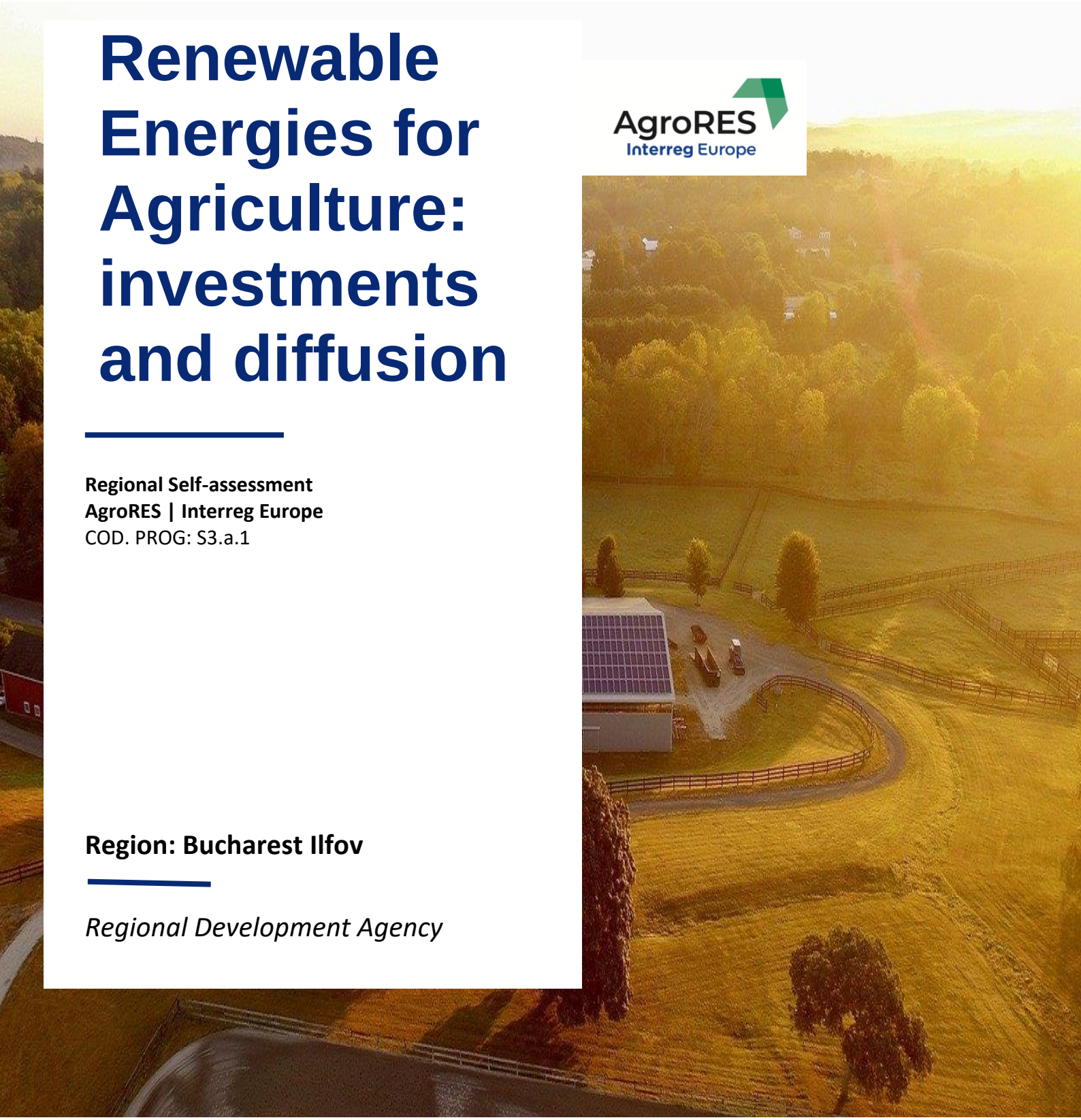
Renewable Energies for Agriculture: investments and diffusion



Regional Self-assessment
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Region: Bucharest Ilfov

Regional Development Agency

INDEX

1. Introduction

The agricultural sector accounts for almost 10% of greenhouse gas emissions in the EU, majority of which is caused by food production and transport. While there is an enormous potential to produce renewable energy on farms due to the availability of wind, sun, biomass and agricultural waste, important barriers and challenges remain. Recent studies have proven that the main barriers identified by farmers to produce renewable energy are: complex permits and subsidies' procedures, high investment costs, limited access to credit and doubts about profitability. Subsidies and feed-in tariffs are a key factor in encouraging farmers to shift towards a more environmentally friendly production and use of energy.

Romania, as an EU Member State, has an obligation to comply with the European Community environmental and energy efficiency standards set out in the specific directives and to contribute to the achievement of European strategic objectives and policies in terms of sustainable development.

The re-emergence of the Romanian agricultural sector continues to provide employment and to contribute to the national economy. However, the agricultural sector is one of the higher emitters of C02, and this contributes to the pollution of the whole territory. Although the country has a strong performance in hydropower, other renewable energy sources have not been developed in such a way. Specially wind and solar are under-represented compared to other EU countries, these technologies, having a very high potential in rural areas.

The general purpose of this analysis – *regional self-assessment* – is to establish an overall picture of renewable energy consumption and production in Bucharest-Ilfov region, with regard to investments and the use of renewable energy in agriculture and in rural communities. The report starts from the analysis of the regional social-economic framework, that characterizes the region and, with the aim of photographing the current situation and providing reflections on the potential existing, with a view to future developments, it underlines the existing policies and actions that promote renewable energy production and use in the agricultural sector. In addition, the strengths and weaknesses of these policy instruments are analysed and based on the results, the document emphasizes opportunities and threats connected to the spread of renewable energy in agriculture and suggests key measures to support positive development in this field. Increasing the energy production from renewable sources is a challenge to meet EU 2030 targets and, in this way, we will be able to identify which RES are more cost-effective and have the greatest potential, and therefore should be promoted.

This document has been prepared in the **AgroRES** project – **"Investing in Renewable Energies for Agriculture"**, with the financial support of the **Interreg Europe** programme.

2. Regional socio-economic framework

I. Regional overview

The Bucharest-Ilfov region is one of 283 European Union regions, located in the south-eastern part of Romania, more precisely in the centre of the Romanian Plain, being formed by two entities, respectively Ilfov County and Bucharest municipality. Ilfov County consists of 40 territorial administrative units, of which 8 cities, 32 communes and 91 villages. The city of Bucharest is made up of six sectors, arranged radially around the central area of the city.

