National Energy Efficiency Action Plan Through 2020

DRAFT

Prepared by Ukraine as Contracting Party of the Energy Community, on the Basis of the NEEAP Template and IEE-Supported EMEEES Project for the Member-States

In accordance with the decisions of the Energy Community made in December 2009, September 2010, and in October 2011, the Contracting Parties of the Energy Community (including Ukraine) are in the process of implementation of the European Directives on energy efficiency:

1. Directive 2006/32/EC on energy end-use efficiency and energy services.
2. Directive 2010/31/EC on the energy performance of buildings.
3. Directive 2010/30/EC on labelling of energy products.

The task force on energy efficiency was established in the Energy Community in December 2007 with a view to support and ensure the coherent implementation of the directives in the Energy Community. The working programs of the task force on energy efficiency involve the tasks of preparation of National action plans on energy efficiency (NEEAPs) for the Contracting Parties, as well as establishing a system of monitoring and evaluation of energy savings. In order to come to a concerted approach to this task fulfilment, the members of the task force have prepared the national action plans on energy efficiency.

The Directive 2006/32/EC of the European Parliament and of the Council on energy end-use efficiency and energy services (hereinafter referred to in this document as the Directive, or ESD) requires from the EU Member States to prepare three National energy efficiency action plans for the period of 2008-2016 and to submit them to the European Commission. The first NEEAP, for the period of 2008-2010, has already been submitted before June 30, 2007 by the majority of the EU Member States.

The Contracting Parties in the Energy Community have the same obligations to develop and implement NEEAP as the EU Member States, only with shifted deadlines, i.e. in the case of Ukraine, the 1st NEEAP covers the period from 2012 to 2020. With a view to a coherent approach to this problem, the Template of the National action plan on energy efficiency of EU was reviewed and adjusted by the Energy Efficiency Task Force, to be used during the development of NEEAP.

The present action plan was developed based on the requirements of the directive 2006/32/EC of the European Parliament and of the Council on energy end-use efficiency and energy services. The used model was recommended by the European Commission for the Member States of the European Union, and was also adapted for the Contracting Parties of the Energy Community.

The reporting period of NEEAP for Ukraine to achieve the estimated goal according to the Directive is from 2012 to 2020. The main objective is to ensure that all Contracting Parties have planned energy savings in the amount of 9% of the average of the final domestic energy consumption for the last statistically available period (2005-2009) for the ninth year of application of the Directive. The first NEEAP sets an interim indicative target within three years of the implementation period in amount of 2% of domestic target consumption of energy. The above mentioned purpose does not apply to energy consumers covered by the Directive 2003/87/EC, which establishes a scheme of emissions trading of greenhouse gases emissions in the Community (hereinafter referred to as the ETD), as well as end consumers in the areas of air and inland waterway transportation.In order to achieve the goal, aggregated and individual data on energy consumption were used. These data were provided by the State Statistics Service of Ukraine. Used indicators of energy balance do not differ from the data provided by the Eurostat.

In the course of implementation of the Plan, Ukraine should also introduce efficient normative, taxation, financial and organizational measures for the overall implementation and fulfilment of the Directive.

Implementation of measures necessary to achieve the indicative objective requires mobilization of significant financial resources, enhancing of energy efficiency measures planned by the State, and further liberalization of the energy market, particularly in terms of offering of energy services, as well as development of public-private partnerships in the field of energy efficiency.

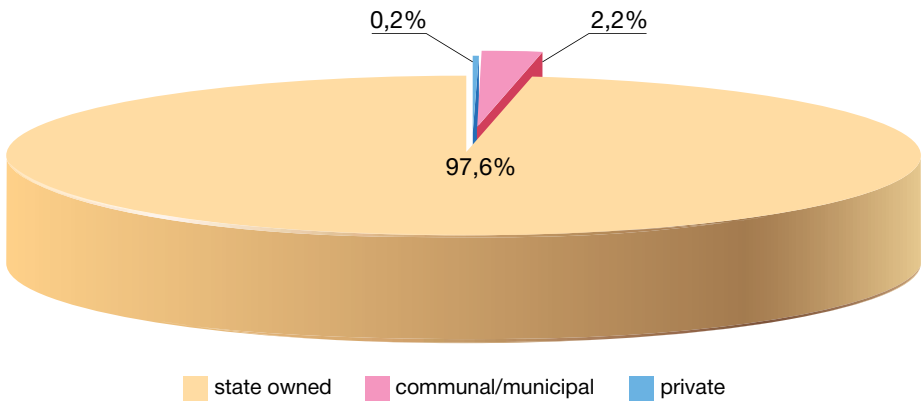
NEEAP is aimed at achieving 9% decrease of final energy consumption by 2020 through provision of energy services and implementation of energy efficiency and energy saving measures.

According to the definition used in the European Parliament and Council Directive #2006/32/EU (ESD) for calculation of energy performance results, each state shall use statistical data on final energy consumption for the last five years prior to implementation of the Directive. According to Article 4 of ESD, «Member States shall adopt and strive to achieve the national indicative energy savings of 9% for the ninth year of this Directive application, the indicated target should be achieved. Member States should implement cost-effective, practical and reasonable measures to achieve this target.» According to the definitions of the ESD, the National Action Plan for Energy Efficiency of Ukraine should cover nine periods from 2012 to 2020.

The last year when savings of 9% should be achieved is 2020. Article 4 of the ESD also states that «pursuant to Article 14: To present the first National Action Plan for Energy Efficiency (NEEAP), each Member State shall establish an intermediate national target of energy saving for the third year of implementation of this Directive, and also shall review its strategy to achieve the intermediate and overall targets.» The year 2014 can be set as intermediate result for Ukraine, it is the third year of the Action Plan implementation.

To begin calculation of the National Target in energy efficiency the final energy consumption over five years from 2005 to 2009 was used.

POPULATION: RESIDENTIAL BUILDINGS (households)



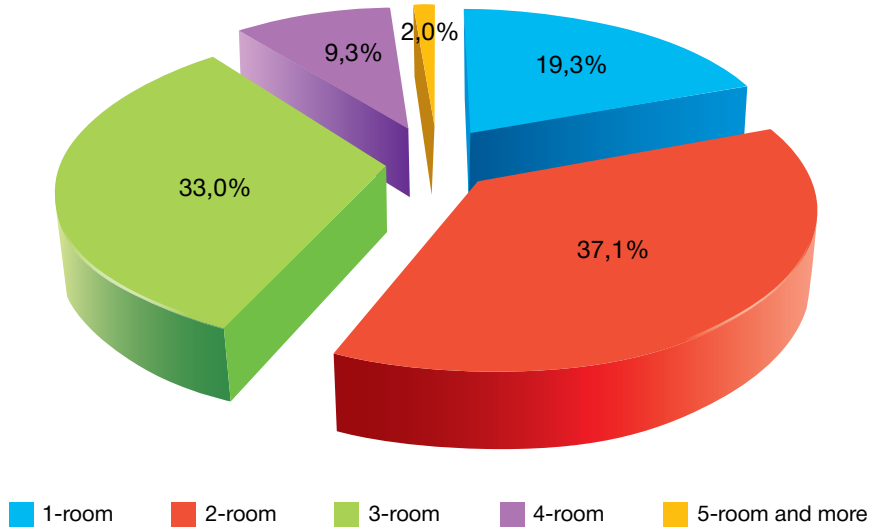
Structure of the housing stock of Ukraine by the form of ownership as of 01.01.2011

