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RESOURCE SAVING REGULATORY APPROACHES AND FACTORS AFFECTING COMPANY'S ENERGY SAVING MANAGEMENT

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ABSTRACT

Climate change mitigation is the most important driver for implementing energy-efficiency policies in a country, which, in turn, are among the main driving factors for the company's environmental innovation. Despite numerous studies investigating energy saving in general, management and regulatory-related side of the issue is not duly covered. The aim of the study is to define the main factors (including the regulation-related ones) affecting energy saving of a company.

By way of statistical, generalisation, graphical and factor analysis methods energy production, consumption and energy intensity both on global and national levels were investigated. The countries with highest level of energy intensity occurred to be Ukraine, Russian federation, Taiwan, South Africa, Kazakhstan and Canada. To countries with the lowest energy intensity belong United Kingdom, Turkey, Portugal, Germany, Japan and France.

The research defined factors affecting company's energy saving. External factors include government regulation, market conditions, scientific and technological progress, political, socio-economic, environmental, natural and climatic factors. Internal factors comprise production modernization and reconstruction; consumed

materials quality; use of secondary resources; technology improvement; company's innovative development; enterprise management; quality control; staff motivation; financial and economic indicators.

Based on the analysis of legislative and regulatory framework in a number of countries, the main energy saving approaches of state policies are: national and international standards; certification programs; grants; key indicators of resource use efficiency; multi-level structure of state energy saving management; energy prices (tariffs) regulation; penalties; resource audit and management; government subsidies; soft-window facilities.

The results of this study can be applied as the basis for theoretical and practical researches of factors affecting energy saving management of a company. Findings of the research can be applied by scientists and officials in developing governmental programs and policies aimed at promotion energy saving.

Key words: standard of living, quality of life, QOL, living conditions, consumer freedom, human capital, human potential, well-being, economy of happiness

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1. INTRODUCTION

Climate change mitigation is the most important driver for implementing energy-efficiency policies in a country (Visscher et al., 2016). Energy saving efforts reduce the demand for energy services, and this leads to better environmental protection, national security, financial benefits and social security (Hafezalkotob, 2017).

Among serious challenges to the economy of a country is its high energy intensity. Having high energy intensity of GDP implies great opportunities for large amounts of energy to be more efficiently spent. Therefore, the government of such countries are highly interested in developing and implementing energy efficiency and energy saving policies (Kozhukhova et al., 2019).

Energy efficiency does not solely depend on the availability of energy laws in the country, namely on the mandatory structure and strategy for ensuring compliance with laws, which leads to increased energy efficiency. Regulatory assessment and revision of laws improves their quality and increases the number of successful ones. The experience of implementing energy regulations in different countries worldwide shows that the law structure, enforcement criteria, energy efficiency measures and performance assessment, previous regulations, their nature, and integrated approach of code development are important considerations for successful implementation of any energy regulation (Chandel et al., 2016).

There are six regulatory rules in terms of energy saving governmental policies: deregulation, direct tariffs, direct restrictions, government certificates, government permits, joint energy conservation. All intervention policies are beneficial because they lead to greater social security than deregulation policies. Regulation policies should be selected regarding impacts on consumers, environmental supply chains and the environment. The joint energy conservation policy provides the highest level of social utility (Hafezalkotob, 2018).

Environmental regulations and ecological efficiency are the driving force and objective function of the country's economic growth (Song et al., 2020). Energy policy provides a

dynamic comparative advantage, if companies learn early to respond to future challenges in energy supply and use (Rammer et al., 2017). As one of the regional regulatory measures, energy saving policies have already been utilized by major countries as an important tool to advance sustainable development and can directly influence firms' decision-making (Zhang et al., 2020). Thus, environmental regulation plays politically and categorically variable role even in location decisions involving pollution-intensive industries: heavy air-polluting industries can be pushed from the more developed regions to the peripheral regions of the country (Shen et al., 2017).

