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ENERGY AUDIT AND INCREASE OF ENERGY EFFICIENCY IN THE REPUBLIC OF KAZAKHSTAN

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ABSTRACT

In modern conditions of development the energy observation plays the key role because it is the complex technical-economical inspection of organization which is being made to receive authentic information on volume of energy resources used to identify the structure and effectiveness of energy expenses of organization, to detect the possibilities of energy-saving and increase of energy effectiveness. The aim of energy audit is to evaluate the effectiveness of fuel-energy usage and work out effective measures to decrease company's expenses. In article the steps of energy audit that stimulate its effective conducting are improved.

KEYWORDS: energy effectiveness, energy audit, energy savings, environmental management.

INTRODUCTION

Positive developments in the energy efficiency of the economy possibly in obtaining objective data that can be obtained with the help of an energy audit, which to be conducted properly and in accordance with international standards. Kazakhstan has implemented concrete steps to improve the energy efficiency. Government adopted the Law "On energy saving and energy efficiency" (2014), which establishes certain requirements for businesses such as mandatory energy audit, the introduction of energy managers, development of strategies for energy efficiency. The main instrument of state policy in the field of rational and efficient use of energy in the Republic of Kazakhstan is a comprehensive plan to improve energy efficiency of Kazakhstan for 2012-2015.The practical stage of implementation of energy saving policy in Kazakhstan started in 2013: more than 3000 standards of energy consumption, requirements for energy efficiency for buildings and design documentation, transportation and electric motors, adopted by more than 200 technical standards for energy efficiency.

Energy facilities and infrastructure in Kazakhstan require speedy modernization. It is estimated that over 90% of the gas turbines, nearly 60% of the steam turbine and steam boiler 33% have worked at least twenty years. Investments are needed not only for the producers of electricity, but also for its end-users: the lion's share of Kazakhstan's industry consumes a great deal more energy to produce (five times) than similar enterprises in European Union.

There are many studies worldwide identifying a wide variety of sector-specific and cross-cutting energy efficiency improvement opportunities for industry. Significant numbers of energy efficiency measures is discussed in various studies (DeCanio 1998; Golove and Eto 1996; de Groot et al. 2001; Jaffe and Stavins 1994; Thollander and Ottosson 2008; Rohdin and Thollander 2006; Rohdin et al. 2007). Questions of energy management and energy audit is discussed in Kazakhstan (Zeinolla, Tovma and Tleppayev 2015).

Rational and ecological responsible usage of energetic resources is one of the main priorities of energy politics of most of countries, firstly members of EU. Republic of Kazakhstan is a competent participant of world society, accepted the obligations on accomplishment of missions settled on Agenda of XXI century (Rio de Janeiro, 1992) and declarations of Millennium Summit (New York, 2000) and World-wide summit on stable development (Johannesburg, 2002). Republic of Kazakhstan accepted measures directed on achieving of stable development. Kazakhstan is member and active participant of Development Committee of UN, "Environment for Europe" and "Environment and

stable development for Asia" processes, regional Eurasian network of World-wide counsel entrepreneurs for stable development. Being political, cultural and economic bridge between Europe and Asia Kazakhstan performs the same connecting function in development of landscape and ecological systems of continent.

As for the production of energy resources in Republic of Kazakhstan, in 2015 its total volume was 2169,4 million tones (equivalent to oil), that includes: production of coal 58,8 million tones (equivalent to oil), comparing to 1991 the production of coal decreased to 12,2%, production of oil increased on 209% and it was 82,4 million tones, production of natural gas increased on 169,5% that was 17,3 million tones (equivalent to oil).

In Message of President of Kazakhstan Republic N. Nazarbayev "Strategy "Kazakhstan 2050: new political direction of successful country" the following statement was announced: "Humanity is on the threshold of Third Industrial Revolution that changes the meaning of production. Technological inventions cardinally change the structure and needs of world markets. We live in totally different technological reality than before".

Requirements to "green jobs" (according to the UNEP): "green jobs" are those in production or companies decreasing the impact on environment because of resources output increase, recycling and utilization of waste, and also because of retention and regeneration of ecosystems and bio variety. "Green jobs" should correspond criteria of deserving labor, means that it should be high-quality jobs, guaranteeing good salary, safe working conditions, employment, adequate perspectives of qualification increase and promotion, and also employees' loyalty. Right after the summit "Rio+20", that took place in 2012 in Brazil, development of "green strategies" became one of the prior directions of economical politics either in developed or in developing countries. Kazakhstan became one of the first countries within the post-soviet space that switched to the "green development" way.

Kazakhstan, Russia and Belorussia are going to form electricity-energy market in terms of Eurasian Economic Union (EEU) by 2019. Countries are already in process of discussion of project concept creation program of this market, which in common production of energy is going to be largest in the world. In nearest 4 years members of EEU have to take measures to harmonize legal-actual base in spheres of energy, technological regulations and standards, to prepare base for working subject to access the markets of other countries, and to create new common legal acts in sphere of energy. According to power balance of Kazakhstan for the period till 2030, that was issued by Government of Kazakhstan N724, June 28, 2014 "Concept of development of fuel and energy complex of the Republic of Kazakhstan till 2030", the power surplus in 2016 will be 1504 M. Watt, in 2020 – 1874 M. Watt, in 2025 – 1448 M. Watt.

The concept of Kazakhstan's switch to "green economy" is going to be implemented in 3 steps: 2013-2020 – within this period the main priority of government will be the optimization of resources usage, together with creation of "green" infrastructure. 2020-2030 - on the base of created "green" infrastructure it is going to be started the transformation of national economy, oriented on careful usage of water, stimulation of development and wide implementation energy regeneration technologies, as well as construction of objects on the base of high standards of energy effectiveness. 2030-2050 – the switch of national economy to the principles of as it called "Third Industrial Revolution", that requires the usage of natural resources in conditions of its regeneration and stability. Issues of transfer to "green economy" will be regulated with legislative acts of the Republic of Kazakhstan on issues of transfer to "green" economy.

RESULTS

Industry is a major consumer of electricity (70%) and thermal energy (50%), the population consumes less than 25% of electricity and 30% heat. According to the forecast of the Energy Research Institute of the Russian Academy of Sciences (ERI RAS), consumption of electricity and heat in the world from 2010 to 2035 GG will increase due to the growth needs of the industry (industry) and the public (HCS).

If Kazakhstan save the old industry base and low rates of its modernization without the introduction of energy-saving and energy-efficient technologies, then further development of Kazakhstan's production will only be used to meet the needs of the industry. This will lead to reduced competitiveness; reduce product quality and preservation of the status of "raw" appendage of the developed countries of the world.

