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National assessment of carbon management potential in Bulgaria

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List of abbreviations

BFIEC	Bulgarian Federation of Industrial Energy Consumers
ETS	Emissions Trading System
EU	European Union
EPG	Energy Policy Group
CAWI	Computer Assisted Web Interviewing
CBAM	Carbon Border Adjustment Mechanism
CM	Carbon Management
CCUS	Carbon Capture, Utilization, and Storage
CHP	Central Heat and Power
CO_2	Carbon Dioxide
PV	Photovoltaic
CCS	Carbon Capture & Storage
CCU	Carbon Capture & Utilization
CM	Carbon Management

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1. Summary Overview

Even though Bulgaria is among the EU's most carbon-intensive economies, ranked third in the EU, the country has strong potential to deploy carbon capture, utilization, and storage (CCUS) technologies in its cement and chemical production. National objectives increasingly link carbon management (CM) to industrial decarbonisation, economic modernisation, and regional transition, with projects such as ANRAV[1], run by Heidelberg Materials at the Devnya industrial cluster as well as the Eastern Lights CCS project in North-East of Bulgaria[2] signalling the start of pilot deployment and future participation in regional CO_2 transport and storage networks in the Black Sea region. EU frameworks, including the EU ETS, Innovation Fund, Net-Zero Industry Act, and Just Transition Fund, create financial and regulatory opportunities for CC(U)S, especially in coal-dependent regions and emerging net-zero industrial clusters where carbon management could support reindustrialisation.

While the technology is already incorporated into the national long-term decarbonisation goals for 55% emissions reduction by 2030 and climate neutrality by 2050, a coherent national strategy is still missing.[3] Political instability over the past 5 years, overlapping institutional mandates, and the absence of a dedicated legal framework continue to delay regulatory reform, infrastructure planning, and investment decisions.[4] High capture costs, missing CO_2 transport systems, and weak national incentives further slow deployment and create uncertainty about timelines for industrial transformation in vulnerable regions. To move forward, Bulgaria must define clear governance, integrate CM into regional transition strategies, align legislation with EU rules, and use EU funding strategically to support industrial competitiveness, regional restructuring, and long-term climate alignment.

2. Policy Context

2.1. Policy Context

Bulgaria's national CM trajectory sits within broader EU developments, EU Green Deal, Industrial Accelerator Act, and Fit-for-55[5] implementation, and the push to scale net-zero industrial technologies, yet the country still concentrates most transition effort on renewables and new nuclear capacity while leaving industrial decarbonisation under-used. Within this context, Bulgaria's core CM objective is to enable deep emissions cuts in hard-to-abate industrial sectors (notably cement, chemicals, steel, and refining) to support the legally binding EU climate targets of at least a 55% reduction in GHG emissions by 2030 and climate neutrality by 2050.

2.2. Government Bottlenecks

Several policy gaps continue to limit CM deployment in Bulgaria, particularly in vulnerable regions such as Just Transition territories and emerging net-zero industrial clusters. Although EU frameworks provide strong financing opportunities, Bulgaria has not translated them into a coherent national strategy that positions CM as a core tool for industrial

[1] ANRAV Project
[2] Pioneering Carbon Management in Eastern Europe
[3] Bulgaria – Final updated NECP 2021-2030, 2025.
[4] Center for the Study of Democracy. *Future Resilience*. Sofia, 2025.
[5] European Green Deal, 2024.

transition. The country still lacks a CO_2 Storage Directive to direct implementation, clear permitting rules, and a defined institutional lead, which creates regulatory uncertainty and discourages investment in regional projects and industrial hubs.[6] Governance fragmentation between ministries further slows coordination on infrastructure planning, while the absence of national co-financing schemes or de-risking mechanisms means EU funds alone cannot support large-scale deployment. Moreover, industry stakeholders consistently highlight prolonged permitting timelines—even where regulatory frameworks and formal deadlines exist—alongside the absence of a single competent authority overseeing industrial decarbonisation, underscoring the challenge of advancing innovative pilot projects without the need for new bespoke legislation in each case.[7]

At the same time, Bulgaria has not yet developed a CO_2 transport network or certified storage sites, preventing industrial clusters from forming around shared infrastructure. Weak planning in national strategies, including insufficient detail on how and when carbon capture will scale, risks compressing timelines for industrial transformation and undermining both reindustrialisation efforts in coal-dependent regions and alignment with 2030 climate targets.

