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HEAT AND HOT WATER FROM AMBIENT ENERGY
FOR YOUR FAMILY



HEAT PUMPS

FOR YOUR FAMILY AND COMMUNITY

Do you want to save on utilities? Are you wondering how and what to use to heat your house? Do you want to become more energy independent?

An interesting solution may be to install a heat pump.

Benefits for using heat pumps for the family and community:

- ◆ covers all own needs in heating, cooling and hot water
- ◆ works during cold seasons;
- ◆ allows to be autonomous and independent from the gas supplier and change in tariffs;
- ◆ provides high level of automation and comfort as well as modern design;
- ◆ saves money on utility bills;



WHAT IS A HEAT PUMP AND HOW DOES IT WORK?

A heat pump is a device that is used for heating and cooling of premises as well as for hot water supply. The principle of operation of the device is similar to the operation of an air conditioner or refrigerator: any household refrigerator is a heat pump, because it takes heat from inside the chamber and dissipates it outside. In turn, the heat pump converts the energy of a low-temperature environment into heat and transfers it to a higher-temperature object or environment.

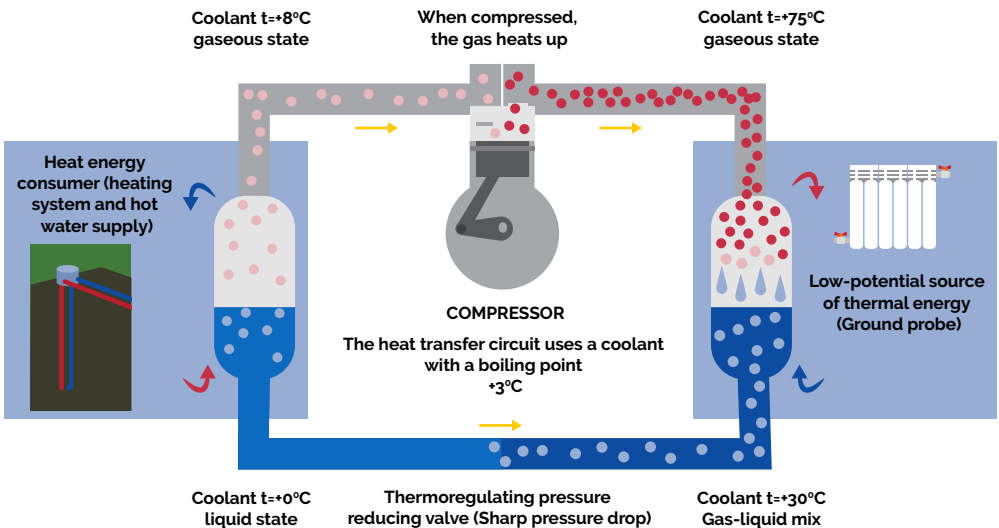
In the cold season, the heat pump transfers thermal energy to the premises and water heating system, taking it from the environment and concentrating. In spring and summer, heat from the premises of the house is accumulated and transferred by heat pumps to the outside, cooling the air in the house. Commercial heat pumps can operate at outdoor air temperatures down to -20°C and provide warm water in a range between 35°C and 65°C , depending on the system design and the heat source temperature.

Heat pumps use mostly renewable sources to heat premises and water, as they draw thermal energy from air, water or ground, which in turn are warmed up by the sun throughout the day or year. At their best, they can use as much as 80% of renewable energy, while the remaining 20% of premises heating and hot water supply are provided by the electricity feeding the heat pump. In this case, the Coefficient of Performance of the heat pump - the ratio between the total thermal energy generated by the heat pump and electricity consumed by the heat pump - equals 5.



Heat pump's operation chart

The operation of heat pumps is based on the process of heat release from the environment, for example from the soil (which has a temperature of about 8°C), through heat exchange between three contours:



A general scheme of operation of a heat pump is presented in the figure:

1. earth contour;
2. heat pump contour;
3. heating contour.

A heat pump is a device inside of which the temperature is converted from $+8^{\circ}\text{C}$ to $+75^{\circ}\text{C}$.

Depending on a heat source, there are several types of heat pumps:



Air-source heat pumps

Use cold air as a source of heat. Such heat pumps usually have an external unit, that captures heat from the air. In addition to this, an internal unit that contains main hydraulic components (a hot water storage tank and electronics needed to manage the system) is normally installed in a technical room.

