

## **Statistical analysis regarding energy supply and demand in the EU and Romania between 1990 and 2014**

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**Abstract:** *Climate changes and mankind's unlimited needs in term of energy, in opposition with the limited nature of our planet energy sources, impose an all new approach regarding the way in which we produce our energy and how efficient we are using it. The European Union is a world leader in promoting sustainability in this field, and Romania, as part of this multi-state organization, follows the same path. We will see further in this paper the evolution of the main statistical indicators regarding energy, with a particular emphasis on electricity, for both the EU and Romania. The starting point will be primary energy production and demand, continuing with the sources of energy, and finishing with electricity and its relevant indicators regarding production and renewable sources. Finally, the relevant conclusions will be drawn.*

**Key-words:** *energy, electricity, supply, consumption, renewables*

### **1. Introduction**

Throughout history mankind has continuously consumed the resources of this planet that hosts us, at first to secure our survival and then gradually arriving to satisfy our most complex needs, whether these are material or spiritual. All these needs have in common the fact that they require energy, and this energy is obtained in the most diverse ways, each stage of our development having a predilection towards one energy resource or another. Unfortunately, this consumption of resources was not the most rational possible, so that we are now in the position to try to radically change our thinking from this point of view, being aware that the planet's resources will end well ahead of the needs of mankind. A noticeable interest emerged in recent decades in sustainable energy resources, materialized in worldwide initiatives and the implementation of these with considerable efforts to ensure the sustainability of our way of development; the massive investments in renewable energy resources are

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one of the most eloquent examples. Also, as technology has progressed, the efficiency with which such limited resources are being used has increased significantly, and long-term effects can only be positive, provided that it is maintained at the same intensity.

## **2. The purpose of the analysis**

The evolution and development of a society is based on energy use. This is essential in the production of goods and services that contribute to obtaining welfare. In recent decades, worsening climatic conditions, depletion of natural resources and the demographic explosion caused a change in traditional approach, determining the finding of solutions to reduce dependence on imports of primary energy resources and fighting climate change. These solutions materialized in the use of renewable energy sources and technologies that protect the environment, favoring the emergence of a new market, constantly expanding and registering very interesting phenomena that need to be analyzed.

That being said, it is important to constantly monitor the progress made so far, knowing the relevant statistical indicators, as this will represent the starting point for further measures that will increase even more the efficiency with which energy resources are being used, and with an even less impact on the environment.

## **3. Statistical analysis of electricity supply and demand in the EU**

The European Union is the largest interstate alliance in the world, counting 28 European member states. With a population of about 7% of that of the entire world and a GDP of about 24%, this union of states, which initially started as a mere economic community between 6 member states in the 1950s, it became nowadays a supranational organization very well put together, having increasingly more the characteristics of an organism by itself than that of a traditional alliance. With a well-planned legislation and implementation institutions and a functional control mechanism, EU policies are well defined in all areas, including a crucial area such as the energy field.

The EU currently imports more than half its energy demand. This dependence is even more pronounced with fossil fuels, over 90% of oil and over 66% of natural gas coming from import. Furthermore, many member countries are captive to a single supplier, including countries that depend exclusively on the Russian natural gas.

To address these challenges, in 2014 the European Commission developed the Energy Security Strategy, designed to ensure a safe and stable energy supply. In addition to short-term goals, like the confrontation with possible energy problems, this strategy targets on a long-term the reduction in energy consumption at the European level by improved energy efficiency, increased production of energy

from both traditional resources and renewables, diversified energy suppliers and improved energy infrastructure.

A measure in this regard is the 20-20-20 Directive (2012/27/EU EED) which imposes a 20% reduction in emissions of greenhouse gases (CO<sub>2</sub> equivalent) compared to 1990, a 20% reduction in the final energy consumption compared to 2005, through increased energy efficiency, and the increase of renewables share in the overall energy mix to at least 20% by 2020.

