

## **AT A DECARBONISATION CROSSROADS: ASSESSING THE FEASIBILITY AND POLICY PATHWAYS FOR CLIMATE NEUTRALITY IN BULGARIA**

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In the aftermath of the Russian invasion in Ukraine, the EU has raised its overall decarbonisation ambitions via the REPowerEU initiative. The EU has defined a new energy and climate security strategy that aims to **decouple from the dependence on fossil fuel imports** on the basis of accelerating renewable energy investments, boosting energy savings and diversifying and **friendshoring** the supply of energy and materials.<sup>1</sup> Yet, amid the continuing political instability, Bulgaria has been reluctant to update its 2030 climate targets.<sup>2</sup> The country can utilize the EU funds at its disposal to create the necessary investment environment for ushering a **private sector and citizen-led switch to renewables en masse**. Instead Bulgarian policy-makers remain focused on a few unnecessary large infrastructure projects and the preservation of coal, beyond agreed deadlines. Without an effective and transparent spending plan with long-term objectives and indicators for success, the transition could cause a popular **backlash**.

The current analysis aims to draw the key policy lessons from the introduction of the **Pathways Explorer-based** decarbonisation scenarios for Bulgaria into the report of the national Energy Transition Commission (ETC), the body that will form the basis for the country's **Climate Neutrality Roadmap by 2050** (also a milestone of the National Recovery and Resilience Plan (NRRP)). These decarbonisation scenarios include:

- **WEM (With Existing Measures):** approximates the Bulgarian Reference scenario in line with the European Environmental Agency's (EEA) 2020 WEM sce-

<sup>1</sup> Vladimirov, M., Rangelova, K., and Dimitrova, A., *The Great Energy and Climate Security Divide: Accelerated Green Transition vs. the Kremlin Playbook in Europe*, Sofia: Center for the Study of Democracy, 2022.

<sup>2</sup> Center for the Study of Democracy, *Tackling the Energy and Climate Security Conundrum in Southeast Europe*, Policy Brief No. 110, May 2022.

### **KEY POINTS**

- Decarbonising the Bulgarian economy requires a **deep transformation of the national energy mix** towards low-carbon sources. Power and heat demand decarbonisation are crucial, as they account for **two-thirds of all total national greenhouse gas (GHG) emissions**
- All three decarbonization pathways foresee **power demand growth** by 2050. The coal-based generation is substituted with a **mix of PV and wind** (onshore and offshore) in combination with battery storage already by 2030.
- New nuclear power plants should not be **planned before 2040** when Bulgaria could invest in the replacement of the two existing reactors in the Kozloduy plant to secure new baseload capacity in the electricity system.
- The **enormous offshore wind energy potential** should be unlocked through the creation of a comprehensive regulatory framework.
- Bulgaria should **invest in the electricity transmission and distribution grids**, so that they could accommodate annual additions of 1 to 2 GW of renewable energy capacity in the system.
- Instead of fuelling the new-building construction bubble, the government should rather focus on measures and support tools that incentivize the **renovation of empty, old buildings**.
- Bulgaria should implement policies to **reduce the overall demand for transport** and focus on the **electrification of production processes** in the industrial sector using renewable energy sources.

nario. It assumes a continuation of current trends and policies.

- **KEP:** steps on the vision jointly developed by the members of the ETC in cooperation with the Ministry of Energy and the European Commission. The scenario envisions coal phaseout by 2030, i.e. the more ambitious scenario of the two constructed by the ETC. The other one sees coal phased out by 2038.
- **LTS:** presents a Long-Term Strategy for decarbonisation, which sets out more ambitious long-term decarbonisation targets leading to carbon neutrality by 2050. It assumes transformational behavioural changes that imply lifestyle changes and lead to a decentralised, citizen-oriented power system with 100% renewable energy.

This assessment considers the feasibility of Bulgaria’s current long-term decarbonisation framework and zooms in on the five key economic sectors: energy, buildings, transportation, industry, and agriculture and land use (LULUCEF).

