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Energy Efficiency as a Resource: Energy Efficiency's Role in Meeting Ukraine's Energy Needs

N Kholod
M Evans
V Roshchanka

March 2016

Pacific Northwest
NATIONAL LABORATORY

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Executive Summary

Energy efficiency is a critical element of solutions to Ukraine's political, social and economic challenges. Given that Ukraine's energy intensity is three times higher than that of Organization of Economic Co-operation and Development (OECD) countries, many opportunities exist to improve energy efficiency in the country. As Ukraine faces shortages of energy supply, policymakers should view energy efficiency as a resource in itself. This has been the approach in most OECD countries but is a new concept in Ukraine.

Residential buildings account for the largest share of total final consumption in Ukraine (34%). Combined with commercial and public services (8%), buildings in Ukraine consumed 42% of energy supplied in 2013. For this reason, this report focuses on energy efficiency measures in buildings, facilities and utilities. The report reviews best practices and offers recommendations on raising consumer awareness of energy consumption, regulating energy efficiency of buildings and improving energy efficiency of utilities, in particular district heating.

A key challenge for Ukraine's energy sector and economy more broadly, is non-cost-reflective energy prices, with government subsidizing consumption of industry and households. Absence of utility metering in the majority of buildings and few installed heating controls exacerbate the problem by providing no incentives for consumers to save energy. Policymakers in Ukraine should build on best practices in OECD and other Eastern European countries and introduce regulation that better reflects costs and incentivizes consumer saving. Government programs and incentives can encourage consumers analyze and improve their home's energy efficiency, particularly focusing on protecting vulnerable consumers, while capacity building and awareness programs can help further drive energy efficiency improvements.

Energy efficiency of new buildings will improve with introduction of more stringent building energy codes that should cover not only thermal insulation but also lighting and air conditioning efficiency. A system for effective code enforcement during construction is an investment in improving building's energy efficiency in the decades to come. Given the global trend of increasing importance of appliances, policymakers should also focus on appliance labeling and mandate procurement of energy efficiency appliances in government agencies. Retrofit programs and financial incentives are key to improving efficiency of existing buildings, which represent the majority of the stock and energy consumption.

Addressing inefficiency of utilities is critical. Demand-side management and integrated resource planning have helped successfully improve efficiency and reduce costs of providing energy in many countries. Other successful measures include mandates and targets to improve energy efficiency, such as Energy Efficiency Resource Standards and White Certificates. Best practices in planning and regulation of district heating involve structuring heat tariffs in such a way that incentivized utility saving, in contrast to the tradition cost-plus approach. A key challenge for district heating systems is balancing supply and demand: planning should consider the effect of energy efficiency programs on demand but also improve services and customer satisfaction to retain consumers. Upgrades of boilers or their components, installation of heat sub-stations and switching to using waste heat, where possible, will further improve efficiency of this important sector.

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Acronyms and Abbreviations

ACEEE	American Council for an Energy-Efficient Economy
Bcm	billion cubic meters
CHP	combined heat and power
DBN	State Construction Norms of Ukraine (standard)
DOE	U.S. Department of Energy
EBRD	European Bank for Reconstruction and Development
EEA	European Environment Agency
EERS	Energy Efficiency Resource Standard
EIA	Energy Information Administration
EPA	U.S. Environment Protection Agency
EPC	Energy Performance Certificate
ESCO	energy service company
EU	European Union
FEMP	Federal Energy Management Program
GDP	gross domestic product
GEF	Global Environmental Facility
HOA	homeowner association
HVAC	heating, ventilating, and air conditioning
IEA	International Energy Agency
IFC	International Finance Corporation
IMF	International Monetary Fund
Ktoe	thousand tons of oil equivalent
kWh/m2/yr	kilowatt hours per square meter per year
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design
Mtoe	million tons of oil equivalent
NKREKP	National Commission for State Regulation of Energy and Utilities
OECD	Organization of Economic Cooperation and Development
toe	tons of oil equivalent
TPES	total primary energy supply
TWh	terawatt-hour
UAH	Ukrainian Hryvnia
WHEEL	Warehouse for Energy Efficiency Loans

Introduction

Ukraine's energy sector is facing many challenges, but with these challenges come abundant opportunities for investment. Ukraine is one of the top 10 most energy intensive economies in the world, with three times as much energy required to produce a unit of GDP compared to OECD countries. Improving Ukraine's energy intensity to a level comparable to that of the EU would save nearly 30 million tons of oil equivalent annually, or about 34 billion cubic meters of natural gas (IEA, 2012). This is equal to 60% of Ukraine's natural gas consumption in 2012 (MinRegion, 2014). Tapping into this potential will help Ukraine reduce its dependence on energy imports and improve energy security.

Many countries have come to view energy efficiency as a preferred source of energy. Energy efficiency became the "first fuel" option because efficiency measures often cost less than traditional energy resources. The Ukrainian government should also prioritize energy efficiency investment and view energy efficiency as a fuel source in itself.

Traditionally, Ukraine's energy strategy has focused on the energy supply side, with an emphasis on attracting investment for increased energy supply. A more comprehensive approach to energy planning is to incorporate both supply and demand-side measures. Considering demand-side energy efficiency measures will help avoid overcapacity, ensure that demand projections are more realistic, and ensure that investments in the energy system are optimized on a least-cost basis. For example, instead of investing in construction of a new power plant, it might be more cost-effective to invest in efficiency measures to reduce future energy demand.

Integrating energy efficiency in the strategic planning process can also help in addressing short-term supply emergencies. Ukraine is facing energy shortages due to shortages of coal and, potentially, natural gas. Energy efficiency programs should target the areas where peak loads are forecasted to exceed the supply. This is an integral part of grid reliability programs in the United States, Europe and elsewhere, which work through market mechanisms such as demand-response of peak pricing. Thus, energy efficiency options should be included in Ukraine's national energy contingency plan.

Throughout this report we use such terms as "energy efficiency", "energy savings" and "renewable source of energy". "Energy efficiency" and "energy savings" are often used interchangeably, but there are differences. "Energy efficiency" means using less energy inputs while maintaining an equivalent level of economic activity or service. "Energy saving" or "energy conservation" refers to a reduction in energy use but involves a behavior change or decreased economic activity, i.e. an absolute decrease in energy consumption. Switching to renewable sources of energy does not always improve energy efficiency. For example, replacing a gas boiler with a boiler based on renewable sources of energy, such as wood pellets, can help reduce natural gas dependency. However, such measures are not energy efficient because of increased energy consumption since the efficiency of a natural gas boiler is higher than that a wood-fueled boiler. While renewables can help reduce natural gas consumption (the supply of these resources should be considered), renewables do not reduce energy intensity. The Ukrainian government should focus both on improving energy efficiency and developing renewable sources of energy for improvement of Ukraine's energy security.

1. The Role of Energy Efficiency in Energy Security

1.1. Energy efficiency as a resource

Ukraine is one of the most energy intensive economies in the world, consuming about three times more energy resources per unit of GDP that the average in OECD countries. High dependence on exported natural gas undermines Ukraine's energy security. During the winter of 2014-2015, Ukraine faced not only high prices for imported energy resources but also physical inability to deliver these resources to the consumers. Energy security became vitally important to the country.

Ukraine consumed 106 million tons of oil equivalents (Mtoe) in 2014, down from 132 Mtoe in 2010 (Ukrstat, 2015). In 2010, Ukraine's energy mix was dominated by natural gas, which accounted for 40% of total primary energy supply (TPES) (55 Mtoe); coal accounted for 31%, while nuclear power stations supplied 17% of TPES. Hydro contributed 2% to TPES, with only marginal supply amounts from other renewable energy sources (IAE, 2012). In 2014, the role of natural gas decreased to 34% of TPES (39 Mtoe) but 60% of natural gas was imported (See Attachment 1).

Ukrainian government considers natural gas, coal and nuclear energy as priority energy resources in Ukraine today. Yet the country has another very important energy resource which Ukraine can use: energy efficiency. The International Energy Agency (IEA) defined energy efficiency as a resource that "provides energy services while avoiding a portion of the energy that would otherwise have been consumed to deliver the same level of service" (IEA, 2013a). This is a new idea for Ukraine to consider energy efficiency as a resource and as an alternative to supply-side investments. Internationally, however, energy efficiency has been viewed as a resource since the 1970s. Many countries consider energy efficiency an important energy source. For example, the U.S. National Action Plan for Energy Efficiency defined Goal 1 as "Establishing Cost-Effective Energy Efficiency as a High-Priority Resource" (National Action Plan for Energy Efficiency, 2006).

The IEA's "Energy Efficiency Market Report" provides evidence that investments in energy efficiency can deliver energy resources equivalent to investment in energy supply, with additional economic and environmental returns to investment. Energy efficiency investments can help reduce both domestic and international pressures on energy supply systems, while increasing system resilience and improving security. "It can also produce positive economic outcomes, such as allowing spending on energy to be redirected towards other economic sectors, and by reducing public expenditures" (IEA, 2013a).

Both policy and higher natural gas prices have stimulated investment in energy efficiency. OECD countries started actively investing in energy efficiency after the oil crisis in the 1970s. In 2011, total investment in energy efficiency was similar in magnitude to supply-side investment in renewable or fossil fuel electricity generation. The IEA estimates that for 11 IEA member countries, investment in energy efficiency since 2005 has resulted in cumulative avoided energy consumption of 570 Mtoe over the five years to 2010 (IEA, 2013a).

In Ukraine, rapidly rising energy prices in many sectors created strong incentives for investments in energy efficiency measures. For example, high gas prices were a key motivating factor behind

Ukraine's natural gas transmission company Ukrtransgaz installing energy saving equipment (Roshchanka and Evans, 2014). Energy prices are a key determinant of the financial benefits from avoided energy consumption.

Because buildings and facilities account for the largest share of Ukraine's energy consumption, this report focuses on improving market signals, buildings and utilities. Similar recommendations came from the IEA: "Given Ukraine's important financial constraints and the urgency to make progress, the draft strategy – and energy policies – should focus more on improving energy efficiency in buildings and in district heating systems through regulatory approaches and financial incentives" (IEA, 2012).

Traditionally, any energy strategy in Ukraine focused on the supply side. The metrics of the supply-side energy markets is clear and official statistics focuses on volumes of production and imports, prices and consumption. The energy efficiency market is more diffused and investment in energy efficiency is distributed unevenly across energy consuming sectors. The supply of energy resources deals mainly with large volumes and qualities from limited number of sources; the energy efficiency side covers myriad small improvements which are difficult to catch.

Improving energy efficiency is one of the most cost-effective ways to address the issues of energy security, high energy prices and pollution. It is time for Ukraine to learn from international best practices and experience in implementing energy efficiency programs.

1.2. Developing evaluation criteria for energy and energy efficiency measures

A number of evaluation criteria can help assess and prioritize potential measures for improving the energy sector, including energy efficiency. Usually policy makers take into account several criteria depending on the existing situations. The same criteria may also be helpful in guiding policymakers as they decide how to prioritize measures to improve energy security.

Cost-effectiveness. Cost-effectiveness is a measure of the relevant economic effects resulting from the implementation of an energy efficiency measure. If benefits are greater than the costs, the measure is cost-effective. Cost-effective projects are more likely to attract financing.

Time. Time is another important evaluation criterion. The timeframe includes the entire time taken to develop the policy proposal, gain approval and implement the project. Energy efficiency measures that help reduce consumption of energy resources by the next heating season may have higher priority than those aimed at decreasing energy consumption in the medium or long term.

Feasibility. It is not only important to quickly deploy energy efficiency measures but also ensure that they are technically feasible. For example, switching from anthracite coal to other types of coal might not be possible because boilers are designed to burn anthracite. As a result, this measure might not be feasible in the medium period; switching to other types of coal would require substantial investments.

Energy impact. This evaluates the total energy saved or newly produced as a proportion of the total energy that would have been consumed without the program.

Impact on reducing energy imports. This criterion is one of the most important for countries which are depended on energy import. Higher volume of avoided imported energy resource might give the program higher priority.

Economic effects. By using the domestically produced materials and equipment, the implementation of the energy efficiency measures help bolstering the national economy. Energy efficiency measures also have impact on employment and incomes. Policymakers should take into account the overall effect of proposed energy efficiency measure on the national economy. An analysis of energy efficiency policy measures and economic growth in developed countries shows a high level of correlation between them.