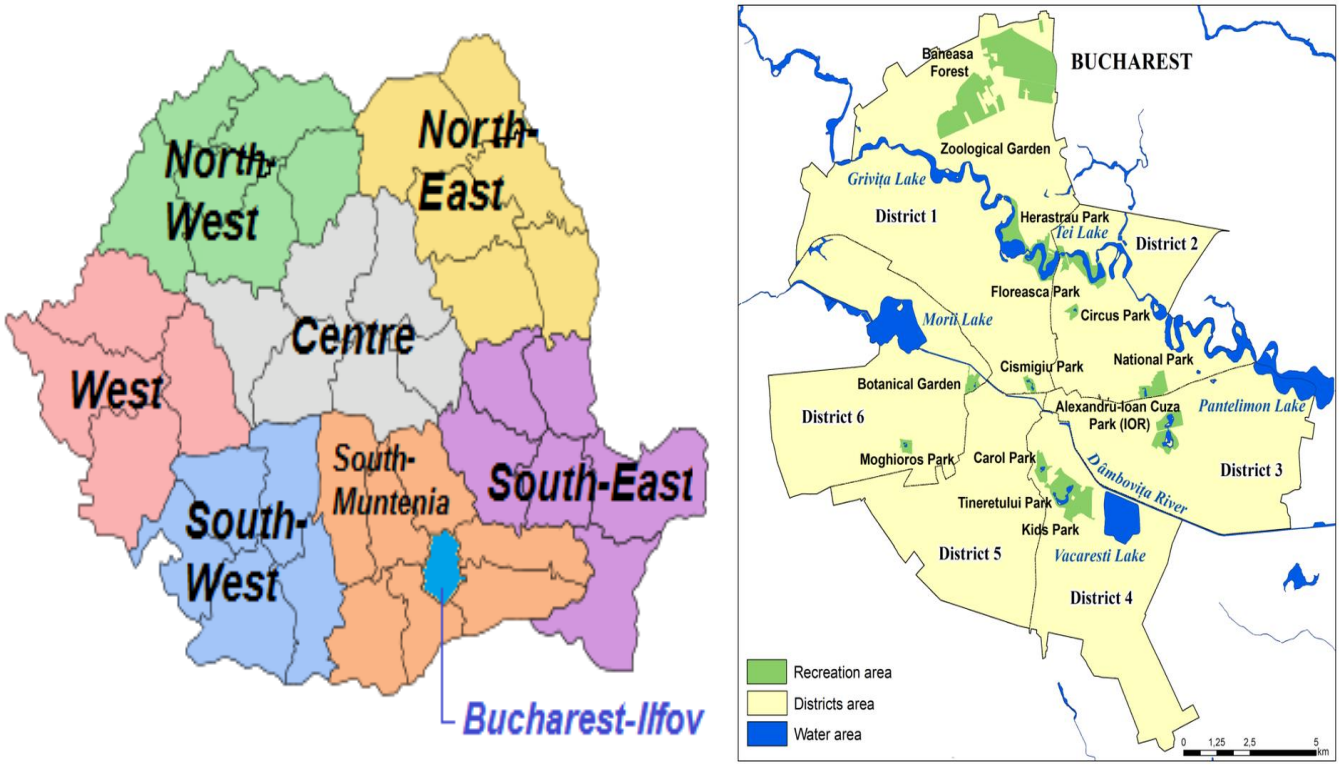


Fig.1 – Bucharest Ilfov region

The region the region is located entirely in the plain area, at altitudes between 48 and 128 m and it has a total area of 1823 square km, of which Ilfov County owns 86.83% (1583 square km), while Bucharest has an area of 240 square km (13.17% of the total region). The territory is characterized by a high density of valleys, being transited by five main river courses: Ialomita, Dambovita, Colentina, Sabar and Arges, to which are added some smaller rivers, many of these with a semi-permanent course, drying up during dry

summers. With a total water surface of 5107 ha and and a density of the hydrographic network of 0.2 -0.3 km/km2, the region concentrates the most important natural or anthropic lakes, especially in the N, V, and E part of the region, as follows: Snagov (575 ha), Căldăruşani (224 ha), Buftea (307 ha), Buciumeni (60 ha), Mogoşoaia (92 ha), Pantelimon (313 ha) and Cernica (360 ha). From a climatic point of view, the analysed territory is located in the area of temperate continental climate, with drier shades, highlighted by average annual rainfall between 550-600 mm, average annual temperatures of 10 - 12 degrees Celsius and relative humidity around of 74%. The wind regime is characterized by the predominance of winds from NE (21.6%) and E (19.7%) that blow with average annual speeds of 2 - 2.5 m/s, with maximums in winter that can exceed 125 km/h. In terms of pedological characteristics of the territory, within the region prevail preluvosols and chernozems with low natural subsoil resources, there are deposits of natural gas and crude oil, to which are added the thermal water resources around Otopeni and Snagov. Moreover, on the territory of the region there are several natural areas protected by faunal and community importance - Natura 2000. (http://natura2000.eea.europa.eu)

Bucharest - Ilfov region is the most populated region of the country, in 2018, the number of population residing in the region was 2,552,740 inhabitants, of which, Bucharest registered over 83.1% of the total population, the difference representing the county population Ilfov.

	BI Region	Bucharest	Ilfov County	% of BI Region in Romania
Area	**1 823 km^2**	**13.17%**	**86.83%**	**0.76**
Population	**2 552 740 inh.**	**83.1%**	**16.9%**	**13.14**

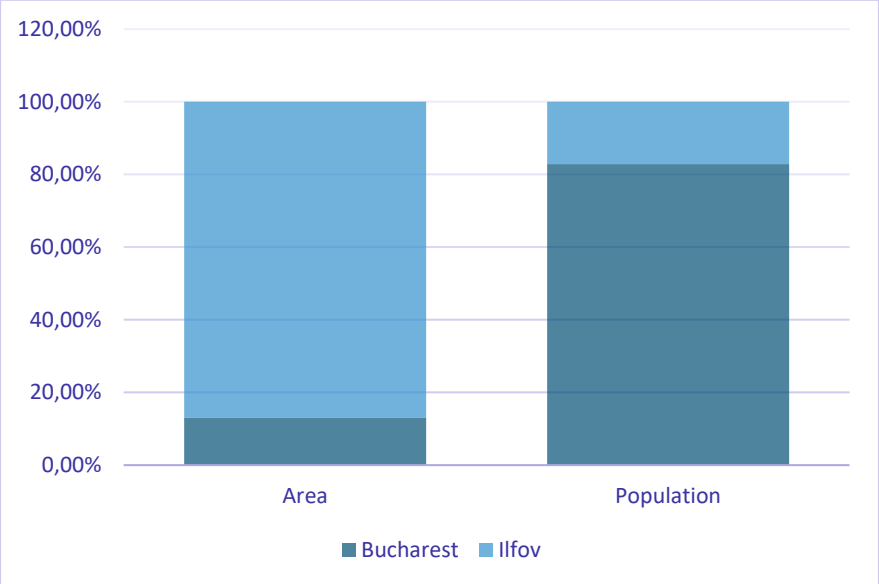


Fig.2 - Demographic evolution in relation with regional area

The city of Bucharest presents the most important population concentrations at national level, this fact is revealed by the high values of the population density, respectively, of 8840.8 inhabitants per square km, in 2018.

From an evolutionary point of view, in the 2012 – 2018 period, the population of the region has an annual growth rate of 0.35% and compared to 2012 the population of the region has now increased by about 2.13% representing an increase of over 53 thousand residents. The city of Bucharest registers a reduction of approximately 30 thousand in the number of inhabitants, while Ilfov County has an average annual growth rate of 24% compared to 2012.