This program reached its intermediate targets so far; according to latest reports from the EU, 2014 saw a 16% renewable energy contribution in gross final consumption of energy in Europe, avoided CO<sub>2</sub> emissions of 326 Mt in 2012 and 388 Mt in 2013, reduced demand for fossil fuels to about 116 Mt in 2013. Furthermore, in 2014 the EU's dependence on energy imports dropped to around 53%.

The European Union is the 3<sup>rd</sup> largest energy consumer in the world, following China and The United States of America. However, from the supply point of view, the same EU is only the 4<sup>th</sup> largest energy producer, after the China, USA and Russia. The particularity of this hierarchy is that, whereas other mentioned countries register an increase, or at least a constant, supply and demand between 2010 and 2014, the EU registers a light decrease both in consumption and production of energy.

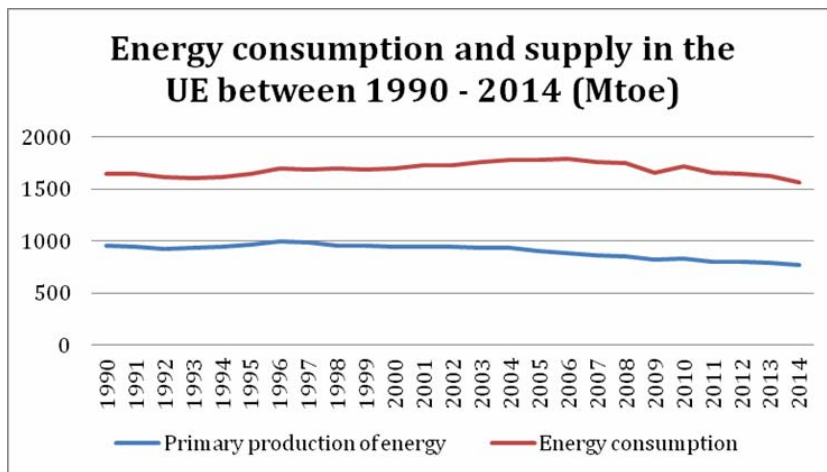


Figure 1. Energy consumption and supply in the UE between 1990 - 2014

It can be easily noticed the significant gap between energy supply and demand. Even if between 1990 and 2014, 16 new countries joined the EU, the impact on the two macro indicators was relatively low in terms of their evolution. However, especially in the last five years, a downward trend is noticeable, especially on the consumption part, a good sign that the directives regarding energy efficiency are showing their effect. Also, in 2014 it is being confirmed the EU's reduction in energy dependence on imports.

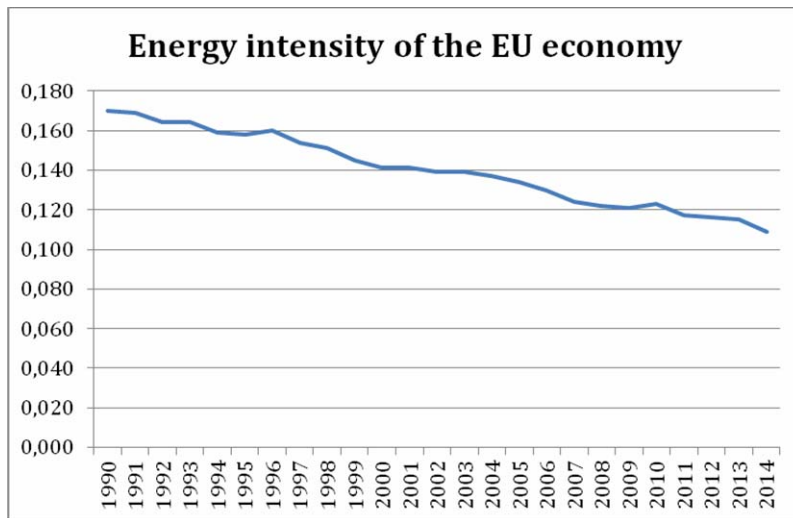


Figure 2. Energy intensity of the EU economy

Significant progress is observed in the energy efficiency of the economy, between 1990 and 2014 business processes gained a 46% increase in energy efficiency.