Today, energy efficiency in all sectors of the country (the company, the transport sector, housing, and agriculture) is a priority issue in the development of Kazakhstan. In Kazakhstan, the energy saving and energy efficiency of all sectors of the economy are now a priority, with the decision which will be solved complex problems - energy, environmental, economic and social.

Kazakhstan's government adopted a new Law "On energy saving and energy efficiency" № 541-IV in January 13, 2012. The law was adopted to replace the pre-existing Law "On energy saving". [4] The new law defines the concept State Energy Registry - a systematic set of information about business entities, consuming more than 1,500 tons of fuel per year, or 2 MWatt of installed capacity.
The most effective solution to the reduction of natural resources is the practice of energy conservation and introduction of energy efficient technologies. Improving energy efficiency is a very important issue for the economy of Kazakhstan. Unit GDP energy intensity according to the IEA Kazakhstan remain very high (1,8 USD / kg.o.e) compared with developed countries (5,5 USD / kg.o.e).

During the period of reforming the economy from 1991 to 2001 energy intensity of GDP has increased by 15 - 20%, which had a negative impact both on the economy as a whole, and on end users. During the period 2001-2012 the energy intensity of GDP fell slightly, but still higher than the average trend in the 5 times. According to expert data overrun fuel for electricity production is 10-15% on heating - 15-20%. The costs of implementing power saving is about 5 times lower than on a new energy production.

So, following the global socio-economic trends, Kazakhstan, as well as many countries of the West and the East, he joined the international environmental movement and is now taking its first steps along the road of sustainable development. This is confirmed by the Strategic Development Plan of the Republic of Kazakhstan till 2020. According to this document, which generally does not change the general trend, Kazakhstan aims to reduce the energy intensity of the economy (by Strategic plan on 25%) and carbon emissions (in accordance with the obligations under the Kyoto Protocol - by 15% by 2025 and by 25% by 2050).

Speaking about the potential of energy saving in the CIS countries, it is worth noting that today, in a number of companies are already elements of the energy used, for example, developed and implemented programs, plans and energy saving projects carried out purchase more energy-efficient equipment, analyzes the opportunities for improving the energy efficiency of certain production facilities and / or processes.

After the adoption the law "On energy saving and energy efficiency", the deadline for energy audit for the companies was moved from July 2015 to July 2016. There are 79 companies was the accredited license from Ministry of investments and development on Kazakhstan energy audits market.

The audit from 3270 companies was conducted only by 7%. Energy auditors note that most of the companies do it only "for reporting" trying to decrease the potential of energy effectiveness.
Auditing for energy purchases, use, conversion, and waste is the first step in managing your energy consumption. For maximum effectiveness, it is essential to focus on the essentials. This is best done through the Pareto Principle (80% of the effect is caused by 20% of the factors).

Currently, the existing national standards in the field of energy management systems are available in almost all the developed and rapidly developing countries:

- USA (ANSI / MSE 2000: 2008)

- United Europe (EN 16001: 2009)

- United Kingdom (BS EN 16001: 2009)

- China (GB / T 23331: 2009)

- South Korea (KS A 4000: 2007).

European Standard EN 16001: 2009 has been prepared by CEN / CLC BT / TF 189 "Energy management and related services - general requirements and qualification procedures". Adopted by the CEN (European Committee for Standardization) June 6, 2009 At the heart of EN 16001 are well-proven national standards: Denmark (DS 2403: 2001), Sweden (SS 627750: 2003), Ireland (IS393: 2005) and Spain (UNE 216 301: 2007).

Also the European Union developed and adopted to the new standard IEC 60034-30, according to which three energy efficiency class set (IE - International energy efficiency) of single-speed three-phase asynchronous motors with squirrel-cage rotor:

- the IE1 - Standard energy efficiency class - roughly equivalent to the energy efficiency class EFF2, used now in Europe;

- the IE2 - High energy efficiency class - roughly equivalent to the energy efficiency class EFF1,

- the IE3 - the highest energy efficiency class - the new class of energy for Europe.

The introduction of the new standard in Europe will take place in three stages:

- since January 2011, all engines must conform to class IE2,

- from January 2015 all engines from 7.5 to 375 kW must be no lower than class IE3; at the same time allowed the class IE2 motor, but only when working with variable frequency drive,

- from January 2017 all motors with power from 0.75 to 375 kW must be no lower than class IE3; at the same time it allowed the class IE2 motor and when working with variable frequency drive.

Some of the above-mentioned standards came out in the second and even a third version, which once again demonstrates their relevance and development. International experience has shown that the energy standards in the field of energy management systems are a viable instrument of policy and market mechanism, which allows achieving a sustainable energy industry. As a result of the implementation of programs in the US, UK and China can unequivocally say that the potential for optimization of industrial systems and energy efficiency is not less than 20%. As an example, the experience of two companies in one of them is the plant, owned by a large company, Dow Chemicals.

In order to increase energy and reduce inventories of CO2 emissions, the European Union (EU) has focused attention on the achievement of energy efficiency. In particular, the energy efficiency of the housing funds of the EU's largest energy consumers will increase in more than 40%. Directive on energy performance of buildings (DEEZ) and its updated revision (recast), adopted in 2002 and 2010 respectively, the EU contributes to achieve its ambitious goals in energy use and energy saving. Although some EU Member States (such as Belgium, the Netherlands and Germany) have already made considerable progress towards the achievement of high energy efficiency standards, other countries (such as Poland, Spain, and Czech Republic) have faced great challenges in achieving these figures.

Germany has long been a world leader in the development of energy efficiency standards and regulations at the national level ("Progress with Implementing Energy Efficiency Policies," OECD / IEA, 2009). On the basis of the federal German law on Energy Savings 2002, the government has been developed Regulation on Energy Conservation, where the detailed requirements with respect to indicators of energy consumed were presented in new and existing buildings (Regulation on Energy Conservation was modified in 2004, 2007 and 2009 according Schettler-Köhler (2008); Schettler-Köhler & Kunkel (2010)). Through Decree on energy saving and other activities aimed at the development of energy efficiency in the country, in Germany managed to implement many aspects of energy performance of buildings (ECD).

Directive on energy performance of buildings (ECD) is the main legislative instrument which affects the energy consumption and energy efficiency in the EU. This document regulates the construction of buildings erected and controls existing buildings. The original directive was adopted in 2002 (Directive 2002/91/EC); updated edition – in 2010 and published in 2010, which were proposed significant changes to the standards and energy efficiency standards ("Energy Efficiency of Buildings Directive", ECEEE, 2010).

