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The Relevance of the Circular Economy in the Context of Sustainable Development

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Abstract: *Circular economy, the economic model that aims to maximize the use of resources and minimize the impact on the environment by reusing, recycling and encouraging regeneration. Through the SPSS statistical program, estimates are made regarding 3 indicators, the final energy consumption by agriculture and forestry per hectare of used agricultural area, The share of renewable energy in the final gross energy consumption per sector, The recycling rate of municipal waste are needed to be able to identify the direction Romania is heading in the next 10 years. Thus, the final energy consumption by agriculture and forestry per hectare of surface increases from 43.32% in 2021 to 43.32% in 2030, being necessary to adopt new sustainable agricultural practices in order to achieve efficient agriculture by reducing the consumption of energy. According to estimates, the share of recycled municipal waste has increased significantly over the last 20 years, from 1.6% in 2001 to 11.3% in 2021, with Romania expecting to reach 27% by 2030.*

Keywords: Circular economy. sustainability. development. SDG, Romania, EU.

Introduction

In recent years, political and economic atmosphere has also changed drastically. In 2015, the Sustainable Development Goals were developed by the UN and the Paris Climate Agreement was signed by 174 nations. Specific institutions and localities around the world are working to reduce plastic waste. For instance, the sale of plastic water bottles is prohibited at the San Francisco International Airport. Passengers can only buy refillable glass or metal bottles at the airport beginning on August 20 2019. In 2018, the European Commission released the Single-Use Plastics (SUP) Directive, which outlines a plan for plastics in a circular economy (Netherlands Enterprise Agency. 2020; Dumitru et al., 2022).

Converting from the conventional linear economic model to a circular one would not only save the EU's economy, but also greatly minimize the unfavorable impact on the environment. As a result, the circular economy (CE) has gained prominence as one of the most powerful and contemporary pushes toward sustainability. An economy may become circular by adopting circularity into its business models. which is dependent on both authorities and their actions as well as commercial entities (Lewansowski et al., 2016).

The EU uses and promotes the idea of a circular economy to boost competition shield firms from inadequate resources and support the development of new possibilities and emerging economies (Sousa et al., 2021; Iancu et al., 2022)

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With the emergence and implementation of the European Green Deal, a series of measures came into force aimed at propelling the circular economy model, restoring the proper functioning of ecosystems, reducing pollution and offering added value to products that would have been lost in the supply chain. However, adapting to the new rules is not at all within reach as a series of measures and sacrifices are required, thus adapting to the new laws is not at all feasible (Potârniche et al., 2022).

The circular economy in Romania is in the development phase, but there are initiatives at both the government and private levels that can support and contribute to its development. The promotion of ecological products. The selective collection and recycling of waste are some of the programs implemented, but there are many challenges to face in order to reach a high level of implementation of the circular economy in Romania (Dumitru et al., 2021; Iancu et al., 2022).

Among the benefits that the circular economy can bring are the reduced costs related to waste management the reuse of resources and the increase in productivity of their use.

Agriculture represents an important pawn in the process of implementing the circular economy through the implementation of sustainable agricultural practices, which aim to reduce energy and water use, protect biodiversity and contribute to the improvement of soil quality. The circular economy can use recyclable technologies and materials instead of non-biodegradable ones but also renewable energy sources for agricultural activity (Micu et al., 2022; Motofeanu et al., 2022).

Literature review

The circular economy is the significance of enormous importance to both practitioners and academics since it is considered a commercial conceptual model of the much-discussed sustainable development idea. The latter approach has been criticized for being too ambiguous to be implemented and has consequently begun to lose traction. A popular notion is frequently used by a variety of stakeholders. These can cause confusion since they usually work in vastly distinct worlds of mind (Kirchherr et al., 2017).