Environmental regulation including fiscal and taxation measures are among the main driving factors for the enterprise's environmental innovation (Liao at al., 2018). Environmental innovation, in turn, is an important approach to delivering a win-win situation for the economy and the environment (Pombo et al., 2016). Green technology innovation is the behaviour of creating environmentally friendly new technology of product and process, pursuing economic growth benefits brought by technology innovation and seeking the green ecological benefits of energy cleaning and emission reducing. The goal of green product innovation is "energy saving": it refers to the development of green products by finding new energy that could save materials and using new technology which could easily regenerate and recycle (Guo et al., 2018).

Energy-saving regulation tends to be quite effective in targeting energy-intensive enterprises, since companies have to reduce energy costs with a stable or growing level of efficiency in order to remain competitive (Ma & Yu, 2017; Meshcheryakova, 2017). Thus, by decreasing the amount of energy consumption, energy-intensive companies significantly reduce greenhouse gas emissions, and the power consumption of most products developed and manufactured by such company are reduced as well. The latter is especially appealing to customers who seek energy saving performance in the products they purchase since a reduction in power usage represents a tangible benefit (Bernhardt & Böttner, 2017). In terms of global competitiveness, energy saving tends to have no influence on companies' international market position. Moreover, companies that introduced new energy technologies or that developed such technologies for the market report better export performance, indicating that investment in 'greener' energy technologies pays off (Rammer et al., 2017).

Companies with high energy consumption are the key elements for improving energy efficiency in the country. Support from senior management has a positive effect on the energy-saving behaviour of firms. Command and control tools, mimetic pressure, and financial weaknesses influence companies' energy-saving behaviour through support from senior management, while incentive and regulatory pressures have a direct impact on companies' energy-saving behaviour. In addition, financial weakness positively mitigates the impact of senior management support on companies' energy-saving behaviour (Zhang et al., 2018).

In addition to energy-saving-related benefits, the burden of environmental policy costs is often quite insignificant. Leadership in implementing ambitious environmental policies can lead to small, statistically significant adverse effects on trade, employment, business location and productivity in the short term, especially in polluting and energy intensive sectors. However, the scale of these impacts is small compared to other determining factors in choosing a place of trade and investment, such as transportation costs, proximity to demand, quality of local workers, availability of raw materials, lower capital costs and agglomeration (Dechezleprêtre & Sato, 2017).

The common obstacles for energy saving implementation include high transaction costs, lack of innovation policies and accounting methods, and lack of awareness, while the

particular obstacles include the unstable political situations, the ineffective enforcement of related policies and the lack of reasonable criteria in a country or region. Moreover, international collaboration in energy saving regulatory policies is highly critical, so that each country could learn from another, and more mature policies can be transferred from more advanced countries to less developed countries (Huang et al., 2016).

Numerous researches are dedicated to analysis of energy saving regulations, policies and management at various levels.

The investigation of energy use problems in Kenya and South Africa resulted in conclusion that Kenya has greater potential for capital growth through joint consideration of energy with capital and production (Kumar, 2013).

Kumar et al., (2014) revealed that the balance between efficient energy consumption and effective government policy on energy saving tends to support economic growth in Albania, Bulgaria, Hungary and Romania.

The research of Bompard et al. (2017) resulted in a common methodology for assessing energy security, which considers and integrates its external and internal dimensions: security of energy supply from abroad (external) and security of national energy infrastructures (internal).

García-Gusano et al. (2017) suggested a Renewable Energy Safety Index based on a combination of environmental life cycle assessment and modelling of feasible energy systems.

As a result of investigating energy saving at a micro-level, Cui et al. (2019) suggested methodology aimed at improving the resource management system of a company so as to increase its performance indicators.

Le & Bao (2020) argued that the long-term use of renewable and non-renewable energy, together with other factors like government spending, gross domestic product, financial development, have a positive impact on economic growth in 16 Latin American and Caribbean countries.

While the majority of researches investigate energy saving in general, management and regulatory-related side of the issue is not duly covered. Moreover, there are some confusions in a varied views on the role of a state in energy saving management at various levels: from a company to the country in general.

The aim of the study is to define the main factors (including the regulation-related ones) affecting energy saving of a company.

to achieve the aim of the study, the following objectives were set:

1. to evaluate the situation with energy production, consumption and energy intensity both on global and national levels;

2. to summarise and asses the internal and external factors affecting the energy saving management system of an entity;

3. to investigate energy saving regulation and approaches in different countries.

