# IDENTIFICATION OF THE POTENTIAL TO REDUCE GREENHOUSE GASES IN THE ROMANIA ECONOMY

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***Abstract.*** *This paper aims to analyze the economic sectors and the ways in which circular models can be introduced, for decarbonization and increasing economic competitiveness in Romania. The purpose of this study is to identify the strategies, the effective circular measures that can be implemented and to evaluate the potential of their implementation, given that the Romanian economy is still going through a structural transformation. These strategies aim at more efficient productions and uses, extending the lifetime of the product and component parts, and optimal use of materials. The decarbonization of the country to achieve the "Net Zero" objective, which means achieving a balance between the amount of emissions produced and those removed from the atmosphere, can be achieved through the transition to a circular economy and will result in global economic benefits, through the circular interventions implemented, through the application of a regenerative production, the elimination of waste and the valorization of waste. The long-term sustainability of the economy, and the ability to provide products and services, can be achieved through drastic changes in the way we produce and consume to meet the goals of the Paris Agreement.*
***Keywords:*** *circular economy, greenhouse gases emissions, decarbonization, pontential, climate goals*
***JEL:*** *Q01, Q10, Q53, Q54, Q56*
***UDC:*** *502.15(498)*

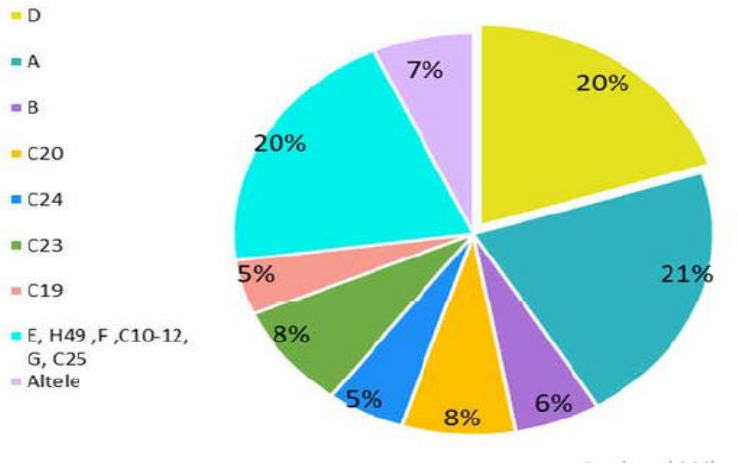
**Introduction.** The transition from the linear to the circular economy involves a major transformation of current production and consumption patterns that will have a significant impact on the economy, the environment and society. Understanding these effects is important for decision makers involved in developing future policies in the field. In recent years, the concept of the circular economy has attracted particular interest. The circular economy has been presented in various studies as a concept with promising prospects for generating profit in new ways, capable of ensuring the achievement of the European objectives of sustainable economic development in the restrictive conditions of the environment.

Although the circular economy has a multitude of definitions of the concept, the aspects they measure are often varied, and the way to implement the circular

model in the activity of companies is not clear. There is also uncertainty regarding the sectors and processes that fall under the scope of the circular economy.
Moreover, this field of research is still in its initial phase, and therefore the applied quantitative models are sometimes based on simplifications and assumptions that could be challenged. Thus, it could be questioned whether circular models sufficiently take into account many challenges related to the transformation of linear structures and models that have existed for several decades in the economy.

**Circular economy actions within the production chain.** The analysis and understanding of the link between climate change mitigation and circularity cannot be independent from understanding the structural characteristics of the final use of products and massive GHG emissions and high energy consumption in some of the economic sectors. The intensity of GHG emissions in 2023 has been reduced to almost half compared to 1990, at a faster pace than the EU average, which suggests the decoupling of the Romanian economy from carbon dioxide emissions, although the reductions can be considered in many situations as unintended consequences of some economic restructuring. The distribution of greenhouse gas emissions by main economic activities in 2023 is presented as in Figure 1. The largest share of GHG emissions belongs to the activities of production and supply of electricity and thermal energy, gas, hot water and air conditioning (CAEN D), followed by agriculture, forestry and fishing activities (CAEN A).