The introduction of the international standard ISO 50001 energy management is defined as state regulatory purposes. The standard is based on the common elements used in all of ISO management system that provides a high level of compatibility with other management systems. The purpose of the standard is to provide companies a structured and comprehensive management to optimize the process of consumption of energy resources and systems management data process. The purpose of the introduction of ISO 50001: 2011 is to provide companies with a structured and comprehensive guide to the process optimization of consumption of energy resources and the system managing the process.

ISO 50001: 2011 - Energy Management System is a fundamental basis for the creation of an efficient and modern energy management in the industrial, commercial and other enterprises and organizations. The international standard ISO 50001: 2011 has been prepared by Technical Committee ISO / TC 242 "Energy Management" which adopted by ISO (International Organization for Standardization) June 9, 2011. ISO 50001: 2011 is based on the European Standard EN 16001: 2009, the American ANSI / MSE 2000: 2008 and Korean KS A 4000: 2007.

Companies that have implemented ISO 50001 standard for energy management system, the ability to get an objective data to reduce the costs of energy consumption and reduce carbon dioxide emissions into the environment, as well as give a great number of benefits to users. With regard to the specifics of the enterprise energy management, basic steps that should be provided for the effective management of energy use in the enterprise:

- The adoption of the energy policy of the company;

- Planning of energy production and consumption;

- The introduction and operation of power plants;

- Monitoring and measuring energy use, including the result of the activities of the staff;

- Corrective and preventive actions to identify and predictable inconsistencies;

- internal audit;

- Management Analysis in energy use;

- Improving management.

The standard is intended for independent use and for its use as a part of other quality management systems, environmental impact, safe working conditions and social responsibility. ISO 50001 standards includes requirements for the development and implementation of energy policy, objectives, targets and energy management action plans, taking into account the legislative regulatory legal acts. The standard will be to organize any type of base, along with the standards for ISO 9001 quality management system and ISO 14001 environmental system management.

The main standard in this series is ISO 50001: 2011 "Energy Management Systems. Requirements with guidance for use". ISO 50001: 2011 is a new voluntary international standard that is applicable to all organizations, including large and small industrial enterprises, commercial organizations, institutions and government agencies wishing to demonstrate their compliance with the declared energy policy by self-assessment and self-declaration of conformity or by passing the system of certification procedures Energy.

ISO 50001: 2011 specifies requirements for designing, implementing, maintaining and improving an energy management system in order to achieve continuous improvement in the field of energy management, including energy efficiency, energy use and consumption in the framework of a systematic approach based on the PDCA cycle.

In addition, as described in the standard requirements apply to measurement, documentation and reporting, design and practice of procurement of equipment, systems, processes, selection and training, which contribute to improving the energy efficiency of the organization.

Standards ISO 50000 have a several series. These include:

1) ISO / CD 50002 Energy audit;

2) ISO / CD 50003 energy management system audits and competence of the auditors;

3) ISO / CD 50004 Guidelines for the implementation, maintenance and improvement of the energy management system;

4) ISO / CD 50006 Basic use of energy and energy efficiency - General Principles and Guidelines;

5) ISO / CD 50015 Monitoring, measurement, analysis and verification of the organizational level of energy efficiency.

Standard ISO 50001:2011 is based on a model of continuous improvement management system, so it can be used either alone or in conjunction with other well-known standards such as ISO 9001, ISO 14001, ISO 22000 and OHSAS 18001 standards. This enables organizations to integrate energy management into their overall efforts to improve product quality and safety as well as environmental management and the management of occupational safety and health personnel.

The main aim of energy audit is to find the ways and possibilities for energy saving and help to the subjects of monitoring to identify the directions of effective usage of energy resources.

According rules of regulations, the energy audit consists of 4 main parts:

1. Preparation step. Aims of that step are to create a program of conducting the energy audit (pointing all deadlines and the full list of objects that are on company's balance sheet) and to form the list of necessary documentation and information that have to be provided to customer.

2. Measuring (Trial) step. Aims of that step are to measure and register the characteristics of energy resources consumption with the help of stationery or/and portable devices, to investigate oil-energy streams on object in general or partially.

3. Analyzing step. Aims of that step are to analyze information and records (calculations of actual figures of energy effectiveness of buildings and types of equipment with all the standards) received from measuring step and to analyze the effectiveness of object's oil-energy resources usage.

4. Conclusive step. Aims of that step are to summarize analysis of energy resources consumption by building, objects, equipment by groups and types of energy sources and to give the conclusion on energy saving and ways to increase energy effectiveness of the object in general and partially.

In order to make the energy investigation to be more effective it is necessary to operate the process of energy inspection more efficient. The main instrument of energy management is an energy audit. We think it is necessary to make the steps of energy audit detailed:

I step. Evaluation of actual effectiveness of innovations and measures implemented before.

II step. Evaluation of energy effectiveness of resources' potential and determination of main directions of rational energy consumption.

III step. Working out the energy passport.

IV step. Working out the program of energy effectiveness increase.

Energy audit is a necessary tool for the assessment of the actual state, identifying the main causes of the loss and the development of recommendations aimed at reducing energy consumption.

Thus, an energy audit is necessary in the event that management of the company or institution has taken a course to reduce energy costs, improve product quality and enhance the energy security of the enterprise. As a result of the energy audit is compiled opinion on energy conservation and efficiency.

The main purpose of the energy audit is energy-saving recommendations and assistance to business entities in determining the areas of energy efficiency. The main tasks of the energy audit:

- identification of reserves and potential energy savings;

- development of a program of energy saving measures, energy-saving technologies;

- determination of the economic effect of the introduction of energy-saving measures;

- definition of the payback period of energy-saving measures and the costs of their implementation;

- improving the system of control and metering of energy resources;

- energy passport of the enterprise.

We allow to clarify that an energy audit conducted to assess the effectiveness of the use of fuel and energy resources (electric and thermal energy, natural and associated gas, solid fuel, oil and processed products) to identify opportunities to conserve resources and to develop a set of energy saving measures. This definition is more fully and clearly reflect the concept of energy audits.
Currently, there are many techniques for energy audits, which are designed for individual systems, types of equipment, technological and power plants in various industries. They regulate the audit process, and the need to prioritize those or other measurements.

In Kazakhstan the procedure of energy audit are determined by "Rules of the audit" (2012).

In our opinion, the main stages of the energy audit can be shows in figure 1.
In accordance with these Rules, an energy audit consists of 4 main steps:
I stage. Preparatory: a program of energy auditing, including a program of instrumental examination.

Stage II. Measuring (Test).
Phase III. Analytical: a technical report on energy audit.
Stage IV. Final: an action plan for energy conservation and efficiency.

According to other researchers, energy audit consist from the following activities:

1. Analysis of the state of power supply systems, heating, water supply, the technical equipment of the park industrial enterprise.

