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Energy efficiency and conservation as a strategic vision of the agricultural entities' competitiveness increasing

Abstract. The article deals with theoretical and methodological aspects of the business strategy. The authors define the basic principles of the business strategy formation, the most important among which are validity, transparency, rationality, adequacy, consistency, flexibility, competitiveness, etc. The place of energy efficiency and conservation in the system of strategies of the enterprise is identified according to the levels of strategic management. It is established that the energy saving strategy of domestic enterprises, which is in high need to transfer to energy-saving technologies gets into the national scale, and therefore is the concern of the corporate or business level of strategic management. The authors of the article have proved the necessity of energy efficiency and conservation as the most perspective direction of strategic development of agricultural enterprises, which will enable to solve the problem of self-sufficiency and efficiency of energy use.
The current level of energy capacity of agricultural enterprises and resources in Ukraine in 2015 has been analysed. Negative trends in reduction of most types of specialised agricultural machinery and its energy capacity between 2010 and 2015 has been defined. The availability of equipment for the generation of renewable energy of agricultural entities and the need for alternative energy sources have been assessed, as in 2012-2015, renewable sources of energy at the agricultural entities in Ukraine comprised only 4% of the total consumption of energy in the country. The experience of developed countries related to the improvement of energy efficiency is studied. The article determines the basic barriers and problems of implementation of the energy saving strategy in agriculture, among which are the structure of the industry; a lack of information on advanced energy saving technologies or limited access to them; a lack of capital for upgrades of technology, machinery and equipment; financing of promising projects. The basic directions of energy conservation in agriculture are outlined.
Keywords: Agrarian Enterprise; Business Strategy; Strategic Management; Resources Conservation; Energy Conservation
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Енергозбереження як стратегічна альтернатива підвищення конкурентоспроможності суб'єктів аграрного підприємництва

Анотація. Досліджено теоретико-методологічні аспекти стратегії підприємства. Визначено основні принципи формування стратегії підприємства. Ідентифіковано місце енергозбереження в системі стратегій підприємства згідно рівнів стратегічного управління. Обґрунтовано необхідність енергозбереження як найбільш перспективного напряму стратегічного розвитку аграрного підприємництва, що дозволить розв'язати проблему дефіциту та ефективності використання енергоресурсів. Проаналізовано сучасний рівень забезпечення сільськогосподарських підприємств енергетичними потужностями та ресурсами в Україні. Досліджено досвід підвищення енергоефективності розвинених країн світу. Встановлено основні бар'єри та проблеми впровадження стратегії енергозбереження суб'єктів аграрного підприємництва. Окреслено основні напрями енергозбереження в сільському господарстві.
Ключові слова: аграрне підприємництво; стратегія підприємства; ресурсозбереження; стратегічне управління; енергозбереження.

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Энергосбережение как стратегическая альтернатива повышения конкурентоспособности субъектов аграрного предпринимательства

Аннотация. Исследовано теоретико-методологические аспекты стратегии предприятия. Определены основные принципы формирования стратегии предприятия. Идентифицировано место энергосбережения в системе стратегии предприятия согласно уровням стратегического управления. Обоснована необходимость энергосбережения как наиболее перспективного направления стратегического развития аграрного предприятия, что позволит решить проблему самообеспечения и эффективности использования энергоресурсов. Проанализирован современный уровень обеспечения сельскохозяйственных предприятий энергетическими мощностями и ресурсами в Украине. Исследован опыт повышения энергоэффективности развитых стран мира. Установлены основные барьеры и проблемы внедрения стратегии энергосбережения субъектами аграрного предпринимательства. Очерчены основные направления в сельском хозяйстве.
Ключевые слова: аграрное предпринимательство; стратегия предприятия; ресурсосбережение; стратегическое управление; энергосбережение.

