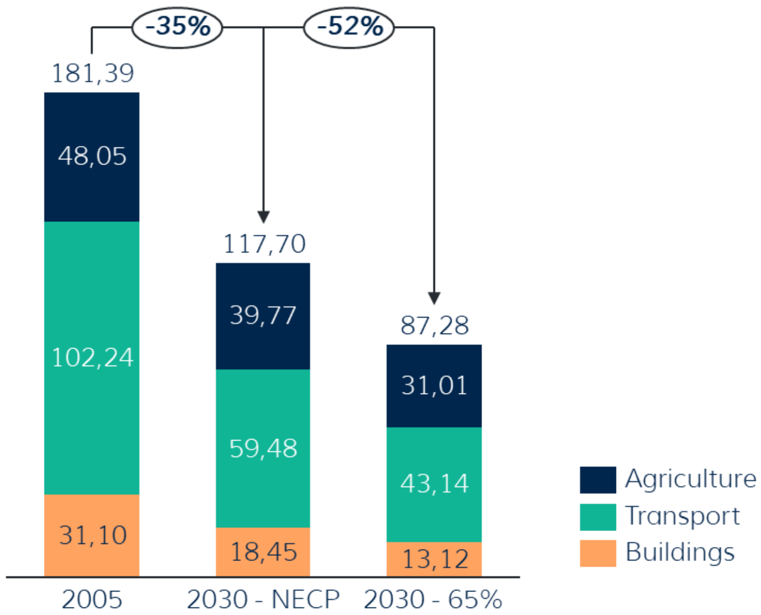

Figure 10 Comparison of GHG emissions [MtCO2e] in NECP and -65% scenarios

Transport sector

To achieve the desired reduction, all levers, whether technological or behavioural, must be pushed to a high level, close to the maximum level (3.7 or 3.8). The same trends observed in the NECP scenario are observed and accentuated. The passenger and freight demand are further reduced (figures 11 et 12), the modal shift is accelerated (-27 % of cars and -18% of trucks in 2030 vs 2020) and the vehicles become even more efficient. The electrification of the car fleet mentioned in the NECP is still necessary and the same trend needs to be observed in the truck fleet.