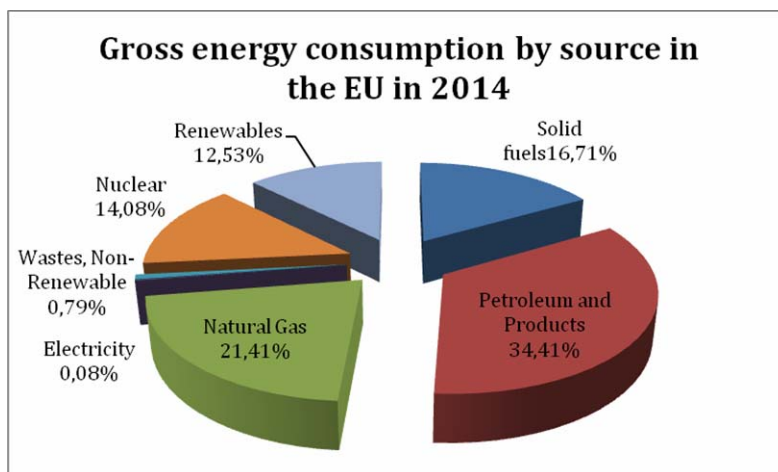


Figure 3. Gross energy consumption by source in the EU in 2014

Analyzing the gross energy consumption structure, there can be seen that the main supplier is oil (and its similar products), followed by natural gas and solid fuels. Noticeable the near 13% held by renewable energy, with biomass being the highest contributor, followed by hydropower.

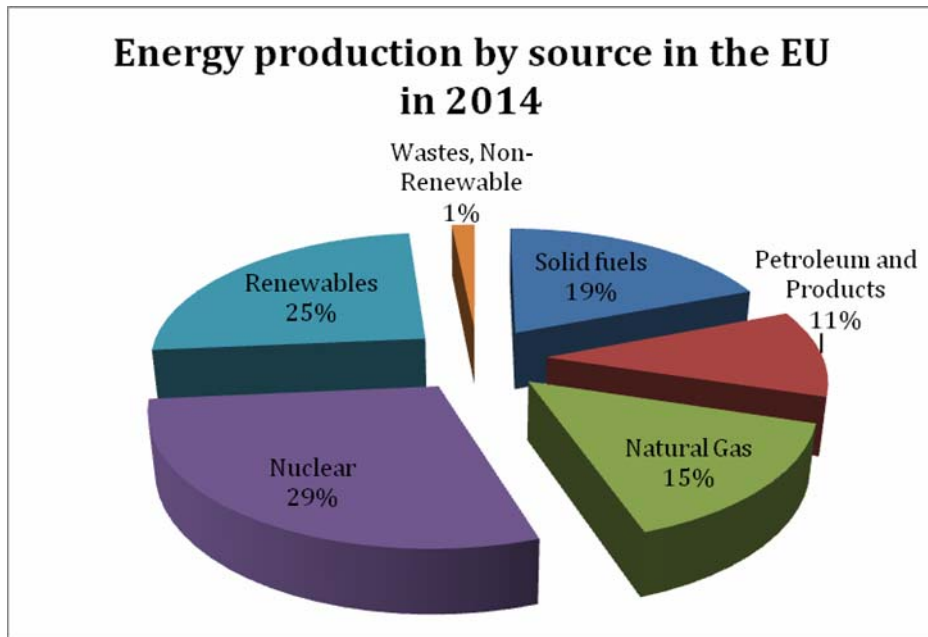


Figure 4. Energy production by source in the EU in 2014

On the production side however, the main share is held by a low carbon source, namely nuclear energy, followed closely by renewables, whilst fossil fuels contribute with only 45% of the total energy produced in the EU.

Considering the importance of nuclear energy in the EU's energy balance, specific measures have been taken, the so called 'Euratom Safeguards' being established under the 1957 Euratom Treaty to make sure that fissile nuclear material such as uranium and plutonium is not diverted from its intended use by the users, and is used only for peaceful purposes in the EU.

