Russia and UK: Studying the Problem of Energy Efficiency in Household Sector

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Abstract
Energy efficiency in household sector has recently become an issue of pressing topicality according to the latest studies and reviews in this domain. The issue can be found in numerous publications of the renowned scientists of the past and nowadays it is still receiving a wide support. There are a number of circumstances connected with the emergence of this phenomenon.

Firstly, energy consumption of households in Russia and UK is constantly growing. This is true for many other sectors in both countries as well as worldwide. The Statistical Review of World Energy released by British Petroleum in June 2013 states that global consumption of primary energy grew by 60% over the last 25 years and the growth is continuing. It is expected that by 2035 global consumption will grow by 41%.

Secondly, energy strategies of both countries call switching to the path of innovative and energy-efficient development one of the main objectives of household sector development.

The paper intends to draw attention towards the energy efficiency issue. The paper observes existing energy efficiency problems in household sector in Russia and United Kingdom and governmental programmes that serve to address them. It also considers the peculiarities of energy efficiency programmes of these countries. The paper shows the distinctive and similar features of legislation and policies in energy efficiency area in Russia and United Kingdom. The research reveals each country's good practices in household sector that can be adopted for another country and can contribute to sector development.

Keywords: energy efficiency, household sector, programme management

Why is it important to address energy efficiency problem?

Energy has always played a significant role in human and economic development and the welfare of the society. We used wood to get fire and wind force to travel by sea. Today we use heat, electricity in production, service sector, on transport and in our homes.

Saving energy resources in all sectors of the economy is one of the most important strategic challenges of the 21st century. Energy consumption nowadays is growing in many sectors worldwide. Over the last 25 years global consumption of primary energy grew by 60% [4], it is expected that by 2035 global consumption will grow by 41% [3].

