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FINAL REPORT

ASSESSMENT OF INDIVIDUAL HEAT SUBSTATION (IHS) INSTALLATION PRACTICES AND EFFICIENCY IN UKRAINE

USAID Energy Security Project (ESP)

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REPORT AUTHORS:

Andrii Levkoniuk

Diana Kasparova

Ukrainian Technology Alliance (UTA)

USAID/ Ukraine
Sukru Bogut
Contracting Officer's Representative
4 Ihoria Sikorskoho St.,
Kyiv, 04112, Ukraine
sbogut@usaid.gov

USAID Energy Security Project
Tetra Tech ES, Inc., a contractor for USAID
Michael Trainor
Chief of Party
5th floor, 14A Yaroslaviv Val St.,
Kyiv, 01030, Ukraine
mike.trainor@tetratech.com

1320 North Courthouse Road:
Suite 600
Arlington County, Virginia 22201
Tel.: +1-703-387-2990
www.tetratech.com

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ACRONYMS

Minregion	Ministry for Communities and Territories Development of Ukraine
DHI	District Heating Infrastructure
DHS	District Heat Supply
DH	District Heating
IFI	International Financial Institution
NEURC/ Regulator	National Energy and Utilities Regulatory Commission
DHC	District Heating Company
HOA	Homeowners' Association
HCC	Housing Construction Cooperative
ESP	USAID Energy Security Project
HWS	Hot Water Supply
CU	Communal Utility
LG	Local Governemnt
EBRD	European Bank for Reconstruction and Development
NEFCO	Nordic Environment FinanceSCU Corporation
USAID	U.S. Agency for International Development
CA	Common Areas

Note: at the moment - at the time of Report preparation

1. EXECUTIVE SUMMARY

The purpose of the assessment is to inform readers about practical obstacles to the installation of individual heat substations (IHSs) in residential buildings in Ukraine and to share comprehensive details about the experiences of parties who have already installed IHSs and maintain those substations. It also draws conclusions and recommends ways to promote more widespread IHS installation in Ukraine based on information received from several stakeholder groups.

The assessment of IHS installation practices covers the Ukrainian cities below.

The chosen cities represent **different approaches to IHS installation projects, diverse funding sources, and a variety of approaches to housing management**.

In addition, we used information from our experience in the sector regarding other cities (Ternopil, Chernivtsi, Kherson, Mykolaiv, Lviv, Vyshneve, and others) to demonstrate specific aspects of the survey objective.

The findings of the social survey under the World Bank–financed Ukraine District Heating Energy Efficiency Project (UDHEEP) were used where relevant.

The information obtained from each of the stakeholders included in the assessment can be summarized as follows:

Representatives of local self-government bodies

Overall, representatives of local self-government bodies from each city **show positive attitudes toward the mass-scale installation of IHSs in their cities**.

They usually do not have a firm opinion of how this should be carried out in their city (at a massive scale) and tend to believe the initiative should come from the state (by creating suitable programs, financed by the Government of Ukraine) or the consumers themselves.

Representatives in each city **have diverging views as to who shall be the owner of IHSs that are installed in multi-family buildings**. For instance, representatives from the city of Lutsk believe that the local district heating (DH) company should own the IHSs. Lutsk's local DH company (State Utility Company Lutskteplo) is currently engaged in a large project to install IHSs in Lutsk, financed by the European Bank for Reconstruction and Development (EBRD). Hence, local self-government bodies in Lutsk consider it to be logical for that company to own and maintain the IHSs.

Representatives of local self-government bodies in Mariupol believe that homeowners' associations (HOAs) should be the owners of installed IHSs and choose the party responsible for maintaining them and controlling temperature regimes. Of note, they strongly support HOAs in the city and their initiative to improve energy efficiency in buildings. Representatives in Kharkiv are also inclined to think that HOAs should own the IHSs.

Representatives in Kharkiv and Poltava do not have a clear judgement as to who should own IHSs and who should maintain them and control temperature regimes.

Representatives in Poltava city do not have a vision of who should own IHSs in multi-family buildings, although they tend to think it should not be the local DH company (Regional communal production enterprise Poltavateploenerho).

In general, representatives of local self-government bodies from each city claim they are ready to support initiatives aimed at mass-scale installation of IHS in multi-family buildings in their cities, although they are waiting for a certain program or project financed by the government or other funding source.

Representatives of local self-government bodies indicate that **lack of funds is the main obstacle to mass-scale installation of IHSs**. These bodies **do not fund the installation of IHSs in their cities at the moment and do not have plans to do so in the near future**. The exception is the self-government

	body in Mariupol, which provides partial funding within the framework of programs like Tepli Kredyty or Energodim.
Representatives of DH companies	 Almost every DH company from each city considers mass-scale installation of IHSs to be beneficial and necessary for consumers as well as for efficient operations within the DH company.  However, they indicate certain technical issues that may arise during mass-scale installation of IHSs and should be resolved beforehand, such as the conditions of basements in buildings, the condition of the DH system in the city, the fact that the current heat supply scheme of their city does not envisage the mass-scale installation of IHSs, the level of thermal modernization inside each building, and so on. Representatives of DH companies from each city have a more-or-less clear understanding of the necessity of IHSs in multi-family buildings as well as their benefits in terms of cost savings for heat consumption. In practice, local DH companies **do not fund IHS installation in multi-family buildings in their cities because they do not have the available funds in the first place**. It is rare that a DH company funds the installation of IHSs in multi-family buildings (such cases were found in Mariupol and Poltava). Different DH companies have different views regarding the party that should be responsible for installation, maintenance, and control over IHSs' mode of operation. In some cases, DH companies believe they should be involved in controlling the mode of operation if mass-scale IHS installation is implemented in their city. **50%** Approximately 50 percent of DH companies' representatives believe that DH companies should perform maintenance of IHSs and control the mode of their operation. **50%** The other 50 percent either do not have an opinion on the matter or believe that HOAs may decide who will maintain and control the IHSs, including controlling the temperature regime.
Representatives of homeowner's associations	Representatives of HOAs in each city have their own experiences with IHS installation.

(HOAs) and housing managers

Practically all HOAs report experiencing IHSs' positive impact on utility bills and the overall level of comfort in the building.

Housing managers also indicate that IHSs have had a positive impact on consumers' overall level of satisfaction with DH services. However, they cannot provide more detailed information on any of these impacts.

In practice, IHSs that were installed as part of an HOA initiative with the support of programs (like Teply Kredyty, Energodim, or city and regional support programs for HOAs) are owned by the HOAs, who also control the mode of their operation and establish temperature regimes. HOAs usually hire private companies, which install IHSs and maintain them on a contractual basis.

In some cases, representatives of HOAs themselves or even residents of buildings carry out IHS maintenance.

If an IHS is installed by a DH company within the framework of a project funded by an international financial institution (IFI) and owned by the DH utility (like in Lutsk), HOAs still belive they should own the IHS, because it is installed inside their property.

Housing managers, on the other hand, consider that DH companies should own IHSs and should be responsible for maintaining them, controlling the mode of their operation, and establishing temperature regimes and that consumers should pay for that.

There are different views on the question of setting temperature regimes:

HOAs usually appoint a person who is responsible for that.

In **65–70 percent** of cases, consumers have a role in the process and their opinion is taken into account. In other cases, that decision is up to the representatives of HOAs.

Housing managers do not know the details of setting temperature regimes in buildings where IHSs are installed. In practice, they can only indicate that the DH company is responsible for setting the temperature regime and that consumers may request that they change it if they jointly decide to do so.

There is a certain distrust of local DH companies from HOAs and confidence that local DH workers will try to benefit from the installed IHSs if they have access to them. Therefore, some HOAs simply do not allow employees of local DH companies to enter their basements, where IHSs are installed.

	Housing managers, on the other hand, believe that DH companies are interested in consumers being satisfied with DH services. They have no complaints with the operation of IHSs installed by local DH companies.
DH service consumers	Consumers of DH services from each city say that **they are satisfied with the operation of IHSs and they experience its impact on utility bills** and on the overall level of comfort in building apartments. A number of DH consumers who reside in buildings with installed IHSs do not know what an IHS is or how it operates. As for those consumers who reside in buildings where IHS installation is planned, they are looking forward to implementation of this measure and have positive expectations. These consumers expect to save on heat consumption bills and to have a more comfortable temperature inside their apartments. A certain number of consumers do not want IHSs to be installed in their buildings, but they are the minority of residents, and their opinion may not be decisive for the decision to install an IHS in a building. Most consumers of DH services from each city claim they save around 20–30 percent, and in some cases up to 50 percent of costs paid for heat consumption.* ** The percentage is based on consumers' perceptions of how much they save, and it may differ from the actual amount saved on utility bills.* Consumer feedback about the temperature regime implemented with an IHS is mostly positive. However, some residents do not like the temperature regime being set in their building. These residents became used to having a temperature of 27–28 °C inside their apartments due to the specifics of operating the DH system inside their building. Now that an IHS is installed, a temperature of 21–22 °C has been set, and consumers who are used to overheating are against lower temperatures. The fact that they pay less for their utility bills has not convinced them that this temperature regime is the norm and is more beneficial for them. Most DH consumers believe that they are the ones who should be responsible for IHS installation—that they should both decide on the need to install an IHS and decide how to do it. **50%** Up to **50 percent** of DH consumers who are aware of what an IHS is and its functions do not have an opinion about who should own and maintain the IHS. A few consumers believe that the local DH company may own IHSs if it installed them with its own funds. Other consumers believe the HOA should own the IHSs and that maintenance should be carried out by a private company with available specialists.

	Consumers who reside in buildings where IHS installation is planned do not have an opinion on who should own the IHSs, who should maintain them, and who should be responsible for setting the temperature regime. As for the additional costs of installing and maintaining IHSs, most consumers who have IHSs installed in their buildings and those who plan to install them are willing to pay additional fees. They only want to make sure these costs are spent as intended.

AVAILABLE FUNDS FOR IHS INSTALLATION. The cost of installing an IHS **may vary from UAH 120,000 (approx. $4,379) to UAH 800,000 (approx. $29,197)**. The cost depends on the manufacturer of the selected equipment, the complete set of an IHS, whether balancing valves are installed, the need to undergo a State Expertise review of design documentation, etc. It is not possible to cover the entire cost of IHS installation in buildings by using consumers' funds in one installment.

Funding sources that are available and acceptable to interested parties in Ukraine:	
Funding through city/regional support programs for HOAs/ local housing authorities on a 70/30 basis	In almost every city, there are financial support programs for HOAs/local housing authorities that aim to encourage these entities to modernize their multi-family buildings.
Energodim (program of the Energy Efficiency Fund)[1]	The Energodim program of the Energy Efficiency Fund provides partial reimbursement of costs for thermal modernization of buildings and full project support.
Funds provided by IFIs	One way to finance IHS installation in some cities of Ukraine is with grant or credit funds provided by IFIs under infrastructure support programs in Ukraine.
Funding sources that were used for installation of IHSs by HOAs but are no longer available:	
Tepli Kredyty[2]	The state program Tepli Kredyty was launched to minimize the consumption of traditional energy sources in heating buildings. As of 2021, the loans are provided ONLY to individuals; funds for lending to HOAs/local housing authorities are not provided in the budget.

[1] https://energodim.org/
[2] https://www.oschadbank.ua/credit/tepli-krediti, http://www.ukrgasbank.com/private/credits/warmhouse/

INTERPRETATION OF SURVEY RESULTS

- IHSs have positive effects on consumers of DH services when installed both by HOAs and DH utilities. However, **when an IHS is installed by consumers/HOAs, the impact of the IHS on the DH system is not taken into account**, and the installation of IHSs is rather random (the aspect of heating districts is not taken into consideration).

- There are ways to have an IHS installed by participating in one of the programs supported by the state/oblast/city. However, **most of these programs are targeted at HOAs** as a way to induce the creation of HOAs. Residents of multi-family buildings who have not created HOAs are not able to apply for such programs, and they are not able to pay for the installation of IHSs by themselves.

  Besides, according to the information obtained during the survey, the **cost of procuring and installing an IHS is much higher for an HOA—up to UAH 800,000 (around $30,000)—than for DH utilities, who pay UAH 300,000 (around $11,000).**

- **DH companies are interested in mass-scale IHS installation**, but they indicate that lack of funds and issues with accessing the premises of multi-family buildings are the main issues that prevent them from taking on IHS installation in their cities.

- **HOAs and housing managers believe that IHS installation is the first step toward enhancing building energy efficiency.**

- **Consumers are mainly satisfied with the functioning of IHSs,** and the level of their satisfaction is due to the amount of money paid for utility bills and the overall level of comfort inside the apartment.

- If an IHS is owned by a DH utility, it is usually serviced by the utility.

- If an IHS is owned by the HOA, its maintenance is carried out by an external company (service provider), which can be a private service company (usually the installer of the IHS) or the DH utility (if the utility installed it or has an agreement with homeowners to service it).

  Both cases are acceptable, **although it is preferable for the DH utility to handle maintenance:** when a DH company is engaged, it is more likely that DH system operations will improve with IHS operation on top of the reduction of utility bills and improvement in overall comfort inside apartments. In addition, DH companies have available specialists who can carry out IHS maintenance (which was confirmed by representatives of DH utilities).

CONCLUSIONS BASED ON IMPLEMENTATION EXPERIENCE

TECHNOLOGY

- **IHS should be equipped with a heat exchanger for space heating**, which is the only modern way to implement the IHS (providing a full set of benefits to consumers and enabling

	benefits for the DH utility by making it possible to adjust operational modes and optimize the system).
▪	IHSs that were **assembled as a single unit within the factory** are the preferred option.
▪	**Heat exchangers should be service-friendly** (able to be disassembled and reassembled after cleaning) so that it is possible to clean them during non-heating seasons to maintain their efficiency and extend the service time.
▪	It is better to consider **IHSs with variable speed drives on pumps** so building blocks can be self-balanced, depending on the conditions.

COSTS

▪	If installed individually by homeowners/managers, IHSs can cost twice as much (about UAH 600,000–800,000) as wholesale turnkey installations procured by DH utilities (UAH 300,000–350,000).
▪	The cost of IHS installation is still high (perception-wise) when co-financed by homeowners, which is often a barrier for IHS implementation even when there is an HOA (without the support of the municipality or state).

BENEFITS OF MASS-SCALE IHS INSTALLATION

(based on survey results and implementation experience)

▪	**A DH consumers can mstly benefit from IHS installation only in cases where the entire heating district is covered by IHSs.** In such cases, the DH utility can adjust operational modes (introduce variable flow, reduce temperature and pressure, etc.) to reduce electricity usage and heat losses, thereby reducing expenses.

INSTALLATION, OWNERSHIP, AND CONTROL

•	It is possible for HOAs/housing managers to install IHSs (unrelated to installation across the whole heating district). However, **mass-scale IHS installation** (especially covering the whole heating district so that the DH utility changes its operational modes) **is possible mostly via DH utilities**.

- It is equally possible and feasible for IHSs to be **owned by HOAs or by the DH utility**.
- IHSs can be controlled by homeowners or by the DH utility (as a response to a building owner request to change the operation mode), so in practice, **homeowners set the operational mode for IHSs regardless of who controls it.**
- **Practical and workable temperature control** should involve a gradual reduction of the indoor temperature (with some period of time in between so that residents do not experience a dramatic change) until the level is reached when residents start complaining. Better savings are generated by introducing new temperature patterns, especially when consumers are being educated and used to the new temperature patterns.

OVERALL RECOMMENDATIONS

- Installation of IHSs by HOAs is possible, and support to HOAs in this matter may be provided. However, the mass-scale installation of IHSs by HOAs only is not feasible, given that such cases do not take into account the impact of IHSs on the DH system.
- **Installation of IHSs by DH utilities is the realistic option and should be made available** because DH utilities can cover whole heating districts with IHSs and consider the impact of IHSs on the DH system. **PRIORITIZE IHS INSTALLATION BY DH UTILITIES AND IMPLEMENTATION BY HEATING DISTRICTS.**
- It is better to install IHSs in buildings where all consumers are connected to centralized DH.
- **It is necessary to provide support to DH utilities to install IHSs as the complex measure for heating districts** (in practice, this is possible with the support of external financing like IFIs). **PROVIDE FOR A WORKING INVESTMENT REMUNERATION MECHANISM.**
- **Equip IHSs with heat exchangers for space heating** (as required, to be introduced with the regulations) and **heat exchangers for hot tap water** (if the system is existing or will be (re)installed). **REQUEST THAT IHSs BE EQUIPPED WITH HEAT EXCHANGERS.**
- Connection of new consumers (buildings) only via IHSs. **CREATE AN OBLIGATION TO CONNECT NEW BUILDINGS VIA IHSs.**
- **It is necessary to communicate the showcase project results to DH utilities** (sharing the benefits of IHSs for utilities as the ultimate step in transforming the system). **CONDUCT AWARENESS-RAISING CAMPAIGN.**

- **Ukraine should mitigate the permitting barriers for DH utilities to install IHSs** (in particular, the requirement to obtain technical conditions for interconnection to electricity, water, and sewerage by introducing changes to regulations or manuals on the way forward within ethe xisting framework). **REVIEW PERMITTING REGULATIONS.**

2. INTRODUCTION

2.1. PURPOSE AND OBJECTIVES OF THE SURVEY

The general purpose of the survey is to provide the impetus needed to make the necessary changes in the legislative and regulatory framework of Ukraine to promote large-scale IHS installation in multi-family buildings. This will make it possible to improve DH services for the population.

THE PURPOSE OF THE SURVEY is to identify practical obstacles to IHS installation in residential buildings in Ukraine and to draw conclusions and recommendations for promoting more widespread IHS installation based on information from stakeholder groups in all participating cities.

The following cities were surveyed:

The reasons for choosing these cities for the survey were as follows:

- **Geographic location**. The chosen cities represent different parts of Ukraine, which allows the survey to cover more regions.
- **Difference in approach**. The difference in approach to IHS installation in multi-family buildings in the chosen cities is striking. Because of this, the survey can demonstrate in greater depth the obstacles and problems that stand in the way of more widespread IHS installation in Ukrainian households.

- **Prevalence of IHS installation**. Our objective is to examine both positive and negative experiences, which is why we have chosen cities with different levels of progress in installing IHSs in multi-family buildings.

THE SUBJECT OF THE SURVEY is the obstacles that stakeholders of different levels of influence face in installing IHSs in their multi-family buildings. This report highlights the current situation regarding challenges to widespread installation of IHSs and provides general findings and recommendations.

2.2. INFORMATION ON THE CITIES COVERED BY THE SURVEY

TABLE 1.	Lutsk
Population of the city, persons	217,197
Population of the city territorial community, persons	244,577
Number of registered HOAs in the city	596
Number of registered HOAs in the oblast	1,200
Financing of city programs for HOAs and the housing and utilities subsidy (HUS), including reimbursement of annual expenses from 2016 to 2019 for energy efficiency activities; million UAH	7.5
Name of the communal utility (CU) providing heat for heating and hot water for the housing stock, public utilities, and other facilities (central)	State communal utility "Lutskteplo" (hereafter SCU Lutskteplo)
Characteristics of the facilities maintained by the CU[3]	Total number of residential buildings: 788. Of these, 381, or 48 percent, are equipped with heat energy metering devices. Total heated floor area of apartments with centralized heating: 2,629,335.8 m^2. Total heated floor area of legal entities: 1,034,132 m^2.