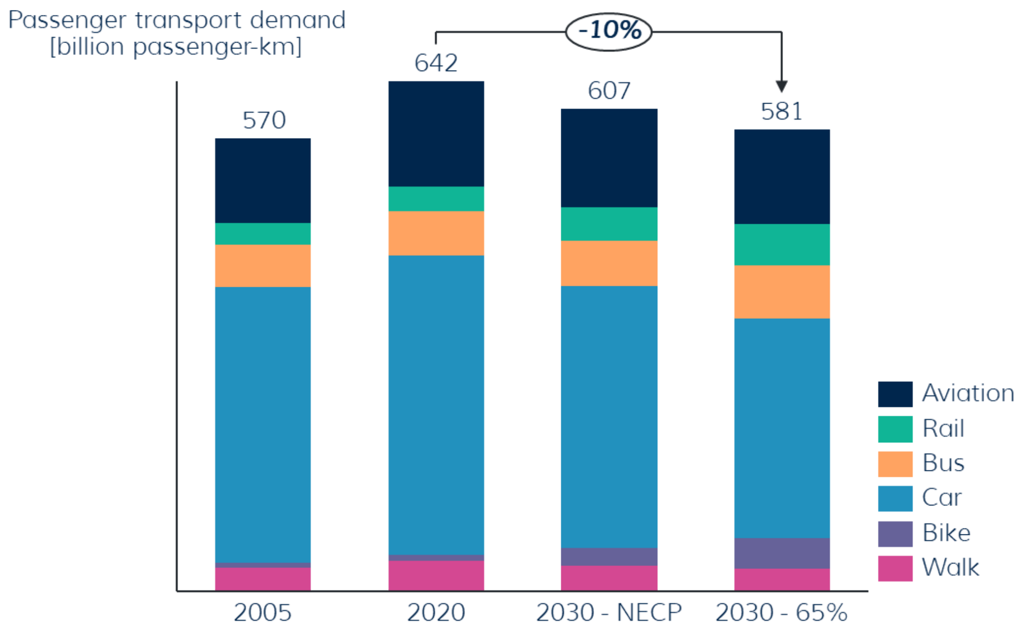

Figure 11 Evolution of the passenger transport demand

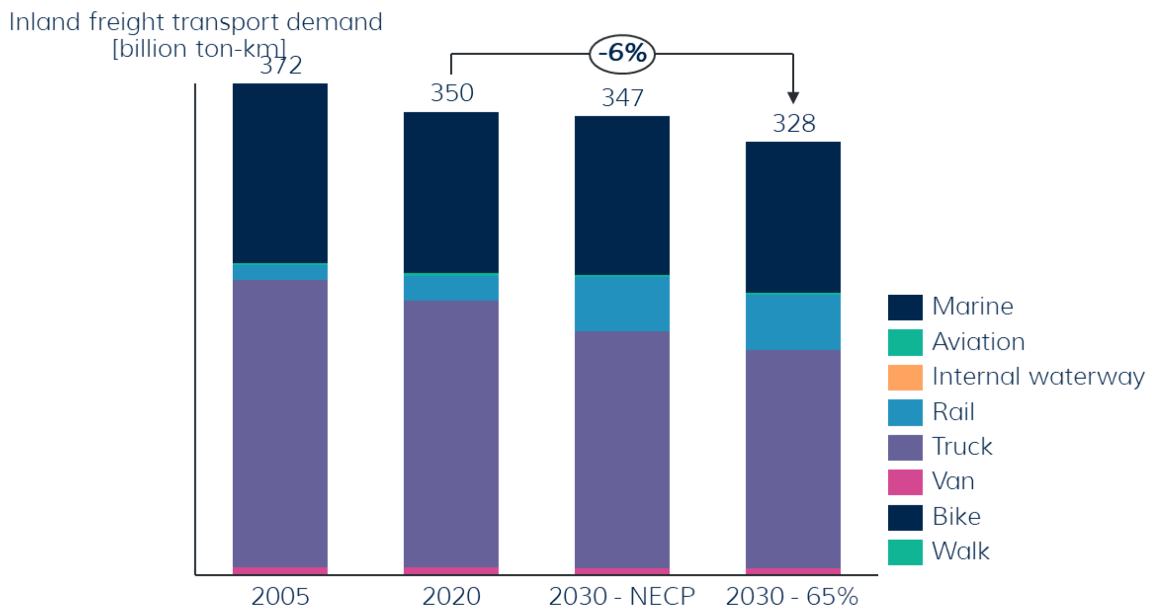

Figure 12 Evolution of the freight demand

Buildings sector

Regarding the building sector, the renovation rate and depth as well as the shift from fossil fuels must be pushed further. The renovated area needs to be multiplied by 4 in 2030 vs 2020, instead of 3 in the NECP scenario. Heating and cooling needs decrease faster (-1.7°C for heating and +1.7°C for cooling instead of -/+1°C for the NECP scenario). Two new levers are activated (in comparison with the NECP scenario) to reach the reduction target: the living space per person is decreased (38.8 m2/cap in 2030 instead of 40.2 in 2015) and the use of non-residential floor area is more rational (stabilisation of the surface since 2015).

Agriculture sector

To reduce the emissions from the agricultural sector, all levers in the Pathways Explorer are pushed to 4, the maximal level (instead of 2.5 in the NECP scenario). Levers corresponding to diet are also activated at maximal level. A new lever is activated (in comparison with the NECP scenario): the food waste are reduced at farm and post farm stages, especially meat waste (-41% in 2030).

Conclusions

This document shows two concrete pathways to reach two different levels of GHG reduction in Spain by 2030.