Disadvantage of the air-source heat pump:

In the coldest days, when outdoor temperatures drop below -10°C , the heat pump cannot supply the heating system with water warmer than $50\text{--}55^{\circ}\text{C}$: during the coldest days of the year, this could be insufficient in poorly insulated houses which use old radiators.

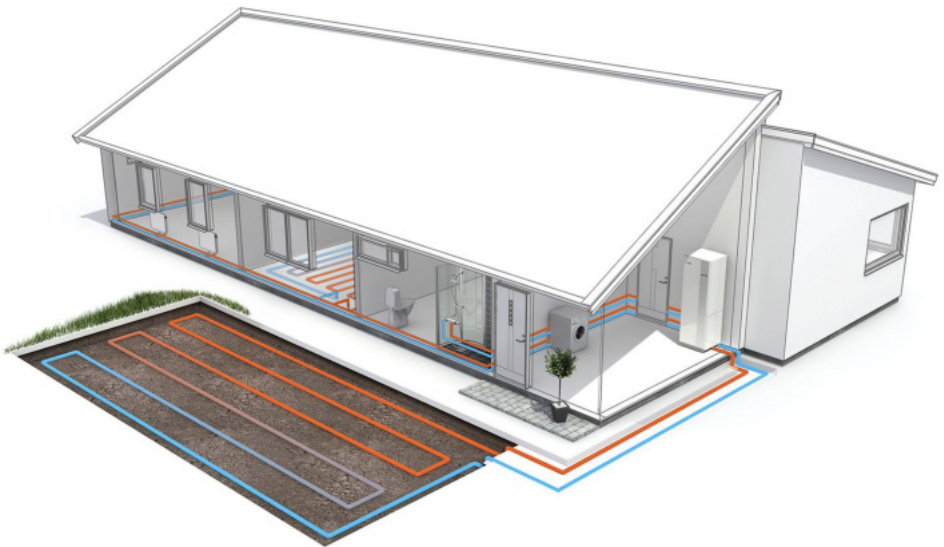
This is the reason why air-source heat pump systems are best adapted to houses with good insulation and low-temperature under-floor heating.



Ground-to-water heat pumps

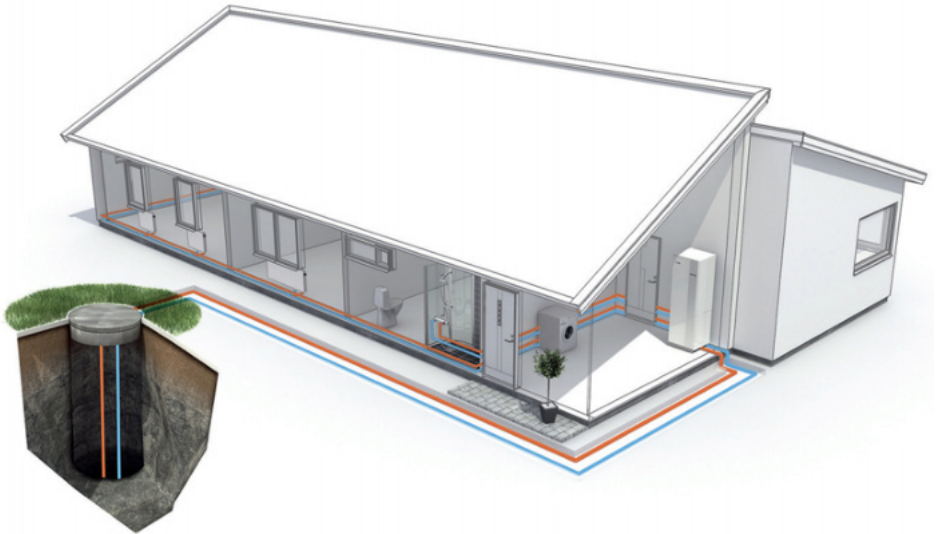
They are very similar to the previous ones with respect to their indoor components. The external unit, however, is replaced by a pipe embedded under a layer of soil, in which water circulates, that is kept warm by heat from the soil.

When the pipe is located horizontally, usually 2 to 5 meters deep under ground, it is called a "horizontal geothermal field" (requires a large area for the soil collector).