These bottlenecks delay potential investment decisions and weaken the ability of vulnerable regions and industrial clusters to use CM as part of their decarbonisation pathways. Closing these gaps will require clearer national leadership, regulatory reform, infrastructure planning, and targeted support mechanisms that link EU funding with regional transition strategies.

In practice, Bulgaria's near-term CM objectives therefore need to focus on building technical readiness through geological assessment and storage site appraisal, creating a complete regulatory framework and streamlined permitting processes aligned with EU rules, and with the support of existing EU instruments (e.g., Innovation Fund) to de-risk first movers, especially where CM could support transition in regions and industrial areas facing the steepest decarbonisation and competitiveness pressures.

2.3. Enabling Factors

Several factors could enable the development of CM in Bulgaria across legal, financial, institutional, and social dimensions.

- Legally, aligning national legislation with the EU CO_2 Storage Directive and establishing clear permitting, monitoring, and liability rules would create the regulatory certainty needed for project developers and early investors.
- Financially, Bulgaria can leverage available EU funds, but scaling CM will also require state aid mechanisms and targeted incentives to bridge the cost gap between capture technologies and current carbon prices.
- Institutionally, designating a clear lead authority, strengthening coordination between ministries, and building technical capacity within public institutions would accelerate decision-making and infrastructure planning.
- Socially and culturally, early industrial engagement, transparent communication with local communities, and stronger public awareness of CM's role in preserving jobs

[6] Directive 2009/31/EC of the European Parliament and of the Council, 2009.
[7] Center for the Study of Democracy, *National Study on Capacity Gaps in Carbon Management: Emphasizing Carbon Capture and Storage Deployment in Bulgaria*, 2025.

and supporting regional transition, particularly in industrial and coal-dependent regions, could improve acceptance and reduce resistance to deployment.

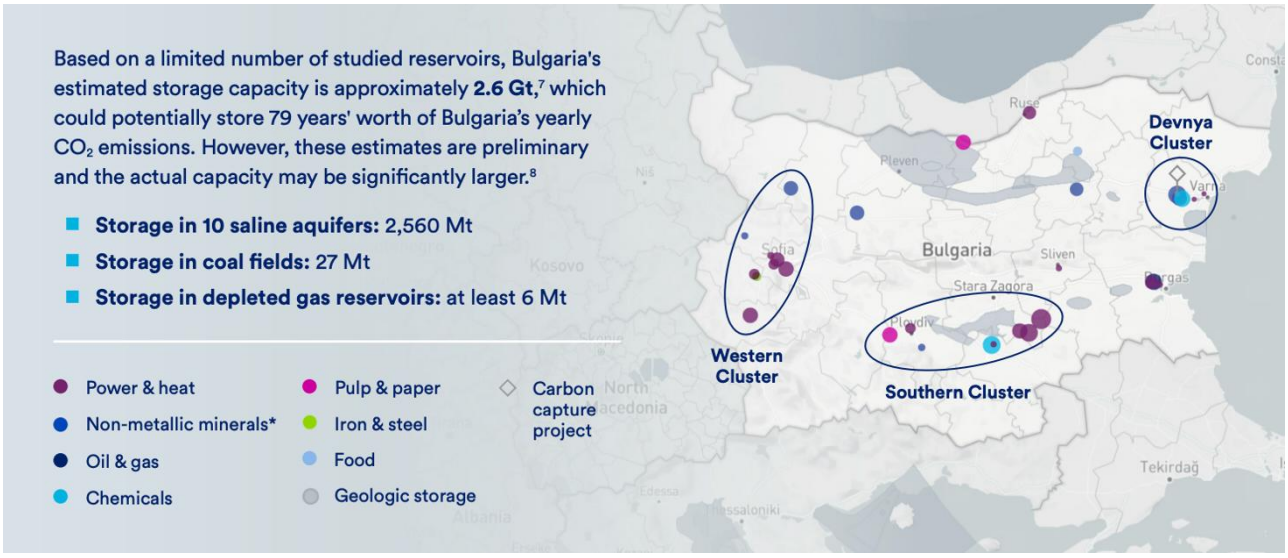
Together, these enabling conditions would help transform CCUS in Bulgaria from isolated pilot initiatives into a credible pathway for industrial decarbonisation and regional economic restructuring.