2. Assessment of the systems and measuring instruments.

3. Identification of unreasonable losses.

4. Assessment of the system of regulation of energy consumption and energy use.

5. Checking the energy balances of the enterprise.

6. Calculation of the specific energy consumption standards for manufactured products or types of work.

7. The evaluation of the major energy-saving measures.

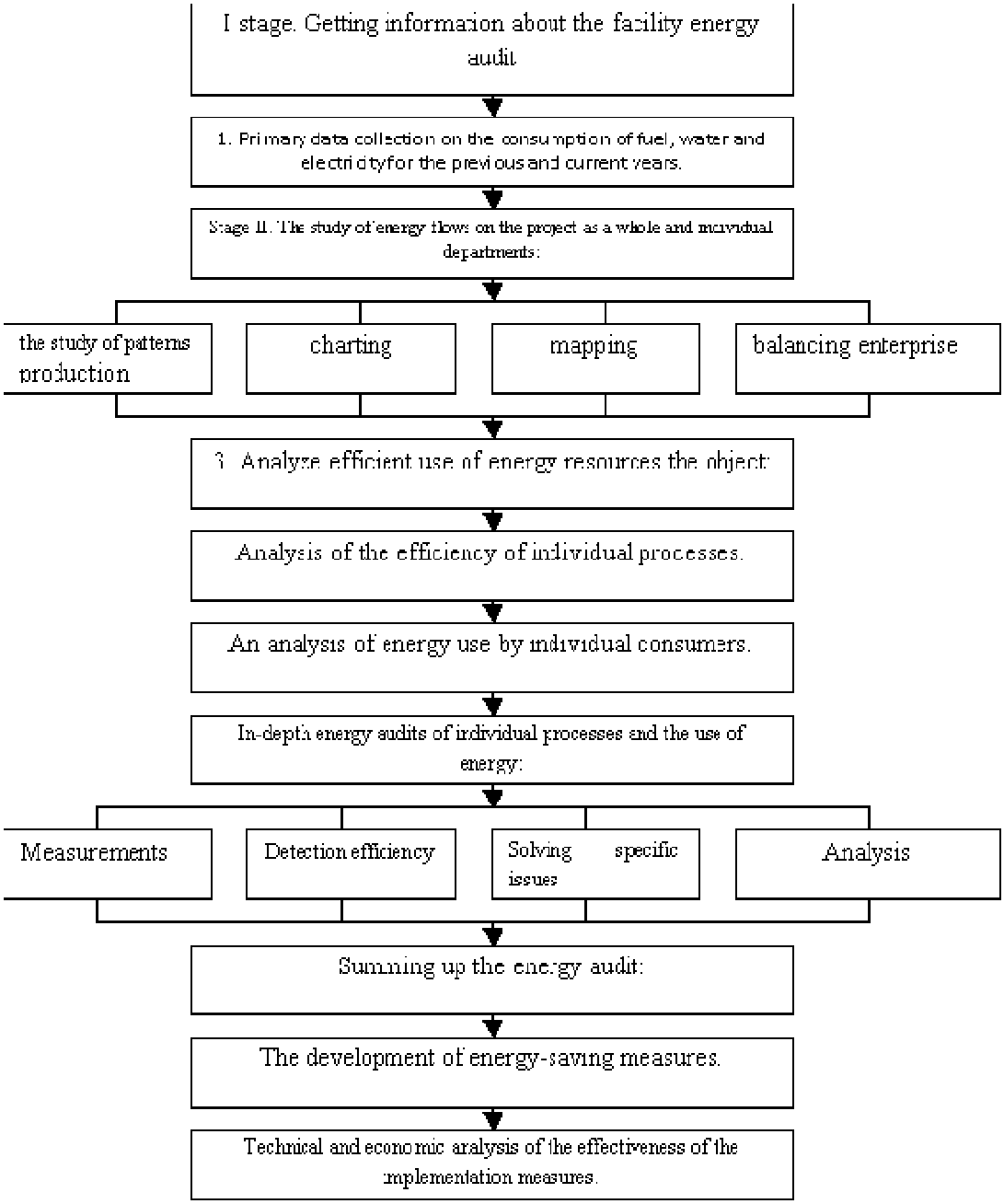

FIGURE 1: STAGES OF ENERGY AUDITS IN KAZAKHSTAN

The result of the energy audit may be:

- conclusion about the quality of produced energy, particularly electricity;

- recommendations for an energy-saving measures and technologies;

- recommendations for the steps (including changes in technology), aimed at improving the energy efficiency of products.

Agreement in the field of energy saving and increase of energy efficiency shall be concluded on a voluntary basis between the authorized body, local executive body of the oblast, city of republican significance, the capital and subject of the State Energy Register consuming energy resources in the volume of one hundred thousand and more tons of the equivalent fuel per year (hereinafter – Agreement).

Ground for conclusion of the Agreement is the application of a subject of the State Energy Register consuming energy resources in the volume of one hundred thousand and more tons of the equivalent fuel per year, to the local executive body of the oblast, city of republican significance, the capital.
Subject of the Agreement is acceptance of obligations by a subject of the State Energy Register on decreasing the energy intensity by it for a production unit in the volume no less than for fifteen percent within five years on account of performance of the plan of measures on energy saving and increase of energy efficiency. Agreement shall be concluded for the term no less than five years.

Termination of the validity of the Agreement shall be carried out in accordance with the rules of civil legislation of the Republic of Kazakhstan.

Information support of activity on energy saving and increase of energy efficiency shall be carried out by central and local executive bodies and subjects of a quasi-public sector on a regular basis by:
1) propaganda of effective use of energy resources
2) coordination of works on creation of demonstration projects of high level energy efficiency;
3) assistance in organizing the exhibitions of energy saving materials and equipment.

Thereby, energy inspection, in other words “energy audit” this is first of all an activity directed on evaluation of energy resources consumption and working out the measures on its shortening in company.

CONCLUSIONS

Energy is becoming an integral part of the modernization of the enterprise. An audit will show you problems that may, when corrected, save you significant amounts of money over time. Audits also determine the efficiency of your home’s heating and cooling systems. An audit may also show you ways to conserve gas, hot water, and electricity.

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REFERENCES

Concept of development of fuel and energy complex of the Republic of Kazakhstan till 2030 (2014). [Online], [Retrieved September 05, 2016], http:// http://online.zakon.kz/Document/ ?doc_id=31581132.

DeCanio, S. (1998), ‘The Efficiency Paradox: Bureaucratic and Organizational Barriers to Profitable Energy-Saving Investments’, *Energy Policy*, 26 (5), 441–454.

de Groot, H., Verhoef, E., & Nijkamp, P. (2001), ‘Energy saving by firms: Decision-making, barriers and policies’, *Energy Economics*, 23 (6), 717–740.