[3] http://teplo-dkp.lutsk.ua/ua/zvit_pro_upravlinnya/

Mechanisms of IHS installation in the city	EBRD-funded "Reconstruction of the District Heating System in Lutsk" Project Program for repayment of part of the loan amount to HOAs in the Lutsk city territorial community Energodim Program
Number of IHSs installed in the city	About 200 (installed under the EBRD-funded project; about 50 of them were installed at the initiative of the residents of households/ HOAs)

TABLE 2.	Mariupol
Population of the city, persons	431,859
Population of the city territorial community, persons	441,489
Number of registered HOAs in the city	1,070
Number of registered HOAs in the oblast	4,776
Financing of the city programs for HOAs and HUS, including reimbursement of annual expenses from 2016 to 2019 for energy efficiency activities; million UAH	11
Name of the CU providing heat for heating and hot water for the housing stock, public utilities, and other facilities (central)	CU Mariupol Heat Network
Characteristics of the facilities maintained by the CU	Provides heat to 2,519 facilities, including 1,887 residential buildings, 87 child care institutions, 34 hospitals, 3 orphanages, 69 schools (total area: 7,600,000 m^2)
Mechanisms of IHS installation in the city	HOA Support Program Energodim Program
Number of IHSs installed in the city	About 30 (in 2020 and 2021)

TABLE 3.	Poltava
Population of the city, persons	283,037
Population of the city territorial community, persons	309,647
Number of registered HOAs in the city	257
Number of registered HOAs in the oblast	889
Financing of the city programs for HOAs and HUS, including reimbursement of annual expenses from 2016 to 2019 for energy efficiency activities; million UAH	0.3
Name of the CU providing heat for heating and hot water for the housing stock, public utilities, and other facilities (central)	Regional Communal Production Enterprise Poltavateploenerho
Characteristics of the facilities maintained by the CU[4]	The total number of CU consumers from among budget institutions, religious organizations, and other categories of consumers (except for the population) is 1,463. DH and hot water supply services are provided to almost 200,000 residents of the city. Among them, over 150,000 use the service of district hot water supply.
Mechanisms of IHS installation in the city	HOA Support Program in Poltava Energodim Program
Number of IHSs installed in the city	Around 25

[4] https://drive.google.com/file/d/1OI8G-xuVFKRSYuv5u8wzKjNh7kDkzo87/view

TABLE 4.	Kharkiv
Population of the city, persons	1,433,886
Population of the city territorial community, persons	-
Number of registered HOA in the city	613
Number of registered HOAs in the oblast	1,402
Financing of the city programs for HOAs and HUS, including reimbursement of annual expenses from 2016 to 2019 for energy efficiency activities; million UAH	1.0
Name of the CU providing heat for heating and hot water for the housing stock, public utilities, and other facilities (central)	CU Kharkiv Heat Networks
Characteristics of the facilities maintained by the CU[5]	Connected to the DH system, including over 5,900 residential buildings. Hot water supply services are provided to over 880,000 residents.
Mechanisms of IHS installation in the city	City HOA Support Program "Teplyi Kredyt" Energodim Program District Heating Energy Efficiency Project in Ukraine (funded by the World Bank)
Number of IHSs installed in the city	No exact data available[6]

[5] http://te.pl.ua/pro-pdpriyemstvo/pdpriyemstvo-sogodn
[6] Unspecified information available: CU: 10 IHSs, HOA: 20–30 IHSs.

3. CONCLUSIONS

3.1. ANALYSIS AND ASSESSMENT OF EXPERIENCE WITH IHS INSTALLATION IN MULTI-FAMILY BUILDINGS IN THE CITY

Impressions of IHS functioning. Almost all representatives of each group surveyed express a positive attitude toward the functioning of IHSs and state that they have had a positive experience.

This indicates that the practical experience of installing IHSs in multi-family buildings can convince other house residents and HOAs/housing cooperatives (HCOs)/management companies to implement the same in their buildings.

Practically no one regrets the decision to install an IHS in their house. There are rare cases when consumers of DH services were dissatisfied with the functioning of IHSs, but in more than 90 percent of cases, people remain satisfied with having introduced this measure in their buildings.

In practice, it makes no difference whether the IHS was installed and maintained by the heat supply company or by the HOA and contracting companies. Consumers and HOAs/HCOs/management companies are satisfied with the work of the IHS and have no serious complaints about its functioning.

However, in almost every multi-family building where an IHS is installed, some residents are dissatisfied with the established temperature regime. More about this problem is given below.

Temperature control. In practice, IHS temperature control and the process of setting and adjusting the temperature regime may occur in different ways.

In buildings where IHSs are installed at the initiative of the residents or HOAs, a person appointed by the HOA or HOA board chair is responsible for controlling the temperature regime. In about 60 percent of cases, the residents' opinions are taken into account; in some houses, the decision to set a temperature regime is made through a meeting of the house residents where the majority vote for a particular temperature regime. In 40 percent of cases, however, the residents have no role in the process, and for good reason. Some residents are against setting an optimal temperature regime in their homes.

Quite often, apartments in multi-family buildings in Ukrainian cities experience a phenomenon called "overheating," when the indoor temperature during the heating period exceeds 20–21 ˚C. In some rooms, the temperature can reach 27–28 ˚C, which is significantly higher than normal. However, after the installation of an IHS, almost every building has residents who complain about the decrease in temperature to the optimum, which is 21–22 ˚C on average. Savings on heat consumption reflected in decreased bills do not convince such residents of the advantage of establishing a temperature mode that corresponds to the norm.

The percentage of such residents in each building is relatively small, and they have no influence on decisions regarding the establishment of the temperature regime. However, in the case of large-scale IHS installation, this type of resident should be taken into account, and additional awareness-raising activities on the harm of overheating should be held with them.

In buildings where IHSs are installed by DH companies at the expense of IFIs or at the expense of the DH companies, the temperature regime is controlled by employees of the heating company, and they change it at the request of the residents.

In general, in any situation, the residents or co-owners of the multi-family building have a role in establishing the temperature regime. Residents' opinions should be taken into account, but the generally established norms should be followed as well. However, the DH company should also monitor this process to ensure the stable operation of the centralized heating system.

Title to IHSs and their maintenance. In practice, either the heating companies or HOAs hold title to IHSs installed in Ukrainian buildings.

In a case when an IHS is installed in a building at the expense of an IFI by a heat supply company, the latter holds title to the installed equipment. This is the situation in Lutsk. In different situations both the local heat supply utility and the contracted company (the one that installed the his under the contract with the heat supply utility) provide technical maintenance of the installed IHSs.

In Kharkiv, the situation is somewhat different: there is an IHS-installation project funded by IFIs, but the HOAs or HCOs hold the title to the IHSs. At this stage, the local heat supply company handles maintenance, but it is unknown who will do it after the project is completed.

There is no consolidated opinion as to who should hold the title to the installed IHSs. Reviewing the opinions expressed by the majority of representatives of each stakeholder group, most believe that the HOAs, as co-owners of the building, should hold this title. In any case, even if the HOAs engage in the large-scale installation of IHSs, there will be a need to coordinate ownership issues with the co-owners of the building.

In cases where there is no HOA established and the building is managed by an HCO or management company, the situation is more straightforward. They mostly have no objection to the fact that the heat supply company holds the title to the IHSs.

Both of these options are acceptable and realistic in Ukrainian conditions. However, when talking about the installation of IHSs as a component of the fully-fledged modernization and development of the DH system in the city, it is better that the DH company install the IHSs, hold the titles, and have access to maintain them and regulate their mode of operation.

3.2. FINANCIAL ASPECTS OF IHS INSTALLATION IN MULTI-FAMILY BUILDINGS

Representatives of local governments and heat supply companies predominantly cite the cost of installing IHSs as the main obstacle to their more widespread introduction in multi-family buildings in Ukraine. They say that the cost of installation varies from UAH 120,000 to UAH 800,000, depending on the year when the equipment was installed (there is a difference between the cost of IHS installation in 2016 and in 2020–2021), the equipment, the presence or absence of balancing valves, the cost of services on IHS installation, and other aspects.

The following means of funding IHS installation are available and used in practice:

Funding through city/oblast HOA/HCO support programs on a 70/30 basis. Virtually every city has HOA/HCO financial support programs that are designed to encourage HOAs and HCOs to perform energy retrofits on their buildings, which helps achieve heat and cost savings.

To participate in the program, one must prepare a project according to a prescribed form and guarantee that the HOA or HCO will pay at least 30 percent of the total work cost. Funds allocated under the program can be used not only to install IHSs but also to implement a raft of measures to improve the thermo-modernization of the building:

- Heat insulation, major repairs to roofs and basement ceilings
- Replacement of windows and doors in common use areas with energy-efficient ones
- Modernization and replacement of the house utilities
- Insulation of facades
- Replacement of lighting fixtures with energy-efficient ones and/or installation of motion sensors to regulate lighting in common areas
- Reconstruction of heat and/or hot water supply systems using renewable or alternative energy sources
- Major repairs or technical re-equipment of in-house electrical equipment

The requirements for the package of documents, selected types of work, and other components for participation in the program are determined by the city. Some of the funds for thermo-modernization activities are provided at the expense of the city budget.

Established HOAs have no available funds to pay for the installation of IHSs on their own. They need support from the state or the city, which can cover part of the cost. This is how programs like Tepli Kredyty or HOA support programs like Energodim work.

The Energodim Program aims to reduce people's consumption of energy resources by improving the energy efficiency of multistory residential buildings, which it does by encouraging residents to make efforts toward energy efficiency. The program, from the Energy Efficiency Fund, provides partial reimbursement of the cost of measures to thermo-modernize buildings and complete support of the project.

It has two packages of actions—light and fully-fledged. HOAs can receive a grant for partial reimbursement of the cost of energy efficiency actions up to 70 percent for the preliminary energy audit, development of project documentation and its expertise, technical and author's supervision services, inspection of utilities, and energy-efficiency certification of the building. Depending on the selected package, the program is expected to reduce energy consumption in multi-family buildings by 20 to 60 percent.

In practice, HOAs do not take advantage of this program because of the complexity of the procedure and the number of steps.

IFI funding. Another source of funding in some cities is grant or loan funds provided by IFIs as part of programs to support infrastructure development in Ukraine.

Since 2020, the installation of IHSs in Lutsk has been in progress under Contract No. 1 "New Heat Substations (Individual Heat Substations in Residential Buildings)," which is part of the District Heating Modernization Project in Lutsk. It is implemented by SCU Lutskteplo with the financial support of the EBRD and the support of Lutsk City Council.

In Kharkiv, a heating components modernization project is being implemented with funds from the World Bank. That project is also installing IHSs in Kharkiv's multistory buildings.

In 15 multi-family buildings in Poltava, IHSs were installed under a program funded by NEFCO—DemoUkrainaDH.

In practice, we cannot talk about the large-scale installation of IHSs solely with the funds of IFIs. Such projects are more of a demonstration and aim to encourage others to find ways to carry out the large-scale installation of IHSs at the state level and in cities and oblasts.

However, almost all representatives of local governments and DH companies consider this method of funding IHS installation to be acceptable.

IHS installation funded by DH utilities. Cases of IHSs being installed at the expense of DH companies were recorded only in Mariupol and Poltava. In Lutsk and Kharkiv, DH companies install IHSs using funds from IFIs. In Lutsk and Kharkiv, they do not invest their funds in the IHS installation process.

This method of funding IHS installation is not considered practical by the local governments, residents and representatives of HOAs, or the companies themselves. There are two reasons for this:

- The companies in the surveyed cities state that they do not have the money to fund the installation of IHSs in multi-family buildings.
- Most residents and representatives of HOAs/HCOs do not trust heat supply companies.

Each source of funding for IHS installation has advantages and disadvantages. Based on the interviewees' implementation experience, DH companies install IHSs at approximately half the cost (UAH 300,000–350,000 compared to UAH 600,000–700,000). Therefore, for large-scale installation, a more desirable scenario is when DH companies are able to fund and control this process.

An instrument for IHS installation that has been in demand but is not currently available is the Tepli Kredyty program. It was launched to minimize the consumption of traditional energy carriers in heating premises. Funds were allocated annually, allowing citizens of Ukraine to:

- Take out loans for heat retrofits of residential buildings (one- or two-family houses) on favorable terms; and
- Be partially reimbursed for the amount spent on insulating buildings and installing energy-efficient products—translucent structures with energy-efficient glass (except for one-chambered), including windows and balcony doors, as well as accessories to them.

Under Tepli Kredyty, a consumer (in 2021—ONLY an individual person; funds for crediting HOAs/HCOs are not provided for in the budget) takes out a special loan from one of the partner banks of the program. The funds are used to purchase materials for the building modernization, and then the state reimburses part of these funds to the bank. Thus, the consumer does not have to repay the entire amount, only the remaining amount. The share of the amount that the state reimburses under Tepli Kredyty may vary.

In practice, in each of the four cities, HOAs used the Tepli Kredyty loans to pay for the funds needed to install IHSs. Representatives of HOAs were attracted by the relative simplicity of the procedure for taking out a loan and the possibility to pay only part of the total amount.

According to practical experience, some of the funds obtained through Tepli Kredyty could also be reimbursed by the city (at least, that is how it happened in Kharkiv and Mariupol). The amount of compensation from the city budget could be about 20 percent. After this, HOAs/HCOs themselves pay about 10–20 percent of the total cost of IHS installation.

3.3. TECHNICAL ASPECTS OF IHS INSTALLATION AND MAINTENANCE IN MULTI-FAMILY BUILDINGS

Problems with basement premises. In Lutsk and Poltava, people noted certain problems both with the basement premises themselves and with the ability to access them to install the equipment.

The problem with the state of basements in the multi-family buildings of the old housing stock is not a new one in Ukraine. In most cases, such basements must be repaired and the sanitation conditions of the premises must be brought to an acceptable level.

Unfortunately, not all HOAs or HCOs carry out repairs to the premises, so when installing IHSs in such buildings, there is a problem with their internal sanitation conditions and the inability to install equipment properly.

Another problem is that representatives of the heat supply company may simply not be allowed into the basement by the house co-owners. Because the heat supply company is not the owner of the premises in which the IHS is installed, this leads to problems obtaining technical specifications for the electricity and water supply of the IHS, installation of metering devices, etc. (technical specifications are issued based on the title to or lease agreement for the premises). After IHS installation, the heat supply company takes over the equipment but has problems keeping it safe, preventing access by unauthorized persons, and ensuring unimpeded access for company specialists to maintain the IHS equipment.

This problem was encountered in Poltava: In 50 percent of cases, when trying to install a meter for hot water metering, the employees of Poltavateploenerho were not allowed into the basement by the house co-owners. This can be solved by going to court, but such a process may be lengthy for both parties, and the heat supply company may simply not have enough interest in it.

Nonprofessional maintenance of IHSs. In some cases, maintenance of IHSs is performed by plumbers and HOA managers themselves or even by ordinary residents of the house, rather than by professionals with appropriate qualifications from the heat supply company or a specialized company.

This problem arises from reluctance to pay for IHS maintenance performed by qualified workers. HOA representatives or residents also do not trust local heat supply companies with this process. They believe that employees of heat supply companies will damage the equipment and set it up in such a way that the IHS does not work correctly. However, no such examples have been presented in any of the cities.

HOA representatives and residents who maintain IHSs by themselves do not see this as a problem and believe that their understanding of how the equipment works is enough to ensure its proper functioning. Although the equipment is expensive, HOAs take this risk in order not to pay the contracting company for maintenance and not to allow the employees of local heat supply companies to access the equipment.

This practice is undesirable and can damage the equipment and the correct functioning of the IHSs. It is recommended to use the services of specialized companies or DH company employees to service the IHSs.

3.4. ANALYSIS AND ASSESSMENT OF PRACTICAL HINDRANCES TO IHS INSTALLATION IN MULTI-FAMILY BUILDINGS

Need for programs with state and city financial support. In practice, local government and DH company representatives point out the need for large-scale IHS installation programs with the financial support of the state and/or the city. In the presence of such a large-scale program, they agree to be more actively involved in this process and to assist it in every possible way. The companies point to the lack of funds for such actions, and heat supply companies in Ukraine are now in crisis and have large debts for energy consumption. Therefore, funding for such programs is expected from the state or the city.

Note: According to the statement of President V. Zelenskyi, in 2022, Ukraine planned to launch a large (about UAH 300 billion) energy-saving program that would cover multi-family buildings. He announced that the program would be discussed in detail with partners from the European Union.[7]

Need to introduce a raft of measures concerning the thermo-modernization of the building. Residents decide on the installation of IHSs mainly in the context of rising tariffs for heating. The desire to save on payment for heat energy forces the consumers of DH services to find ways to save on heat consumption. Another element is the desire to improve the overall level of comfort in the house—often the temperature in apartments (comfortable or not) depends on whether the heat carrier is fed from bottom to top or vice versa in the building.

IHS installation is one of the means to solve this problem and provides an opportunity to save on heat consumption. It is also one of the first steps to improve energy efficiency in the house. However, along with IHS installation, it is possible to take other actions to improve energy efficiency:

I	**Modernization of in-house heating system utilities** a) Partial modernization • Installation of an automatic heat flow regulator • Installation of heat-insulating reflectors downstream from the heating units b) Fully-fledged modernization • Installation of an automatic heat flow regulator • Balancing of the heating system • Installation of modern low-inertia heating units • Installation of thermostatic regulators for heating units • Installation of distributors for heating units • Installation of heat-insulating reflectors downstream from the heating units

[7] https://www.rv.gov.ua/news/v-ukrayini-zaprovadzhuvatimut-veliku-programu-energozberezhennya

2	**Modernization of the facade walls** a) Insulation of the facade walls with foam polystyrene slabs, finished with light, thin-layer plaster b) Insulation of the facade walls with mineral wool slabs with a ventilated air layer, finished with ceramic tiles (the thickness of the heat-insulating layer is at least 150 mm)
3	**Modernization of the roof slab** Insulation of the roof slab using a thermal insulation layer (e.g., basalt wool slabs, minimum 100 mm thick) and a vapor barrier layer
4	**Modernization of the basement ceiling** Floor insulation on the basement side with thermal insulation (e.g., basalt wool slabs, minimum 100 mm thick) and a vapor barrier layer.
5	**Replacement of windows and balcony units** Installation of energy-efficient windows and balcony units
6	**Modernization of the ventilation system** Installation of local ventilation devices with heat recuperators
7	**Insulation of entranceways** Replacement of windows with energy-efficient ones, installation of entrance doors with heat insulation, restoration of lobbies
8	**Modernization of the lighting system of entranceways** Replacement of incandescent light fixtures with energy-saving light-emitting diodes (LEDs) with presence and light sensors

If at least some of the above measures are implemented, the installation of IHSs may have a better effect on consumers than expected.

Another factor is the level of energy efficiency within each apartment in a multi-family building. Provided the resident of the apartment has not taken measures to improve energy efficiency inside their apartment (for example, has not changed the old radiators or replaced the old windows with energy-efficient ones), IHS installation may have no effect on savings on heat consumption or improved comfort.