Overview of housing stock of Ukraine

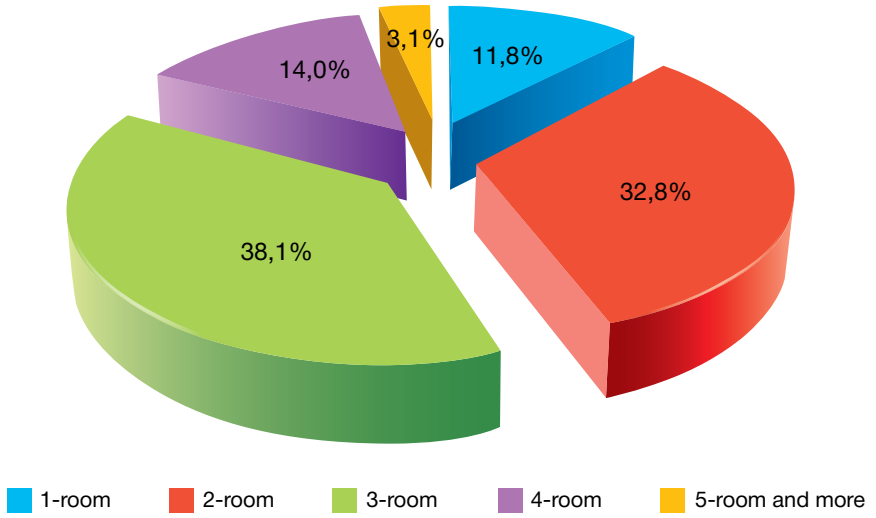
As of January 1, 2011, Ukraine's housing stock totaled 1079.5 mln. m^2 in total floor area, including housing stock (2.2 mln. m^2) kept on the balance sheet of bankrupt enterprises and enterprises that discontinued their activity. Urban housing stock constituted 64.2%.

Apartment type residential houses account for nearly all housing stock (98.1%). The share of hostels and residential premises in non-residential buildings in the total housing stock constitutes 1.9% (20.4 mln. m^2).

Total number of apartments in Ukraine was 19.3 mln., i.e. one apartment per 2.4 citizens on average. The breakdown of apartments by the number of rooms is as follows: 19.3% – one room apartments, 37.1% – two room apartments, 33.0% – three room apartments, 10.6% – apartments with four rooms and more.

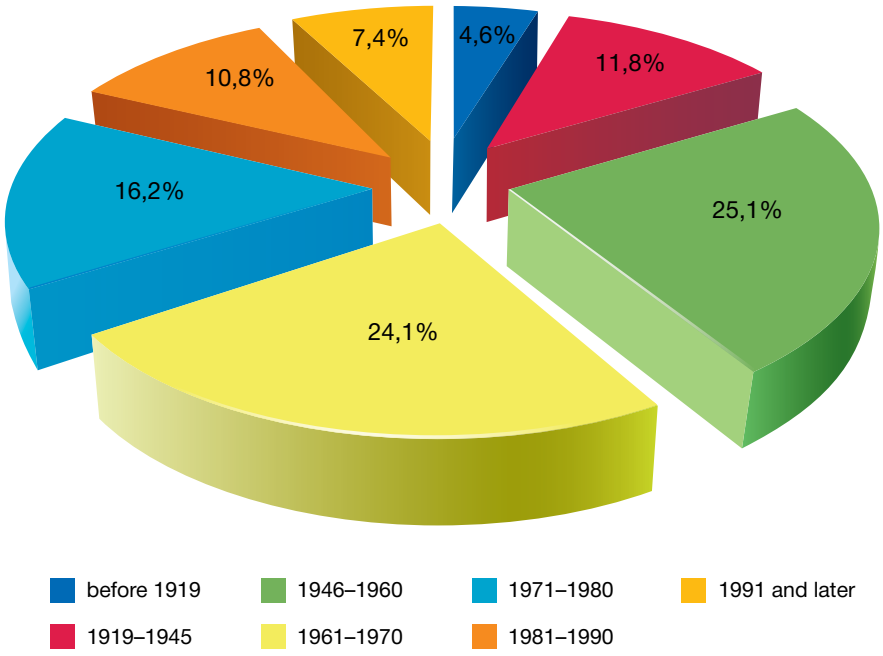


Structure of apartments of Ukraine's housing stock by the number of rooms as of 01.01.2011

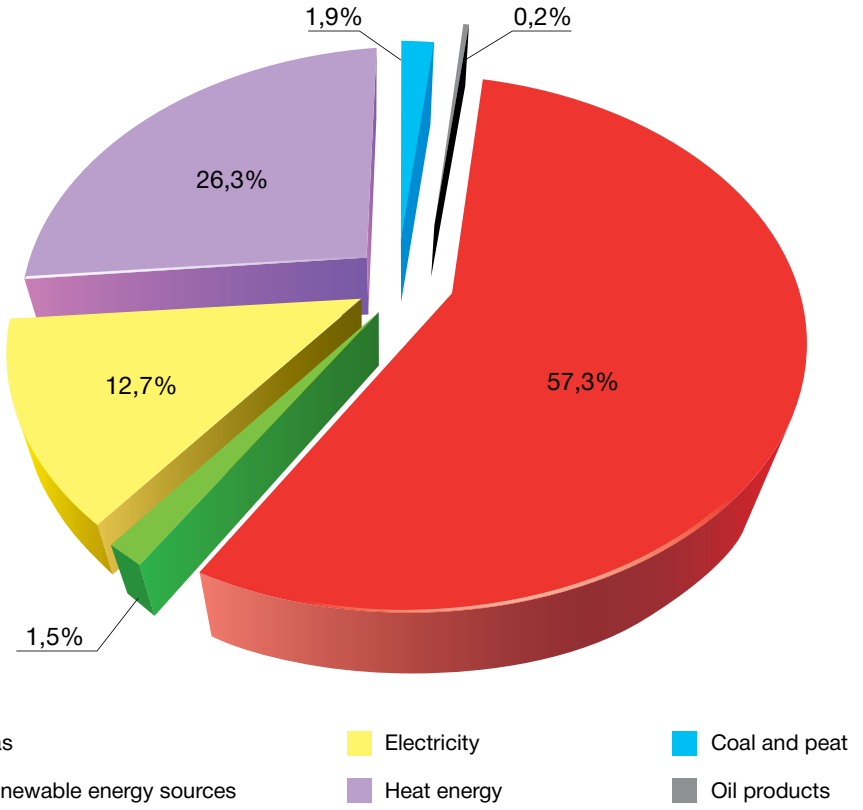


Structure of total floor area of apartments of Ukraine's housing stock by the number of rooms as of 01.01.2011

As of January 1, 2011, the housing stock included 10,171.2 thousand buildings. Of these, 629.2 thousand are untenanted buildings with total floor area of 31.2 mln. m^2, which constitutes 2.9% of housing sock's total floor area, and 11.5 thousand buildings kept on the balance sheet of bankrupt and terminated enterprises.



