

# OPPORTUNITIES IN THE AGE OF CLIMATE CHANGE THROUGH CULTIVATION OF ENERGY PLANTS IN “SIRET-PRUT-NISTRU” EUROREGION

## OPORTUNITĂȚI ÎN EPOCA SCHIMBĂRILOR CLIMATICE PRIN CULTIVAREA PLANTELOR ENERGETICE ÎN EUROREGIUNEA „SIRET-PRUT-NISTRU”

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### Abstract:

*The cultivation needs of energy plants were identified and land was provided for possible cultivation. The potential introduction of new species were calculated and trends of energy plants in Moldovawere examined. It was found that the raw material in the country of phyto-products allows the contribution of biomass in total energy consumption up to the level of 25%. Opportunities to increase the amount of biomass for energy provide energy for plant cultivation, which will help improve the environment.*

**Keywords:** *biomassenergy plants, Salix, Miscanthus, sylph, calorific value, land for energycrop cultivation.*

**JEL:** *C22, D58, L72, Q27,*

### 1. Introduction.

Biomass is one of the most important renewable energy resources of the present and the future, due to its great potential and the various benefits offered socially and ecologically. Biomass is, in fact, available for use all over the world. Affordable cost and greenhouse gas neutrality make biomass a promising energy resource in many countries, including our own. The Republic of Moldova, being a predominantly agrarian country, practically does not have its own energy sources, thus, 98% of the necessary energy is covered at the expense of the import of energy agents. Therefore, the issue of the use of renewable energy sources (RES) has been and remains very current. The biomass obtained in phyto-technics can be used for energy purposes, but it does not cover the need for renewable biomass. That is why it is necessary to cultivate energy plants.

### 2. Degree of investigation.

The theoretical basis of the research was anchored in the works of local and foreign scientists who significantly contributed to the development of the approach to the energy alternative: Milner B.Z., Reisberg B.A., Rapoport B.C., Horwart I., Gribincea A., Bârdan V., Epuraș O. Other researchers such as Dzyga NV, Kosenko VG, Pilzer M have greatly contributed to the development of the bioenergy economy. At the same time, the current developments do not address the development of conceptual approaches and development management tools that take into account the specificity of the bioenergy sector and the tasks

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of territorial distribution of bioenergy facilities have not been resolved.

**The aim of the research** is to investigate the global energy problem by replacing traditional fossil resources with alternative biomass resources.

**The methodological basis** of the study was the works of domestic and foreign researchers on the issues of global energy theories, program-oriented planning and management of the development of bioenergy fields. In solving the problems, methods of comparative analysis, grouping, systematic approach and comparison of theoretical and practical material were used, which allowed the provision of reasonable and reliable conclusions.

### **3. Necessity to develop businesses in cultivation of energy plants**

The International Energy Agency estimates that in Europe, oil resources will be depleted in 40 years, natural gas resources in 60 years, and coal resources in 200 years, which would mean that, in about 20 years, Europe will have to import 70 percent of its energy needs. As a result, the states of the union had to proceed with the use of renewable sources. The task has been to ensure that by 2020, 20% of the energy consumption of the EU states will be provided from renewable sources [9]. The Republic of Moldova has an important biomass potential, the capitalization of which would make a large contribution to rural development and the implementation of sustainable heat, electricity and fuel supply systems for means of transport. In this context, the role of the state is to promote an integrated environment and energy policy, with a threefold objective - to limit the country's vulnerability to the import of primary energy resources, to ensure economic growth and to combat climate change. It is necessary to take into account the recommendations of pedological scientists on the use of plant residues and to maintain soil fertility and then as SER. In our country, there are no concrete recommendations regarding the minimum of plant residues necessary to maintain soil fertility. From the practice of some countries, it appears that 75% of the biomass is chopped directly as field residues or used in animal husbandry, which is returned to the fields as organic fertilizer to maintain sufficient soil fertility [6]. Therefore, 25% of the residues obtained in phyto-technics can be used for energy purposes. That is why it is necessary to cultivate energy plants for satisfaction in RES [5]. A document that refers to renewable sources and, in particular, to biomass, is the Energy Strategy of the Republic of Moldova until 2020, adopted by Government Decision no. 958 of August 21, 2007, which mentions the role of energy plants [1]. Energy willow or Chinese reed, also known as elephant grass, are two of the plants cultivated for their superior caloric properties. Specialists say that in the climatic conditions in our country, both energy willow and reeds could be cultivated. The calorific value of one kilogram of willow is 5.7 kWh, and one kilogram of reed - 4.75 kWh, while the calorific value of one kilogram of deciduous wood is 3.1-4.2 kWh. In addition, heating with power plants is 10 times cheaper than diesel and 30% cheaper than gas.