In addition, if an IHS is installed for heating and hot water supply, there is almost always a need to replace the external heat networks to the residential building—the transition to a two-pipe heating system with an increase in its existing capacity (increasing the diameter of pipelines), etc. This aspect should also be taken into account in the large-scale installation of IHSs in multi-family buildings in Ukraine.

Lack of initiative on the issue of IHS installation in multi-family buildings in the city. There is a general trend around IHS installation initiatives: most stakeholders express interest and

consider it useful and necessary, but these opinions do not lead to specific actions, or stakeholders encounter practical obstacles that are not solved, and the initiative comes apart at the very beginning.

Local government representatives generally express a positive attitude toward the large-scale installation of IHSs in their cities but usually do not have programs to support HOAs/HCOs/other management companies. If such a program exists, no one promotes it, and few people know about it. Also, governments do not have strategies that would allow for larger-scale IHS installation and do not always have a clear opinion as to who should own an installed IHS, who should maintain it, who should pay for it, who should monitor its operation, and so on. Only in Mariupol do the representatives have a clear vision and strategy for the development of the city housing stock, which includes larger-scale installation of IHSs.

DH company representatives also communicate their positive attitude toward the large-scale installation of IHSs, and most of the representatives express their desire to participate in this process. However, they do not yet have the ability to finance the installation in multi-family buildings in their city. They are also not very interested in conducting awareness-raising campaigns for the residents of multi-family buildings regarding the benefits and necessity of installing IHSs in their buildings.

Local government representatives still point to a number of technical problems and issues that prevent them from initiating large-scale installation of IHSs.

HOA representatives are interested in having IHSs installed in their buildings, but the percentage of initiative HOAs who are ready to take the initiative in cities is relatively low. This is due to the reluctance of HOAs to take responsibility for organizing the process—collecting necessary documents, holding meetings among residents and collecting signatures (at least two-thirds of residents of a multi-family building should be "for"), conducting awareness-raising activities with dissatisfied residents, finding contractors who install equipment, and so on. There are also cities where the total percentage of established HOAs is not proportional to the number of multi-family buildings in the city—a situation that is particularly acute in Kharkiv and Poltava. There is also distrust of the programs through which it is possible to implement thermo-modernization actions and get reimbursement from the state and the city/oblast.

However, HOA representatives that have decided to install IHSs in their buildings and have collected the necessary residents' consent for this purpose do not regret it and share their experience with other colleagues. Perhaps in the long run, this practice will have results.

Distrust in heat supply companies. There is a high level of distrust in heat supply companies, both among local government representatives and among HOAs and consumers of DH services.

One of the reasons for such distrust is the general dissatisfaction of consumers with the quality of heat supply service. This includes the general state of heat supply systems in the cities, which are already outdated and cause failures in the supply of heat to houses. It also includes consumer dissatisfaction with the speed of response by DH company employees to complaints and system failures, high company bureaucracy, dissatisfaction with the quality of the heat carrier, etc.

With regard to IHS installation, distrust in DH companies is caused by the general opinion that such measures are unprofitable for heat supply companies. It is believed that these companies are interested in selling more heat carrier to consumers, and that this is how they make their profits.

Large-scale IHS installation enable consumers to save on heat consumption, so company revenues will decrease, which means the companies are not interested in the large-scale installation of IHSs in multi-family buildings – this is how it is perceived. Some local government representatives, as well as almost all HOA representatives and consumers of DH services, believe that one should not give DH companies the title to the IHS and let them maintain it and control its operation because they will simply act to the detriment of consumers and make the IHS function improperly.

In reality, such companies express an interest in installing IHSs in the city's multi-family buildings. At a minimum, this would allow them to save on energy consumption and in-house production costs. However, almost all company representatives note that a number of technical and other problems should be solved before the large-scale installation of IHSs:

- The unsatisfactory state of the heat supply system in the city
- The need to change the diameter of the heat supply pipe in the case of large-scale installation of IHSs
- The need to modernize and balance the components of heat supply networks
- The need to take fully-fledged energy-saving actions in multi-family buildings
- The problem with access to basements and their general sanitation condition
- The lack of a clearly defined plan by which the city will implement the large-scale installation of IHSs

There was practically no negative feedback on the performance of IHSs installed and owned by DH companies (for example, as happens in Lutsk under the EBRD-funded project). On the contrary, people noted companies' responsiveness to problems with the IHS and enjoy savings on heat consumption.

However, the problem of mass distrust in DH companies in Ukrainian cities remains unsolved, and this distrust could be a very real obstacle to the large-scale installation of IHSs by heat supply utilities and prospects for granting them the title to equipment and the ability to technically maintain and control its operation mode.

The human factor. In practice, one of the main obstacles to the large-scale installation of IHSs may be people's unwillingness to consent to the installation of equipment in their buildings.

When IHS is installed free of charge for the house residents and the funds for its maintenance are in the tariff for heating (usually a small amount), there are almost no protests or discontent. At least, this is the case in Lutsk and Kharkiv, where a large number of IHSs are installed under projects financed by IFIs, and they are free of charge for the residents of the building.

When HOAs initiate the installation of IHSs in their buildings and plan to use funds received under support programs such as Tepli Kredyty or Energodim, problems arise. There are cases when residents actively express their dissatisfaction, and the HOA board chairperson has to conduct awareness-raising activities and convince such residents to agree to the measure. According to HOA representatives, most finally agree, but this is because of the persistence of HOA representatives themselves.

In general, there is a low level of awareness about the process. This topic is not actively covered by the media or on television at either the national or local level. Also, there are practically no awareness-raising campaigns in the cities to promote the installation of IHSs as an effective measure to improve energy efficiency. Neither the local governments nor the DH companies have plans or strategies for such awareness-raising campaigns.

However, such awareness-raising campaigns are necessary for the public. In the absence of knowledge about what an IHS is, how it functions, and what its benefits are for improved energy efficiency in the building, consumers of DH services cannot form a positive attitude toward it and tend to be hostile to such an initiative.

Residents who learn about successful experiences with IHS installation from their neighbors/friends/relatives or are persuaded by energy efficiency experts who are invited by HOA board chairs to the house residents' meetings tend to become more open to IHS installation. The practice of disseminating information about other consumers' successful experiences should be promoted so that more people can learn about the benefits of IHSs and take the initiative to find ways to install them in their buildings.

4. KEY RESULTS OF THE SURVEY

4.1. RESULTS OF THE SURVEY AMONG REPRESENTATIVES OF LOCAL GOVERNMENTS

QUESTION	ANSWER
How do local governments assess the impact of IHS on the DH system and the quality of DH service?	**LUTSK** Lutsk government representatives recognize the positive impact of IHSs on the city's centralized heating system. They noted that this is a major step toward improving DH services and saving energy products. They communicated their interest in installing IHSs in the city's multi-family buildings and have noticed the benefit in this process—first of all, it may give impetus to regulating and balancing the city's heating system. There is also a general opinion that such a measure is beneficial, and that the introduction of IHSs improves the quality of heat supply services. This allows the heat supply in the building to be balanced. **KHARKIV** Kharkiv representatives positively assessed the impact of IHSs on the centralized heating system. They pointed to the need for the large-scale installation of IHSs but do not themselves create initiatives for such a process. They have mostly generalized opinions about the impact of IHSs on the quality of DH services—the impact is there, and it is predominantly positive. **POLTAVA** In Poltava, local government representatives have a rather superficial understanding of the principles of IHS operation and its impact on the quality of DH services. In general, there is an understanding that an IHS functioning in a multi-family building enables residents to consume less heat and therefore pay less for heat consumption.

	MARIUPOL Mariupol local government representatives clearly understand the influence of IHSs on the quality of DH services. This impact is assessed as extremely positive. There is also an assessment of the IHS impact on the savings of heat consumption. Mariupol representatives reported about 20–25 percent savings on payment for heat supply.
Does the representative of the local government believe the large-scale installation of IHSs in multi-family buildings to be beneficial and necessary?	**LUTSK** Lutsk representatives believe that the large-scale installation of IHSs in multi-family buildings in the city is beneficial and necessary. However, they pointed to the lack of available financial capacities to implement such measures (except for IFI-funded projects). **KHARKIV** Kharkiv representatives see the undoubted benefit of installing IHSs, primarily for the residents themselves. However, they noted that the large-scale installation of IHSs will also be beneficial for heat networks, despite the widespread opinion that it is not profitable for DH companies because they will sell less heat energy. The representatives also noted that CU Kharkiv Heat Networks will benefit through savings on the heating carrier, which is why they notice only positive effects from the large-scale installation of IHSs in Kharkiv buildings. **POLTAVA** Local government representatives in Poltava generally expressed a positive attitude toward the large-scale installation of IHSs in multi-family buildings in Poltava. They confirmed that they are aware of the benefits of such measures in terms of savings in payments for heat supply. However, their opinions are rather superficial. They gave no answers to more specific questions about their vision of the strategy for a larger-scale installation of IHSs. There is also an element of distrust of the local heat supply company; Poltava City Council believes that allowing Poltavateploenerho to own the IHSs in the city is simply not profitable. There are fears that

	the representatives of the heat supply company simply will not give residents the opportunity to save on heat energy. **MARIUPOL** Local government representatives in Mariupol have a clearer understanding of the benefits and necessity of IHS installation in multi-family buildings in the city. In particular, they understand the impact of IHSs on the amount of heat consumed and the potential savings for multi-family building residents by reducing this amount.
Do local authorities inform citizens about opportunities to install IHSs in the city?	**LUTSK** There is no specific mechanism for informing local residents of multi-family buildings about the installation of IHSs in Lutsk. Representatives of SCU Lutskteplo hold awareness-raising meetings for residents of multi-family buildings IHS installation is planned with loan funds provided by the EBRD. At these meetings, residents are told in detail about the benefits of installing IHSs, as well as the source of funding, who will have the equipment on their books, and how it will be maintained. All appeals and suggestions from the residents are recorded and resolved. **KHARKIV** In Kharkiv, there are no mechanisms through which the local government informs residents of multi-family buildings about the possibilities for installing IHSs in their buildings and about the benefits and advantages of such an event. Representatives in Kharkiv do not see the need for this but rather trust the "word of mouth" method. **POLTAVA** According to the Poltava local government representative, at the moment, there are no existing or planned awareness-raising campaigns promoted by the Poltava City Council on boosting IHS installation in multi-family buildings. They believe that these measures are necessary, first of all, for HOAs and residents of multi-family buildings.

	The representative also said there is no HOA initiative to implement energy efficiency actions in their buildings and install IHSs. **MARIUPOL** Mariupol local government does not conduct awareness-raising campaigns for residents of multi-family buildings on the issue of installing IHSs. However, some local government representatives attend building-wide meetings at which residents are informed about the intention to install IHSs and try to come to a consensus on this issue. At this meeting, they show practical examples of savings on payments for heat consumption by demonstrating savings by the residents of multi-family buildings where IHSs have already been installed.
Did the local authorities provide funds for IHS installation in multi-family buildings from the local budget? If so, what was the approximate percentage of this participation in the total cost of IHS installation?	**LUTSK** The local government does not directly allocate funds for the installation of IHSs from the local budget. A representative of the Lutsk City Council confirmed that currently, IHSs are installed with loan funds in Lutsk (since 2020, the installation of IHSs in Lutsk has been in progress under Contract No. 1 "New Heat Substations (Individual Heat Substations in Residential Buildings)," which is part of the District Heating Modernization Project in Lutsk. It is implemented by SCU Lutskteplo with the financial support of the EBRD and the support of Lutsk City Council). However, funds for repayment of the loan are partly from Lutsk City Council. The representative also noted that the City Council is interested in installing IHSs in Lutsk houses, so it contributes in every possible way. There are now two support programs in Lutsk for both HOAs and ordinary buildings (that have not established HOAs yet). This program provides for the financing of building thermo-modernization actions at a 60/40 rate (60 percent of the cost is paid from the city budget and 40 percent is co-financed by residents) as well as the repayment of the principal amount of the loan for the implementation of energy-saving actions. The actions that can be implemented under this program include not only IHS installation, but also insulation of the facade, roof repair, replacement of windows, and other thermo-modernization actions.

	KHARKIV At the moment, Kharkiv City Council does not financially support the installation of IHSs in Kharkiv because of a lack of appropriate programs. The work under the World Bank-funded project could be considered their first experience in installing IHSs in Kharkiv buildings. However, we found that there is some financial support from the city—not for the installation of IHSs, but for the implementation of a raft of measures to improve thermo-modernization in multi-family buildings under the program to support local HOAs. Generally, local government representatives in Kharkiv expressed their readiness to provide financial assistance for the installation of IHSs in multi-family buildings in the city, subject to the availability of the IHS installation program financed by the city/state/IFI. **POLTAVA** In Poltava, there are also virtually no mechanisms for local self-government to fund IHS installation itself. There are mechanisms to reimburse a certain part of the costs of thermo-modernization actions in multi-family buildings. However, in practice, local governments do not inform residents and HOA representatives about these mechanisms, so many simply do not use them. Local government representatives would not hesitate to consider proposals on the allocation of funds from the city budget for energy efficiency improvement measures, including those for IHS installation. **MARIUPOL** Mariupol city authorities provide strong financial support to local HOAs in their attempts to improve energy efficiency in multi-family buildings. Since 2016, the city has had Tepli Kredyty in place, but Mariupol HOAs did not begin participating in this program more actively until 2020. At the moment, Mariupol is smoothly transferring to the Energodim program (a program of the Energy Efficiency Fund). This program has just begun to develop in the city, and the Mariupol City Council also

	budgets its share of the cost of energy efficiency measures as well as repayment of the interest rate up to 20 percent.
What sources of funding are deemed suitable and available to install IHSs?	**LUTSK** At this point, there is no discussion of direct funding for IHS installation from the Lutsk City Council. Funding for IHS installation from IFIs or through programs like Tepli Kredyty is generally considered suitable for Lutsk local government. **KHARKIV** In Kharkiv, at the moment, there is no definite and consolidated opinion on who should finance the installation of IHSs in multi-family buildings and what sources can be considered available and suitable. In general, IHS installation in Kharkiv is available under the Tepli Kredyty program, and the city authorities reimburse a part of funds spent by HOAs on thermo-modernization of buildings. But local government representatives did not point to this mechanism as a proper or available source of funding for installing IHSs. Also, the number of established HOAs in the city is very small. **POLTAVA** Poltava local government representatives do not know of a proper and available source of funding for IHSs. They are only aware of the problem of IHS installation and can talk about the issue (but without a clear vision of proper and available funding). There is an HOA support program, but it is not in wide demand due to the lack of information for residents and HOAs themselves on the mechanism. **MARIUPOL** In Mariupol, the funding allocated under the Tepli Kredyty and Energodim programs is considered to be suitable and available. This opinion prevails among representatives of Mariupol's local government, also due to the active position of HOAs in the city. Since 2020 the number of applications for IHS

	installation funds within the Tepli Kredyty program has increased considerably, and the city has seen the efficiency of this mechanism. Representatives in Mariupol also believe that residents of multi-family buildings should contribute a little to the cost because it makes them more likely to treat the installed equipment more responsibly and have greater awareness of this issue.
Who should perform maintenance on IHSs and who should pay for it?	**LUTSK** Local government representatives in Lutsk believe that the heat supply company—SCU Lutskteplo—should have the title to the IHSs installed in the city's multi-family buildings. This is because the heat supply company has specialists who know how to properly maintain IHSs. They can provide a comprehensive approach to regulating the IHS operation. Regarding the issue of maintenance, Lutsk already has a strategy—at the moment, the heat supply company is maintaining IHSs installed with EBRD funds. In the future, Lutsk plans to include funds for operation, maintenance, and proper keeping of IHSs in the tariff for heating. Overall, Lutsk's local government believes that SCU Lutskteplo should service IHSs and the consumers of DH services should pay for it. **KHARKIV** In Kharkiv, HOAs have the title to IHSs installed in multi-family buildings under a project funded by the World Bank. Kharkiv's government representatives believe that this is the right way. They believe IHS maintenance can be done by specialized contracting companies. Consumers should pay for the technical maintenance of IHSs so that the residents will have stable and energy-efficient heating.

	POLTAVA According to the local government representatives in Poltava, HOAs should have the title to IHSs, which will ensure the more efficient operation of the equipment. They have no definite opinion as to who should maintain the installed IHSs and who should pay for it. The only thing they are certain of is that this should not be done by the heat supply company (Poltavateploenerho), because they believe that if the company has the title to the IHSs and can control the temperature itself, it may not do so in good faith. That is an element of distrust of the local heat supply company, even at the local government level. Such distrust is also due to the fact that Poltavateploenerho is owned by the oblast council and is not subordinate to local governments. **MARIUPOL** In Mariupol, HOAs have the title to the equipment in the majority of multi-family buildings where the IHSs are installed. The installed IHSs are maintained by contracting companies selected and contracted by HOAs. Mariupol's local governments are satisfied with this setup and think it should continue.
Who should control the IHSs' operation mode (including the temperature regime)?	**LUTSK** The local government representatives in Lutsk believe that SCU Lutskteplo should control the IHSs' operation mode because it is a heat supply company and has specialists with the necessary qualifications and skills. **KHARKIV** The local government representatives in Kharkiv do not have a consolidated position on who should control the IHSs' operation mode. Some argue that the residents themselves should control the process, or at least should be informed about how the temperature will change in their dwellings, while others believe the contracting company should deal with this process.

	POLTAVA Poltava's local government representatives do not have a vision of who should control IHS operation mode in the city's multi-family buildings. However, they believe it definitely should not be the local heat supply company. **MARIUPOL** Local government representatives did not express an opinion on who should control the operation mode of the installed IHSs. There is a practice of appointing of the HOA board members responsible for this who decide the issues of controlling the IHS operation mode, including the temperature regime. The representatives generally consider such practice to be acceptable.
Do you know of any consumer-initiated (or HOA-initiated) IHSs installed in your city?	**LUTSK** The representatives in Lutsk are aware of cases where IHSs were installed at the initiative of residents. According to a representative of the Lutsk City Council, there are not many IHSs in Lutsk multi-family buildings that were installed precisely at the initiative of the residents of these buildings—about 20–30 for the entire city. **KHARKIV** The representatives in Kharkiv are aware of cases where IHSs were installed in multi-family buildings at the initiative of residents or HOAs. These cases are considered nonrecurrent, and no statistics can be gathered based on them. The representatives do not know exactly how many houses have installed IHSs this way but point out that most buildings installed heat meters rather than IHSs themselves. **POLTAVA** According to the representatives of Poltava City Council, there is no initiative among HOAs and residents to implement energy efficiency measures in buildings or install IHSs. The number of established HOAs in Poltava is quite small—there are just over 300 of them in the city. The representatives noted that not all of the allocated funds are spent for HOA needs.