1. Introduction

A business entity has to operate in a highly dynamic competitive environment where technologies are innovated rapidly; its product range, as well as its customers' needs, interests and preferences, is changing; there appear new competitors; its advantages are differentiated and business reorganisation is carried out according to market requirements. In such circumstances, a company must have mobile means of operations, effective forms and methods of management and behaviour to be favourably positioned in a competitive field and contribute to the achievement of strategic objectives.

Ukraine belongs to energy deficient countries with a low level of self-sufficient energy resources. However, the national economy is highly energy intensive - the share of energy costs in GDP is from 2.7 to 3.1 times higher than in highly developed countries. This leads to the necessity to ensure the competitiveness of domestic business by, for example, the sale of goods at dumping prices or reduction of labour costs and social needs [1]. The problem is actualised due to strained relations with Russia, which was the main supplier of natural gas to Ukraine, limitations and exhaustion of own fossil fuels, low sufficiency and high cost of technologies of their production. Thus, the most powerful consumers, which include the agricultural sector, should focus on the energy efficiency and conservation strategy, providing an efficient use of the existing volumes of energy and alternative sources of energy. In addition, there is an actual problem of a low efficiency use of generating facilities by traditional agriculture, including tractors, vehicles, combines, stationary engines, electric motors and electrical equipment.

2. Brief Literature Review

The topicality of the problem is accentuated by the works of foreign and domestic scientists who are studying the process of energy conservation in the agricultural sector and the development of strategies of its growth.

World famous classics of theoretical and methodological foundations of development and implementation of business strategy and its separate components are J. Johnson and K. Scholes (2002); M. Porter (1985); A. Strickland and A. Thompson (1987); A. Chandler (1987) and others [2-4]. The following domestic scholars are engaged in the search for new ways of energy saving for business entities: L. Bilan (2011) [5]; M. Bulgakova (2011) [1]; V. Bazylevych (2012) [6] and others.

Of great interest is the study of foreign scientists in energy saving. In particular, R. Wustenhagen (2007) researches social acceptance of renewable energy innovations [7]. Shahriar Shafiee (2009) developed an econometric model that takes into account huge coal reserves and low coal prices, if compared with oil and gas, which will make coal, a clean energy source, a major energy substitute for oil and gas in the future [8]. Teresa M. Mata (2010) disputes about sustainable production of renewable energy [9]. The authors review the current status of microalgae use for biodiesel production, including their cultivation, harvesting, and processing. N.-G. Park (2015) considers that the intensive use of solar energy is an alternative source of energy saving [10]. F. Ma (1999) considers the ways to produce biodiesel [11]. B. Zalba, (2000) [12] and I. Dincer (2000) [13] examine the current and future prospects of energy-saving regarding renewable energy, environment and sustainable development.

However, despite a considerable amount of scientific directions of research concerning the issue of competitiveness enhancement of agrarian business in conditions of the current fuel and energy crisis in Ukraine, the issue of energy saving strategies has not been resolved enough.

3. The purpose of the article is to identify and evaluate promising directions of energy saving development in agriculture of Ukraine. The object of the research is the implementation and development of energy saving strategies in agrarian business. The subject of the study is a set of theoretical and methodological foundations and developed scientific guidelines for energy efficiency in the context of strategic development of agrarian business.

A systematic approach and dialectical method of cognition of analysis of economic and energy problems in terms of the strategic development of business is a theoretical and methodological basis of the study. The study includes the following methods: abstract-logical method (to justify necessity of economic and energy assessments/estimations of activities of agricultural enterprises); statistical and economic method (to analyse the current state and trends in saving resources of agricultural enterprises); method of calculation and construction (to determine energy supply indices). To assess the current state of availability of power resources of agricultural enterprises, the statistical and economic method has been applied, including its own techniques, i.e. spreadsheet, comparison (analysis and visual display of the results), etc.