Most ground-to-water heat pumps use vertical pipes to generate energy from the ground. "Vertical geothermal fields" consist of long pipes installed in wells, which usually reach a depth of 100–150 m (in some cases up to 200 m deep). Depending on characteristics of soil, a family house may require from 1 to 3 wells and the same number of pipes at a distance of about 10 m between them. In this case, the ground area is much smaller than in the previous one, but the drilling process is longer and more expensive.

The main advantage is that the soil temperature is relatively independent of the temperature fluctuations of the outside air, therefore, it remains quite stable throughout the day and year, which allows to achieve high efficiency (about 3) even in the worst weather conditions.



Heat pump systems can also use water from wells. In this case it is sufficient to drill a well close to the building. This is a far cheaper solution compared to ground source heat pump systems, since drilling costs are much lower.

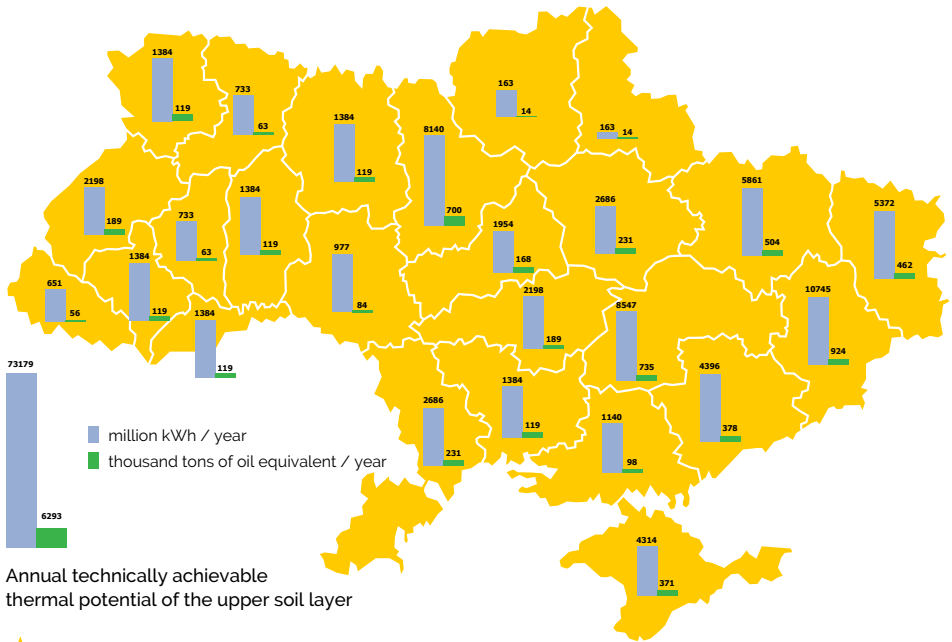
Furthermore, in this case, the heat source temperature is quite stable over the year (around 5 to 15°C) and does not depend on weather conditions.

Ground waters, however, are not always available and special permits might be required in order to be able to use this source.





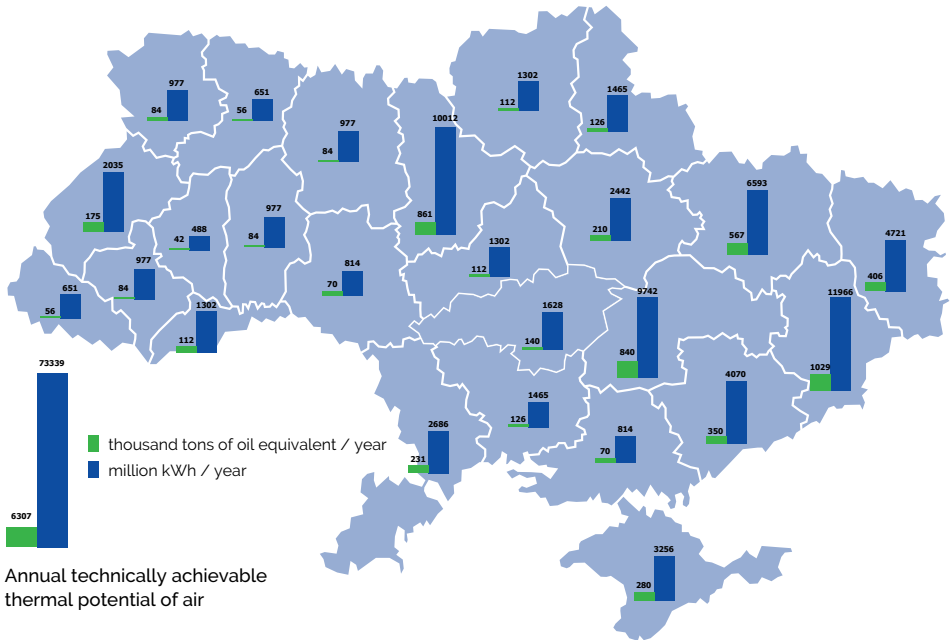
Energy potential of the upper layer of soil in Ukraine



