EPG

ISSN 3061-3515

EPG Policy Papers • November, 2024 • Bucharest, Romania

High-Level Roadmap for Decarbonising Cement and Lime Production in Romania

Sabina Strîmbovschi

Luciana Miu

Mihnea Cătuți

Corina Lazăr

www.enpg.ro

EPG

Policy Paper Title

High-Level Roadmap for Decarbonising Cement and Lime Production in Romania

A study by

Energy Policy Group (EPG)
Constantin Noica Street 159, Bucharest, Romania
www.enpg.ro, office@enpg.ro

About EPG

EPG is an independent think-tank specialising in energy and climate policy, focusing on the decarbonisation of the Romanian and Central and Southeastern European economies. Founded in 2014, EPG operates as a research institute primarily financed through competitive research grants. Its research aims to promote a constructive, evidence-based dialogue on decarbonisation and economic transformation among decision-makers and the public, both regionally and globally.

Suggested quotation

Energy Policy Group (2024). High-Level Roadmap for Decarbonising Cement and Lime Production in Romania. EPG Policy Papers, November, 2024

Cover image by

Banana Republic images on Shutterstock

Key findings

With stringent climate policies in place, the timeline for decarbonising emission-intensive industries is becoming increasingly tight. To remain competitive in the long term, the cement and lime industries (two hard-to-abate sectors) will have to implement complex transformation plans and increase investments in low-carbon solutions and costly technologies. Although these sectors receive limited funding and support for decarbonisation, and no CCS projects are being developed in Romania (unlike in Bulgaria or Poland), they will undoubtedly continue to play a key role in Romania's development, given the country's planned road infrastructure rollout and buildings investments until 2030. To turn the transition into an opportunity, both industry and government will need to demonstrate that they are committed to implementing the best available solutions to achieve net zero emissions.

Therefore, to ensure that the cement and lime industries have feasible chances of achieving climate neutrality by 2050, a set of recommendations can be formulated for the next five to ten years:

1. **Deploy new renewable energy capacities**: As the sector moves towards decarbonisation, energy demand is expected to rise, particularly due to carbon capture. Ensuring that this additional energy demand is clean will require substantial amounts of low-carbon energy and additional capacities to support both self-consumption and reducing the carbon intensity of Romania's grid electricity supply.
2. **Accelerate CO_2 transport and storage infrastructure development:** Given the existing regulatory and permitting barriers and limited ambition for advancing CCS/CCUS technologies that have hindered progress on CO_2 transport and storage infrastructure, public authorities must strengthen their commitment to advancing CCS solutions.
3. **Strengthen the cooperation between the cement and lime industries and hydrocarbon producers**: Romania's significant potential for geological CO_2 storage capacities and its obligation to capture and store 9 Mt of CO_2 annually until 2030, as outlined in the NZIA, requires an accelerated dialogue between the owners of depleted gas and oil fields and industries that will rely heavily on CCS (such as the production of cement, lime, fertilisers and oil refining). The dialogue is particularly relevant given the discussions around the adoption of a National Carbon Management Strategy.
4. **Accelerate investments and the disbursement of public funding:** CCS is a costly yet essential technology for decarbonising the cement and lime sectors. Both the disbursement of funds and private financing are essential for kickstarting deep decarbonisation investments.
5. **Design complementary funding mechanisms:** In addition to issuing green bonds to raise funding, it is important to design new financial mechanisms such as Carbon Contracts for Difference, a flexible funding mechanism offering industrial operators a stable carbon price through a contract between the operator and the government. This can help finance operational costs based on actual emissions reductions.
6. **Adopt a clear, ambitious yet feasible Green Public Procurement Plan for construction products**: Implementing a well-designed and ambitious GPP system is a complementary tool that can indirectly compensate decarbonisation costs and stimulate market creation for low-carbon cement, lime and other construction materials.

In conclusion, the pace and effectiveness of the cement and lime industries' transition toward decarbonisation depend not only on the companies' investment plans but also on robust policy support.

Table of Contents

Table of Figures

EPG

Overview of the cement and lime industry in Romania

The cement and lime industries play an important role in Romania's economy. In 2022, the production of non-metallic minerals[1] employed 46,151 people, and accounted for 0.71% of Romania's gross value added (GVA).[2] However, these sectors are also a major source of the country's industrial emissions. In 2022, process emissions from the cement industry totalled 3.72 Mt CO_2, while emissions from fuel combustion in non-metallic minerals amounted to 3.34 Mt CO_2.[3]

In order to remain competitive, cement and lime producers will have to decarbonise deeply and rapidly, in alignment with the provisions set out in the EU's Fit for 55 package. The revised EU Emissions Trading System (EU ETS) Directive is putting pressure on the cement and lime industries to reduce their emissions and boost investments in low-carbon production within the next years. With 2050 only one investment cycle away, these sectors must implement low-carbon production within this decade. Nonetheless, without adequate funding and policy support instruments, in an undesirable scenario it could become more cost-effective for industry to downscale domestic production or relocate facilities to countries with more favourable conditions. Without steady emissions reductions will become more expensive in the long term as free allowances under the ETS will be phased out by 2034.[4]

Romania is the sixth largest cement producer in the European Union after Germany, Italy, Poland, Spain and France.[5] It has seven operational plants for the production of clinker[6] owned by multinational companies:[7] Heidelberg Materials has three plants in Tașca, Fieni and Chișcădaga; Holcim owns two plants in Aleșd and Câmpulung; and CRH, through subsidiary Romcim, operates two plants in Medgidia and Hoghiz.