Breakdown of residential buildings by the year of construction



Balance of housing sector's energy consumption by types of energy

Statistical overview of housing stock's energy consumption

According to 2010 Energy Balance of Ukraine, total energy consumption by housing stock with total floor area of 1,079.5 mln. m^2 totaled 24.8 mln. toe. This is nearly 33.7% of 2010 total final energy consumption (hereinafter – TFEC). For comparison, according to IEA data this indicator in 2008 totaled 23.34 mln. toe, and in 2009 – 22.08 mln. toe.

Available statistical information is insufficient for further assessment of energy saving potential in the housing stock, since it does not make it possible to assess energy consumption by the regions of Ukraine, which is required to determine the value of possible energy saving. Based on available information it is only possible to determine average specific annual energy consumption by the housing stock of Ukraine, which constitutes 267 kW·h/m^2 of consumed energy.

According to EBRD data, in Norway statistics proves that total energy consumption of households near Oslo is 140-170 kW·h/m^2 on the average. The number of heating degree days in Oslo is 4,000, while in the coldest climate zone of Ukraine – 3,750 on the average.

Comparing specific energy consumption with other more climate friendly countries, in Bulgaria, for example, housing sector's energy consumption constitutes 100-130 kW·h/m^2. On average, Bulgaria's climate corresponds to the 3rd – 4th climate zones of Ukraine.

Considering the above, calculation assessment/estimate of energy consumption by Ukraine's housing stock is presented below.

Energy saving potential in residential sector

As it was found out earlier, official statistics on energy consumption by different types of buildings in different climate zones is not collected in Ukraine. Therefore, energy efficiency potential is determined based on computer modeling of consumption in accordance with respective methodology. Computer models were based on actual thermal performance of buildings, their age, type and specifics of four climate zones of Ukraine, which were extrapolated to the entire housing stock.

Selection of representative samples

The following buildings were selected as representative samples for calculations:

- one family cottage type house with total floor area of 60 m^2;
- two-storey and two-entrance building 12 m x 36 m as specified in design documents;
- five-storey and four-entrance building, series 1-437/1-438;
- ten-storey and one-entrance building, series BPS;
- five-storey and one entrance hostel building, series 164-80-1.

Calculation of housing stock's energy consumption level

Calculation of specific housing stock's energy consumption based on selected representative samples was carried out by climatic zones of Ukraine against the structure of housing stock breakdown by regions and local types.

Table 1.1. Energy consumption by existing housing stock buildings determined as a result of modeling

Required energy, toe	Zone I	Zone II	Zone III	Zone IV
6-storey and higher residential buildings	1,660,022.154	561,610.674	239,408.044	40722.887
5-storey residential buildings	2,154,469.536	766,560.448	397,413.564	136,108.75
2 to 4-storey residential buildings	1,431,041.866	404,752.647	237,487.374	29,730.566
Hostels	221,403.587	81,204.639	41,761.998	7,177.068
Cottage type houses	11,016,088.69	3,766,048.108	2,197,323.421	209,072.409
Annual residential sector's energy consumption	16,483,025.92	5,580,176.518	3,113,394.403	422,811.595
TOTAL	25 599 408,43			

The obtained value of residential sector's energy consumption totaling 25 mln. toe only by 3% exceeds the baseline level of energy consumption determined in accordance with statistical data.

Based on calculation results, total specific energy consumption (energy efficiency indicator) on average in Ukraine constitutes 276 kW·h/m^2 of consumed energy and ranges from 145 to 327 kW·h/m^2 depending on the type of building and climate zone in which a building is located.

Determining of energy saving technical potential

The process for determining energy saving potential was based on methodology proposed by the company «ENSI» within the framework of **«**Market Research of Ukraine's Residential Sector: Legal, Regulatory, Institutional, Technical and Financial Aspects**»**.

In technical terms, achievable energy saving potential is based on the use of available, practical, and time-tested technical solutions used by «ENSI» for residential sector research without taking into account economic characteristics and market requirements.

Table 1.2. Maximum possible positive energy saving potential in residential sector, by measures

No.	Measures	Potential ktoe		
		Multiple-apartment buildings	Cottage type buildings	Total
1	Additional thermal insulation of walls	1699,015	3312,731	5011,746
2	Installation of energy efficient windows	975,009	1901,104	2876,113
3	Additional thermal insulation of a roof	927,6401	1808,855	2736,4951
4	Installation of energy efficient engineering equipment	1439,001	2805,747	4244,748
5	Replacement/change of indoor lighting	149,3149	291,164	440,4789
	Total	5189,979	10119,6	15309,579

Calculation results show that implementation of comprehensive energy efficiency measures in existing residential buildings in Ukraine and improvement of buildings' energy efficiency will result in reduced total energy consumption by 15,3 mln. toe. This is 60% of the acceptable calculated value of baseline consumption (25 mln. toe).

Given low quality of input data received from official statistics (which lacks a lot of data required for more accurate calculations), the obtained calculation results should be viewed as the best assessment possible under current conditions. Nevertheless, the obtained result should be sufficient for substantiation of conclusion that energy saving potential is significant and there is a great need for implementation of measures aimed at reducing the consumption of heat energy by residential sector. It is also possible to conclude that more accurate assessment of energy saving potential requires a detailed analysis of Ukraine's housing stock by regions and local types of buildings.

Practically achievable reduction of total energy consumption is 511 ktoe by 2014 and 2,303.9 ktoe by 2020.

Table 1.3. Practically achievable potential energy efficiency in residential sector, by measures and years

№	Type of the program/ measure	Category	Usage	Task force/sector	PEE target activity of final energy consumption (according Annex 1)	Status and terms of realization	The actual amount of energy saving, expected in 2014/2020
1.	Additional insulation of walls	Energy services for energy saving	Regional	Households	b	In the early Stage	167,28/754,2
2.	Energy efficient windows' installation	-//-	-//-	-//-	b	-//-	96/432,82
3.	Additional roof insulation	-//-	-//-	-//-	b	-//-	91,33/411,81

№	Type of the program/ measure	Category	Usage	Task force/sector	PEE target activity of final energy consumption (according Annex 1)	Status and terms of realization	The actual amount of energy saving, expected in 2014/2020
4.	Energy efficient engineering equipment installation	-//-	-//-	-//-	f	-//-	141,68/638,78
5.	Replacing of the interior light	-//-	-//-	-//-	d	-//-	14,71/66,29

Assessment of required investment volume

The breakdown of monetary value (saving) of determined technical potential by specific energy efficiency measures is specified in Table 1.3.

Considering the market value of selected energy efficiency measures it was determined that total investment required for implementation of comprehensive energy saving solutions in residential sector totals **UAH 670 bln.** (EUR 60 bln.). Of these, UAH 435 bln. are investments in cottage type buildings and UAH 235 bln. – in multi-apartment buildings.

SECTOR OF PUBLIC SERVICES: PUBLIC AND COMMERCIAL BUILDINGS

Service buildings (offices, administrative offices, education sphere, health, trade, hotels, warehouses, etc.) are built mainly before 1990, their traditional architectural and building systems (large-panel, large-block, frames made with precast concrete, etc.) according to their parameters do not meet modern requirements as for energy efficiency, and therefore are characterized by low energy-saving properties, a large part of them is in need of integral remodelling and renovation. Lack of activity of the local authorities concerning improvement of the energy efficiency of buildings in the budget sector (schools, hospitals, administrative buildings, etc.) has led to the fact that this category of consumers used for their consistently high volumes of thermal energy (more than 30% of which was lost), without creating the conditions of thermal comfort in buildings. That is, there is a typical example of inefficient use of public budget funds for heating of buildings of budget and municipal sector.