2. METHODOLOGY

With the purpose of the study the following methods were used:

- previous researches in the sphere of energy saving regulations were investigated with the help of general scientific methods like synthesis, analysis, deduction and induction;

- to identify the ways of using the experience of different countries on example of Ukraine, the theoretical prediction method was applied;
- to analyse the specific traits of various countries including content, forms and methods of state energy saving management, the retrospective method was used;
- experience of resource management in different countries was summarised by way of systematic and structural methods;
- the indicators of energy consumption and production, as well as GDP energy intensity were compared with the help of horizontal, vertical and factor analysis methods;
- the dynamics of GDP energy intensity in Ukraine and the world was reflected through statistical and graphical methods;
- the directions of state regulation and factors impacting the energy saving management of a company were determined by way of method of generalization;
- abstract-logical, monographic and grouping method were also applied with the purposes of the study.

The following data and indicators for 44 countries for the period from 1990 to 2018 from Global Energy Statistical Yearbook (2019) were used with the purposes of the study:

- energy consumption: total and per country;
- energy production: total and per country;
- energy intensity of GDP at constant purchasing power parities for the period from 1990 to 2018: total and that of 44 countries;

Energy intensity of GDP at constant purchasing power parities for the period from 1990 to 2018: total and that of 19 countries: the countries with the highest energy consumption and the lowest one

3. RESULTS

According to the Global Energy Statistical Yearbook (2019), the highest scores of energy intensity of GDP at constant purchasing power parities (more than 0.15 koe/$2015p) have Ukraine, Russian Federation, Taiwan, countries of the Central Asia, Canada, Iran, South Korea and South African Republic (Figure 1).

As shown on Figure 1, Australia, New Zealand, USA, countries of Central and South America, Eastern and Northern Europe (except for Ukraine and the Russian Federation), Southern, Eastern and South-eastern Asia (except for Taiwan and South Korea) have moderate to low scores of GDP energy intensity (0.13-0.08 koe/$2015p). The lowest score have the countries of Western and Southern Europe (from 0.07 to 0.05 koe/$2015p), Venezuela, Turkey and Columbia.

Note: the aforementioned geographic regions correspond to the Standard Country or Area Codes for Statistics Use (1999) of the United Nations (M49 standard).

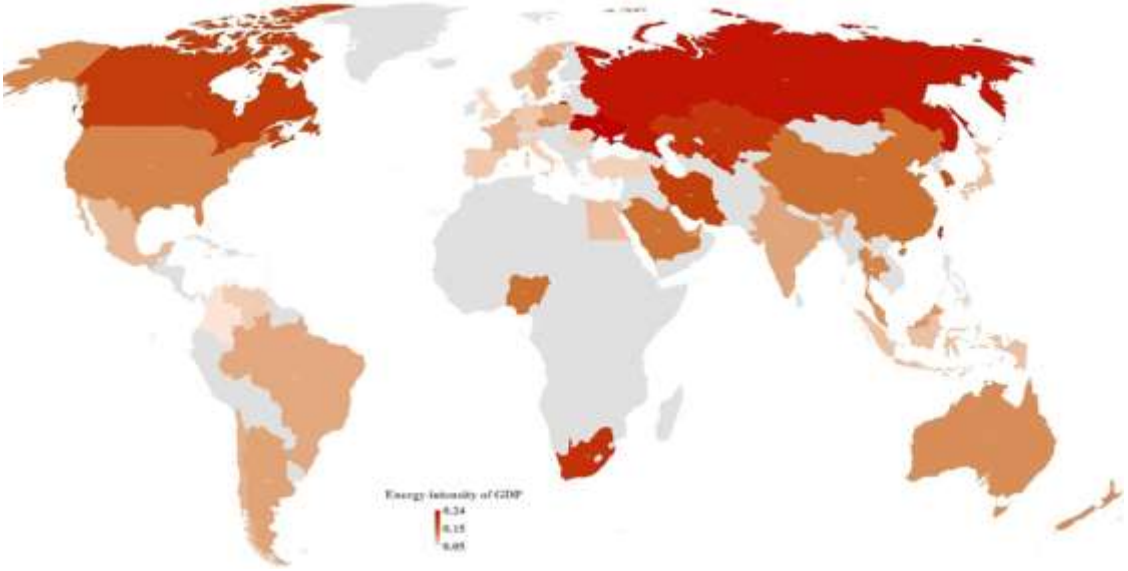

Figure 1. Geographical distribution of countries' scores of GDP energy intensity in 2018 (koe/$2015p). Note: the darker the colour is, the higher GDP energy intensity a country or region has. Source: developed by the authors based on the data of the Global Energy Statistical Yearbook (2019).