	This is a complicated issue for Poltava's local government representatives. **MARIUPOL** In general, the majority of IHSs installed in multi-family buildings in Mariupol over the last two years were initiated by the residents and HOAs. They are the ones who decide on participation in Tepli Kredyty or Energodim as well as what energy efficiency improvement actions will be implemented in their houses with these funds. The city reimburses a certain percentage of the cost (the share of reimbursement by Mariupol and the state can reach up to 90 percent of the total loan amount).
Do you know of any problems, obstacles, misunderstandings, and conflicts between neighbors or with the DH company itself or electricity and water supply companies that residents of a building or HOAs faced when installing IHSs?	**LUTSK** Lutsk representatives are not aware of any cases of conflicts or disputes between residents of a building or with the heat supply company during IHS installation in the building. **KHARKIV** Kharkiv representatives are not aware of any cases of conflicts or disputes between residents of a building or with the heat supply company during IHS installation in the building. **POLTAVA** Poltava representatives are not aware of any cases of conflicts or disputes between residents of a building or with the heat supply company during IHS installation in the building. **MARIUPOL** Mariupol representatives are not aware of any cases of conflicts or disputes between residents of a building or with the heat supply company during IHS installation in the building.
What could give impetus to the more widespread installation of IHSs in multi-family buildings in your city?	**LUTSK** The local government in Lutsk sees purely financial barriers to the larger-scale installation of IHSs—the cost of the equipment does not allow the city to finance the large-scale installation of IHSs in multi-

	family buildings in the city on its own. In some cases, along with IHS installation, there is a need to modernize the entire in-house heating system or some of its parts. **KHARKIV** The Kharkhiv City Council listed modernization of city heating networks and the ability to attract credit funds, funding from IFIs, and an effective nationwide program to provide IHSs. In their opinion, these factors should give impetus to the large-scale installation of IHSs in Kharkiv. Also, the Council pointed out the necessity of a more effective mechanism to advance the large-scale installation of IHSs at the national level. **POLTAVA** Poltava's local government sees the main obstacle to the large-scale installation of IHSs in multi-family buildings as the unwillingness of the people themselves and the absence of initiatives from HOAs. Its representatives believe that the residents of multi-family buildings and HOA representatives must take steps toward the large-scale installation of IHSs in their buildings. **MARIUPOL** When talking specifically about large-scale installation, Mariupol's local government also points to the need for additional funding to install IHSs in multi-family buildings. In general, it does not consider the possibility of IHS installation by the local heat supply company—Mariupol Heat Network—and believes that it is HOAs that should deal with these issues on their own initiative.

4.2. RESULTS OF THE SURVEY AMONG THE REPRESENTATIVES OF LOCAL HEAT SUPPLY COMPANIES

QUESTION	ANSWER
How does the local heat supply company assess the impact of IHSs on the DH system and the quality of DH service?	**LUTSK** The local heat supply company, SCU Lutskteplo, is directly involved in the installation of IHSs in multi-family buildings in Lutsk under an EBRD-funded project and analyzes the results of such action itself. Its representatives feel the results are positive—they count on average 30 percent savings on heat consumption among most consumers of heat supply services and 45–50 percent savings among consumers of heat supply services living in buildings where other thermo-modernization actions were taken. In general, SCU Lutskteplo positively assesses the impact of installing IHSs on the DH system itself and plans to continue installing IHSs in multi-family buildings in the city under the EBRD-funded project. **KHARKIV** Representatives of CU Kharkiv Heat Networks said that, as the heat supply company, they are also interested in installing IHSs because this allows for savings and ensures an optimal temperature regime for the consumers (and hence, helps reduce the number of complaints). Therefore, in general, they are positive about the impact of IHSs on the DH system. **POLTAVA** Poltavateploenerho positively assesses the impact of IHSs on the DH system. The heat supply company believes that the large-scale installation of IHSs in multi-family buildings in Poltava would have a positive impact on the DH system's operation and the supply of heat and would reduce fuel consumption. **MARIUPOL** Mariupol Heat Network, in general, is not ready to provide a comprehensive assessment of the impact of IHSs on the DH system and on the quality of DH services. Representatives of the heat network have a more superficial opinion on their benefits and effectiveness.

	Mariupol Heat Network conducted its own monitoring of heat consumption indicators before and after the installation of IHSs and found approximately 15 percent savings. Its employees also indicated the necessity of solving certain technical issues before introducing larger-scale installation of IHSs—for example, changing the heat supply pipe diameter.
Does the heat supply company believe the large-scale installation of IHSs in multi-family buildings to be beneficial and necessary?	**LUTSK** In general, SCU Lutskteplo believes the large-scale installation of IHSs in multi-family buildings to be necessary and beneficial. The company has already installed about 80 IHSs under the EBRD project but does not plan to stop there and is actively working on further projects. The representatives of SCU Lutskteplo believe that they have gained useful experience since the beginning of the EBRD-funded IHS installation project in Lutsk, and they have already learned a lot. **KHARKIV** There is now steady progress on the installation of IHSs in Kharkiv, thanks to a joint project with the World Bank to modernize heating components in the city. In general, the representatives of CU Kharkiv Heat Networks assess the dynamics of IHS installation in the city quite positively and see great prospects for and benefits from installing such equipment for both heat supply companies and residents. **POLTAVA** Poltavateploenerho sees benefits from the installation of IHSs both for DH consumers and for the heat supply company itself. Its representatives are interested in the larger-scale installation of IHSs in the city and consider this measure beneficial. **MARIUPOL** Mariupol Heat Network understands that the savings of ordinary residents on heat payments due to IHSs will lead to certain savings for the heat supply company itself, reducing the cost of providing

	heating services. Therefore, foremost, its representatives understand the economic benefit of IHS installation in multi-family buildings, primarily for the consumers of DH services themselves. Mariupol Heat Network is not so sure about the effectiveness of large-scale IHS installation, as there are too few IHSs installed in Mariupol to allow for definite conclusions or forecasts. However, its representatives recognize the prospects for the large-scale installation of IHSs in multi-family buildings in the city.
Was the installation of IHSs in multi-family buildings funded by the heat supply company? Was there enough funding compared to the needs?	**LUTSK** SCU Lutskteplo does not finance the installation of IHSs in multi-family buildings in Lutsk and installs IHSs in the city with EBRD loan funds. **KHARKIV** CU Kharkiv Heat Networks currently does not provide funding for the installation of IHSs in multi-family buildings in Kharkiv and does not plan to do this in the near future. However, CU Kharkiv Heat Networks is ready to cooperate with city authorities, as the installation of IHSs is beneficial to all participants in the process—both implementers and end-users. For the DH company, the installation of IHSs will mean cost savings for the production and supply of heat, so there is a certain benefit. **POLTAVA** Poltavateploenerho does not finance the installation of IHSs in multi-family buildings in Poltava. The company is only an asset holder of IHSs installed under the DemoUkraina DH Program funded by NEFCO. **MARIUPOL** CU Mariupol Heat Network does not directly finance the installation of IHSs and currently plays practically no role in this process. In individual cases, the network installed IHSs in Mariupol buildings, but that was more than three years ago.

What are other sources of funding considered available and eligible for IHS installation?	**LUTSK** SCU Lutskteplo considers it eligible to finance the installation of IHSs using IFI funds. Also, according to SCU Lutskteplo, eligible and available sources include city programs to reimburse part of the funds for the implementation of measures to improve the thermo-modernization in multi-family buildings. **KHARKIV** In Kharkiv, the main source of funding for IHS installation is IFIs, particularly a joint project with the World Bank to modernize heating components in the city. According to Kharkiv Heat Networks representatives, this is quite a powerful impetus to start stepping up the process of IHS installation in multi-family buildings in Kharkiv. Successful cases and positive experiences are expected to be an impetus for more widespread IHS installation in the city, even after the project ends. There are also two other sources of funding for IHS installation that are considered available and eligible to Kharkiv Heat Networks—the investment program and the city budget. According to Kharkiv Heat Networks representatives, proposals on the investment program for IHS funding are being developed for 2022, but probably for no more than ten objects. **POLTAVA** Representatives of Poltavateploenerho have no precise opinion on what sources of IHS installation can be deemed available and eligible. The heat supply company mentioned only that paying for IHS installation with funds from IFIs (e.g., NEFCO) is considered an option. Representatives of Poltavateploenerho have no clear idea about the possible funding mechanism for IHS installation because they are not subordinate to the city authorities but to the oblast authorities, who are not interested in this process. The city authorities are not interested in this process either because they are detached from heat supply issues in Poltava, according to Poltavateploenerho representatives. **MARIUPOL** Representatives of CU Mariupol Heat Network do not have a clear and consolidated opinion on what sources of funding for IHSs can be considered eligible and available. Approximately 30 percent of

	respondents believe that investment from the city authorities is an eligible source of funding for IHS installation in multi-family buildings.
Who should perform maintenance on IHSs and who should pay for it?	**LUTSK** SCU Lutskteplo believes that its specialists are the ones who should be in charge of IHS technical maintenance and that it has the necessary technicians. In the representatives' opinion, the residents of the building should pay for this, but SCU Lutskteplo has not indicated the mechanism by which this should happen. **KHARKIV** According to Kharkiv Heat Networks representatives, the DH company's technicians should maintain IHSs so they can monitor the impact of IHS operation on the DH system. The representatives also said that there is a need for specialists in the industry, and these specialists are on the staff of Kharkiv Heat Networks. This service must be paid for by the residents of the multi-family buildings themselves through the inclusion of additional fees in the heat tariff. Kharkiv Heat Networks understands that this decision may lead to resistance from the consumers of DH services but considers this decision correct. **POLTAVA** Representatives of Poltavateploenerho noted that there is a problem with access to the basement for employees of the heat supply company. Therefore, maintaining IHSs in buildings may be problematic for them. In general, the representatives do not have a specific opinion on who should perform the maintenance. Theoretically, they do not mind doing it themselves if they have access to the basement rooms. **MARIUPOL**

	Mariupol Heat Network representatives have no clear opinion on this question, which may be because the majority of IHSs in multi-family buildings in Mariupol are installed without the participation of the heat supply company.
Who should set the IHS operation mode (including the temperature regime)?	**LUTSK** SCU Lutskteplo believes unambiguously that employees of the heat supply company should set the IHS operation mode. At the moment, employees of SCU Lutskteplo set the temperature regime in those buildings where they installed the IHSs under the EBRD-funded project. To change the temperature regime, the HOA chairperson must write an application to SCU Lutskteplo. **KHARKIV** Kharkiv Heat Networks representatives believe that the HOAs themselves should set the IHS temperature regime. However, this process should be controlled by Kharkiv Heat Networks specialists for the smooth and stable operation of the DH system itself. No mechanism for Kharkiv Heat Network's control over this process was mentioned. **POLTAVA** Representatives of Poltavateploenerho have no definite opinion as to who should set the IHS operation mode. However, they noted the problem of a lack of access to the basements of multi-family buildings, which makes it impossible to transfer the process of setting and controlling the IHS operation mode to Poltavateploenerho. **MARIUPOL** Mariupol Heat Network noted that with the number of IHSs currently installed in the multi-family buildings in Mariupol, the temperature regime could be controlled by, for example, HOAs themselves.

	But representatives of the heat supply company are against such practice if IHSs will be installed in the majority of multi-family buildings in the city. Mariupol Heat Network plans to conduct awareness-raising activities on the control and regulation of temperature regimes with residents of the buildings where IHSs are installed. This should help avoid disturbing the operation modes set by the heat supply company itself and provide an opportunity for residents to set up the IHS effective functioning. In the case of large-scale installation of IHSs, Mariupol Heat Network representatives expect to have remote access to information about IHSs' operation mode and enter into an agreement with HOAs, providing that HOAs are obliged to carry out the company's recommendations on IHS operation mode.
Are there any known cases when IHSs were installed at the initiative of the house residents in the city?	**LUTSK** SCU Lutskteplo is aware of buildings in Lutsk that have had their IHSs installed directly at the residents' initiative and with residents' co-financing. According to the heat supply company, about 50 such IHSs have been installed. However, the company representatives said that such IHSs are mostly of poor quality and do not perform their purpose. This is because of poor-quality equipment and the involvement of nonprofessional specialists. Representatives of the heat supply company also pointed out that HOA board members in the buildings where poor IHSs were installed forbid the residents to apply to SCU Lutskteplo for help. **KHARKIV** Kharkiv Heat Networks is aware of cases where IHSs were installed at the residents' initiative in multi-family buildings in Kharkiv but had no detailed information about the number of such cases or the specifics of the IHS installation process in those cases. **POLTAVA** Representatives of Poltavateploenerho noted that about 14 IHSs have been installed in Poltava's multi-family buildings without the company's involvement but does not have more detailed information about these cases.

	MARIUPOL Representatives of Mariupol Heat Network know of cases where IHSs were installed in multi-family buildings of the city at the residents' initiative but does not have more detailed information about these cases or their number. Mariupol Heat Network only considers IHS installation projects submitted to the company for approval. There are no problems with project approval.
Do you know of any problems, obstacles, misunderstandings, or conflicts between neighbors or with the DH company itself that residents of a building or HOAs faced when installing IHSs?	**LUTSK** SCU Lutskteplo is not aware of any instances of conflicts between neighbors or with the DH company itself that residents of a building or HOAs faced when installing IHSs. Residents of multi-family buildings in Lutsk predominantly have a positive attitude toward the installation of IHSs in their buildings and report an improvement in the overall comfort of the buildings. But there were other conflict situations directly related to the process of IHS installation in the buildings. These were related to the need to dismantle heat meters installed in the basements that were on SCU Lutskteplo's books. In these cases, the residents of the building resisted and did not allow the employees of the heat supply company onto the premises to dismantle the meters. **KHARKIV** Kharkiv Heat Networks has not recorded any protests or conflicts among residents or between residents and the heat supply company on the issue of IHS installation. Company representatives indicated that, on the contrary, residents are very positive about introducing such a measure in their houses (this refers to the positive attitude of people toward IHSs installed in their buildings for free as part of the project funded by the World Bank). **POLTAVA** Representatives of Poltavateploenerho are not aware of any conflicts between neighbors or with the DH company itself that residents of a building or HOAs faced when installing IHSs. This is because the

	number of IHSs installed in Poltava is quite small (approximately 25), and Poltavateploenerho was involved in the installation of only half of them. **MARIUPOL** Mariupol Heat Network representatives are not aware of any conflicts between neighbors or with the DH company itself that residents of a building or HOAs faced when installing IHSs.

4.3. RESULTS OF THE SURVEY AMONG HOA REPRESENTATIVES AND BUILDING MANAGERS

QUESTION	ANSWER
How do HOA heads and building managers assess the operation of the installed IHSs and their impact on the amount of utility charges and the level of comfort in the building?	**LUTSK** Representatives of Lutsk HOAs positively assessed the impact of IHS operation on the amounts of utility charges. In general, they reported that savings are about 40 percent.[8] They also noted a short term—about two to three months—during which they had to cover the expenses for IHS installation (if it is a case of IHS installation, partly at the expense of building residents, and partly from the city budget under the HOA support program). The level of comfort in the buildings also improved. Representatives of HCOs and management companies have less interest in the issues of IHS installation and operation than HOA representatives. About 20 percent of HCO representatives in Lutsk were not able to assess the impact of IHSs on the amounts of utility payments and savings on heat consumption. About 30 percent of representatives of HOAs, HCOs, and management companies could not name the scheme used to install IHSs in their buildings. The remaining 70 percent of representatives noted (after

[8] This figure was cited by HOA representatives in Lutsk as a percentage of savings on the payment for the heat consumed due to the installation of IHSs.

	the explanation of IHSs as dependent or independent systems) that IHSs were installed in their buildings as dependent systems. **KHARKIV** Installation of IHSs with balancing valves solved the problem of unbalancing in some multi-family buildings in Kharkiv. Thus, as HOA representatives pointed out, thanks to the installation of IHSs, it became possible to balance the temperature regime in the house and enable all residents to have a comfortable temperature in their homes. HOAs in Kharkiv indicated about 50 percent savings on heat supply bills in general.[9] Residents of a two-room apartment can save about UAH 5,000 during the heating season due to the IHS installed in the building. Representatives of CU Zhylkomservis in Kharkiv provided almost no information about their IHS impact assessment and other aspects of its functioning. They noted only that there were no complaints. In Kharkiv, 16-story buildings have IHSs installed as an independent system (there are two such buildings). In the low-rise multi-family buildings, the IHSs are installed as a dependent system, which was confirmed by the HOA representatives. **POLTAVA** HOAs in Poltava are satisfied with IHS installation in their multi-family buildings and stated that the overall improvement of comfort in the buildings is because the temperature in each apartment is now optimal, while in some cases, it might have been too high or too low before the installation. Approximately 20 percent of the surveyed HOA representatives noted a savings of 20 percent on heating payments. Another 20 percent of respondents indicated that they did not discover significant savings on their heating payments because the heating system in the building was already balanced. However, the

[9] This figure was cited by HOA representatives as a percentage of savings on the payment for the heat consumed due to the installation of IHSs.

	phenomenon of underheating has ceased in some apartments, and the temperature has become more comfortable. Most HOA representatives do not know the details of the IHS installation schemes in their buildings. Only about 17 percent of respondents managed to determine that IHSs were installed as the "dependent system" in their buildings. **MARIUPOL** In Mariupol, HOA representatives provided more scattered data on savings on heat consumption charges, namely: • Twenty-five percent of respondents claimed savings of 40–50 percent • Twenty-five percent claimed savings of 10 percent • Thirty-five percent claimed savings of 30 percent • Fifteen percent claimed savings of 20–25 percent The level of savings on heat supply with installed IHS depends on the level of building thermo-modernization: whether the doors and windows were replaced, whether the facade was insulated, whether the roof was repaired, and so on. Also, Mariupol HOAs noted the necessity of changing the system of risers and installing balancing valves—then the savings will be maximized. Also, the HOAs mentioned better redistribution of heat energy between apartments and even heating of apartments on all floors of the multi-family building. Only one out of ten respondents mentioned that the IHS was installed as an independent system in his house. In all others, IHSs were installed as dependent systems.
How much did it cost to install the IHS, and what sources were used to fund the IHS installation?	**LUTSK**

	Some HOA representatives pointed out that the cost of installing IHSs (under the Tepli Kredyty program) ranged from UAH 500,000 to 700,000. The cost of IHS depends on whether balancing valves are installed with the IHS, because this requires additional funds. Also, some HOA representatives in Lutsk participated in the Energy Efficiency Fund program, which provided for the necessary funds to insulate the in-house heating network completely. The insulation increases the cost of IHS installation by another UAH 200,000. Other HOAs indicated that the IHSs in their buildings were installed free of charge by SCU Lutskteplo (under the EBRD-funded program). All representatives of HCOs and management companies in Lutsk confirmed that IHSs in their buildings were installed by SCU Lutskteplo under the EBRD-funded project. However, none of them knew the cost. **KHARKIV** Most of the HOAs interviewed in Kharkiv installed IHSs in their buildings under Tepli Kredyty. In this case, the state reimbursed 40 percent of funds, the city reimbursed 35–40 percent, and the building residents reimbursed the remaining 20–25 percent. • Sixty-five percent of the surveyed HOA representatives mentioned that IHS installation cost about UAH 500,000–600,000. • Twenty percent reported that IHS installation cost about UAH 200,000. • Fifteen percent of respondents reported that IHS installation cost about UAH 120,000. Funds to reimburse part of the loan were collected from the residents of the buildings through lump-sum fees. The IHSs installed in multi-family buildings under the project funded by the World Bank are in buildings that CU Zhylkomservis maintains. Representatives of CU Zhylkomservis do not know how much it cost to install IHSs in their buildings.