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (2010). [Online], [Retrieved September 05, 2016], http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&from=EN

Golove, W., & Eto, J. (1996), 'Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency', *Lawrence Berkeley National Laboratory*, [Online], [Retrieved May 22, 2015], http://eetd.lbl.gov/ea/emp/reports/38059.pdf.

Jaffe, A. and Stavins, R. (1994), 'The Energy-Efficiency Gap: What Does It Mean?', *Energy Policy*, 22 (10), 804–810.

On Energy Saving and Energy Efficiency (2014). [Online], [Retrieved September 22, 2016], http://online.zakon.kz/Document/?doc_id=31112351.

Rohdin, P. and Thollander, P. (2006), 'Barriers to and Driving Forces for Energy Efficiency in the Non-Energy Intensive Manufacturing Industry in Sweden', *Energy*, 31 (12), 1836–1844.

Rohdin, P., Thollander, P. and Solding, P. (2007), 'Barriers to and Drivers for Energy Efficiency in the Swedish Foundry Industry', *Energy Policy*, 35 (1), 672–677.

Schettler-Köhler, H., (2008), 'Implementation of the EPBD in Germany: Status and Future Planning'. [Online], [Retrieved September 05, 2016], http://www.epbd-ca.eu/outcomes/2011-2015/CA3-2016-National-GERMANY-web.pdf

Schettler-Köhler, H. and Kunkel, S., (2010), 'Implementation of the EPBD in Germany'. . [Online], [Retrieved September 05, 2016], http://www.epbd-ca.org/Medias/Downloads/CA_Book_Implementing_the_EPBD_Featuring_Country_Reports_2010.pdf

Strategy Kazakhstan - 2050: a new policy established state (2014). [Online], [Retrieved September 02, 2015], https://strategy2050.kz/en/news/5142/

The Rules of the Energy Audit (2012). [Online], [Retrieved September 22, 2015], http://adilet.zan.kz/rus/docs/P1200001115

Thollander, P. and Ottosson, M. (2008), 'An Energy Efficient Swedish Pulp and Paper Industry - Exploring Barriers to and Driving Forces for Cost-Effective Energy Efficiency Investments', *Energy Efficiency*, 1, 21–34.

Tleppayev, A., Zeinolla, S. (2015), 'Benchmarking Of Energy Audit in Kazakhstan', *Al-Farabi Kazakh National University Bulletin, Economy Series*, 2/1 (108), 164-170.

Tleppayev, A., Tovma, N. (2015), 'The Role of Energy Management and Energy Audits for Organization's Energy Efficiency in Kazakhstan' Proceedings of the 26th Inernational Business Information Management Association (IBIMA), ISBN: 978-0-9860419-5-2, 11-12 November 2015, Madrid, Spain.

CONSTRUCTION OF KAZAKHSTAN'S SYSTEM OF ENERGY EFFICIENCY INDICATORS FOR THE DEVELOPMENT OF INDUSTRIAL COMPETITIVENESS

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ABSTRACT

An important task in modern management is to increase energy efficiency as one of the key priorities of economic policy. The purpose of this paper is to develop a theoretical and methodological approach and practical recommendations aimed at the implementation of evaluation and monitoring of energy efficiency policy instruments. Methods of research are analysis and mathematical modeling. In this article the authors develop the research-based energy efficiency indicators. Implementation of the system of energy efficiency indicators should be used to assess the efficiency of the proposed measures, and to compare the current status in various sectors to global peers.

KEYWORDS: Energy efficiency, economic growth, energy consumption and energy savings.

INTRODUCTION

To achieve the goals of sustainable development is necessary to ensure the improvement of energy efficiency of country's economy. Energy efficiency is one of the most important areas in the complex of measures to stimulate economic growth and strengthen the international position of the companies. In modern conditions, energy conservation and energy efficiency is one of the priorities of the economic policy of many private companies and government agencies, focused on the rapid development, both in terms of reducing the cost of production of goods and services, and in accordance with the general thrust of government programs aimed at reducing energy intensity of the economy.

Kazakhstan has implemented concrete steps to improve the energy efficiency. Government adopted the Law "On energy saving and energy efficiency" (2014), which establishes certain requirements for businesses such as mandatory energy audit, the introduction of energy managers, development of strategies for energy efficiency. The main instrument of state policy in the field of rational and efficient use of energy in the Republic of Kazakhstan is a comprehensive plan to improve energy efficiency of Kazakhstan for 2012-2015.The practical stage of implementation of energy saving policy in Kazakhstan started in 2013: more than 3000 standards of energy consumption, requirements for energy efficiency for buildings and design documentation, transportation and electric motors, adopted by more than 200 technical standards for energy efficiency.

Reduced energy consumption - one of the important tasks for the state. For its achievements Kazakhstan's government adopted the laws "On energy saving and energy efficiency" and "On amendments and additions to some legislative acts of Kazakhstan on the issues of energy saving and energy efficiency". Government planned to reduce energy intensity of Kazakhstan's GDP by 40% in 2020 (table 1). Currently government being upgraded technology in more than 200 industrial

enterprises in the country and plan to invest more than 300 billion tenge. From these measures in industrial enterprises, government plan to get the effect in energy saving in the amount of almost 3 million tons of oil equivalent.

TABLE 1: REDUCING THE ENERGY INTENSITY OF GDP FROM THE 2008 LEVEL ACCORDING THE PROGRAM ENERGY SAVING-2020

	2015	2016	2017	2018	2019	2020
Reducing the energy intensity of GDP relative to the 2008 level,%	30	32	35	36	38	40

As the table shows, the state assumed a gradual annual reducing in energy intensity. At the present stage global trend is reducing energy intensity of GDP; except for this trend are the figures for Russia. China, Kazakhstan was recorded a significant jump in the previous years according Enerdata.net (figure 1).