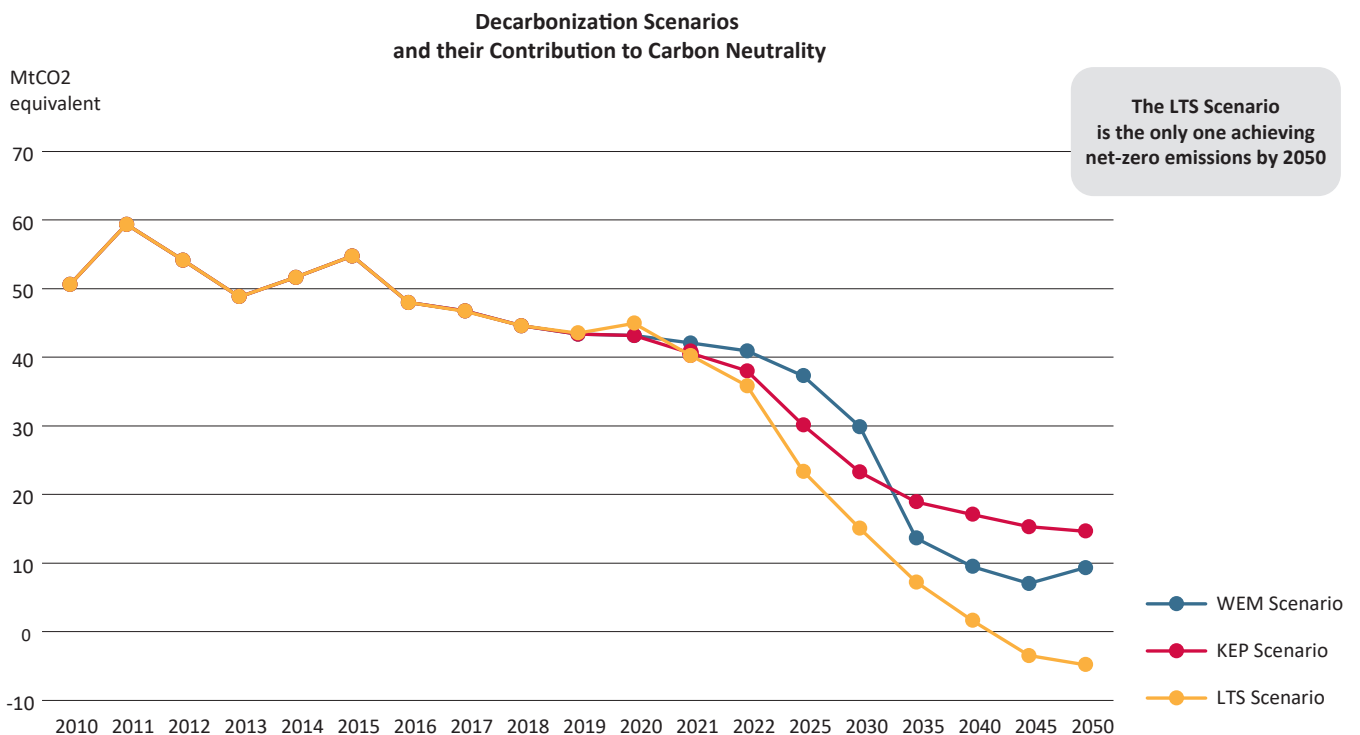
For the first time, the assessment **integrates effort sharing targets** in the scenarios for Bulgaria as part

of the EU’s Effort Sharing Regulation (ESR). None of the existing modelling assessments of the country’s decarbonisation policy has so far included the ‘Fit-for-55’ policy framework, in which the European Commission (EC) has proposed new effort sharing targets in line with the 55% emission reduction goal for 2030. The assessment of the decarbonisation pathways in the current exercise will assist the Bulgarian government in developing adequate policy measures that raise the country’s 2030 and 2050 climate ambitions.

## Deep Transformation of the Energy Mix

Decarbonising the Bulgarian economy requires a **deep transformation of the national energy mix** towards low-carbon sources. The decarbonization of power and heat production is crucial, as the latter accounts for about **two-thirds of all total national greenhouse gas (GHG) emissions**. Moreover, decarbonising electricity production is a key step in ensuring the electrification of final energy use, in particular in the buildings, transportation, and industry sectors.