4. Results

Defining strategic approaches to the choice of the model of development of Ukraine, the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine has noted that it is necessary to become aware of the fact that the existing logic of global economic growth must be changed. If the whole world got to the current level of consumption as the United States, there would be enough resources only for a few years. Therefore, the international community will soon have to reconsider their idea of progress and its form. Economy, conservation, rational behaviour and business ethics have always been important components of successful formation of successful citizens and society. The logic of further development will force the world to harmonise social relations and public attitudes to nature and its resources [6, 11].

Foreign classics of economics have been studying the nature of the strategy and the need for strategic manage-

ment in business. American researchers J. Johnson and K. Scholes offered to regard it as the direction and scale of an enterprise in the long term perspective, providing benefits for business entities through a configuration of its resources in a competitive environment to meet market needs and expectations of partners [2]. A successfully developed strategy enables to ground business directions in the long term perspective; to choose attractive markets in which a company will be able to compete successfully, to determine its competitive advantage, to evaluate potential resources (labour, competences, assets, funds) needed to enhance competitiveness, to identify environmental factors that affect the ability of business entities to compete. M. Porter's ideas accentuate the need for a strategy for determination of a position of a company and a unique combination of resources, skills and competencies to create a competitive advantage of business [3, 14].

The process of formation of individual strategies is an essential component of business management because it determines its long-term success - the achievement of expected results of effective activities in economic, technological, social and environmental spheres. The basis of the strategic management is grounded by basic principles which must be met by a possible variant of a company's development in the long run, accounting its current and future goals (Figure 1).

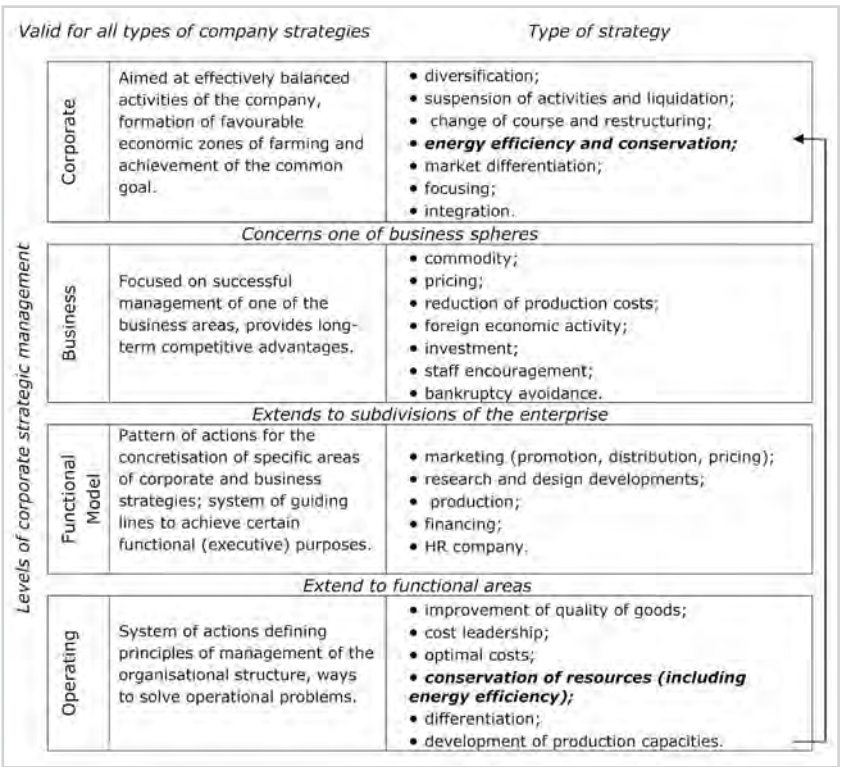

Fig. 2: **The place of energy-saving strategy in the formation of a strategy of an agrarian business**
Source: Developed by the authors based on [4]

In the world practice, there are 4 levels of strategic management, at each of which an appropriate strategy is determined and implemented (Figure 2). At the corporate level strategic decisions are taken in relation to the overall mission and the level of business activities. At business and functional levels, strategies of business units or separate business subdivisions are formulated and aimed at successful competition in a market economy.