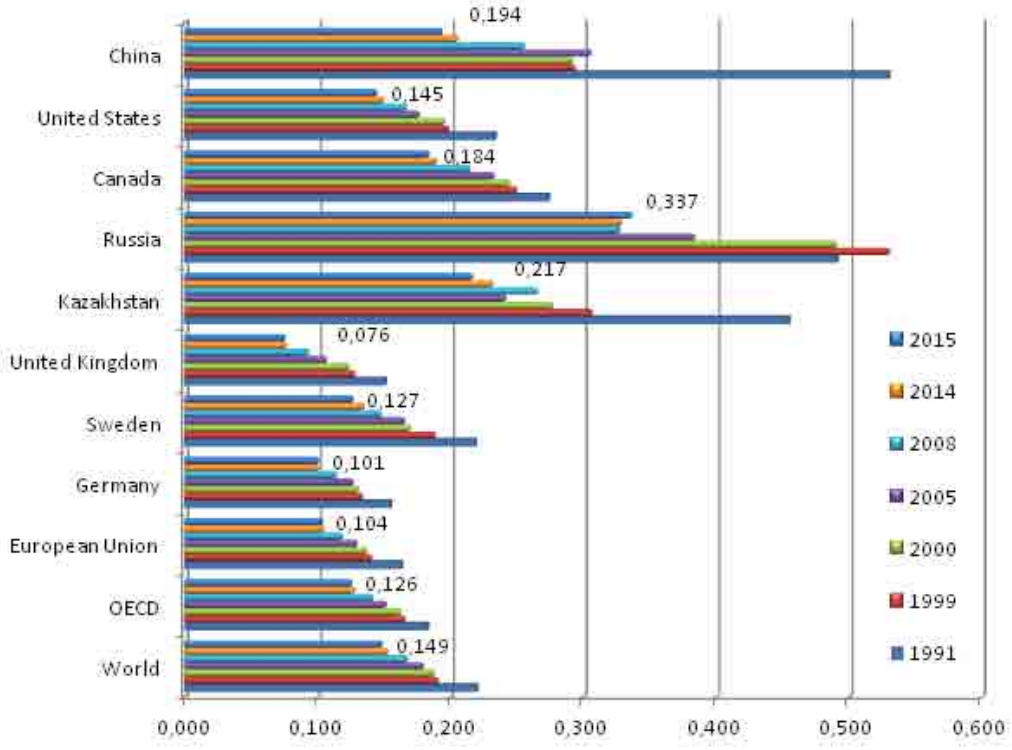

FIG 1: THE ENERGY INTENSITY OF GDP AT CONSTANT PRICES ACCORDING TO PPP (KILOGRAM OF OIL EQUIVALENT IN 2005 PURCHASING POWER PRICES)

Nowadays, important problem for Kazakhstan is creation an effective and efficient model in the field of performance management of energy intensity of GDP. It is important to have a clear idea of how to relate to the world's and Kazakhstan's energy intensity of GDP.

For monitoring the degree and progress of energy efficiency in different sectors, a system of energy efficiency and energy savings indicators should be available. Such accounting systems are developed and implemented in different countries and groups of countries. They allow to quantify the impact of various factors on the dynamics of energy consumption and energy intensity in selected sectors and to identify the effectiveness of measures to improve energy efficiency policy.

There are many studies worldwide identifying a wide variety of sector-specific indicators and cross-cutting energy efficiency improvement opportunities for economy. Significant numbers of energy efficiency measures is discussed in various studies by Ang et al. (2010, 2015), Bashmakov (2013), Brun et al. (2011). DeCanio (1998); Golove and Eto (1996); de Groot et al. (2001); Jaffe and Stavins (1994); Filippini et al. (2014), Thollander and Ottosson (2008); Rohdin et al. (2007), Worrell et al. (2007). Questions of energy efficiency measurement are discussed in Kazakhstan by Zeinolla, Tovma and Tleppayev (2016).

This paper aims to develop theoretical and methodological approaches of energy efficiency indicators and practical recommendations aimed at improving energy efficiency.

In accordance with this purpose the research objectives are:

1) theoretical and methodological approaches of energy efficiency indicators
2) develop a the system of energy efficiency indicators and calculate for some industries;
3) develop a recommendation .

RESULTS

At the present stage, Kazakhstan's economy is characterized by the absence of a system of indicators and insufficient energy indicators, which depend on industry development. For example, in Kazakhstan, energy efficiency problems are related to the following main sectors:

- Industry is one of the sectors where energy efficiency policies are very limited. Problems relate exclusively to energy audits and lack of experience of long-term (5-12 years) target energy efficiency agreements between the government and energy-intensive industrial holdings. Mechanisms to establish market commitments in energy has not yet been taken. There are no standards for energy efficiency and the package of measures to promote energy efficiency in small and medium-sized enterprises.

- In the housing sector is completely lacking policies to promote passive houses and houses with zero energy consumption, reducing energy consumption appliances. The State Statistics does not collect data on the average of the energy consumption, or average power, or the class of energy efficiency of household appliances that greatly complicates monitoring the effectiveness of measures to improve the energy efficiency of household appliances. Government does not set policies for the development of high-efficiency light sources and alternative energy sources.

- In the transport sector, government has very weak domestic policy of energy efficiency. There are no mandatory standards for the fuel efficiency and CO2 emissions; policies on energy-efficient driving, the use of biofuels, hybrid vehicles and electric vehicles.

- Utility companies do not have the energy efficiency policy among consumers, schemes similar a «white» certificate; do not use the experience of developed countries using flexible tools.

Nowadays according Committee of statistics of Kazakhstan, fuel and energy resources (FER) of the country in 2014 amounted to 349.7 million tons of fuel and increased in comparison with 2013 year by 0.7%. The resource of the fuel and energy balance (FEB) is 84.6% of the extraction of natural resources, production of petroleum products, electricity and heat, and 2.9% of their imports. The export of energy resources was decreased by 7.1% and imports by 38.7%. Natural resources constitute 70.5% of the total energy resources. The natural resources of the republic’s fuel and energy resources consist from oil - 43.2%, including gas condensate, coal - 35.2% and natural gas - 21.6%.

In 2014, the domestic market of the republic was consumed 147.5 million toe or 42.2% of the total volume of fuel and energy. 17.8% of these volumes were to transform into other forms of energy and fuel, 24.4% - in the production and other technological needs. An analysis of the energy balance of

the republic showed that Atyrau region has the largest fuel and energy potential (91.4 million toe) and energy consumption (32.1 million toe), Pavlodar region - 75.8 and 36.4 million toe, respectively, Almaty - 51.2 and 9.3 million toe, respectively, and North-Kazakhstan region has the least fuel and energy potential (5.6 and 4.1 million toe, respectively).

Per capita energy consumption (energy consumption of every citizen of the republic for cooking, heating of housing and other economic purposes) in the Republic of Kazakhstan was 10.9 toe in 2014. In 2014, the main areas of energy consumption were mining (21%); manufacturing (37%); electricity, gas, steam and air conditioning (30%); housing sector (16%); services (7%); exports (37.2%); loss (2.4%) (table 2).