3. Potential for Development

3.1. Carbon Emission Sources - Sectoral Analysis

In 2023, 48% of Bulgaria's CO_2 emissions came from electricity and heat producers, while the transport and industrial sectors were responsible for 32% and 12.9% respectively.[8] Bulgaria's major industrial emission sources are concentrated in energy- and process-intensive sectors - cement, glass, chemicals and fertiliser production, petroleum refining, and non-metallic minerals in particular.[9] These industries combine high energy demand with unavoidable process emissions, making them among the country's most carbon-intensive activities and exposing them to rising costs under the EU ETS. Fertiliser production (ammonia), cement manufacturing, and glass production are especially significant emitters, while chemical and petrochemical industries generate substantial emissions due to their reliance on natural gas as both energy source and feedstock.[10]

Figure 1. Bulgaria's carbon storage capacity and high emission zones.



Source: Clean Air Task Force, *Carbon Capture & Storage in Bulgaria*, 2023.

In these sectors, CM strategies can play an important role alongside efficiency and circularity measures. Potential mitigation pathways include the deployment of carbon capture and storage (CCS) to address process emissions in sectors such as cement, glass, and ammonia production, as well as carb on capture and utilisation (CCU) to convert captured CO_2 into chemical feedstocks or other industrial products. Additional strategies include electrifying energy-intensive processes where technically feasible and increasing

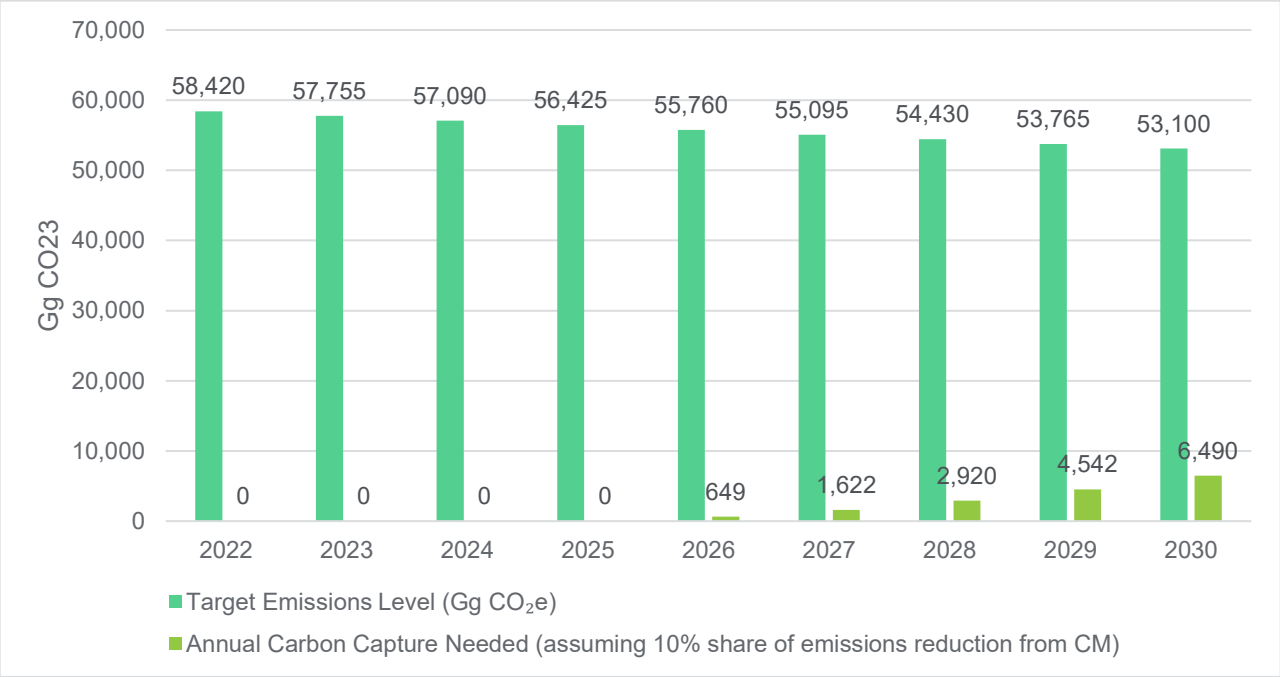
[8] International Energy Agency, Bulgaria: Emissions Overview, 2024.
[9] Net Zero Lab. The Bulgarian Chemical Industry: Carbon Footprint, Resource Dependencies, and Regulatory Challenges, 2026.
[10] Kapsalyamana, Z., Paltsev, S., Use of Natural Gas and Oil as Feedstock, 2020.

