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## METHODS FOR ACHIEVMENT OF ENERGY EFFICIENCY TARGETS: ANALYSIS OF EXPERIENCE IN THE EU

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**Abstract. Purpose.** The purpose of the presented research is to discuss the key directions for the reformation of energy management in support of sustainable development policy implementation under conditions of transitional economy. In accordance with this aim the following objectives were formulated: 1) to analyse the experience of the EU and European countries, which have implemented the energy efficiency concept; 2) to identify the main methods for the implementation of energy efficiency concept in a transitional economy; 3) to suggest conceptual approaches for balancing targets of energy saving and economic growth in Ukraine. **Methodology.** The main arguments in the article are developed by analysing scientific papers on the issue of energy efficiency in the context of sustainable development, through comparative analysis of statistics in the area of energy consumption, energy efficiency and economic growth in various regions and countries, and by analysing experience of different countries in this field, Germany in particular. **Conclusions.** This article analyses the relationship between energy intensity and GDP growth, reviews the contemporary model for energy efficiency in the EU and studies differences between energy policies in various regions and the EU. The system approach allows to identify the main methods and measures that ensure the effectiveness of energy policy in Germany, which can be considered as useful for Ukraine. **Originality.** The study reviewed and analysed the main methods and measures that ensure the effectiveness of energy policy in Germany, including the domains of regulatory policy, funding, market instruments. **Practical value.** The proposed system of methods and measures may be useful for the planning of actions towards strengthening the capacity of energy efficiency in the conditions of the transition economy.

**Keywords:** *energy efficiency management; energy saving; sustainable development; New European Energy Policy; energy trilemma; energy efficiency indicators*

## МЕТОДИ ДОСЯГНЕННЯ ЦІЛЕЙ ЕНЕРГОЕФЕКТИВНОСТІ: АНАЛІЗ ДОСВІТУ ЄС

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**Анотація. Мета.** Мета дослідження полягає у визначенні ключових напрямків реформування енергетичного менеджменту в підтримку здійснення політики сталого розвитку в умовах перехідної економіки. У відповідність з цією метою, були сформульовані наступні дослідницькі завдання: 1) проаналізувати досвід ЄС і європейських країн, які пройшли шлях імплементації концепції енергоефективності; 2) визначити основні способи реалізації концепції енергоефективності в умовах перехідної економіки; 3) запропонувати концептуальні підходи до збалансування цілей зниження споживання енергії та економічного зростання в Україні. **Методика.** Основні аргументи у статті розроблені на основі аналізу наукових праць з проблем енергоефективності в контексті сталого розвитку, порівняння статистики в області енергоспоживання, енергоефективності та економічного зростання в різних регіонах і країнах, аналізу досвіду різних країн, особливо в Німеччині. **Результати.** У статті аналізується взаємозв'язок між енергоемністю і зростанням ВВП, розглядає сучасну модель ЄС у галузі енергоефективності, вивчає відмінності енергетичної політики в різних регіонах та ЄС. Системний підхід дозволяє виявити основні методи і заходи, що забезпечують ефективність енергетичної політики в Німеччині, що корисні для України. **Наукова новизна.** У дослідженні проаналізовано основні методи і заходи, що забезпечують ефективність енергетичної політики в Німеччині, у тому числі таких областях, як регуляторна політика, фінансування, ринкові інструменти. **Практична значимість.** Запропонована система методів і заходів можуть бути корисними для планування дій, спрямованих на зміцнення потенціалу енергоефективності в умовах перехідної економіки.

**Ключові слова:** *управління енергоефективністю; енергозбереження; сталий розвиток; Нова Європейська Енергетична Політика; енергетична трілемма; показники енергоефективності*