Figure 1. **Share of emissions from polluting sectors**




*Source: INS (2023)*

All these subcategories of the main polluting sectors of the economy, representing 91% of the total national GES (Table 1), in Romania the package of circular measures was carried out as in Table 2.

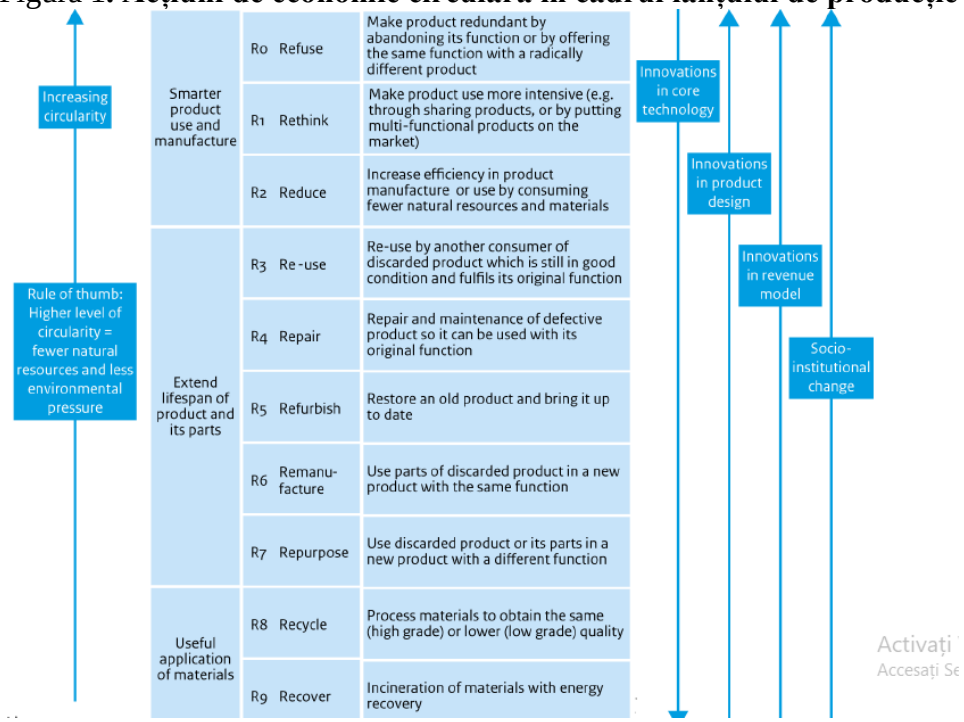
Tabel 2. **List of economic activities that produce GHG (CAEN code)**

| **Categories of activity** | **The name of the categories of activities** |
|---|---|
| A | Agriculture, forestry and fishing |
| B | Extractive industry |
| C10-12 | Manufacture of food products, beverages and tobacco products |
| C19 | Manufacture of coke oven products and products obtained from crude oil processing |
| C20 | Manufacture of chemical substances and products |
| C23 | Manufacture of other products from non-metallic minerals |
| C24 | Metallurgical industry |
| C25 | The industry of metal constructions and metal products, excluding machinery, equipment and installations |
| D | Production and supply of electricity and thermal energy, gas, hot water and air conditioning |
| E | Water distribution; sanitation, waste management, decontamination activities |
| F | construction |
| G | Wholesale and retail trade; motor vehicle and motorcycle repair |
| H49 | Land transport and pipeline transport |
| Altele | Other economic activities |

*Source :INS (2023)*

For these categories of polluting activities we will choose circular economy actions within the production chain. These have as their main purposes refusal, rethinking, reduction, reuse, repair, recovery, remanufacturing, reorientation and recycling, the 9 key elements in circular economy thinking (Figure 1).