Ease of implementation. Implementation of energy efficiency measures can be limited by many constrains. Policymakers should assess the limiting effects of the following constrains: availability of financial resources, adopted legislation or a need for additional regulation, support from key stakeholders, technical capabilities for implementing energy efficiency measures.

Time and ease of implementation are two the most important factors for implementing energy efficiency measures. There are vast opportunities for energy efficiency measures in any economy. By implementing less difficult and less time consuming measures, governments can reach low-hanging fruit in improving energy efficiency. All other criteria are also important while considering energy efficiency measures.

2. Energy Efficiency Improvements: International Best Practices

2.1. Better market signals and consumer awareness

2.1.1. Energy prices

Cost-reflective energy prices are essential for development of any energy saving or energy efficiency measures. Prices send information signals to the consumers: low energy prices discourage consumers investing in energy efficiency while high / cost-reflective energy prices create strong incentives to implement cost-effective energy efficiency measures.

While many countries subsidize energy prices, the general trend in the world is to increase energy prices for population and businesses to the cost-recovery level. Governments can provide energy subsidies only for vulnerable groups of population.

Ukraine is not unique in its high energy intensity, unrealized energy saving potentials and vulnerability from energy exports. Many other post-Soviet countries had very similar starting conditions in their energy reforms. We use examples from Eastern European countries, such as Poland and Lithuania, to show possible ways for improving energy efficiency in Ukraine. These successful examples will serve as a reference for the analysis of the Ukrainian potential in energy savings.

The experience of Eastern European countries showed that countries with successful policies rapidly brought energy prices to cost-reflective levels. Crisis proved to be an effective time for energy price increases. For the countries with high energy intensity, the World Bank's number one recommendation is to quickly increase energy prices to fully cover the short-term cost of supply (Stuggins et al., 2013). Market adjustment of the energy prices created strong stimulus for economic reconstruction. Rising energy costs forced businesses to invest in energy efficiency. As a result, energy intensity dropped significantly in all countries that followed a sudden price increase approach in the energy sector.

2.1.2. Metering

Metering of energy consumption (electricity, natural gas and heat) is an essential element of the energy system. None of energy efficiency measures can be fully understood without information on energy consumption. Metering is important for monitoring and evaluating implementation of energy efficiency measures.

Metering also enables consumption-based billing and is an important prerequisite for planning energy efficiency investments. Successful Eastern European countries quickly implemented building-level metering and temperature controls. These measures resulted in a 15-25% decrease on energy consumption by changing the incentives for households to control energy usage (IFC-World Bank, 2008, World Bank, 2012, Stuggins et al., 2013).

The next step in energy metering is the installation of smart meters. Smart meters are electronic measurement devices used by utilities to provide information about the usage, billing and operating their electric systems, water, gas or heating. The European Union demands that final

customers of electricity, natural gas, district heating, district cooling and domestic hot water should have information that reflects the final customer's actual energy consumption based on actual time of use (Directive 2006/32/EU). Final customers in multi-apartment buildings with central heating/cooling/hot water system must be provided with such meters by the end of 2016. Individual meters for each apartment also should be installed where it is technically feasible and cost-efficient.

According to the EU directives (2009/72/EU and 2012/27/EU), all energy operators in the European Union must install smart meters for remote energy readings for at least 80% of consumers until the end of 2020. In the U.S. all new commercial buildings must be wired for submetering. Twenty-two states, three counties and Washington, D.C., have statutes, regulations, or rulings on utility submetering (NCSL, 2016).

Poland has started implementing smart meters since 2013. The online account access and ability to track the energy usage will allow saving up to 9% in energy costs, according to estimates.

In Ukraine, only one third of buildings on average were equipped with water and heat meters in 2014 (see Appendix 2 for detail).

2.1.3. Energy audits

Energy audits and ratings can help increase consumer awareness of their building energy consumption, but also of options to improve energy efficiency.

Energy audit is an inspection and analysis of energy flow in buildings to help identify energy losses and potential for energy savings. Energy audits provide detailed information on energy use and saving potential. An energy audit would normally include an evaluation of the thermal characteristics of the building, its existing infrastructure and the appliances in use. In addition, the audit report documents users' activities and the saving potential, and provides recommendations for investments. Energy audits are helpful for industry and their systems as well.

In the United States, utility providers, professional companies or state energy agencies can facilitate energy audits; a typical audit cost is 3-5% of the annual energy bill. Utility companies and the federal, state and local governments offer many programs and incentives, such as tax credits, rebates, co-funding, for homeowners and small businesses to undergo energy audits. For example, in Maryland, utility companies pay 50% of energy audits by ENERGY STAR-certified experts.

In the EU, large companies should undergo energy audits carried out by qualified and/or accredited experts or implemented and supervised by independent authorities. Each EU state must develop programs to encourage small companies to undergo energy audits and implement the recommendations from these audits.

2.1.4. Energy ratings and energy labels

Energy rating is another tool to evaluate how energy efficient a building is; however, energy ratings compare a building to other similar buildings and will generate a score based on its energy performance.

In the United States, Department of Energy has developed the ***Home Energy Rating System (HERS) Index***, which is the nationally recognized system for inspecting and calculating a home's energy performance. To calculate a home's HERS Index Score, a certified HERS rater does an energy rating on a home and compares the data against a "reference home" – a designed-model home of the same size and shape as the actual home. Building owners have an option to also request more comprehensive HERS ratings that would provide recommendations and cost-effectiveness of energy efficiency investments.

The Department of Energy also awards the ***ENERGY STAR certifications*** to new and existing buildings. ENERGY STAR has shown impressive results: in 2010 Americans saved enough energy to avoid greenhouse gas emissions equivalent to those from 33 million cars, while saving nearly $18 billion on utility bills (DOE, 2015c).

In the European Union, the ***Energy Performance Certificates*** aim to increase investments in energy efficiency by addressing the issue of imperfect information (European Commission, 2003). Energy Performance Certificates present the energy efficiency of buildings, including energy use and typical energy cost. Each certificate shows the rating of a building; it also contains recommendations on how to reduce energy use. In Europe, buildings rated as A, A1 and A2 (or A+ and A++) exceed the minimum energy standard in building codes.

To ensure existing buildings also obtain labels, legislation requires owners obtain building labels also when selling or renting. Potential buyers use certificates to home purchasing decisions. For example, in Germany 78 % of respondents used certificates their home search (CPI, 2011). Building labels help consumers find buildings that will demand less in utility costs and can stimulate demand for energy efficient buildings. The analysis of property transactions from residential property markets in Austria, Belgium, France, Ireland and the UK shows that the market rewards energy efficiency (Bio Intelligence Service, Ronan Lyons and IEEP, 2013).

LEED, or ***Leadership in Energy and Environmental Design***, is another way to show energy efficiency of buildings. Projects pursuing LEED certification earn points based on materials and performance and can receive one of four LEED rating levels: Certified, Silver, Gold and Platinum. LEED is the most widely used green building rating system in the world (Green Building Council, 2016). Studies show that the overall vacancy rate for green buildings is lower than for non-green properties and that LEED-certified buildings have the highest rents.

There are other energy efficiency standards that show various level of energy consumption by building. For example, **Passive House** standard, developed in Germany, is a voluntary international building standard for new building construction. It represents a roughly 90% reduction in heating and cooling energy usage and up to a 75% reduction in primary energy usage from existing building stock. In the U.S., a **Zero Energy Ready Home** is a high performance home that is so energy efficient a renewable energy system can offset all or most of their annual energy consumption (DOE, 2016).

2.1.5. Dissemination of information and capacity building

Dissemination of the information to increase consumer awareness plays an important role in promoting energy efficiency. Central and local governments can bring such information to consumers in several ways, including through:

- Education to provide information on energy efficiency investments and installation of more efficient technologies;
- Training on practical experiences, such as developing skills for identifying energy efficiency improvements, energy audits and energy management;
- Public engagement or communication campaigns targeting specific consumer groups can cover a wide range of issues: from awareness about energy consumption to available technologies and to energy efficiency potentials. Campaigns also can raise awareness about options for energy efficiency financing. Demonstration projects can provide information on the usefulness, costs and energy savings of particular technologies.

These approaches have been successfully used in Organization of Economic Co-operation and Development (OECD) countries. For examples, governments have required buildings in the public sector to lead by example to demonstrate technology, a financing scheme or an increased awareness. In the United States, government agencies must purchase energy efficient products, such as ENERGY STAR certified products, where applicable. Existing federal buildings are required to meet energy use reduction targets, while new federal buildings must be designed to achieve "net zero energy" by 2030. Similarly, central governments of the EU member states must purchase only products, services and buildings with high energy efficiency performance and government must renovate at least 3% of the total heated and/or cooled floor area of existing buildings starting January 2014 (MURE-ODYSSEE, 2015).

Voluntary programs have also been a popular policy instrument for improving energy efficiency in OECD countries. Industries participate in such programs because of the desire to influence regulatory policy, to receive public acclaim or in response to consumer or investor demand. An example of such voluntary program is the Combined Heat and Power (CHP) Partnership led by the U.S. Environmental Protection Agency. This voluntary program aims to reduce the environmental impact of power generation by promoting the use of CHP, which is an efficient, clean and reliable source of power and thermal energy from a single fuel source. The partnership includes over 400 members and has assisted in installing 917 CHP projects between 2001 and 2013 (U.S. EPA, 2015). Utilities can also use voluntary programs to reduce customer consumption of electricity. Such demand-response programs aim to reduce the peak load to cut costs.

Another example of a method to increase consumer awareness comes from Riga. The city developed an online database that shows multi-apartment residential buildings in the city, which are connected to the district heating. The database gives information about heat consumption per square meter in all buildings and allows comparing this indicator with average heat consumption of the retrofitted buildings in the city (Green IT NET, 2013).

2.2.Policy instruments for improving energy efficiency in buildings

2.2.1. Building energy codes

Buildings account for about 40% of total final energy consumption in the EU-28 and even more than 45% of final energy consumption in countries such as Estonia, Latvia or Hungary in 2012 (European Commission, 2015). Given the large share of energy consumed by buildings, it is important to minimize energy loses in this sector.

Building energy codes (also known as "energy standards for buildings" or, in case of Eastern European countries, as "thermal building regulations") provide mandatory, minimum standards for entire buildings or their individual components. Building energy codes are a key instrument for reducing energy consumptions in buildings; the average annual energy consumption savings ranged from 6 to 22% in OECD countries over the last twenty years (IEA, 2014).

Implementation is critical to achieve energy consumption reduction. Ideally, implementation will include building plan reviews, on-site inspections to ensure that buildings are built to the code. It may also include end-of-pipe tests and, sometimes pre-occupancy tests. As a result of stringent building energy codes and their effective implementation, the energy consumption for heating varied from 60-90 kWh/m2 in southern countries with lower heating needs (Malta, Spain, Bulgaria, Greece and Croatia) to 175-235 kWh/m2 in colder countries such as Estonia, Latvia and Finland (ODYSEEE-MURE, 2015). The average energy consumption in residential buildings in Ukraine is 267 kWh/m^2/year (varying from 145 to 327 kWh/m^2/year) (SAEE, 2014).

Another key characteristic of building code policies in OECD countries is their continuous improvement and tightening of requirements for energy efficiency. For example, all new buildings in EU must be nearly zero energy buildings by December 2020 (public buildings by the end of 2018).

In the United States, building codes are revised every 3 years Energy codes continue to evolve and increase energy savings in buildings. For example, U.S. Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE Standard 90.1) looks at building envelope, HVAC, plumbing, lighting, and elevators and escalators and requires additional reduction in the energy use.

Building energy codes should also deal with existing buildings, which tend to be the largest share of the building stock in most industrialized countries. Building codes in OECD countries usually cover existing buildings when they are altered or upgraded; although a few localities have begun requiring preventative audits and inspections for older building.

2.2.2. Retrofit programs

The building energy codes are most successful in addressing energy efficiency of new buildings, while existing buildings, the largest share of the stock in developed countries, require additional retrofit programs to increase their energy efficiency.

Retrofit programs in buildings cover a wide range of energy efficiency measures aimed at reducing energy consumption. Retrofitting of the existing building stock is the fastest way to reduce energy losses and increase comfort of living for residents. Energy efficiency measures in existing residential buildings could reduce heating demand by 30 to 40% and reduce gas consumption by 25% to 30% (IEA, 2012).