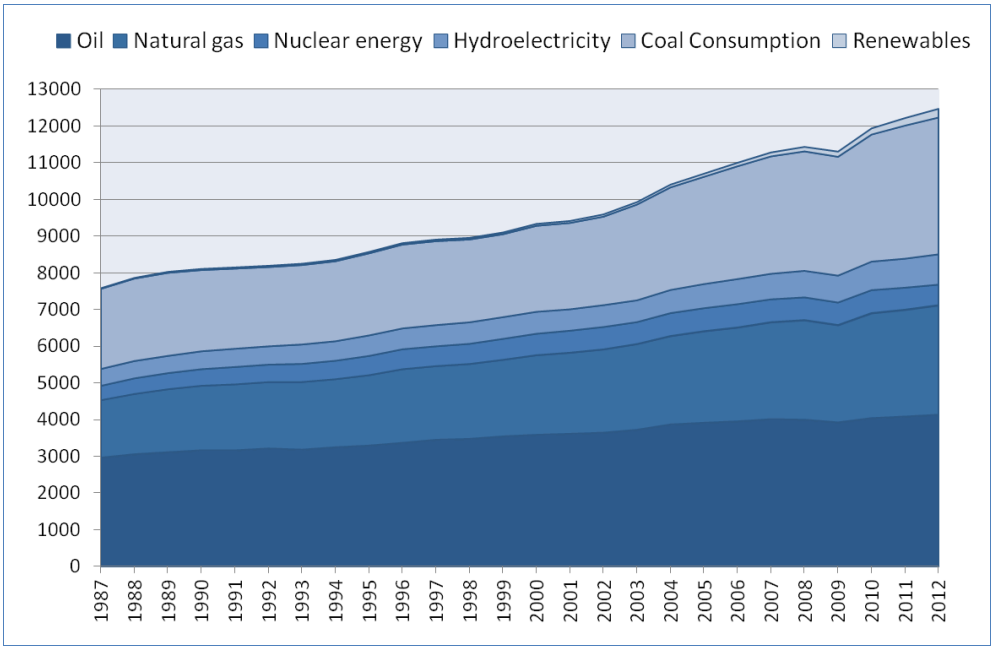

Figure 1. Growth of world primary energy consumption in 1987-2012, million TOE

Energy strategies of both countries declare that one of the main objectives of household sector development is switching to the path of innovative and energy-efficient development. In order to be competitive you have to be energy-efficient. The UK government focuses on establishing an energy-efficient economy, as it is one of the key climate and energy priorities. According to David Cameron, Prime Minister of the UK, European countries «are in a global race and the countries that succeed in that race, the economies in Europe that will prosper, are those that are the greenest and the most energy efficient» [10]. The same attention is paid to the issue of energy-efficiency in Russia. Russian Minister of energy, Alexander Novak, claimed that «today the question of energy efficiency is a question of economic competitiveness, introduction of new technologies, modernization and ecology; generally, it's a question of competing on world markets».

Energy efficiency is a matter of individual behaviour, it reflects the rationale of energy consumers [9]. Energy efficiency is a strategically important issue that allows to:

- Enhance energy security of the country and contribute to economic growth;

- Improve environmental safety of the country;
- Facilitate the implementation of national projects;
- Increase the welfare of society.

Despite the social and economic importance of energy-efficiency in household sector, the countries still suffer from various problems that need to be addressed.

Energy efficiency problems in household sector in Russia and UK

Energy efficiency problems in household sector can be divided into two components: houses and people. Problems connected with houses and buildings refer to the construction process, regulations and standard compliance, the use of energy efficient technologies. Problems connected with people refer to effective energy consumption, awareness and willingness to change. Energy consumption within a household means that energy is used for such activities as lightning, space heating, water heating and appliance use [15].

Each country has its specific problems in the sector, this is why they were studied separately.

The case of Russia

The household sector in Russia has the greatest potential for energy-efficiency, the technical potential of reduction is estimated at 33 million TOE till 2020 according to the Ministry of Energy of the Russian Federation. Energy consumption of households in Russia is by 25-30% higher than energy consumption of the households in Europe.

These are the barriers inherent for Russia.

1. Lack of consumer awareness about the energy efficiency measures.

Lack of information in Russia is one of the key barriers for energy efficiency. Households lack necessary knowledge about energy-saving technologies and measures. Despite the majority of Russian households admit the importance of energy savings, they do not know how to do it and even whom to consult.

2. High depreciation of buildings and facilities.

The level of depreciation of buildings and facilities over the country is nearly 60%, average age of the majority of assets is more than 10 years. Russia has no supervisory authority to control energy consumption and depreciation level. As a result it is very difficult to assess the need in energy efficiency measures during reconstruction and overhaul.

3. Blurring or absence of governmental support and economic motivators.

Governmental support exists only on paper, in fact receiving financial benefits or support is almost impossible. Companies who are responsible for the implementation of energy efficiency programs are usually unable to meet the rigid criteria of project selection and other requirements to get financial support.

4. Low compliance of standards and regulations in construction.

Non-compliance of mandatory requirements in construction and energy efficiency requirements in buildings results in administrative liability. However even the

maximum fine for noncompliance cannot seriously affect construction companies or encourage them to comply with the standards and regulations. Furthermore, some standards and regulations in construction are not binding. These standards recommend to employ certain technologies and construction solutions, but they do not imply that every construction company will follow the recommendations.

5. Poor quality of programme management in the companies of housing and communal services.

There are many issues connected with programme management in these companies. Firstly, the companies have limited budgets and large number of projects to implement. All the projects are effective in terms of net present value, payback period, internal rate of return, but it is obvious that not all projects can be selected for implementation. As a common practice companies choose to implement short-term and low-cost projects aimed at instant payback and minimum investments.

6. High rates and low quality of the housing and communal services.

In 2013 the rates in Russia grew on average by 110,1%. 10 regions out of 83 experienced growth of 112% more. The rates grow from year to year, while the quality of the services remains poor. According to the study of Russian center of public opinion research in 2013, 60% of Russians are dissatisfied with the quality of provided services [22], 71% of Russians declare that the rates cause financial difficulties for their households. Less than 10% of Russians are ready to pay more in order to get high quality services instead. They believe that current rates are well enough to provide better quality. Around 2% of Russians do not pay for the housing and communal services for several months already. There is a risk that the number of defaulters will grow in the case of subsequent growth of rates.