Figura 1**. Acțiuni de economie circulară în cadrul lanțului de producție**




*Source : RLI 2015, edited by PBL*

Reviewing the specialized literature of EC strategies that have the ability to mitigate the emissions of critical sectors, the relevant measures are identified. In this sense, we propose the following circular economy actions for the categories of polluting activities (Table 2).

Table 2. **Categories of polluting activities**

| The name of the activity category | Circular economy strategies |
|---|---|
| Electricity production | The "no coal" scenario (1/5 of capacity), electricity generated by coal replaced by renewable energy |
| | Copper removal losses during and after use |
| | Electricity savings during production in pulp and paper |
| Pulp, paper and printing | Decrease in demand for paper |
| Mining (excluding fuels) | Energy efficiency for mining operations |
| | Elimination of copper losses during and after use |
| Unspecified industry | No mitigation potential was identified |
| Domestic aviation | Advanced technological systems to improve efficiency |
| | Improved airframe design and propulsion |
| | Use of alternative fuels |
| machinery | Various low-carbon measures on the transport system |
| | Various low-carbon measures on the transport system |
| | Various low-carbon measures on the transport system |
| Commercial/institutional | No mitigation potential was identified |
| Residential | Reduction potential due to thermal improvement after construction, refurbishment |
| Extractive industry | Thermal efficiency |
| | Slag production |
| Production of iron, steel and metallurgical coke | Circulation of materials |
| | Circular production |
| Refrigeration and air conditioning | Process changes, including alternative refrigerants |
| Enteric fermentation | Diet modification |
| Garbage management | Maximum implementation of anaerobic digestion |
| Direct emissions of N2O from soils | changes in food |
| Waste disposal management | Optimized process parameters for low N2O yield |
| Treatment and disposal of domestic wastewater | Optimized process parameters for low N2O yield |
| | Anaerobic treatment with gas recovery or combustion |

*Source: data processed by the author*

The energy sector is identified as one of the major sectors emitting GHG emissions. Thus, the energy transition offers Romania the opportunity to create competitive advantages by investing in new industries and technologies, and it is found that there is a need for a reconfiguration of the energy field in relation to the new strategic approaches at the national, European and global level.

**Implementation of the circular economy in romanian agriculture.** Agriculture is unique in that the sector relies on natural resources and cycles as primary inputs for crop and livestock production. High levels of dependence on

natural resources and cycles can undermine the sustainability of the natural systems that support agricultural production. Resource efficiency and consumer product reuse are one way to make agricultural business models more sustainable.
The transition to a circular economy in agriculture requires a move away from the use of technical nutrients towards the use of biological nutrients. This transition to biological nutrients can be seen in Europe, with a greater focus on the development and use of biogas and organic fertilizers. Regenerative agriculture is based on principles such as preserving soil health, minimal use of pesticides and inorganic fertilizers, and combining crop and animal production to create a regenerative agricultural system that preserves the integrity of the natural system.

As a result, some of the major risk factors facing commercial agriculture today are:

- degradation of natural capital,
- increasing vulnerability to climate change,
- the volatility of input prices for agricultural products,
- long-term pressure on agricultural production.

For the development of the circular, regenerative agricultural system, which preserves the integrity of the natural system, practices such as crop rotation, and minimum reduction to cover are used. Also, livestock and crop production are often combined to create additional nutrient loops. Circular agriculture can increase the efficiency of conventional farming systems and has shown good potential for combination with regenerative practices. The use of IT (Intelligent Technology) in agriculture, real-time remote sensing of environmental data can optimize crop yields while reducing environmental externalities. Realigning food production and consumption through peri-urban and urban agriculture reduces food transport and associated costs (such as food waste, fuel and environmental externalities). Also, specialized urban farming techniques (vertical farming, hydroponics and aquaponics) can be more resource efficient, saving energy, water and fertilizers.
Supporting sustainable agricultural development within the circular economy involves securing and maintaining productive capacity for the future and increasing productivity without damaging the environment or endangering natural resources. In addition, it requires respect and recognition of local knowledge and local management of natural resources and efforts to promote the capabilities of current generations without compromising the prospects of future generations.
Consequently, economic and environmental sustainability, adequate incomes for farmers, productive capacity for the future, improved food security and social sustainability are important elements of agricultural development within the circular economy of countries.