	POLTAVA Ten percent of HOA representatives surveyed mentioned that an IHS was installed in their building under the Poltavateploenerho program. No information about the details of this program or the cost of IHS installation under this program was provided. In one building in Poltava, an IHS was installed under the Energodim program (the state and the city reimbursed 70 percent of the IHS installation cost). IHS installation with balancing valves cost UAH 647,000 under this program. In another building, the cost of installing the IHS was UAH 220,000. About 56–58 percent of that amount was reimbursed in the form of compensation under the Tepli Kredyty program. The rest was reimbursed by the residents of the multi-family building as loan repayment fees. **MARIUPOL** In Mariupol, a large number of IHSs were installed with loan funds from the Tepli Kredyty program and with funds from city support programs. In some multi-family buildings, IHSs were installed with the help of funding from the regional budget. The cost of IHS installation is almost the same under the different funding sources —about UAH 700,000. The city reimburses up to 90 percent of the funds received by HOAs for the IHS installation under the Tepli Kredyty program. The rest of the funds are reimbursed by the residents of multi-family buildings by paying additional funds included in the tariff for building maintenance or by paying a lump sum fee.
Who performs IHS maintenance in a multi-family building, and how is this service paid for?	**LUTSK** IHSs installed by HOAs using funds from programs like Tepli Kredyty or city support programs are maintained by the contracting companies that installed the equipment. HOAs enter into a contract with them, and the building residents pay for this service through additional payments for building maintenance or to the fund for repairs.

	Information about who maintains the IHSs installed in multi-family buildings that are on the books of HCOs and management companies varies. Most representatives of HCOs and management companies noted that SCU Lutskteplo provides IHS maintenance services. The representative of the management company also noted that in their buildings, IHS maintenance services are provided by SCU Lutskteplo and are paid for by the building residents. The additional cost of IHS maintenance services is added to the heating tariff. About 30 percent of HCO representatives in Lutsk do not know who pays for IHS maintenance in their buildings. **KHARKIV** • Twenty-nine percent of HOA representatives surveyed in Kharkiv noted that the contractors who entered into agreements with HOAs maintain the IHSs installed under the Tepli Kredyty program. Building residents pay for this service by paying extra money for the overall building maintenance. • Forty-seven percent pointed out that during the warranty period, the installed IHSs were maintained by the contracting company that installed them. However, later a decision was made not to enter into an agreement with them so as not to pay additional money. In such cases, the IHSs are maintained either by HOA heads themselves or by the technical staff of the building—plumbers, electricians, etc. • Twenty-four percent noted that they are engaged in technical maintenance of the IHSs. Representatives of CU Zhylkomservis know that IHS maintenance is provided by CU Kharkiv Heat Networks, but they cannot either evaluate their services or provide information on who pays for this service. **POLTAVA** In some buildings, the IHS is maintained by the company that installed it. The HOA signs a contract with them, and they do the IHS maintenance for a fee paid by the building residents.

	As one HOA representative in Poltava noted, in his building, the IHS is maintained by a responsible person—a board member. This solution is used to save money on payments to the contracting company. In buildings with IHSs installed under the Poltavateploenerho program, the heat supply company itself maintains the IHSs. HOA representatives have no complaints about their work. **MARIUPOL** In the case of IHS installation under the Tepli Kredyty program, a contracting company performs the installation and maintains the equipment. The vast majority of HOA representatives are satisfied with the work of the contracting company for IHS maintenance in the building. However, there are also dissatisfied people who pointed out the high cost of the service—UAH 12,000 per year for the entire building. In the case where IHSs were installed under the oblast financing program, the heat supply company installed and maintained the equipment. HOA representatives pointed out that they were dissatisfied with the work of the Mariupol Heat Network employees. After they adjusted the IHS operation mode, the heat consumption in one of the buildings increased by 20 percent.
Who controls the IHS temperature regime in the building, and do the building residents have any influence on this process?	**LUTSK** Building residents have no particular influence on the temperature control in the premises. A certain temperature is set, and the IHS operates to maintain this temperature. If residents have any questions, they turn to the maintenance company, which adjusts IHS operation so that the set temperature regime is constantly maintained. In some cases, HOA board chairs deal with these issues and control the IHS temperature regime. Representatives of Lutsk Housing and Utility Organization, the buildings that had IHSs installed under the EBRD-funded project, do not know who precisely controls the temperature regime of the IHSs in the buildings.

	About 50 percent of HCOs whose buildings have IHSs installed do not know who controls the temperature regime and whether there are complaints from residents on this issue. It is also unknown whether residents have any influence on this process in their buildings. A representative of the management company in Lutsk noted that the contractor who installed the IHS under a contract with SCU Lutskteplo is in charge of regulating the IHS temperature regime. Changing the temperature regime takes place at the request of the residents of the multi-family building where the IHS is installed. **KHARKIV** In Kharkiv, the issues of controlling the temperature regime in the buildings where IHSs were installed under the Tepli Kredyty program are dealt with directly by the HOA representatives. In these issues, the opinion of the building residents is taken into account—if the set temperature becomes uncomfortable for them, then the HOAs change it.[10] Representatives of CU Zhylkomservis in Kharkiv do not know who regulates the IHS temperature regime in their buildings; they assume it is done by CU Kharkiv Heat Networks. However, they could not provide exact information on this issue. **POLTAVA** In some multi-family buildings in Poltava where IHSs are installed, HOA representatives predominantly perform the temperature regulation themselves. This process takes into account the peculiarities of the construction and the heating system inside the building. Residents' opinions are taken into consideration, but they do not have a significant impact. **MARIUPOL** In one HOA in Mariupol, the decision on temperature control in the building is made collectively. In other HOAs (about 30 percent of those surveyed), the issue is settled either by questioning the

[10] In this case, HOA representatives did not specify how the opinion of the building residents is taken into account when regulating the temperature regime.

	residents or at the meeting of multi-family building residents. Thus, residents of multi-family buildings in Mariupol with installed IHSs influence the process of temperature control in their dwellings. About 17 percent of HOA representatives surveyed mention that HOA board chairs control the temperature regime at their discretion, as they know the condition of temperatures in apartments and "weak spots" of the buildings and do not need additional questioning.
Are the building residents aware of the installed IHS, and how do they evaluate its performance (utility bills, comfort, etc.)?	**LUTSK** Residents of multi-family buildings are mostly aware of the installation of IHSs due to meetings at which the majority should agree (sign) on the installation of IHS in the building. In the beginning, a certain number of residents were hostile to this event and did not trust the HOA board members. According to the HOA representative, during the first year of IHS operation, people changed their opinion and noticed significant savings on heat consumption. With this result, people saw that the money was not spent in vain. Residents are mostly positive about the IHS's impact on utility bills and overall comfort in the building. In most cases, representatives of HCOs and management companies in Lutsk are not aware of residents' impressions and opinions about the IHS installation. A representative of a management company in Lutsk assured the team that the residents of their buildings are satisfied with the IHS installation and have no complaints about its operation. **KHARKIV** HOAs assured the team that their residents are mostly satisfied with the IHS installation in their multi-family buildings. Residents positively assess the IHS's impact on the overall comfort in the apartments and the optimal temperature setting.

	Some residents were unaccustomed to living in colder temperatures than they had been used to (a decrease in temperature from 28 to 24 ˚C). However, most of these residents are mainly used to it and do not have a negative attitude toward setting such a temperature regime in their homes. Representatives of CU Zhylkomservis in Kharkiv did not say whether they ask the opinion of residents about their satisfaction or dissatisfaction with the IHS operation in their buildings, and they do not know whether residents pay for the IHS maintenance service. **POLTAVA** In Poltava, residents of multi-family buildings with IHSs installed are mostly aware of such a measure in their buildings primarily due to mandatory fees. Most residents are satisfied with the IHS installation due to the ability to live at a more comfortable temperature in the apartments; for example, previously, in one of the buildings, the temperature during the heating period was 17 ˚C in the apartments. Thanks to the IHS installation, the temperature is now more comfortable. **MARIUPOL** Many residents of multi-family buildings in Mariupol were initially hostile to the prospect of installing IHS in their buildings. However, after its installation and based on the results of its functioning, residents changed their opinion and now understand the benefits of IHS functioning in their building. At the least, people notice a comfortable temperature in their homes and the absence of overheating or underheating. They also notice savings on their heating bills compared to those of residents of Mariupol buildings with no IHS installed.
What problems or obstacles were encountered during the installation of equipment and commissioning of IHS?	**LUTSK** In one of the multi-family buildings in Lutsk, there was an obstacle in the form of the residents themselves, most of whom were persons entitled to benefits. Because they already paid a lower price for utilities than the average consumer, they were not interested in implementing measures to improve the thermo-modernization of their building.

	Another problem was the beginning of the COVID-19 pandemic—people began to withdraw their signatures for installing IHSs under the Tepli Kredyty program because they were afraid to invest their money in such an insecure period. In Lutsk, all HCO representatives noted no problems with the installation or commissioning of IHS. **KHARKIV** There were cases in which the process of obtaining approval documentation from CU Kharkiv Heat Networks took a long time—several months—apparently because of the unwillingness of the heat supply company employees themselves to accommodate HOA representatives in terms of coordinating the necessary documentation. Some HOA representatives noted the complexity of obtaining a loan for IHS installation in a multi-family building—the process was problematic and took approximately half a year. In some buildings, there were problems with the use of low-quality equipment due to the desire of residents and HOAs to save money on IHS installation. Representatives of CU Zhylkomservis in Kharkiv said they were not aware of any problems or obstacles during the installation or commissioning of IHSs. All issues with IHS installation were raised at the building-wide meetings and resolved appropriately. No serious complaints or problems mentioned by the residents were recorded. **POLTAVA** Poltava HOAs also noted the problem with a certain number of building residents having utility payment benefits: they are not interested in IHS installation as a measure for saving on payment for heating services and are not willing to contribute their funds for this purpose. **MARIUPOL** In general, Mariupol HOAs said that they did not have any extraordinary problems or difficulties with the installation and commissioning of IHSs.

	The only difficulty they named was with the approval processes when applying for a loan from a bank within the Tepli Kredyty program.
Who should have the title to the IHS in a multi-family building; who should maintain the IHS; who should control the temperature regime?	**LUTSK** HOA representatives have an unambiguous answer to the question of the title to the IHS. In their opinion, it should be the co-owners of the building. As for IHS maintenance, they believe that a specialized company should do it and that they can choose any company that does it. This option seems better to them than the option of using SCU Lutskteplo technicians. As for the regulation of IHS operation mode, one of the HOA representatives admitted that he does it himself by turning off the power for the valve. He said that this did not harm the system and that he did it because they had to wait a long time for help from SCU Lutskteplo employees. Therefore, representatives of HOAs with IHSs installed in their buildings under the EBRD-funded program and maintained by SCU Lutskteplo believe that the title to the IHSs and the right to choose who should perform its maintenance should be transferred to them. Lutsk HOAs are skeptical about the technicians and the general interest of SCU Lutskteplo in the effective operation of the IHSs installed in multi-family buildings. They believe that if HOAs directly control the IHSs' operation, the savings could be more significant because the heating company does not seem to benefit from residents making notable savings on heat consumption. Sixty percent of the Lutsk HCO representatives surveyed have no clear opinion as to who should have the title to the IHS and who should maintain it. Some even pointed out that it is better to reach the heat supply company with this issue and do not want to discuss this topic. The remaining 40 percent believe that the heat supply company should have the title to the IHS and maintain it. The representative of the management company in Lutsk said that who should have the title to the IHS depends on who was responsible for installing it and who funded the purchase of the equipment. **KHARKIV**

	HOA representatives in Kharkiv are convinced that the co-owners of the building should have the title to the installed IHS and decide on who should maintain it. The vast majority of HOA buildings with installed IHSs are maintained by contractors. In Kharkiv, most HOA representatives find this acceptable. In Kharkiv, representatives of CU Zhylkomservis, the buildings of which are equipped with IHSs by the heat supply company at the expense of IFIs, have no definite opinion as to who should hold the title, who should maintain them, and who should control the temperature regime. **POLTAVA** Poltavateploenerho representatives have no consolidated opinion as to who should hold the title, who should maintain IHSs, or who should control the temperature regime. Poltavateploenerho representatives do not mind being the owners of the IHSs and maintaining them but pointed to a number of obstacles: lack of financial ability to install IHSs at the expense of the heat supply company, problems with access to the basements, and lack of initiative from other stakeholders in the city and others. **MARIUPOL** Representatives of Mariupol HOAs with IHSs installed in their buildings believe that HOAs should have the title to the IHSs, as well as the right to control the temperature regime. A specialized contracting company should maintain the equipment.
Do building residents complain about having to pay extra money for IHS maintenance?	**LUTSK** There are residents of some apartments who do not pay the fee for IHS installation and maintenance because the temperature in their rooms has become less comfortable after that. Their apartments experienced overheating, and they were used to opening windows to make the temperature in the apartment more comfortable. Surprisingly, these residents are hostile to the fact that they now have a

	more comfortable temperature in their apartment without having to open windows and pay for the extra heat. About 30 percent of HCO representatives in Lutsk do not know who pays for IHS maintenance in their buildings. Other representatives noted that the building residents pay for it, and they have not recorded any resistance or complaints about it. **KHARKIV** Neither the HOA representatives nor the representatives of CU Zhylkomservis noted resistance among building residents to paying additional money for IHS maintenance. The reason is that when people consent to the IHS installation, they automatically agree to pay extra money for its maintenance, and this is discussed at the building-wide meetings. Representatives of CU Zhylkomservis cannot provide information about who pays for the IHS maintenance in their buildings and whether there are any complaints about this. **POLTAVA** In Poltava, for the majority of multi-family building residents who have to pay additional funds for IHS maintenance in the building, the amount is not noticeable. A certain percentage of residents complain about the increase in the cost of building maintenance by several hryvnias per month. In one of the multi-family buildings in Poltava, a tariff for building maintenance (which covers the costs of IHS maintenance) amounts to UAH 7 per square meter. About 6–7 percent of residents of multi-family buildings do not pay extra tariffs for the maintenance of their IHSs. **MARIUPOL** Mariupol HOAs noted that before introducing an extra tariff for IHS maintenance, awareness-raising activities were held with multi-family building residents. A small percentage of residents were

	dissatisfied, but the majority agreed to pay additional funds for IHS maintenance and did not complain about it.

4.4. RESULTS OF THE SURVEY AMONG DISTRICT HEATING CONSUMERS

QUESTION	ANSWER
Do DH consumers know what an IHS is and what its functions are in a multi-family building?	**LUTSK** Most DH consumers know what an IHS is and what its primary functions are in the building. Some residents of multi-family buildings even mentioned that they themselves maintain the IHS in the building. **KHARKIV** In Kharkiv, the vast majority of multi-family building residents, who were DH consumers, learned about the initiative to install an IHS in their building through a meeting of the building residents. **POLTAVA** About 33 percent of the surveyed DH consumers whose buildings had IHSs installed do not know what an IHS is or what its functions are in the building. The remaining 67 percent know what the IHS is and understand its influence on the temperature in the apartments and heat consumption. **MARIUPOL** About 79 percent of the surveyed DH consumers know what an IHS is and what its primary functions are in the building. Some residents of multi-family buildings even mentioned that they themselves maintain the IHS in the building.

Are consumers willing to have an IHS installed in their building?	**LUTSK** DH consumers who plan to have IHSs installed in their buildings have rather positive expectations. They want to have IHSs installed in their buildings and expect to save on their heating bills. **KHARKIV** In Kharkiv, consumers would like to have IHSs installed in their buildings to achieve a comfortable level of temperature in their apartments and save on their heating bills. **POLTAVA** In general, DH consumers' attitude toward the potential installation of IHSs in buildings is neutral in Poltava. **MARIUPOL** Basically, DH consumers with plans to install IHSs in their buildings have optimistic expectations. They want to have IHSs installed in their buildings, and they are happy about such an initiative in their buildings. A certain number of the residents of multi-family buildings from all cities planning to install IHS has a hostile attitude toward such an event and are against it. However, such residents are few and have no substantial influence on the decision-making process for IHS installation.
What are consumers' personal impressions of IHS functioning in the building?	**LUTSK** In Lutsk, DH consumers predominantly evaluate the impact of IHS on the overall comfort in apartments and the payments for heating as positive. Some Lutsk DH consumers initially found it unusual to get used to the new temperature regime after the installation of IHSs. This is because many apartments had been overheating—the temperature was significantly higher than necessary in the heating pipes of the apartment, so the temperature in the apartment could reach 28–30 ˚C.

	In Lutsk, DH consumers also pointed to the need to introduce other measures besides installing IHS to improve the thermo-modernization of the building. **KHARKIV** In Kharkiv, most residents of multi-family buildings with IHSs installed noted their positive impact on overall comfort in apartments, as well as savings on heating bills. Residents of multi-family buildings reported savings of 20–30 percent on heating bills due to IHS installation in their buildings. DH consumers also noted that the maximum effect of IHS installation in the building could be achieved by introducing a raft of measures to improve thermo-modernization. More than 50 percent of the surveyed DH consumers, who live in multi-family buildings where complex measures to improve thermo-modernization have been introduced, indicate 40–45 percent savings on their heating bills. **POLTAVA** In Poltava, the majority of DH consumers reported an improvement in general comfort and the level of heat supply services in their apartment buildings. There are also buildings in Poltava where the IHS installation was part of broader activities to improve energy efficiency, which had a positive effect on the residents of the multi-family building. Most of the DH consumers surveyed in Poltava mentioned that they save UAH 300–500 on heating costs per month. **MARIUPOL** In most cases, DH consumers are satisfied with IHS installation in their buildings in Mariupol. They also noted the active support of the city on this issue and the high activity of HOAs in Mariupol. DH consumers reported that the general comfort in their buildings has improved, and the temperature has gotten better.

	Only one consumer out of ten respondents expressed dissatisfaction with the performance of the IHS installed in his building, citing the increased heating bill and the uncomfortable temperature in the building.
What information do DH consumers receive from other consumers about the impact of IHS on utility bills and the comfort level in the building?	**LUTSK** DH consumers living in multi-family buildings in Lutsk receive mainly positive feedback from other building residents. They noted significant savings on heating bills and improved overall comfort in apartments. There are several dissatisfied residents per house, but the reason for their dissatisfaction is that the temperature in the apartments has dropped to a more optimal level. **KHARKIV** In general, residents of Kharkiv multi-family buildings noted that their neighbors and other residents of their building commonly report IHSs' positive impact on overall comfort and savings on heating bills. Although there are situations when some residents remain against it, they are in the minority, and the majority remains satisfied. A few building residents are not satisfied with lowering of the temperature in the dwellings to a more optimal level (from over 25 ˚C to 21–22 ˚C). **POLTAVA** Information received by DH consumers from other residents of multi-family buildings that have installed IHSs can be described as largely positive. Residents share their impressions, and the feedback, in most cases, is good. In Poltava, residents of multi-family buildings reported a general improvement in comfort in apartments and the ability to save more on heating bills. **MARIUPOL**

	In general, Mariupol's DH consumers receive neutral feedback about the IHSs from other building residents. Some residents of Mariupol multi-family buildings virtually do not comment or discuss the functioning of the IHS in their building. A few building residents are not satisfied with lowering of the temperature in the dwellings to a more optimal level (from over 25 ˚C to 21–22 ˚C).
Who do they think should be responsible for installing IHSs in multi-family buildings?	**LUTSK** According to Lutsk residents, HOAs should be directly responsible for IHS installation in multi-family buildings—it is they who are responsible for the improvement of the building. HOAs should deal with these issues, arrange the search for or collection of funds, and negotiate with the contracting company that installs IHSs and has the relevant specialists. However, about 16 percent of customers surveyed feel that HOAs cannot deal with these issues themselves and that the state or city should provide support for IHS installation. **KHARKIV** In Kharkiv, a certain portion of DH consumers believes that the residents themselves should be responsible for IHS installation (or at least should initiate the process). **POLTAVA** Several DH consumers in Poltava believe that the residents should decide whether to install the IHS, while specialized companies should install it. Other consumers do not have a vision on this issue. **MARIUPOL** A certain percentage of Mariupol DH consumers expressed that the people should initiate the process of IHS installation, and they should be the ones to organize this process. Other consumers do not have a vision for this issue.