Annual technically achievable thermal potential of the upper soil layer



Energy potential of air in Ukraine



Annual technically achievable thermal potential of air



How much can I save thanks to a heat pump?

Let's take a look at investment costs and savings on heating when using a heat pump (air or ground (geothermal) one).

In the first example, a heat pump is installed in a 150 m² **house** in Kyiv where only one family lives. The heating demand is 100 kWh/m², while the hot water demand of the house is 25 kWh/m², which corresponds to a total heating demand of approximately 16 Gcal (18,500 MWh) per year. Radiators are used for heating of premises.

A 15-kW heat pump is equipped with a 5-kW electric device (additional heater) to cover peak loads. To meet this need in the traditional way, one would need a 25-kW gas boiler.

Indicators	Gas boiler	Heat pump Air-source	Heat pump Ground-source
Technical parameters:			
● Installed capacity, kW	25	15 (+ 5 запасу)	15 (+ 5 запасу)
● Boiler conversion efficiency, %	92	—	—
● Heat pump CoP (including HP efficiency and backup electric device)	—	2,3	2,5
● Calorific value of natural gas - MWh/thou m ³	9,3	—	—
● Natural gas consumption – m ³ /y MWh/y	2000	—	—
● Electricity consumption – thousand kWh/y	—	8,4	8,0
Economic parameters:			
● Residential price (tariff) for fuel (electricity)			
– natural gas - UAH/thou m ³	7 274	—	—
– electricity (up to 3 MWh per month) - UAH/kWh	—	0,90	0,90
– day tariff (100%)	—	0,45	0,45
– night tariff (50%)	—	—	—
● Seasonal heating expenditures, including			
– Natural gas, UAH/y	14 500	—	—
– Electricity, UAH/y	—	7 560	7 200
– Electricity including benefits, UAH/y	—	5 670	5 400
● Savings from the use of a heat pump, UAH/y	—	8 880	9 150
● Cost of equipment, UAH, including	60 000	180 000	450 000
– Cost of a heat pump, UAH	52 200	155 000	370 000
– delivery and installation costs, UAH	7 800	25 000	80 000

In the first example, a heat pump is installed in a 150 m² **newly built insulated house** in Kyiv where only one family lives. The heating demand is 50 kWh/m², while the hot water demand of the house is 25 kWh/m², which corresponds to a total heating demand of approximately 9,7 Gcal (18,500 MWh) per year. Low-temperature underfloor heating system is used for heating of premises.

A 15-kW heat pump is equipped with a 5-kW electric device (additional heater) to cover peak loads. To meet this need in the traditional way, one would need a 25-kW gas boiler.

Indicators	Gas boiler	Heat pump Air-source	Heat pump Ground-source
Technical parameters:			
● Installed capacity, kW	25	15 (+ 5 запасу)	10 (+ 5 запасу)
● Boiler conversion efficiency, %	92	—	—
● Heat pump CoP (including HP efficiency and backup electric device)	—	2,8	3,2
● Calorific value of natural gas - MWh/thou m ³	9,3	—	—
● Natural gas consumption – m ³ /y MWh/y	1300	—	—
● Electricity consumption – thousand kWh/y	12,2	4,0	3,5
Economic parameters:			
● Residential price (tariff) for fuel (electricity)			
– natural gas - UAH/thou m ³	7 274	—	—
– electricity (up to 3 MWh per month) - UAH/kWh	—	—	—
– day tariff (100%)	—	0,90	0,90
– night tariff (50%)	—	0,45	0,45
● Seasonal heating expenditures, including			
– Natural gas, UAH/y	9 500	—	—
– Electricity, UAH/y	—	3600	3100
– Electricity including benefits, UAH/y	—	2700	2325
● Savings from the use of a heat pump, UAH/y	—	6 800	7 175
● Cost of equipment, UAH, including	60 000	120 000	300 000
– Cost of a heat pump, UAH	52 200	104 000	260 000
– delivery and installation costs, UAH	7 800	16 000	40 000

✦ WHAT SHOULD I DO TO INSTALL A HEAT PUMP? 10 SOUND RECOMMENDATIONS

Note! For private households, heat pump installation works are not regulated and do not require certification or any other additional permits.