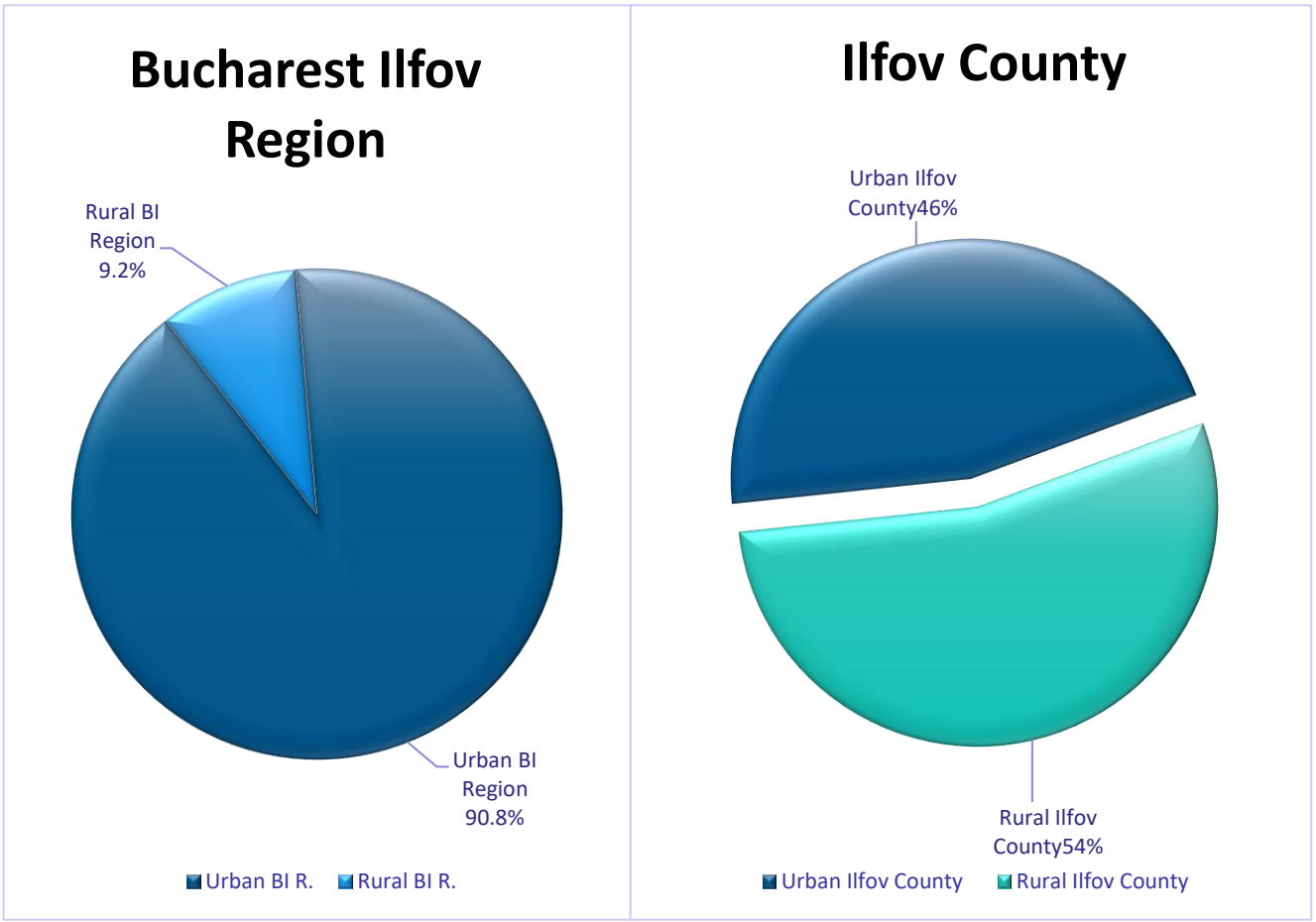


Fig.3 - Population by areas of residence

Regarding the division of the population by areas of residence, it is observed that 90.81% of the population of Bucharest - Ilfov region live in urban areas, respectively 2.3 million inhabitants, these values revealing the high degree of urbanization of the region. Regarding Ilfov County, here is registered a majority share of people living in rural areas, respectively 54%.

Compared to the gender structure, for 2018, in the Bucharest Ilfov region, the predominance of females is observed, in a percentage of approximately 53%. At the level of Bucharest, the gap between the two sexes is more pronounced, the female population has a share of 53.2% while the gap is lower in Ilfov County, with a share of 51.4%, for the same category. The urban environment at regional level indicates a majority share of the female population, of 53.17%, the gap decreasing at the level of Ilfov county.