TABLE 2: ENERGY BALANCE OF THE REPUBLIC OF KAZAKHSTAN IN 2014 YEAR

	COAL, TH. TONNES OF OIL EQUIVALENT	OIL AND CONDENSATE, TH TOE	NATURAL AND ASSOCIATED GAS, TH TOE	OTHER FUELS, TH TOE	ELECTRIC POWER, TH TOE	HEATING, TH TOE
AGRICULTURE, FORESTRY AND FISHERIES	147,93	0,00	16,40	616,21	182,68	108,35
MINING AND QUARRYING	773,15	440,81	14 417,34	902,59	3 269,76	554,00
MANUFACTURING	8 423,37	13 728,81	1 119,06	4 007,01	7 393,43	2 048,68
ELECTRICITY, GAS, STEAM AND AIR CONDITIONING	20 824,18	7,89	5 504,95	429,77	2 415,92	1 956,83
CONSTRUCTION	45,48	0,00	38,66	1 138,81	122,45	42,84
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	43,01	2,83	17,31	457,28	162,29	35,07
TRANSPORT AND PIPELINES	0,50	0,00	141,66	5,58	21,42	8,57
WATER TRANSPORT	14,17	3,15	272,66	802,15	224,03	35,20
AIR TRANSPORT	0,20	0,00	0,15	5,33	0,59	0,22
INFORMATION AND COMMUNICATION	23,21	117,67	31,19	773,66	377,43	35,41
FINANCIAL AND INSURANCE ACTIVITIES	2,27	0,00	7,38	34,77	66,76	23,51
PUBLIC ADMINISTRATION AND DEFENSE; COMPULSORY SOCIAL SECURITY	25,26	0,00	50,97	112,97	299,60	96,00
EDUCATION	170,55	0,00	421,86	199,69	172,52	167,19
HEALTH CARE AND SOCIAL SERVICES	288,96	0,00	284,99	150,56	538,54	521,47

For the case of Kazakhstan the idea is to quantify the following energy efficiency indicators: energy consumption of domestic product, energy consumption in industrial production, electric capacity of industrial production, the index of energy efficiency, fuel economy of new passenger cars, the average specific energy consumption in homes. Reduced domestic product energy intensity can measure by the formula 1 as follows:

$$DEI_{gdp_t} = 100 * \left(\frac{EID_t}{GDP_t} / \frac{EID_0}{100} \right) \quad (1)$$

where:

DEI_{gdp_t} - reduction of energy intensity of GDP in year t due to the implementation of the program of activities;

EID_t и EID_0 - primary energy consumption in year t and base year;

GDP_t - index of GDP in year t to the base year.

Table 3 shows the most appropriate indicators, in our view that can be applied to the conditions of Kazakhstan.

TABLE 3: ENERGY EFFICIENCY INDICATORS PROPOSED FOR USE IN KAZAKHSTAN

The energy intensity of industrial production of primary energy to the level of the base year, %	$\mathrm{EI}_t = 100 * (\mathrm{EIC}_t / \mathrm{IPP}_t) / (\mathrm{EIC}_0 / 100)$ where: EIC_t - energy consumption in the industry in year t; IPP_t - industrial output in year t
Electric capacity of industrial production to the level of the base year, %	$\mathrm{El}_t = \mathrm{FElC}_t / \mathrm{IPP}_t$ where: FElC_t - power consumption in the industry in year t; IPP_t - industrial output in year t
energy efficiency index for the oil refining, %	$\mathrm{INEFPR}_t = \mathrm{eiPR}_{it} / \mathrm{PR}_{it}$. where: eiPR_{it} - specific energy consumption for refining technology i-th in the year t; PR_{it} - the volume of oil refining technology i-th in year t
The index of energy efficiency for the ferrous and nonferrous metallurgy, %	$\mathrm{INEFP}_t = \sum_i \mathrm{eiFER}_{it} / \mathrm{FER}_{it}$ where: eiFER_{it} - specific energy consumption for production of i-th industry in year t; FER_{it} - the volume of production of i-th industry in year t
The energy intensity of agriculture , %	$\mathrm{ElFg}_t = \mathrm{EAgC}_t / \mathrm{IAgP}_t$ where:

	$EAgC_t$ - energy consumption in agriculture in year t; $IAgP_t$ - agricultural production in year t
Fuel economy of new cars (gasoline) l / 100 km	$$AFGef_t = \sum_i EGef_i * dGCARM_{it}$$ where: $EGef_i$ - Passport fuel consumption of i-th car model per 100 km; $dGCARM_{it}$ - the share of passenger i-th car models in the overall volume of sales of cars in the year t
The share of public transport ridership per capita (pass-km / person / year)	$$IPT_t = \sum_i PT_{it} / POP_t$$ where: PT_{it} - ridership of public transport in year t; POP_t - population in year t
The energy intensity of public utilities (water supply, sewerage and street lighting) per inhabitant, %	$$IEICOM_t = ECOM_t / POP_t$$ where: $ECOM_t$ - energy consumption in public utilities (water supply on purpose) in year t; POP_t - population in year t
The average specific energy consumption in residential buildings (kg of toe fuel / sq. m / year)	$$EIHB_t = EHB_t / SHB_t$$ where: EHB_t - energy consumption in residential buildings in year t, thousand toe; SHB_t - total area of residential buildings in year t, million sq. m.

It should be noted that the reduction of the GDP energy intensity can occur under the influence of a number of factors, in particular the structural changes in the economy (the redistribution of economic activity to less energy-intensive industries), changes in capacity utilization (eg, due to the economic crisis), weather and etc.

This reduction in energy consumption cannot be accompanied by improvements in technology in certain industries - there is a "nominal" increase the efficiency of the whole without increasing the efficiency of individual industries and processes in them (table 4).

Therefore we must analyse not only common energy efficiency indicators, but also changes in technology and processes. This situation is the changes in energy efficiency in a narrow sense - the technological efficiency of the individual processes of energy consumption in the economy.

A common method for calculating the energy saving potential by improving the energy intensity is the comparison of energy consumption in a wide range of industries with the actual and potential attainable parameters of energy efficiency for the individual sectors, the production of specific products and the implementation of individual processes in these industries. We can use data on specific energy consumption for the world's best practices to assess the energy efficiency index.

There are several categories of energy efficiency technologies for each sample:
“Practical minimum” - best practically achieved the world's energy intensity indicators using technologies that have proven the commercial viability;

“Real consumption abroad” - the most common indicators of specific energy consumption in other countries (corresponding indicator "mode" in the statistics).

The problem of energy intensity is also the fact that he is certainly not comparable across countries and regions. For example, one of the problems of the government policy of improving energy efficiency is to monitor the energy efficiency of each region. Obviously, the comparison of the level of energy intensity of GRP will largely reflect differences in the sectoral structure of the region and climate, rather than the degree of implementation of new technologies and their potential use. Also other side, a more correct, of course, is a comparison of comparable countries such as Russia, Canada, Kazakhstan, and the Nordic countries, adjusted for the influence of other factors.