Among the advantages of energy plants is the fact that they are grown only once and can be exploited annually, for a period, some up to 25 years, which qualifies these plants to be considered sources of renewable energy. Another immediate advantage would be the protection of forests, as there would be no need for massive cutting of firewood trees. Willow, for example, grows 7 meters high, and one hectare produces 40 tons of wood per year.

Other advantages of this energy willow culture are:

- due to high content of salicylic acid, chopped willow does not require closed storage. In a few months the water content of the cut wood decreases to 14 - 16%, which allows its processing without artificial drying;
- the crop is harvested with ordinary agricultural machines (combine, tractor, trailer) and in the winter months (November - March, after the fall of the leaves) thus ensuring a better exploitation of the car park and the labor force;
- the spread of the energy willow culture guarantees a safe and non-polluting source of energy, but at the same time it protects the forests from the continuous deforestation caused by the chase for cheap firewood;
- renewable energy. The life period of a plantation is approx. 25 to 30 years, which, starting from the second year, apart from harvesting, does not require any other intervention [5].

Energy willow is a fast growing plant (approx. 3 - 3.5 cm / day, bringing in the first year 4 - 6 shoots and reaching 2 - 3 m in height.

The maintenance of the crop is very simple, a good part of the works being executed before and at the beginning of the vegetation: deep plowing, soil disinfection, planting and mechanical weed control. Next, the willow grows very fast, in the second year the bushes bringing 10 - 25 shoots, of which approx. half reach a height of 6 - 7 m and a diameter of up to 3 - 4 cm. The crop is harvested with special machines of different capacities (and prices) depending on the areas to be harvested, using ordinary agricultural machines (combine, tractor, trailer). These works are carried out in the winter months (November - March, after the fall of the leaves), thus ensuring a better exploitation of the car park and the labor force (fig.1.)

The Chinese reed grows four meters high and has a multiple use: pellets, briquettes, furniture industry, cellulose, as well as plastics and construction materials industry. Moldova is in a favorable position to be able to cultivate the most important energy plants in the world in conditions of maximum efficiency. We are referring, first of all, to maize, the surface of which can be increased and a part of the surface is destined for the production of biofuel. Rapeseed, a plant that has seen a great expansion in recent years, follows in order. Its cultivated area would also expand in cultivation, mainly due to the good price offered by oil factories, now the biggest businesses are related to the financial groups that have invested in the production of biodiesel.

Agrotechnical arguments:

- from an agrotechnical point of view, these energy plants are very good precursors for wheat, a crop that occupies almost half of the arable land;
- energy plants release the soil early, and from plowing to sowing there is enough time for soil mineralization;
- wherever agrotechnical rules apply, power plants leave the land free of weeds, which greatly reduces herbicide costs;
- plant residues, almost entirely, are incorporated into the soil, and the resulting organic matter contributes to increasing soil fertility;
- soybeans have the great quality of storing in the soil 100 kg of natural nitrogen per hectare, which is equivalent to 300 kg of ammonium nitrate or 200 kg of urea;

- in the case of some energetic plants - sunflower and rapeseed - the deep root system contributes to the breaking of the harpoon, which is equivalent to a deep work of the soil. In addition, the roots after rotting play a dual role: aerating the soil and providing organic matter.

**Figure.1.** Harvesting energy willow culture [authors' research]



#### **4.Possible land for cultivating energy plants**

The lands for cultivating energy plants are chosen according to the biomass production systems. These systems represent ensembles of vegetable crops grown within a household (farms), some of which are intended for obtaining biomass for energy purposes. This concept is determined by the fact that not all plant products in the farm can be used for commercial purposes, but all together can bring profit through differentiated use and utilization. Thus, in addition to the main product of a crop, there are by-products (straw, coke, etc.) that can be transformed or used for energy purposes. Also, within some judiciously designed crop rotations, valuable species from the energy point of view can be introduced to cover the need for renewable biomass and at the same time to ensure the efficient use of land, resources and to contribute to the conservation of the environment.