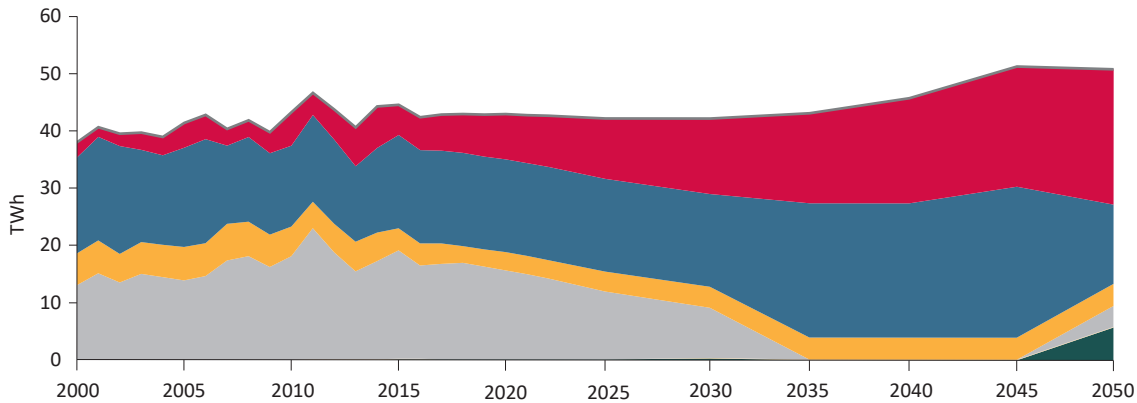
**Figure 1. Total GHG emissions for all economic sectors: Buildings, Transport, Industry, Agriculture, Energy Supply, Land-Use, Waste and Others**



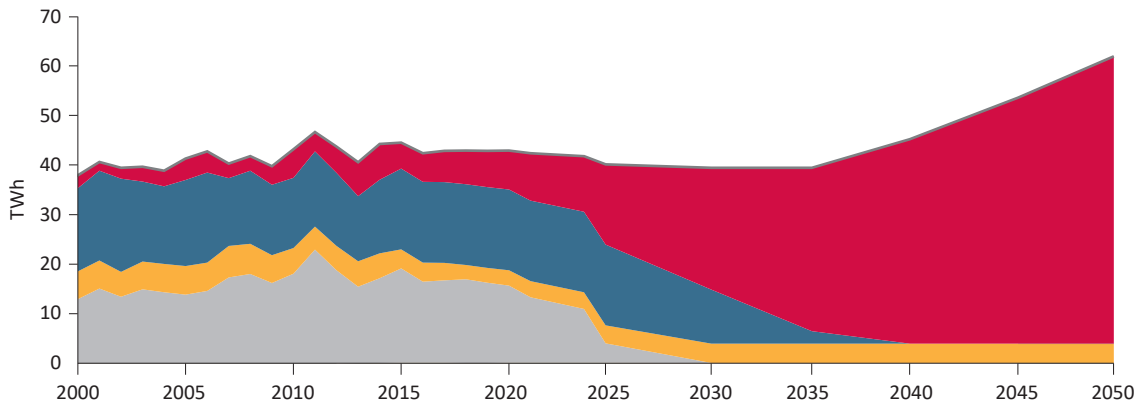
Source: CSD developed scenarios based on the Pathways Explorer.