Who should have the title to the IHS in a multi-family building; who should maintain the IHS?	**LUTSK** Most residents of Lutsk multi-family buildings argue that HOAs should have the title to the IHSs. They view the local heat supply company, SCU Lutskteplo, with a high level of distrust. Some Lutsk consumers believe that the local heat supply company may have the title to the IHS if it has installed it at its own expense (about 10 percent of respondents). Provided that the IHS was installed at the initiative and at the expense of the building residents, the opinion regarding the title to such equipment is unequivocal—the HOAs should have the title. In general, Lutsk DH consumers believe that companies that have experience installing IHSs in multi-family buildings should maintain them. DH consumers who live in buildings with IHSs installed do not consider it an option for SCU Lutskteplo to maintain the IHSs, again, due to a lack of trust in the heat supply company. **KHARKIV** In Kharkiv, some DH consumers are not versed in the issues of IHS installation and the title to it (among consumers living in multi-family buildings with IHSs already installed). Some DH consumers also believe that the building residents or the HOA should have the title to the IHS. In Kharkiv, DH consumers assume that the companies that install IHSs should maintain them, as they have qualified specialists. **POLTAVA** Fifty percent of DH consumers, who know what IHSs are and how they functions, are not well versed in such issues as who should be responsible for IHS installation in multi-family buildings and who should have the title to it.

	Some residents of multi-family buildings with IHSs installed believe that either the building residents or, if there is an HOA, the HOA should have the title to the IHSs. The majority of DH consumers living in multi-family buildings in Poltava expressed that a specialized company should be involved directly in the installation and maintenance of the IHSs. **MARIUPOL** In Mariupol, some DH consumers are not versed in the issues of IHS installation and titling. They could not express their opinion on who should be responsible for the installation of the IHSs or who should have the title to it (about 45 percent of the respondents). Other DH consumers believe that HOAs should have the title to the IHSs. Some Mariupol DH customers suppose that a qualified company with the necessary expertise should maintain the IHSs (about 65 percent of the respondents). Other consumers have no specific opinion on who should maintain the installed IHSs. In all four cities, the majority of consumers who plan to install IHSs do not have firm opinions on who should have the title to the IHSs, who should install them, and who should maintain them. Some consumers state that HOAs or appropriate building managers should deal with IHS installation.
Who has the right to regulate the IHS temperature regime?	**LUTSK** In a large number of cases, setting the correct IHS temperature regime is done by trial and error, and either the building residents themselves (on their own initiative) or HOA representatives do it. Some DH consumers note that this is done by SCU Lutskteplo. In Lutsk, DH consumers mostly have no definite opinion as to who should regulate the IHS operating temperature. **KHARKIV**

	In Kharkiv, in some multi-family buildings with IHSs installed, the building managers or HOA chairs control the temperature. The residents of these buildings do not participate in this process, as they have unreasonable requirements for the temperature regime in their buildings. There are often cases when residents of a multi-family building want their apartments to have a temperature of 26–28 °C, which is not an optimal temperature for apartments during the heating period, neither in terms of comfort nor in terms of moderate heat consumption. Most of the DH consumers surveyed in Kharkiv believe that a responsible person should control the temperature and that the intervention of the building residents into this process should be minimal. **POLTAVA** In some multi-family buildings in Poltava, residents have some influence on temperature control in their apartments and have an opportunity to express their opinion at the general meeting where the decision about the temperature regime in the building is taken. In several multi-family buildings in Poltava, residents have no such influence on temperature control, and they agree that the HOA board chair assumes this responsibility. **MARIUPOL** Not all DH consumers living in multi-family buildings in Mariupol are versed in the issue of who controls the temperature regime and who should be responsible for it. However, in cases when there are some failures in IHS operation, the residents can service the IHS themselves. In general, consumers from Mariupol are poorly versed in who in their building is responsible for controlling the IHS temperature regime. They basically do not take part in discussions on this issue and do not try to influence it.
Are DH consumers willing to pay extra money for the IHS installation or pay extra money to be included in the DH tariff?	**LUTSK** In Lutsk, one of the multi-family building residents claims that they paid a lump-sum fee to cover the cost of IHS installation in their building. The amount of the lump-sum fee was approximately UAH 200–250 per two-room apartment.

	In another building, the payment for the building repair fund includes funds to repay the loan for the IHS installation. However, not everyone is willing to pay such fees. A resident of another building claimed that the loan for the IHS installation is repaid by including additional amounts in the bill for the repair fund contribution. The amount is UAH 2.75 per month in one building and UAH 6 in another. The amount is paltry, particularly as compared with the savings that the residents of multi-family buildings have thanks to the installation of IHSs. In most cases, people agree to pay extra money for the installation and maintenance of IHSs. There may be five or six apartments in a multi-family building whose residents do not want to pay extra money for the installation and maintenance of IHSs. **KHARKIV** In some cases in Kharkiv, DH consumers paid lump-sum fees for the IHS installation. Part of the cost for the IHS installation in the building was reimbursed using those fees. People predominantly agree to pay extra money for IHS installation. **POLTAVA** In one of the buildings, reimbursement was done by including additional funds in the building maintenance tariff. Most people were not against this measure because they discussed it at the meeting and made the decision collectively. In another building, funds for repaying the share of the loan for the IHS installation were collected as lump-sum fees from each building resident. In general, Poltava DH consumers do not mind paying additional funds for the installation of IHSs. **MARIUPOL** Generally, in Mariupol, DH consumers do not mind paying extra money for the installation of IHS because they understand that they will save significantly on heating payments this way. According to

	them, a few extra hryvnias for a subscription fee cannot outweigh thousands of hryvnias saved on heating payments for the heating period. Approximately 70 percent of the surveyed consumers from all cities are ready to pay the additional funds in the form of a subscription fee, payment for building maintenance, or additional funds included in the heating tariff. The remaining 30 percent of consumers are not willing to pay the additional funds through any of these mechanisms.

5. CASE STUDY

In order to identify and classify the typical obstacles and/or problems during the phases of preparation (project development), commissioning, and post-installation maintenance in Ukrainian cities, we studied the following sources of information:

Annual reports of heat supply CUs in the cities of Ukraine
Publications on official websites of the heat supply CUs in the cities of Ukraine
Reports prepared by the city council departments of housing and utilities, energy efficiency, and the like
Publications on official websites of the city councils of Ukraine
Publications on official websites of Ukrainian ministries and offices
Sustainable development programs (strategies) of the cities of Ukraine
Reporting on investment projects and programs to modernize heating systems in the cities of Ukraine
Mass media (printed publications and online resources, reports of regional and national TV channels, etc.)

Thus, we determined the following categories of cases with similar problematic aspects in each phase:

CASE 1. Low level of public awareness
STAGE: Preliminary preparation

Cities	All cities of Ukraine
Short description of problems / obstacles	The population of Ukraine (including residents of buildings with HOAs) is currently insufficiently aware of the stages of IHS installation, maintenance, and energy efficiency issues in general.

Short description of problems / obstacles	Typical examples: 1. The analytical report on the results of the survey among institutional consumers of heating and hot water supply services conducted by the Center of Social Expertises under the project "Improving consumer services and increasing the level of citizen involvement in the governmental program to install heat meters in residential buildings, build or upgrade boiler houses, and install and repair heat substations," implemented in Dnipro in 2018, states the following: *The breakdown of respondents by their awareness of the IHS depending on the institution activity sector showed that only 4 out of 16 respondents among the representatives of educational institutions are aware of the existence of IHSs, which is significantly different from the figures for other institutions, where at least 80 percent of respondents are aware of this issue. Recall that educational institutions are one of the largest groups of institutions that participated in the study (16 institutions). In the equal in size group of institutions—health care and social assistance institutions—15 people out of 16 surveyed know about the existence of IHSs.*[11] 2. Civil Network OPORA presented the results of a survey among active members of HOAs from different regions of Ukraine regarding their plans to participate in the State Support Program for the population, HOAs, and HCOs to implement energy efficiency activities in 2016, their motives for participating in it, and doubts about its effectiveness. Among other things, the following was noted: "Respondents from HOAs (82 percent of which are board chairs) suggest that the main reason is the unreadiness of apartment owners to use the loan mechanism and low awareness of the program features."[12] 3. Decision of the Antimonopoly Committee of Ukraine No. 136-p of 02/20/2020 states the need to ensure the activities of a public consultation center on energy efficiency and implement the 2020–2022 Action Plan of Public Institution "Energy Efficiency Center in Mykolaiv" (forums, thematic and educational panels, roundtables for HOA chairs and members), which should be aimed at raising public awareness on energy efficiency.[13]
Additional Info	Given the aforementioned problems in energy efficiency, it is no surprise that one of the Council of Ministers of Ukraine's strategic objectives for the future is to ensure transparency of economic entities in the energy sector and consumer awareness.[14]

[11] https://www.minregion.gov.ua/wp-content/uploads/2019/04/UDHEEP_Dnipro_consumers.pdf
[12] https://www.oporaua.org/news/zhitlo/42242-derzhavna-pidtrymka-osbb-do-vprovadzhennia-enerhoefektyvnykh-zakhodiv-dosiahnennia-ta-perspektyvy
[13] https://amcu.gov.ua/storage/app/uploads/public/5e5/ce7/166/5e5ce7166ad232245198 35.pdf
[14] https://zakon.rada.gov.ua/laws/show/188-20#n2

CASE 2. Lack of funds to implement projects and repay credits
STAGE: Preparatory (elaboration of tender and project documentation)

Project/Program	District Heating Energy Efficiency Project in Ukraine (funded by the International Bank for Reconstruction and Development [IBRD] and Clean Technology Fund at $272.05 million, the project was planned to end in 2020)
Cities/CUs	Ivano-Frankivsk (State Municipal Enterprise Ivano-Frankivskteplokomunenerho) Donetsk (Oblast CU Donetskteplokomunenerho) Vinnytsia (CU Vinnytsiamiskteploenerho)
Short description of problems / obstacles	Due to the lack of justification for the above CUs' inability to repay their loans and problems with financial obligations to restructure their debts for value-added tax and income tax, on March 24, 2016, the Agreement was amended to withdraw $66.5 million from the loan funds and exclude Donetsk and Ivano-Frankivsk from the project participants. On June 13, 2017, the Agreement was amended to withdraw $43.45 million of the loan funds and exclude Vinnytsia from the project participants.[15]

CASE 3. Bureaucracy and paperwork burden is beyond capacity of consumers
STAGE: Preparatory (elaboration of tender and project design documentation)

Cities	All cities of Ukraine
Short description of problems/obstacles	There is a complicated mechanism for obtaining permits and technical documentation, consisting of several procedures (obtaining permits, approvals, drawings, etc., as well as the need for the relevant state authorities to approve all technical documentation, which leads to a significant need of time and resources). Typical examples: The abovementioned report by the Center of Social Expertises states the following: *According to consumers, the most challenging barrier to installing IHSs is the need to raise considerable funds for modernization. This was pointed out by 31 respondents out of 40. In addition to this, two other important barriers stand out. Firstly, it is the difficulty of technical documentation approval by the authorities as required for the IHS installation. This barrier was mentioned by 19 respondents. Secondly, 18 respondents believe that*

[15] https://www.mof.gov.ua/storage/files/GetFileAttachment2019.doc

	the obstacle is the difficulty in obtaining permits and preparing technical documentation (project).[16]

CASE 4. Obsolete housing stock and utilities
STAGE: IHS commissioning

Project/Program	District Heating Energy Efficiency Project in Ukraine (funded by the IBRD and Clean Technology Fund, the project was planned to end in 2020[17])
Cities/CUs	Kherson (City CU Khersonteploenerho) Kamianets-Podilskyi (CU Miskteplovodenerhiia) Ternopil (CU Ternopilmiskteplokomunenerho)
Short description of problems/obstacles	1. Lack of space in the basements for installing IHSs 2. Lack of utilities in most basements (electricity, pipelines, etc.) 3. Need to replace in-house networks (modernization of hot water supply system and installation of additional recirculation lines, etc.) for proper operation of IHSs and minimization of heat losses 4. Lack of comprehensive preparation of the building (thermo-modernization) before the installation of IHSs (uninsulated facades, unreplaced windows and doors in multi-family buildings), which can lead to worse performance of IHSs than expected[18; 19; 20]

CASE 5. Violation of construction regulations and legislation
STAGE: IHS commissioning, functioning, and maintenance

Cities	All cities of Ukraine
Short description of problems / obstacles	Scheduled and unscheduled inspections of IHSs' functioning in many cities have found cases of improper installation, a lack of professionalism, and a negligent attitude to work among some contractors whose task was to commission IHSs.

[16] https://www.minregion.gov.ua/wp-content/uploads/2019/04/UDHEEP_Kherson_focus-groups.pdf
[17] https://www.minregion.gov.ua/napryamki-diyalnosti/international-cooperation/spivpraczya-z-mizhnarodnymy-finansovymy-organizacziyamy/mizhnarodnyj-bank-rekonstrukcziyi-ta-rozvytku/spilni-zi-svitovim-bankom-proekti/shhodo-realizatsiyi-proektu-pidvishhennya-energoefektivnosti-v-sektori-tsentralizovanogo-teplopostachannya-ukrayini/
[18] https://www.minregion.gov.ua/wp-content/uploads/2019/04/UDHEEP_K_Podilskyi_focus-groups.pdf
[19] https://www.minregion.gov.ua/wp-content/uploads/2019/04/UDHEEP_Ternopil_focus-groups.pdf
[20] https://www.minregion.gov.ua/wp-content/uploads/2019/04/UDHEEP_Kherson_focus-groups.pdf

	A typical example comes from an excerpt from a publication on the website of Varash City Council, Rivne oblast: *Residents of many buildings and HOA heads complain about inadequate heat supply and, in some apartments, even the lack of heating at night, a considerable difference in the in-house temperature in the rooms on the upper and lower floors. Problems arise from the lack of proper automatic operation of IHSs, breach of IHS installation schemes (presence of elevators), improper heat supply in residential buildings (due to improper setting of pumping equipment in neighboring buildings), excessive consumption of heat volume by some buildings, resulting in the unbalanced system as a whole.* *Unauthorized interference of consumers in the heating system of buildings, changes in the boundaries of the living space (combining balconies and rooms), and improper installation of heating facilities (radiators) also contribute to the imbalance of the system. These problems also include the poor quality of adjustment and fine-tuning of the IHS operation, as well as the lack of working contact with the contractor (as well as means of influence on it by residents or HOAs).*[21]

CASE 6. Lack of external communication mechanisms
STAGE: IHS commissioning

Project/Program	Energy Efficient District Lviv Project, Sykhiv (supported by Deutsche Gesellschaft für Internationale Zusammenarbeit [GIZ] GmbH through the EBRD grant program, the project planned to end in 2022[22])
Cities/CUs	Lviv (Lviv City CU Lvivteploenerho)
Short description of problems / obstacles	A typical example of a violation by contractors of the Law of Ukraine "On Peculiarities of Property Rights in a Multi-Family Building" is as follows: In some buildings, IHSs were installed without the consent of the building co-owners. According to residents of the Lviv district Sykhiv, a certain number of IHSs were installed in the basements, which were privately owned by individual residents of the building, without the agreement and prior consent of the owners, which caused a number of conflict situations.[23]

[21] https://varash-rada.gov.ua/misto/istoriya
[22] http://eedlviv.tilda.ws/
[23] https://sykhiv.media/articles/ni-zharko-ni-holod-kilka-sliv-pro-itp/

CASE 7. Conflicts between the customer and the contractor
STAGE: IHS commissioning

Project/Program	Energy Efficient District Lviv Project, Sykhiv (supported by GIZ GmbH through the EBRD grant program, the project planned to end in 2022[24])
Cities/CUs	Lviv (Lviv City CU Lvivteploenerho)
Short description of problems / obstacles	A quote from the director of the contracting company Ecopower: *Individual heat substations were installed for the residents of Sykhiv last year. The only thing to do is to launch the mechanism, to complete the paperwork. However, now it is impossible because Lvivteploenerho refuses to take the IHSs in its books. When we launched the first IHSs in October 2020, we agreed to complete some stages faster. It should run for some period, and after that, it had to be commissioned into operation, and the warranty period would begin. That is how it was done in the beginning. But later, the biggest problems with Lvivteploenerho began. The facilities were running, but Lvivteploenerho did not take them in the books. We had to do the entire maintenance process during the whole heating period at our expense. Sometimes there were even statements like, if we do not do the maintenance, they will not accept our facilities further.*[25]
Additional Info	The official website of the State Energy Efficiency Fund states the following concerning the installation of IHSs and heat meters: ***Problem:*** *There are cases when after the installation of an IHS or a heat meter, heat supply companies refuse to register a commercial heat accounting unit or supply heat to the building networks. Thus, the implementation of the project to modernize the building is artificially delayed, and the residents incur unnecessary financial costs.* ***Note:*** *If an IHS and a heat metering device were installed in compliance with the current legislation, the refusal is unlawful and can be appealed.*[26]

[24] http://eedlviv.tilda.ws/
[25] https://sykhiv.media/articles/ni-zharko-ni-holod-kilka-sliv-pro-itp/
[26] https://eefund.org.ua/vstanovlennya-teplovogo-lichilnika-yak-uniknuti-nepravomirnikh-diy-teplopostachalnikh-kompaniy?fbclid=IwAR1iEMQQI5AzxiF-0Q9ugrGjSUkV2szjmLpvjgQ4Sue2DAIDzil6ahQmAfI

CASE 8. Complaints and dissatisfaction from the building residents after IHS installation
STAGE: IHS operation and maintenance

Project/Program	Zhytomyr City Heat Supply System Development Project (supported by the EBRD; the project planned to end in 2020[27])
Cities/CUs	Zhytomyr (CU Zhytomyrteplokomunenerho) Lviv (Lviv City CU Lvivteploenerho)
Short description of problems/ obstacles	Renovated heating mains, along with IHSs installed in almost 50 buildings, cannot provide regular heating in the apartments; on the contrary, they have brought suffering and led to a deluge of complaints from people.[28]
Additional Info	Residents of multi-family buildings in many cities have published similar comments on Facebook, where one can find comments like this one: *Hello. Our house is insulated, there is IHS, all the residents have individual heat meters installed. But we sometimes receive bills for heating in common areas twice as much as for heating of the apartment, although there is not a single radiator in the entrance hall. [Common areas]—as explained to us later after meetings with Lvivteploenerho, after complaints, applications to the court—is the difference between the house meter and the individual meters in the apartments. I emphasize again, the house is insulated, with plastic windows, double doors to the entrance hall. Maybe someone faced with this situation. how to change this. Because there are no savings from the use of IHS and individual heat meters.*[29]—Lviv

[27] https://tke.org.ua/559-2/
[28] https://zt.20minut.ua/Podii/problemi-teplopostachannya-abo-chomu-tak-buvae-do-stini--teplo-a-vsere-10975127.html
[29] https://www.facebook.com/upravbud.ua/posts/2809720096006704

6. ANALYSIS OF THE IMPLEMENTATION EXPERIENCE

General situation. IHSs are actively implemented in buildings with HOAs established and by heat supply companies/cities that receive grant or loan funding from IFIs.