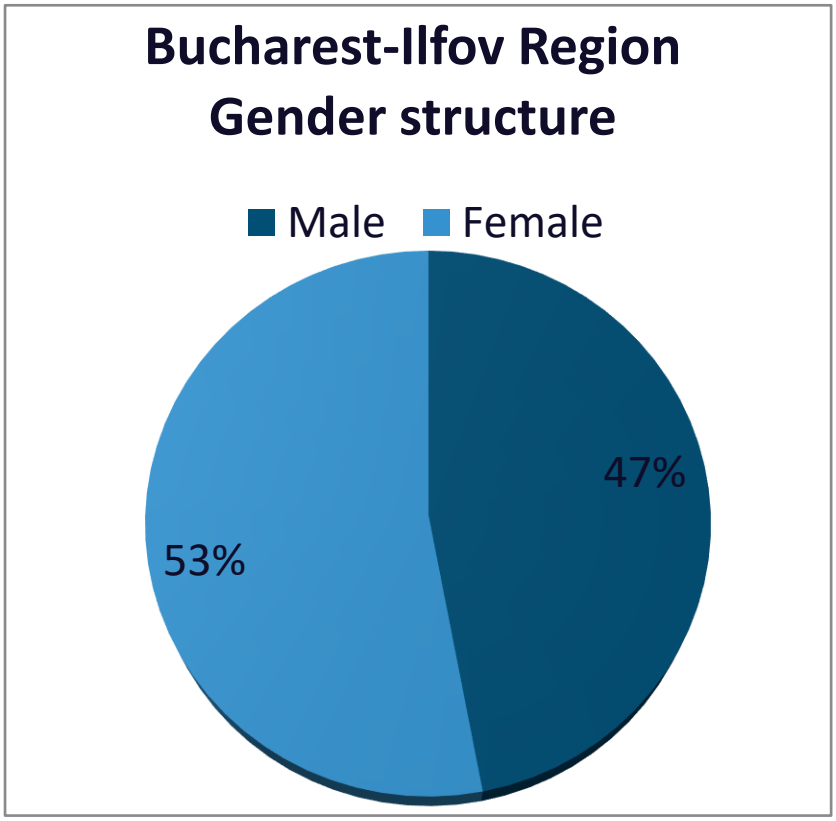
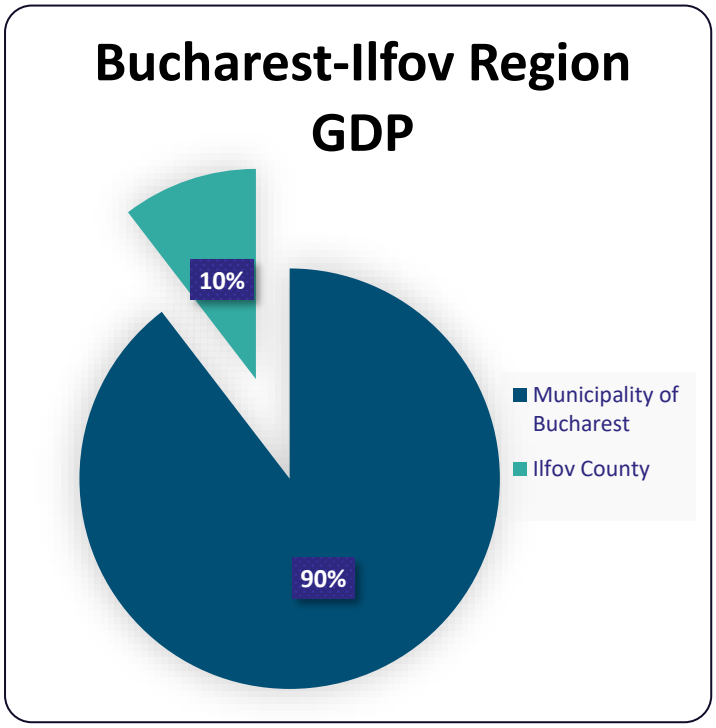
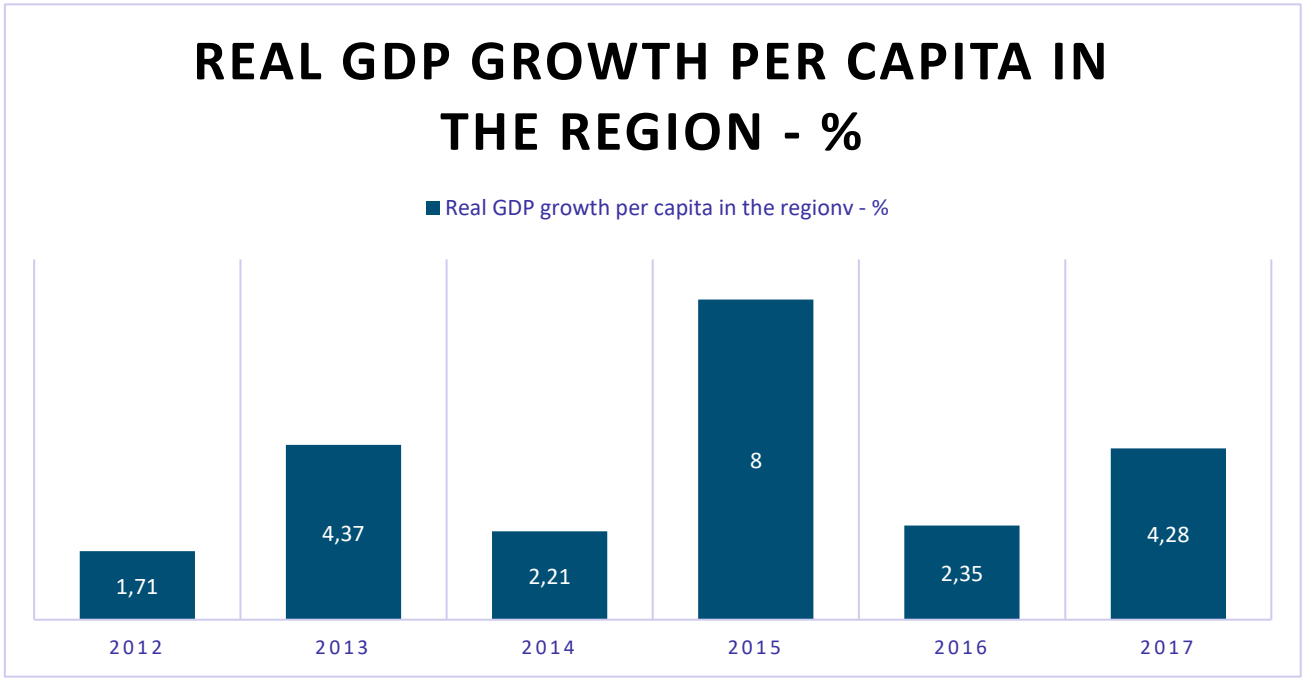