the use of renewable energy in already highly electrified industries, such as copper refining. Together, these strategies could significantly reduce emissions in the long run in Bulgaria's hard-to-abate industries while preserving and increasing their economic competitiveness.

3.1. Current Investments and Future Outlook

The most concrete national progress on CM implementation to date is the ANRAV full-chain CC(U)S project at Devnya Cement (Heidelberg Materials), backed by an EU Innovation Fund grant of 190 million EUR. The project targets capture of 0.8 $MtCO_2$/yearly and storage in the Galata depleted offshore gas field in the Black Sea, with construction launched in 2023 and operation expected by 2028.[11] The installation will capture 0.798 $MtCO_2e$ annually at the kiln line, thus preventing 95% of emissions at this level.[12] After the completion, Bulgaria would have the strong position to join future regional CO_2 transport and storage cooperation with neighbouring EU Member States, but also with other countries from the Black Sea region. However, this project, along with others funded by the EU Innovation Fund, is currently on hold, and no initial investment decision has been made; this will depend on the price of allowances and, more broadly, on the decision of the European institutions regarding the future of the Emissions Trading Scheme.

Figure 2. CM Implementation to Achieve Bulgaria's 2030 Emission Reduction Goals.



Source: CSD based on data from First Biennial Transparency Report of Bulgaria, 2024.

[11] Innovation Fund, ANRAV CCUS, 2022.