The case of UK

The household sector in the UK has a great potential for improvement in terms of housing stock, the technical potential of reduction is estimated at 38,2 million TOE till 2020 according to UK National Energy Efficiency Action Plan [21]. Nevertheless the household sector in the UK is more efficient than in Russia.

These are the barriers inherent for UK.

1. Conservativeness of construction industry.

Although there are new technologies that allow creating buildings with low or zero space heating demands, people still remain conservative in selecting homes. Despite 84% of buyers admit their readiness to pay extra 2% for an «eco home», such homes are still rare in UK. Significant opportunities for reducing the energy demands of lighting and appliances exist but are not being implemented.

2. Low compliance of standards and regulations in construction.

In 2004 Buildings Research Establishment survey found that one-third of new homes did not achieve the required energy efficiency standard [14]. Disruption is one of the dominating barriers to the process of improving energy efficiency [8].

3. Lack of consumer awareness about the energy efficiency measures.

Existing homes represent the greatest opportunity for efficiency improvements. As well as in Russia, UK consumers are also not well aware of energy efficiency

measures, along with this they lack advice, trustworthy information and reliable brands.

4. Lack of capital, psychological barrier and payback time.

Such barriers as lack of capital (high up-front costs) and «hassle» factor prevent the majority of households from making any improvements. In UK it's more about low public interest than low awareness. Even those people and households, who are relatively well informed, are not likely to install energy efficient measures in their homes [5]. Those who install are motivated by noneconomic reasons. A Local Energy report conducted in 2007 showed that those households who install energy efficient measures and technologies, are not necessarily motivated by a rational cost-benefit analysis, they may be just keen to own the latest environmental innovations [16].

5. Specific house types and high depreciation of buildings and facilities.

UK has the oldest and most inefficient housing stock in Europe. Over the last 40 years there has been a pronounces change in types of the homes. Detached and semi-detached homes are the most common house types nowadays. These houses typically have more energy losses than flats, due to external walls and more windows than equivalent homes of other types. They also tend to be larger than average homes and since the amount of heating energy is associated with the size of floor area, it means that increase in the number of detached houses will result in increase of energy consumption and low energy efficiency. New homes built since 1991 and up to 2011 represent 13% of total housing stock. The largest number of houses exploited were built in 1918-1990, with high depreciation today.

The analysis of the problems in two countries in shown in Table.

Table 1. Comparison of key barriers for energy efficiency in household sector

Problems	Russia	UK
Lack of consumer awareness about the energy efficiency measures	☑	☑
High depreciation of buildings and facilities	☑	☑
Blurring or absence of governmental support and economic motivators	☑	
Low compliance of standards and regulations in construction	☑	☑
Poor quality of program management in the companies of housing and communal services	☑	
High rates and low quality of the housing and communal services	☑	
Conservativeness of construction industry		☑
Lack of capital, psychological barrier and payback time		☑

Problems	Russia	UK
Specific house types		

On the path towards energy-efficient economies

Governmental energy efficiency programmes in Russia

Russian government developed an energy efficiency programme till 2030 that covers many sectors of the economy including housing sector. The housing sector in Russia has the greatest potential for energy efficiency, technical potential to reduce energy consumption is estimated at 33 million toe. To compare, the consumption of energy suppliers in housing sector in Russia 25-30% higher than of European suppliers. It is expected to achieve tangible household energy savings up to 2030 and increase energy efficiency by the means of four main programmes:

- Building and energy regulations;
- Buildings, equipment upgrade, innovation and development;
- Energy audit and monitoring;
- Impact on householder behavior.