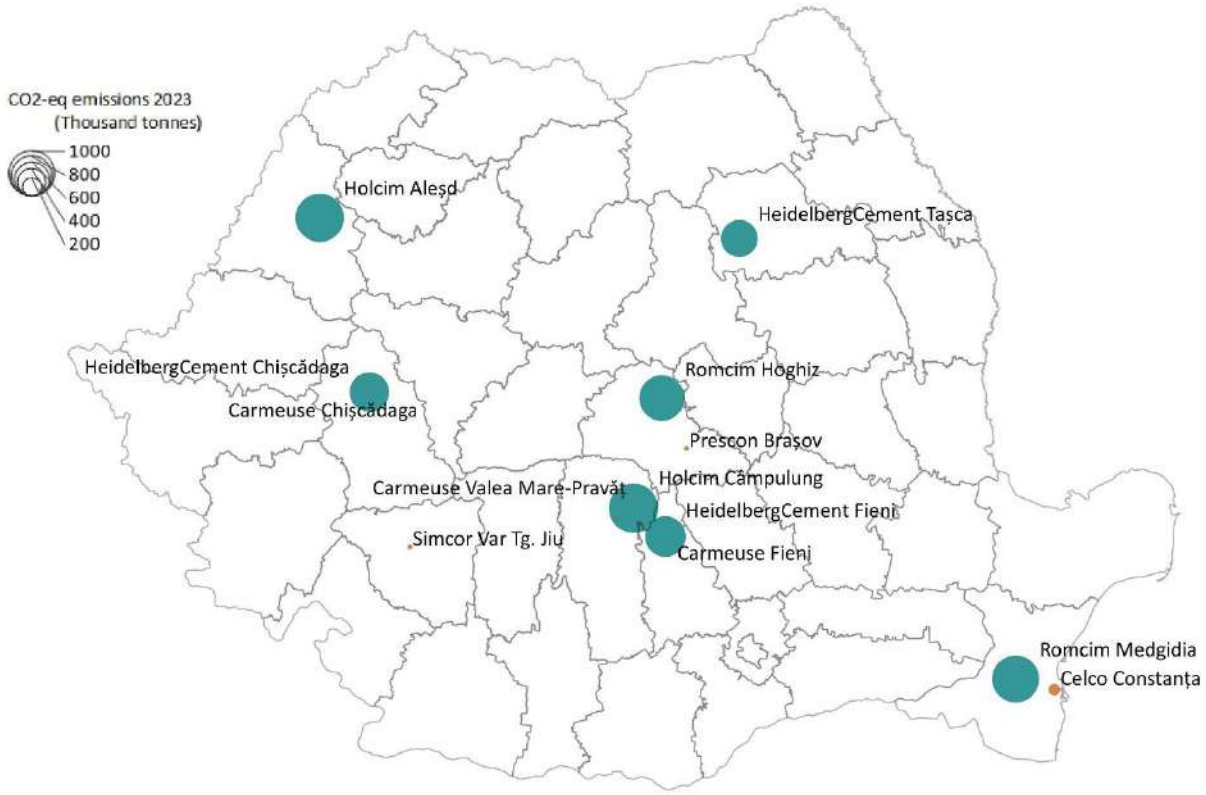
In 2022, national cement production stood at 10.2 million tonnes[8] and clinker production at around 6.6 million tonnes.

Cement plants are usually built near natural resources like limestone quarries, most often co-located with lime producers. Romania has six operational lime plants owned by four companies: Carmeuse, Celco, Simcor Var and Prescon. The Carmeuse Valea Mare Prăvăț plant is located near Holcim Câmpulung, Carmeuse Chișcădaga near Heidelberg Materials Chișcădaga, and Carmeuse Fieni close to Heidelberg Materials Fieni. Celco-Corbu is located

[1] Non-metallic minerals consist mainly of cement, lime and glass, and to a lesser extent gypsum, clay or sand.
[2] National Institute of Statistics
[3] Miu, L., Cătuți, M., Lazăr C., 2023 The way forward for a low-carbon industry in Romania, Energy Policy Group
[4] Miu, L., Bălașa, M., Cătuți, M., Strîmbovschi, S., Lazăr C., 2024 The cost of Romania's Industrial Transition: An assessment of the steel, cement, and chemicals sectors, Energy Policy Group
[5] Statistica, 2022, Production volume of cement in Europe in 2022, by country
[6] This publication focuses on the largest lime and cement producers in Romania equipped with kilns. However, there are also other plants, including grinding stations, in Romania involved in cement production, which are not the subject of this document.
[7] Miu, L., Cătuți, M., Lazăr C., Postoiu C., 2023 Decarbonising Romania's Industry, Energy Policy Group
[8] Agenda Construcțiilor, 2023, CIROM: Productia de ciment a scazut cu 7,5% in primul trimestru, conform INS

closer to Romcim Medgidia, whereas Simcor Var (Târgu Jiu) and Prescon (Brașov) are situated slightly farther from the cement producers (Figure 1).

Figure 1. Map of cement and lime manufacturers in Romania



Source: EPG based on EUTL data[9]

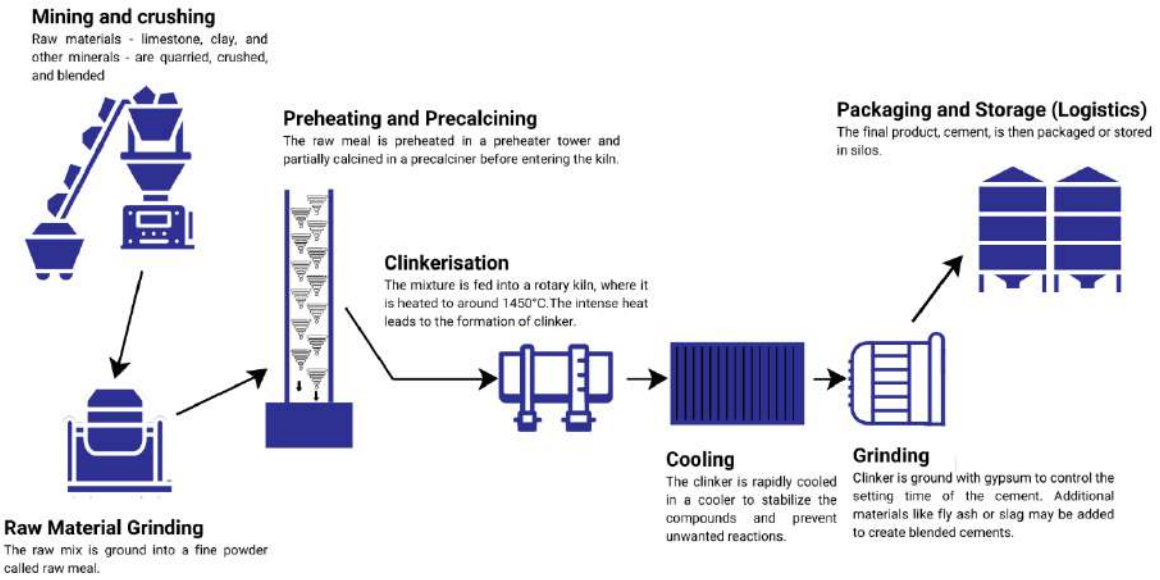
Process emissions generated during cement and lime production

The decarbonisation of cement and lime production is challenging due to the high share of emissions inherent to clinker production (variously termed "unavoidable" or "hard-to-abate" process emissions). Cement is produced from a mixture of limestone, clay and other minerals, which are heated at high temperatures to form clinker (Figure 2). During this process, limestone is converted to clinker in a process known as calcination, which transforms limestone into calcium oxide, or lime.[10] It is during this process most of the CO_2 emissions are released, accounting for 60%-65% of the total cement manufacturing emissions. After cooling the clinker to a temperature between 100°C and 200°C, it is ground into a fine powder with gypsum and other minerals to produce cement.[11]

Lime production is simpler, involving only calcination (Figure 3) a process in which nearly 75% of production emissions are generated.