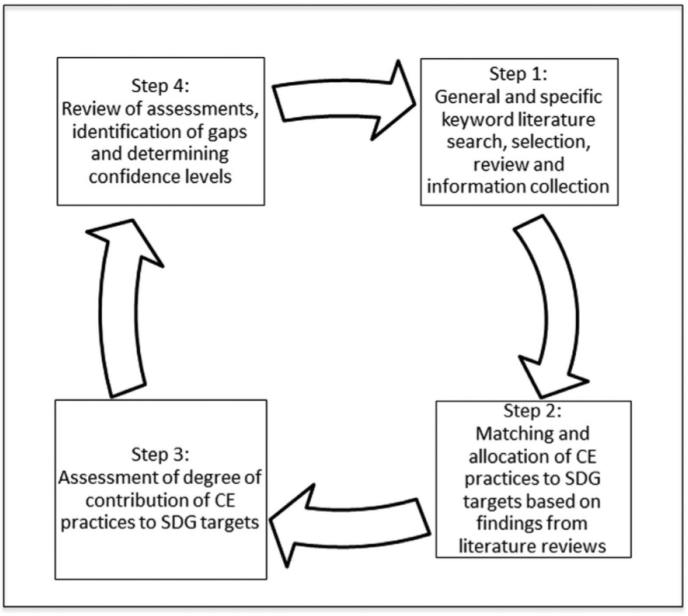


Figure 1. Research methods and procedures. where CE is circular economy and SDG is Sustainable Development Goals

Source: Schroeder et al., 2018.

According to Sauvé et al. (2016), sustainable development is a notion or goal that is distinct from previous failed endeavours and, more significantly, distinct from the linearity of the production-consumption paradigm. Sustainable development is a macro-level society goal that incorporates broad conceptions of ecological, economic, and developmental or social sustainability, whereas the circular economy approach is primarily defined at the micro-level through a consumption and production model. If the implementation of circular projects yields superior outcomes in terms of sustainability, the circular economy will be a vehicle for sustainable development.

Taking a look back offers some perspective: Sustainable development was promoted during the 1992 Rio de Janeiro Earth Summit for nations at all developmental levels. At the Johannesburg summit in 2002. efforts were made to rekindle sustainable development through collaboration with the private sector. Greening the economy has now been proposed as a strategy for sustainable development at the 2012 Rio+20 summit, and new global development objectives are being created (United Nations. 2012).

The Rio+20 summit adds fuel to this approach by requesting goals for sustainability (SDG) "that should address and encompass all three elements of sustainable development (environment, economy and society) and their inter-linkages" (Bartelmus. 2013).

According to the European Commission, the circular economy and sustainable development goals are inextricably linked. On the other hand, Based on the United Nations (2023). If the number of births hits 9.6 billion by 205, it will require resources comparable to three Earth planets to sustain the current standard of living. Humans, on the other side, are contaminating the water faster than nature can recycle and purify it from rivers and lakes, leaving more than one billion people without access to safe drinking water. According to the same source, if everyone in the world switched to low-energy bulbs, they would save USD $120 million every year.

Due to dietary habits that impact the environment through the consumption of energy related to food - which represents about 30% of the total energy consumption as well as 22% of the total emissions of greenhouse gases - and the generation of waste, households have a significant impact on the environmental effects related to food (Rodriguez-Anton et al., 2019).

Methodology

The paper is based on data provided by Eurostat, on the basis of which estimates are made for the next 10 years.

SPSS is a statistical processing software program, widely used in research for the purpose of testing certain hypotheses. calculating statistical indicators. grouping data and performing certain advanced statistical processes.

With the help of this software. estimates were made for the following indicators: final energy consumption by agriculture. recycling rate of municipal waste. share of renewable energy in gross final consumption.

The purpose of the paper is to provide an overview of a couple indicators, both at the level of the European Union and at the level of Romania. but also to identify the place our country occupies at the EU level. Also. the direction in which Romania is heading with regard to renewable energy. The recycling rate and energy consumption of agriculture is essential topics to discuss and it is important to identify how these indicators will evolve in the next 10 years.