01

Before installing a heat pump, it is worth conducting an energy audit and raising the level of energy efficiency of the house (installation of meters, insulation, etc.).

02

Make sure that the temperature of supply of heat into the heating system in the rooms has been reduced as much as possible by means of a suitable monitoring and control system

03

Give preference to the underfloor heating systems, also for walls and ceilings

04

Pick a service company or a specialist with experience in designing heat pump systems

05

Make sure that the service company designs and places the heat pump system, taking into account the daily needs of the house for premises and water heating, as well as climatic conditions of the region

06

Make sure that the calculated overall efficiency values for the heat pump system (not only the heat pump itself) over a year of operation are in line with measured data (see tables above).

07

Pick a service company or specialist who will install the heat pump, with proven experience in creating such systems. Most accredited manufacturers train local professionals to provide high quality and durability of installed systems.

08

Install the monitoring system and configure it to obtain the required amount of data on electricity consumption of the heat pump and heat production for the house

09

Make sure that the monitoring system provides such performance figures as daily, weekly and monthly consumption of electricity and thermal energy, and CoP of the installed system.

10

Check the performance figures weekly; react promptly if they are not in line with the initial calculations and contact equipment installer and the company that designed the system. To this end, it is advisable to sign a maintenance contract that provides for a guarantee of system operation in the first years after commissioning.



← CO-FINANCING PROGRAMS FOR SUCH INSTALLATIONS

Given the innovative nature of technologies and the still small market, the cost of installing a heat pump may be higher compared to the use of, for example, natural gas boilers. However, various support programs are being implemented to help households cope with the financial burden.

Effective support to implementation of energy efficiency projects and solutions can be provided by a state/local program, fund, programs of international organizations, banking institutions, etc.

For example, the Energy Efficiency Fund has been established in Ukraine. The Fund (<https://eefund.org.ua>) provides grants and introduces comprehensive technical solutions for energy efficiency of buildings, taking into account the best European practices. As a result, the co-owners of such buildings will be able not only to save money on utilities but also increase the level of comfort and quality of life.

One can also ask local support programs when planning energy efficiency measures or using renewable sources. Does such a program work in your city, district, region? Find out the details here:



IN REGIONAL STATE ADMINISTRATIONS



ON THE MAP OF LOCAL PROGRAMS



In addition, some banks in Ukraine also offer programs for financing energy-efficient equipment and RES technologies.



Eco-trend at the Hrinchenko University

In the summer of 2018, 3 Octopus IS 120 heat pumps and solar panels were installed in the educational building of the Kyiv Borys Hrinchenko University within the framework of the project "Overhaul of the hot water supply system using alternative and renewable energy sources".

*In 2019, as a part of the same project, heat pumps and solar panels were installed in the dormitory, and a solar station was also installed at the university college.
It allowed:*

- ✦ *to obtain an autonomous source of thermal energy for water heating in the hot water supply system, which ensures uninterrupted use of hot water regardless of the state of the district heating networks (repairs, accidents, etc.);*
- ✦ *to reduce the load on the district heating networks;*
- ✦ *to obtain an economic effect of more than 400 thousand UAH per year in relation to municipal heat networks due to the efficiency of Octopus heat pumps, - as a result, the payback period of the investment is less than 4.5 years;*
- ✦ *to put into operation 3 solar power plants with a capacity of 10.6 kW each (total capacity is 32.4 kW);*
- ✦ *to pay 1.8 times lower price for the generated thermal energy than the price for the energy received from the district heating system (excluding the cost of equipment and work performed).*





Nataliia Frolova

Kyiv oblast

«I am happy to share my own story of the transition to “clean” energy. In 2009, we installed a heat pump with a regulated thermal capacity of 4.5-18 kW to heat our 360 m² house. Having analysed the geology of the area, six 60-meters-deep wells were drilled. Since then, thanks to the pump, we have started to use the energy of the earth. The maximum temperature in the system of a heat-insulated floor and walls reaches 35°C. In summer, the wells provide comfortable cooling through a system of fan coils (with a temperature of + 8 - 14C).