However, by 2030, nuclear capacity that will be lost due to the closure of a number of reactors – either because they have reached the end of their operating lifetimes or due to political interference – is expected to outweigh that gained from new reactors. A slight decrease from the current EU nuclear capacity of 122 GWe is therefore expected soon.

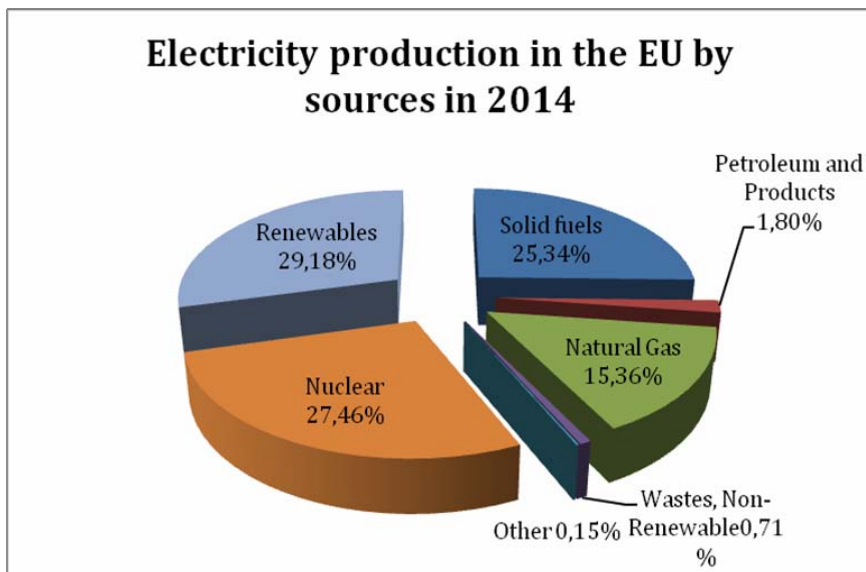


Figure 5. Electricity production in the EU by sources in 2014

Electricity production sees a situation somewhat similar to that of the whole energy sector, considering that the main supplier for electricity in the EU is represented by renewable sources followed closely by nuclear power and solid fossil fuels.

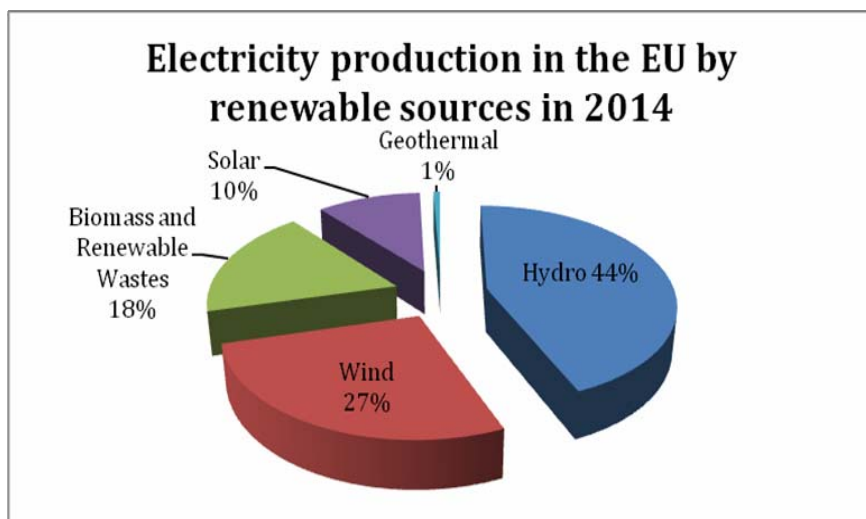


Figure 6. Electricity production in the EU by renewable sources in 2014

In terms of renewables, hydropower holds the largest share (close to half), followed by wind and biomass, as shown below. Solar energy also contributes with about 10% of total electricity production in the EU. Due to modest values, tidal and wave energy are not present in graph (although used, with a contribution of just 0,02 %).