In other cases, IHSs are not implemented (with a few exceptions). Therefore, the large-scale installation of IHSs (and in fact, the construction of a modern DH system) requires the following:

1	Cooperation to finance the development of the DH system (including international)
2	Creation of incentives by adapting the legislation/regulatory framework
3	Promotion of HOA establishment in the cities of Ukraine

Installation of IHSs by heat supply companies. This approach has the following implementation advantages:

1	Large-scale installation of IHSs in a short period of time (by heating districts)
2	Process unification
3	More reliable IHS design (as it is a mass-produced factory-assembled device)
4	Professional maintenance (e.g., by a heat supply company)
5	Upgrade of the DH system to modern principles

However, this approach has certain disadvantages, namely the worst one—the neutral attitude (and sometimes resistance) of residents toward IHSs.

With the large-scale installation of IHSs by heat supply companies, slower progress toward further thermo-modernization of houses is also expected (due to residents being less involved in the implementation of energy efficiency actions).

Implementation problems identified by heat supply companies:

	The saturated and competitive market of IHS suppliers often leads to price dumping through the cost of installation. In such cases (in Chernivtsi, Ternopil, and other cities), the proposed equipment itself is completely satisfactory, but the budget for installation (design, erection, commissioning) is so low that it is difficult to attract qualified subcontractors, so the progress of IHS implementation is rather slow.
	Access to premises, permits (described in another section) remain a challenge.

The need to synchronize with other stakeholders (renovation or remodeling of the basement by the building owner, connection to electric networks, connection to water supply networks, etc.) can significantly slow down implementation, and contractors may not be ready for such interaction and delays.
The use of turnkey contracts (based on the FIDIC Yellow Book) complicates many aspects of the management of large-scale IHS installation contracts.

Heat supply companies have observed **satisfactory progress** of IHS implementation in such cities as Lutsk, Zhytomyr, and Lviv. A common feature (and the only condition) of effective implementation is the very close involvement of the DH company in contract management (de facto daily management of processes, including design management, approval support, daily management of subcontractors and construction, commissioning support, etc.).

However, difficult IHS implementation is observed in Ternopil (where IHSs are installed and have already had a positive effect on both residents and DH companies, but many of them are not commissioned formally—that is, implementation is not over), Chernivtsi and almost all cities of the UDHEEP program. This is caused by peculiarities of contracts, dumping of IHS components by contractors, and the neutral attitude of the heat supply company toward the contractors (no active position).

Specifics of implementation by co-owners of multi-family buildings that established HOAs:

As a rule, cities have a particular contractor or several contractors who install and maintain IHSs (which stabilizes the technical diversity of IHS equipment, but only relatively).
In general, IHS equipment to be installed is produced at low volume in Ukraine with active use of hand-assembly (although the main components—shutoff valves, pumps, meters—may be from reliable European manufacturers).
IHS installation costs approximately half as much when carried out at scale (for example, €20,000 for a single installation versus €10,000 for large-scale installation, which is partly explained by a slightly different amount of repair work, but mainly due to the significant competition and economies of scale in a large-scale installation).
IHSs installed by HOAs are aimed at providing comfort and savings for residents. Therefore, the vast majority are deprived of a heat exchanger for heating. Therefore, the positive impact on the DH system is limited in this case.

The greatest limitation of the approach in which HOAs install IHSs is the lack of actual positive impact on the DH network (that is, the system cannot transition to quantitative regulation, temperature regime, pressure adaptation, etc.). This is due to two factors:

- Transition to HOAs is gradual (often slow), so ensuring 100 percent transition to HOAs in certain areas of cities is unlikely.
- HOAs are not interested in installing IHSs if there are technical complications (size of basement or lack thereof in the building, etc.).

In the example of Mariupol, we can see progress in IHS installation thanks to the incentives for HOA establishment as well as co-funding from the city budget.

7. RECOMMENDATIONS

Note: The following recommendations for larger-scale installation of IHSs in multi-family buildings of Ukrainian cities are based both on the results of the survey and on our practical experience.

7.1. TECHNICAL RECOMMENDATIONS

HOAs and Contractors

The main input data for high-quality design and proper selection of IHS equipment are:

- Design overpressure in the supply and return pipelines of the primary circuit;
- Design overpressure in the supply and return pipelines in the in-house heating systems;
- Resistance of the in-house heating systems; and
- Static pressure of the in-house heating systems.

This is quite a significant problem for HOA representatives; lack of specialized experience and instrumentation in the in-house heating systems does not allow them to collect data on the actual performance of these systems and provide them to the design organization. Therefore, quite often, the equipment is chosen incorrectly, which later causes HOAs to complain about the inadequate operation of IHSs and the lack of the desired effect.

Most of the surveyed population is distrustful of heat supply companies, which have both relevant experience and qualified specialists to provide a full range of services to install and maintain IHS equipment, expecting these companies to act only for their own benefit.

In most cases, HOA representatives choose a contractor on the recommendation of friends, residents of neighboring buildings, etc., or via the Internet. This choice is not always successful. The involvement of contractors who do not have enough experience in installing IHSs and their choice of inefficient and low-quality equipment to reduce costs means that later, residents of multi-family buildings need to invest extra money in changing IHS operation process flow diagrams, replacing the installed equipment and reconfiguring its operation. All this ends up costing more than if the IHSs had been properly installed in the first place.

To avoid this problem; to ensure the sustainable, reliable, uninterrupted, correct operation of the IHS equipment; to comply with the regulatory parameters of heating and hot water supply in a residential building; and to get actual savings, we recommend that HOA representatives involve proven specialized organizations before the design stage.

The best option is to choose a contractor who can perform the full range of works on a turnkey basis, namely design, supply, installation, and maintenance of IHSs during operation. In other words, choose a contractor who will take responsibility for the expected effect.

As HOA representatives do not have specific knowledge about this technical area, we also recommend that HOA representatives require the contractor to submit a complete set of design and estimate documentation for a construction expert to examine beforehand. The expert can confirm the compliance of the design and technical solutions with the existing hydraulic conditions,

heat and hot water demand, energy efficiency requirements, and current standards and rules; they can also compare the cost of the IHS installation with market prices in Ukraine.

Recommendations for Technical Solutions

An IHS is designed to connect, transmit, and distribute heat energy within a single discrete building or a part of a building.

An IHS is installed between the heating system of the boiler house and the direct heat consumer. It is designed to automatically transmit heat energy from the DH network to the heating system of the building and to prepare hot water (if any) within the specified parameters directly at the consumer's facility.

An IHS comprises integrated equipment with elements of the automation system and devices to measure, control, and automatically maintain the optimal modes of space heating and hot water supply (if any). The temperature and pressure of the heat carrier and hot water are controlled and regulated in the IHS.

The temperature of the water entering consumers' heating devices is subject to regulation in terms of the outside air temperature.

Automated IHSs allow the implementation of measures to save heat and electricity at the pumping of heat carrier and hot water (if any).

Heating units can be automated according to the dependent diagram with the installation of water-jet pumps with an adjustable nozzle section or mixing pumps with an electric drive, or according to the independent diagram with the installation of heat exchangers separating the external circuit of the heating network and the internal heating circuit of the building.

The main advantage of the dependent system is the significantly lower cost of equipment as compared with the independent system.

In residential buildings that do not have enough space for heat exchange equipment, the best practice is to connect in-house heating systems to the heat supply network under the dependent diagram through a modular heat substation. Under this setup, the substation equipment shall include:

- Heating system circulation and mixing pumps
- Thermostatic control valve with electric drive
- Differential pressure regulator of direct action
- Downstream pressure controller
- Automatic regulation and control systems
- Mud boxes and filters
- Shut-off valves and other fittings
- Commercial heat consumption metering unit

- Commercial metering unit for electricity consumed by the IHS equipment
- Instrumentation and safety equipment
- Electrical equipment, electric wiring with protection (voltage and current), and start-up equipment
- Electrical switchboard
- Other equipment necessary to perform all the functions required

Advantages of the independent system:

- The possibility of flexible temperature regulation on the premises (the heat carrier of a thermal network is isolated from the heat carrier of an in-house heating system) by keeping up the necessary pressure
- The energy-saving effect—heat energy saving from 10 to 40 percent
- The high level of reliability
- The improvement of the hot water quality (if applicable)

Therefore, the recommendation is to connect in-house heating systems to the heat supply network under the independent diagram and connect hot water systems (if any) through the single-stage heat exchanger of a hot water system.

The equipment of the modular heat substation for connection under the independent diagram shall include:

- Heat exchanger of in-house heating system
- Heat exchanger of hot water supply system (if any)
- Circulation pumps for in-house heating system
- Circulation pumps for hot water supply (if any)
- Automatic regulation and control systems (heating and hot water supply)
- Mud boxes and filters
- Shut-off valves and other fittings
- Expansion tank for the independent connection diagram of the in-house heating system
- System for filling and make-up of the in-house heating circuit, taking into account the flow of water
- Commercial metering unit for heat consumed by the heating system
- Technical metering unit for heat consumed by the hot water system (if any)

- Commercial metering unit for cold water consumed for hot water preparation (if any)
- Commercial metering unit for electricity consumed by the IHS equipment
- Instrumentation and safety equipment
- Electrical equipment, electric wiring with protection (voltage and current), and start-up equipment
- Electrical switchboard
- Other equipment necessary to perform all the functions required

Modules or units should be suitable for manual transportation to the basement in compliance with safety regulations.

Pipelines that are part of the IHS should be protected against corrosion, primed, and painted (under the applicable regulatory documents).

Elements and components of the IHS should be factory insulated.

Equipment, pipelines, and fittings should be marked in accordance with the flow diagram and the requirements of state standard GOST 26828-86 "Instrumentation and machine building products. Marking." The pipelines should contain the indication of the flow direction and the designation of the medium.

IHS Installation Problems

IHS installation by heat supply companies in basements of residential buildings has many obstacles. A particular problem is that the heat supply company is not the owner of the premises in which the IHS is installed, and this makes it more difficult to obtain the IHS's technical specifications for electricity and water supply, installation of metering devices, etc. (technical specifications are issued based on the title to or lease agreement for the premises).

In order to enter into a lease agreement, the owner of a multi-family building needs to determine the rental value of the premises that will be allocated for the IHS installation, and this requires obtaining a Property Appraisal Report—a monetary appraised value of the entire building to determine the cost per square meter—which is quite an expensive procedure.

In addition, after IHS installation, the heat supply company takes over the equipment but has difficulty ensuring its safety, lack of access by unauthorized persons, and unimpeded access for company specialists to maintain the IHS equipment.

This is probably the reason that heat supply companies are not implementing many programs for IHS installation.

7.2. OTHER RECOMMENDATIONS

Define a unified strategy for promoting energy efficiency measures at the city level.

In order to ease the process of large-scale IHS installation, all stakeholders should define common goals and outcomes of activities in the following areas:

- Ensuring 100 percent mandatory commercial metering of energy consumption in the residential sector
- Reducing heat consumption in residential buildings
- Increasing the efficiency of fuel use for heat production by improving production efficiency and reducing losses in the networks

With a shared vision for energy efficiency development and common goals and priorities among stakeholders in the city, the process of large-scale IHS installation in multi-family buildings in Ukraine will become easier.

Develop the institutional capacity of the state authorities and local governments on energy saving and energy efficiency.

The dequate level of institutional capacity of the state authorities and local governments is absolutely necessary for the development and implementation of the state and regional policy in the area of energy efficiency, for initiation, preparation and implementation of the projects aimed at increasing energy efficiency.

Envisage large-scale IHS installation when developing a city's heat supply scheme.

Based on the existing experience of designing concepts for IFI investment projects for IFIs and implementing such projects in Ukraine, it is considered appropriate, in the case of DH system development, to provide for IHS installation for all consumers (except for autonomous or quasi-autonomous systems, where the feasibility of installing IHSs can be considered individually). Such a measure will allow Ukraine's cities to develop their DH systems more effectively, with the following impacts:

- Optimal diameters of heat networks
- Optimal parameters of pumps
- Optimal temperature regimes
- Optimal pressure
- Introduction of quantitative regulation

Carry out an awareness-raising campaign and measures to popularize the large-scale installation of IHSs.

Improved understanding of how IHS affects energy efficiency and energy savings will be key to generating support for large-scale installation of IHSs among Ukrainian city residents. Increased awareness will provide a better understanding of the benefits of installing IHSs and the active participation of residents in energy efficiency programs in the oblast.

It is recommended that cities conduct awareness-raising campaigns to raise public awareness of IHS installation as part of energy saving in everyday life, comprehensive energy-saving measures in buildings, and state and regional policies on energy efficiency. The campaign may include the following measures:

- Promoting successes in addressing energy efficiency problems by installing IHSs in multi-family buildings
- Airing awareness-raising campaigns in the local mass media on securing financial resources from various funding sources to install IHSs in multi-family buildings and highlighting the results of such projects
- Holding meetings and workshops for representatives of local governments, DH companies, HOAs/HCOs/management companies, and contractors involved in the installation and maintenance of IHSs to exchange experiences on IHS installation
- Placing information on the implementation of energy-saving measures, such as IHS installation in multi-family buildings, and their results on the official websites of the authorities and social media
- Publishing leaflets, booklets, and posters to build a culture of efficient energy consumption and efficient use of heat carriers; popularize the economic, environmental, and social benefits of energy saving; and improve public awareness in this area

As a result, the population should have a positive attitude toward installing IHSs as a measure to improve energy efficiency in their buildings.

ANNEX 1. KEY RESULTS OF THE SURVEY AMONG REPRESENTATIVES OF LOCAL GOVERNMENTS

CITY AUTHORITIES' ASSESSMENT OF THE CURRENT STATE OF IHSs IN THE CITY

Significance of IHSs for the City's DH Infrastructure

LUTSK

In general, the attitude toward the large-scale installation of IHSs in Lutsk is rather positive. According to a representative of the Lutsk City Council, this is a serious step toward improving the heating services and saving energy.

For several years, there has been an IHS installation program in Lutsk. The project donor is the EBRD as the administrator of the Eastern Europe Energy Efficiency and Environment Partnership (E5P) Fund, and the executor is SCU Lutskteplo.

The amount of the E5P grant is €4 million.

The project involved a tender procedure to select a contractor for IHS installation in the buildings. As a result of the procurement, a contract was awarded to a successful bidder, the Italian company AMAR DHS.

According to the results of the project impact assessment, social effects included the following: "Installation of 254 new individual heat substations will improve energy efficiency, increase the quality of district heating services and decrease the population's payments for heating services."

Monthly progress reports are submitted to the Lutsk City Council. The official websites of the utility and the Lutsk City Council contain information on the main aspects of the project's implementation progress. Correspondence is maintained with citizens who have questions about the project, and open meetings and public hearings are held. News is posted on the official website of the utility (www.teplo-dkp.lutsk.ua) and on Facebook (https://www.facebook.com/lutskteplo/).

This is SCU Lutskteplo's first experience implementing such a project. Therefore, its experience can be quite useful to other heating companies in Ukrainian cities.

According to both the representative of SCU Lutskteplo and online media,[30] the installation of IHSs in multi-family buildings has shown their effectiveness. The average rate of **savings on heat carrier is 30 percent** compared to the previous heating period.

More than **200 buildings in Lutsk have already installed IHSs**. In the winter, the use of IHSs has particular advantages due to their ability to regulate the temperature inside the premises. Special sensors help regulate the temperature in apartments based on the temperature outdoors. The convenience is also notable during the warm period, when an IHS helps avoid overheating in the apartment, as confirmed by the representatives of the Lutsk City Council.

[30] https://volynonline.com/u-luczku-prodovzhat-vstanovlennya-itp-u-bagatokvartyrnyh-budynkah/

In Lutsk, IHSs are serviced by SCU Lutskteplo. If necessary, they maintain IHSs, regulating the pressure to ensure a normal heat supply in multi-family buildings in Lutsk.

KHARKIV

In Kharkiv, a heating components modernization project is currently being implemented with funds from the World Bank. As part of the project, IHSs are being installed in multi-story buildings, so it was quite interesting to hear the opinions and experiences of representatives of Kharkiv's local government.

A representative of the Kharkiv City Council said that in Kharkiv, IHSs were installed only under the World Bank project and that **there were no other initiatives in the city at that moment**. The council knows of cases where HOAs have installed IHSs in Kharkiv on their own initiative, but these cases are so isolated that they cannot be used in any statistics. We were not told how many houses installed IHSs this way, but the council pointed out that most of them installed heat meters rather than IHSs themselves.

Regarding their opinion on the larger-scale installation of IHSs in Kharkiv buildings, a representative of the Kharkiv City Council said the following:

> *I would prefer to intensify this process because we do not have active city programs today. That is, if we are going to talk about speeding up this process even more, then, of course, so that we could cover as many houses as possible, it is desirable to receive funding, for example, from the city budget, IFIs, and credit funds from national banks...*

Tepli Kredyty operates in Kharkiv, as in many other Ukrainian cities. As we have already noticed in other cities, this program provides an opportunity to install IHSs and receive reimbursement partly at the expense of the city budget. However, in Kharkiv, this program is used mainly to cover the cost of repairs to the roof, replacement of doors/windows, and repairs in the basements of multi-family buildings. IHSs are not installed under the Tepli Kredyty program in Kharkiv buildings.

POLTAVA

In Poltava, the local heat supply company, Poltavateploenerho, is not directly subordinated to the city. That is why the city has an unusual situation with regard to the resolution of issues related to DH for residents of multi-family buildings. Local governments make almost no decisions regarding heating in Poltava; however, we had to know their opinion regarding the installation of IHSs in Poltava (which is not so common in the city).

Therefore, we spoke with representatives of the Poltava City Council and learned their opinions as to the promotion of more widespread installation of IHSs in multi-family buildings in the city:

> *Well, I believe that most likely [the installation of IHS is] necessary, but will it also be beneficial for the heat companies [meaning the local heat supply company]? Because we are all well aware that people need to understand what they pay for. Accordingly, during the heating period, it is possible to consume less heat. This is regulated generally by these [individual heat] substations.*
>
> *Probably, it is necessary, but we need to understand at whose expense it will be done... If it is a state program—our people will go for it and will do it.*

Who will regulate the individual heat substation, who will hold it on the balance sheet (that is, who will have the title to it). A heating company? If it is an HOA to be responsible for all these actions, then, for sure, people will care. If it is a heating company—well, I do not think it will be beneficial to people.