At the operational level, strategies are focused on the increase of competitiveness of each link of business, organisation and implementation of strategies of a higher level. Therefore, operational strategies are focused on addressing the strategic targets of resources, processes and personnel.

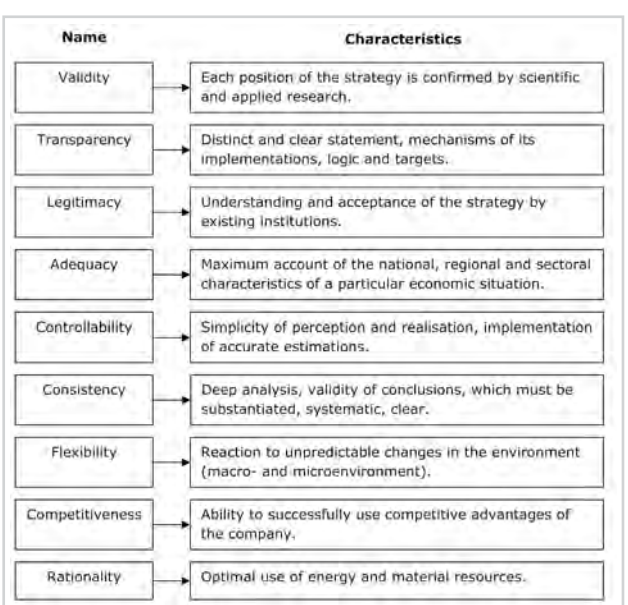

Fig. 1: **Basic principles of business strategy formation**
Source: Compiled by the authors based on [15]

According to a well-known classification by A.-A. Thompson and A.-J. Strickland (1987) [4], one of the possible alternatives of business development may be implementation of a resource conservation strategy, which includes a set of principles, factors, methods, plans and measures to ensure steady cost reduction related to joint resources per unit of a useful effect of a particular product. A strategy for energy efficiency can be a variation of this strategy. At the same time, under the conditions of an urgent need for the transfer of domestic enterprises to energy-saving technologies, it is wrong to assert that energy saving belongs to the operational level of management. Transition to alternative sources of energy is a responsibility of corporate or business strategic management as it requires rethinking of the philosophy of the company in conditions of limited resources, a need for simultaneous operation of all links of the internal environment aimed at the accomplishment of economic and energy assessments of intensive, resource-saving and alternative technologies of production of agricultural products/output. Only such an approach will allow domestic agricultural enterprises to integrate into the European community.

In the Law of Ukraine «On energy saving», the term «energy efficiency» is defined as «activities aimed at the rational use and economical consumption of unprocessed and processed energy and natural energy resources ...» to facilitate «... achievement of maximum efficiency of energy resources at the current level of development of machinery and technology» [16, 283]. Energy efficiency and conservation is the area that covers almost all sectors of the national economy and intersectoral relationships. Each enterprise or unit is likely to have reserves of energy savings and capacities to increase the efficient use of production and alternative technologies.

The process of energy saving in agriculture accounts for a set of measures aimed at providing rational use of energy resources by reducing their losses, improvement of organisational and economic mechanisms of energy consumption, use of energy saving technologies, equipment, and renewable and recyclable energy [5].

In recent years, a negative trend in providing agricultural enterprises with machinery in Ukraine has been observed (Table 1).

Tab. 1: **Availability of specialised agricultural machinery for agricultural enterprises in Ukraine in 2010, 2012 and 2015**