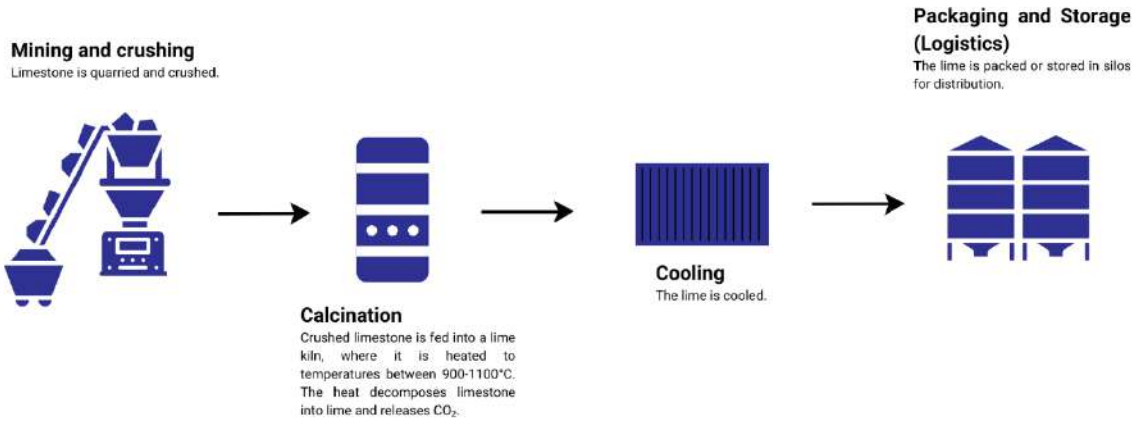
[9] Because lime plants have lower production capacities and, consequently, lower emissions compared to cement plants, they are less visible on the map.
[10] Passaro, F., 2023. Concrete policies to underpin the cement transition, Climate Bonds Initiative
[11] Ibidem

Figure 2. Cement production process



Source: Energy Policy Group

Figure 3. Lime production process



Source: Energy Policy Group

The remaining emissions (about 30%) come from the combustion in the kiln of a mix of fossil fuels, such as natural gas and pet coke, waste and biomass.[12] The high operational temperatures required by cement (around 1450°C) and lime (between 900-1100°C) production kilns mean that fuels with high calorific value are required. Many cement producers have progressively substituted fossil fuels for alternative combustion fuels, most prominently waste, and some of them already have kilns that can replace 100% of fossil fuels with waste and biomass.

Due to this high share of process emissions, decarbonisation of the calcination process is difficult without either the capture of CO_2 emissions and their permanent storage or the implementation of highly innovative technologies based on alternative binders or advanced recycling technologies for the recovered cement binder.

Cement producers are major consumers of electricity, gas, coal and pet coke, while lime producers primarily use electricity, gas and biomass, but in smaller amounts compared to cement plants, resulting in a lower impact on emissions.

[12]Around 10% are indirect emissions related to electricity consumption. See European Commission: Joint Research Centre and Marmier, 2023 A., Decarbonisation options for the cement industry, Publications Office of the European Union

Emissions and energy consumption of cement and lime plants

The European Union's climate and energy policies, most prominently the EU ETS, have driven the deep reduction of emissions across the covered sectors. ETS emissions in 2023 were 47% lower than in 2005.[13] Deemed at risk of carbon leakage, the carbon price pressure has been less intense in the cement industry. In fact, between 2008 and 2012, industrial sectors, including cement, received more free emission allowances than their total emissions, which enabled the sector to sell the surplus on the market, for over 8 billion euros in profit.[14] Since 2013, the ETS has slightly reduced free allocations, but cement manufacturers still generally receive more free allowances. Given that the European cement industry is among the main emitters, accounting for around 4% of the EU's CO_2 emissions,[15] the coming years will be crucial for transforming this industry and responding to the gradual phaseout of free allocation and the gradual reduction of the ETS cap.

Between 2019 and 2023, the emissions covered by the ETS in Romania decreased by 35%, with the industrial sector showing the largest reduction (37%).[16] [17] However, emissions from the lime and cement sectors have increased by 24% in 2023 compared to 2013. A quarter of Romania's total ETS emissions (24%) were generated by cement and lime production in 2023.[18] Despite technological and energy improvements – such as replacing wet kilns with dry kilns, adding pre-calcination units, and reducing fossil fuel use through waste co-incineration – the rise in emissions over the past decade is attributed to the expansion of cement and lime production capacities. For instance, in 2023, Holcim increased production capacity at its Câmpulung cement plant by 20%.[19]

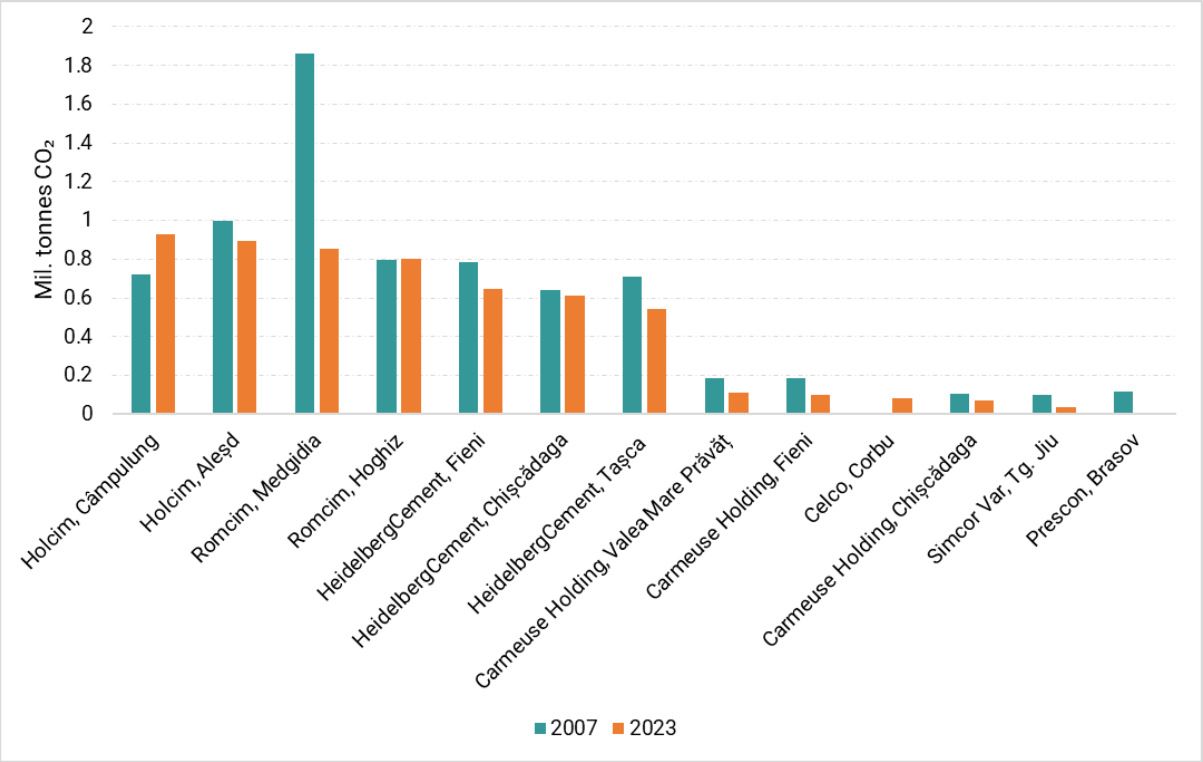
In 2023, the emissions from the Romanian cement plants varied between 545,740 tonnes (Heidelberg Materials Tașca) and 931,733 tonnes of CO_2-eq (Holcim Câmpulung) (Figure 4), generally driven by differences in production volumes.