In the public service sector, buildings of old periods of construction with low level of energy efficiency were also mainly used (rented, or were purchased) as offices, warehouses, retail spaces and so on. If these buildings were redeemed, buildings' owners that belong to the group of commercial consumers paid high tariffs for heat energy (compared with the ordinary population and state-financed institutions) and applied certain measures to conserve the heat energy, but in case of building rental the buildings would often only further degrade.

Such a situation is aggravated by an additional fact that the service sector is the segment of the economy, which is dynamically developing, constantly increasing its share in the GDP, and therefore one can expect a significant increase of used construction areas used already in the near perspective and, thus, significantly increasing the amount of thermal energy for their heating systems (and hence also a significant increase its losses while maintaining the current situation).

Therefore, to optimize consumption of thermal energy in the buildings of the municipal/budget sector and the service sector means the significant potential to reduce energy resources consumption and economize budget funds, which will provide high actuality to the solving of the task of energy efficiency increasing in the relevant buildings.

It should be noted that owners of commercial companies in general understand the need to take actions to reduce energy waste in their buildings, including savings on heat. Energy saving in the buildings of social and budget spheres is under the responsibility of the relevant bodies of executive power. Because the heat thermal modernization of the buildings of budget fund is the most important direction of saving the energy resources, in the upcoming years the growth of consumption of energy resources through the active development of these industries and, as a consequence, significant growth in commercial areas is likely.

In the upcoming years significant growth of tariffs for the services of the heat supply for the category of «budgetary institutions» is expected under the influence of such factors as cancellation of government subsidies on the price of natural gas for the heat utility companies; establishment of tariffs for heat supply services at a level that provides for the required 100% level reimbursement of costs for the production of thermal energy, transportation and supply (today, in many cases the fares are set at a level of 70-90%); regular price increases for fuel and energy resources.

In the nearest future, as provided by the law, all financed building will be equipped with thermal counters (registration and regulation means), by making the relevant costs in the rates for heat or special budget programs that will substantially save heat (and, accordingly, budgetary funds), but for this the municipalities will have to implement some serious energy-saving measures. And, thus, development of special programs, including upgrading the heating system settlements and thermal renovation of buildings in the budget sector will become increasingly popular in development plans of various levels of localities.

The main risk factors that might prevent the adoption of energy saving measures in the sphere of heating buildings budget sector may be an imperfect tariff policy that fails to encourage energy saving measures; uncertainty regarding budget support of energy saving at the prospect; high risks inherent in the housing and communal sector; low level of management skills in the field, lack of culture of efficient use of energy resources.

From the point of view of energy saving impact on the state budget, the groups of state owned and municipally owned public buildings tend to be of the highest interest.

Total final energy consumption of public buildings

Total baseline energy consumption of public buildings (both commercial and budget funded) has been determined based on 2005 data at the level of 5.69% of final consumption of energy and fuel overall in Ukraine. In absolute values it equals to 4.71 mln. toe.

Within the framework of NEEAP development a mode has been elaborated, which makes it possible to assess energy consumption and energy efficiency potential in pre-school facilities (PSF) and secondary education facilities (SEF). Pre-school and secondary education facilities are nearly fully funded by communities or municipalities. Energy saving in these buildings obviously impacts the formation of city or administrative district budgets. **In addition, improving the level of comfort in these buildings tends to be of special social significance.**

Given a limited nature of available statistical information on the stock of public buildings, the results of the model for assessing energy saving potential in educational institutions were used as a basis for extrapolation to the entire stock of public buildings.

Official statistics lacks information on structural breakdown by types of public buildings and includes the information only on the general number of certain types of public buildings in Ukraine. This makes it impossible to accurately determine the generalized value of estimated heat input for heating of the entire stock of public buildings, since it is impossible to accurately determine (as %) the number of typical objects relative to the general number of buildings. This, in turn, does not make it possible to properly assess specific weight of each type of representative sample within the total value of estimated specific input for heating of public buildings. Therefore, further assumptions are based on official statistics.

Energy saving potential in PSF and SEF buildings

Selection of representative samples

Pre-school and secondary education facilities for public use have typical architectural form and official statistics on the number of such buildings is available.

Pre-school facilities include public nurseries, nursery-kindergartens, kindergartens, family combined, or compensating day care centers (special and health), educational day care complexes, etc.

Secondary education facilities include schools, lyceums, gymnasiums, colleges, teaching and educational complexes, schools-therapeutic facilities of all levels, as well as special schools (boarding schools) and schools of social rehabilitation.

A school comprising 33 classes (1266 pupils) was selected as a representative sample for secondary education facilities (secondary schools). A kindergarten with capacity of 330 children was selected as a representative sample for pre-school facilities.

Determination of PSF and SEF energy consumption volume

An assessment of energy consumption by PSF and SEF is provided in more detail in Table 1.4.

Table 1.4. – The maximum positive potential energy savings in the public sector

№		Capacity, thousand toe			
		Pre-school education	Secondary schools	Total education	Total public and commercial funds
1	Additional insulation of walls	50,37	114,03	164,4	657,75
2	Energy efficient windows' installation	32,78	93,12	125,9	503,8
3	Additional roof insulation	40,67	83,75	124,4	497,54
4	Energy efficient engineering equipment installation	66,84	230,92	297,8	1191
	Total	190,66	521,9	712,5	2850,09

Evaluation of energy consumption by public buildings of pre-school and secondary education facilities is based on the generalization of calculations of energy consumption by a representative sample of buildings taking into account the number of facilities and number of children they have and then extrapolated to all schools

Energy consumption in monetary terms was calculated in accordance with average rates for consumed heating applicable to commercial enterprises in each temperature zone. For zone I this rate was 471.9 UAH/Gcal, for zone II – 503.7 UAH/GCal, for zone III – 624.3 UAH/GCal, and for zone IV – 514.4 UAH/Gcal.

Thus, the volume of energy consumed by PSF and SEF totals **1.16 mln. toe per year**. This is nearly of the above mentioned volume of total final energy consumption in public sector (4.71 mln. toe. per year).

Assessment of energy efficiency potential in PSF and SEF, and in public buildings

The difference between the values of measured consumption and consumption after implementation of energy efficiency measures determines the potential energy that can be saved in the public building stock. Evaluation of the energy saving potential was performed for both Ukraine as a whole, and separately for each climatic zone.

Table 1.3 specifies energy saving potential by four most likely energy saving measures, which can be taken with regard to public buildings in Ukraine. Saving in monetary terms was calculated in accordance with average rates for consumed heating applicable to commercial enterprises in each temperature zone. For zone I this rate was 471.9 UAH/Gcal, for zone II – 503.7 UAH/GCal, for zone III – 624.3 UAH/GCal, and for zone IV – 514.4 UAH/Gcal.

According to the statistical data and calculations, the energy saving potential in pre-school facilities is 66.6% against the current energy consumption and in secondary schools this indicator is 61.7%. This result can be achieved through 100% energy efficient modernization of buildings, replacement of windows and automation in 100% of buildings belonging to the above group of public facilities.

Therefore, technical potential of energy efficiency in preschool and secondary education facilities is **712.5 ktoe**.

Practically achievable reduction of total energy consumption is 23.2 ktoe by 2014, and 104.4 ktoe by 2020.