Table 2. Energy-efficiency programmes in Russia

Government programme	Aims	Actions
Building and energy regulations	1. To enable householders to reduce energy costs and enjoy improved comfort	1. Make rigid mandatory standards of construction and design: For new houses and buildings For existing houses and buildings (certain categories of building work) 2. Focus on compliance of the requirements, introduction of penalties 3. Improve tariff and tax policy in energy sector
Buildings, equipment upgrade, innovation and development	1.To provide safe and energy-efficient homes and equipment, prevent accidents	1. Complete works on modernization, reconstruction and renovation 2. Introduce innovative, highly efficient technologies in homes 3. Develop regional energy supply
Energy audit and	1. To ensure compliance	1. Organize governmental

Government programme	Aims	Actions
monitoring	with energy-efficiency requirements	statistical observation of energy efficiency and energy saving 2. Mandatory energy audits of energy suppliers
Impact on householder behaviour	1. To reduce energy consumption by 20% 2. To influence householder behaviours in how they use energy in their home 3. To encourage the installation of energy saving measures	1.Imlement specific projects: Measure, save and pay New light Energy-efficient district

Building regulations in Russia consist of the following measures:
- Building Regulations 31-02-2001, Single-family houses;
- Building Regulations 31-01-2003, Multicompartment residential buildings;
- Building Regulations 23-02-2003, Thermal performance of the buildings;
- Building Regulations 41-01-2003, Heating, Ventilation and Conditioning.

Existing building regulations are already outdated and do not fit to new technologies and requirements. New revised mandatory building regulations are expected to come not earlier than in 10-15 years. Along with this it is also crucial to tackle the problem of non-compliance. The government plans to introduce penalties for non-compliance and improve tariff and tax policy in energy sector.

The need to ***upgrade, innovations and development*** is dictated mainly by the current state of buildings and homes. Today it is critical to complete construction works on improvement of the majority of buildings and homes. The programme is determined to provide safer dwellings first of all, and increase the level of energy-efficiency.

Energy audit and monitoring is aimed at ensuring the compliance with energy efficiency requirements. Statistical observations, audits and monitoring will be organized within a corresponding governmental department. Energy audits of energy suppliers will become regular and mandatory.

Governmental programme ***to impact householder behaviour*** includes three main projects:
- Measure, save and pay;
- New light;
- Energy-efficient district.

Project «Measure, save and pay» intends to provide energy meters for the households (measure), establish a reward system to encourage economic behaviour (save), and set the system to ensure the full payment of energy (pay). The project is driven by the introduction of Smart Metering technology and development of financing mechanisms to install them. The project is currently piloted in Urals region (cities

Izhevsk, Perm, Kirov and Kamensk-Uralskiy). Afterwards the government plans to replicate regions best practices all over the country.

Project «New light» intends to modernize the country's existing systems indoor and outdoor lighting, achieving their highest possible energy-efficiency. One of the tasks is to replace existing incandescent and mercury arc lamps to energy-efficient light sources with a focus on diode lamps. As expected the project will reduce the households electricity bills on average up to 60% from the level of 2009. The project is currently piloted in 5 cities: Gorno-Altaysk, Perm, Kazan, Tyumen and Kirov.

Project «Energy-efficient district» intends to modernize districts and small cities. The project is focused on modernization, reconstruction and renovation of buildings and homes. It is expected the project will help to reduce household expenditure on housing and communal services on average by 15-25%. The project is currently piloted in 4 cities: Tyumen, Apatity, Vorkuta and Kazan.

Governmental energy efficiency programmes in UK

The UK government expects to achieve nearly all estimated household energy savings up to 2020 and increase energy efficiency by the means of four main programmes [19]:

- Building Regulations;
- Obligations on energy suppliers;
- Appliance labelling;
- Impact on householder behavior.