Emissions from lime plants are significantly lower compared to those from cement plants due to the production volumes. Since 2007, lime plants have slightly reduced their emissions (Figure 4). In 2023, the highest emissions were recorded by Carmeuse Valea Mare Prăvăț, with 111,919 tonnes of CO_2-eq, while the lowest emitters were Carmeuse Chișcădaga (73,096 tonnes), Celco Corbu (81,793 tonnes), Simcor Var (36,676 tonnes) and Prescon with only 943

[13] Although mainly driven by emissions reductions in the power sector where free allocations were phased out earlier, fully exposing operators to the carbon price.
[14] Scott, E., Tamellini, L., 2024 A beginner's guide to the EU's Emissions Trading System, LIFE ETX EU ETS 101
[15] European Commission: Joint Research Centre and Marmier, 2023 A., Decarbonisation options for the cement industry, Publications Office of the European Union
[16] European Commission, 2024 Country Report – Romania
[17] The reduction in emissions is partly attributed to the suspension or partial suspension of production in certain industries (such as fertilisers), which were affected by high gas prices, as was the case with Azomureș. See Economedia, 2023, Azomureș reia producția de îngrășăminte la 50% din capacitate, din octombrie
[18] European Commission, 2024 Country Report – Romania
[19] Business Magazin, 2023 Elveţienii de la Holcim extind cu 20% capacitatea de producţie a fabricii de ciment din Campulung, după investiţii de peste 25 mil. euro

tonnes of CO_2-eq (this is why the emissions of the latter are not visible in Figure 4). Celco Corbu emissions are not available for 2007 because the lime plant was only opened in 2008.

Figure 4. CO_2 emissions generated by cement and lime plants in Romania 2007 vs. 2023



Source: Eurostat

Technologies and pathways to decarbonise the cement and lime industries

By 2030, about 30% of today's cement production plants in the EU will reach the end of their lifetimes,[20] thus creating an important window of opportunity for investing in low-carbon technologies and production pathways. This requires a multi-pronged approach, including energy efficiency improvements and waste heat recovery, the use of alternative materials, fuel switching, and the capture and utilisation or storage of process emissions.

According to CEMBUREAU's Net Zero Roadmap[21], European cement production, which generated 657kg CO_2/t of cement in 2021, has the potential to reach climate neutrality by 2050. This could even extend to becoming carbon-negative through the use of CCUS and bioenergy with CCS (BECCS).[22]

Energy efficiency and material substitution

Energy efficiency

European cement producers have made various energy efficiency investments that enabled the industry to reach a thermal efficiency[23] level of 70-80%, mostly due to the switch from wet to dry kilns.[24] Further operational efficiency improvements are likely to be challenging. However, thermal efficiency in limestone calcination and clinker cooling kilns can be still improved through various upgrades, for example by converting preheater and other kiln types into precalciner kilns, and utilising heat from the cooler to help meet electricity demands.[25] Most modern dry kilns are equipped with preheater[26] units and many also include precalciner[27] kilns, which are advanced versions of preheater kilns. In 2014, 4 out of 9 dry kilns in Romania were equipped with precalciner units,[28] so there is still potential to extend the use of these technologies. Waste Heat Recovery (WHR) is also crucial for capturing excess heat from kiln

[20] Witecka, W., Hauser, P., Sartor, O., 2020. Breakthrough Strategies for Climate-Neutral Industry in Europe, Agora Energiewende and Wuppertal Institute
[21] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap
[22] Another solution could be recarbonating the concrete by absorbing CO2 from the atmosphere. Pilot projects are underway for recarbonation, the process by which cement or lime products absorb CO2 from the atmosphere over time, acting as CO_2 sinks. Once used in construction, the lime in concrete gradually reacts with CO_2 in the surrounding air, forming calcium carbonate and effectively absorbing atmospheric CO2. According to claims from industry, by 2050, recarbonation could reduce CO_2 emissions in cement production by 60 kg/t of cement and is being considered both by cement and more specifically lime producers, e.g. Celco Corbu. However, accounting issues remain and such solutions do not preclude the need to decarbonise existing production.
[23] Thermal efficiency refers to how effectively the heat energy is utilised during the manufacturing process, particularly in the clinker production phase.
[24] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap
[25] Ibidem
[26] Preheaters improve heat transfer efficiency by using hot exhaust gases to preheat the raw material.
[27] Precalciners are positioned between the preheater and kiln, enabling partial fuel combustion, reducing the thermal load on the kiln and improving heat distribution.
[28] CIROM | Istoria cimentului

exhaust gases to generate electricity, as demonstrated by the Rohrdorf plant in Germany.[29] Here waste heat is converted to electricity, covering roughly 30% of the plant's energy needs.

In Romania, in addition to using modern dry kilns equipped with precalciner units, for instance, Holcim Aleșd and Heidelberg Materials Fieni have also implemented WHR projects since 2012 and 2015. However, there is significant potential for further adoption, especially by major energy consumers. Further reductions are also possible through electrical energy efficiency improvements and the use of renewable electricity, but these are overall relatively minor (29 kg CO_2/tonne of cement by 2050).