#### 4. Statistical analysis of electricity supply and demand in Romania

We treated so far the situation of the energy sector at the European level. But how does Romania fit in in this context, considering that it's been a member state of the EU for approximately 9 years?

Our country has a diversified range of primary energy resources (fossils and minerals such as oil, natural gas, coal and uranium) but in relatively modest amounts. However, it also holds a great potential of usable renewable resources. Although the latest discoveries of natural gas in the Black Sea give Romania a significant advantage in the path to achieving energy independence, the energy balance is still a poor one, involving considerable fossil fuel imports, mainly from Russia.

This dependence on imports is even more obvious since between 1990 and 2014 the primary energy production of our country has declined steadily, caused mainly by the depletion of fossil fuels reserves and the closing of many coal mines, especially during post-communist transition.

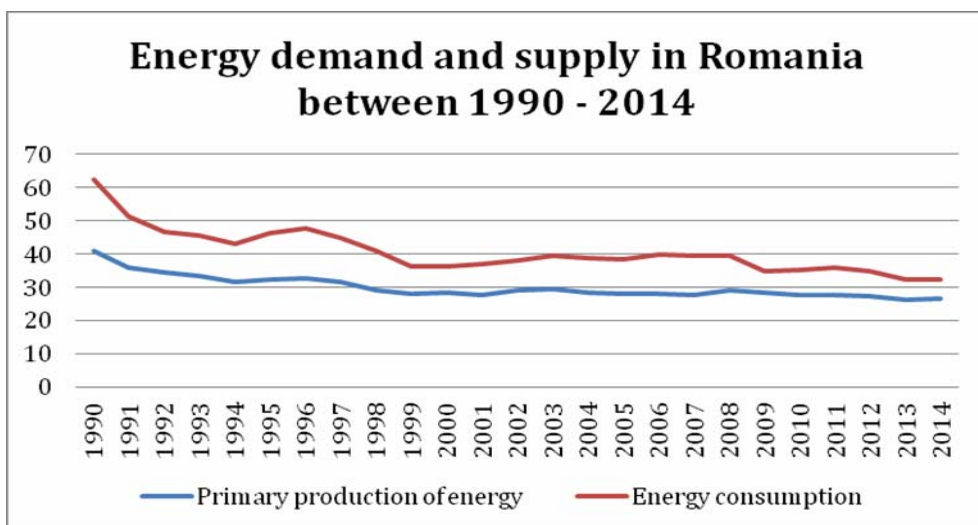


Figure 7. Energy demand and supply in Romania between 1990 - 2014

As shown in the figure above, Romania's energy balance has been consistently poor in the time slot in question. However, the gap has a clear downward trend.