The European online database MURE (Mesures d'Utilisation Rationnelle de l'Energie) provides information on energy efficiency policies and measures that have been carried out in the member states of the European Union. The MURE database contains around 300 measures in the household sector, including measures at the national level and Europe-wide measures aimed at implementing of EU directives. The most successful policies include subsidies and other financial incentives, credit lines, policies for strengthening building codes and enforcement, informational campaigns (MURE, 2015).

In the U.S., Database of State Incentives for Renewables & Efficiency (DSIRE) provides information on policies and incentives in different states aimed at increasing energy efficiency in the United States (DSIRE, 2016). It is the most comprehensive source of information in the United States on renewables and energy efficiency incentives and policies for developers, policymakers, researchers, and the general public.

Central and local governments may invest in energy efficient retrofit of public buildings. Such retrofit can serve as example for businesses in retrofitting commercial buildings. For example, California's The Clean Energy Jobs Act of 2012 provides $550 million annually for five years to fund school energy efficiency upgrades. Leadership in project planning, implementation, monitoring and evaluation will help determine the most successful project which would serve as examples in other sectors. Retrofitting public building also help governments to assess and close loopholes in regulation.

U.S. also developed new model to finance building retrofits. For example, the Warehouse for Energy Efficiency Loans (WHEEL) provides low cost, large scale capital for residential energy efficiency loan programs sponsored by states, local governments and utilities. WHEEL is the secondary market for home energy loans designed to simply and effectively deliver nearly unlimited capital at lower costs to energy efficiency and renewable energy programs. The Green Bank in New York facilitates private sector financing from private lenders to extend project terms and reduce interest rates.

Energy consumption of buildings in the post-Soviet countries was higher compared to energy consumption in OECD countries. As a result Eastern European countries showed a large decrease in energy intensity in the residential sector. While the rate of improvement reached around 2.3% per year at the EU level, in Romania, Slovenia, Latvia and Slovakia this the reduction was over 3% per year (ODYSEEE-MURE, 2015).

Eastern European countries also have ambitious retrofit programs. For example, a World Bank program was effectively used in Lithuania to finance energy efficiency improvements in residential buildings which resulted in 17% reduction of energy consumption, on average. After the World Bank project closed in 2001, the government continued the program, including the capital subsidies (up to 30%) and support for low-income household participation (covering debt service payments). This program has now been converted into an overall apartment building

renovation program that uses commercial loans and guarantee/ credit insurance mechanisms. For example, the Lithuanian government declared an ambitious target to retrofit 70% of its pre-1993, multi-unit residential buildings, mostly constructed with pre-fabricated panel technology.

2.2.3. Appliance standards and labeling

Appliances have been of increasing importance in OECD countries. In U.S., electricity consumption by appliances has been steadily growing in the last decades. For this reason, minimum energy performance standards in combinations with energy efficiency labels play an important role in energy efficiency policy. Energy standards set maximum level of energy consumption by various types of appliance while an energy label show energy consumption by an appliance comparing with other appliances of the same type.

Standards cover televisions, air conditioners, water heaters, furnaces and other heating equipment; they also include industrial appliances such as industrial motors, heating boilers, heat pumps, space heaters (see Appendix 3 for details). Introducing more stringent energy efficiency standards now helps reduce energy demand in the future.

The United States has implemented minimum energy standards for more than 60 categories of appliances and equipment. Standards have helped drive significant gains in the energy efficiency of household appliances, resulting in large energy bill savings. For example, today, the typical new refrigerator uses one-third the energy than in 1973, despite offering 20% more storage capacity and being available at half the retail cost. As a result of appliance standards, energy users saved about $58 billion on their utility bills in 2014. By 2030, cumulative operating cost savings from all standards in effect since 1987 will reach nearly $1.8 trillion (DOE, 2015a).

The U.S. Department of Energy now focuses on new categories such as battery chargers, consumer electronics, pool pumps and spas and luminaires. The American Council for an Energy-Efficient Economy (ACEEE) estimated that savings from these new product categories could add up to over 80 TWh of annual energy savings by 2020 (IEA, 2013a).

In the EU, appliance standards have helped average household save €465 per year in energy bills (European Commission, 2015). For instance, on average, about 15% of new refrigerators sold in the EU in 2012 were in the highest efficiency classes (labels A++ or A+++) compared to only 2% in 2008 (MURE-ODYSSEE, 2015).

The European countries started with labeling for large appliances. However, small electrical appliances represent a higher share of the total consumption of appliances than large appliances. Large appliances are more and more efficient, with efficiency gains around 35% for refrigerators, washing machines and dish washers since 1990, thanks to labeling and eco-design regulations. As a result, policymakers must now also target now small appliances.

2.2.4. Industry

The industrial sector offers huge opportunities for energy savings through energy efficiency programs. Energy can be save by using more efficiency equipment, can be improved through changes how equipment is used, by employing energy-efficient processes and technologies. Companies also can use the energy management standard ISO 9001 to use energy more efficient, set targets, track energy use and measure the results of energy efficiency measures.

In this report, we do not focus on industrial energy efficiency. The industry operates in the competitive environment and companies are interested in energy savings for cost reductions.

2.2.5. Transport

Transport is another large consumer of energy. Increasing energy prices create strong stimuli for economical vehicles; drivers tend to select vehicles with better fuel economy is priced for fuel are high. However, government policies play an important role in promoting energy efficiency of vehicles in the future.

In the United States, the Energy Tax Act of 1978 required manufacturers of new cars to meet the minimum fuel economy level of 22.5 mpg (12.6 l/100 km). The United States now proposed new ambitious standards for passenger vehicles, which requires average performance of 54.5 miles per gallon, or 5.2 l/100 km by 2025, a 50% improvement in fuel economy from the current level.

In Europe, legislation sets mandatory fuel efficiency standards for transport. For new cars, the EU wants to achieve average performance of 4.1 l/100 km for petrol cars and 3.6 l/100 km for diesel cars by 2021 (EC, 2015). These initiatives focus both on energy conservation and reduction of greenhouse gas emissions.

However, energy efficiency in transport in Ukraine is beyond the scope of this paper.

2.3.Utility programs

2.3.1. Demand-side management

Demand-side management programs began in the United States in the 1970s as a response to growing concerns about energy dependence from other countries. To balance electricity supply and demand, utilities traditionally increase power generations. Instead of adding more generation to the system, demand-side management mechanism focuses on activities to encourage the consumers to use less energy.

The National Energy Conservation Policy Act (1978) required utilities to offer onsite energy audits to residential customers and acknowledged that saving energy could be cheaper than producing it.

The U.S. Energy Policy Act of 2005 encouraged time-based pricing and other forms of demand response to provide reliable and affordable demand response services to the public. The Energy

Policy Act presents definition of the term "integrated resource planning" as "a planning process for new energy resources that evaluates the full range of alternatives, including new generating capacity, power purchased, energy conservation and efficiency, cogeneration and district heating and cooling application, and renewable energy resources, in order to provide adequate and reliable service to its electric customers at the lowest system cost." Demand-response is a tariff or program established to motivate changes in electric use by end-use customers in response to changes in the price of electricity over time, or to give incentive payments designed to induce lower electricity use at times of high market prices or when grid reliability is jeopardized.

Under integrated resource planning a utility is required to (ACEEE, 2014): 1) Evaluate all options, from supply and demand sides, in a fair, consistent and comparable manner; 2) Minimize total costs (and not just average rates); and 3) Create a flexible plan that allows for uncertainty and permits adjustment in response to changed circumstances.

This approach requires a utility to objectively analyze the potential of all available resources – supply and demand – and identify the mix of resources that produces a least-cost, reliable resource plan. Because energy efficiency is such a low-cost resource, proper utilization of integrated resource planning tends to result in the incorporation of energy efficiency as a utility system resource and reduce the need for additional supply resources. This also reduces total resource costs for utilities.

The U.S. utility demand side management programs now include providing general and technical information about energy saving opportunities, financial assistance for customers to procure energy saving technologies, load control through voluntary obligations and innovative pricing programs which targeted large industrial customers.

A successful utility resource plan should include a load forecast supply options, fuel prices, evaluation of existing resources, demand-side management options and uncertainty analysis. In the United States, a number of states, including California, Iowa, Minnesota, Massachusetts, Connecticut, Maine, Washington, Delaware, Vermont and Rhode Island have implemented some form of integrated resource planning. Most states have a planning horizon from 10 to 20 years and review their plans every two or three years.

However, integrated resource planning could be time-intensive for utilities and hence state legislation or regulation requires utilities to undertake planning efforts. Integrated resource planning approaches were originally applied to vertically integrated power systems, in which one utility or agency has the responsibility and authority to build, maintain and operate facilities for the generation, transmission and distribution of electricity to end-users. On competitive generation markets, state or regional government can require to develop benchmark plans which can help in monitoring the performance of the electricity sector.

Integrated resource planning no longer exists in many U.S. states. The program was actively used before power sector liberalization, when energy prices where regulated. However, the experience in demand-side management could be useful for many countries with regulated energy prices, including Ukraine.

2.3.2. Energy Efficiency Resource Standards and White Certificates

Energy Efficiency Resource Standards (EERS) and energy saving certificates are requirements for utilities to meet certain energy efficiency goals.

In the United States, EERS is one of the most effective ways to achieve long-term energy savings by establishing a long-term energy saving target for utilities. It requires utilities to save energy through energy efficiency programs for customers. Typically, such targets are 1.5-2% of their energy sales per year, but they may be as high as 15% of electricity consumption (for example, in New York). The distinct characteristics of EERS is that it requires a minimum amount of savings but does not demand a specific efficiency measure or set of measures to save electricity or natural gas; utilities have flexibility to choose how to best achieve those savings.

In the United States, 24 states are currently implementing EERS policies requiring electricity savings. Of these states, 15 also have EERS policies in place for natural gas. Seven of the 24 states have requirements that utilities or third-party administrators achieve all cost-effective energy efficiency.

The most common energy efficiency measures include rebate programs for energy efficiency appliances, home weatherization, lightening replacement programs and behavioral-based programs. Under the demand-side management program the costs of implementing energy efficiency programs were typically recovered though adjustments in energy rates but a regulator could limit the increase in energy rates. A regulator was responsible for assessing the total cost and cost-effectiveness of energy efficiency measures. Now, states pay a bonus linked to energy savings to utilities for achieving compliance.

EERS is an effective tool in energy savings. In the United States in 2013, states with an EERS achieved incremental electricity savings of 1.1% of retail sales on average, compared to average savings of 0.3% in states without an EERS (ACEEE, 2015b).

In Europe, energy saving certificates are called ***White Certificates***. The idea behind White Certificates is that retail utilities (energy suppliers or distributors) have to reach a certain amount of energy saving. There are several elements of the White Certificate scheme: energy saving target by government, institutional infrastructure (independent body for issuing certificates, rules for compliance and trading), cost-recovery mechanism (in some countries, for example, in Italy), a system of sanctions for non-compliance and a tradable instrument (White Certificate).

National governments set the energy saving goal which can be defined in primary or final energy. The operators are given a target level of energy reduction to achieve each year. Utilities receive certificates for savings achieved and can use them for their own target compliance or sell to other parties. Companies that cannot receive White Certificates have to pay a fee for non-compliance. In some European countries, like Italy and Poland, White Certificates are tradable at power exchanges, while France has limited trading, and the UK system does not include trading at all.

Energy savings should be measured and verified. Most European countries focus on standardized saving measures. The experience of the European countries shows that utilities achieve the results over targets; in same cases at costs below policy makers' expectations.

2.3.3. District heating

District heating is another area of opportunities for energy savings. A defining characteristic of district heating is centralized production of heat and its distribution to customers through the networks of pipelines. At the right scale and with the right policy approach, district heating is an energy efficient, cost-effective and reliance source for heating homes.

One of the most important issues in the district heating programs is tariff setting. In Europe, there are three main ways to set heat prices or tariffs: free market conditions (alternative heating methods), independent energy regulator or municipality/state institution. In most transitional countries, the hear prices are set (controlled) by an independent regulator. The cost-plus approach is the most common method to set heat prices in most European countries. Such countries as countries such as Estonia, Denmark, Hungary, Lithuania and Poland have introduced some form of incentive regulation.

Most countries with the regulated district heating market use cost-plus approach with some elements of benchmarking and economic incentives (Lukosevicius and Werring, 2011). Most utilities do not have incentives to promote energy efficiency because it means reduction in sales of their products.

Lithuania is a good example of successful reforms in tariff settings in the district heating. The country relies on benchmarking, i.e., comparison of costs of other similar companies. Benchmarking introduces an element of competition and encourages district heating companies to pursue energy efficient investment. In addition, municipalities and an independent regulator analyze proposed costs and review companies' quarterly reports.