Figure 2. Electricity Production per Source and Net Imports until 2050

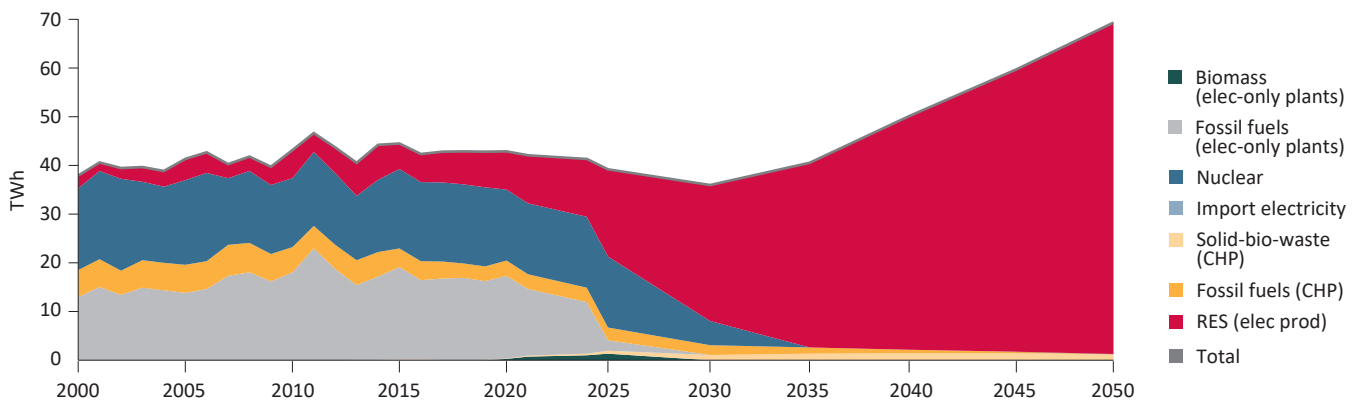
WEM Scenario



KEP Scenario



LTS Central Scenario



Source: CSD developed scenarios based on the Pathways Explorer.

Any divergence from the path of the EU’s transition to carbon-neutrality by 2050 would mean higher energy and climate security risks for Bulgaria, linked to the high exposure to the inherent volatility of fossil fuel prices. This has been vividly revealed by the energy price crisis, which started in August 2021, and was further exacerbated by the Russian invasion in Ukraine. Going forward, the economic feasibility of operating

coal- and gas-fired power plants will decline on the back of rising fossil fuel and carbon prices (Emissions Trading System – ETS allowances), to the point where they could become **stranded assets**. To avoid a fossil fuel lock-in, the Bulgarian government should develop a plausible and detailed strategy for the phase out of coal and gas-fired power plants as soon as possible, and ensure the uptake of renewable energy sources.

While the energy supply has the potential to transition to carbon-free energy sources, there is also significant scope for achieving large **energy efficiency** gains. Therefore, to achieve the EU's and national decarbonization targets, it is necessary to promptly electrify all national economic sectors and ensure carbon-free energy carriers.

Scenarios aimed at **achieving the net-zero emissions target** by 2050 can be achieved by using low-carbon fuels such as biogas, liquid biofuels, liquid and gas e-fuels, hydrogen, and renewables. Following global trends, in Bulgaria, solid coal will almost disappear as a vector in final energy consumption by 2050, compared to 2.9 TWh in 2020. The share of natural gas will shrink six-fold over the same 30-year period, while the liquid oil's share will decrease by over 50%. Together, renewables and low-carbon fuels will account for more than half of the final energy in 2050.

Zooming in on the **electricity sector**, all three decarbonization pathways – the WEM, KEP, and LTS scenarios – predict a growth in power demand by 2050. In the WEM Scenario, power consumption increases by 42 % between 2015 and 2050 or 1.4% per year on average. This trend is mainly driven by the electrification of the transport sector, particularly between 2025 and 2030. In contrast, the demographic decline combined with modest energy savings in buildings are expected to reduce power demand in the residential sector by 0.7% per year or 20% for the period 2015-2050. The other two scenarios are expected to achieve more significant savings in the building sector – between 40% to 42% – through targeted and ambitious actions focused on improving energy efficiency and implementing deep renovations. These figures are in line with other European models.

The KEP and LTS pathways envision an **accelerated coal phaseout**, and lignite is substituted with a mix of PV and wind (onshore and offshore) in combination with battery storage already by 2030. Following the GHG emission reduction trajectories in the energy sector, the KEP scenario replaces 2/3 of the fossil-fuel based power generation with renewables by 2025 achieving 53% CO<sub>2</sub> emissions cuts.

The accelerated coal phaseout comes on the back of the **increasing costs for coal-based power generation** as the price of ETS allowances stays consistently around EUR 100/ton raising the marginal cost of the existing coal fleet in Bulgaria to levels above the expected wholesale power price. No new fossil gas plants are added to the system and gas-fired power genera-

tion remains online only in CHP mode as a by-product to heat generation in district heating plants.

The LTS scenario envisages Bulgaria to phase out coal and gas-fired power generation completely by 2030, with the largest power plants already shut down by 2025. This scenario achieves carbon neutrality in the entire economy and aims for -70% CO<sub>2</sub> savings by 2025. The LTS assumptions about renewables uptake are ambitious, and both coal and natural gas load factors decrease significantly after 2025. This suggests that new **investments in conventional technologies are not economically feasible** due to the oversaturated electricity market.