Estimation of required investment

Monetary value of saving resulting from implementation of energy efficiency potential in PSF and SEF totals **UAH 3.5 bln. per year (EUR 0.3 bln)**.

Monetary value of saving resulting from implementation of energy efficiency potential in PSF totals UAH 0.95 bln. Monetary value of saving resulting from implementation of energy efficiency potential in SEF totals UAH 2.6 bln.

Considering market value of selected energy efficiency measures, it was determined that total investment required for implementation of comprehensive energy efficiency measures in pre-school and secondary education facilities totals **UAH 29 bln. (EUR 2.6 bln)**.

The main measures to be implemented in residential, public and commercial buildings include the following:

- Reconstruction and overhaul of residential buildings through the use of energy saving technologies and equipment;
- Development and reconstruction of heat supply systems (replacement of outdated boilers, replacement of heat supply networks' pipelines with preinsulated pipelines, automation of fuel combustion processes in boilers to secure full combustion of fuel, etc.);
- Implementation of energy and resource saving sources of lighting and lighting systems «Reconstruction of outdoor lighting through the use of energy saving devices».

The volume of funding over 2012-2020 will total about UAH 814,5 bln, specifically:

- Population: residential buildings – UAH 670 bln;
- Public services: public and commercial buildings – UAH 144,5 bln.

Total volume of energy saving in 2020 will constitute about UAH 2408,3 bln, specifically:

- Population: residential buildings – 2303,9 ktoe, including in 2014 – 511 ktoe;
- Public services: public and commercial buildings – 104,4 ktoe, including in 2014 – 23.2 ktoe.

INDUSTRY

Over the years of independence Ukraine has hardly modernized its economy with its out-dated energy and resource-intensive technologies and a large portion of environmentally unfriendly and inefficient productions, inherited from the Soviet Union.

Although the industrial companies generate substantial profits, the product profitability for 2003-2010 is not more than 3-6%.

The most energy-intensive industries in Ukraine are the mining and metallurgical complex, chemical industry, cement industry and mechanical engineering.

Metallurgy

Enterprises of the mining and metallurgical complex (MMC) in Ukraine are the largest producers of industrial output and, therefore, are the largest consumers of the energy sources.

The most important problem that has a systemic impact on the development of the MMC of Ukraine is highly (50–85%) worn-out fixed assets and the technological level of the Ukrainian MMC lagging behind the best global achievements. In Ukraine, 54% cock oven batteries, 89% blast furnaces, 87% open-hearth furnaces, 26% converters, and almost 90% rolling mills are operated excessively beyond their useful life, which leads to the extremely high energy intensity of production and low competitiveness of product.

The industry-wide energy consumption by the metallurgical complex has a clear growing tendency for certain types of products. This level of consumption by far exceeds the energy consumption of the foreign peers from the first distribution.

Thus energy-intensity of production of the pig iron in the Ukrainian industry in the first half of 2011 was 635.3 kg o.e./t , which is almost 33% higher than at the leading global companies, particularly, in EU countries this figure is 483.4 kg o.e./t, and in China – 477.4 kg o.e./t.

Natural gas accounts for a great portion of energy resources used for production of pig iron in Ukraine, whereas in leading countries of the world, natural gas is no longer used for smelting. These excessive energy intensity lead to lower competitiveness of the Ukrainian metal products and loss of a significant share of domestic and export markets.

In 2010 Ukrainian steel mills spent per ton of pig iron, on average:

- 76 m^3 of natural gas (almost not used in the world);
- 540 kg of coke (global figures are 350-450 kg, while at some mills, that use 170-200 kg PF, they use only 285-320 kg of coke);
- 18 kg of coal (the global average is 125-135 kg/t).

Such excessive consumption of energy sources may be explained by insufficient use of the technique of pulverized fuel (PF) at the blast furnaces in Ukraine. For comparison, the average consumption of pulverized fuel in Ukraine is 169 kg/t, in the EU – 104 kg/t, in China – 120 kg/t, and in Japan – near 130 kg/t.

To produce a ton of pig iron in Ukraine local companies spend over 600 kg of reducing agents for iron oxide. As a matter of fact, the global average figure is about 550 kg, while modern stoves require only 460-480 kg of these.

Ukraine also lags behind in the use of modern technologies in steel production. Almost 45.2% of the steel is smelted at the open-hearth furnaces, 51% – in the converters, and a negligible 3.8% in the electric ovens. Consumption of the fuel in the open-hearth steel production in Ukraine is 5 times higher than in the converter production. Under such conditions, the consumption of the natural gas increases 15 times.

According to the research data of the International Energy Agency (IEA), of all top world producers, Ukraine has the highest potential of energy saving per ton of steel – 9 GJ against the world's average of 4.1 GJ. However the existing domestic technologies that are used at each stage of steel production lag far behind modern world standards.

Ukraine is one of few countries that still use open-hearth method of steel production (26%). In terms of fuel consumption the open-hearth methods of steel production is very cost-intensive: one ton of steel production uses 75-85 m^3 of the natural gas vis-à-vis 4-5 m^3 in oxygen-converter production and its zero usage in the production of the electrical steel.

The overwhelming steel casting via ingots is an example of the inefficient production process of the Ukrainian steel-making enterprises. According to available estimates[1] the continuous steel casting (50% of all steel in Ukraine and 95% at the world cast at the CCM) is by 1.6 GJ/t more energy efficient than teeming via ingots.

[1] See. for example: M. Mazur, M. Bogatskaya, R. Olenich, A. Lopata «Influence of continuous casting technology on the environment/Black metal.» – 2003. - №12. – S.58-62.

So in terms of energy efficiency, taking out of the exploitation/replacement of the old equipment is the only possible scenario of development of the domestic steel industry in the mid-term. Practical dimension of these processes, expressed in the realization of action plan and volumes of production the particular product will depend on the market conditions and international competitive environment. Limitation of the open-hearth steel production and introduction of the continuous teeming in years to come will be the key areas for improved energy efficiency at the stage of production and further processing of steel.

Practically achievable reduction of total energy consumption in MMC is 338.3 ktoe by 2014, and 1,522.6 ktoe by 2020.

Chemical industry

Chemical industry of Ukraine plays an important role in widening of the consumer goods range, ensuring in-depth processing of the natural resources and raising productivity of the agricultural sector. The production structure of the chemical industry includes six nitrogen complexes: three producers of the complex fertilizers (two of them produce titanium dioxide), two producers of the polymers and one producer of the alumina (aluminum production). In addition, there are two operating soda factories, one producer of the synthetic fibers and fabrics and a range of the small manufactures (from 100 to 1,000 employees), working at the field of plastic processing and production of paint and varnishes.

Geographically, chemical industry operators are located in different regions, but major drivers of their location are concentration of and proximity to raw material, fuel and consumers. Thus, the portion of raw material in the cost of production varies from 45 to 90%. For example, production of one tone of acetylene or ammonia from coke takes about 5 tons of raw materials. Production of 1t of the chemical fibers takes up to 25 times more water than production of 1t of the pig iron. In many fields of the chemical industry there is a high demand for fuel and power. For example, production of 1t of phosphorous needs more than 20 thousand kWh of energy. Overall consumption of energy resources by all chemical industries constitutes 6152 ktoe. For comparison, the portion of energy in the production cost of chemical products manufactured by domestic producers is 30-40 % higher than in Europe. Administrative and general expenditures are higher by 25-35%. However the portion of labor in the cost of production is lower by 15-20%.The main raw material for some local chemical industry players is natural gas. Cost of natural gas accounts for 60% of the production cost of ammonium nitrate, whereas in Europe this figure is not more than 50%, with processing ratio indexes from gas to nitrate differing only by 1-2%.