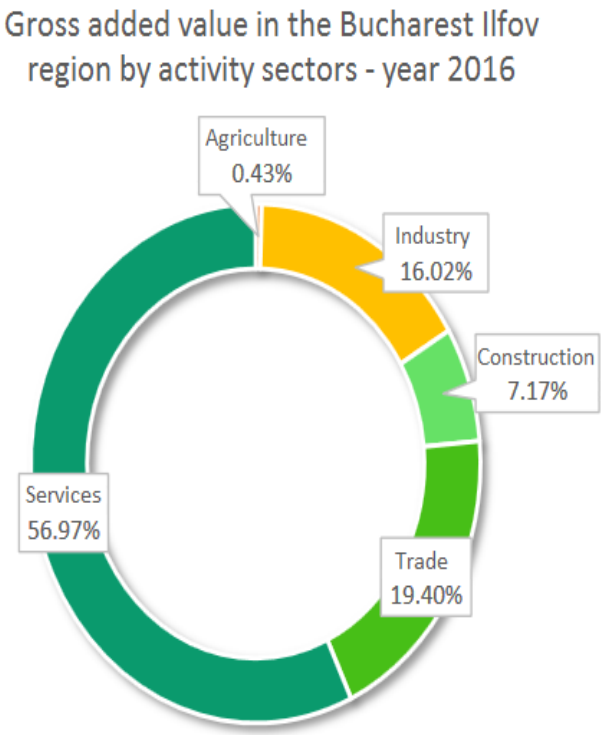
Fig.4 – Population by gender structure



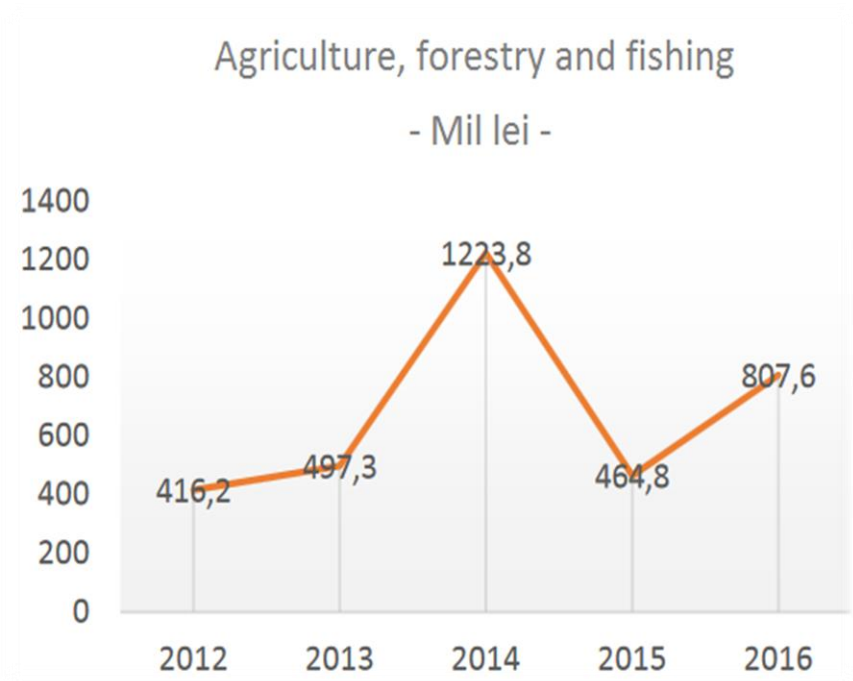
From an economic point of view, the Bucharest - Ilfov region is the most economically developed region of the country, permanently positioned on the 1st place in the national top, with a total regional GDP of over 56 billion euro and a value of GDP / inhabitant double compared to the one registered on average in the country (of 9600 euro / inhabitant in 2017) and increasing from 15,700 euro / inhabitant in 2012, to 22,000 euro / inhabitant in 2017, representing a 40% increase in GDP / inhabitant in the analysed period. (Eurostat - July 2019)



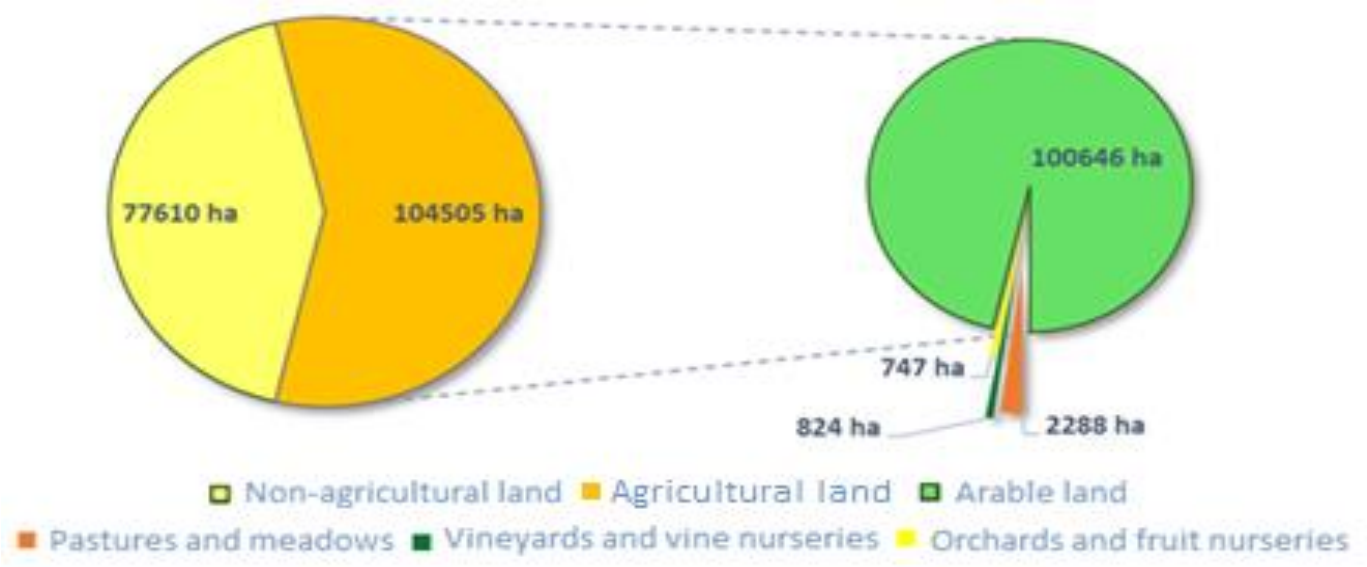
Regarding intra-regional GDP per capita, significant differences can be observed between Bucharest and Ilfov, so that, in Bucharest the GDP per capita exceeds both the national average - 9600 euros, and that of regional level 22,000 euros, while for Ilfov county the average is slightly above the national average, at the level of 10100 euros - GDP per capita.



The analysis of gross added value by economic sectors reveals the characteristic feature of a capital region, namely the majority contribution of services and trade (over 76%), followed by the secondary sector (industry and construction) and the primary sector - agriculture with only 0.43%. As can be seen in the graph below, regarding the evolution of gross value added on the main economic activities, Agriculture shows an oscillating evolution, but on an increasing trend, almost doubling its value, from 416 million lei in 2012, up to 807 million lei in 2017. Moreover, in concrete values, in agriculture, the total number of enterprises shows an uninterrupted growth of approximately 21%, from 910 enterprises in 2012, to 1105 in 2017. From the point of view of the regional competitiveness index in 2016, the Bucharest - Ilfov region ranks first in the country and 161st out of 263 regions in the European Union. Our region surpasses the capital region of Bulgaria - Sofia (ranked 207) but is ahead of more developed regions such as Berlin, Vienna, Budapest or Prague. In fact, another indicator that can highlight the national level socio-economic features is the average total income per household, amounting to about 1100 euro per household.



The agricultural area of Romania is about 14.6 million Ha, representing 61.4% of the total area of the country. The share of the agricultural surface at the level of the Bucharest-Ilfov region is below the national average, respectively 57,4% - with 104505 hectares of agricultural land.



Bucharest – Ilfov region - Agricultural land distribution

Regarding the distribution of arable land, as can be seen in the graphic representation, the most important proportion is held by arable land - 96.3%, followed by pastures and meadows - 2.2% and land occupied by vineyards and orchards, which cumulatively represents only 1.5% of the total agricultural area. Regarding the dynamics of cultivated areas in 2020, compared to 2019, for the Bucharest - Ilfov region, there is a decrease of 740 ha, mainly from private agricultural holdings.

In this context, the existence of 21022 agricultural holdings is highlighted, with a surface of agricultural area of 64277 Ha, and depending on their destination, 86.7% are only with the agricultural land used while 13.3% are exclusive farms with livestock.