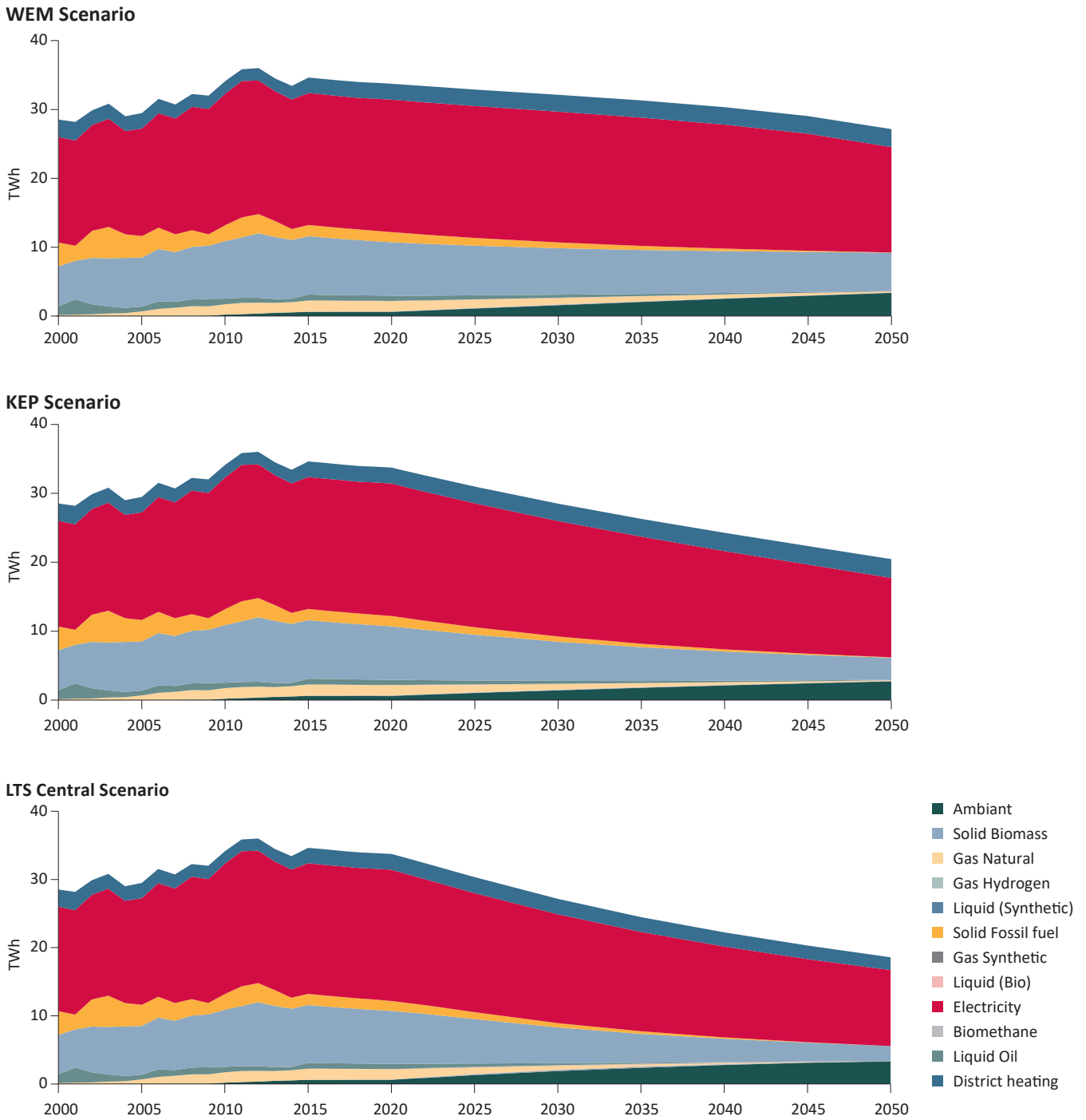
To keep pace with these ambitious targets, Bulgaria should **invest in the electricity transmission and distribution grids**, so that they could accommodate annual additions of 1 to 2 GW of renewable energy capacity in the system. The completion of these grid investments requires a comprehensive policy framework, risk-sharing instruments, transparency in terms of grid planning and capacity allocation, as well as improved coordination and cooperation among authorities managing the permitting process. **Innovation** is key to developing new clean energy technologies and advancing existing ones. Almost 50% of the emissions reductions needed for reaching climate neutrality depend on technologies **that are at the prototype or demonstration stage**, are not yet available on the market or are conditioned by specific infrastructure constraints.