Type of machinery	Agricultural enterprises			2015 to 2010, %	Including farming enterprises			2015 to 2010, %
	2010	2012	2015		2010	2012	2015	
Tractor trailers	70,879	61,557	49,004	69.14	10,194	10,977	9,793	96.07
Seed drills of all kinds	72,366	71,182	65,492	90.50	15,453	18,365	19,342	125.17
Potato planting	2,200	2,120	1,631	74.14	605	833	715	118.18
Irrigation machines	4,480	3,538	3,815	85.16	381	390	565	148.29
Mowing tractors	8,178	8,446	7,892	96.50	1,428	1,812	2,001	140.13
Cropper rollers	15,225	14,417	13,595	89.29	2,824	3,069	3,592	127.20
Combines - grain-harvesting:	32,750	31,158	26,735	81.63	7,743	8,844	8,774	113.32
- corn-harvesting	2,548	2,114	1,634	64.13	344	307	321	93.31
- fodder-harvesting	7,841	6,571	4,982	63.54	558	545	493	88.35
- flax-harvesting	458	298	187	40.83	24	22	14	58.33
- potato-harvesting	1,694	1,598	1,215	71.72	365	514	434	118.90
Beet-harvesting (without circumcision of beetroot leaves)	240	3,556	2,427	1011	7,66	7,28	5,13	66.97
Milking machines and apparatus	10,865	11,022	10,232	94.17	604	737	780	129.14
Forage distributors: - for cattle	4,597	4,036	3,484	75.79	144	158	203	140.97
- for swine	1,883	2,514	3,452	183.32	69	239	449	650.72

Source: Calculated by the authors according to [17]

Thus, from 2010 to 2015, the number of all types of agricultural machinery reduced, except for beet harvesters. Due to the unprofitability and decline of cattle breeding industries, forage and flax production, the number of forage and flax harvesting equipment in Ukraine significantly declined - for 36% and 60% respectively.

Facilities of agricultural enterprises are mobile enough. For the working process, it is necessary to provide the means of production with engines, which in terms of mechanical power form energy capacities of agricultural enterprises. It is defined that specific weight of tractor, car and combine engines is around 70% in the structure of power capacities of agricultural enterprises in Ukraine (Table 2).

The share of tractor engines in the total energy capacity of agricultural business of Ukraine in 2015 was 39%, cars - about 32% and combines - 19%. In terms of organisational forms of entities of agrarian concern of Ukraine, it has been found out that 58% of the generating capacity was concentrated within commercial companies, 16% - within the farming enterprises and 13% - within private enterprises. The least amount of generating capacity was concentrated within state-owned enterprises (2%).

The availability and structure of energy capacity of agricultural entities in Ukraine in 2015 affected the differentiation of their supply with energy resources in a ratio as follows: one company, one employee to1 ha of agricultural land (Table 3).

It has been established that in 2015 the average energy availability of one agricultural enterprise in Ukraine was 724 kW. However, the level of this index ranges among 204 kW at farming enterprises to 3,841 kW at state-owned enterprises (SOEs), which is primarily due to the size of companies and business scale. In 2015, the highest level of energy supply was in cooperatives - 2.59 thousands kWh per 1 ha of agricultural lands and farming enterprises - 2.37 thousands kWh per 1 ha of agricultural lands, the lowest - in private companies (0.97). The highest level of power consumption was recorded at farming enterprises - 0.09 thousands kWh and 0.08 thousands kWh - in agricultural corporations, whereas the lowest level (0.005 thousands kWh per one worker engaged in agricultural business) was observed at private and state enterprises. It is likely that the level of mechanisation and automation of work at farming enterprises and agricultural corporations is the highest compared with other agricultural entities. This significantly affects the ultimate outcome of agricultural production: with the growth of power load of labour, the yielding capacity of crops, livestock and poultry increases and production costs per unit of output are reduced.