According to the Global Energy Statistical Yearbook (2019), Ukraine ranked first in the world in terms of GDP energy intensity with 0.238 koe/$2015p, followed by the Russian federation (0.215), Taiwan (0.198), South Africa (0.187), Kazakhstan (0.181) and Canada (0.176). (Picture 2).

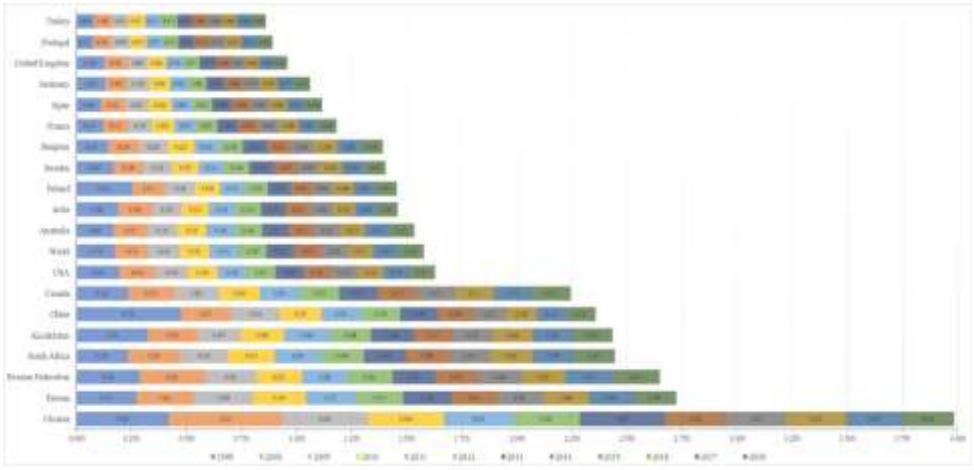

Figure 2. World GDP energy intensity for the period 1990-2018 (koe/$2015p). Source: developed by the authors based on the data of the Global Energy Statistical Yearbook (2019).

As shown at Figure 2, the lowest GDP energy intensity score as of 2018 have United Kingdom with 0.062 koe/$2015p, Turkey (0.066), Portugal (0.069), Germany (0.072), Japan (0.079) and France (0.086). The global GDP energy intensity was at a moderate level of 0.114 koe/$2015p as of 2018.

In terms of GDP energy intensity improvement, the absolute leader is China, which succeeded to drop the level of koe/$2015p by 262%: from 0.474 in 1990 to 0.131 in 2018. China is followed by Poland (160%), United Kingdom (102%), India (98%), Germany (82%), Kazakhstan (78%), Ukraine (76%), Sweden (70%) and the USA (66%). The global decrease in GDP energy intensity comprised 54% between 1990 and 2018.

In 2018, global energy production and consumption continued to grow (Figure 3). The increase in world energy production was mainly driven by the US and China (increase of 54% in 2018). Energy production in the EU countries continued to decline due to a climate policy, drop in electric power generation by nuclear energy plants, depletion of oil and gas resources (Global Energy Statistical Yearbook, 2019).