Results and discussions

According to the data analysis, the Netherlands will have the highest value for final energy consumption in agriculture in 2021, with a value of 2.192.48, which is higher than the 2015 value of 1.969.54. At the opposite pole are Slovakia with 70.98% and Greece with 58.04% at the level of 2021 (Table 1).

Tabel 1. Final energy consumption by agriculture/forestry per hectare of utilised agricultural area (%)

Country	2015	2016	2017	2018	2019	2020	2021
Netherlands	1.969.54	2.046.65	2.060.85	2.187.61	2.212.77	2.162.24	2.192.48
Belgium	547.57	578.41	602.88	593.3	669.9	635.25	635.91
Malta	170.57	259.15	397.58	454.4	538.95	598.22	634.11
Cyprus	308.18	371.83	358.37	320.92	344.36	354.83	371.18
Finland	334.99	343.38	339.09	322.25	336.68	330.15	326.96
Poland	231.27	245.57	267.7	269.54	262.08	262.14	257.33
Italy	210.37	206.35	207.27	216.77	206.79	210.25	225.07
Germany	86.73	89.91	84.97	198.39	214.41	216.37	216.48
Denmark	240.79	239.7	229.18	226.23	221.41	216.71	215.89
Luxembourg	190.54	221.19	205.01	202.61	185.05	212.71	204.73
Sweden	203.01	209.41	208.24	201.14	207.66	196.09	188.52
Czechia	173.69	183.62	181.6	176.08	180.29	181.01	182.69
Croatia	136.5	137.7	141.49	146.77	146.89	155.15	158.4
Hungary	107.82	120.95	113.67	121.11	126.72	140.75	131.89
Spain	102.57	103.78	104.83	101.51	106.84	111.12	113.89
Portugal	93.63	97.05	100.15	102.36	95.79	103.62	109.07
Latvia	82.48	86.72	95.8	93.24	102.9	104.13	97.26
Estonia	132.64	129.28	134.09	126.12	114.38	110.98	89.3
Slovakia	78.22	77.52	74.61	69.12	67.53	69	70.98
Greece	48.73	51.47	56.52	49.83	53.84	52.64	58.04
Romania	33.09	33.53	37.06	42.18	40.3	40.67	43.32

Source: Eurostat. accessed on 10.01.2023.

In Romania. a slight increase in values can be observed during the analyzed period, consumption was 33.09% in 2015, rising to 44.32% in 2021. Although, in the period 2015-2021, final energy consumption increases, in terms of final energy consumption in agriculture, Romania ranks near the bottom of the European Union. This can be explained by the fact that most crops are grown in open fields, where energy consumption and costs are lower compared to agricultural products obtained in greenhouses (Figure 1).