TABLE 4:COMPARATIVE AVERAGE ENERGY LEVELS FOR KAZAKHSTAN’S INDUSTRY

ENLARGED TECHNOLOGY OF PRODUCTION OF GOODS, WORKS AND SERVICES	UNITS	SPECIFIC CONSUMPTION	PRACTICAL MINIMUM	REAL CONSUMPTION ABROAD
oil refinery	toe/t	0,108	0,037	0,052
gas processing	toe/ 1000 m3	NA	0,032	NA
ferrous metals production	toe/t	NA	0,021	0,047
aluminum	toe/t	NA	1,103	1,216
alumina production	toe/t	NA	0,224	0,283
manufacture of pulp	toe/t	0,412	0,279	0,335
papermaking	toe/t	NA	0,166	0,221
cement production	toe/t	NA	0,008	0,009
clinker production	toe/t	NA	0,068	0,100
glass manufacturing	toe/t	NA	0,091	NA

On the basis of specific energy consumption data for the production of goods, works and services, we made a comparison of the average energy efficiency and energy efficiency levels for only a few sectors (table 4). We use practical minimum and real consumption abroad from research studies by Bashmakov (2013), Worrell etc. (2007), Brun etc. (2011), Golove etc. (1996).

For some of industries, we have not found data on the energy consumption of individual products and processes. Substantially, there is a significant gap levels of energy efficiency with the "actual consumption abroad" for all of the technology.

Based on the above analysis, it should be noted that the lack of tools, financing mechanisms and adapted predictive models in the framework of Kazakhstan's energy efficiency programs have a

negative impact on energy efficiency. Changing this situation involves the implementation of a number of measures. We offer together with the creation of the energy efficiency indicators of the list of tools for this policy.

In electricity and heat power: long-term target agreements to reduce the unit costs of electricity generation; long-term target of the agreement to reduce the share of losses in electric networks; a program of modernization of power supply systems; the creation of energy efficiency parameters system ("benchmarking") and the development of the statistical system for monitoring the levels of energy efficiency in the electricity industry.

In the industry: long-term target agreements to improve energy efficiency and energy savings for the most energy-intensive enterprises; standardization of types of industrial equipment; subsidies for the development of energy efficiency programs in small and medium-sized enterprises, subsidies or preferential taxation of acquisition of high efficiency industrial equipment; the creation of energy-saving revolving funds; implementation of schemes of ESCO; the creation of energy efficiency parameters system ("benchmarking"); standards and certification of energy management systems and the organization of training, development of the system of statistical monitoring of the levels of energy efficiency in industry.

In residential buildings: target requirements for energy efficiency in the heating, air conditioning, hot water system and lighting of residential buildings, incentives for the construction of energy efficient buildings; program to improve energy efficiency of buildings in capital repairs projects; classification and rating of residential buildings by the level of energy efficiency; program for the reducing energy poverty.

On transport: promoting the purchase of vehicles with low specific fuel consumption, and urban transport planning requirements.

CONCLUSIONS

It should be noted that international experience makes it possible to use it efficiently and to develop a regulatory framework to improve the energy efficiency of Kazakhstan. In this article we examined indicators and calculated consumption for a some industries. The Kazakh government should create an information base of energy consumption of goods according to the indicators methodology.

On the whole, the GDP energy intensity tends to decrease although in recent years the dynamics of decline is slowing or has a tendency to slow growth, which is due to technological backwardness of industries and processes. The Government should accept some measures and improve energy statistics that have been proposed in the article.

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REFERENCES

Ang, B., Mu, A. , & Zhou, P. (2010), 'Accounting frameworks for tracking energy efficiency trends', *Energy Economics*, 32 (5), 1209-1219.

Ang, B. , Xu, X., & Su, B. (2015), 'Multi-country comparisons of energy performance: The index decomposition analysis approach', *Energy Economics*, 47, 68–76.

Bashmakov, I. (2013). Driving industrial energy efficiency in Russia. [Online], [Retrieved September 1, 2016], http://www.cenef.ru/file/Idustry-eng.pdf

Brun L.C., Gereffi G (2011). The Multiple Pathways to Industrial Energy Efficiency. A Systems and Value Chain Approach. [Online], [Retrieved September 1, 2016], http://www.cggc.duke.edu/pdfs/DukeCGGC_EE-Report_2011-2-15.pdf

DeCanio, S. (1998), 'The Efficiency Paradox: Bureaucratic and Organizational Barriers to Profitable Energy-Saving Investments', *Energy Policy*, 26 (5), 441–454.

de Groot, H., Verhoef, E., & Nijkamp, P. (2001), 'Energy saving by firms: Decision-making, barriers and policies', *Energy Economics*, 23 (6), 717–740.

Energy Saving-2020 program (2013). [Online], [Retrieved September 1, 2016], http://adilet.zan.kz/rus/docs/P1300000904.

Filippini, M., Hunt, L., & Zoric, J. (2014), 'Impact of energy policy instruments on the estimated level of underlying energy efficiency in the EU residential sector', *Energy Policy*, 69, 73–81.

Golove, W., & Eto, J. (1996), 'Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency', *Lawrence Berkeley National Laboratory*, [Online], [Retrieved May 22, 2015], http://eetd.lbl.gov/ea/emp/reports/38059.pdf.

On Energy Saving and Energy Efficiency (2014). [Online], [Retrieved September 22, 2015], http://online.zakon.kz/Document/?doc_id=31112351.

Rohdin, P., Thollander, P. and Solding, P. (2007), 'Barriers to and Drivers for Energy Efficiency in the Swedish Foundry Industry', *Energy Policy*, 35 (1), 672–677.

Thollander, P. and Ottosson, M. (2008), 'An Energy Efficient Swedish Pulp and Paper Industry - Exploring Barriers to and Driving Forces for Cost-Effective Energy Efficiency Investments', *Energy Efficiency*, 1, 21–34.

Tleppayev, A., Zeinolla, S. (2015), 'Benchmarking Of Energy Audit in Kazakhstan', *Al-Farabi Kazakh National University Bulletin, Economy Series*, 2/1 (108), 164-170.

Tleppayev, A., Tovma, N. (2015), 'The Role of *Energy Management* and Energy *Audits* for Organization's Energy Efficiency in Kazakhstan' Proceedings of the 26th Inernational Business Information Management Association (IBIMA), ISBN: 978-0-9860419-5-2, 11-12 November 2015, Madrid, Spain.

Worrell, E., Price, L., Neelis, M., Galitsky, C., & Zhou, N. (2007). World Best Practice Energy Intensity Values for Selected Industrial Sectors. - Report Number: LBNL-62806. [Online], [Retrieved September 3, 2016], https://eaei.lbl.gov/sites/all/files/industrial_best_practice_en.pdf