From the analysis carried out for the NECP scenario, the following conclusions can be drawn:

Firstly, the plan lacks diversified measures. Indeed, the plan mostly addresses one or two decarbonization levers throughout the various sectors, not reaping the full potential of behavioural and technical changes.

Then, the ambition throughout the different sectors is quite unbalanced, with the buildings sector bearing the largest part of the decarbonization effort, while transport and agriculture do not see significant cuts in their GHG emissions.

It is necessary for Spain to act on additional measures to the electrification of the vehicles: transport demand & mode of transport for passengers and freight and the energy efficiency of vehicles.

Finally, in the buildings sector, it has been shown that the ambitious GHG reduction target can only be met through significant efforts in terms of renovation rate, depth and shift from fossil fuels.

The second analysis details the requirements to reach an overall GHG reduction of -65% compared to 1990 (ETS and ESR sectors), which is often referred to as the only target compatible with Europe's commitments under the Paris Agreement. The following conclusions can be formulated:

The major result is that it is not possible to reach -52% emissions in 2030 for the sector of agriculture, even when pushing all levers to 4 (maximal level). It is therefore necessary to allocate a greater reduction target for the two other sectors (transport and buildings).

For each sector, all levers that were already activated in the NECP scenario are pushed further, at least to a 3-level. Additional levers need to be activated to reach the reduction targets:

- Reduction of living space per person
- Rational use of non-residential floor area
- Electrification of freight vehicles
- Reduction of food waste (farm and post farm)

Annex I: detailed methodology

This annex provides the detailed methodology (summarized on Figure 1) that is followed to construct scenarios.

STEP 1: Matching between policies and measures from the NECP and the Pathways Explorer levers

The goal of this step is to provide a list of policies and measures from the NECP that can be linked to the Pathways Explorer levers (e.g. a policy promoting the shift to public transportation can be linked with the "Modal share" lever in the Pathways Explorer). For each country, two documents were used in order to list policies from the NECP, based on all the work done throughout the PlanUp project.

	Italy	Spain	Hungary	Romania	Poland
LIFE PlanUp (2019) *Fit to succeed? An assessment of the draft energy and climate* plans	Link	Link	Link	Link	Link
LIFE PlanUp (2020*) Progress Check: final energy and climate plans under review*	Link	Link	Link	Link	Link

STEP 2: Assess positions for the pathways explorer levers in ESR sectors

The goal of this step is to quantify the position of the levers identified in the first step using the information available in the NECP.

Common information for various countries: 2030 projections

Firstly, all countries should include in their NECP the *Reporting of used parameters and variables included in Annex 1, part 2, of the Energy Union Governance*. Among these 2030 projections, the following ones are directly usable to assess the position of the Pathways Explorer levers for all countries.

- 'Population size' and 'household size' can be linked to the Pathways Explorer levers with the same name.
- 'Number of passenger-kilometres' and 'Freight transport tonnes-kilometres' can be linked to the Pathways Explorer levers 'Passenger distance', 'Mode of transport' and 'Freight mode'
- Bioenergy and electricity consumption figures in buildings and transport sectors can be linked with the 'Technology share ZEV' and 'Biofuel switch' levers for the transport sector and with 'Green gas', "Green liquid" and "Electrification" levers for the buildings sector
- Finally, GHG emissions from ESR sectors are used to assess whether the Pathways Explorer lever settings deliver suitable GHG reductions.

This information is not readily available for all countries. The table below gives the list and links of various documents from which the figures mentioned above are extracted depending on the countries.