Total number of agricultural holdings	Holdings without legal personality	Holdings with legal personality	Average area of holdings - ha
21022	20856	166	3.06

If we look at the crop production of the main crops in 2021, according to the statistical data provided by the National Institute of Statistics, there is a decrease in wheat production in 2020 - compared to 2019, of about 26 thousand tons. In the same period analyzed, the production of rye increased by 112 tons, the production of barley and barley halved, reaching 10,000 tons, as well as the production of corn grains, which decreased by about 30 thousand tons. In the same context, the production of sunflower experienced a sharp decline, decreasing by over 7300 tons, reaching an annual value of 20 thousand tons. The production of cauliflower, broccoli and cucumbers is also declining, in the context in which even so, the total production is quite low in our region. According to the same publication, rapeseed production increased during the analyzed period by about 1500 tons, reaching over 17 thousand tons per year. There is also a growth rate for beans, which had an increase of only 15 tons compared to the previous year, reaching an annual production of about 100 tons. On the same upward trend is the production of white cabbage which registers an increase of 150 tons, as well as the production of tomatoes which has a surplus compared to the previous year of 1674 tons, reaching an annual production in the region of over 23 thousand tons. In support of the above information, we present in detail in the following table the vegetable production for the main crops in the period 2014 – 2019:

Bucharest Ilfov	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total Cultivated area (ha)	**64656**	**64683**	**64454**	**66455**	**66769**	**63494**
Grain cereals (ha)	35952	36113	35684	34525	34004	36344
Wheat (ha)	18343	18521	18374	18220	17978	19060
Barley (ha)	5952	4668	4555	4058	3776	3826
Corn grain (ha)	9799	11080	11233	10538	10754	11992
Oily plants **- from which -**	**18298**	**19460**	**19781**	**21876**	**22898**	**18205**

Sunflower (ha)	10248	11569	11347	11519	10806	10542
Colza (ha)	7634	7388	8022	10181	11890	7529
Potatoes (ha)	654	643	480	468	496	496
Vegetables (ha)	5460	5402	5319	5472	5406	5278

A statistical survey published by the National Institute of Statistics in 2020 reveals the following situation in terms of livestock and animal production registered in the Bucharest Ilfov region, as follows:

Name of indicators	Total Agriculture Bucharest Ilfov	Private majority sector – holdings with legal personality	Agricultural holdings without legal personality
Herds of cattle - units	4552	4118	434
Herds of pigs - units	10002	9918	84
Herds of goats - units	14290	14290	-
Herds of sheep – units	27092	26020	1072
Herds of poultry – units	466793	-	-

Thus, it can be seen that there are significant numbers of animals in the region, most of them in the private sector, in agricultural holdings with legal personality. At the same time, the same publication mentions the animal production, both the number of slaughtered units and the amount of meat obtained. In this sense, in 2019, in the Bucharest Ilfov region, a number of 1893 cattle were slaughtered,

with a quantity of meat obtained, over 500 thousand kg. From the pig herds, we can mention the slaughter of 1,350 units, the equivalent of 1.3 million kg. Regarding the cumulative number of slaughtered sheep and goats, it is over 23 thousand unit with a meat production of over 375 thousand kg, in the same period analyzed. Regarding the production of poultry meat, in 2019 over 550 thousand such animals were slaughtered, accumulating a quantity of meat of approximately 860 thousand kg. Moreover, the document also shows the production of dairy products, highlighting the total milk production in the region, of over 11.7 million liters, the total cheese production of about 200 tons and the cream production of 21 tons. Also noteworthy are the specifications for the production of honey, which, for 2019, exceeds 313 tons in our region.

Regarding the value of the production of the agricultural branch, in the period 2014 - 2019, in the Bucharest Ilfov region, the value experienced an ascending trend from approximately 105 million euros in 2014, to over 144 million euros in 2019, the increase being felt especially in crop production and by increasing agricultural services, as shown in the table below.

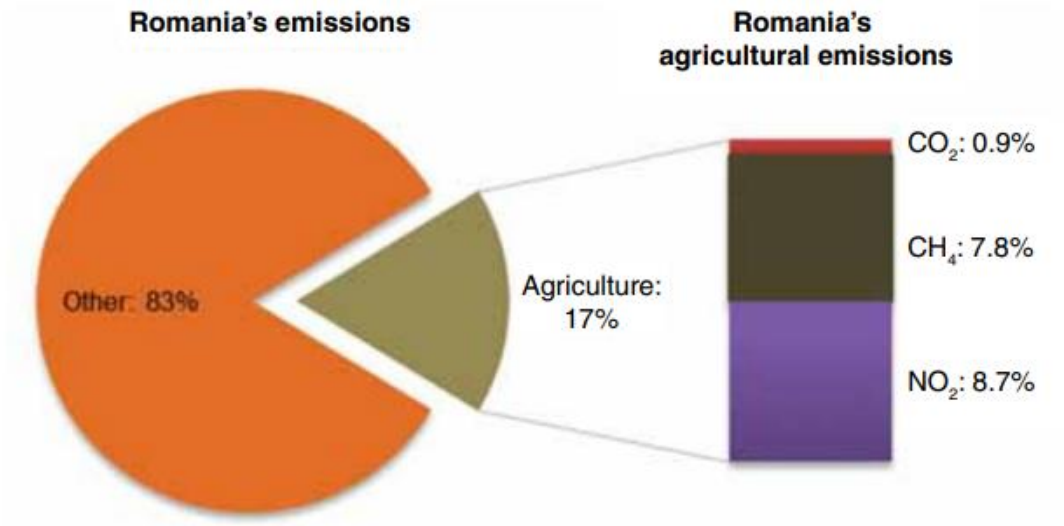
Ilfov County	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Total (thousand lei)	**656705**	**636259**	**621008**	**672750**	**706763**	**720347**
Plant production	467099	458384	461360	490854	549076	562989
Animal production	149799	142060	124189	136110	105649	104956
Agricultural services	39807	35815	35459	45786	52038	52402

Value of Agricultural branch production by agricultural sectors – INSE.ro

3. Evolution of the spread of renewable energies in agriculture and in rural communities

According to the European Environmental Agency, in Romania, Agriculture contributes significantly to overall GHG emissions and it is necessary to take measures to stop this situation. The figure below shows the level of emissions from agriculture in relation to total emissions and, moreover, and structured according to the types of gases.

GHG emissions from Romanian agriculture, total and by gas



Source: European Environmental Agency.

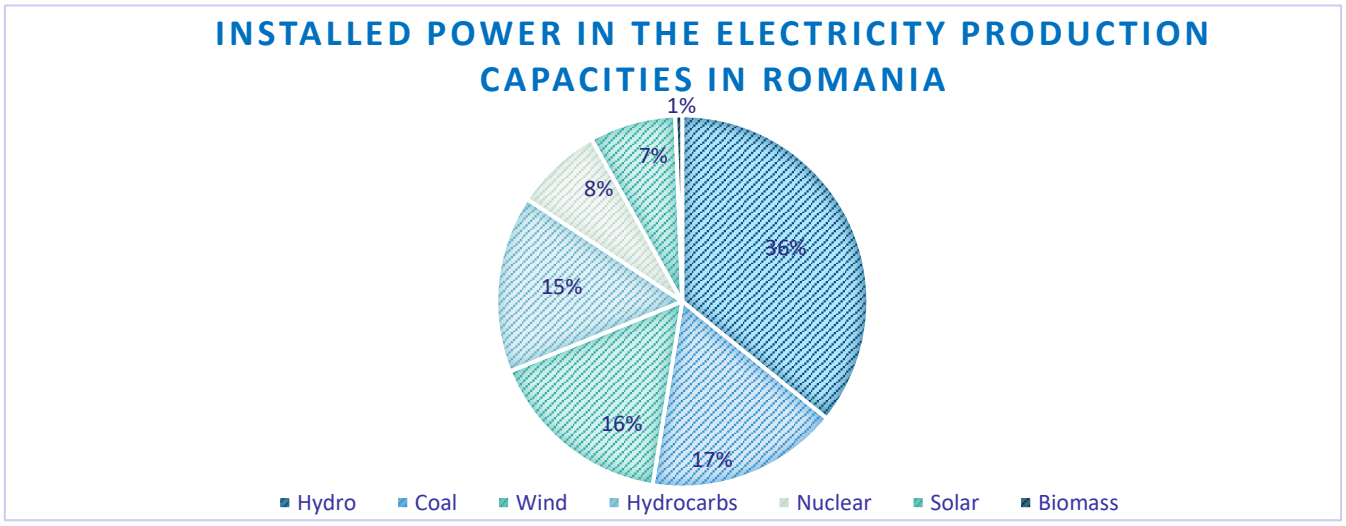
At the same time, our country and implicitly the region, have rich renewable energy resources with an increased potential in terms of the possibility of producing renewable energy from photovoltaic, wind or biomass-based sources. Moreover, in Ilfov County there are also important geothermal water resources, extremely little used, but with a huge potential.