## МЕТОДЫ ДОСТИЖЕНИЯ ЦЕЛЕЙ ЭНЕРГОЭФФЕКТИВНОСТИ: АНАЛИЗ ОПЫТА ЕС

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**Аннотация.** *Цель.* Цель исследования состоит в определении ключевых направлений реформирования энергетического менеджмента в поддержку осуществления политики устойчивого развития в условиях переходной экономики. В соответствии с этой целью, были сформулированы следующие исследовательские задачи: 1) проанализировать опыт ЕС и европейских стран, которые прошли путь имплементации концепции энергоэффективности; 2) определить основные способы реализации концепции энергоэффективности в условиях переходной экономики; 3) предложить концептуальные подходы для сбалансирования целей снижения потребления энергии и экономического роста в Украине. *Методика.* Основные аргументы в статье разработаны на основе анализа научных работ по проблемам энергоэффективности в контексте устойчивого развития, сравнения статистики в области энергопотребления, энергоэффективности и экономического роста в различных регионах и странах, анализа опыта различных стран, особенно в Германии. *Результаты.* В статье анализируется взаимосвязь между энергоемкостью и ростом ВВП, рассматривается современная модель ЕС в области энергоэффективности, изучаются различия энергетической политики в различных регионах и ЕС. Системный подход позволяет выявить основные методы и меры, обеспечивающие эффективность энергетической политики в Германии, которые полезны для Украины. *Научная новизна.* В исследовании проанализированы основные методы и меры, обеспечивающие эффективность энергетической политики в Германии, в том числе таких областях, как регуляторная политика, финансирование, рыночные инструменты. *Практическая значимость.* Предложенная система методов и мер может быть полезна для планирования действий, направленных на укрепление потенциала энергоэффективности в условиях переходной экономики.

**Ключевые слова:** управление энергоэффективностью; энергосбережение; устойчивое развитие; Новая Европейская Энергетическая Политика; энергетическая трилемма; показатели энергоэффективности

**Introduction.** In Europe and the world the issues of energy supply and energy efficiency are extremely urgent on the agenda. The demand for mineral hydrocarbon-based fuel – coal, oil and gas – is growing steadily. According to the International Energy Agency, the global primary energy demand will increase by 37 per cent during the period of 2013-2040. The growth of energy consumption affects the overall level of environmental pollution and accelerates the process of climate change: the energy-related CO<sub>2</sub> emissions are projected to be 16 per cent higher by 2040 [1]. At the same time, it is proven that the growth and continuing increase in energy consumption does not always correspond to rates of economic growth, both in the short and the long run [2]. In recent studies it is well documented that governments of various countries could pursue the energy conservation policies aimed at reduction of energy use for purposes of environmentally friendly development without causing significant negative effects on the economic growth [3-4].

This is why back in April 2010 the Secretary-General's Advisory Group on Energy and Climate Change (AGECC) called for the adoption of two related targets: 1) to achieve universal access to modern energy services by 2030; 2) and for a 40 per cent reduction in global energy intensity also by 2030 [5]. They were later included as targets 1 and 3, respectively, to goal 7 from the recently adopted list of UN's Sustainable Development Goals (SDGs).

The aim of providing universal access to energy should create favourable conditions for the economic take-off. Access to modern energy services must be reliable, affordable and sustainable, as well as, where possible, based on sources with a low greenhouse gas emission potential.

According to Ban Ki-moon, improving energy efficiency is paramount if we are to stop the growth of energy consumption and to reduce greenhouse gas emissions [5, p. 2]. Measures for improving energy efficiency are aimed at the reduction of energy intensity through reducing energy consumption, while maintaining the same level of productivity, and through

transformation of energy sources. Since 2000, the global energy intensity has been decreasing at a rate of about one per cent per year due to both of these approaches [11]. At the same time, it should be noted that the European Union makes a decisive contribution to the global energy policy through its missions, activities and authoritative interaction with countries, peoples and organisations throughout the world.

The European Union member states have committed to the 20/20/20 goals, cutting greenhouse gas emissions by 20 per cent, increasing the use of renewable energy by 20 per cent, and cutting energy consumption through improved energy efficiency by 20 per cent. A number of reviews and scientific publications have shown the fundamental achievements of the European countries (e.g. Germany, Denmark, the Netherlands and others), which in the course of the past decades continuously promoted the energy efficiency mechanisms at national level [17-19].

It should be emphasised that energy efficiency is produced domestically, supporting national energy security [17]. So in 2014, the International Energy Agency countries are estimated to have avoided primary energy imports of natural gas, oil and coal, totalling at least 190 Mtoe, and saving USD 80 billion in import bills. Germany achieved the greatest reductions in imports overall, and is estimated to have saved USD 30 billion as a result of energy efficiency gains that reduced consumption of imported oil, gas and coal.

However, while noting the progress made in developed countries, the special reports confirm that in countries with transitional economies, such as Ukraine, energy management remains limited to an outdated concept of energy consumption. The existing policies, strategies, as well as the practice of coordination of economy- and energy-related issues, are inadequate and insufficient to avert a further deepening of the crisis. In these countries energy policy is still an emerging sphere of activity where little progress has still been made.