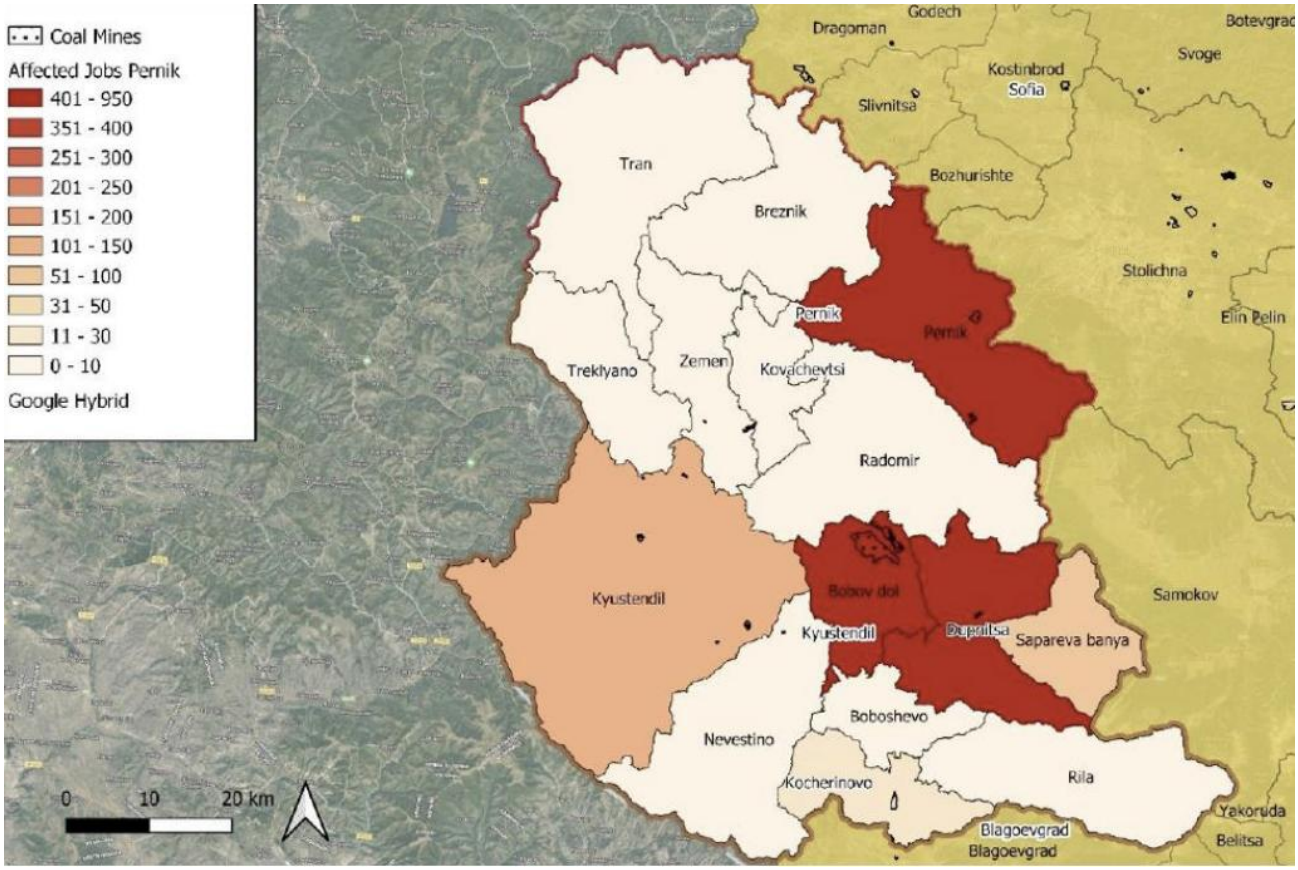
[12] Calculated using the formula $Emission\ Reductions_{CM} = E_{baseline} \times P_{CM} \times E_{efficiency}$, developed in line with GHG Protocol and IEA methodology, where emission reductions are defined as the difference between baseline emissions and project emissions. The ANRAV project aims to capture 95% of emissions from the Devyna cement plant, which produces 0.821 $MtCO_2$ annually at the kiln line. This formula calculates the total emissions reduction from the CCUS project. To avoid overstating theoretical mitigation potential, an implementation efficiency factor (Eefficiency) may be applied in sectoral-level estimates to account for regulatory, financial, and infrastructural constraints, reflecting the distinction between technical and economically feasible mitigation potential recognized in IPCC AR6 (Chapters 3 and 13) and deployment assumptions used in IEA Net Zero modelling frameworks. For project-level calculations, this adjustment factor may be excluded.

Yet, to achieve 10% emission reductions using CM only, Bulgaria would need to capture 6,490 Gg CO2e by 2030. Given the current state of CM in Bulgaria and CM's long implementation timeline, Bulgaria will need to increase the number of pilot projects or coordinate cross-border CM strategies to achieve this goal.

4. CM Deployment in Transition Regions: Economic & Social Impacts

CM technologies could play a significant role in supporting economic stability and regional development in Bulgaria, particularly in areas historically dependent on heavy industry or coal production. Fairness and inclusive decision-making in climate policy have become more important than ever, as the energy sector has seen a lot of upheaval in recent years. Coal workers have been vocal in expressing their concerns not about climate goals themselves but about employment security and exclusion from policy processes. This has led to the removal of the mandatory schedule for the step-by-step reduction of coal capacity at the Maritsa East complex and the imposition of new limits on its operation.

Figure 3. Job losses predicted in Pernik, one of Bulgaria's Just Transition Regions, due to phasing out of coal mines. The region also is a key industrial hub for manufacturing, steel production, and chemical processing, all suitable for CCS.



Source: Bulgaria Just Transition Plans, 2023.