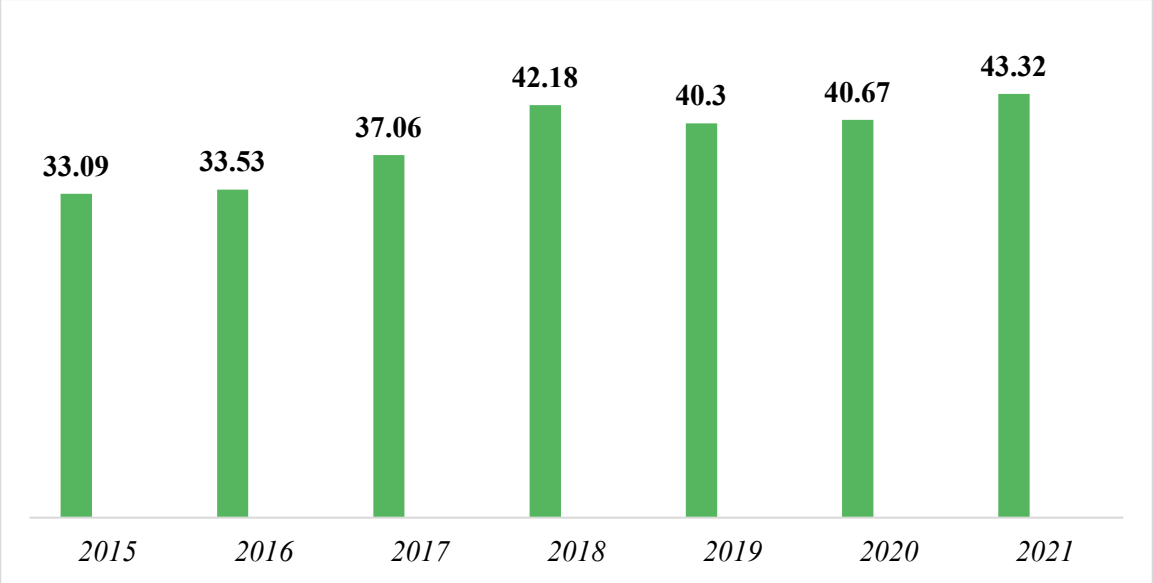


Figure 1. The final consumption of energy in agriculture is found in Romania (%

Source: Processing based on Eurostat data.

At the level of the European Union, in terms of the share of renewable energy in the final gross energy consumption per sector, the first place is occupied by Sweden with a share of 62.57%, followed by Finland with 43.1% and Latvia with 42.1%. Estonia is ranked fourth, with a significant increase in its share of gross final energy consumption. In 2015 it was 28.9%. reaching 37.6% in 2021. Serbia (25.3%). Slovenia (25%) and Romania (23.6%) are ranked last in 2021 (Table 2).

Table 2. Share of renewable energy in the final gross energy consumption per sector (%)

Country	2015	2016	2017	2018	2019	2020	2021
Sweden	52.220	52.597	53.390	53.916	55.785	60.124	62.573
Finland	39.230	38.943	40.857	41.185	42.807	43.939	43.096
Latvia	37.538	37.138	39.008	40.019	40.929	42.132	42.107
Estonia	28.987	29.232	29.538	29.970	31.730	30.069	37.628
Austria	33.497	33.370	33.136	33.784	33.755	36.545	36.445
Denmark	30.469	31.715	34.387	35.159	37.020	31.681	34.718
Portugal	30.514	30.864	30.611	30.203	30.623	33.982	33.982
Croatia	28.969	28.266	27.280	28.047	28.466	31.023	31.329
Lithuania	25.748	25.612	26.038	24.695	25.474	26.773	28.230
Serbia	21.989	21.147	20.287	20.320	21.443	26.297	25.280
Slovenia	22.879	21.975	21.658	21.378	21.968	25.000	25.000
Romania	24.785	25.032	24.454	23.875	24.290	24.478	23.596

Source: Eurostat. accessed on 10.01.2023.

During the time period under consideration, Romania registered a significant decrease in terms of the share of renewable energy in gross final consumption. In 2015 a value of 24.785 was recorded. which reaches 23.596 in 2021 the lowest value of the studied period. In Romania. wind energy represents 12.4% of the total electric current produced. and hydroelectric energy represents 25%. The "Iron Gates 1" hydropower plant is one of Romania's most important (Figure 2).