	Italy	Spain	Hungary	Romania	Poland
Population and household size	Document: NECP Tab. 80	Document: NECP A.7.2 Annex I Part 2 Target Scenario Table	Document : NECP Fig. 2 p. 129 Fig. 3 p. 131		Document: NECP Annex 2 Tab. 1 (population) Tab. 6 (household size)
Transport activity (pkm or tkm)	Document: NECP Tab. 80	Document: NECP A.7.2 Annex I Part 2 Target Scenario Table			Document: NECP Annex 2 Table 8 (pkm) et 9 (tkm)
Biofuels and electricity consumption	Document: PlanUp Progress Check Section "Implementatio	Document: NECP Tab. A.13 for absolute			Document: NECP Annex 2 Tab. 32 for first&secon

	n of policy measures in the transport, buildings and agricultural sectors" for transport	RES consumption (ktoe) in various sectors			d gen biofuels in transport
GHG targets by sector	Document: NECP Tab. 71	Document: NECP Tab. A.9.	Document: NECP Fig. 83 p. 263		Document: NECP Annex 2 Tab. 21, 22 and 23[28]

Country specific measures

Besides the figures above, available for most cases, specific policies from the NECP are taken into account in order to assess the position of the Pathways Explorer levers. As shown in STEP 2 of Figure 1, the Pathways Explorer levers can be divided in three categories regarding the current analysis:

1) **Levers that can be mapped to NECP policies in a quantified way**: an ad-hoc assessment/computation is performed to match as best as possible the quantified information given in the NECP with the given levels for this lever.
2) **Levers that can be mapped to policies covered in the NECP**, **for which no quantified information exists in the NECP** (e.g. an ambitious renovation strategy for the buildings sector with no targets). Without better information, these levers are **set to a level of 2.5** to start the analysis, which corresponds to a moderate decarbonization ambition in the Pathways Explorer rationale.
3) **Levers that cannot be mapped to NECP policies: they are not mentioned in the country document.** If this is the case, it is likely that these levers stay on a rather Business-as-usual trajectory (e.g. there is no mention of zero-emission vehicles policies, which mean that the share of EVs in new vehicle sales might not significantly change compared to the current situation). These levers are **set to a level of 1.5** at the beginning of the scenario creation to reflect this.

STEP 3: Check if the targets are reached and iterate

After setting the position of the levers in ESR sectors, the model is run and the 2030 GHG emissions are compared to the NECP targets. If the targets are reached, the scenario (i.e the set of lever positions) is considered satisfactory.

Otherwise, all ESR sector lever positions are raised by a same increment (e.g. by 0.1 step) before running the model again. This is performed iteratively until GHG reduction targets in ESR sectors are reached.

[28] Attention: figures in CO2, N2O and CH4 to transform in CO2eq with GWP_CH4 = 28 GWP_N2O = 265

In some situations, it might happen that the lever positions defined at step 2 are too high regarding the GHG reduction ambition displayed in the NECP. An ad-hoc reduction of the levels of levers is then carried out in order to match the GHG reduction ambition.

It should be emphasized that the primary focus of this analysis is on reaching GHG reduction targets for the three analyzed sectors. All other indicators (e.g. the bioenergy consumption, the activity in the transport sector, etc) are used to guide the lever positioning in order to reach the GHG targets, they do not constitute a goal in themselves

Annex II: accessing the webtool

To visualize the NECP scenario for Hungary online, please follow these steps

1. Click on this link.
2. **Do not change** any setting on the left side column (both in lever settings or "Choose an example pathway")
3. **Select the right country** in the dropdown menu on the upper right corner of the page
4. You can navigate through the various sectors by clicking on them (upper middle part of the page) and select the graphs you want to see (dropdown menu in the same area)

Acknowledgements

To cite this study: LIFE PlanUp (2021) How can we reach the GHG targets in ESR sectors: decarbonization trajectories for Hungary – Action C2.4 and C2.6

Published: April 2021

Analysis by Climact with input from Carbon Market Watch

Expert group: Sacha Breyer, Benoit Martin, Julien Pestiaux and Agnese Ruggiero.

Deliverable quality review

Quality check	Date	Status	Comments
Project consortium	15/4/2021	OK	

Acknowledgements

The Life PlanUp project has received funding from the LIFE programme of the European Union. The project also acknowledges the generous support of the European Climate Foundation.

Legal notice

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