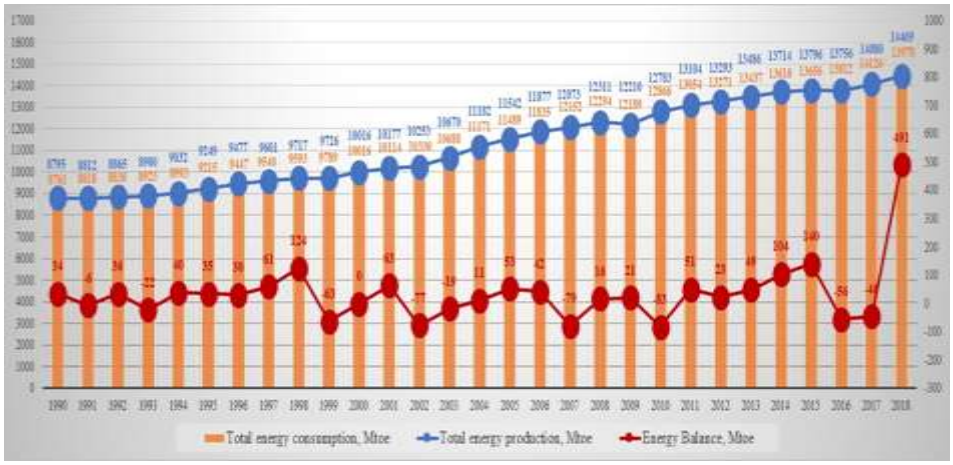

Figure 3. Dynamics of global energy generation, energy consumption and balance in 1990-2018 (Mtoe). Source: developed by the authors based on the data of the Global Energy Statistical Yearbook (2019).

According to Figure 3 the global balance between energy production (blue line and figures) and consumption (orange histogram and figures) is currently positive and comprises 491 Mtoes (red line and figures) or 3.51% of energy consumption.

Despite numerous power generation facilities including the nuclear ones, Ukraine has experienced no positive energy annual balance starting from 1990: the deficit of energy in Ukraine comprised -25 Mtoe (-29.4%) in 2018, while the relative deficit peak was in 1991 with -54.7% and the lowest relative energy deficit was observed in 2013: -25.7%. As of 2018, energy deficit in Ukraine comprised (Global Energy Statistical Yearbook, 2019).

Energy saving management system of a company is influenced by a number of factors having either positive or negative effect on energy saving. Such factors can be split up in factors of external and internal affect (Figure 4).

External factors can be divided as follows: government regulation, market conditions, scientific and technological progress, political, socio-economic, environmental, natural and climatic factors.

Internal factors are often a reaction of a company to the influence of external factors. At the same time, internal factors determine the direct level of resources and energy use in a company.

Among the most influencing internal factors are: production modernization and reconstruction; consumed materials quality; use of secondary resources; technology improvement; company's innovative development; enterprise management; quality control; staff motivation; financial and economic indicators.

