SUSTAINABLE DEVELOPMENT IN AGRICULTURE WITH RESPECT TO ENERGY SAVINGS POTENTIAL

DEZVOLTAREA DURABILA IN AGRICULTURA SUB ASPECTUL POTENTIALULUI DE ECONOMISIRE A ENERGIEI

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Abstract: *The National Program for Rural Development (PNDR), in accordance with European Directives, defines among the general objectives regarding the sustainable development of the Romanian Agriculture for 2007-2013, a series of objectives regarding the decrease of the energy consumptions, production and use of the renewable sources of energy, greenhouse gas emission reduction, providing of biomass resulted from agricultural activities and support for micro-enterprises in rural area to produce electrical and thermal energy using bio-fuels. Despite the fact that agricultural energy consumption represents about 1% (during 2001 -2006) of the final energy consumption in Romania, there are a series of measures which can result in the energy consumption decrease in this field and to the successful use of the renewable energy sources. The research goal is to identify these concrete measures and their application within the different fields of agricultural activities. Starting from the energy consumption structure of agriculture in 2005 and taking into account the foreseen growth rate in this field, the paper analyzes the energy savings potential in the context of Romanian Energy Strategy for 2007 – 2020 period and National Strategy for Energy Efficiency. The presumed evolution of the energy savings is presented and the resulted greenhouse gas emissions reduction for 2009–2020 period is estimated. There are also pointed out the necessary investment funds for the application of the energy efficiency measures in order to achieve the energy savings target.*

Rezumat: *Programul National de Dezvoltare Rurala (PNDR), in conformitate cu Directivele Europene, defineste printre obiectivele sale generale cu privire la dezvoltarea durabila a agriculturii romanesti pentru perioada 2007-2013, o serie de obiective referitoare la reducerea consumurilor energetice, producerea şi utilizarea energiei regenerabile, reducerea emisiilor de gaze cu efect de seră, furnizarea de biomasă provenită din agricultură, sprijinirea micro-întreprinderile din mediul rural, care produc energie electrică/termică utilizând biocombustibili. Desi consumul energetic in agricultura reprezinta doar cca. 1% din consumul de energie finala din Romania, exista o serie de masuri care pot avea ca rezultat scaderea consumului de energie in acest domeniu economic si utilizarea cu success a resurseor de energie regenerabila. Scopul cercetarii consta in identificarea masurilor concrete si a moduluilor de aplicare in diferite activitati din agricultura. Pornind de la structura consumurilor energetice din agricultura in 2005 si tinand seama de ritmul de creştere preconizat in aceasta ramura, lucrarea analizeaza potentialul de economisire a energiei in contextul Strategiei Energetice a Romaniei in perioada 2007-2020 si a Strategia Natională in domeniul Eficientei Energetice. Este prezentata evolutia prezumata a economiilor de energie, precum si reducerile de emisii de gaze cu efect de sera aferente economiilor de energie, pe perioada 2009 ÷ 2020. Deasemenea, sunt evidentiate fondurile de investitii necesare pentru aplicarea masurile de eficienta energetica in vederea realizarii economiilor de energie propuse.*

Key words**:** *agriculture, sustainable development, energy savings potential*
Cuvinte cheie**:** *agricultura, dezvoltare durabila, potential de economisire a enegiei*

INTRODUCTION

Sustainable development of the Romanian economy is based on general objectives which have in view to create a functional market economy, compatible with the principles, mechanisms, institutions and policy of the European Union, with respect to all social and economic sub-systems, including agriculture and rural area. In these strategic objectives achievement, the sustainable development of agriculture plays an important role, having in view the promotion of a multi-functional agriculture with a strong and direct influence in the rural area. We can't speak about sustainable development in any field, without taking into consideration the energy consumption, the energy resources preservation and the environmental protection.

The sustainable development of agriculture and of the Romanian rural areas is carried out based on the Rural Development National Strategic Plan 2007 - 2013 which is implemented by the aid of the National Program for Rural Development (PNDR). This program defines the following objectives for 2007-2013 period:

- implementation of the technical progress, innovations and the production and use of the renewable sources of energy (non-polluting technologies);
- appropriate measures for the greenhouse gas emission reduction and the use of biomass resulted from agricultural and forestry activities as renewable source of energy;
- support for traditional agricultural practices in order to contribute to the greenhouse gas emission reduction;
- support for micro-enterprises in rural area, to produce electrical and thermal energy using bio-fuels;
- support for the investments which take part to the fulfilment of the environmental European Union priorities.

Complementary to this National Program, the National Strategy in Energy Efficiency adopted in 2004 and the Romanian Energy Strategy for 2007 – 2020 stipulate the following measures for agriculture: the efficiency increase by using bio-fuels for agricultural machineries; development of energetic crops both for bio-fuels production and for electrical and thermal power production using cogeneration; irrigation energy efficiency increase.

MATERIAL AND METHODS

In Romania, the classic non- renewable resources were and are still exploited using technologies which have resulted in part in their exhaustion. The practice shows that the rhythm of the natural raw material exploitation exceeds the use of the known renewable resources and the identification of new ones, so the exploitation period is limited.