At the same time, interchangeability of raw material in the nitrite industry is almost excluded, while the interchangeability of energy resources in Ukraine is quite common. Particularly, after replacement of gas compression for electric ones, the natural gas consumption ratio in ammonia production decreased at some plants from 1.17-1.20 to 0.91-0.92, which is evidence of the businesses' wiliness to optimize their power balance in order to reduce the consumption.

The main driver of the economic and technical development of the chemical industry is reduced energy intensity of the output (services, works).

It is important to note that the biggest material adverse outcome of the slump of production in chemical industry is the reduced load on the production facilities below the level of the current costs recoupment.

With the workload of facilities at most operational chemical plants at the level of 20-40%, the energy and raw material intensity of chemical output increases exponentially

To-date, actual energy consumption at most local chemical plants is higher than comparable figures for the leading state-of-the art technologies in the production of:

- ammonia – by 1.4 – 1.8 times;
- caustic soda – by 1.3 – 1.4 times;
- caustic ash – by 2.0 – 2.3 times;
- methanol – by 2.0 – 2.3 times;
- ethylene – by 2.8 – 3.0 times;
- carbon black – by 1.5 – 2.5 times.

Practically achievable reduction of total energy consumption in chemical industry constitutes 123.0 ktoe by 2014, and 558.6 ktoe by 2020.

Machine building industry

Machine building industry of Ukraine is one of the basic sectors of the market economy on which the achievements of innovative technological competitiveness of all types of economic activity depend.

Machine building industry comprises 365 industrial enterprises and 57 academic and research organizations (including 25 owned by the state), with total staff of over 233,000 people.

The growth pace of the machine building production was stable in recent years, and reaches 30 percent or more p.a.

The main components of the machine building industry are products of such sub-sectors as transport and power engineering, automotive industry and machine building for the petrochemical, chemical, metallurgical and mining industries, machine tool industry.

Only significant increase in the competitiveness of machine building products will allow meeting the needs in them in the volume of about UAH 4.7-5.1 billion in the domestic market, and UAH 12-14 billion in the external market.

The machine building complex of Ukraine includes the enterprises of general machine building and has heterogeneous structure. Available production capacities of the machine building industry are morally and physically outdated (70% of equipment is in operation for more than 15 years) and require major reconstruction and technical re-equipment.

Many enterprises require major reconstruction and technical re-equipment in order to create conditions for manufacturing of products with competitive technical and economic indicators.

Organizational and economic, scientific and technical potential of the enterprises requires an optimal structure, formation of closed macro-technological complexes important for the industry which would allow for effective competition in the global markets.

It should be noted that the machine building enterprises providing a complete cycle of technological production, including metallurgic, mechanical assembly and assembly production, are the largest consumers of boiler and furnace fuel used to produce heat and electricity in own CHPs (boiler houses) and in the industrial thermal and heating furnaces.

In the structure of FEC, industry occupies significant positions. For instance, during 2005-2008, its share ranged between 45-47% and only in 2009, in connection with the global financial crisis, it has decreased by nearly 41%.

During 2006-2007, the final consumption of fuel and energy resources by the Ukrainian industry (excluding non-energy consumption) grew by more than 10% and then decreased during the crisis by more than a quarter, and that was caused by a significant decrease in industrial production and especially the most energy-intensive industries.

According to the IEA, energy consumption in the industrial sector decreased by almost 30% compared to 2005. Basically, this is the result of the global financial and economic crisis, in connection with which industrial output significantly decreased. This also led to the situation when FEC structure in the industrial sector slightly changed. Due to increasing gas prices its share in the structure of final consumption decreased by 8.4%, while consumption of solid fuel and electricity increased by 4.5% and 5.2%, respectively.

During 2005-2009, the average annual gas consumption in the industry was about 11.1 billion m^3, electricity – 66.7 billion kWt/h, coal – about 12.6 million ton. The share of renewable energy sources, as in other sectors, is very small, while the potential is quite extensive, only industrial waste, solar and geothermal energy can be used effectively.

The main measures to be implemented in mining and metallurgical, machine building, and chemical industries include the following:

- Construction of top-pressure recovery turbines, use of excess pressure of blast- furnace gas for electricity production. Recovery of up to 40% of energy expended by blast-furnace blowing compressors. Overall, 11 units with capacity of 6.24 megawatt;
- Construction of waste heat recovery boilers to use the heat of discharge flue gas from heating furnaces of metallurgical units.
- Use of secondary energy resources, reconstruction of combined heat and power plants. Replacement of outdated boilers with modern ones, elimination of fuel losses and reduction of primary fuel (natural gas) consumption;
- Development of energy efficient and environmentally friendly technology of absorbing elastomeric material to be used for recycling petrochemicals and detoxifying the surface of water reservoirs from petrochemicals.
- Creation and utilization of «water-water» heat pumps with thermal capacity of 10, 20, 40, 80, 100, 150, 250 kW. Annual saving of 241.4 ktoe in case of manufacture of 100 heat pumps of each type;
- Developing and mastering the production of energy saving automated units for products drying based on infra-red and vacuum impulse technologies.

The volume of funding over 2012-2020 will total about UAH 89 933.4 mln, including:

- In MMC – UAH 58,222.75 mln.;
- In machine building industry – UAH 29,835.287 mln.;
- In chemical industry – UAH 1,875.348 mln.

Total volume of energy saving in 2020 will constitute about 2773.4 ktoe, specifically:

- In mining and metallurgical complex – 2274.1 ktoe, including in 2014 – 504,1 ktoe;
- In machine building industry – 221.8 ktoe, including in 2014 – 49,2 ktoe;
- In chemical industry – 277.3 ktoe, including in 2014 – 61,5 ktoe.

TRANSPORT

Ukraine has a developed infrastructure of railway and water transport. As to the length of its railway network, Ukraine ranks second in Europe (21,700 kilometers of railways), 18 sea ports are located in the Black sea, Azov sea and Danube river basins, the length of inland waterways of the largest European rivers Danube and Dnieper is 2,200 kilometers. The transit factor of Ukraine is among the highest in the world.

Geo-strategic position between the countries of Europe, Asia and the Middle East allows Ukraine to be an advantageous transit bridge for transportation of goods and passengers. The obstacle for this is insufficiently developed entire transport sector. In the presence of developed railway and water transport infrastructure, quality of transportation services, regularity of traffic, speed and preservation of goods prevent the use of this infrastructure in full and effectively. In addition, significant improvements are required for transportation safety, energy efficiency indicators, technological burden on the environment, etc.

In recent years, there was a significant increase in transportation of both freight and passengers. Over this period, freight turnover increased on average by 14% a year and passenger turnover – by more than 4%. However, in 2009, freight and passenger turnover reduced by about 10% compared to 2008.