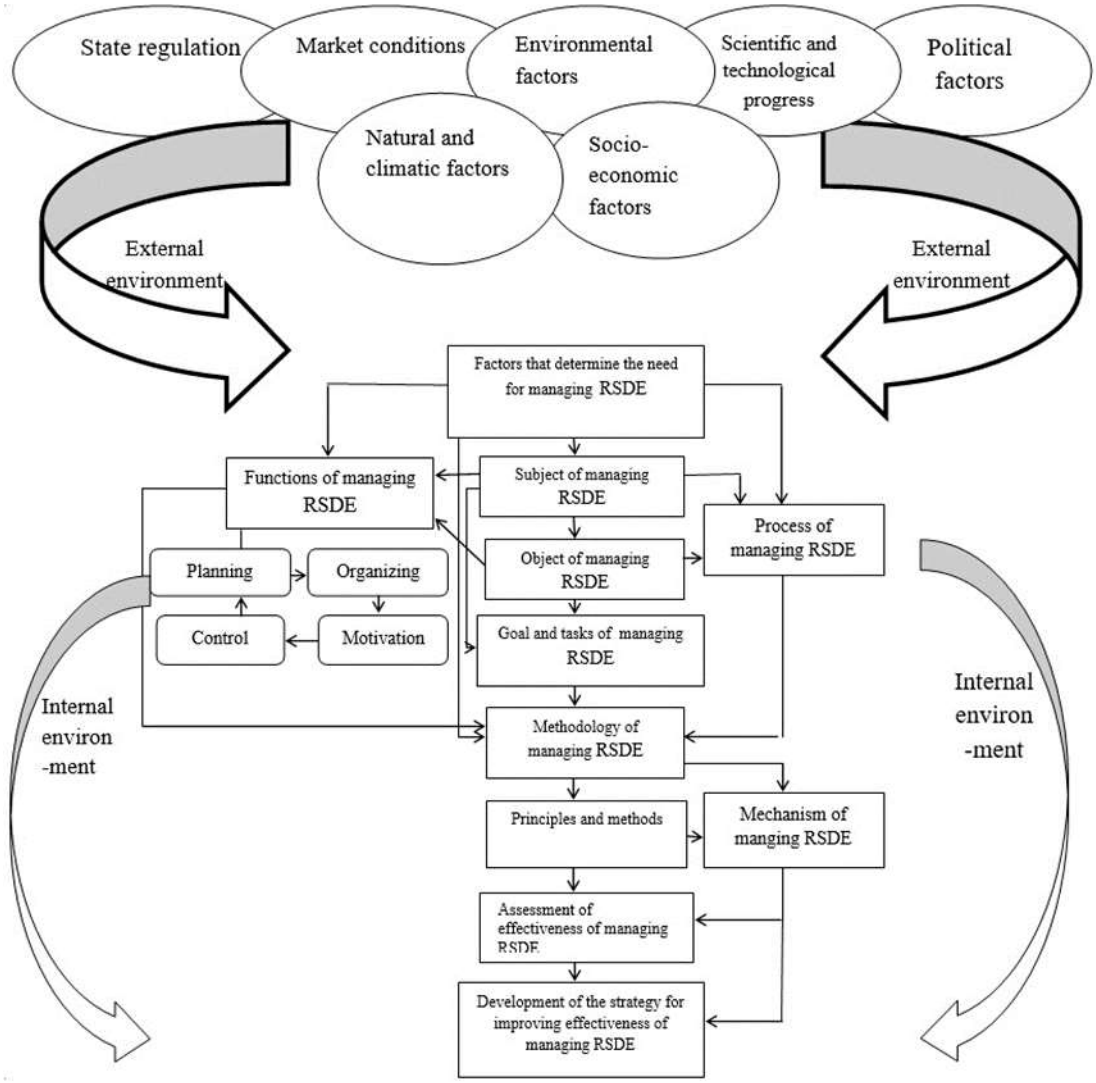

Figure 4. Impact of the external and internal factors on energy saving management. Source: developed by the authors

Among the most powerful factors affecting energy saving in a country, region or company is state regulation and policies. Based on the analysis of legislative and regulatory framework in a number of developed and developing countries, some common approaches can be identified (Figure 5).

According to Figure 5, the main energy saving approaches of state policies are:

1. National and international standards for resource efficiency. The example is the system of efficiency classes marking: A, A+, A++, A+++.

2. Certification programs. In 2012, the United States launched the Superior Energy Performance certification program aimed at improvement of the level of energy efficiency of companies, and maintaining their competitiveness. In Sweden, the "green certificates" are granted for electricity generated by alternative energy sources like geothermal energy, wind, peat, sun, biofuels, waves and hydropower.

3. Grants. Governments in countries like USA, Denmark provide grants to companies allowing to implement resource efficiency projects.