In accordance with the data provided by the Statistics National Institute, shown in table no. 1, the final energy consumption during 2001-2005 has increased. The agriculture has a low quote in the final energy consumption, in comparison with the other economy fields.

Table 1

Final energy consumption in 2001-2005

Thousands toe	2001	2002	2003	2004	2005	Annual average
Final energy consumption	22.438	23.370	25.153	27.332	25.102	24.679
Final energy consumption in ESD action field, of which :	19.074 (100%)	19.675 (100%)	21.338 (100%)	23181 (100%)	20.934 (100%)	20.840 (100%)
Population	7197	7284	7879	7910	8055	7665
Services	1629	887	1826	2001	2095	1688
Industry	5987	6921	7077	7134	6337	6691
Transports	3975	4305	4319	5195	4244	4551
Agriculture	286 (1,5 %)	278 (1,4 %)	236 (1,11 %)	220 (0,95 %)	203 (0,97 %)	245 (1,2 %)

In Figure no.1, it is presented the final energy consumption on energy consumption type in agriculture. (Source: Statistics National Institute)

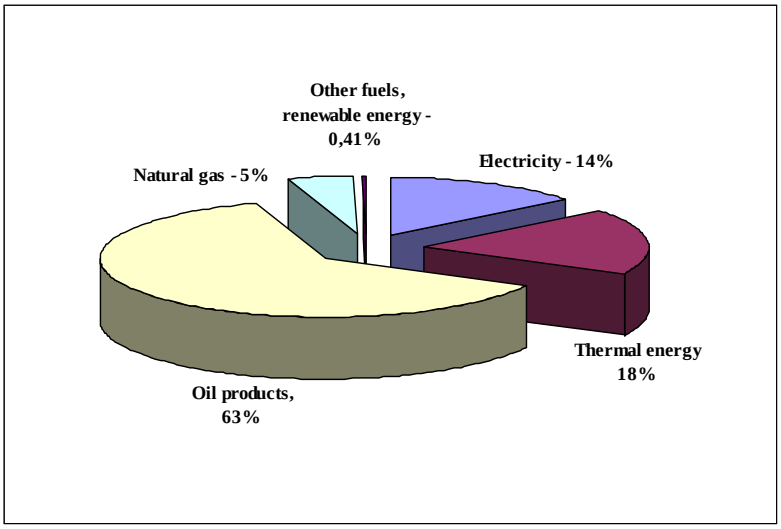

Figure 1. Final energy consumption in agriculture on consumption type

In accordance with the macro-economic forecast performed by the National Forecast Commission for 2007-2013, Romanian Gross Domestic Product will grow in a percentage of about 5,7%. The support to record a high rhythm of economic growth will be mainly the internal demand, and as part of it the investment need, based on foreign investments and on the absorption of the European Community funds. In table no. 2, we present the forecast for the Romanian Gross domestic Product until 2013.

Table 2

Growth Percentage of the Romanian Gross Domestic Product

Economy field	2006	Medium rate (2013)
Total internal demand	9,5	7,2
- population individual consumption	9,4	6,2
- local administration common consumption	4,0	3,3
- gross fixed capital formation	12,6	11,1
Export of goods and services	13,1	8,2
Import of goods and services	18,0	11,1
Gross Domestic Product	7,0	5,7
Industry	6,4	5,1
Agriculture	0,5	2,7
Constructions	15,2	10,7
Services	6,8	5,9

The Directive no. 2006/32/CE regarding the energy efficiency for the final users and the energetic services stipulates that European union states should make the commitment to reduce the final energy consumption with 9% during 2008-2016 (art. 14.2) in comparison with 2001-2005 (for which data are available). The intermediary target for Romania, for 2010 is of 940 thousand toe, which means 4,5 % of the average value during 2001-2005. The target settlement took into consideration the energy savings potential of Romania (table no. 3).

Table 3

Energy savings target

Average value for 2001 – 2005 period [thousands of toe]	20.840
Target: 9% energy savings until in 2016 [thousands of toe]	1.876*
Saving target adopted by Romania until 2016 [thousands of toe]	2.800**
Intermediary target for 2010 [thousands of toe]	940***

*minimum value in accordance with 2006/32/EC Directive
** 13,5 % of the average consumption for 2001- 2005, respectively 1,5 % annually
*** 4,5 % of the average consumption for 2001 – 2005 respectively 1,5 % annually

Starting from the agricultural energy consumption structure in 2005 and taking into account the foreseen growth rate for this field 2,7% annually, we estimate the following structure of energy consumptions in agriculture (total final energy and energy on consumption type).