Table 3. Energy-efficiency programmes in the United Kingdom

Government programme	Aims	Actions
Building regulations	1. To enable householders to reduce energy costs and enjoy improved comfort 2. To achieve half of the energy savings of the UK household sector	1. Make rigid standards of construction and design: For new houses and buildings For existing houses and buildings (certain categories of building work) 2. Focus on compliance of the requirements
Obligations on energy suppliers	1. To reduce energy losses in households	1. Provide energy services and products to households
Appliance labelling	1. To influence or dictate the selection, design and labelling of household appliances	1. Introduce labelling schemes: EU mandatory energy labelling scheme UK's own voluntary Energy Saving Recommended label
Impact on householder	1. To influence	1.Imlement specific

Government programme	Aims	Actions
behaviour	householder behaviours in how they use energy in their home 2. To encourage the installation of energy saving measures 3. To promote understanding and awareness of climate change and inspire households for action	projects: Climate change communications initiative Energy performance certificates Better billing and metering

Building regulations consist of the following four measures:
- Building Regulations England and Wales, 2002;
- Building Regulations England and Wales, 2005-2006;
- Building Regulations Scotland, 2007;
- Building a Greener Future.

Building regulations require the developers to build more energy efficient homes. The latest document, Building a Greener Future, sets out the government's ambitions to achieve zero-carbon housing by 2016. Besides from making building regulations more stringent, the government also focused on compliance. It was revealed that poor understanding of the requirements, poor workmanship, and absence of local authorities to enforce compliance are the main reasons for poor compliance. To address the issue of compliance there is a number of building compliance consulting agencies.

Obligations on energy suppliers include the following regulations:
- Energy Efficiency Commitment Phase 1 (2002-2005);
- Energy Efficiency Commitment Phase 2 (2005-2008);
- Carbon emissions reduction target (2008-2011);
- Future supplier obligation (2011-2020).

The goal of the programme is to promote improvements in domestic energy efficiency. Suppliers are obliged to help the households make energy savings by installing such energy services and products as cavity walls, loft insulation, energy efficient boilers and other. By the end of both phases of Energy Efficiency Commitment (EEC), suppliers successfully overachieved their targets of energy savings and EEC proved to be a very cost effective measure. To bring the obligations in line with the UK climate change targets, Energy Efficiency Commitment was eventually evolved in 2008 to the Carbon emissions reduction target (CERT) [20]. Future supplier obligation involves the implementation of microgeneration or other measures aimed at reducing emissions while maintaining the level of energy service alike in CERT. Both Carbon emissions reduction target and the supplier obligation reflect a shift towards mixing short-term, efficiency-based measures with longer-term strategic development of more sustainable energy technologies [23].

As for the ***appliance labelling*** there are two schemes that are now in operation in the UK:

- EU mandatory labelling (label has ratings between A-G, where an A-rating stands for the most efficient);
- Voluntary UK labelling (label aims to endorse the top 20% (in energy efficient terms) of products in each of 29 product groups).

Both schemes have already increased labelling and have been assumed to be vital in short term. According to a EU-wide review of mandatory energy labelling in 2007, the labelling led to significant market transformation towards A-rated appliances [1].

The government runs various communication initiatives, introduces energy performance certificates and provides better information on household energy consumption to make an ***impact on the households behaviour***.

The communication initiatives are primary aimed at raising awareness (Climate challenge fund to support regional and local communication projects, Climate challenge website with free resources and information tools, Climate change champions initiative to encourage young people act as figureheads for the initiative) and behavioural actions («Act on CO_2» calculator, Act on CO_2» campaign).

Energy performance certificates (EPC) provide information on energy performance rating of the dwelling (from A to G, where A stands for the most energy efficient) and recommendations on ways of improving this rating. Having this certificate is mandatory as per EU Energy Performance of Buildings Directive, but following the recommendations is not. However, it is expected that this initiative will increase the awareness and have positive impacts on households behaviour in the future. A research conducted by the Department of Energy and Climate Change in 2013 showed the link between the EPC rating and home's sales price [2]. Those properties rated A or B were sold 14% more than those with G.

«Better billing and metering» project intends to provide households better information on household energy consumption in an easily understood format. «Better billing» provides historical information on electricity and gas consumption. «Metering» provides smart meters to record information on energy consumption and establish direct communication between households and suppliers. The UK government mandated scheme expects to install 53 million smart meters across England, Scotland and Wales by 2020 [11].