Based on the information available in the National Renewable Energy Action Plan, the National Energy Research Institute (ICEMENERG) estimated the Romanian potential production of sustainable energy, as follows:

Renewable energy source	Annual energy potential	Economic energy Equivalent (ktoe[1])	Application
Solar energy:			
- thermal	60x10^6 GJ	1,433.0	Thermal energy
- photovoltaic	1,200 GWh	103.2	Electrical energy
Wind energy	23,000 GWh	1,978.0	Electrical energy
Hydro energy out of which:	40,000 GWh	3440.0	Electrical energy
- under 10 MW	6,000 GWh	516.0	Electrical energy
Biomass	318x10^6 GJ	7,597.0	Thermal energy
Geothermal energy	7x10^6 GJ	167.0	Thermal energy

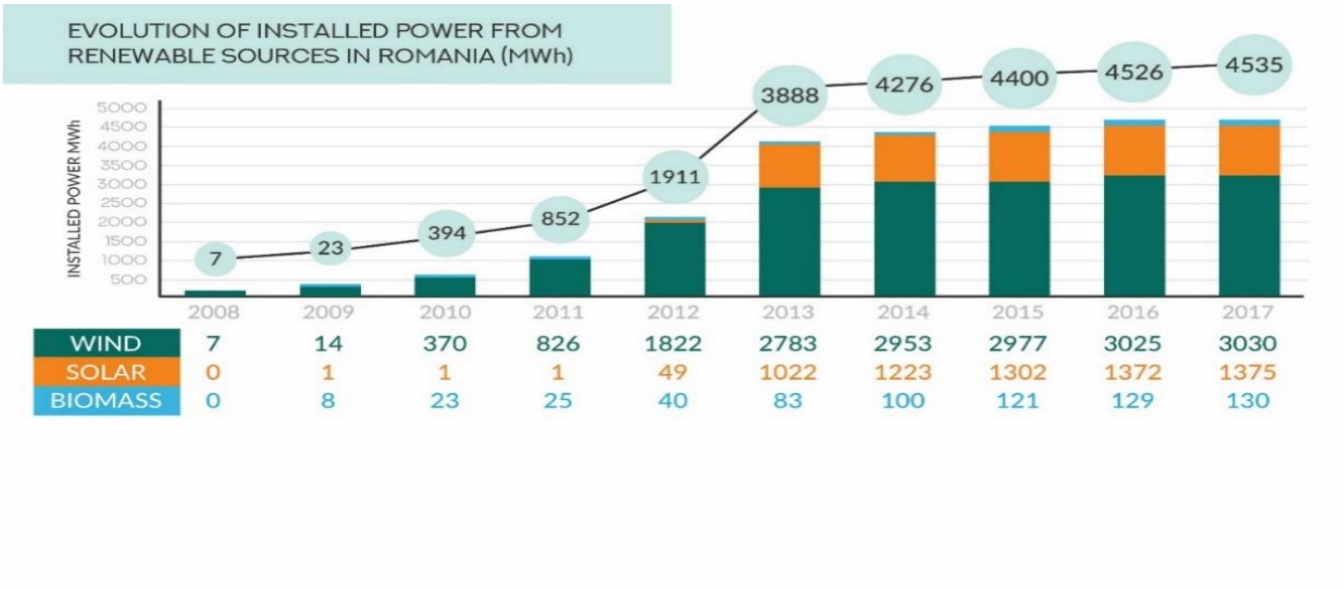
Even though this potential cannot be fully exploited due to technological limitations, low economic efficiency and environmental restrictions, there are major opportunities in terms of our country's potential to become a large producer of sustainable energy.

In this regard, the total power installed in Romania, in the electricity production capacities is 18542, 78 MW and is divided into the following segments, depending on the source, as follows:



[1] Killotons oil equivalent

At the same time, in order to be able to closely analyze the evolution of renewable energy production in the country, as well as the initiatives developed in this direction, we present the dynamics of installed power from renewable sources - wind, solar and biomass.



Regarding the Bucharest Ilfov region, the analysis shows an installed capacity of 8741 MW which includes both renewable sources (solar, biogas, waste) and hydrocarbons. In this regard, we present in the table below some important producers of electricity from renewable sources, as follows:

Name	Location	Installed power MW	Type
CEF Buc - Drumul intre tarlale	Bucharest – 2nd District	2.268	Solar
CETB Chiajna	Bucharest – 6th District	3.6	Biogass
ATWAR & TH SERVICES	Bucharest	2.4	Solar
ELCYROM REALTY & DEVELOPMENT	Bucharest	2.14	Solar
RAMS SOLAR PARK	Bucharest	1.495	Solar

CEF Afumati	**Afumati – Ilfov County**	**2.499**	**Solar**
PARC SOLAIRE DE ZURBAUA	**Zurbaua – Ilfov County**	**8.256**	**Solar**
SPECTRUM TECH INOVATIVE	**Merii-Petchii – Ilfov County**	**7.038**	**Solar**
BIESSE SOLAR	**Dragomiresti Deal – Ilfov County**	**5**	**Solar**
Balotesti	**Balotesti – Ilfov County**	**1**	**Wind**

Even if there are producers of electricity from renewable sources in the region, from the research carried out, the lack of renewable energy production in the agricultural sector is noticeable, until this date no such projects have been identified in our region. Regarding the production of thermal energy for the implementation of agricultural activities, in this case there are no concrete data to highlight a clear picture of the region, being used mainly biomass to generate the necessary thermal energy. There is an activity in the region for growing vegetables for consumption in landscaped solariums that use biomass and pellet-based heat generation plants. In fact, a stakeholder involved in the project activities is a private organization, producing pellet plants, radiant tubes, steam generators and pyrolysis plants that use as fuel, different types of waste.