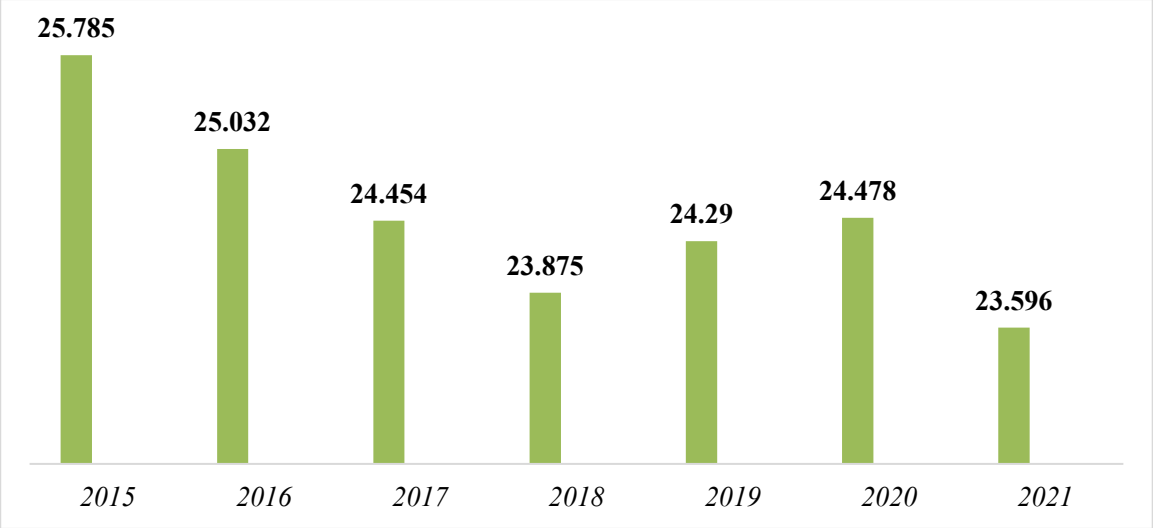


Figure 2. The share of renewable energy in the final gross energy consumption per sector in Romania (%)

Source: Processing based on Eurostat data.

From the analysis of the data presented above. in the year 2021. Germany occupied the first place in terms of municipal waste recycling rate with a value of 69.8, followed by Slovenia 59.9 and the Netherlands 57.8. On the last places are Cyprus with 14.9%, Malta with 13.5% and Romania with 11.3% (Table 3).

Table 3. Recycling rate of municipal waste (%)

Country	2015	2016	2017	2018	2019	2020	2021
Germany	66.7	67.1	67.2	67.1	66.7	69.0	69.8
Slovenia	54.1	55.6	57.8	58.9	59.2	59.3	59.9
Netherlands	51.8	-	54.6	55.9	56.9	56.9	57.8
Luxembourg	47.4	49.2	48.7	49.0	48.9	52.8	55.1
Switzerland	52.7	52.5	52.5	52.5	53.0	52.8	53.3
Belgium	53.5	53.5	53.9	54.4	54.7	51.1	52.8
Slovakia	14.9	23.0	29.8	36.3	38.5	44.6	48.9
France	40.7	39.3	39.7	40.3	40.5	41.3	44.6
Lithuania	33.1	48.0	48.1	52.5	49.7	45.1	44.2
Czechia	29.7	33.6	32.0	32.2	33.3	40.5	43.3
Poland	32.5	34.8	33.8	34.3	34.1	38.7	40.3
Sweden	47.5	48.4	46.8	45.8	46.6	38.3	39.5
Finland	40.6	42.0	40.5	42.3	43.5	42.2	37.1
Spain	30.0	33.9	36.1	34.8	38.0	40.5	36.7
Hungary	32.2	34.7	35.0	37.4	35.9	32.0	34.9
Denmark	47.4	48.3	47.6	49.9	51.5	45.0	34.3
Croatia	18.0	21.0	23.6	25.3	30.2	29.5	31.5
Estonia	28.3	28.1	28.4	28.0	30.8	28.9	30.5
Portugal	29.8	30.9	29.1	29.1	28.9	26.8	30.5
Cyprus	16.6	16.1	16.2	16.5	16.3	16.4	14.9
Malta	10.9	12.6	11.5	10.5	9.1	10.9	13.5
Romania	13.2	13.4	14.0	11.1	11.5	11.9	11.3

Source: Eurostat. accessed on 10.01.2023.