To accommodate a higher proportion of intermittent renewable energy-based power plants, Bulgaria must invest significant public resources in **upgrading the national energy infrastructure**. Many transmission and distribution lines are outdated and not properly maintained, which can result in frequent power outages and blackouts. In order to maintain a secure power supply, dispatchable renewables, in combination with other low-carbon generation units, battery storage, and robust and well-interconnected electricity networks, are critical. Smart meters are also essential for the improved integration of decentralized power producers.

## Electrification and Energy Efficiency in Buildings

A key factor for lowering GHG emissions in the buildings sector is the **reduction in overall energy demand** and the acceleration of the pace of **electrification**. The decline in emissions is driven by the phase out of coal,

Figure 3. Energy Demand per Energy Vector in Buildings



Source: CSD developed scenarios based on the Pathways Explorer.

solid biofuel (firewood), natural gas, and liquid fuels in exchange for electrification, and the uptake of alternative fuels. The three scenarios examined in the buildings sector explore different indicators including the type of residential and service building construction technologies, heating and cooling behaviours, low-carbon heating solutions and buildings envelope renovation. All pathways show that **heating** will remain the

most significant component of energy demand for the next 30 years. However, phasing out coal and solid biofuels in favour of electrification and improved ventilation could reduce consumption by more than 50%, as demonstrated in the *LTS Scenario*.

Energy consumption in buildings can be also significantly impacted by the daily behaviours and choices of

their inhabitants. Individuals can make different choices to optimise their **energy consumption patterns**. Adjustments in daily routines may reduce household costs, carbon emissions, and relieve the pressure on the electrical grid during peak demand periods.

More structurally, to achieve carbon neutrality in buildings, it is crucial to reduce the per capita demand for additional residential surfaces. Currently, **more than 30% of dwellings in Bulgaria are not inhabited**, while around 40% of people live in crowded housing, which necessitates more efficient use of existing and new building stock

Instead of fuelling the new-building construction bubble, the government should rather focus on measures and support tools that incentivize the **renovation of empty, old buildings** – an approach that could be instrumental for lowering emissions in the buildings sector. The use of commercial buildings should also be optimized to reduce surface demand for businesses.

## Different Visions for Sustainable Mobility

Transportation is the second-largest contributor to greenhouse gas emissions in Bulgaria, with a continuous increase in its share of overall emissions, currently accounting for 19% of the total. **Mass transport electrification** is key to decarbonizing the sector in the future.

In the WEM scenario, emissions peak in 2025 at 10 MtCO<sub>2e</sub> and decrease to 6.1 MtCO<sub>2</sub> by 2050, with passenger emissions driving the majority of the decarbonization. The KEP scenario predicts emissions will decline by close to 60% in 2050, dropping from 9.8 MtCO<sub>2</sub> in 2025 to 4.2 MtCO<sub>2</sub>, with a reduction in liquid oil consumption and a significant increase in the use of electricity. Meanwhile, the LTS scenario expects GHG emissions to decrease by 85% by 2050, with a considerable reduction in the use of liquid fuels and a decrease of over 50% in total energy consumption in the transport sector. However, none of the scenarios predict significant changes in behaviour that would incentivize **sustainable mobility**. Although the LTS scenario brings Bulgaria closer to meeting EU transport climate neutrality targets, the main obstacle to decarbonization is changing key behavioural drivers in the sector for both passengers and businesses.

The assessment recommends a two-step approach combining structural optimization with the current

policy ambitions of the Bulgarian government directed towards the introduction of a **cleaner fuel mix** and a **new generation of vehicles** in the passenger segment of the market. The reliance on single technology-driven measures is not sufficient for a deep transformation of the transportation system towards a more sustainable future, and more ambitious policy approaches are necessary to achieve a significant reduction in energy use.