In order to make district heating system more efficient, many countries worked on technical upgrades, such as installing heat substations with temperature controls, installing heat-cost allocators, upgrading networks to reduce losses and installing automated controls on boilers.

2.4. Financing mechanisms and incentives

Financing is key to making energy efficiency projects happen. The key source of sustainable and sizable flows to finance energy efficiency projects is the local banking sector. International development banks may provide direct financing to especially large end users such as utilities.

Many governments have developed programs and incentives for facilitating energy efficiency projects. Such programs can target public facilities, utilities, commercial building owners, private building owners and others. Among these audiences, public facilities, utilities and commercial building owners are easier to work with because they are less dispersed and they have no split-incentives issue. However, governments have also successfully implemented programs targeting residential property owners.

Governments can attract additional financial resources through ***leveraging*** of investments from private companies, including ESCO companies. ***Energy performance contracting*** is a mechanism that allows customer (a building owner) contract a specialized company (an energy service company, ESCO) to identify energy improvements at a facility, install the upgrades and

repay the ESCO through future energy savings. The advantage of EPCs is that they do not require a customer to have up-front capital. EPCs hinge on the ability of ESCOs to legally guarantee energy savings from future installations, as well as on existence of recognized methodologies for quantifying avoided energy consumption, which determines the size of repayments. ESCOs prefer to obtain third-party financing for EPC, as their primary expertise is in identifying and installing energy efficiency measures and ESCOs do not have to tie up their capital. However, there are many types of arrangements for EPCs. Involving an ESCO is more expensive than directly contracting installation of upgrades (if capital funding is available upfront). Thus, EPC projects are better suited for larger, commercial or public facilities, but also for industrial installations, that intend to do deeper retrofits.

In the United States, EPCs has been one of the major mechanisms for reducing energy consumption of government buildings. The government supports this mechanism through an established regulatory framework, in the form of government procurement rules, but also a support program known as the Federal Energy Management Program. FEMP builds the capacity of government agencies to undertake EPCs, manages the contract structure, and significantly reduces risks and transaction costs for participating parties.

A mechanism that can help finance smaller energy efficiency improvements is ***on-bill financing***. On-bill financing is similar in concept to an energy performance contract, by way of future energy savings helping repay the loan. However, on-bill financing offers a much more standardized approach at a smaller scale, which is better suited for residential and small commercial energy users. This mechanism requires governments to issue legislation that authorizes utility companies install or oversee installation of improvements, such as insulation, meters, fixtures, equipment upgrade, and collect repayments through utility bills.

There are many ways to arrange on-bill financing. Repayment can be fixed or tied to bill size; customers might need to qualify, or installations (e.g. smart meters) can be mandatory. Government most commonly provides initial funding for such programs, however, sources can also be private. Success of such programs depends on customer repayment; and thus, government support might be required to reduce risks for utilities and ensure repayment discipline.

In the United States, Clean Energy Works Oregon relied on government funding and a local financial institution to offer funding for energy efficiency improvements in residential buildings. Based on the history of bill payments and customer credit score, the program issued loans for improvements at up to 6% interest rate. A pre-approved contractor installed the upgrades. In addition to saving energy, this program helped the utility manage peak loads (ACEEE, 2015a).

One of the most direct ways governments can support energy efficiency in through ***grants*** and ***appropriations***, which could cover project costs fully or partially. Grants can target critical utility objects or buildings and can be viewed as investments in communities. In the United States, the U.S. DOE manages Energy Efficiency and Conservation Block Grant Program, which provided $3.2 billion in block grants to cities, communities, states and other entities to develop, promote, implement and manage energy efficiency and conservation projects that ultimately created jobs (DOE, 2015b).

Many energy efficiency programs engage and rely on lenders to offer ***energy efficiency loans*** to facilities that participate in energy efficiency improvements. Typically, development of such programs involves capacity building and negotiation with a commercial lender but also defining the requirements of the program, eligibility and elements of implementation or monitoring.

Government involvement and capacity building can reduce risks for lending institutions that do not have expertise in energy efficiency. The sponsoring agencies can also offer to subsidize the interest rates to make energy efficiency loans more attractive. An example of such program is Massachusetts Residential Conservation Services Program in the United States. To qualify for the program, building owners must undergo a building energy assessment, identify energy saving opportunities, submit a proposal and apply for the loan with a participating lender. Massachusetts State's investor-owned utilities are the major sponsor of this program, which helps subsidize such loans and offer them to qualified consumers at 3% interest rate or 0% for low-income households. Upon installation, program developers conduct a post-installation inspection. In 2006, the program incentivized completion of 4,900 energy assessments and issued approximately 600 loans, totaling $4 million. About 200 of the projects used 0% five-year loans, and 400 projects used 3% seven-year loans. The majority of projects helped replace heating systems (468 projects); the rest were for air sealing and insulation (200), domestic hot water upgrades (210) and window replacements (114) (Energy Star, 2007).

Government can provide financial incentives for energy efficiency. Commonly, these include ***tax credits and rebates***. Such programs define the types of installations that qualify as well as any other conditions that might apply. For example, in the United States, homeowners can claim an income tax credit of up to $200 can for upgrading to an ENERGY STAR certified window. Given Ukraine's limited domestic funding, many international financing institutions have programs that offer assistance with energy efficiency financing. They include the World Bank, the International Finance Corporation (IFC), European Bank for Reconstruction and Development (EBRD), Global Environmental Facility (GEF) and others (see Appendix 3). Access to such assistance often requires national government's commitment and guarantee of repayment.

The utility might use ***demand-side management*** to give customers a rebate or other incentives based on commitments to reduce power during periods of high demand (also known as negawatts). Smart meters enable the application of time-based rates and customers can expect savings in electricity bills if they reduce their electricity usage during peak periods. According to the Energy Information Administration (EIA), in 2013, 52 million, or about 36%, of all meters in the United States were advanced (smart) meters.

3. Policy Options for Improving Energy Efficiency in Ukraine

3.1. Energy consumption in Ukraine

3.1.1. Energy consumption by fuel and sector

Ukraine consumed 106 million tons of oil equivalents (Mtoe) in 2014, down from 116 Mtoe in 2013 and 132 Mtoe in 2010 (Ukrstat, 2015). During the last decade, natural gas dominated in Ukraine's energy mix (Table 1). Ukraine depends on natural gas import and as natural gas became more expensive, coal has been playing increasingly important role in the energy mix. Ukraine has the seventh-largest amount of coal resources in the world and used to be the thirteenth largest producer in the world (EIA, 2011).

Table 1. Primary energy supply in Ukraine, %

	Primary supply Mtoe	Primary energy supply in Ukraine, %				
		Natural gas	Coal	Nuclear	Oil	Renewables
2010	132,308	41.7	28.9	17.7	10.0	1.7
2011	126,438	36.9	32.7	18.6	9.8	2.0
2012	122,488	34.8	34.6	19.2	9.4	2.0
2013	115,940	34.1	35.8	18.9	8.5	2.7
2014	105,683	31.6	33.7	21.9	7.2	2.6

Source: (Ukrstat, 2015)

Fifteen nuclear reactors at five nuclear power plants provide about one fifth of primary energy supply in Ukraine. Oil products and renewables (mostly large hydro power plants) account for remaining 10% of primary energy supply.

Natural gas accounted for 34% of the final energy consumption in Ukraine in 2014. Electricity accounted for 18%, heat and oil provided 16-17% of final energy each (Table 2).

Table 2. Final energy consumption in Ukraine, 2011-2014

	Final consumption, toe	Final consumption, %					
		Natural gas	Coal	Oil	Electricity	Heat	Biofuel
2010	74,004	38.4	11.3	16.5	15.6	16.9	1.3
2011	75,852	38.5	12.4	16.1	15.8	15.8	1.4
2012	73,107	36.4	13.1	16.7	16.2	16.2	1.4
2013	69,557	35.9	12.5	16.2	17.0	16.8	1.6
2014	61,460	34.1	14.9	16.5	18.0	14.5	2.0

Source: (Ukrstat, 2015)

The energy consumption has been decreasing since 2011 due to high energy prices (Figure 1).

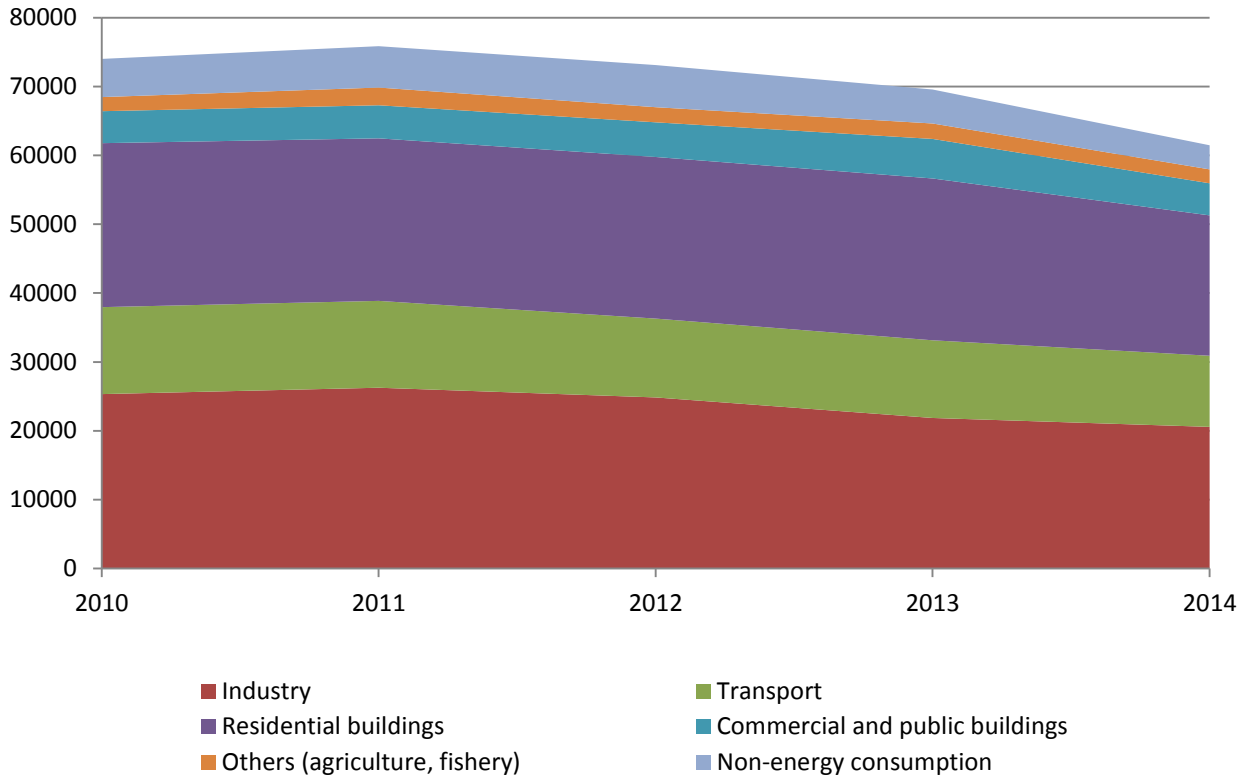


Figure 1. Final energy consumption by sector in Ukraine, 2011-2013 (thousand tons of oil equivalent)

The residential sector is one of the largest consumers of energy resources. In 2013, it consumed about 34% of final energy in Ukraine. Industry is similarly important gas consumer thanks to extensive production of metals and chemicals.

Ukraine remains one of the top 10 most energy intensive counters in the world. Thought the country's energy intensity declined by 5% per year during 2011-12, it still exceeds those of OECD countries by factor of 3. In 2013, Ukraine's overall energy intensity was 0.34 toe per $1,000 dollars of GDP (in 2005 purchase power parity), down from 0.36 in 2002. The OECD average energy intensity is 0.13 (IEA, 2015b).

3.1.2. Natural gas consumption

In this report, we mainly focus on natural gas consumption due to several reasons. First, natural gas is the most important energy resource in Ukraine. Second, natural gas is the most important fuel in district heating which has a huge potential for energy savings. Third, Ukraine imports about 50% of natural gas it consumed and the country depends on gas supply from other countries, including Russia.