Among the advantages of so-called "super-weed" energy plants is the fact that they are not demanding to the soil and land for cultivation, they are cultivated only once and can be exploited annually, for a period of up to 25 years, which qualifies these plants should be considered as renewable energy sources and can be placed on land outside of crop rotations. Another immediate advantage would be that they can be grown on swampy or temporarily flooded land.

Other possibilities to place energy plants is that annually there are over 200,000 hectares of abandoned land (fallow ground) and about 1,000-1,500 hectares of swampy land,

at the same time we mention that they can be cultivated near treatment plants. There are many unused lands, especially in the area of rivers, ponds, where there is an environment conducive to such plants. "From an environmental point of view, it would not be a problem, because oxygen would be produced." According to the Strategy for the Sustainable Development of the Forestry Sector in the Republic of Moldova, it is planned to expand the areas with forest vegetation in connection with the degree of afforestation. The afforestation of new lands will contribute to the creation of a forest network, to the reduction of soil erosion, and to the protection of lands threatened by landslides (about 50 thousand ha), where it is possible to plant acacia, energetic poplar, etc. There are many unused lands in the Republic of Moldova, especially in the river area, where there is a favorable environment for such plants (especially energy willow). Approximately 7,535 ha of agricultural land have been affected, so that in order to improve the situation it is reasonable for these lands to be used for the cultivation of energy crops [5].

The characteristic of the local vegetation potential and the tendencies of the introduction of new species. In the Republic of Moldova, residues from agricultural crops are an important source of biomass, because large areas of land are used in agriculture, generating significant amounts of agricultural residues [3]. At the same time, such crops as rapeseed, sugar sorghum, Jerusalem artichoke can be grown especially as energy plants, which have a fairly high energy potential. Thus, over one t of ethanol with a potential of 78 mln can be obtained from one hectare of sugar sorghum. Mgj and dry vegetable mass of 20 t with an energy of 314 thousand Mgj. One hectare of rapeseed brings a ton of oil, which can be equivalent (indicative) to a ton of diesel and a dry mass of 3 t with a calorific value of 47 mln.Mgj [4]. Ethanol obtained from the fermentation of sugar sorghum juice can be used as an addition to gasoline (20% ethanol) as fuel for internal combustion engines with spark ignition, give rapeseed oil after its transformation into methyl ester - as fuel in internal combustion engines with compression ignition [6]. Annually in the agriculture of the Republic of Moldova biomass, which is the main RES is cultivated on 1839.7 thousand ha of arable land, 153.6 thousand ha live and 141.5 thousand ha orchards, which is 1.1-1.2 mln. tons, or 4.8 million. MW / h.

**Table 1.** Vegetation potential characteristic of new perine species [2]

Characteristics	Units	Willow	Poplar	Acacia
Culture density	stem/hectare	18 - 25 000	10 -15 000	8 – 12 000
Diameter at harvest	mm	15 – 30	20 -50	20 - 40
Height at harvest	m	3,5 – 5,0	2,5 – 7,5	2,0 – 5,0
Fresh harvest	tons/hectare	30 - 60	20 -45	15 - 40
Moisture content	% weight	50 -55	50 -55	40 - 45

**Local and introduced species - requirements for growing conditions and possible cultivation area.** The agricultural crops used for energy purposes are technical plants and cereals. The technical crops include oilseeds (sunflower, soybean, rapeseed), used in the production of oil / biodiesel and sugar plants which, like cereals, can be used in the production of bioethanol [6]. Energy plants are grown exclusively for energy purposes and are not used in other sectors [7]. This group of vegetable crops includes some high-growth

grasses (stuh, Panicum Virgatum, etc.), perennials, oilseeds (rapeseed), fodder crops (sugar sorghum, alfalfa) and even high-growth trees. (poplar, willow, Oltenian acacia).