Operational energy efficiency can be further enhanced by adopting digital and AI-driven control systems to optimise kiln performance. Such systems could boost operational efficiency by 10-20%,[30] minimising energy waste by constantly adjusting key variables, such as fuel feed and raw material flow, in real time.

Material substitution

Material substitution in cement production involves replacing a part of the traditional raw materials (like limestone) or clinker with alternative low-carbon materials. The reduction of the clinker-to-cement ratio is one of the key levers in decarbonising cement production, having the potential to reduce emissions by 137 kg CO_2 per tonne of cement until 2050.[31] In Europe, the clinker-to-cement ratio (defined as the share of clinker in the final cement product) was 77% in 2021,[32] with fly ash (a waste product from coal-fired power plants) and blast furnace slag (a waste product from steel blast furnaces),[33] being the main clinker alternatives (termed supplementary cementitious materials, or SCMs). Using SCMs reduces the need for clinker production, with the associated process emissions. Compared to other regions of the world, the clinker-to-cement ratio in the EU is similar to that produced in China or India, which have access to a significant amount of clinker substitutes, however in the United States the ratio is higher. [34]

As the steel and energy sectors decarbonise, the availability of blast furnace slag and fly ash is expected to decline. Therefore, identifying alternative SCMs is a priority for the cement industry. As the European cement industry represented by CEMBUREAU aims to achieve a clinker-to-cement ratio of 60% by 2050, it stimulates the search for new substitutes such as so-called alternative decarbonated raw materials (ADRM) like calcined clay, recycled concrete fines[35] or biomass ash. By 2050, ADRMs are expected to reduce CO_2 emissions from clinker production by 25 kg/tonne of cement, by avoiding emissions-intensive clinker production and high associated process temperatures.

In addition to reducing the share of clinker in cement, material substitution can also occur further downstream, in the production of concrete from cement. Here, recycled concrete

[29] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap
[30] Miu, L., Cătuți, M., Lazăr C., 2023 The way forward for a low-carbon industry in Romania, Energy Policy Group
[31] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap
[32] Ibidem
[33] Miu, L., Cătuți, M., Lazăr C., 2023 The way forward for a low-carbon industry in Romania, Energy Policy Group
[34] Gangotra, A., Kennedy, K., Carlsen, C., 2024 The US needs to lower cement emissions, World Resources Institute
[35] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap

sourced from demolition projects can be used as an aggregate in new concrete or in applications such as road construction. This process helps reduce reliance on primary resources and minimises landfill waste but is challenged by the overall low rates of recycling of construction and demolition waste in Europe.[36]

The use of alternative materials downstream such as wood or reducing the quantity of concrete through optimised building design should also be taken into consideration in any system-level decarbonisation planning. There is also the possibility of using alternative materials downstream, such as wood, particularly engineered wood products like cross-laminated timber (CLT) or massive timber. CLT is gaining popularity as a viable, low-carbon alternative to traditional building materials such as concrete and steel, especially in Europe which, as of 2017, accounted for around 70% of the global CLT production.[37]

Fuel switching

Process emissions account for two-thirds of cement production emissions and around three-quarters of lime production emissions. The rest stem mainly from fuel combustion. In 2022, emissions from fuel combustion in Romania's cement, lime, and glass manufacturing sectors amounted to 3.34 Mt CO_2.[38] Because CO_2 emissions generated by fuel combustion in these industries must also be accounted for, these emissions can be reduced by replacing fossil fuels with low-carbon alternatives for heat production.

Traditionally, the European cement industry used fossil fuels (e.g., coal and petcoke) for combustion, but as of 2021 had managed to replace 53% of its energy needs with alternative waste and biowaste fuels (made up of biomass and its byproducts, including municipal waste).[39] This use of waste materials, known as co-processing, both reduces fossil fuel consumption and increases circularity.[40] All Romanian cement producers use co-processing, including pre-treating at high temperatures to remove any toxic or harmful waste components.[41]

Biomass and waste-derived fuels, therefore, play an important role as a substitute for fossil fuels in combustion processes, and could reduce cement production emissions by 47 kg CO_2/t of cement by 2050. They can also serve as a replacement for clinker with biomass ash.[42] CEMBUREAU's ambition is to achieve a share of 60% alternative fuels in cement production by 2030, increasing to 95% by 2050 (with shares of 30% and 50% of biowaste, respectively). These targets are also adopted by certain Romanian cement producers.[43]

---

[36] Passaro, F., 2023. Concrete policies to underpin the cement transition, Climate Bonds Initiative
[37] Younis, A., Dodoo A., 2022 Cross-laminated timber for building construction: A life-cycle-assessment overview, ScienceDirect
[38] Miu, L., Cătuți, M., Lazăr C., 2023 The way forward for a low-carbon industry in Romania, Energy Policy Group
[39] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap
[40] European Circular Economy Stakeholder Platform, 2024 Co-processing of waste in EU cement plants: status and prospects
[41] Co-processing can release harmful emissions if not properly controlled, while improper handling or storage of waste materials before use may lead to leaks that could contaminate local ecosystems
[42] Kusuma, R., Hiremath, R., Rajesh P., et al., 2022 Sustainable transition towards biomass-based cement industry, Science Direct
[43] Business Review, 2023 Holcim Romania, under a new visual identity, adopts an integrated decarbonization model and launches ECOPlanet PLUS, a high-performance, 30% less emission of CO2 additive cement

Electricity and hydrogen are other alternative fuels being explored as a substitute for fossil fuels in cement and lime production. Although relatively novel, the electrification of certain types of cement production kilns has been explored, for example as part of the LEILAC project, and is mostly challenged by the extremely high temperatures required in cement and lime production. The use of hydrogen for heat production is technically possible but challenged by the complexity of required infrastructure and operational costs of hydrogen use, as well as some potential technical limitations.

Carbon capture, utilisation and/or storage (CCUS)

Advancements in energy efficiency, material substitution, and the use of lower-carbon fuels could reduce CO_2 emissions from lime and cement production by 25% - 40%. However, a significant proportion of CO_2 emissions are inherent to the calcination process and cannot be reduced, and must be avoided through capture to fully decarbonise these sectors.

Capturing CO_2 emissions involves separating CO_2 from the waste gases of an industrial facility. As an emissions avoidance method, it is most applicable to the cement and lime industries, but also for fertiliser production and oil refining. Once captured, the CO_2 is purified and transported by pipeline, road, rail, ship, or barge to a location for utilization (CCU) or permanent geological storage (CCS) in depleted hydrocarbon fields or other sedimentary formations.[44] With CCU, captured CO_2 can be transformed into products such as synthetic fuels or plastics, which can replace conventional counterparts in sectors where few alternatives are available, such as heavy-duty transport.