In this context, CM technologies may provide a transitional pathway that helps maintain industrial activity and jobs while reducing emissions in certain sectors such as cement, chemicals, and manufacturing. Late 2025 survey results among ~1000 respondents indicate

moderate optimism about this potential: 44.3% of respondents agreed that CO_2 capture technologies could help mitigate climate change, while 46.3% believed they could help preserve existing industries.[13] For regions where industrial decline is closely linked to economic insecurity, CM deployment could therefore support job retention, stabilize local economies, and reduce the social disruption associated with rapid decarbonisation.[14]

The employment case for carbon management should not be overstated. Evidence from comparable European projects suggests that CCS can help retain specific industrial assets and a limited number of skilled jobs, but it is not a one-for-one replacement for coal-region employment losses in the Maritsa Basin or Pernik.[15]

Beyond economic continuity, CM deployment may generate additional co-benefits for vulnerable regions. Retrofitting existing industrial facilities with capture technologies, including cement plants, steel mills, or chemical refineries, could reduce local air pollution and support the modernization of industrial infrastructure. Investments in CO_2 transport and storage networks may also create new technical jobs and regional value chains in engineering, monitoring, and infrastructure maintenance. At the same time, potential risks must be considered. Without adequate governance and financing frameworks, CM projects may concentrate benefits among large industrial actors while leaving local communities exposed to environmental or economic uncertainty. Public perceptions also reveal a contrast between citizen and industry perspectives: while citizens often view CM primarily through the lens of job preservation and regional stability, industry actors emphasize regulatory uncertainty, investment risk, and competitiveness under policies such as the EU Carbon Border Adjustment Mechanism. This divergence suggests that equitable deployment will require both strong policy incentives and transparent stakeholder engagement.

Equitable access strategies and community-focused governance models could help distribute CM benefits more fairly. Mechanisms such as community advisory boards, local benefit-sharing agreements, and targeted workforce transition programs can ensure that affected regions participate directly in decision-making and economic opportunities. Geographic visualizations of industrial emissions, employment patterns, and infrastructure availability can further support equitable planning by identifying regions where CM deployment could provide the greatest economic and environmental benefits. Overall, while public attitudes remain characterized by ambivalence rather than opposition, the survey findings suggest that proactive engagement and inclusive governance could allow CM to strengthen regional resilience while supporting Bulgaria's broader climate transition.

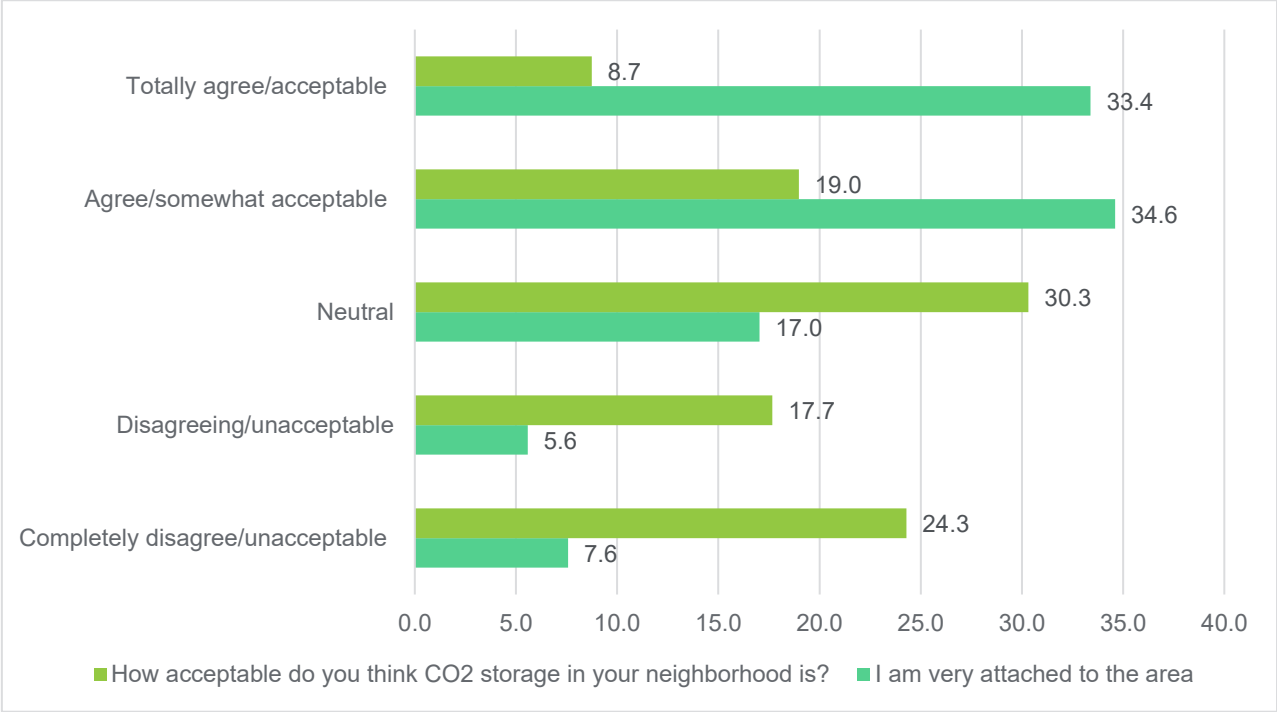
5. Public Perception and Stakeholder Engagement