Recommendations

Existing energy-efficiency programmes of both countries have a number of projects that already proved to efficient. Along with this there is a potential for improvement. Good practices within the projects in one country can be considered for adoption in the other country, taking into account the feasibility and peculiarities of the country.

Based on the experience with current programmes, suggestions for improvement for Russia include:

- Developing contemporary, clear, easy-to-interpret legislation;
- Creating a supervisory authority and ensuring better control and compliance of legislation;

- Introducing obligations on energy suppliers to promote improvements in household energy efficiency and provide information;
- Organizing communication initiatives for the households to raise awareness;
- Introducing mandatory labelling scheme for appliances to dictate the selection.

Suggestions for improvement for the UK include:
- Developing clear, easy-to-interpret legislation;
- Creating a supervisory authority and ensuring better control and compliance of legislation;
- Carrying out modernization, reconstruction or renovation for existing homes;
- Establishing pilot period and pilot cities for new projects to allow initial bugs to be ironed out.

It is important to mention that the governments of the UK and Russia are already working closely to share their experiences of implementing energy-efficiency policies. To develop the energy dialogue between two countries the governments set up the UK Russia Consultative Committee on Energy Efficiency and Renewables. The first meeting took place in October 2013, and brought together the UK and Russian governments, representatives of the UK Energy Services Technology Association and Russian businesses [10].

The path towards energy-efficient economy in the country should be carried out within the framework of enhanced cooperation and interaction among the key stakeholders: the government, energy suppliers, scientists and developers and households. Cooperation must be comprehensive and the government should stand for the «engine».

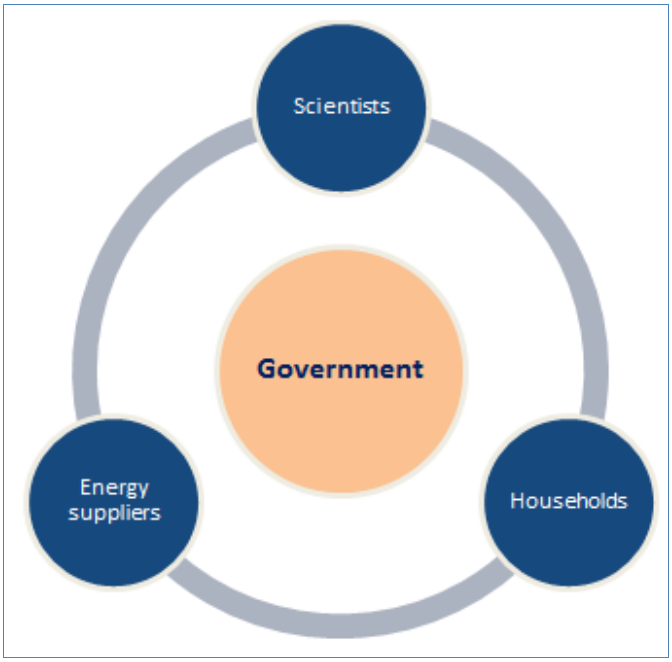

Figure 2. Interaction between key stakeholders

The government is responsible for introducing energy-efficiency policies, regulations and increasing society welfare. The government plays the central role in communication, coordination and execution of the country's energy-efficiency programmes and initiatives.

Scientists and developers are responsible for delivering new technologies and moving forward scientific and technological progress.

Energy suppliers should encourage the households to install new energy-efficient technologies and provide necessary information concerning the ways of reducing energy consumption at home. They are also responsible for carrying out energy-efficiency projects.

The households, primarily interested in reduction of energy bills, should install energy-efficient technologies at home.

Further research

Further research will be dedicated to programme management mechanism of energy efficiency in Russia. The problems lie in the field of programme management:

- Low quality of programme formation and management;
- Limited budgets of the programmes and large number of projects for implementation;
- Lack of governmental financial support.

The object of the study is a Russian company that executes energy-efficient projects. The research will be aimed at developing programme management mechanism that will allow to increase programme management efficiency and compatibility of the company.

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