The evolution of Romania in the period 2015-2021 in terms of the municipal waste recycling rate was constant. in 2015 having a value of 13.2. to decrease in 2021 to 11.3. The highest value in the analyzed period was recorded in 2017, namely 14%. According to the data presented, Romania ranks last in the EU in terms of waste recycling rate. In recent years. the amount of unrecycled waste in Romania has reached high values. reaching an amount of 4.58 million tons of unrecycled waste per year, respectively 12.500 tons per day (Figure 3).

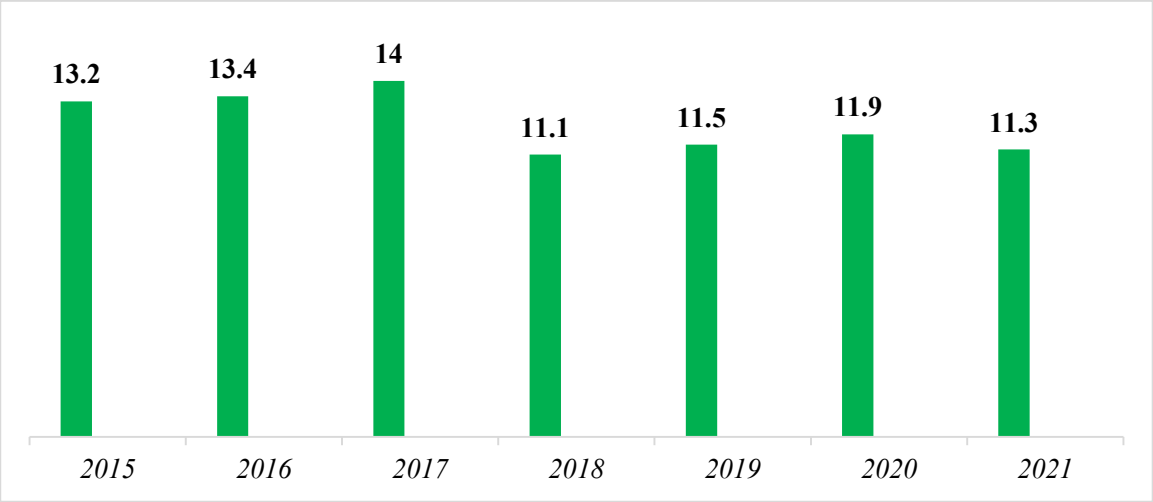


Figure 3. Municipal recycling rate at the Romanian level (%)

Source: Processing based on Eurostat data.

Agriculture's final energy consumption in 2010 was 27.75%. rising to 43.32% in 2021. an increase of 15.57%. According to estimations. the final energy consumption will be 51%. with the optimistic version predicting a consumption of 43% and the pessimistic version predicting a consumption of 58% (Figure 4).