Ukraine consumed 50.4 billion cubic meters (bcm) of natural gas in 2013 and 42.6 billion cubic meters in 2014 (MinEnergy, 2015). In 2015, natural gas consumption in Ukraine decreased by

20.9% to 33.7 bcm. Natural gas consumption decreased due to many factors, mainly due to economic recession but also due to improvements in energy efficiency.

Natural gas is by far the most important energy resource in centralized district heating (Figure 2). The heating system used 12.2 Mtoe in 2014.

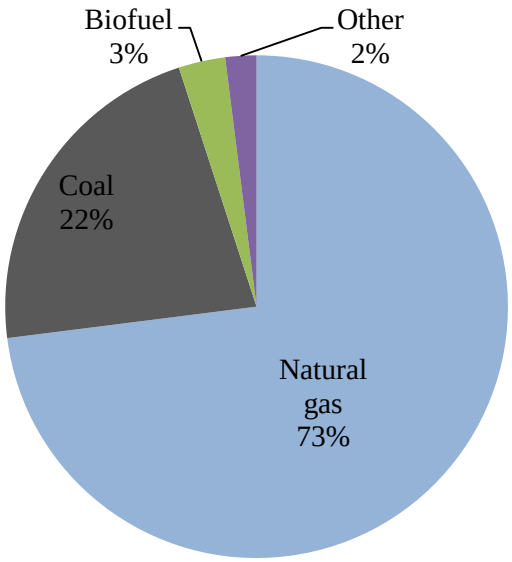


Figure 2. Centralized heating fuel consumption in 2014 (%).
Source: Ukrstat.

Historically, Ukraine is dependent of Russian natural gas. In 1991-2008 Ukraine imported about 80% of natural gas it consumed (Attachment 1) and domestic production covered the remaining gas consumption. Russia used Ukraine's energy dependency energy as a tool to pursue it political and economic agenda. For example, Russia cut off gas supplies to Ukraine for a few days in 2006. In 2009, Russia's Gazprom suspended gas supplies for two weeks not only to Ukraine, but also to other European countries.

As a result of the 2009 gas agreement between Russian and Ukraine, the price for natural gas increased from $180 in 2008 to $259 in 2009 and to $427 in 2012. After 2009-2010 economic recession and a sharp increase in the gas price, Ukraine started working on reducing energy consumption of Russian natural gas. For the first time in recent Ukrainian history, the government started focusing on energy efficiency.

Ukraine also started importing natural gas from Europe. As a result, the share of Russian gas in natural gas imports decreased from 92% in 2013 to 74% in 2014 and 37% in 2015 (UTG, 2016). In November 2015 Ukraine stopped buying Russian gas and finished 2015/2016 heating season without Russian gas.

3.1.3. Energy consumption by buildings

Residential buildings consume about one third of final energy in Ukraine. Public and commercial buildings consume additional 8% of energy. For the long period of time, Ukrainian government heavily subsidized natural gas process for household. This policy created no incentives for reducing energy consumption.

Until recently, households paid only a small fraction of the cost-recovery price for natural gas, while industry and government organizations paid the full price, subsidizing residential consumption. As a result of higher energy prices, industrial users reduced natural gas consumption by 55% between 2005 and 2014, utilities reduced gas consumption by 49% and government organizations by 34%. At the same time, household natural gas consumption decreased only by 12% (Naftogaz Europe, 2015).

In 2015, as a result of higher gas prices all sectors of the economy significantly decreased their energy consumption (Table 3). For example, households and public institutions decreased natural gas consumption by 22.6% (to 12.2 bcm), industry lower has consumption by 19.2% (to 11.4 bcm), and utilities consumed 19.2% less (6.9 bcm).

Table 3. Natural gas consumption in Ukraine, 2014-2015 (bcm)

Category	2014	2015	Percent change
Households	15.1	11.3	-25%
Utilities for households	7.1	5.9	-17%
Total, regulated segment	22.1	17.2	-22%
Public institutions	0.7	0.5	-22%
Utilities for public institutions	1.1	0.9	-22%
Industry	14.4	11.2	-22%
Utilities for industry	0.4	0.3	-27%
Technological needs (production and transportation)	3.6	3.3	-6%
Total non-regulated segment	20.1	16.2	-19%
Loses in non-government controlled territories	0.4	0.4	
Total	42.6	33.8	-21%

Source: Naftogaz. Available at http://www.naftogaz.com/www/3/nakweb.nsf/0/DE729CFE8C5F85E6C2257F49005605A8?OpenDocument

About 60% of all buildings in Ukraine were built before the 1970s. Urban construction largely consisted of low- to medium-rise multi-apartment buildings using large panel construction; these buildings were not designed to be energy efficient. As a result, most buildings in Ukraine have low energy efficiency.

3.2. Energy saving potential in Ukraine

Ukraine has a huge potential for energy efficiency improvements both through reducing energy losses and improvements in energy efficiency.

Energy losses occur when energy is transported from producers to consumers. Losses of electricity and heat are inevitable during the transmission but the efficiency of the grid varies among different countries. For example, the U.S. Energy Information Administration (EIA) estimates that electricity transmission and distribution losses account for about 6% of electricity in the United States. In Ukraine, electricity losses estimated to be 21 billion kWh annually or about 12% of electricity that is transmitted and distributed. Technological advances can significantly improve the efficiency of the transmission system (such as newer conductors and better transmission lines).

Heat losses in Ukraine are very substantial. Heat losses occur at all stages: 15% at district boilers and cogeneration plants, 17% during heat distribution and 50% of heat consumption in buildings (MinRegion, 2016). Ukraine's National Institute for Strategic Studies estimated that the total heat losses in the network may be as high as 700,000 tons of oil equivalent per year (NISS, 2015). According to the Ministry of Regional Development, energy losses in the residential sector are equal to $3 billion annually, or 3% of Ukraine's GDP.

Buildings in Ukraine consume the largest share of final energy resources; at the same time they represent the largest potential for energy efficiency improvements. Even simple retrofits can save 30-40% of heat. According to the World Bank study, Ukraine can reduce heat consumption by 50% (World Bank, 2012). This can be done by installing heat substations with temperature controls (15-25% savings), implementing energy efficiency measures to improve building envelops (20-25% savings), installing heat-cost allocators (15-20% savings); decreasing supply costs by reducing network losses and increased use of combined heat and power plants (10-20%) (World Bank, 2012).

According to estimates of the Ministry of Regional Development, retrofits of multistory and individual houses can save up 7 bcm of natural gas (Table 4).

Table 4. Potential natural gas savings in Ukraine, bcm.

Sector	Gas consumption reduction potential, bcm
Retrofits of multistory buildings	2.3
Retrofits of individual buildings	4.7
Boiler replacement	1.7
Retrofits of public buildings	0.3
Modernization of heat production system and networks	2.4
Total	11.4

Source: (Minregion, 2016)

According to IEA estimates, Ukraine could save up to 17 Mtoe, or 20.5 bcm of natural gas per year if the country reach energy efficiency at the level similar to those in the European Union (IEA, 2015a).

The government has adopted the National Energy Efficiency Action plan in November 2015 (SAEE, 2015a). This plan outlines energy efficiency measures to save 9% of final energy consumed in 2020 compared to the level of 2005-2009.

3.3. Energy efficiency policies in Ukraine

3.3.1. Market signals, information and consumer awareness

The energy price increase created strong incentives to save energy and improve energy efficiency. In the spring of 2015, the government increased prices for natural gas by 285% and prices for heating by 67%. The government signed an agreement with the IMF to reach 75% of cost-recovery level in April 2016 and 100% of cost-recovery level in April 2017 (IMF, 2015b).

Increasing prices for natural gas would reduce demand for energy subsidies and as a result, eliminate deficit of Naftogaz, the largest gas company in Ukraine. In 2013, energy subsidies for residential gas and heating amounted to about 7% of GDP. Naftogaz deficit amounted to 5.7% of GDP in 2014, expected to decline to 3.1% in 2015 and zero in 2016. The government (by the decision of the National Commission for State Regulation of Energy and Utilities) is also increasing the prices for electricity. The price increase was initiated in 2014 and should reach the price-recovery level by March 2017.

One of the most urgent actions in Ukraine is to achieve full metering of energy used. Full metering is an important prerequisite for efficient use of energy resources. Metering enables consumption-based billing, which becomes a strong incentive for energy savings. Availability of reliable data would also help decision makers plan energy efficiency investments and better formulate the country's energy policy.

By end of 2016, the Ukrainian government plans to achieve universal metering of natural gas and heat and move to universal consumption-based billing (IMF, 2015a). In 2014, only 36% of buildings were equipped with heat meters, 33% had municipal water meters and only 18% buildings had hot water meters (MinRegion, 2014, see Appendix 2 for detail). Energy consumption metering and consumption-based billing will further stimulate investments in energy efficiency.

Utilities benefit from unmetered energy consumption and have little incentives to speed up installation of energy meters. Instead of paying for consumed natural gas, consumers without meters pay for natural gas based on the normative approach. The government decided to reduce funding for district heating that bill consumers without meters by 50% starting April 2015. This measure would stimulate utilities to install natural gas meters.

The government, Ukrainian banks and NGOs and international organizations launched an information campaign to promote energy conservation and implementation of energy efficiency measures.

3.3.2. Buildings and district heating

Ukraine has taken several important steps to promote energy efficiency in buildings in the past years. The government has increased energy prices and developed low-interest loan programs for energy efficiency measures. It is also providing energy subsidies for low-income groups. The government is also promoting energy efficiency measures through information campaign and financial incentives.

The Ukrainian government created financial incentive programs for implementation of energy efficiency measures. They include loans for natural gas substitution, energy efficiency improvements in buildings and programs for homeowner associations. To harmonize national legislation with the European standards, Ukraine has adopted a number of national energy efficiency standards for new buildings to reduce building energy consumption. Ukraine adopted a new system of norms and standards for energy performance, started working on harmonization of its national legislations with the European standards and has been introducing modern evaluation methods for measuring energy efficiency.

In October 2014, the government initiated a program to promote replacement of natural gas boiler with boilers that use alternative fuel (alternative source of energy include electricity and biomass). The government compensates 20% of loan principal for boilers on alternative fuels. In addition to the country-wide programs, each region can allocate additional resources for energy efficiency. For example, the Lviv Regional Administration provides additional compensation at 15-20% for boilers on alternative fuel. As a result, the amount of loans in this region is more than twice higher than in other regions. We should note here, however, that while replacing gas boilers reduces natural gas consumptions (and energy dependency), it does not improve energy efficiency (wood-powered boilers are less efficient than gas-powered).

The government initiated two other programs to compensate 30-40% of loan principal for installation of energy efficient equipment and materials. The government allocated UAH 344 million ($15.6 million) in 2015 for these programs. Three national banks – Oschadbank, Ukrgazbank and Ukreximbank – provided additional UAH 1.23 billion ($560 million) in 2015. Both individual homeowners and homeowner associations are eligible. The demand for these loans has been growing (See Appendix 4). However, about 80,000 loans were issued as of February 2016; there are about 15 million households in Ukraine. Thus, it means that the current system provides one loan per 200 households.

Oschadbank, Ukrgazbank and Ukreximbank also provide loans to homeowner associations. According to MinRegion, 16,536 HOAs worked in Ukraine as of January 1, 2015. They cover about one-fifth of buildings in the residential sector.

Increased energy prices have increased demand for energy subsidies for low-income households. About 5.4 million households in Ukraine received energy subsidies in 2015 (the initial estimate was that only 3 million household would receive subsidies). The government allocated UAH 24.5 billion ($1.1 billion) for energy subsidies in 2015 and UAH 38 billion in 2016. Due to too generous provision of energy subsidies, the government will need to allocate even large amount of money in 2017. The current system of energy subsidies discourages energy conservation and does not promote energy efficiency.

Ukraine does not have any mandatory program encouraging heat and electricity generating companies to invest in energy efficiency measures. Utilities use the "cost plus" approach and not interested in energy efficiency improvements. Only 43 out 222 utilities regulated by National Commission for State Regulation of Energy and Utilities (NKREKP) filled investment applications in 2014; NKREKP approved 20 applications for the total amount of UAH127 million ($5.8 million). Utilities invest in replacement of boilers and burners, installation of economizers and heat meters, modernization of pumps and the heat networks, installation of heat substations, building heat meters. Due to proposed measures, utilities would save 8.5 million cubic meter of natural gas (NKREKP, 2015).

3.3.3. New legislative initiatives and international cooperation

Ukraine has adopted an energy performance contract law, and the government is working on secondary legislation to enable large-scale retrofits in the public sector. According to some estimates, the potential market for ESCOs in Ukraine is estimated to be $56 billion (Kovalko, 2015).