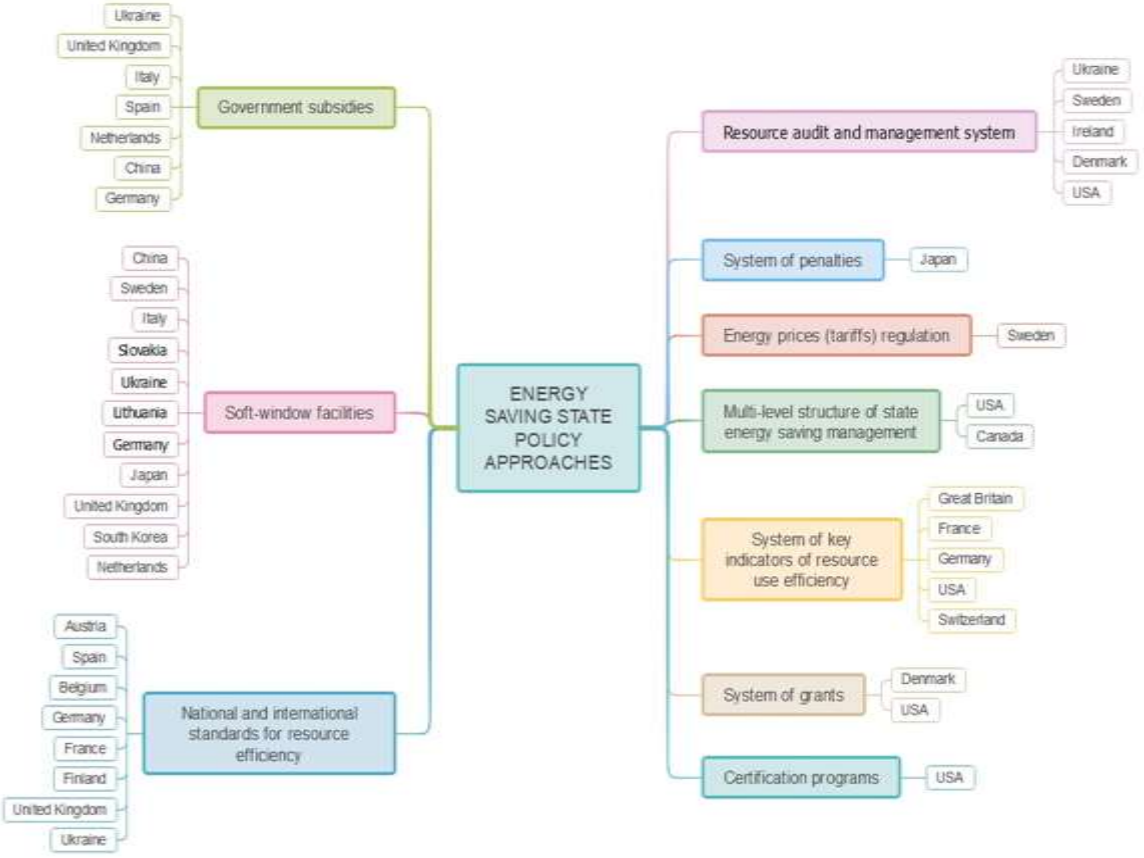

Figure 5. State policies approaches to energy saving management. Source: developed by the authors based on the data of the EU countries' experience (2017).

4. Key indicators of resource use efficiency. Developed countries actively apply the approach of imposing responsibility on public authorities for improving resource efficiency in economic branches, and control the implementation of measures aimed at achieving state-level targets by federal (regional) agencies.

5. Multi-level structure of state energy saving management. Some countries introduced a multilevel structure of state management of energy saving with a sectoral area of responsibility and participation of coordinating bodies.

6. Energy prices (tariffs) regulation. The Renewable Energy Act was adopted in Germany in 2004. According to the Act, energy companies are obliged to buy electricity produced from renewable energy sources at fixed tariffs.

7. Penalties. In Japan it is legally obligatory to rationalize the process of fuel use and reduce energy losses during transportation. If the requirements of the legislation are not fulfilled, penal fines are imposed.

8. Resource audit and management.

9. Government subsidies. The government of Germany subsidizes the use of alternative energy.

10. Soft-window facilities. Japan provides enterprises that use renewable energy resources with a ten-year soft-window facility (Kuksa & Sudarkina, 2017). In Sweden, Italy, Germany, Japan, South Korea and other countries, subsidies and tax benefits are provided for the purchase of energy efficient industrial equipment (Sotnyk et al., 2018).

4. DISCUSSION

For the last decades, a number of countries have implemented a systematic approach to the policy of efficient resource consumption. Such approaches involve harmonization of legislation and regulation, development and implementation of energy saving technologies, organization of effective management of resource consumption at the state and municipal levels, use of economic incentives, creation of systems and tools allowing to monitor energy consumption at production site and in a municipal sphere, information and public support of energy efficiency (EU countries' experience, 2017; Hafezalkotob, 2018).

Energy saving policy in the developed countries is based on understanding of importance of reducing energy consumption and the need to use all possible means to decrease energy use (Shen et al., 2017). The success of a country in sustainable development is also based on the effective implementation of energy saving technologies and use of alternative fuels from energy crops. The use of secondary materials like waste paper, scrap metal and plastics allows to save raw materials. The stocks of secondary materials are so large in some countries, that they can considerably compensate the deficit of natural raw materials. In old industrial areas of Western and Eastern Europe, the volumes of secondary resources procurement overlap local needs and allow to export such materials to other countries (Borisova et al., 2019).