**Research Purpose.** The aim of the presented research is to discuss the key directions for the reformation of energy management in

support of sustainable development policy implementation under conditions of transitional economy.

In accordance with this aim the following specific objectives were formulated: 1) to analyse the experience of the EU and European countries, which have implemented the energy efficiency concept; 2) to identify the main methods for the implementation of energy efficiency concept in a transitional economy; 3) to suggest conceptual approaches for balancing targets of energy saving and economic growth in Ukraine.

**Methodology.** The main arguments in the article are developed by analysing scientific papers on the issue of energy efficiency in the context of sustainable development, through comparative analysis of statistics in the area of energy consumption, energy efficiency and economic growth in various regions and countries, and by analysing experience of different countries in this field, Germany in particular.

**Findings.** Today, the EU has a common energy policy in the overall context of sustainable development concept. However, it should be noted that the basic objectives and approaches of energy efficiency policy have been developed in the EU in the course of many years.

Following a long consultation process with all EU member states, in January 2007, the European Commission published the decision to develop a common energy policy – “Energy for a Changing World: The New European Energy Policy”, which has been approved at a meeting of the European Council on 8-9 March 2007 [8]. As the point of departure the new European Energy Policy declared the progress in re-directing energy management towards achieving the objectives of sustainable, competitive and secure energy supply.

This fundamental goal anticipates that energy policy will lead to a ‘post-industrial revolution’, and to a low-carbon economy in the European Union, as well as it will increase competition in the energy markets and improve security of energy supply and employment prospects [8].

The EU’s common energy policy includes the following key provisions: 1) integration of

networks and energy capacity in the EU; 2) diversification of energy sources for strengthening the energy security; 3) assisting EU countries to increase independence from energy imports; 4) making the EU a world leader in renewable energy and in the fight against global warming.

The EU model for achieving the energy efficiency is set out in the series of directives of the European Parliament and the Council, such as: Directive 2006/32/EU on energy end-use efficiency and energy services; Directive 2010/31/EU on the energy performance of buildings (recast); Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products; Directive 2012/27/EU on energy efficiency. These directives established a unified framework for all member states determining the principles of energy efficiency and coordinating their actions.

Under this main line, the European Union wants to achieve a positive effects by 2020 compared to the 1990 levels, also known as ‘20-20-20’, including a 20 per cent cut in greenhouse gas emissions, a 20 per cent reduction in energy use through energy efficiency improvements and a 20 per cent increase in renewables. In addition, all EU member states must also achieve at least 10 per cent share of renewable energy in their transport sector [8].

But some countries make even more ambitious commitments. For example, Germany aims to cut its greenhouse gas emissions by 40 per cent by 2020 and up to 95 per cent in 2050. Germany’s climate targets were put on paper in 2007 and have been held up by all governments since (Germany’s climate targets were confirmed in the 2014 progress report and are subject to an annual monitoring process. The latest monitoring report was published in November 2015.) [9]. The new energy policy of the UK is designed to achieve steady economic development while reducing greenhouse gas emissions by 60 per cent by 2050 [10].

Annual analytical reviews of the World Energy Council reconfirm that the EU is serious about advancing the path toward a low-carbon future. Today, the EU’s GDP has grown by more than 44 per cent, and at the same time,

it has decreased its emissions 19 per cent below 1990 levels; per capita emissions have likewise fallen [11]. Countries such as Germany set a benchmark for other countries to follow by putting forward its contribution. In contrast, in many countries with transition economies (e.g. Ukraine), one of the main economic differences is high energy consumption leading to increased energy intensity (see Table 1).