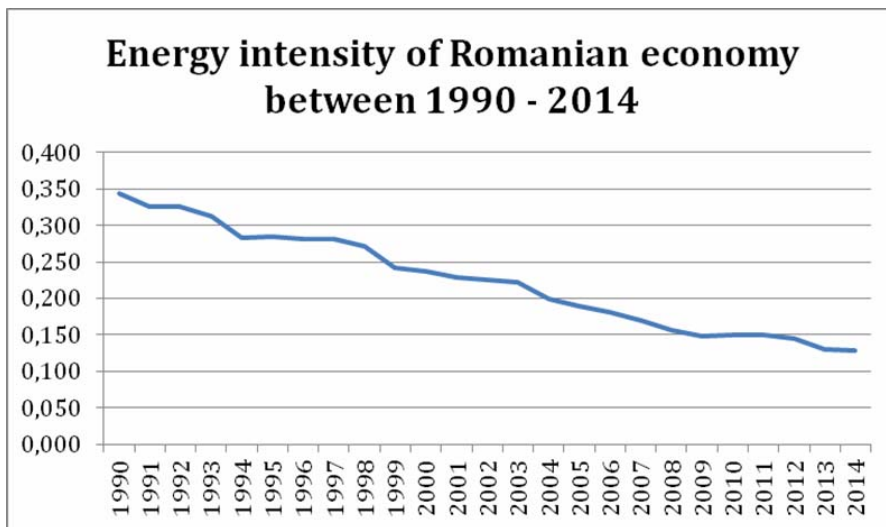


Figure 8. Energy intensity of Romanian economy between 1990 - 2014

From the efficiency point of view, the economy of Romania follows the same European trend of improving energy efficiency, with a consistent decrease in energy consumption per unit of GDP. Taking as reference 2014, Romania appears to be ahead of countries such as Sweden, Belgium, USA, Australia, Czech Republic and Canada.

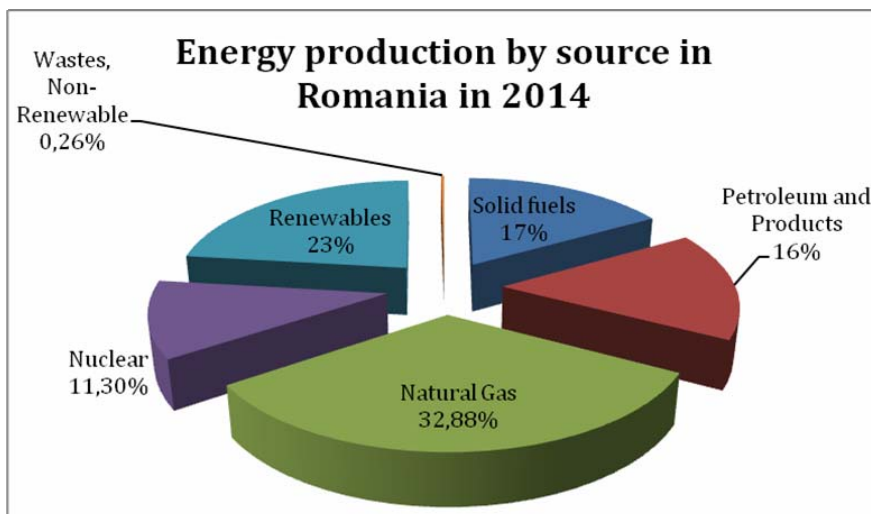


Figure 9. Energy production by source in Romania in 2014



There can be seen from the chart above the current structure of Romania's energy production. The main share of primary energy production is held by natural gas, with almost 1/3 of the total production, a situation that's significantly differentiating Romania from what is happening at the European level. On the other hand, our country took the same commitment to obtain "clean" energy, almost a quarter of the energy produced nationally is from renewable sources. According to the report on the promotion and use of energy from renewable sources, published by the Romanian Ministry of Energy, our country will achieve its assumed targets for 2020, namely that 24% of gross final consumption of energy to be covered by renewable sources. This performance was possible due to massive investments made in recent years in this area, or at least until 2011, when our country was ranked 13th worldwide among the countries that are most attractive for such investments. Unfortunately, changes in legislation made this position to be seriously affected, descending in 2015 to position 35 in the same ranking, as shown by the EY report, Renewable Energy Attractiveness Index country (RECA), issued by AGERPRES. Below is presented the top 20 most competitive countries in terms of attractiveness for investment in renewable energy, according to the mentioned above report.