The experience of doing agricultural business in developed countries shoes that there are several directions of energy efficiency and conservation. According to the American Council of Energy Efficient Economy (ACEEE), an opportunity related to the potential of energy saving of 1 billion dollars per annum is found in the agrarian sector [19]. Savings are possible in energy conservation capacity - 10% of the total energy consumption of the national economy. There are possible substantial savings due to the installation of more efficient systems of lighting and heating. Also, the use of precise agriculture is offered, which will help to save resources, energy and funds on the use of fertilisers. However, the biggest reserves leading to a reduction of energy consumption of agricultural production are tillage systems and effective use of material and technical means. This includes regular maintenance of vehicles, their correct operation that will not only save fuel but also extend their operation term. Regarding tillage systems, reduced-till

Tab. 2: **The structure of energy capacity of agricultural enterprises in Ukraine, 2015, thousands kW**

Type	Business partnerships	Private enterprises	Cooperatives	Farming Enterprises	State enterprises	Of other organizational forms	Agricultural enterprises total	Structure %
Energy capacity, total	16,203	5,182	1,313	6,556	726	1,040	31,020	100
including: tractor engines;	5,970	2,008	440	3,023	215	377	12,033	39.0
- engines and combines self-propelled machines;	2,698	1,034	243	1,596	90	136	5,797	18.7
- car engines;	5,656	1,644	438	1,714	270	322	10,044	32.4
- other mechanical engines;	171	55	21	34	17	14	312	1.0
- electric engines and electrical equipment;	1,685	440	170	187	134	190	2,806	9.0
- equipment for production of renewable energy;	19	0	0	1	0	0	21	0.07
- livestock in terms of mechanical force.	4	1	1	1	1	0	0	0.0

Source: Calculated by the authors based on [17-18]

Tab. 3: **The level of supply of agricultural entities in Ukraine with energy resources in 2015**

Index	Agricultural enterprises	Including					Enterprises of other organizational forms
		Agricultural corporation	Private-enterprises	Cooperatives	Farming enterprises	SOEs	
Power consumption-to-personnel ratio 1 thousand kW per man	0.08	0.08	0.06	0.07	0.09	0.05	0.11
Electric power supply, thousands kWh per 1 ha of agricultural land	1.87	2.02	0.97	2.59	2.35	1.56	3.5
Power capacity, kW per one enterprise	724	2,582	1,610	2,535	204	3,841	2,151

Source: Calculated by the authors based on [17-18]

and no-till systems are offered. This will enable to increase yielding capacity of crops, to keep moisture in soils and reduce labour costs.

Best practices of the EU Member States show that the main areas of potential realisation of energy conservation include: introduction of energy resources accounting systems for facilities, particularly electrical; use of financial advantages; relevance to the government regulations related to the construction of new buildings and constructions (the so-called government building services regulations). It is worth to consider the production of alternative sources of energy. For example, wind farms, solar dryers, internal combustion engines running on gasified biomass. The usage of agricultural waste to produce energy in recycling industry arouses interest.

According to various estimations, alternative sources of energy (which include energy of solar radiation, wind, seas, rivers, biomass, heat of the Earth, as well as secondary energy resources that permanently exist or periodically occur in the environment) comprise 7.12% of the total world energy. One of the conditions for accession of candidate countries to the EU is a minimum figure of renewable energy to the total energy, which should be no less than at least 12% [20, 226]. During the period of 2012-2015, renewable sources of energy of agricultural entities in Ukraine comprised only 4% of the total consumption of energy in our country (Table 4).

Tab. 4: **Availability of equipment for the production of renewable energy of agricultural entities in Ukraine, 2012-2015**

Enterprise	Year	Equipment that converts energy of			
		Wind	Sun	Biomass	Other renewable resources
Agricultural enterprises, total	2012	3	10	3	1
	2013	2	13	4	-
	2014	2	13	4	-
	2015	5	4	9	4
including: - business associations	2012	1	-	2	-
	2013	1	-	3	-
	2014	1	-	3	-
	2015	1	2	8	-
- farming enterprises	2012	-	1	-	-
	2013	-	1	-	-
	2014	-	1	-	-
	2015	1	1	-	-
- other enterprises	2012	2	9	1	1
	2013	1	12	1	-
	2014	1	12	1	-
	2015	3	1	1	3

Source: Calculated by the authors based on [17-18]

Solar power capacity reached 494 MW, and the total wind power capacity was 500 MW. Production of alternative energy can also be realised in the agricultural sector: production of rape for industrial use of biodiesel is increasing; there are reserves for a shift in production of beverage alcohol towards ethanol fuel, the use of biomass and other alternative energy sources are proposed to be used to provide energy security of rural areas.