Table 1  
**Dynamic of energy intensity and GDP growth**  
(Source: compiled by the authors according to [11-12])

	2000	2014	2000 - 2014, %/year	2000	2014
	Energy intensity of industry*			GDP(billion US\$)	
<b>World</b>	<b>0.13</b>	<b>0.12</b>	<b>-1.0</b>	-	-
<b>European Union</b>	<b>0.11</b>	<b>0.08</b>	<b>-2.0</b>	-	-
<b>CIS**</b>	<b>0.36</b>	<b>0.20</b>	<b>-4.0</b>	-	-
Ukraine	0.59	0.27	-5.4	31.3	131.8
Russia	0.35	0.23	-2.9	259.7	1 860.6
Kazakhstan	0.25	0.20	-1.6	18.3	217.9
South Africa	0.18	0.18	0.2	136.4	350.1
China	0.23	0.18	-1.9	1 205.3	10 354.9
Sweden	0.19	0.14	-2.4	259.8	571.1
Canada	0.18	0.14	-1.9	739.5	1 785.4
Australia	0.18	0.12	-2.6	415.0	1 454.7
South Korea	0.16	0.12	-2.0	561.6	1 410.4
India	0.13	0.11	-0.7	476.6	2 048.5
United States	0.13	0.09	-2.6	10 284.8	17 419.0
Japan	0.11	0.09	-1.2	4 731.2	4 601.5
France	0.11	0.08	-1.9	1 368.4	2 829.2
Germany	0.08	0.07	-1.1	1 949.9	3 868.3
United Kingdom	0.09	0.06	-2.0	1 554.8	2 988.9

\*The energy intensity of industry is defined as the ratio between the final energy consumption of industry and the value added measured in constant purchasing power parities

\*\*CIS – New Independent States, the former Soviet Union

A World Bank study indicates that countries with underperforming energy systems may lose up to 1-2 per cent of growth potential annually as a result of inefficient use of scarce energy resources, over-investment and energy subsidies, energy supply outages, and direct energy losses [12].

As for the understanding of efficiency energy systems, it should be noted that it is viewed through the lens of the energy trilemma: energy security, energy equity and energy-related environmental sustainability.

According to the interpretation of the World Energy Council [13], achievement of energy security requires the effective management of primary energy supply, the reliability of energy infrastructure, and the responsibility of energy companies operation to meet current and future demand. Energy equity provides the accessibility and affordability of energy supply across the population. Environmental sustainability is supported by the achievement of provision / consumption efficiencies, and by the development of energy supply from renewable and other low-carbon sources.

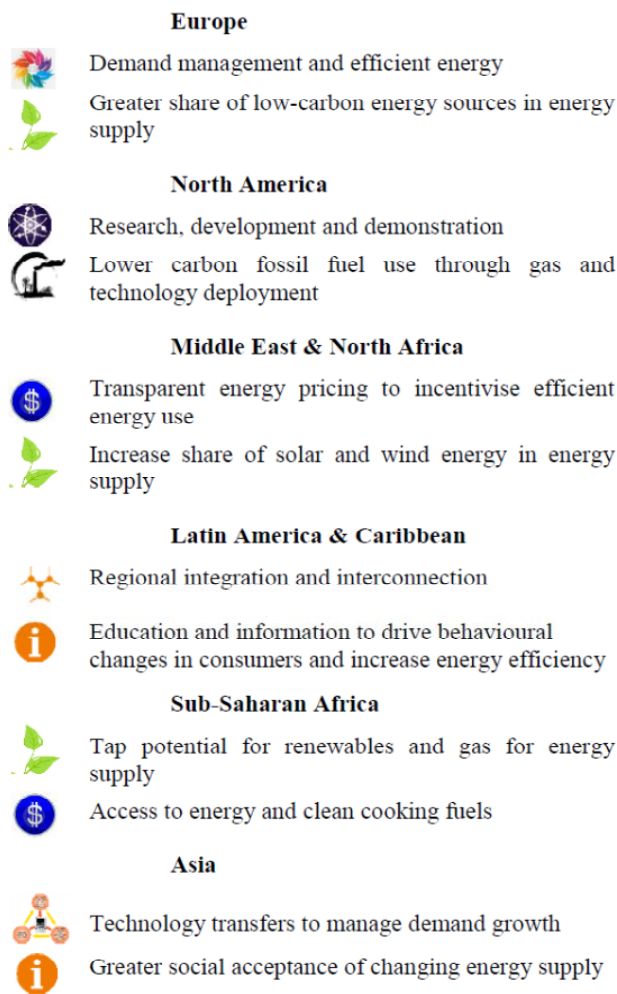


Fig. 1: Regional differences and priorities in measures for developing the energy efficiency (Source: [16])

In this regard, Ukraine’s obligation to EU is to create news models of energy management based on nature conservation and reduction of fossil fuel consumption while minimising additional environmental impacts caused by emissions of greenhouse gasses into the atmosphere [14-15].