Rank	Previous ranking	Market	RECAI score	Technology-specific indices rankings							
				Onshore wind	Offshore wind	Solar PV	Solar CSP	Biomass	Geothermal	Hydro	Marine
1	(1)	China	75.6	1	2	1	3	1	13	1	16
2	(2)	US	73.3	2	8	2	1	2	1	3	9
3	(3)	Germany	66.3	3	3	4	27*	8	8	10	27
4	(4)	Japan	64.5	13	9	3	27*	3	3	4	10
5	(6)	India	62.1	6	17	5	5	15	14	6	11
6	(5)	Canada	59.8	4	11	12	23	13	18	5	6
7	(8)	France	58.9	9	7	8	27*	9	15	15	5
8	(7)	UK	58.5	8	1	10	27*	5	19	24	2
9	(9)	Brazil	56.7	5	25	11	9	4	32	2	24
10	(10)	Australia	56.0	18	18	7	6	20	11	25	12
11	(12)	Chile	55.3	26	22	6	2	21	10	17	14
12	(11)	South Korea	55.0	23	12	13	24	12	28	16	3
13	(13)	Netherlands	54.0	12	5	23	27*	10	24	32	30
14	(14)	Belgium	53.9	25	4	17	27*	11	21	29	31*
15	(16)	South Africa	53.2	19	28	9	4	33	35*	18	19
16	(15)	Italy	51.9	24	21	15	11	14	7	14	23
17	(17)	Denmark	51.8	14	6	29	27*	16	35*	36	17
18	(19)	Turkey	51.5	11	24	28	14	34	6	9	20
19	(18)	Portugal	51.1	22	20	25	18	24	17	20	7
20	(21)	Sweden	51.0	10	13	35	27*	7	26	12	13

Source: Renewable energy country attractiveness index (RECAI)

Figure 10. Top 28 most competitive countries in terms of attractiveness for investment in renewable energy

From a structural point of view, energy consumption in Romania sees the same prevalence of natural gas, although to a lesser extent if we relate to the structure of production, while oil and assimilated products follow closely with about 26% share. It is easy to understand from the 2 charts, supply and demand, that Romania is still depending on oil imports to meet the consumption needs of the economy and population. On the other hand, it appears that the requirements of the EU Directive broadly called "20-20-20" will be easily achieved, since in 2014 already 19% of Romania's energy consumption was covered by renewable resources.

The structure of the latter emphasizes the primary role of biomass and reusable wastes (about 12% of total energy consumption in Romania), followed by hydro (5%) and wind (1,7 %).

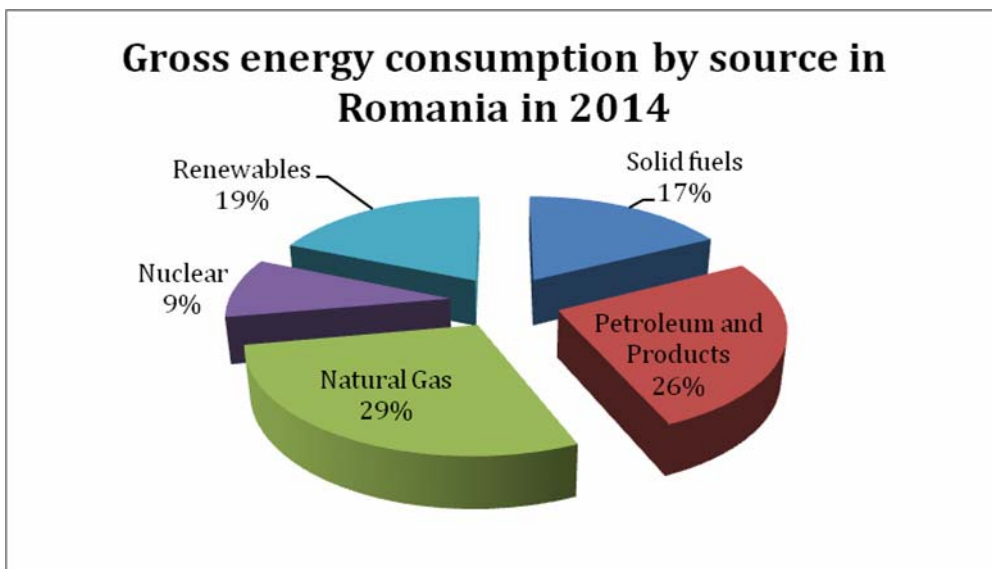


Figure 11. Gross energy consumption by source in Romania in 2014

On the other hand, if we look at the sources of produced electricity, we can see that renewables hold the largest share, followed by solid fossil fuels and nuclear energy. Going further with the analysis, the main source of renewable electricity is hydropower with an overwhelming share of 70%, wind energy being used for producing electricity at a rate of 22 %, while photovoltaics provide approximately 6 % of the total electricity produced in Romania.