For the cement and lime industries, CCUS projects have been emerging at an accelerating rate in Europe.[45] The completion of the Brevik CCS project in Norway, the world's first industrial carbon capture facility in a cement plant, is scheduled for late 2024. Once operational, it will capture and store 50% of the plant's emissions.[46] By 2030, over 30 projects across the EU are expected to be operational, with the capacity to permanently store up to 12 million tonnes of CO_2 per year.[47]

The high investment costs for CCS projects are estimated between 300 million and 900 million euros per plant,[48] are a barrier to large-scale deployment. These costs are primarily for the capture unit and would thus be borne by cement and/or lime producers. This may require some level of public support. Advanced CCS projects in Europe, including the Brevik capture plant have benefitted from significant public funding. The most important funding mechanism at the EU level for CCUS projects - the Innovation Fund - has enabled CCUS projects for cement, lime and chemicals sectors in many EU countries. Romania, however, is not among them.

Beyond capture, regulatory clarity and political will are needed to ensure the development of CO_2 transport and storage infrastructure. Romania has significant potential for geological CO_2 storage capacities, with an estimated 514 Mt in onshore hydrocarbon deposits alone, and

---

[44] Miu, L., Cătuți, M., Lazăr C., 2023 The way forward for a low-carbon industry in Romania, Energy Policy Group
[45] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap
[46] Heidelberg Materials, 2023 The future of construction: Heidelberg Materials launches evoZero®, the world's first carbon captured net-zero cement
[47] Euractiv, 2024 The next European Commission must champion industrial decarbonisation
[48] Miu, L., Bălașa, M., Cătuți, M., Strîmbovschi, S., Lazăr C., 2024 The cost of Romania's Industrial Transition: An assessment of the steel, cement, and chemicals sectors, Energy Policy Group

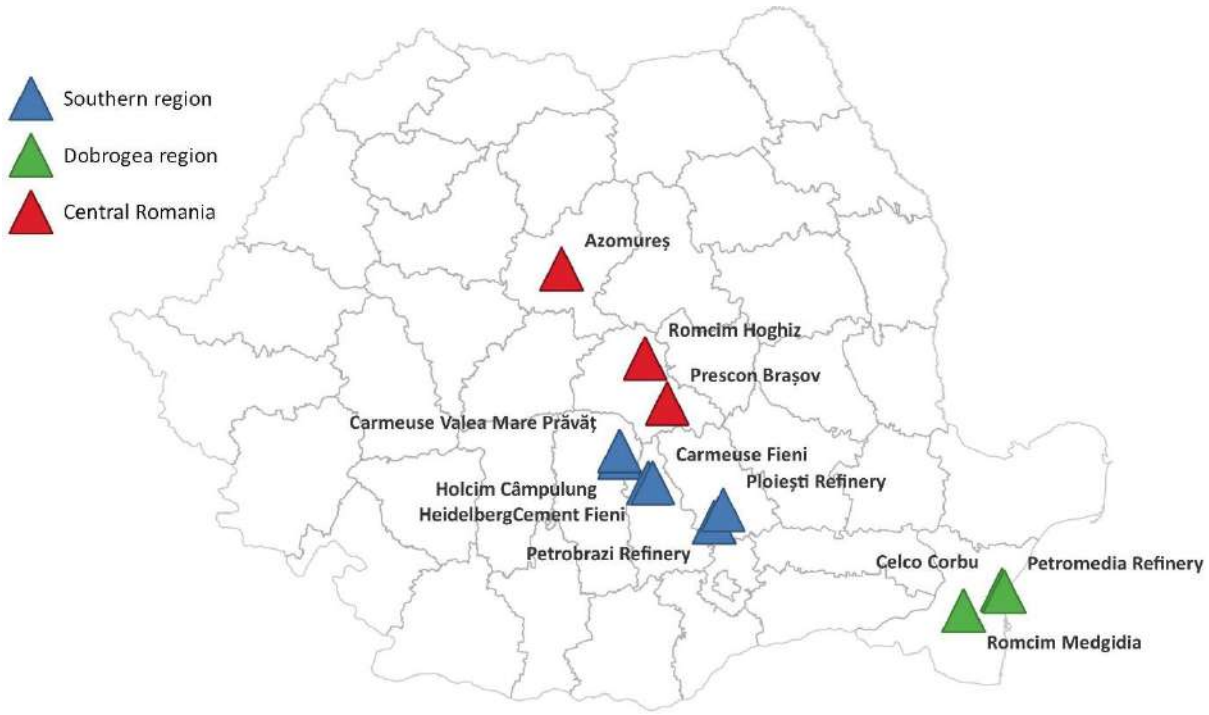
likely more in deep saline aquifers.[49] It will also need to develop 9 Mt of annual CO_2 injection capacity by 2030, as per the Net Zero Industry Act.[50] Although Romania's NECP does commit to elaborating a National Carbon Management Strategy, deploy CO_2 transport infrastructure and co-finance at least 3 CCUS projects by 2027,[51] the long lead times of CCS projects mean that Romania could potentially have its first CCS project operational no earlier than 2033. This means that cement and lime producers will be exposed to the full cost of their emissions under the revised EU ETS while trying to make major investments in emission capture technologies.

The costs of CO_2 transport and storage depend on the particularities of Romanian CO_2 transport and storage infrastructure but are likely to require state intervention for planning and financing. To increase the efficiency and feasibility of CCUS projects, potential industrial users who will require transport and storage access must be mapped, and a cluster approach can be applied to connect multiple emitters to common infrastructure, thus reducing costs and improving liability sharing. The industries in Romania most likely to require CCUS technologies for decarbonisation are the production of cement, lime, and fertilisers, chemicals and petrochemicals. Three such clusters can be pinpointed:

1. **Southern Romania** (Argeș, Prahova and Dâmbovița counties), including cement and lime plants at Câmpulung and Fieni, and the OMV Petrom Petrobrazi and Petrotel Lukoil refineries;
2. The **Dobrogea region** along the Black Sea coast, including the Romcim cement plant at Medgidia, the Celco lime plant at Corbu, and the Rompetrol Petromidia refinery at Năvodari. This region is also relevant due to its significant potential for the production of renewable electricity and green hydrogen;
3. The third potential hub is in **central Romania** (Mureș and Brașov counties), which could connect the Azomureș fertiliser company Romcim Hoghiz and the lime company Prescon.