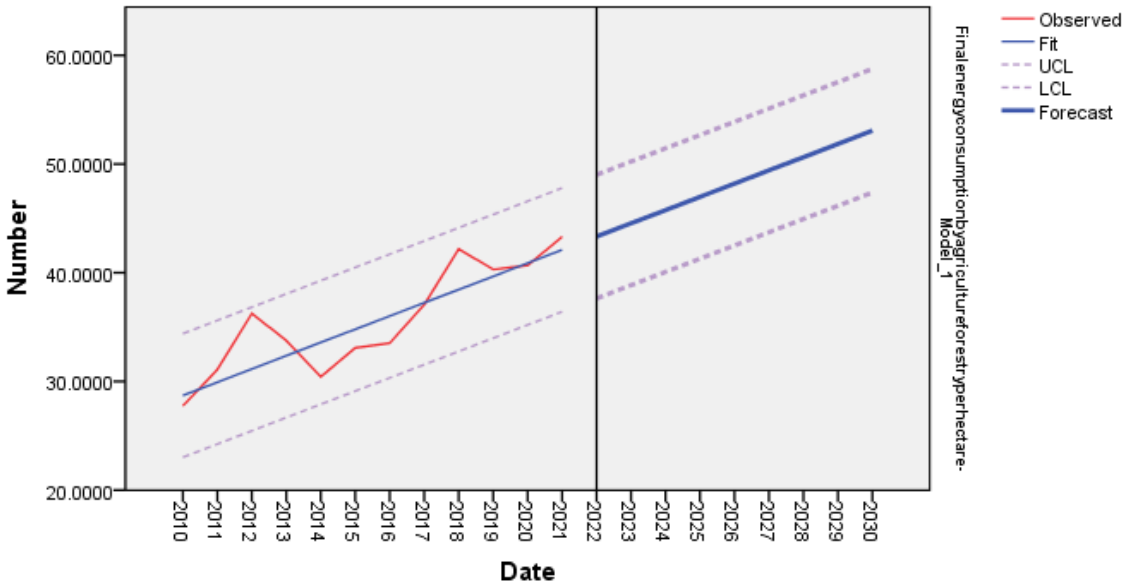


Figure 4. Estimates of final energy consumption in agriculture (%)

Source: EUROSTAT data base processing.

In 2004, renewable energy represented 16.81% of total energy consumption in Romania. rising to 23.59% by 2021. According to projections, renewable energy will constitute for 27% of total energy consumption by 2030, an increase of around 3.5%. The optimistic version predicts a 33% share of renewable energy. whereas the pessimistic version predicts 21%. (Figure 5).

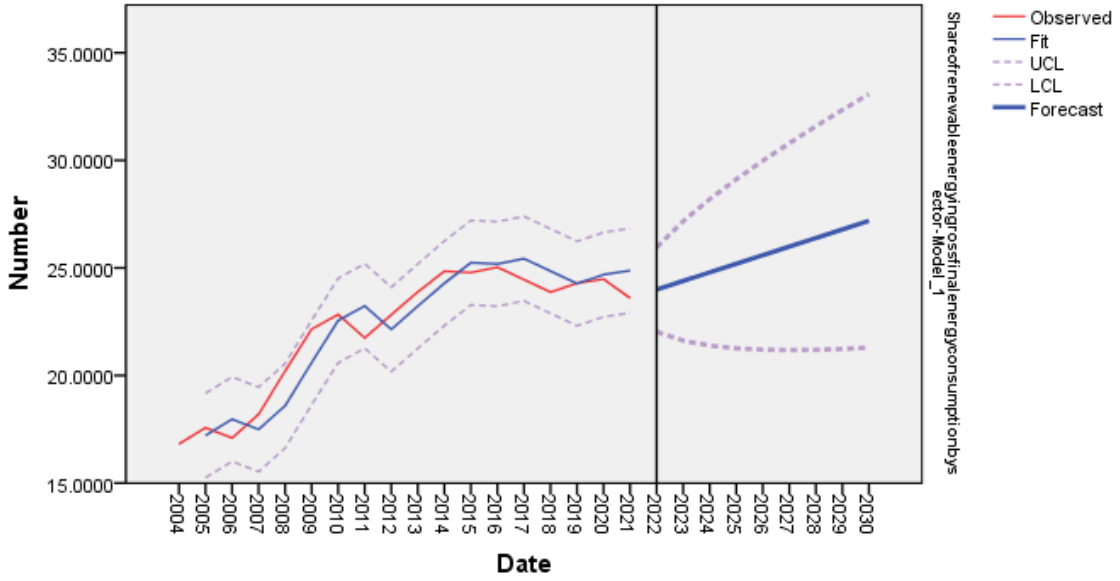


Figure 5. Estimates regarding the share of renewable energy in gross final consumption (%)

Source: EUROSTAT data base processing.

In 2001, the recycling rate of municipal waste was 1.6%, reaching a rate of 11.3% in 2021, increasing by 9.7%. According to predictions. the municipal rate will remain constant until 2030. and the optimistic version anticipates a waste recycling rate of 27%, while the pessimistic version expects a rate of -5%. (Figure 6).