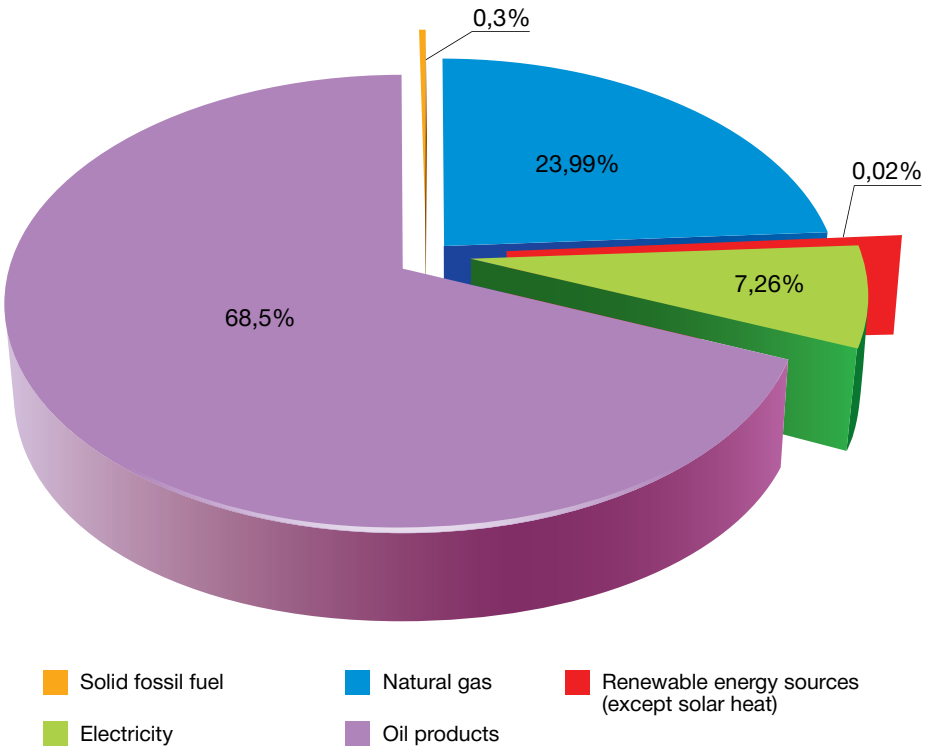
As of 2009, the number of motor vehicles that are registered with the traffic police is 8.422 million. Among them, those running only on gasoline are 78.7%, diesel – 16.0%, liquefied petroleum gas – 1.1%, pressurized gas – 0.5%. The share of transport that uses combined gas and petrol or diesel was not more than 3.7% in 2009.

According to the State Railway Transport Administration «Ukrzaliznytsia», the railway rolling stock at the end of 2009 included: 2,545 diesel locomotives, 1,860 electric locomotives, 52 steam locomotives, 326 diesel link-ups, 1,589 electric train link-ups, 124,910 freight cars, 7,444 passenger cars. Rolling stock of the public electric transport consisted in 2009 of 1,035 metro cars, 4,064 trolleybuses and 2,621trams.

Freight and passenger water (sea and river) transportation was growing in recent years only in 2006. After 2006, the freight turnover dropped by more than half, and passenger turnover – by more than 17%.

Annual average freight and passenger air transportation amounted in recent years to 16,544 t and 3.146 million people, respectively. The crisis had impact on both the freight and passenger transportation by air, but the indicators in 2009 were higher than in 2007.

According to IEA, the share of transport sector (including pipelines) in the structure of FEC increased from 16.6% to 17.1% and amounted on average to 11.9 million toe, where the share of crude oil was 68%. Without taking into account the pipelines and elements of infrastructure not included in other categories, the share of the transport sector in the final consumption increased by 10.3%, from 8.7 million toe to 7.8 million toe.



Structure of Fuel and Energy Consumption in the Transport Sector

Attention should be drawn to increased consumption in land transport, mainly, consumption of petroleum gas, which can be explained by low cost of machine operation, as price of this gas is 50-60% lower than the cost of gasoline. Growth in gas consumption will be observed in the future in connection with gas propane-butane which is used for the cars, and is a combination of two types of gas that are produced at the plants during oil processing.

The main measures to be implemented in railway, motor, maritime, and river transport include the following:

- ensuring restructuring of the transport infrastructure in accordance with the needs of production and social sphere;

- technical and technological modernization of the fixed assets of transport based on the achievements of scientific and technological progress, wide implementation of modern innovative technologies and equipment;

- optimization of the structure of rolling stock aimed at improvement of passenger and freight traffic efficiency;

- improvement of performance indicator of the transport routes;

- increased energy efficiency in the use of vehicles through modernization of the rolling stock, improvement of the transportation process technologies, efficient use of the locomotives, introduction of the energy saving rolling stock in transport;

- improvement of efficiency of the rolling stock and associated equipment operation, optimization of the transport technologies;

- creation of incentives for broader use of the renewable energy sources and alternative fuels in the mobile and stationary transport and communication objects, taking into account the resources available locally and reduction of natural gas consumption due to implementation of these measures;

- creation of the incentives for energy efficiency of motor transport, according to the European norms, use of alternative motor fuels;

- use of modern and modernized means of telecommunication, TV and radio broadcasting, communications, postal equipment and transport;

- introduction of optimal heating modes for the premises and structures, use of effective insulating materials in construction of the new and major renovation of the existing objects of transport and communication, with the use of domestic products;

- introduction in the subordinated public organizations and institutions of instrumental metering of electricity, natural gas, heat energy, cold and hot water, replacement of lighting fixtures with the energy saving ones, mainly of domestic production;

- consideration in development of action plans on reduction of natural gas consumption for heating of the necessity to extend implementation of the individual heat sub-stations in the heating systems, energy accumulating systems of electric heating with the means of differential (hourly) electricity metering for use during the night minimum load of the energy system, heating systems running on renewable sources of energy and local fuels;

- broad introduction of digital broadcasting, extension of the network of customers by reducing the analog equipment;

- creation of a section of public digital broadcasting network and conditions for further digitalization of telecommunication systems; and

- development of the communications infrastructure with the use of modern equipment from domestic producers.

The volume of funding over 2012-2020 will total about UAH 152 735,79 mln, including:

- railway transport – UAH 94,696.2 mln.;

- motor/highway transport – UAH 41,238.66 mln.;

- maritime and river transport – UAH 16,800.93 mln.

Total volume of energy saving in 2020 will constitute about 1056,5 ktoe, including 234,7 ktoe in 2014.

FINANCIAL LEVERAGES OF THE NEEAP IMPLEMENTATION

Ukraine, as one of the most industrialized countries and the eastern EU partners, is looking for the ways of developing the innovative energy efficient technologies.

IFIs' resources may be an important source of ensuring the NEEAP implementation, a tool of institutional reform and international integration.

Considering importance of the above, and in order to improve energy efficiency, the State Agency for Energy Efficiency of Ukraine expands cooperation with the following IFIs:

The Eastern Europe Energy Efficiency and Environmental Partnership Fund («E5P») (Swedish Initiative).

The Fund's aim is to coordinate effective provision of financial assistance by raising grant funding by such institutions as EBRD and others, to implement and support important energy efficiency and environmental projects, which will lead to higher energy efficiency, reduced CO_2 and other greenhouse gases emissions.

As of late February 2012, the Fund has mobilized approximately 52 million EUR of the 91.8 million EUR committed at the last meeting of the Donor Assembly.