In addition to public buildings, street lighting proves to be great pilot for ESCO projects both because of its technical feasibility and a short payback period. Lighting upgrades can be the cheapest and fastest way to save electricity and to shave electricity demand in the peak hours. Ukraine faced frequent rolling electricity black-outs in the past winter due to lack of coal at electricity-generating facilities. Lighting represents a great possibility for energy savings. In Kyiv, for example, EBRD and IFC are financing a lighting project and Philips will replace incandescent lamps with its LED lamps. The city estimates it will save about 45% of electricity on street lighting.

The government is working on creation of an Energy Efficiency Fund. This fund should provide financing for energy efficiency measures to households and home-owner associations. The preliminary assessment shows that Ukraine might need up to $57 billion to finance energy efficiency projects in buildings and the district heating system (MinRegion, 2016). The key idea of the Fund is to redirect energy subsidies to financing energy efficiency measures. According to the IMF, energy subsidies may reach 10% of the state budget expenditures in 2017. The fund would use money from the budget and international donors to provide loans to grands. In order to make the Fund a success, the government needs to monetize energy subsidies.

Many international organizations work on energy efficiency projects in Ukraine. The largest institutional investors include the World Bank group, EBRD and the European Investment Bank. Appendix 5 provides more details about purpose, timeframe and scope of the projects financed from international sources.

3.4. Recommendations on priority energy efficiency measures in Ukraine

Effective changes to the legal and regulatory framework can help Ukraine fully realize its energy efficiency potential. Currently, Ukraine has many opportunities to improve energy efficiency and strengthen energy security. Delaying such improvements has costs for all energy users and for the economy.

Key recommendations for Ukraine are listed below.

Key legislation

- Adopt legislation that requires government agencies to achieve energy saving goals.
- Introduce a requirement for the central and local governments to procure energy efficient products.
- Develop supplementary legislation to enable implementation of energy performance contracts (EPCs) to finance energy efficiency retrofits in public and commercial installations.
- Introduce energy efficiency criteria in public procurement.

Better market signals and consumer awareness

- Speed up installation of natural gas and heat meters in all buildings. Central and local governments should co-finance the installation of meters together with utilities. Utilities should welcome the installation of meters by homeowner associations and individual consumers.
- Install temperature controls and heat substations. While retrofitted buildings require less energy to create a comfortable environment for the inhabitants, they would waste energy without temperature controls and/or heat substations.
- Eliminate billing by normative consumption that is inaccurate, non-transparent and carries no incentive to save energy.
- Promote awareness of future energy costs, options for energy efficiency improvements and available financing among all economic agents through a comprehensive system of trainings, public awareness campaigns and educational outreach activities.
- Local governments should create energy management departments to monitor energy consumption, promote energy efficiency and work on sustainable energy planning.

Energy efficiency in buildings

- Ukraine should require the high-level accountability within government agencies and municipalities for achieving energy efficiency targets. The Ukrainian government already expressed interest in developing energy efficiency measures for the region; it also should require reporting from government agencies and identify other ways to monitor progress.
- Policymakers and implementers should critically approach switching individual natural gas boilers to renewables to ensure that biomass is available and alternative boilers do

not increase energy intensity (renewable-fueled boilers are less efficient than gas-fueled boilers).

- Introduce a more stringent energy building code. Without efficient building energy codes and robust implementation, the country could be locking in inefficient investments for many years to come.
- Building codes should consider not only thermal insulation, but also efficiency of lighting and heating, ventilating and air conditioning. Adequate capacity of systems, such as HVAC, is important to ensure that they run at their optimum.
- Ukraine should quickly adopt energy efficiency standards for household and industrial appliances. Appliance standards have a proven track-record of savings large amounts of energy at the national level in most developed countries. Ukraine started implementing standards for large appliances but small appliances should also be covered.

Utilities

- Introduce cost-recovery heat tariff (as stipulated in the Letter of Intend to the International Monetary Fund from 27 February 2015), but also structure tariffs in a way that incentivizes utilities to save energy (in contrast to the traditional cost-plus approach).
- Continue protecting vulnerable consumers though weatherization and other social programs.
- Ensure that consumer billing is transparent, consistent and accessible. Better information on the structure of the heat costs is important given the likely increase in utility costs.
- Set targets for improving consumer relations and customer service. Better customer service will help ease transition to higher utility prices, help retain customers and enforce payment discipline.
- Require district heating companies develop local energy plans that take into account realistic demand forecast and the impact of energy efficiency programs.
- Encourage utilities to adopt energy efficiency goals (for example, by adopting the Energy Efficiency Resource Standards or White Certificates) as well as plans for investments to ensure the systems are well-maintained.

Financing and incentives

- Ukraine should redirect available money from energy subsidies to energy saving technologies, while protecting vulnerable consumers through creative programs, such as weatherization assistance.
- Develop programs that would enable energy users take out loans for weatherization, retrofits and energy efficiency. Such programs could help buy down the interest rate, use an established relationship with utilities to offer financing (on-bill financing) or offer tax credits for energy efficient installations.
- National government should ensure high collection rates from financing programs, so that funding can be replenished and reused for future improvements.
- Municipalities should provide additional financing to bolster national programs on energy efficiency. For example, the Lviv Regional State Administration covers additional 30% of a loan for energy efficient materials.
- Given that Ukraine has limited budget resources, cooperation with international financial institutions is essential for obtaining required affordable and long-term financing. Strong

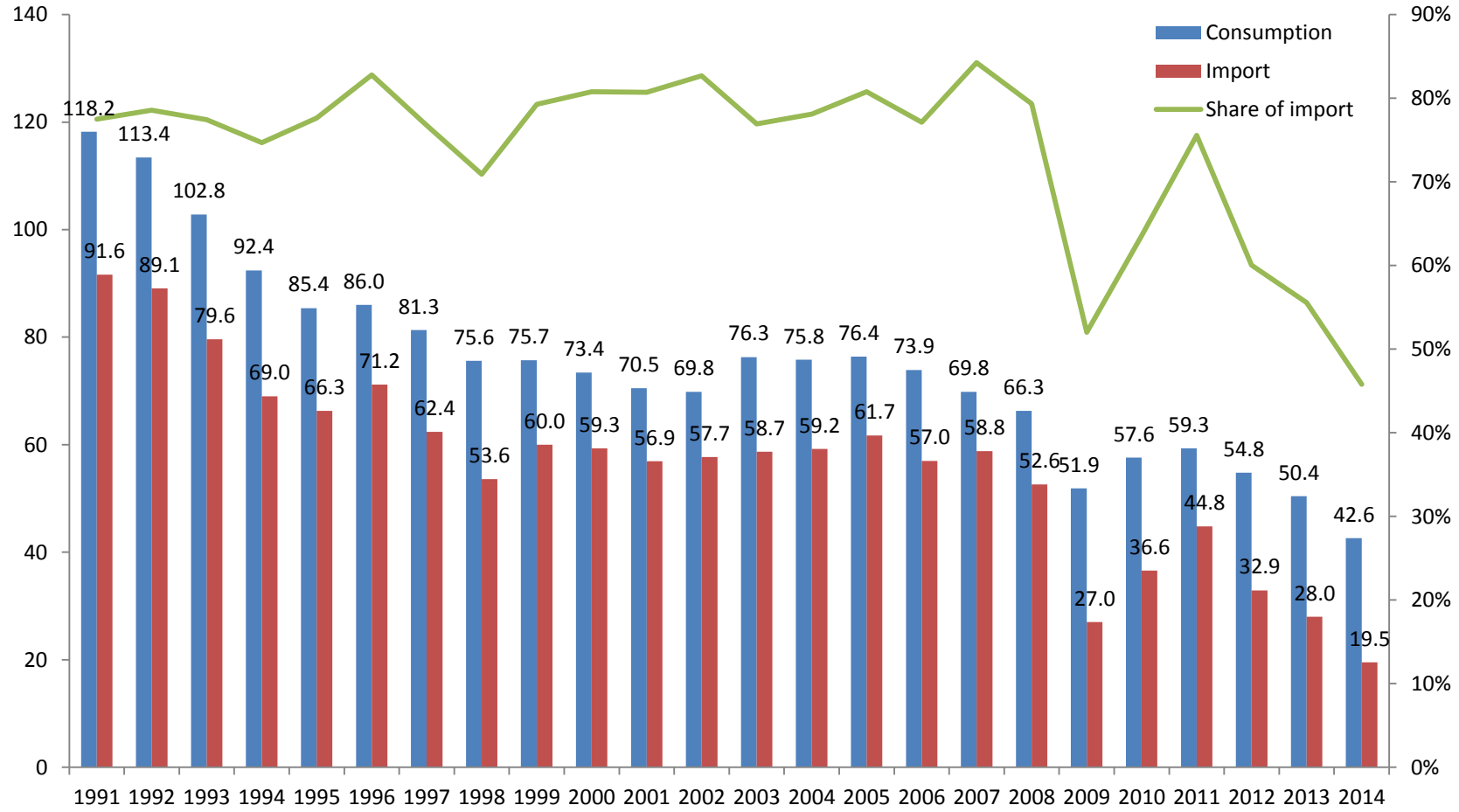
coordination between Verkhovna Rada, the government and international organizations is key for success.

- Create an Energy Efficiency Fund to finance retrofit programs.
- Government should provide loan guarantees for home-owner associations. HOA do not have assets that could be used as collateral; the government should bolster investments in retrofits.

Ukraine has an opportunity to consolidate gains from last years by developing a comprehensive strategy on energy efficiency linked to overall energy policy goals and pursing additional energy efficiency policies, such as those described above, with new vigor.

Appendices

Appendix 1. Consumption and import of natural gas in Ukraine



Source: Naftogaz of Ukraine http://www.naftogaz.com/www/3/nakweb.nsf/0/74B2346ABA0CBC69C22570D80031A365

Appendix 2. Building-level cold water, hot water and heat metering in Ukraine

Region	Cold water meters				Hot water meters				Heat meters			
	Number of buildings with meters, as of 1 July 2014		Number of buildings with centralized cold water supply	Number of buildings where meters need to be installed	Number of buildings with meters, as of 1 July 2014		Number of buildings with centralized hot water supply	Number of buildings where meters need to be installed	Number of buildings with meters, as of 1 July 2014		Number of buildings with district heat supply	Number of buildings where meters need to be installed
	Units	%	Units	Units	Units	%	Units	Units	Units	%	Units	Units
Vinnytsya	1,547	43.4	4,159	2,017	220	20	975	856	904	60.5	1,472	590
Volyn	553	33.4	2,906	1,104	71	10	692	612	418	25.4	1,648	1,228
Dnipropetrovsk	1,816	14.2	17,086	10,987	623	16	4,139	3,296	5,042	44.5	12,535	6,301
Donetsk*	9,062	38.9	30,032	14,234	496	19	4,139	2,116	6,484	31.1	20,997	14,398
Zhytomyr	835	27.4	2,440	2,207	44	9.6	537	413	405	22.0	2,116	1,433
Zakarpatska	488	24.7	2,644	1,486	0	0	0	0	0	-	-	-
Zaporizhzhya	1,957	31.0	6,735	4,347	111	51	2,578	107	1,863	36.9	4,759	3,185
Ivano-Frankivsk	2,048	77.4	3,070	597	378	68	558	181	629	60.9	1,124	404
Kyiv	1,790	43.6	5,017	2,317	337	33	1,823	695	1,022	37.3	3,396	1,720
Kirovohrad	1,092	73.1	1,494	402	0	*	0	0	661	56.6	1,167	506
Luhansk*	2,633	27.3	9,604	7,022	22	1.2	1,824	1,747	716	15.6	4,747	3,876
Lviv	509	5.39	18,216	8,943	302	12	2,083	2,231	2,122	46.2	4,594	2,472
Mykolayiv	2,425	42	671	3,350	332	37	2,386	560	1,285	53.8	2,386	1,103
Odesa	4,256	40.1	9,877	6,369	1,026	29	2,623	2,506	2,841	47.8	4,965	3,098
Poltava	339	5.05	6,703	6,369	133	4.5	2,976	2,843	676	20.1	3,501	2,692
Rivno	179	7.68	2,557	2,152	72	7.8	668	850	352	26.7	1,466	966
Sumy	351	16.9	4,504	1,723	0	0	906	714	980	38.5	2,494	1,568
Ternopil	1,228	62.5	2,359	738	32	8.2	390	358	74	8.7	853	779
Kharkiv	741	6.65	12,351	10,410	81	2.3	3,591	3,510	1,510	16.4	8,168	7,684
Kherson	730	17.3	3,671	3,479	3	0	60	0	471	26.1	1,398	1,333
Khmelnytsk	191	5.79	4,277	3,110	47	5.6	1,071	796	905	42.1	2,286	1,246
Cherkasy	222	20.4	3,205	868	4	0.6	680	676	324	17.7	1,961	1,509
Chernivtci	898	29.6	3,179	2,140	0	*	0	0	157	24.3	645	488
Chernihiv	454	19.9	2,808	1,828	172	15	1,232	951	529	29.3	2,043	1,278
Kyiv city	12,033	84.3	11,150	2,245	2,973	38	11,047	4,770	4,654	52.7	11,123	4,177
Crimea*	4,117	28.6	14,743	10,288	92	5.2	1,786	1,694	2,599	49.4	5,305	2,665
Sevastopol City*	2,226	78.1	3,799	623	7	0.7	1,011	960	341	15.3	2,327	1,893
UKRAINE	**54,720**	32.9	**189,257**	**111,355**	**7,578**	18	**49,775**	**33,442**	**37,964**	35.6	**109,476**	**68,592**

There is no centralized hot water supply in Zakarpatska, Kirovohrad and Chernivetska regions.