## The Herculean Challenge of Industrial Decarbonisation

Bulgaria faces a significant challenge in decarbonizing its industry and lowering energy and carbon intensity. The country's strategic framework focuses primarily on transforming the energy sector, leaving industrial decarbonization largely unaddressed. The WEM scenario, which continues current policies, sees stronger decarbonization due to the electrification of industrial demand and moderate phaseout of oil, coal, biomass, and gas. In contrast, the KEP scenario, reflecting Bulgaria's current economic development vision, almost doubles natural gas and coal consumption by 2050, driving up carbon intensity. The more ambitious LTS scenario shows a much greater potential for decarbonization in industry but **requires significant state support**, such as tax incentives, loan programs, and high manufacturing standards, to encourage circular economy supply chains with high material efficiency. This support is crucial for accelerating the transition to alternative processes using renewable energy and green hydrogen, or a combination of renewable energy and Carbon Capture, Utilization, and Storage (CCUS) technologies, especially in chemicals, iron, steelmaking, cement, and ceramics. Upgrading existing facilities to produce **synthetic fuels** on a sectoral level would require substantial initial capital investments, which can be covered through dedicated support. Without these measures, the LTS scenario remains unlikely.

## The Missing Piece of Decarbonisation Policies: the Carbon Sink

Bulgaria **lacks well-defined policies** and measures for reducing greenhouse gas emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sector, hindering the creation of specific scenarios for emissions reduction and carbon sequestration. The three elaborated scenarios are based on the EU's environmental,



climate, and biodiversity protection commitments, but there is a lack of clarity on the extent of necessary measures and targets for emissions reduction in the draft national strategic plans in relation to the Common Agricultural Policy. The scenarios predict emissions trajectories based on current forest management strategies, trends in the development of the agriculture sector, and the possible effect of less intensive agricultural practices. The LTS scenario is the ambitious and aims to reveal the potential evolution of emissions and carbon removals with most integrated actions. The land allocations and land-use changes, emissions and removals from forest lands, and emissions associated with agricultural soil management are the main drivers of emissions trends in all scenarios. The direct effects of behavioural changes on emissions reduction, such as meatless diets, limited consumption, and food waste management, are not considered, but they can contribute to changes in emissions through better land allocation.

## What's Next?

The **delayed debate** about the impact of the European Green Deal on a national, regional and local level has led to a limited progress on building a consensus around common decarbonisation strategies in Bulgaria. There is an urgent need for a **long-term national data-based energy transition policy** with consistent targets, concrete milestones and policy actions. Currently, Bulgaria lacks a coherent and up-to-date energy strategy and most key policy documents reveal no clear vision for long-term decarbonisation pathways.

To enable the deep decarbonisation of the economy, the modelling scenarios show that business-as-usual and even a moderately ambitious policy strategy would not deliver net-zero carbon emissions by 2050. The EC should work with the Bulgarian government to promote the **adoption of more ambitious climate transition measures**, such as:

- **Phase out coal** as early as possible and focus on sustainable energy infrastructure and renewable energy sources.
- **Invest in innovative technologies** like offshore wind, battery storage, and smart grids and remove legal and administrative barriers for citizen-driven projects.
- The country has **enormous offshore wind energy potential** that should be explored through the passing of a regulatory framework and the development of maritime spatial plans.
- **Postpone the construction of new nuclear power plants** until after 2040 and focus on implementing comprehensive energy efficiency measures to reduce energy consumption.
- Prioritize the development of **smart grid capacity** and increase the rate and depth of renovations to reduce emissions and increase energy efficiency.
- Promote **sustainable transport** through the development of infrastructure for cycling and walking and the expansion of public transport systems.
- Implement policies to **reduce the overall demand for transport** and focus on the **electrification of production processes** in the industrial sector using renewable energy sources.
- Develop a **National Forestry Strategy** until 2030 to reduce climate change-related risks for the forest ecosystem and introduce carbon farming practices to sequester carbon in the soil and in vegetation.
- **Encourage sustainable livestock management practices** to reduce emissions and explore synergies with the energy sector, such as the production of biogas and electricity from biomass.