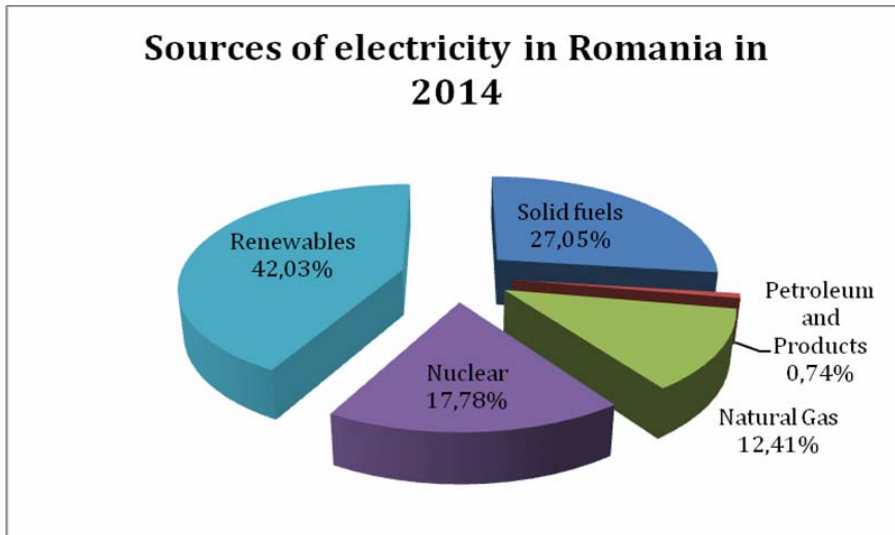


Figure 12. Sources of electricity in Romania in 2014

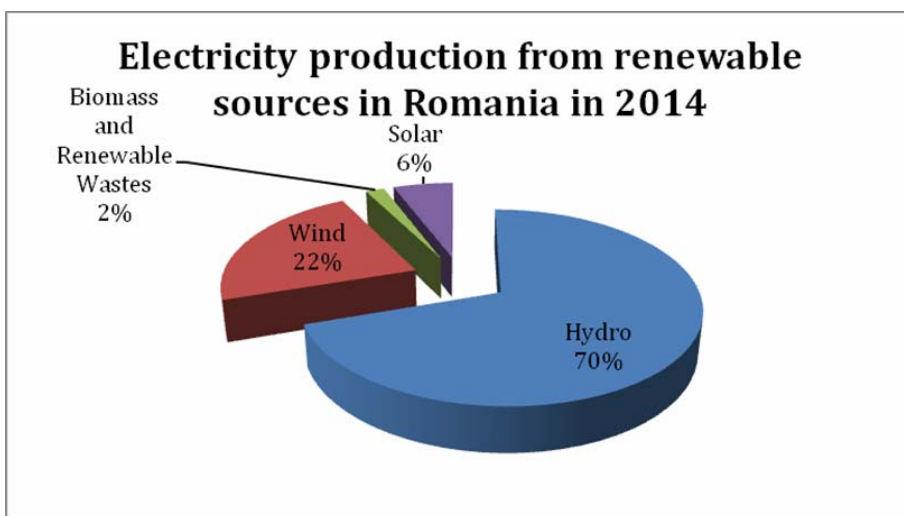


Figure 13. Electricity production from renewable sources in Romania in 2014

## 5. Conclusions

Important steps have been taken in the past 15 years or so in terms of sustainable use of our energy resources, and the examples of both the EU and Romania can provide

a more optimistical approach for future initiatives. Even taking into account the particularities of natural resources available for every country, EU has managed to provide a common energy perspective that showed, and will do so in the future, significant results both in terms of the efficiency with which energy resources are used and in terms of usage of energy sources with low impact on the environment.

We do not know what the future holds, but we know what we can do now for a more rational use of our resources and more states worldwide seem to realize this fact.

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