The crops that can be established as non-food energy plants are

<p>Populus hibridus energetic (Populus hibridus),                  Silfia (Sida hermaphrodita),                  Energy willow (Salix viminalis "energo"),                  Arundo (Arundo donax L.),                  Artichoke (Cynara cardunculus),</p>	<p>Jerusalem artichoke (Helianthus tuberosus),                  Elephant grass (Miscanthus giganteus),                  Oltenian acacia (Ammodendron Fisch.),                  Switch grass (Panicum virgatum),                  "Szarvasi-1" energy grass.                  The Princess Tree (Paulownia tomentosa).</p>
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Requirements for growing conditions and possible cultivation area of energy plants. Willow makes very good use of land unsuitable for other crops, such as floodplains. Having a high evapotranspiration capacity (approx. 15 - 20 l / m<sup>2</sup>) it is successfully used for the decantation of domestic water (around treatment plants). It has an annual collection capacity of 20-30 t / ha of sludge from wastewater treatment. This property, in addition to the advantage that in an area where the plantation can be flooded with waste from treatment plants, grows faster, has the great advantage that wastewater should not be treated biologically (expensive operation) and on the other hand the water resulting from at treatment plants - they reach very clean rivers, avoiding water pollution but also additional costs due to payments as a penalty for improper water quality [2]. The use of lands with high humidity, where other plants cannot be cultivated is beneficial for the energetic hybrid poplar and miscanthus [5]. Sugar sorghum, sylphia and acacia can be grown on less moist soils [8]. Artichoke proves to be the only economic plant that capitalizes in conditions of maximum efficiency on poorly productive land, often unsuitable for agricultural crops. Or, in Moldova, an agricultural area threatened by a strong desertification, in the southern households considered to be the most fertile, artichokes are the plant that can stop the desolation of the plain and ensure people an economic and social chance.

### 5. Conclusions

The sustainable development of the national economy requires a secure energy supply. Because energy supply is a complex issue, it can be solved by using renewable energy resources such as biomass energy.

In the Republic of Moldova, the raw material from phytotechnical by-products allows the contribution of biomass in the total energy consumption to be at the level of 25%. Real possibilities for increasing the amount of biomass for energy purposes offer the cultivation of energy plants, which will contribute to improving the environment.

### Bibliography

1. Arion V., Bordianu C. *Biomass and its use for energy purposes*, Chisinau, 2008, 268p.
2. Borkowska H., Styk B. *Slazowiec pensylwanski uprawa i wykorzystanie*. Lublin: WAR 2006, 68 p.
3. Gribincea A., Bârdan V., Epuraş O. *The global problem - the substitution of traditional fuels. Theoretical-scientific journal Economics and Sociology*, Nr. 3/2011, pp. 47-56.
4. Gribincea A., Epuraş O. *Opportunities to use alternative energy sources in the Siret-Prut-Nistru Euroregion. The role of Euroregions in sustainable development in the context of the global crisis. Example Siret-Prut-Dniester Euroregion*, vol. VII, International Conference. October 29, 2010, Iaşi: Inst. Gh.Zane, Tehnopres, 2010, pp. 241-249.
5. Gumovschi A. *Biomass as a renewable energy source*. The training module. ACSA, Chisinau, 2012, 45 p.
6. Gumovschi A. *Vegetable waste - a safe source of energy. Economic store*, Chisinau, no.185, 13 08 2008, 18 p.
7. Gumovschi A. *Plant debris - a reliable source of bioenergy and organic matter for maintaining and increasing soil fertility*. EcoMagazin Weekly, 1. 05. 2009, Bucharest
8. Hăbăşescu I., Cerempei V., Deleu V. *Biomass energy: Technologies and technical means*. Chisinau, 2009, p.365.
9. *Renewable energy law*, no. 160-XVI of 12.07.2007. Official Gazette of the Republic of Moldova. no.127-130 / 550 of 17.08.2007, 11 p.
10. Sobor I., Caraghiaur D., Şota Nosadze et al. *Renewable energy sources*. Lecture course. Chisinau, UTM, 2006, 380 p.
11. Stolarski M. *Biomasa pochodzenia rolniczego jako odnawialne zrodio energii*, PODR w Gdansku Oddzial w Starym Polu. Gdansk, 2008, 82p.