[49] Miu, L., Cătuți, M., Lazăr C., Postoiu C., 2023 Decarbonising Romania's Industry, Energy Policy Group
[50] European Commission, 2024 Romania - Final updated NECP 2021-2030 (submitted in 2024)
[51] Ibidem

Figure 5. Map of industrial clusters for CCUS



Source: Energy Policy Group

While such industrial clusters could serve to reduce infrastructure costs, some emitters, such as the cement and lime plants at Aleșd, Tașca and Chișcădaga, are relatively isolated from other large industrial sites. These industrial sites will require special consideration in the planning of future CO_2 transport networks in Romania, allowing them to either connect to pipeline networks at a later stage or to access non-pipeline CO_2 transport methods, such as road or rail transport.

Without regulatory clarity, adequate funding to incentivise the deployment of CCS/CCUS technologies, and in the absence of state accountability for developing CO_2 infrastructure and mapping of storage sites, the cement, lime, refining and chemical industries risk being unable to decarbonise their production. This could lead to losses in competitiveness, especially after 2034, when CO_2 allowances are phased out.

Therefore, the coming years will be crucial for the Romanian government, transport operators and energy-intensive industries to collaborate on developing CO_2 transport and storage infrastructure. Given the expected growth in low-carbon electricity consumption in the cement and lime sectors, along with the high energy demand of CO_2 capture processes, the expansion of renewable energy installations will also be essential. This expansion will place additional pressure on the electricity transmission and distribution network to upgrade and expand.

Solutions for implementing decarbonisation pathways and increasing the competitiveness of the industry

With an increasingly urgent decarbonisation timeline for cement and lime production in Romania, it will be essential that both the government and the industry take concrete actions to implement low-carbon technologies and processes. This includes de-risking investment through the creation of lead markets, the deployment of infrastructure, and leveraging EU and national funding to overcome initial high costs.

As a country that lacks the fiscal space to implement significant state aid programs for industrial decarbonisation, Romania needs to accelerate the absorption rate of EU funds, design targeted funding schemes for decarbonisation, and explore other potential solutions, such as Green Public Procurement[52] to drive market creation for low-carbon construction materials, and Carbon Contracts for Difference[53] (CCfD) schemes, which can help finance the operational costs of low-carbon cement and lime production.

Despite these clear needs and a projected increase in cement and lime demand for planned infrastructure projects, these sectors receive limited policy and funding attention. Sectoral decarbonisation plans, while expected to be developed from 2025 onwards, [54] are currently mostly absent. Long-term certainty regarding the governmental commitment to supporting cement and lime decarbonisation is key for starting projects at this stage.

Romania's cement and lime industries have mainly received state support for renewable energy via the EU Modernisation Fund and under Romania's National Plan for Recovery and Resilience. Neither scheme has addressed high-cost measures, such as CCUS (although Romania does commit to co-finance three such projects under the NECP, a crucial starting point).[55] In the latest state aid schemes for heavy industry, comprising over €2 billion for 2025-2032 (with €1 billion specifically dedicated to decarbonisation), the Romanian government has committed to primarily finance projects aimed at decarbonising industrial production processes through electrification, the use of renewable energy, green hydrogen-based fuels or energy efficiency projects. However, nothing has been adopted to support the purchase of costly low-carbon technologies for the cement industry.[56]

With the slow absorption and delayed disbursement of EU funds, limited national funding for decarbonisation of the lime and cement sectors, and the anticipated rise in EU carbon prices

[52] Strîmbovschi, S., Miu, L., Cătuți, M., Lazăr, C., 2024 Green Public Procurement in Romania: A key tool to enable low-carbon industrial production, Energy Policy Group
[53] Miu, L., Bălașa, M., Cătuți, M., Strîmbovschi, S., Lazăr C., 2024 The cost of Romania's Industrial Transition: An assessment of the steel, cement, and chemicals sectors, Energy Policy Group
[54] Financial Intelligence, 2024 Florin Spătaru: România a declarat deschis că se alătură inițiativei de dezvoltare industrială
[55] European Commission, 2024 Romania - Final updated NECP 2021-2030 (submitted in 2024)

[56] Government of Romania, 2024 Emergency Ordinance for the establishment of the National Program for the Support of Large Industry

– together with declining ETS revenues (Innovation Fund and Modernisation Fund) after 2034 - the government long-term support schemes such as Carbon Contracts for Difference could provide certainty and spread out the fiscal effort. The CCfD scheme provides a flexible funding mechanism, offering industrial operators a stable carbon price, dynamically linked to actual emissions reductions.[57]

Demand-side market signals are equally important. Romania's booming construction sector, including significant public construction commitments,[58,59] can serve to launch essential market creation instruments for incentivising low-carbon cement and lime production. The demand for low-carbon construction products is expected to grow, bolstered by legislative measures such as the revised Energy Performance of Buildings Directive (EPBD), the forthcoming Construction Products Regulation (CPR) and the anticipated revision of the Public Procurement Directive. However, Romania will also need to develop its own policy instruments for lead market creation, including clear standards and labels, robust life-cycle emission calculation tools, and a national Green Public Procurement (GPP) system.

[57] Miu, L., Bălașa, M., Cătuți, M., Strîmbovschi, S., Lazăr C., 2024 The cost of Romania's Industrial Transition: An assessment of the steel, cement, and chemicals sectors, Energy Policy Group
[58] Legislative portal, 2022 The National Strategy for Circular Economy
[59] Economica.net, 2021 România va trebui să aloce anual 2% din PIB pentru cofinanțarea proiectelor de infrastructură - proiect MTI

Key recommendations for decarbonising cement and lime production in Romania

There is no doubt that the cement and lime sectors will continue to play a key role in the country's development, given Romania's planned investments until 2030 in both infrastructure and buildings. As two hard-to-abate sectors, they face unique challenges that require high-level government commitment and clarity in terms of regulations, funding mechanisms and policy support instruments. To turn this transition into an opportunity, both industry and government will need to demonstrate that each side is committed to implementing the best available solutions to achieve deep emissions reductions. The coming years are therefore crucial for implementing the necessary solutions, policies and investments to take advantage of this transition and contribute to a strong, sustainable and competitive economy.