There is no centralized heat supply in Zakarpatska region.

*Updated information was not provided as of 1 July, 2014.

Source: Minregion, Available at http://www.minregion.gov.ua/attachments/content-attachments/3389/Tablutsa_na_sait.pdf

Appendix 3. Energy efficiency standards for appliances and equipment in the United States, EU and Ukraine

United States	EU	Ukraine
Heating & Cooling		
Air conditioning, central Air conditioning, room Boilers Furnaces Heat pumps, air-source Heat pumps, geothermal Commercial water heaters	Heaters Water heaters Hot water storage tanks Air conditioners Fans Industrial fans Water pumps Electric motors Simple set-top boxes Circulators	Air conditioners (Under development)
Appliances		
Air purifiers (cleaners) Clothes dryers Clothes washers Dehumidifiers Dishwashers Freezers Refrigerators	Cookers Fridges Freezers Dishwashers Washing machines Tumble dryers Vacuum cleaners	Refrigerators (2011) Washing machines (2011) Dishwashers (under development)

Electronics		
Audio/video Professional displays Set-top boxes & cable boxes Slates and tablets Telephones Televisions	Televisions Standby and off mode for domestic and office equipment	Televisions (under development)
Lighting & Fans		
Ceiling Fans Commercial light fixtures Decorative light strings Light bulbs Light fixtures	Directional and non-directional lamps Light emitting diode lamps and related equipment Fluorescent lamps (without integrated ballast) High intensity discharge lamps Ballasts and luminaires able to operate such lamps	Lamps and light fixtures (Under development)
Office Equipment		
Computers Data center storage Displays Enterprise servers Imaging equipment Small network equipment Uninterruptible power supplies Voice over Internet protocol (VoIP) phones	Computers Imagining equipment	

Notes: EU Energy Labelling Directive 2010/30/EU does not cover office equipment (e.g. computers, monitors and printers) for which the Energy Star label is applicable.

Sources: Energy Star certified products in the United States http://www.energystar.gov/products
EU energy-efficient products https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

Appendix 4. The dynamics of energy efficiency loans in Ukraine

Date	Number of loans	Amount (million UAH)
Nov-14	140	2.3
Dec-14	737	12.4
Jan-15	1604	28
Feb-15	1688	29.4
Mar-15	2007	35
Apr-15	2339	41.4
May-15	2838	50.2
Jun-15	3984	71.3
Jul-15	7405	131
Aug-15	14,474	251.3
Sep-15	23,132	392.5
Oct-15	34,756	583.1
Nov-15	49,113	810.9
Dec-15	68,845	11,13.2
Jan-16	79,545	12,74.7
Feb-16	79,817	12,80.3

Source: SAEE. Plans for 2016.

Appendix 5. International organizations working on energy sector reforms and energy efficiency in Ukraine

Organization	Project	Date	Objectives	Financing
USAID	Local Alternative Energy Solutions in Myrhorod	May 23, 2013 – May 22, 2015	Introduce a supportive regional regulatory environment; developing the infrastructure for collection, treatment, storage of biomass; preparing and implementing a model biofuel boiler facility; and developing a Public Private Partnership framework for private sector driven expansion of biomass in Poltava. http://www.usaid.gov/where-we-work/europe-and-eurasia/ukraine/environment-and-climate-change	n/a
USAID	Municipal Energy Reform Project (MERP)	September 27, 2013 – September 29, 2017	To support improvements in the clean energy regulatory and legislative enabling environment; 2) promote investment in clean energy technologies and applications; 3) provide capacity building training and awareness raising; 4) enhance the capacity of the Government of Ukraine in low emission development strategies. http://www.usaid.gov/where-we-work/europe-and-eurasia/ukraine/environment-and-climate-change	$ 14.5 million
EBRD	Legal EE Infrastructure: Dnipropetrovsk	Signed July 2013	The EBRD is considering providing a loan to the Municipal Energy Managing Enterprise of Dnipropetrovsk (the "Company") for financing energy service company (ESCO) energy efficiency investments in public buildings and street lighting in the city of Dnipropetrovsk. http://www.ebrd.com/work-with-us/projects/psd/legal-ee-infrastructure-dnipropetrovsk.html	Up to €22.5 million. The loan financing is to be complemented by a grant of up to € 2.5 million from the Eastern Europe Energy Efficiency and Environment Partnership ("E5P")
EBRD	Poltava District Heating	29 August 2014	The installation of individual heating sub-stations, biofuel boiler, network replacement with pre-insulated pipes, modernisation of boilers and control systems, and the installation of monitoring and dispatching system in the City http://www.ebrd.com/work-with-us/projects/psd/poltava-district-heating.html	Up to €28.5 million €15 million from EBRD, €4 million from the Clean Technology Fund (CTF), co-financed by a grant of up to €5

				million from E5P.
EBRD	Ukrainian Residential EE Financing Facility (UREEFF)	Target board date: 02 Sep 2015	The EBRD is considering establishing the Ukrainian Residential Energy Efficiency Financing Facility. The funds will be made available to Participating Financial Institutions ("PFIs") in Ukraine for on-lending to eligible private sector sub-borrowers for sustainable energy ("SE") investments in the residential sector. http://www.ebrd.com/work-with-us/projects/psd/ukrainian-residential-ee-financing-facility.html	€65 million
EBRD	Lutsk District Heating Project	15 July 2014	The installation of individual sub-stations, biofuel boiler(s?), network replacement with pre-insulated pipes, decommissioning of obsolete basement boiler houses, modernisation of boilers and control systems, and the installation of monitoring and dispatching system. http://www.ebrd.com/work-with-us/projects/psd/lutsk-district-heating-project.html	Up to €16 million.
EBRD	Luhansk District Heating Cancelled	23 July 2013	The installation of individual sub-stations, network replacement with pre-insulated pipes, modernisation of boilers and control systems, installation of monitoring and dispatching "SCADA" system. http://www.ebrd.com/work-with-us/projects/psd/luhansk-district-heating-.html	€20 million
EBRD	Donetsk District Heating Project	16 July 2013	The installation of individual sub-stations, network replacement with pre-insulated pipes, modernisation of boilers and control systems, installation of new gas engine units for simultaneous co-generation of heat and electricity, installation of dispatching and monitoring system. http://www.ebrd.com/work-with-us/projects/psd/donetsk-district-heating-project.html	€15 million
EBRD	Ukraine Sustainable Energy Financing Facility (USEFF)	10 Dec 2013	The EBRD is considering a framework operation of $100 million to address acute needs for sustainable energy investments in energy intensive Ukraine. The framework will comprise credit lines to local banks and leasing companies (PFIs) for on-lending to private companies undertaking sustainable energy investments. The facility will be supported by a grant from the Austrian Ministry of Finance for technical assistance to participating financial institutions, sub-borrowers and local experts. http://www.ebrd.com/work-with-us/projects/psd/ukraine-sustainable-energy-financing-facility-%28useff%29.html	$100 million.
EBRD	Ternopil District Heating Modernisation	18 Sep 2012	The EBRD is considering providing a loan to the municipal district heating utility operating in the City of Ternopil to finance the installation of individual heating substations, installation of a bio-fuel boiler, modernisation and rehabilitation of existing boilers and sections of networks, installation of controlling and monitoring equipment. The project aims at significantly improving the energy efficiency, reducing energy losses, gas and electricity consumption and improving the quality of heat and hot water supply services in the City of Ternopil. http://www.ebrd.com/work-with-us/projects/psd/ternopil-district-heating-	Up to €16.1 million.

			modernisation.html	
EBRD	Ukraine Energy Efficiency Programme (UKEEP)	Since 2007	- 5 partner banks - 90 implemented projects in energy efficiency and renewable energy fields http://www.ukeep.org/en/about-ukeep.html	Credit line
World Bank	District Heating Energy Efficiency Project	May 1, 2014	To improve the energy efficiency and quality of service of selected Ukrainian district heating companies, improve their financial viability and decrease their CO2 emissions.	$332 million
World Bank	Assistance to the National Commission for Regulation of Communal Services: District Heating Regulatory Reform Support Program	July 16, 2014	n/a	$ 2.23 million
World Bank	UA - Energy Efficiency	May 17, 2011- March 31, 2016	To contribute to improved energy efficiency by industrial and commercial companies, municipalities, municipal sector enterprises and energy service companies by facilitating sustainable financial intermediation for the financing of energy efficiency investments http://www.worldbank.org/projects/P096586/ua-energy-efficiency?lang=en	$200.00 million
World Bank	Hydropower - Additional Financing	November 19, 2009	To improve operational stability and reliability of power supply by increasing regulating capacity, efficiency and safety of hydroelectric plants, and therefore, facilitate unimpeded operation and opening up of the electricity market in Ukraine	$66 million
IFC	Ukraine Sustainable Energy Finance Program	2010 - present	to encourage investments in energy efficiency projects across the country. The Project helps financial institutions and companies to assess modernization projects, and supports banks in building their internal capacity to develop new financial products to develop the market for energy-efficiency financing.	n/a The Program is supported with funds from the Ministry of Finance of Austria, and the Ministry of Economic Affairs (EVD) of the Netherlands.

IFC	Promoting Energy Efficiency in Ukraine's Residential Housing	2010 - present	To create an effective legal and institutional platform to support Ukrainian homeowner associations and housing management companies in obtaining access to finance for energy efficient modernization of multifamily buildings.	n/a Supported with funds from the Swiss Confederation
IFC	Europe and Central Asia Sustainable Energy Finance Program	2013 - present	To increase energy efficiency in industrial sectors and reduce GHG emissions via collaboration with the financial sector. The program aims to create a platform to support financial institutions (FIs) in the development and marketing of energy efficiency (EE) lending products to small and medium enterprises (SMEs), and to the corporate and residential sectors, to build awareness and market demand for EE finance.	n/a Supported with funds from the Ministry of Finance of Austria and the Ministry for Foreign Affairs of Finland
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	Energy Efficiency in Buildings in Ukraine	Since 2007	To contribute to the reduction of primary energy use and associated greenhouse gas emissions in the Ukrainian housing and construction sectors through the improvement of national and local energy efficiency policies and practices for new and existing buildings. The key priorities of the Project are to support the development of a strategy for a national energy efficiency policy in the building sector in Ukraine and to improve energy efficiency in the Ukrainian municipal building sector through policies and strategies for implementation in four selected pilot cities: Chernihiv, Ivano-Frankivsk, Myrhorod and Novohrad-Volynskyi.	n/a
GIZ	Energy efficiency in municipalities	2013 to 2016	Six partner municipalities are signatories to the European Covenant of Mayors initiative for local sustainable energy and are developing and implementing action plans for sustainable energy use geared to achieving the European 20-20-20 targets. http://www.giz.de/en/worldwide/30658.html	n/a
GIZ	Establishing energy agencies	2014 to 2017	To create a suitable national legal framework that will promote energy efficiency measures at the local level. Furthermore, GIZ is assisting two regions to set up and pilot energy agencies. These agencies are to provide ongoing support to municipalities on rolling out energy efficiency and energy-saving activities at local level. Lead executing agency: MinRegion http://www.giz.de/en/worldwide/30667.html	n/a
GIZ Project EnPC-INTRANS:	Capacity building on energy performance	24 months, starting from March	ENPC-INTRANS aims at the adaptation and introduction of EN PC best practices in the countries at different stages of the transition to a low-carbon economy. EN PC is an innovative financing model that allows cities and communities to promote implementation of energy efficiency measures in public buildings when	