The following motivational incentives for the use of renewable energy are among popular governmental policies in developed countries:

- direct measures: financial incentives for renewable energy producers which are implemented through the certain economic mechanisms like tax and customs benefits, tender schemes, reduced tariffs, subsidies, "green" certificates and other bonuses (Hafezalkotob, 2018);
- indirect incentives - encouraging the use of renewable energy sources directly by reducing attractiveness of fossil substances through introduction of environmental taxes, CO2 taxes, etc. (Chandel et al., 2016);
- incentives aimed at increasing the willingness of consumers to pay higher prices for the energy generated from renewable sources and products produced with the help of such sources due to environmental concerns in order to maintain a stable situation in the long term. (Bernhardt & Böttner, 2017).

Effective energy saving management both at national and company levels reduces import dependence and provides necessary potential for further development of the state and society's economy (Markina et al., 2018; Song et al., 2020).

Similar to the majority of other countries, legislation of Ukraine provides for a varied state support for enterprises and farms to promote resource efficiency practices: import duties; direct budget funding; partial exemption of profit from taxation; setting economically reasonable utility tariffs; exemption from VAT, state guarantees for loans etc. (Liao at al., 2018).

The problem of high energy intensity in Ukraine can be solved only through joint efforts on energy saving by the state and companies accompanied by production modernization. Such a partnership in the field of energy saving should be formed in the following spheres: ecotechnology, use of secondary material resources, energy saving, minimizing energy and resources losses and use of social modernization resources (Pombo et al., 2016; Guo et al., 2018; Zhang et al., 2018).

5. CONCLUSION

Sustainable development and production require involvement of innovative green technologies and tools, accompanied by motivation of all participants in the process to achieve high overall performance. One of the ways to increase efficiency and rationality is introduction of the energy saving management system, which is impacted by both external and internal factors impact the management system.

By way of statistical, generalisation, horizontal, vertical, graphical and factor analysis methods energy production, consumption and energy intensity both on global and national levels were investigated in course of the study. The results show that the countries with highest level of GDP energy intensity are Ukraine (0.238 koe/$2015p), the Russian federation (0.215), Taiwan (0.198), South Africa (0.187), Kazakhstan (0.181) and Canada (0.176). To countries with the lowest GDP energy intensity belong United Kingdom (0.062 koe/$2015p), Turkey (0.066), Portugal (0.069), Germany (0.072), Japan (0.079) and France (0.086). The global GDP energy intensity was at a moderate level of 0.114 koe/$2015p as of 2018.

The global balance between energy production and consumption is currently positive and comprises 491 Mtoes or 3.51% of energy consumption. Despite numerous power generation facilities including the nuclear ones, Ukraine has experienced no positive energy annual balance starting since 1990: the relative deficit of energy in Ukraine (relative difference between the balance and energy consumption) comprised -29.4% in 2018, while the relative deficit peak was in 1991 with -54.7% and the lowest relative energy deficit was observed in 2013: -25.7%.

The research defined factors affecting company's energy saving. External factors include government regulation, market conditions, scientific and technological progress, political, socio-economic, environmental, natural and climatic factors. Internal factors comprise production modernization and reconstruction; consumed materials quality; use of secondary resources; technology improvement; company's innovative development; enterprise management; quality control; staff motivation; financial and economic indicators.

Based on the analysis of legislative and regulatory framework in a number of countries, the main energy saving approaches of state policies are: national and international standards; certification programs; grants; key indicators of resource use efficiency; multi-level structure of state energy saving management; energy prices (tariffs) regulation; penalties; resource audit and management; government subsidies; soft-window facilities.

The results of this study can be applied as the basis for theoretical and practical researches of factors affecting energy saving management of a company. Findings of the research can be applied by scientists and officials in developing governmental programs and policies aimed at promotion energy saving.

This study is limited to theoretical research of energy saving affecting factors and state policies, and is based on a limited number of studies and countries. There's a room for further theoretical and practical researches in the field of factors impacting energy saving management and governmental approaches using wider set of countries and studies.

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