At the end of 2011, Ukraine was included in the international ranking of attractiveness of countries for the development of renewable resources. The ranking is published by Ernst & Young quarterly, and Ukraine is ranked there as 32nd among 40 countries, gaining 37 points out of 100 possible. The three leaders are China (70 points), the USA (66 points) and Germany (65 points). In Q3 of 2012, Ukraine was ranked 29th due to the increased quantity of investment in the sector. According to the statements of the Ukrainian government, 2020 is scheduled to increase alternative energy production up to 15% of the total energy production. In general, the total energy consumption in Ukraine in recent years has been about 990 million of tons of fuel. The consumption of energy could be reduced to the amount of 650 million tons of fuel, when using energy-saving technologies and equipment at the same level as in the EU, which means that the energy saving potential of Ukraine is about 35% [21].

However, there are many barriers to energy efficiency in agriculture. These include: the climate of the country, which may require increased energy costs; the structure of the industry; the lack of information on advanced energy saving technologies or limited access to them, while the most topical problem is the lack of capital needed to modernise technologies, machinery, equipment, financing of projects.

The USA have established various federal programmes to help farmers to successfully overcome such barriers. For example, the Rural Energy for America Program (REAP) has helped hundreds of farmers to restructure production and gain benefit from energy saving. Other agricultural programmes, such as the Environmental Quality Incentives Program (EQIP), have proved the effectiveness of energy conservation by funding innovative approaches in this field [19]. Most funding has been allocated to the development and implementation of power systems of renewable energy. There are competitive grants and loans, which cover 75% of the projects for the implementation in the production of energy-saving technologies. The initial precondition for receiving such funds is energy auditing which purpose is to audit the costs covered by the programme. Thus, effective control over the use of purpose-oriented funds is provided. The last part of the grant programme is the TEO - a feasibility study report of the project.

5. Conclusions

Analytical studies, business experience of developed countries show that energy efficiency and alternative energy production will continue to grow and develop at both the international and national level. The International Energy Agency believes that in 2030 the world's alternative energy will increase to 16% of the total world energy production (from 12.7% of the achieved level at present) [20, 225]. Therefore, the strategy of energy efficiency in the agricultural business should be aimed at the implementation and development of a range of legal, organisational, scientific, technical, industrial and economic means regarding energy efficiency and attraction of renewable energy that will increase soil fertility, yielding of crops, livestock and poultry; reduce production costs; increase productivity, efficiency of logistical and energy resources. Implementation of this strategy is possible due to the improvement of organisational and economic mechanisms of energy consumption, use of energy saving technologies and equipment, renewable and recycling energy. With regard to plant cultivation enterprises, we can outline the following areas of saving and rational use of energy resources: implementation and development of means to ensure improvement of soil fertility and yielding of crops; improvement of energy saving technologies of production; development and production of new energy saving technologies; an increase in energy consumption share from alternative sources.

Equally important aspects of energy conservation in agriculture are: improvement of the management system by implementing and developing of organisational, technical and economic means to provide savings and reduce losses of oil products; technological development of regulatory and technical documentation for mechanical processes and equipment, creation of a system of the state support and enhancement of energy efficiency in agriculture.

Complex energy saving solution to the problem is one of the most likely ways for Ukraine to successfully overcome the economic and energy crises and join the European community. This includes an increase in gross value added, investments and jobs in the renewable energy sector. Energy conservation will allow our country to reduce dependence of its economy on imported energy, to decommission a number of generating facilities, to improve technologies for energy-intensive industries and to restructure economic systems, to create an optimum level of self-sustainment of energy resources of different regions and sectors, to create domestic industries for production and introduction of competitive energy saving equipment, to significantly limit the impact of factors caused by technological activities of people on the environment and to ensure individual welfare needs.

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