At the national level, there are several initiatives transposed into implemented projects, all of them meant to promote the production and use of renewable energies, as follows:

- "Rumegus 2000" – based on the sawdust use technology as energy source within the central heating system of 5 cities which was developed based on the cooperation with Denmark;

- Modernisation of 4 hydro-aggregates within "Portile de Fier II" Hydropower System – a project developed in cooperation with Netherlands;

- Modernisation of 3 hydro-aggregates within "Portile de Fier I" Hydropower System - a project developed in cooperation with Netherlands;

- “Use of geothermal energy within the central heating system of Oradea – area 2 and Beius ”, a project developed in cooperation with Denmark;
- Recovery of biogas from the waste landfills of Focsani and Târgu-Mures ;
- Use of biomass for energy production in Neamt County.

Even though we are at the beginning of the road, the potential of the country and the region is high, with many renewable sources (wind, solar, biomass, thermal energy) and the policies that govern this field are either constantly changing or absent. which also generates a lack of confidence and interest in implementing such initiatives.

4. Local policies and actions for the pursuit main goals of the Europe strategy

Romania was the first country specified in Annex 1 of UNFCCC which, by means of Law No 3/2001, that approved the Kyoto Protocol, being obliged to reduce by 8% greenhouse gas emissions in comparison with the reference year 1989, for the first engagement period 2008-2012.

The RES exploitation became an important component of the national energy policy at the beginning of this decade, in the context of overcoming the transition period and the EU approach and the adoption of the Community Acquis in terms of energy resulted in significant effects for the exploitation of renewable energy sources.

In this regard, we present some important legislative initiatives which aim to develop and to encourage energy production from renewable sources, as follows:

- Romanian Energy Roadmap - GD 890/2003 (subsequently amended by GD 519/2007) - prepared in the context of the accession to the EU accession negotiations and provides for the encouragement of the use of RES
- Romania's energy strategy for the period 2007-2020 - GD 1069/2007, with the 3 strategic objectives:

- ✓ Energy security (increasing energy security by ensuring the need for energy resources)
- ✓ Sustainable development (promoting the production of energy from renewable sources, so that the share of electricity produced from these sources in total gross electricity consumption is 33% in 2010, 35% in 2015 and 38% in 2020).
- ✓ Competitiveness (development of competitive markets for electricity, natural gas, oil, uranium, green certificates, greenhouse gas emissions certificates and energy services).

- National Integrated Energy and Climate Change Action Plan (PNIESC 2021 - 2030) - the main regulatory instrument on decarbonisation, energy security, energy efficiency and renewable energy
- National Action Plan for the Recovery of Renewable Energy Sources (PNAER) - following Directive 2009/28 / EC
- Strategy for capitalization of renewable energy sources - GD 1535/2003, with the following general objectives:
  - ✓ integration of renewable energy sources in the structure of the national energy system;
  - ✓ ensuring the energy supply of isolated communities by capitalizing on the potential of local renewable sources;
  - ✓ creating the conditions for Romania's participation in the European market of "Green Certificates" for energy from renewable sources
- The National Strategy on Climate Change in Romania in 2013-2020 provides clear guidance on appropriate climate actions in the agricultural sector, as follows:

- ✓ Direct emission reduction - improving energy efficiency, plus managing carbon and nitrogen flows from the agricultural ecosystem can reduce CO2, CH4 and N2O emissions

- ✓ Reducing emissions through carbon sequestration measures - agricultural ecosystems have the highest carbon stocks and can store more through the range of practices appropriate to local conditions

- ✓ Avoiding (or eliminating) emissions - especially through the production of energy from renewable sources

In order to accelerate the production of E-RES, the Romanian Parliament adopted Law 220/2008 on the establishment of the promotion system of the energy produced from RES. By this law, the annual target and the number of GCs issued for the electricity produced from RES are changed by introducing specific targets for different renewable resources.

In this context, the share of energy provided from renewable sources in the gross final energy consumption is higher in Romania that in EU-28 countries, as is stated in the following table:

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Target 2020
European Union-28 countries (2009-2018) (%)	12,622	13,158	13,411	14,69	15,378	16,219	16,732	16,995	17,473	17,977	**20**
Romania (%)	22,157	22,834	21,186	22,825	23,886	24,845	24,785	25,032	24,454	23,875	**24**

To promote the production of electricity from renewable sources, Romania uses the system of mandatory quotas coupled with the trading system for green certificates. Based on this mechanism, suppliers acquire mandatory quotas of green certificates and the electricity is sold separately on the energy market. The acquisition quotas for green certificates are established in correlation with the targets and their values increase every year. The market energy has dispatching mechanisms that give priority to sales of electricity from renewable sources.

5. Risks and opportunities from policies and market for the spread of renewable energy in agriculture

Based on the research and documentation activities carried out for the implementation of this activity, the SWOT analysis was carried out, which analyzes the strengths and weaknesses, opportunities and threats for a widespread diffusion of the production and use of renewable energies in the agricultural sector and we present in the following table its conclusions:

SWOT analysis	
	

• Rural development programs include in the list of eligible expenditures those for investments in renewable energy production systems or award additional points in the evaluation to meet this condition. • High potential for the development of photovoltaic energy • Abundance of land available for the placement of photovoltaic panels • Use of biomass for thermal energy production • High potential for exploitation of geothermal energy • There are organizations whose research topic is - the development of renewable energy production facilities for the agricultural sector - INMA Bucharest	• Low financial incentives for investments aimed at the development of renewable energy in the agricultural sector, although energy consumption is considerable • Policy formulation could be clearer and sector-specific • Inability to use the degraded agricultural fund for the cultivation of energy plants and their use for energy production • Inability to use geothermal energy sources in the region • Lack of sludge and manure processing facilities • Lack of awareness-raising activities among the population on the benefits of renewable energy production and use in this sector
	
• Possibility of using solar energy for irrigation • Potential for cultivating energy plants as a raw material for biomass production • Potential for the use of geothermal energy in Ilfov County • Potential for biogas production obtained in anaerobic digestion plants - with raw materials from agriculture or the food industry	• Small-scale renewable energy installations may not be economically viable without financial incentives • Decreased agricultural income - lack of capital to invest • Modest income and volatile cash flow • Economic crisis and uncertainty due to Covid-19 • The still high price of renewable energy production facilities - photovoltaic panels • Significant decrease in the agricultural area of the region as a result of the territorial expansion of Bucharest in the surrounding areas and the occupation of construction land

6. Conclusions

Based on the SWOT analysis, the key parts that can contribute to the development of this sector have been identified, and if we correlate all this information, we can conclude the following:

- There is a high potential in the region in terms of the possibility of using geothermal, photovoltaic or biomass energy, a potential that is not supported by financial incentives to encourage investment in this direction.
- Although biomass is an important and truly rich resource in the country, it is not so widespread and used in the region.
- There is concern among regional actors regarding the development of renewable energy generation facilities for the agricultural sector.
- The low level of awareness of the benefits of producing and using renewable energy among farmers, coupled with the volatility of income and the lack of financial incentives to provide investment, determines the development of this sector.
- There is a lack of available strategies and funding for the construction of biogas plants, which use sewage sludge, manure sludge or food industry as raw materials.
- The territorial expansion of Bucharest increases the degree of urbanization of the region and therefore attracts the decrease of areas and agricultural activities.
- The development of resilient and flexible infrastructure will be central to the integration of renewable energy sources - a high degree of network stability can ease the energy transition.

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