	contracting in the European markets in transition	2015	local budgets lack their own resources. At least 50 trainers and 3,000 skilled personnel are to be trained till the project end. www.eeim.org.ua http://www.enpc-intrans.eu/	
The International Climate Initiative (the international component of the German Federal Government's Climate Initiative)	The Energy Efficient Pilot Project	Since 2008	To develop and implement an energy efficient and resource protecting building concept for new building projects. To achieve this goal, the following measures will be implemented	n/a
German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	Energy Efficient and Climate Friendly Modernization of Industry in Donetsk Region	2011 – 2014	To promote the systematic approach to the Energy Management and demonstrate that energy consumption and greenhouse gas emissions can be reduced through the introduction of an effective energy management system.	n/a
NEFCO	DemoUkrainaDH Funding Programme	Since 2012	DemoUkrainaDH is a funding programme established by NEFCO in cooperation with the Ministry of Regional Development, Construction and Municipal Economy of Ukraine, supported by Sweden and E5P. The objective of the DemoUkrainaDH programme is to demonstrate in Ukrainian cities new District Heating technology and District Heating system solutions in combination with the introduction of international practices for project preparation, design, procurement, implementation and follow up for more energy-efficient and sustainable District Heating services. http://www.demo-dh.org.ua/	Capital expenditure grant up to €0.3 million per project. • loan up to € 0.5 million per project
European Investment Bank	Support to the rehabilitation of district heating systems in 3 cities in Ukraine	May 2015	The overall objective of the project is to ensure environmentally, economically and financially sustainable heat supply to customers of three District Heating Systems in Ukraine and to contribute to their modernization aiming at (i) increasing energy efficiency, (ii) reducing related emissions and environmental impact, (iii) improving reliability and safety of heat supply, and (iv) to improve the service quality for customers. (in Kryvyi Rig, Olexandria and Lozova) http://www.eib.org/about/procurement/calls-technical-assistance/ta2014113.htm	€800,000

EU and UNDP	Community Based Approach to Local Development Project (CBA)	06.06.2011 - 30.06.2015 (phase – II)	CBA Project assists rural Ukrainian communities and local/regional authorities to achieve the vision of energy efficiency through collective action under the framework of its "energy efficiency component. - Energy efficiency strategy development in 6 selected oblasts - Seed grants for implementation of 300 micro-projects in 24 regions of Ukraine and AR Crimea - Training, roundtables, workshop and exposure visits – for raising awareness and skills; - Advocacy/motivation for psychological preparedness – to come together and to act together. http://www.cba.org.ua/en/activities/energy-efficiency-component http://www.ua.undp.org/content/ukraine/en/home/operations/projects/human_development/project_sample111/	€3.65 million

Appendix 6. Recommendations on energy efficiency policy improvements developed during the seminar "Energy efficiency and district heating: a strategic policy approach to improving Ukraine's energy security"

Verkhovna Rada of Ukraine
Committee on Fuel and Energy Complex, Nuclear Policy and Nuclear Safety
Committee on Construction, Urban Development, Housing and Communal Services and Regional Policy

No. 04-26/24-335 May 18, 2015

To: Cabinet of Ministers of Ukraine

On April 16, 2015, Verkhovna Rada of Ukraine and Pacific Northwest National Laboratory (PNNL) with the support of the U.S. Department of State held a seminar, entitled "Energy efficiency and district heating: a strategic policy approach to improving Ukraine's energy security."

More than 130 participants, including members of parliament, representatives of the executive branch, such as the state energy regulator, diplomats, international and Ukrainian experts, participated in the seminar. Geoffrey Pyatt, Ambassador of the United States to Ukraine was among the honorary speakers at the seminar.

Speakers from Ukrainian ministries, National Commission for State Regulation of Energy and Public Utilities, as well as representative of PNNL, the European Commission and Energy Community Secretariat presented at the seminar.

As an outcome of the seminar, recommendations on integrating energy efficiency policy into the energy sector strategic planning were developed for the Cabinet of Misters of Ukraine. Participants stressed that these steps would help avoid short- and long-term emergencies in Ukraine's energy sector in the future.

Attachment: Recommendations, 2 pages.

Head of Verkhovna Rada Committee on Fuel and Energy Complex, Nuclear Policy and Nuclear Safety
Mykola Martynenko

Deputy Head of Verkhovna Rada Committee on Construction, Urban Development, Housing and Communal Services
Olena Babak

Recommendations on energy efficiency improvements in Ukraine

Participants of the seminar "Energy Efficiency and District Heating: a Strategic Policy Approach to Improving Ukraine's Energy Security" believe that Ukraine should implement a balanced approach to enhancing energy security which includes improving efficiency of traditional energy resources usage, energy savings and development of alternative sources of energy.

Participants stressed the need to improve the national legislation further, including through:

- Adoption of strategic documents, where energy efficiency would be defined as one of the strategic goals;
- Aligning the existing legislation with the norms of Directive 2012/27/EU on energy efficiency; development of mechanisms for implementing the Directive requirements;
- Adoption of the National energy efficiency action plan by 2020 and its implementation measures;
- Amending the existing legislation on state regulation of the natural monopolies by taking into account local energy markets peculiarities (heat and water supply);
- Introduction of mandatory energy audit of enterprises and organizations of all forms;
- Development and implementation of financial mechanisms to encourage energy companies to lower energy consumption by their clients;
- Introduction of more stringent energy efficiency standards for construction and reconstruction of buildings and energy efficiency improvement of the existing buildings;
- Stimulate the development of energy service companies (ESCOs) through the development of appropriate legislation and introduction of the mechanisms for energy service contracts;
- Adopting legislation for the development of the alternative energy sources;
- Implementation of transparent tariff policy;
- Implementation of comprehensive measures for metering of energy resources at production and consumption stages.

Energy efficiency programs should target the areas where peak loads might exceed the electricity supply capacity. This approach is an integral part of grid reliability programs in the United States and Europe.

In addition, participants proposed additional measures for preparing the heat supply systems for the 2015-2016 fall-winter heating period, namely:

- Engage the State Inspection on Energy Surveillance (Derzhenergonaglyad) in monitoring (technical audit) of the preparation of heat generation facilities and other socially important objects for the heating season. The agency should also monitor whether these measures are comprehensive and inform regional state administrations, the Cabinet of Ministers of Ukraine and key ministries about its findings.

- Recommend local authorities and energy companies develop a comprehensive approach to energy saving, especially natural gas saving, during the heating season;
- Develop recommendations for local authorities and energy companies on implementation of energy efficiency measures.

Appendix 7. Memo from the Ministry of Regional Development, Construction and Communal Services on energy efficiency policies and programs in Ukraine

After the seminar "Energy efficiency and district heating: a strategic policy approach to improving Ukraine's energy security", the first Vice Prime Minister of Ukraine requested government bodies responsible for energy and efficiency policy to provide information of their activity to promote energy efficiency in the country.

From: Ministry of Regional Development, Construction and Communal Services of Ukraine
To: Verkhovna Rada Committee on Fuel and Energy Complex, Nuclear Policy and Nuclear Safety
Date: 04 June, 2015
No. 7/9-6386

Per the request of the first Vice Prime Minister Zubko dated 26 May 2015 No. 21113/1/1-15, the Ministry of Regional Development, Construction and Communal Services of Ukraine, the National Commission for State Energy and Public Utilities Regulation and the State Agency on Energy Efficiency and Energy Conservation of Ukraine reviewed the letter from the Verkhovna Rada dated 18 May 2015 No. 04-26/24-355 about the recommendations developed at the seminar "Energy efficiency and district heating: a strategic policy approach to improving Ukraine's energy security" and report the following.

Per received recommendations, the following work is being currently carried out regarding the improvement of national legislation:

The National Commission for State Energy and Public Utilities Regulation is developing a number of draft laws on Commission's functions, rights and responsibilities, as well as legislation on electricity and natural gas markets, and centralized heat and water supply. While developing these drafts, the Commission gives priority to promoting energy efficiency measures, included the following recommended at the seminar:

- Taking into account the norms of Directive 2012/27/EU on functions and rights of the regulator in the sphere of energy efficiency.
- Developing mechanisms to stimulate energy supply companies to reduce consumptions by their consumers;
- Improving legislation for alternative energy sources development;
- Proposing measures on tariff policy improvement;
- Introducing energy metering at the stages of generation/production and consumption.

In 2015, the State Agency on Energy Efficiency and Energy Conservation has participated in the development of the following legislation in the sphere of effective use of energy resources and energy efficiency:

- Law of Ukraine No.327-VIII dated 09 April 2015 "On introducing new investment possibilities, guarantee of rights and legitimate interests of economic agents for conducting large scale energy modernization" ; Law of Ukraine No.328-VIII dated 09

April 2015 “On amendments to the Budget Code of Ukraine on introducing new investment possibilities, guarantee of rights and legitimate interests of economic agents for conducting large scale energy modernization” which introduced a new legal institute of energy service contract and determined the relations between a client and a provider of energy service, determined the mechanism for price setting of an energy service contract and so on;

- Decree of the Cabinet of Ministers of Ukraine dated 08 April 2015 No. 231 “On amendment to CMU decrees No. 243 and No.1056” which amended the State target economic program on energy efficiency and alternative energy sources development for 2010-2015. The Decree also amends the procedure of funds appropriations for encouraging energy efficiency measures through partial rebates of loans for energy efficient equipment and/or materials.
- Regulation of the Cabinet of Ministers of Ukraine dated 20 May 2015 No. 499 “On approval of the plan for implementation of EU legislation”.

As of now, the State Agency on Energy Efficiency and Energy Conservation has developed a number of draft laws on energy efficiency, namely:

- Draft law “On energy efficiency of buildings” to implement the provisions of European legislation on energy efficiency in buildings (Directive 2010/31/EU);
- Draft law “On amendment of Article 19 of the law of Ukraine “On heat supply” regarding long term contract on heat energy supply” which creates the legal foundation for providing financial guarantees to investors through long-term contracts for heat energy supply;
- Draft law “On amendment of Law of Ukraine “On natural monopolies”, which introduces mandatory stimulating tariff regulation on adjacent markets starting in 2019;
- Draft decree of the Cabinet of Ministers of Ukraine “Regarding state specialized financial institution “The Energy Efficiency Fund”, which defines the Statute of the Fund, sources of financing and direction of fund use. The draft decree approves the revolver order for transformation of energy subsidies into energy efficiency investment.
- Draft Order of the Cabinet of Ministers of Ukraine “On approval of the National Energy Efficiency Action Plan by 2020” which introduces measures to reach 9% energy saving from the average final domestic energy consumption of 2005-2009 period by 2020; with an intermediate goal being 5% reduction by 2015.

The State Agency on Energy Efficiency and Energy Conservation continues to work on implementing technical regulations for appliances labeling.

In addition, the agency works on promotion of the alternative energy sources. The 2020 National Renewable Energy Action Plan was approved by the Cabinet of Minister of Ukraine on October 1, 2014 No. 902-r. The Plan recommends local authorities and heat supply companies develop a comprehensive approach to energy saving during the heating period and focus on attracting investment projects, stipulated by the local authorities’ Road Maps, aimed at replacing natural gas with other sources of energy.

In February-March 2015, The Ministry of Regional Development, Construction, and Communal Services of Ukraine together with regional state administrations and heat supply companies

developed the 2015 Action Plan on consumption reduction and replacement of natural gas. According to the plan, natural gas is expected to be replaced in 1,149 heat stations, or in 1,743 boilers, with the total cost of the work being 889.4 million hryvnia. In addition, it is planned to modernize boiler equipment to reduce natural gas consumption at 700 heat stations, or 1,138 boilers for 403.4 million hryvnia.

The Ministry considers the recommendations provided at the seminar "Energy efficiency and district heating: a strategic policy approach to improving Ukraine's energy security" to be of crucial importance. The Ministry plans to continue its work to achieve a balanced approach toward energy security of the country that encompasses improving efficiency of traditional energy resources usage, energy savings and development of alternative sources of energy.

Volodymyr Kistion

First Deputy Minister
The Ministry of Regional Development,
Construction and Communal Services of Ukraine

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