**Circular business models in agriculture and forestry.** In agriculture and forestry, new circular business models can be created by optimizing the use and reuse of resources, and residues from initial harvesting activities and co-products from the transformation of raw materials in other commercial activities can be reused.

The circular economy represents a real opportunity for the development and efficient management of alternative processes and products, as well as for gaining access to new markets. The circular economy approach must become more attractive to small and medium-sized enterprises, supporting them to maximize their innovation potential, identify commercial opportunities for co-products and by-products, enabling them to become more competitive, guaranteeing employment and generating economic growth and new jobs in rural areas. In this sense, the bioeconomy represents an intelligent, sustainable and inclusive use of renewable resources, in the form of agricultural and forestry co-products and by-products. By using these resources and maximizing their value, the bioeconomy places itself at the heart of the circular economy. This contributes to the reduction of raw materials of fossil origin and the promotion of bioenergy and bioproducts that are complementary to food production.

In accordance with this orientation, farmers and agricultural cooperatives have launched themselves into the development and use of alternative energy sources, especially biogas, wind and solar energy. The transformation of existing food production models into circular models in a more sustainable, resilient and productive agriculture will lead to reduced food loss and waste, improve the efficiency of the food system and, at the same time, reduce pressure on natural resources and reduce greenhouse gas emissions. The agricultural sector employs billions of people worldwide, is a major user of the planet's fresh water and mineral resources, including petroleum products, transforms soils, landscapes, forests and biodiversity, and influences climate change.

Ecosystems and resources used by farmers are under constant pressure from other users with conflicting interests and approaches. However, their sustainable management is vital for the livelihood of future generations. In this sense, farmers have both the responsibility to play a major role as stewards in protecting, maintaining or restoring the environment and ecosystems in which they operate.

The threat of land degradation - or desertification, in cases where land degradation occurs in arid, semi-arid and dry sub-humid areas - persists and adversely affects the living conditions of over one billion people. Unsustainable agricultural practices, overgrazing, deforestation and overexploitation of water, together with climate change, are the main causes of land degradation in rural areas. Land degradation also means that more people have to share increasingly scarce resources. This trend leads to conflicts over land, water and energy and compounds poverty. Also, biological nutrients should be returned to nature and agricultural systems through composting and anaerobic digestion. Dutch households are reported to waste 13.6% of edible food, while UK households waste almost 20%.

These international trends suggest that household food waste is increasing as countries become more developed. Also, changes in consumption patterns due to the rise of the middle class are already being reported.

**Development of circular agriculture value chains.** Many entrepreneurs have difficulty accessing local and regional agricultural markets. This issue needs to be addressed to combat price volatility, reduce poverty and enable small farmers to help meet the growing demand for food. The EU supports the development of inclusive value chains – an effective way of linking small farmers to markets – and promotes regional integration. It also helps farmers to organize themselves, as this can increase their links with other actors in the value chain. The EU aims to improve the competitiveness of commodity chains by improving support services at producer level to establish links between competitive markets, by strengthening partner countries' capacities to implement commodity chain strategies and by developing regional support services. Also, the E.U. aims to increase governments' capacities to support and strengthen the links between rural growth, rural business development services and local, national and regional food markets

Farmer organizations play a key role in reducing poverty and improving food security and nutrition. They should be involved at all levels, from local to international, allowing farmers to be heard and involved in the decision-making process. Farmers' organizations also help empower women and youth in agricultural production, and at the E.U. fair distribution of investment returns is promoted so as to enable small farmers to overcome their systemic weaknesses.