The results of this study show that specific measures for developing the energy efficiency vary greatly between regions and, in addition, present great diversity among them (see Fig. 1).

Country reports also reveal that the speed and willingness to act varied greatly between countries. The challenges have varied with each country but often included limited financial resources, insufficient experience or training in leadership of authorities, as well as the lack of experience in the developing and submitting competitive proposals on energy services.

German experience is particularly valuable for Ukraine, because both countries do not have sufficient reserves of their own natural energy resources. However, Germany’s ranking reached the thirteenth position in the Energy Trilemma Index (calculated by the World Energy Council among 129 countries, 2015). Germany also constantly improves its position to balance the three sides of the energy trilemma, with additional focus on social and economic indicators, see Fig. 2 [13].

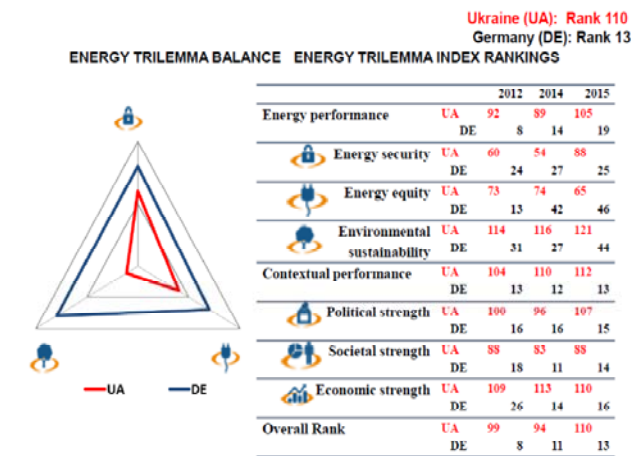


Fig. 2. 2015 Energy Index Rankings (Source: compiled by the authors according to [13])

Germany has made progress in the implementation of energy efficiency targets owing mainly to technology innovations and new emerging energy service models, as well as due to priorities set towards clean energy sources and energy management systems. A large variety of services is offered by a plenitude of stakeholders that differ significantly in size and specification and that actively compete with each other [6].

Consultation for private consumers is most common in the following subjects: buildings, saving electricity and saving fuel. The German

market-oriented energy efficiency approach is characterised by a variety of instruments and measures that can be structured in the fields of regulatory policy, funding and market instruments.

The regulatory policy includes legal requirements regarding quality of buildings and energy consumption of new and refurbished buildings (EnEV), legal requirements for energy services (EDL-G), and legal requirements for energy consumption of products (EVPG).

Examples of financial instruments include: programme BAFA 'Local consultations to save energy', providing, among others, grants for consultations with home owners by qualified engineers; KfW programmes for energy-efficient construction and refurbishment, providing public authorities with four to five euros in revenue for every euro that went into the promotion of energy-efficient construction and refurbishment (as of 2010); market incentives programme for the use of highly efficient cross-sectional technologies, etc.

Examples of marketing instruments include: energy performance certification, pilot projects, information and motivation, training and qualification of technical specialists.

**Originality and Practical value.** The study reviewed and analysed the main methods and measures that ensure the effectiveness of energy policy in Germany, including the domains of regulatory policy, funding, market instruments. The proposed system of methods and measures may be useful for the planning of

actions towards strengthening the capacity of energy efficiency in the conditions of the transition economy.

### Conclusions

1. The government can pursue the energy conservation policies aimed at reduction of energy use for purposes of environmentally friendly development while supporting economic growth.

2. UN included a goal to ensure access to affordable, reliable, sustainable and modern energy for everybody to its list of Sustainable Development Goals (SDGs) based, among others, on two related targets: 1) to achieve universal access to modern energy services; 2) to reduce the global energy intensity.

3. The EU's energy policy includes the following key lines of action: 1) integration of networks and energy capacity of the EU; 2) diversification of energy sources for strengthening the energy security in the EU; 3) development of renewable energy.

4. The measures for developing the energy efficiency vary greatly between regions and, in addition, present great diversity among them.

5. Energy management in the EU includes two main sets of actions: 1) demand management and efficient energy; 2) greater share of low-carbon energy sources in energy supply.

6. The German market-oriented instruments and measures can be structured in the domains of regulatory policy, funding and market instruments. All of these methods can be recommended to Ukraine.

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