Preliminary findings from the public perception study suggest that societal readiness for CM in potential deployment regions is best described as *latent but fragile*, shaped by limited understanding, conditional acceptance, and persistent concerns about fairness and institutional credibility. While a majority of respondents recognized the term "carbon management," their actual comprehension of what CM entails remained low, indicating that

[13] Center for the Study of Democracy, *National Study on Public Perception in Carbon Management in Bulgaria*, 2026.
[14] Maesano, Mitchell-Larson, Clark-Sutton, Pike, Siezing the Industrial Carbon Removal Opportunity, 2025.
[15] World premiere at Heidelberg Materials: Opening of CCS facility in Norway marks new era of sustainable construction, 2025

attitudes are still provisional and likely to shift in response to framing effects, media narratives, and perceived trustworthiness of implementing institutions.

Figure 4. Degree of Acceptance of CO_2 Storage and attachment to the area [%]



Source: Center for the Study of Democracy, *National Study on Public Perception in Carbon Management in Bulgaria*, 2026.

At the local level, the survey revealed neither strong support nor outright opposition to hosting CO_2 capture and storage infrastructure, pointing instead to a "conditional, undecided acceptance" that could evolve if governance mechanisms, safety assurances, and tangible community benefits are demonstrated. Acceptance increased when respondents were asked about using end-products derived from captured CO_2 rather than hosting the infrastructure, reinforcing the importance of proximity, perceived risk, and local accountability in shaping acceptance.

6. Deployment Pathway & Timeline

In order to achieve its 2030 climate targets and long-term climate neutrality goals, Bulgaria needs to move CM from an isolated pilot activity toward a credible national transition pathway that supports industrial decarbonisation, increases its competitiveness, and promote regional restructuring.

- Achieving this will require closing key governance and regulatory gaps by aligning national legislation with EU CCUS rules, including permitting, monitoring, and long-term liability frameworks, while designating a clear institutional lead and streamlining approval procedures to reduce investor uncertainty.
- At the same time, Bulgaria must advance infrastructure planning by conducting geological assessments of storage capacity, developing CO_2 transport corridors and open-access networks, and strengthening regional cooperation in the Black Sea basin to enable shared storage and transport systems.

- Financial support will also be essential, combining EU instruments with national co-financing and de-risking mechanisms to help bridge the cost gap for pilot projects and support industrial clusters in priority hard-to-abate sectors.
- Equally important is ensuring early and meaningful engagement with local communities, particularly in Just Transition regions, through transparent communication, credible regulatory oversight, and benefit-sharing mechanisms that address job fairness and build trust.
- Integrating CM into Bulgaria's broader climate and development strategies will be critical in reaching emissions reduction goals and ensuring Just Transition regions can safeguard employment and economic viability.
- Rather than functioning as a stand-alone technology, CM should complement energy efficiency, electrification, circularity, and renewable energy expansion while supporting industrial competitiveness and regional economic resilience.

National assessment of carbon management

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