Therefore, the EU supports:

- promoting agricultural practices and technologies that are environmentally sustainable and increase rural incomes, such as integrated pest management, soil and water conservation methods, agro-ecological approaches and agro-forestry;
- improving access to productive assets such as land and capital and measures to ensure better provision of essential services;
- initiatives that improve incomes and reduce vulnerability for producers through capacity building and a comprehensive value chain approach.

In the broader context of agricultural development, particular attention is focused on animal husbandry, fisheries, agricultural aquaculture and commodities.

The livestock sector contributes to economic and social development as well as food security. Because of its strong positive relationships with agricultural production, livestock production is generally an integral part of agricultural systems.

The EU provides support by improving the structural, organizational and technical framework to develop effective sector strategies. The activities are aimed, more precisely, at:

- strengthening the skills of veterinary services to respond quickly and manage animal diseases, as well as the implementation of good practices for animal production for increased competitiveness;
- promoting regional and international cooperation for the coordination and implementation of the livestock sector and related policies;
- improving the national capacity to develop livestock production, while protecting natural resources and the environment.

**Addressing weak points along the agri-food chain.** The return on investment in countries' agriculture can have a powerful multiplier effect on development, especially if it is channeled through productive investments that focus on addressing vulnerabilities along the agri-food chain. Value chains involve a complex interaction between actors, and the nature of these links defines the creation of value along the chain. The objective of interventions in this context is to achieve a fair distribution, balancing wealth and power. Farmers and their organizations, agricultural workers, commodity suppliers and small and medium-sized enterprises (SMEs) need support in this effort to improve value chain governance. For example, it can help foster dialogue and trust, develop long-term agreements that provide better guarantees and strengthen beneficiaries' skills to negotiate fair terms.

Local SMEs can add value by handling part of the processing, accessing innovative financing schemes, accessing markets directly and moving up the value chain. Finance in the value chain should take into account the needs of farmers and propose adaptive financial products such as insurance schemes, microcredit, venture capital and seed funds. The objective is to link contractual relationships between producers and buyers with financial products, to facilitate contractual arrangements based on a secure supply of inputs (including outgrower schemes), to work with customers with a more attractive risk profile and to encourage mechanisms quasi-equity finance appropriate to the medium and long-term needs of farmers and other small and small enterprises. Providing quality agricultural inputs, quality post-harvest infrastructure, improved storage and distribution systems, can help smallholders add value, meet quality standards and reduce post-harvest losses, thereby encouraging distribution.

The development of agricultural value chains adds value to agricultural commodities through local micro, small and medium-sized enterprises (SMEs) and can be both a job generator and a major factor in a more equitable distribution of income. equitable economic growth.

The efforts they must make to overcome the systemic challenges they face must also consider entrepreneurial action to help farmers develop in the value chain. The establishment of farmers' organizations creates an opportunity to defend the interests of small agricultural owners.

**Conclusions.** The energy sector is identified as one of the major sectors emitting GHG emissions. Thus, the energy transition offers Romania the possibility to create competitive advantages through investments in new industries and technologies, and it is found that there is a need for a reconfiguration of the energy field in relation to the new strategic approaches at the national, European and global level. In agricultural production provides income, jobs and affordable food, as well as raw material for the processing industry and foreign exchange from exports.

Creating a sustainable agricultural development path means improving the quality of life in rural areas, ensuring sufficient food for present and future generations, and generating sufficient income for farmers.

Food security and prices are a growing concern worldwide. Apart from the risks associated with natural disasters and droughts (which can be mitigated by land insurance), concerns about price fluctuations between the purchase of seeds and equipment and the harvesting and sale of a product can have a beneficial effect on farmers.

There is a growing demand now for products that enable control of price risk in food production. Although the products exist in emerging markets, often the upfront costs for companies are prohibitively high, preventing their widespread use. The EU supports global food security and develops a principled voluntary framework for responsible agricultural investment. Such a framework of internationally agreed principles is needed to guide investors, host countries and intermediaries towards investments in agriculture that respect human rights, livelihoods and natural resources.

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