The Fund provides direct investments in energy efficiency, including, inter alia, central heating installations and power generation facilities, as well as more efficient delivery of heat and energy. The initiative also stipulates Ukraine's long-term commitment to reform national energy sector - together with donors and international financial institutions.

On April 21, 2011 at the founding meeting of the E5P's Coordination Group, the Agency presented for consideration by the Coordination Group a portfolio of projects listed in the Register of projects that received pre-approval of the Agency (NAER order of 17.04.07 No. 59, registered with the Ministry of Justice of Ukraine of 07.05.07, No. 462/13729) to be examined for further implementation with the use of grant funds from the Foundation.

On November 10 and 11, 2011 Ukraine's delegation headed by M.A.Pashkevych, the Head of the Agency, took part in the first session of the Assembly of Donors of the Eastern European Partnership for Energy Efficiency and Environment (E5P) Fund, which took place in London (UK).

Participants of the meeting discussed and approved 7 projects for Ukraine with the purpose of funding them as part of the Swedish Initiative for a total cost of EUR 31 million (Table 1.5).

Табл. 1.5. Funding under the Swedish Initiative

№	Project	MFO	Amount of investments, mln. EUR	Credit. mln. EUR	Grant, mln. EUR	Approved
1	Upgrade of the water supply and wastewater system (Mykolayiv), approved after the first meeting of the Coordination Group	EIB	40	15,54	5,1	√
2	Technical assistance in energy efficiency, households	EBRD	1	-	-	√
3	Technical assistance in energy efficiency, utility buildings	EBRD	3	-	-	√
4	Upgrade of the central heating system (Zhytomyr)	EBRD	16	10	5	√
5	DemoUkraine. Investing in energy efficiency of medium-sized municipalities	NEFCO	14,5	4	0,5	√
6	Rehabilitation of the central heating system (boilers in Soshenko and Makarova streets of Teplotranservis Company (Rivne)	NEFCO	2,75	2	0,5	√
7	Central heating system (Ternopil)	EBRD	16,1	10	5	√
8	Energy efficiency project (Zaporizhya)	EBRD	18,6	13	5	√
9	Project of HPS upgrade (Lviv)	EBRD	31	21	10	√
	Total amount approved by the Donor Assembly		**142,95**	**75,54**	**31**	√

The World Bank

The World Bank Group is a multilateral lending institution consisting of five agencies, with a mission to improve people's lives in developing countries by providing loans, guarantees and analytical and advisory services. Established in 1944, the World Bank is headquartered in Washington, D.C. The World Bank Group consists of five organizations:

- The International Bank for Reconstruction and Development (IBRD);
- The International Development Association (IDA);
- The International Finance Corporation (IFC);
- The Multilateral Investment Guarantee Agency (MIGA);
- The International Centre for Settlement of Investment Disputes (ICSID).

The World Bank is a vital source of financial and technical assistance to developing countries around the world.

The development objective of the Energy Efficiency Project is 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.

The project includes Ukreximbank that has a successful track record of lending to industrial companies for energy efficiency projects under a parallel credit line provided by the European Bank for Reconstruction and Development (EBRD).

As part of cooperation between Ukraine and the World Bank the Guarantee Agreement between Ukraine and IBRD was signed on June 10, and ratified by the Law of Ukraine on 4 October 2011 #3812-VI. Public JSC Ukreximbank is the main administrator of the project funds.

The Nordic Environment Finance Corporation (NEFCO)

The Nordic Environment Finance Corporation (NEFCO) is an international finance institution established in 1990 by the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. To date, NEFCO has financed a wide range of environmental projects in Central and Eastern European countries, including Russia, Belarus and Ukraine.

NEFCO's activities, coordinated from its headquarters in Helsinki, are focused on projects that achieve cost-effective environmental benefits across the region. NEFCO prioritizes projects that reduce releases of climate gases, improve the ecological status of the Baltic Sea or mitigate release of toxic pollutants.

NEFCO's investment portfolio currently comprises nearly 400 small and medium-sized projects spread across various sectors, such as chemicals and food, agriculture, energy and utilities sector, the use of mineral resources, metal products and other industries, reliant on wastewater treatment, waste management, engineering, reduction of radioactive pollution, environmental management, and production of environmental equipment.

Using a variety of financial mechanisms NEFCO administers a range of different funds for a variety of projects. The most significant of these mechanisms are: the Investment Fund, Nordic Environmental Development Fund, the Baltic Sea Region Testing Ground Facility (TGF), the NEFCO Carbon Fund (NeCF), the Barents Hot Spots Facility (BHSF). NEFCO administers several special purpose funds on behalf of different donors, including the European Commission and governments of the Nordic countries, which provide financial resources for the implementation of environmentally significant projects.

Usually NEFCO works with project «owners». Direct investments use various arrangements of public and private cooperation, i.e. communal entities. Each project supported by NEFCO, requires a reasonable risk/benefit ratio for all stakeholders and a transparent investment structure and environmental performance. Considering the situation in the context of related risks, NEFCO always strives to offer competitive terms.

Soft loans are offered to the enterprises and companies of all types of ownership, and public utility organizations that implement projects aligned with NEFCO's priorities in achieving environmental benefits.

Using its extensive partner network, NEFCO engages other stakeholders and financial institutions to participation in the projects. Also, NEFCO is an active participant of bilateral environmental programs.

Ukraine cooperates with NEFCO in order to attract investment for joint EE projects in housing, communal and social sectors.

As part of this cooperation, a Coordination meeting with representatives of the Agency and NEFCO was held on October 19, 2011 to coordinate the principles of cooperation.

Currently, with support of the Agency, NEFCO is getting prepared to enter into agreements with 10 Ukrainian cities whereby it will lend money to the cities to implement projects in the areas of energy efficiency, energy conservation and development of renewable energy.

Eligibility Criteria include significant and measurable benefits from reduced heat losses in the utilities networks of social facilities (schools, kindergartens, hospitals and others.

Implementation of energy efficiency measures in residential, public services, industry and transport sectors will make it possible:

- to achieve energy saving in 2020 at the level of 9% from average final energy consumption, specifically – 6283 ktoe;
- to reduce energy intensity of product unit production, fulfillment of works, and provision of services by 9% from the level of 2012;
- to reduce the level of heat energy losses in public and residential buildings by 50% from the level of 2012;
- to reduce average specific annual energy consumption by the housing stock of Ukraine and bring it in line with the EU norms and standards;
- to reduce by 15-20% the volume of natural resources usage (through decreased consumption of fuel and energy resources);
- to secure the decrease of pollutant emission by 15-20%;
- to improve the level public utility services provided to the Ukrainian public at large.

Tabulated summary of the NEEAP measures implementation

№	The scope of economic activity in which the measures of NEEAP are implemented	Expected savings in 2014, thousand toe	Expected savings in 2020, thousand toe	Responsible executive	Overall funding for the period of 2012-2020 billion UAH	Source of funding
1	Population: residential buildings	511	2303,9	Ministry of regional development, construction and housing and communal services of Ukraine	670	investments
2	Sector of public services: public and commercial buildings	23,2	104,4		144,5	investments
3	Industry	615,1	2773,4	Ministry of Industry	89	investments
4	Transportation	234,7	1056,5	Ministry of Infrastructure	107,8	investments
Total		**1384**	**6283,3**		**1011,3**	**investments**

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Держенергоефективності України