Several actions are necessary to provide targeted support for the complex transformation plans that cement and lime producers will need to implement over the next decade to remain competitive and keep their facilities operational in Romania:

1. **Deploy new renewable energy capacities**. The decarbonisation of the cement and lime sectors will require substantial amounts of clean energy to replace fossil fuels, particularly for electricity consumption and carbon capture technologies. In the EU, energy demand is projected to grow by two or even six times, from 20TWh in 2021 to a range between 47 TWh and 113 TWh in 2050, depending on the specific decarbonisation measures and CCS technologies implemented.[60] The Ministry of Energy, the National Authority for Energy Regulation, and the Transmission System Operator (Transelectrica) must therefore account for potential future sources of renewable electricity demand in their network and renewable capacity planning.
2. **Accelerate CO_2 transport and storage infrastructure development.** Speed up planning and investment in CO_2 transport and storage infrastructure by identifying potential industrial carbon capture hubs, removing regulatory barriers and streamlining permitting procedures, unlocking funding, and designating transport operators. The National Agency for Mineral Resources and the National Regulatory Authority for Energy should amend or establish legislation for CO_2 transport and storage.
3. **Strengthen the cooperation between the cement and lime industries and hydrocarbon producers**: Romania's significant potential for geological CO_2 storage capacities and its obligation to capture and store over 9 Mt of CO_2 annually until 2030 requires an accelerated dialogue between oil and gas operators and the industries that will rely heavily on CCS technologies (including the production of cement, lime, fertilisers and oil refining). The dialogue is particularly relevant given the discussions around the adoption of a National Carbon Management Strategy.
4. **Accelerate investments and the disbursement of public funding through the Modernisation Fund and other national funding for CCS**. Both the disbursement of public funds and private financing are essential to kick-start deep decarbonisation

[60] CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap

investments. The Ministry of Economy, as the contact point for the Innovation Fund, should intensify its dialogue with industry stakeholders to increase Romania's success rate in accessing the Innovation Fund.

5. **Design complementary funding mechanisms**: In addition to issuing green bonds to raise funds, the Ministry of Finance, in collaboration with the Ministries of Energy and Economy, should develop additional financial tools such as Carbon Contracts for Difference - a flexible funding mechanism that would provide industrial operators a stable carbon price through a contract between the operator and the government. Such a mechanism can help finance operational costs based on actual emissions reductions and should be selected based on a competitive bidding process.
6. **Adopt a clear, ambitious yet feasible Green Public Procurement Plan for construction products:** Implementing a well-designed and ambitious GPP system is a complementary tool that can indirectly compensate decarbonisation costs and stimulate the creation of low-carbon markets. To harness this mechanism, the Ministry of Environment together with the National Public Procurement Agency must speed the adoption and implementation of the GPP Plan. In collaboration with competent institutions such as the Romanian Association for Standardisation and the Authority for the Digitalisation of Romania, essential tools for lead market creation should be developed, including clear standards and labels for low-carbon/green products and robust life-cycle emission calculation tools.

Bibliography

Agenda Construcțiilor, 2023 CIROM: Productia de ciment a scazut cu 7,5% in primul trimestru, conform INS

Business Magazin, 2023 Elveţienii de la Holcim extind cu 20% capacitatea de producţie a fabricii de ciment din Campulung, după investiţii de peste 25 mil. euro

Business Review, 2023 Holcim Romania, under a new visual identity, adopts an integrated decarbonization model and launches ECOPlanet PLUS, a high-performance, 30% less emission of CO2 additive cement

Celco, 2024 Recarbonatare: BCA-ul CELCO absoarbe carbonul din atmosferă

CEMBUREAU, 2024, From Ambition to Deployment – 2050 roadmap

Economedia, 2023, Azomureș reia producția de îngrășăminte la 50% din capacitate, din octombrie

Economica.net, 2021 România va trebui să aloce anual 2% din PIB pentru cofinanțarea proiectelor de infrastructură - proiect MTI

Euractiv, 2024 The next European Commission must champion industrial decarbonisation

European Circular Economy Stakeholder Platform, 2024 Co-processing of waste in EU cement plants: status and prospects

European Circular Economy Stakeholder Platform, 2024, Cement recarbonation

European Commission, 2024 Country Report – Romania

European Commission, 2024 Romania - Final updated NECP 2021-2030 (submitted in 2024)

European Commission: Joint Research Centre and Marmier, 2023 A., Decarbonisation options for the cement industry, Publications Office of the European Union

Financial Intelligence, 2024 Florin Spătaru: România a declarat deschis că se alătură inițiativei de dezvoltare industrială

Gangotra, A., Kennedy, K., Carlsen, C., 2024 The US needs to lower cement emissions, World Resources Institute

Government of Romania, 2024 Emergency Ordinance for the establishment of the National Program for the Support of Large Industry

Heidelberg Materials, 2023 The future of construction: Heidelberg Materials launches evoZero®, the world's first carbon captured net-zero cement

Kusuma, R., Hiremath, R., Rajesh P., et al., 2022 Sustainable transition towards biomass-based cement industry, Science Direct

Legislative portal, 2022 The National Strategy for Circular Economy

Miu, L., Bălașa, M., Cătuți, M., Strîmbovschi, S., Lazăr C., 2024 The cost of Romania's Industrial Transition: An assessment of the steel, cement, and chemicals sectors, Energy Policy Group

Miu, L., Cătuți, M., Lazăr C., 2023 The way forward for a low-carbon industry in Romania, Energy Policy Group

Miu, L., Cătuți, M., Lazăr C., Postoiu C., 2023 Decarbonising Romania's Industry, Energy Policy Group

Moul, R., 2024 New Cement-Free Concrete Could Slash Construction Industry Carbon Emissions, IFL Science

Passaro, F., 2023. Concrete policies to underpin the cement transition, Climate Bonds Initiative

Rolfing, H., Batilliet, E., Sartor, O., Westhof, M., Metz J., 2024 Creating markets for climate-friendly basic materials, Agora Industry

Scott, E., Tamellini, L., 2024 A beginner's guide to the EU's Emissions Trading System, LIFE ETX EU ETS 101

Statistica, 2022, Production volume of cement in Europe in 2022, by country

Strîmbovschi, S., Miu, L., Cătuți, M., Lazăr, C., 2024 Green Public Procurement in Romania: A key tool to enable low-carbon industrial production, Energy Policy Group

Witecka, W., Hauser, P., Sartor, O., 2020. Breakthrough Strategies for Climate-Neutral Industry in Europe, Agora Energiewende and Wuppertal Institute

EPG

ISSN 3061-3515

EPG is an independent think-tank specialising in energy and climate policy, focusing on the decarbonisation of the Romanian and Central and Southeastern European economies. Founded in 2014, EPG operates as a research institute primarily financed through competitive research grants. Its research aims to promote a constructive, evidence-based dialogue on decarbonisation and economic transformation among decision-makers and the public, both regionally and globally.

Scan for more publications

www.enpg.ro