Table 4

Agricultural Final Energy Total Consumption and its structure

Energy type	M.U	Average value 2001-2005	2013	2016	2020
Total	Thousands of toe	245	284	304	322
Electrical power	Thousands of toe	35	41	43,6	46,16
Thermal energy	Thousands of toe	44,5	52	55,26	58,54
Oil products	Thousands of toe	153,34	178	190,26	201,53
Natural gas	Thousands of toe	11,16	13	13,82	14,64
Coal	Thousands of toe	-	-	-	-
Other fuels, renewable energy, wastes	Thousands of toe	1	1	1,06	1,13

Having the in view the Romanian Energy Strategy for 2007-2020 and assuming the economic growth mentioned above, for agriculture, we have analyzed the energy savings potential, suggesting the following scenarios for the reduction of the energy consumptions:

Electric energy consumption

- reduction of electric energy consumption for lighting and power supply (in irrigation pump stations, fodders production, equipment in livestock farms) by the energy efficiency increase of the equipment use, automated operation and diminishing of losses with about 20%.

- power production using renewable energy sources (biogas cogeneration systems, wind power, hydropower) - 38% of the total need in 2020, in accordance with Romanian Energy Strategy stipulations for 2007-2020.

Thermal energy consumption

- reduction of the thermal energy for heating and sanitary hot water production by increasing the energy efficiency of the equipment use, automated operation and heat losses decreasing as a result of the thermal rehabilitation of the heated buildings and their related installations. We estimate the reduction potential of 30%.

- thermal energy production using renewable sources of energy (biogas cogeneration systems, solar energy, biomass).

Oil products consumption

- reduction of the oil products consumption with about 10% by increasing the efficiency of the agricultural machine engines, modernization of the agricultural machines park rational operation, improvement of the moving management;

- bio-fuels use in 10% of the total fuel.

Natural gas consumption

- reduction with about 30% of the natural gas consumption, by replacing it with renewable sources of energy (biomass, biogas).

RESULTS AND DISSCUSSIONS

Based on the proposed measures and scenarios, the energy consumption in agriculture will have the following structure:

Table 5

Structure of the Final Energy Consumptions and on Type

Energy type	M.U	2020 without reductions	2020 with reductions
Total	Thousands of toe	322	276,1
Electrical power	Thousands of toe	46	22,8
Thermal energy	Thousands of toe	59	25,6
Oil products	Thousands of toe	202	163,8
Natural gas	Thousands of toe	15	11,5
Coal	Thousands of toe	-	-
Other fuels, renewable energy, wastes	Thousands of toe	1	52,4

Analyzing the figures in table no. 5, the energy reduction potential in 2020 could be of around 18.73%, in terms of a production growth of 40% in comparison with 2005 (taking into consideration the same annual growing coefficient of 2,7% also for 2013-2020 period) and the resulted consumption structure is: 19% renewable sources of energy and 81% classic sources.

In table no. 6 the presumed evolution of the final and primary energy savings and the afferent greenhouse gas emission reduction for 2009 ÷ 2020 is presented (for a medium value of emission coefficient of 2,4 t/co_2 / toe). There also emphasized the necessary investment funds to apply the energy efficiency measures in order to achieve the estimated energy savings (for a specific investment of 170 € / toe – primary energy).

Table 6

Energy savings potential and investment costs

		Annual average 2001÷2005	**Year 2010**	**Year 2016**	**Year 2020**
Presumed final energy demand in agriculture [thousands toe]		245	275	304	322
Final energy savings in agriculture [thousands toe]	annual		3,53	3,53	3,53
	total		10,59	31,77*)	45,9
Primary energy savings in agriculture**) [thousands toe]	annual		5,43	5,27	5,04
	total		16,29	47,42	58,76
Greenhouse gas emission reduction corresponding to primary energy savings [thousands CO_2]	annual		13,03	12,65	12,10
	total		39,10	113,81	141,02
Necessary investments to achieve the estimated energy savings [mil. €]	annual		0,92	2,09	2,00
	total		2,77	8,06	10,00

*) Final energy savings target for 33,04 thousands of toe for agriculture in accordance with the Romanian Energy Strategy 2007-2020.

**) The average energy efficiency adopted in estimation: 0,65 – for 2010; 0,67- for 2016 ; 0,7 – for 2020.

The proposed scenarios lead to final energy savings of 45,9 thousands toe in 2020 and represent 18,73% of the average energy consumption in 2001-2005. The final energy savings are of 31,77 thousands toe in 2016 and represents about 13% of the average energy consumption in 2001-2005. These values are correlated with the energy savings national target

undertaken by Romanian Government until 2016 (1,5 % of the average consumption for 2001 ÷ 2005, annually, during 9 years, starting from 2007).

CONCLUSIONS

A realistic energy policy should be really connected with all the relevant strategies (for example with those connected to energy efficiency, renewable sources of energy, climate changes). The energy savings programs can have success only in the existence of an active policy for development and energy efficiency. In this context, the following measures and actions are proposed:

• promotion of energy efficiency and renewable sources of energy where they are available;

• promotion of clean technologies;

• promotion of the use of domestic and industrial wastes to produces electric and thermal power;

• development of energy education programs for all type of consumers;

• development of the energy use management programs (Demand Side Management – DSM), which will result in postponing the investments in new production capacities and reducing the effort to import primary energy resources;

• implementation of the modern and efficient energy consumption survey and management systems, high automation of the processes using fuels and energy;

• development of stimulating financial mechanisms for the actions which have in view energy efficiency measures and energy conservation.

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