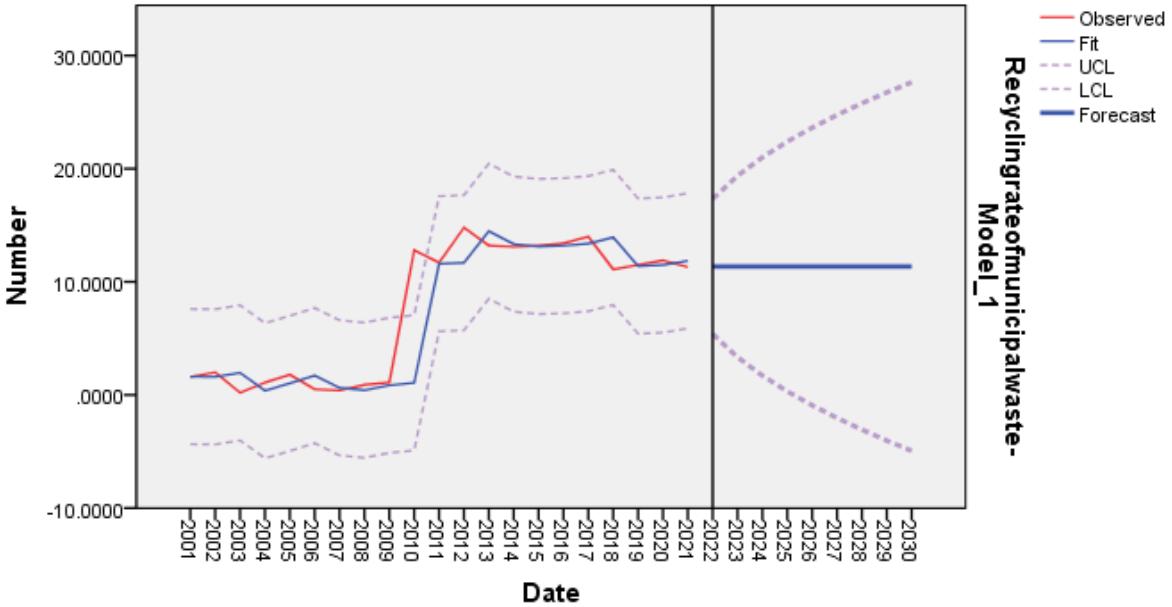


Figure 6. Estimates of municipal waste recycling rate (%)

Source: EUROSTAT data base processing.

Conclusion

According to the estimates made in SPSS, the final energy consumption by agriculture/forestry per hectare of agricultural area increases from 43.32% in 2021 to 43.32% in 2030. For Romania to move towards a sustainable agriculture, this consumption would have to decrease for an energy-efficient agriculture. Therefore, they should use practices that reduce energy needs, such as conservative agriculture. use of renewable resources. intelligent irrigation (Tudor et al.. 2022).
Regarding the indicator of the share of renewable energy in the gross final consumption, the estimates show us an increase in the year 2030 (27%) compared to the year 2021 (23.59%).

The recycling of municipal waste registered an increase in the period 2001-2021. Thus in 2001, a share of 1.6% was recorded, reaching 11.3% in 2021, and according to estimates in the next 10 years this is maintained constant; the optimistic scenario shows us an increase that reaches 27%.

The relevance of the circular economy when it comes to sustainable development refers to the limitation of resources and the impact it has on the environment and ecosystem. Thus, together with the efficient and sustainable use of resources. the circular economy is essential for the development of green technologies, the creation of jobs, therefore contributing to economic and sustainable growth.

Educating and raising awareness of the circular economy at the population level should be the main measure that Romania takes, because the key to success lies in changing both the mentality and behavior of the consumer and the producer.

Another important measure can be investments in collection and recycling infrastructure. as well as their implementation.

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