In addition, the rooms have a remote thermostat with which we remotely choose a comfortable temperature and save energy.

Also, having a heat pump, we always have hot water. The heater tank holds 300 liters of water, and its temperature is 50-55C.

Talking about savings, in winter we consume 1600-1800 kWh of electricity per month and spend about 720-810 UAH, respectively (tariff in 2015 was 0.45 UAH/kWh). In summer, when it is warm, the expenditures are much lower.

Therefore, a heat pump is a safe, environmentally friendly and cost-effective solution. And underfloor heating and hot water provide the desired comfort for families and children throughout the year».





USEFUL SOURCES OF INFORMATION

If you are interested in the use of clean energy sources and energy efficient technologies, you can also contact the following agencies and organizations:



State Agency on Energy Efficiency and Energy Saving of Ukraine

State Agency on Energy Efficiency and Energy Saving of Ukraine

Contacts: +38 (044) 590-54-09 +38 (044) 590-59-60

E-mail: saee@sae.gov.ua vde@sae.gov.ua

We are in social media:
<https://www.facebook.com/saeEU>
https://twitter.com/SAEE_Ukraine
https://t.me/SAEE_UA



→ UA MAP



an Interactive Investment Map of Renewable Energy and Energy Efficiency Projects in Ukraine

<https://uamap.org.ua>
uamap@sae.gov.ua

→ Learn more information on "clean" energy use contacting relevant regional state administrations:

<http://sae.gov.ua/uk/content/regional-contacts>

→ Organization «Global 100% RE Ukraine»

info@100re.org.ua <https://100re.org.ua>
<https://www.facebook.com/100REUA>

→ Фонд енергоефективності

+38 044 222-95-90 info@eefund.org.ua
<https://eefund.org.ua>

→ The National Commission for State Regulation of Energy and Public Utilities

box@nerc.gov.ua <https://www.nerc.gov.ua>
<https://www.facebook.com/nerc.gov.ua>

→ Ukrainian National Heat Pump Association

+38 (044)-227-59-50 info@unhpa.com.ua
<http://www.unhpa.com.ua>

→ European Heat Pump Association

<https://www.ehpa.org>

→ Institute of Renewable Energy of the National Academy of Sciences of Ukraine

+38 (044) 206-28-09 info@ive.org.ua
<http://www.ive.org.ua/renewable@ukr.net>

There are numerous portals on the Internet where you can also find certain needed information, including:

→ Heat pump energy efficiency calculator:

<https://freenergy.com.ua/economy/>

→ «In the capital, McDonald's has installed a heat pump and energy-efficient windows»:

[https://ecotown.com.ua/news/Stolychnyy-MakDonal-z-vstanovyv-teplovyv-nasos-ta-enerhoefektyvni-vikna-/](https://ecotown.com.ua/news/Stolychnyy-MakDonal-z-vstanovyv-teplovyv-nasos-ta-enerhoefektyvni-vikna/)

→ «A heat pump has been providing heating and hot water at OKKO petrol stations near Lviv for 5 years in a row»:

<https://elementum.com.ua/blog/teplovyv-nasos-heliotherm-okko/>

→ «Barvichata» are provided with heat»:

https://zhovkva-rada.gov.ua/no_cache/informacija-dlja-gromadjan/novini-mista/novina/article/barvinchata-u-tepli.html

→ «The Swedish boiler house operates in the village school of Velykoandrusivska amalgamated community in Kirovohrad oblast»:

<https://auc.org.ua/uspilny/shvedska-kotelna-pracyuye-u-silskiy-shkoli-velykoandrusivskoyi-otg-na-kirovogradshchyni-video>

→ «Rava-Ruska saves money»:

<https://www.youtube.com/watch?v=3bH1MoWS77o>



Be energy efficient and energy independent!

Use CLEAN energy!



↳ THIS PROJECT IS FUNDED BY THE EUROPEAN UNION



*State Agency on Energy Efficiency
and Energy Saving of Ukraine*



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