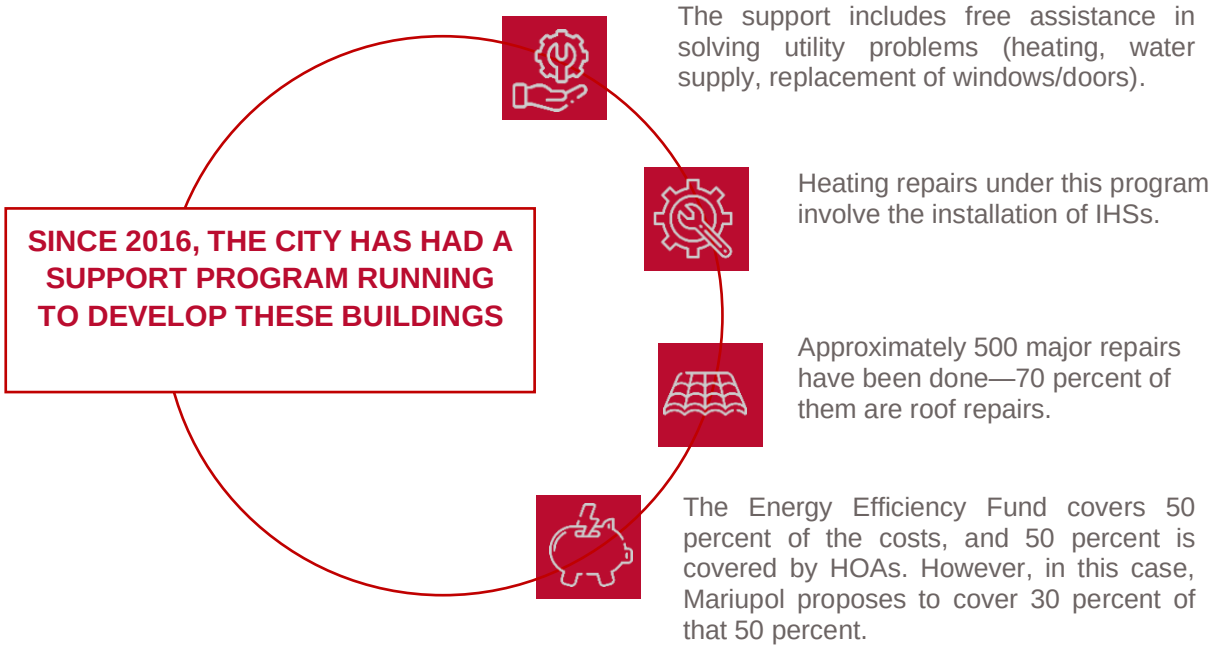
There is an understanding that IHSs, in general, are necessary and beneficial for residents of multi-story buildings in Poltava. However, unfortunately, there is no vision regarding their large-scale installation and functioning, nor any strategy on these matters.

There is also an element of distrust of the local heat supply company; Poltava City Council believes that allowing Poltavateploenerho to own the IHSs in the city is simply not profitable. There are fears that the heat supply company, which supplies heat energy, simply will not give residents the opportunity to save on that energy.

MARIUPOL

In general, the implementation of energy efficiency actions in buildings, both in budget buildings and in ordinary multi-family buildings, is a priority for the Mariupol City Council, according to its representatives.

IN TOTAL, THERE ARE 2,208 MULTI-FAMILY BUILDINGS IN MARIUPOL



A representative of the Mariupol City Council shared the following about the advantages of IHS installation for residents of multi-family buildings:

Why is IHS good for residents? Because residents are aware that if they have paid something today, they will see the feedback tomorrow in the bills—the bill will be for a lower amount. Heating, its price is growing, and we are talking about the fact that if you simply install an individual heat substation, then ***20–25 percent is the minimum savings on the bill****; it's not me confirming this but residents... The figures are not pulled out of a hat.*

The representatives shared that they will keep going and are looking for other approaches and projects that will allow the implementation of energy efficiency actions in Mariupol multi-family buildings.

They also talked about the importance of communication and how to properly communicate information to residents to convince them to decide to install IHSs:

> *When there is proper communication, when you tell the residents, "Let's collect, for instance, 100 hryvnias from each, and instead we will get this much," then we have some results.*

UAH 6.50	UAH 10
the average price for building maintenance in Mariupol (old housing stock)	the average price for building maintenance in 80 buildings in Mariupol (with IHSs installed)

The representative of the Mariupol City Council said the following concerning the residents' contribution to the process of IHS installation:

> *When a resident invests a penny, then he will definitely go to the basement to see what has been done, how much has been done, check the documents... That is, everything is done honestly, transparently, and with understanding for people. They treat it with care... Because if you do it without people, it would not work either.*

In Mariupol, they believe that they are in the lead in Ukraine as regards IHS installation. The Teplyi Dim program (under the State Energy Efficiency Program) ensured up to 90 percent compensation of the cost of materials necessary to install IHSs in buildings. Mariupol representatives believe that is almost a record among Ukrainian cities. Participation in the program proved to be very profitable for HOAs; therefore, progress in IHS installation accelerated in Mariupol. Also, with the banks having shown loyalty and given the transparency of the program in taking out loans, in 2020, the number of IHSs installed in the buildings was higher than expected by Mariupol local governments.

In addition, a representative of Mariupol City Council underlined that they informed HOA representatives that the objective of this program is the modernization of the heating system and the installation of IHSs. After all, in the city's opinion, HOAs can undertake less significant projects, such as the replacement of windows, doors, and others, and it is not necessary to involve Teplyi Dim money for those purposes. Here is a quote from a representative of the Mariupol City Council:

> *That's why, after all, in 2020, we agreed on the condition that our priority was to repair the heating system with the installation of individual heat substations.*

Informing the Residents of Multi-Family Buildings about IHS Installation

LUTSK

A probably reason why progress on IHS installation in Lutsk residential buildings can be deemed successful (compared to some other Ukrainian cities) is that multi-family building residents were actively informed about IHSs and the benefits of their installation. Residents are informed through a meeting, as confirmed by a representative of the Lutsk City Council.

Of course, before the installation of individual heat substations, a meeting of building residents is mandatory, [they are] informed about works to be done, what people will receive, the ongoing situation... Informed about the contractor, the equipment, and so on.

The meeting is held in the building. Residents are told in detail about the benefits of installing IHSs, the source of funding, who will have the equipment on their books, and how it will be maintained. All appeals and suggestions from the residents are recorded and duly resolved.

KHARKIV

In Kharkiv, the lack of initiative from the residents and HOAs concerning the IHS installation can be associated with a practical lack of mass awareness among the people. We asked whether residents were better informed about the benefits and effectiveness of IHSs after the appearance of the project funded by the World Bank in Kharkiv.

The representatives of the Kharkiv City Council confirmed that there is no awareness-raising campaign on IHS installation in multi-family buildings in the city. The only sources of information on this topic for Kharkiv citizens are publications on the news hubs, on the website of the city council, and on the Internet and in the media.

Representatives of the Kharkiv City Council see no reason for a fully-fledged awareness-raising campaign for the residents of Kharkiv on IHS installation and consider word of mouth to be the most effective:

I believe that the more IHSs we install, the more people will understand the advantages of this device... advantages in terms of comfort, advantages in terms of saving money. I think it will be all over, like, you know, word of mouth... I believe that for our people, no matter whether you conduct campaigns or not, only when they hear, to say, their authoritative acquaintance...

Representatives of the council are not aware of any cases where residents have stubbornly protested against the installation of IHSs in their buildings, somehow prevented it, or had a conflict with each other on this issue. Whether this is because most people in multi-family buildings have a neutral attitude toward such measures or because they do not understand what is happening in their houses (because they are rarely informed) is an open question.

MARIUPOL

Because there are no large-scale awareness-raising campaigns about IHSs for residents of multi-family buildings in Mariupo, it is logical to assume that some residents might perceive such innovation with hostility. Regarding conflicts between residents and HOAs on the installation of IHSs, the representative of the Mariupol City Council answered as follows:

No, as a rule, in those buildings where the installation of IHSs has taken place and that have serious HOA board chairs, they have well-established relations with the residents, so I do not catch any problems in this issue either. Well, I will not speak for all HOAs; there are probably some of them where problems arise, the ones that have not dealt with me and have no individual heat substations installed. Thus, these HOAs simply have not applied for loans and failed to enjoy help from the city or other budgets.

Temperature settings and the IHS operation mode in general are controlled by HOAs in their buildings. As a representative of the council told us, all installed IHSs in the city are equipped with the ability to display information for remote control via smartphone. An app installed on the

smartphone shows the parameters of IHS operation and allows the user to control the temperature in buildings. People responsible for temperature regulation are taught how to do it properly. Still, no randomness is allowed to avoid causing losses for the building residents.

POLTAVA

As a representative of the Poltava City Council told us, HOA representatives are aware of the possibility to reimburse a certain share of the money spent on improving energy efficiency in multi-family buildings—including IHS installation—from the city budget. Below is a quote from a council representative:

> *They know about it. There are HOA alliances that personally communicate with me.*

According to the representative, there is no HOA initiative to implement energy efficiency actions in their buildings or install IHSs. We were also told that the percentage of established HOAs is quite high in Poltava. We were even told that not all of the allocated funds are used for HOAs' needs. Thus, there are funds, there are opportunities, and there is a special mechanism of support from local governments. But there is no initiative from HOAs.

To the logical question—what exactly could encourage HOAs to be more active and address the issue of installing IHSs in Poltava buildings?—we were told the following:

> *Those HOAs that are active now—they are doing it, and they apply [to the Poltava City Council]. The thing is that more active HOAs are in new buildings, they have everything ready, and they try to work in HOAs. But no one wants to take some old five-story building with four entrances and engage in this issue. Because everything is to be done there.*

According to a council representative, at the moment, there are no existing or planned awareness-raising campaigns promoted by the council on the issue of boosting IHS installation in multi-family buildings. The council believes that these measures are necessary, first of all, for HOAs and residents of multi-family buildings.

> *If they find some issue—the installation of IHSs, for example—why not do it. If the people, the HOAs, the heat supply company need such actions, first of all, they need funds. Of course, they need it, they gather at a meeting, elect a representative, and the representative goes to the city council and talks about whether it is possible to do it. And then it's brought up for consideration; if it is agreed to, then the program is then involved.*

But, as we understood, in Poltava, HOAs do not use this scheme for some reason.

EXTENT OF FINANCIAL SUPPORT BY THE CITY AUTHORITIES IN INSTALLING IHSS

Financial Support for Projects/Initiatives to Install IHSs in Multi-Family Buildings

LUTSK

The local government does not directly allocate funds for the installation of IHSs from the local budget. Instead, a representative of the Lutsk City Council confirmed to us that IHSs are installed with loan funds (since 2020, the installation of IHSs in Lutsk is in progress under Contract No. 1 "New Heat Substations [Individual Heat Substations in Residential Buildings]," which is part of the District Heating Modernization Project in Lutsk. It is implemented by SCU Lutskteplo with the

financial support of the EBRD and with the support of Lutsk City Council). However, funds to repay the loan are partly from Lutsk City Council.

The representative also noted that the council is interested in installing IHSs in Lutsk houses, so it contributes in every possible way.

> *It does lead to improvement and to the adjustment and balancing of the citywide heating system, so it is a very important step forward.*

When asked whether the council currently sees possibilities to provide at least a certain percentage of funds to install IHSs in Lutsk buildings, a representative noted that they have **two programs to support the activities of both HOAs and conventional buildings** (although no HOAs are established at the moment).

This program provides for the **financing of building thermo-modernization actions at the rate of 40–60 percent (60 percent of the cost is paid from the city budget and 40 percent is co-financed by residents)** and for the repayment of the principal amount of the loan. The actions that can be implemented under this program include not only installation of IHSs, but also insulation of the facade, roof repair, replacement of windows, and other thermo-modernization actions.

KHARKIV

At the moment, Kharkiv City Council does not financially support the installation of IHSs because of a lack of appropriate programs. The work under the World Bank-funded project could be considered as the first experience with installing IHSs in Kharkiv buildings. Perhaps this will encourage both local government and HOAs to develop the IHS infrastructure in the city after the project is completed.

Given the above, a logical question arose—is the Kharkiv City Council ready to support programs that will help local HOAs financially in installing IHSs in their buildings when programs for this appear in the city?

> *Absolutely. Generally, if this process is, shall we say, more active... the mechanisms, the means of working with it can be developed and implemented, as I believe, in a short time.*

The council recognizes the undoubted benefit of installing IHSs, primarily for the residents themselves. However, representatives noted that the large-scale installation of IHSs will also be beneficial for heat supply companies—despite the widespread opinion that the large-scale installation of IHSs in multi-family buildings is not profitable for DH companies because it will mean they sell less heat energy.

As noted by the council, CU Kharkiv Heat Networks will benefit by saving on heat carrier. That is why local government representatives see only positive effects from the large-scale installation of IHSs in Kharkiv buildings.

MARIUPOL

According to a representative of the Mariupol City Council, there are plans for IHS system development in the city, but the process of IHS installation mainly occurs during major repairs and reconstruction of public sector buildings. So far, ten public sector buildings where capital repairs and

reconstruction were completed already have IHSs installed. At least five buildings are still under reconstruction and will also be equipped with IHSs.

According to a representative of the council, they initiated IHS installations that were not part of major repairs and reconstruction procedures in 17 educational institutions of Mariupol. Projects have already been developed, and the council expects the successful implementation of these projects in the coming years. This indicates that the city generally understands the importance and necessity of installing IHSs, at least in public sector buildings, and is taking some action in this direction.

Here is a quote from a representative of the Mariupol City Council:

> *As for IHS—it ensures savings at least, as we have calculated,* ***at least 20 percent for [educational] institutions****, well, maybe even more, and this project is implemented successfully, and the institutions where IHSs were installed after overhaul and reconstruction. Most of the IHSs (which have already been commissioned) are maintained by contractors. That is, in principle, there are no complaints about this work on IHSs, and we expect the development of this situation in the budget for the future.*

As we can see, at least in educational buildings, there are already successful experiences with IHS installation—although few buildings have been covered so far. Nevertheless, the council envisages providing for IHS installation in public sector buildings in future years.

As for funding, at the beginning of 2018–2019, the Tepli Kredyty program (which launched in 2016 in Mariupol) was little used directly due to residents' distrust of the program. People did not want to take out a loan. Nevertheless, **in 2020, the situation drastically changed**, and the results of the program exceeded all expectations of the council representatives.

In general, during the years of the Tepli Kredyty program, multi-family buildings in Mariupol were equipped with the following:

- 2018–2019: about 6 IHSs installed
- 2020: 23 IHSs installed

However, hot water production is available in only two of all previously installed IHSs.

In 2020, the Teplyi Dim program ended and is no longer funded to provide loans for HOAs and HCOs. That is why the Mariupol City Council notes that they have smoothly transitioned to the Energodim program (a program of the Energy Efficiency Fund).

For this project, Mariupol authorities created their program—"Enerhoefektyvnyi budynok" (Energy-Efficient Building)—where, in addition to the support from the Energy Efficiency Fund, the city council also provides its share of the costs for implementing energy efficiency actions, as well as **repayment of interest rates up to 20 percent**.

As pointed out by a representative of the council, the program has just begun to develop in the city and has already approved eight applications for the fund. **Two HOAs (three residential buildings) have already started implementation under their applications,** all under package B. This means that all of them plan to repair the heating system as well as install IHSs. There are two implementation packages in Mariupol under Energodim:

PACKAGE A (LIGHT)	PACKAGE B
Replaces the heating system and pipelines; installs IHSs. The city reimburses 20 percent of the money spent.	Envisages a fully-fledged thermo-modernization of the building, including insulation of the facade and roof. Under this option, the city reimburses 30 percent.

This tool for implementing energy efficiency improvement actions in buildings was new for Mariupol. By the time the program launched, the Fund had accumulated about UAH 3 billion in its account. These funds were assigned for the modernization of HOAs.

POLTAVA

At the moment, in Poltava, there are almost no mechanisms to reimburse funds for the installation of IHSs in multi-family buildings or to fund them (at least partially) from the budget of the Poltava City Council. When asked if there are any means of funding the installation of IHSs in Poltava, a representative of the council said:

> *Well, the only thing I can say is that we have a support program for various major repairs, insulation, and other things. Thus, if HOAs apply for funding for this type of service [installation of IHSs], it could also be considered. There hasn't been such a request yet. That could also be considered. And again, if they prepare all the documents, some percentage from the city budget [for reimbursement of the cost of implementing thermo-modernization actions]—we have such [mechanisms of] support. I think that can be considered as well.*

So, there are theoretically mechanisms to support HOAs in the installation of IHSs in their buildings, and the officials themselves would not mind considering such proposals. However, no such proposals have simply been received from HOAs.

Is this because of the unwillingness of Poltava HOAs to address such issues and take responsibility for such activities? Is it because they are unaware of the opportunity due to a lack of information and general ignorance of the issues of installing IHSs and of their benefits in general? We will be able to answer this question in the Annex 3, in which we will examine the experience of city HOAs with the installation of IHSs in their homes.

THE CITY GOVERNMENT'S VISION OF THE FUTURE DEVELOPMENT OF IHS INFRASTRUCTURE

Title to IHSs

LUTSK

When an IHS is installed with the help of credit funds or with the participation of several parties—both the residents of the building and the local governments—a logical question arises as to who should have the title to the IHSs.

A representative of the Lutsk City Council answered this question unambiguously—the company providing heat supply services (in this case, SCU Lutskteplo) should have the title. According to the

representative, this is because the heat supply company has specialists who know how to properly maintain IHSs. They can provide a comprehensive approach to regulating IHS operation.

Building heating systems include certain features of laying pipes and communication networks, and if the regulation and balancing of IHS operation transfer to the residents, problems cannot be avoided.

Regarding the issue of maintenance and payment for this service, a representative of the Lutsk City Council HUS Department said that while the process of installing IHS for EBRD loan funds was ongoing, SCU Lutskteplo maintained the IHSs. The latter also has the title to the IHSs installed under this program. The company will not transfer them to the balance sheets of HOAs, because SCU Lutskteplo should have the title to the IHSs under the contract.

However, according to the HUS Department representative, SCU Lutskteplo will maintain the IHSs until the end of Contract No. 1 "New Heat Substations (Individual Heat Substations in Residential Buildings)." Subsequently, the council envisages tariffing the funds for operation, servicing, and proper maintenance of the IHSs.

KHARKIV

In Kharkiv, the HOAs themselves have the title to the IHSs installed under the project funded by the World Bank. They freely give access to the basement premises and have the right to control the temperature regime of the IHSs.

We wanted to know the opinion of representatives of the Kharkiv City Council about the title to the IHSs—who exactly should have it? After all, in Lutsk, IHSs are also installed at the expense of IFIs (EBRD); however, the owner of the IHSs is SCU Lutskteplo, and as they point out, it was stated in the contract.

When asked about the title to the IHSs, a representative of the Kharkiv City Council answered as follows:

> *First of all, the one who has all the legal rights to it, and, well, directly financed the installation of IHSs... That is, it can be a heat supply company, and, also, building residents... The residents, in principle, should control the IHS operation modes. Or at least, have effective mechanisms of informing to change this temperature.*

Although the HOAs themselves have the title to the IHSs installed in Kharkiv buildings with funds from the World Bank, CU Kharkiv Heat Networks performs technical support and maintenance. Whether it will continue to service these IHSs at the end of the project is still unknown.

When asked who should technically service the IHSs (according to representatives of the Kharkiv city authorities) and who should pay for it, we were told the following:

> *At the first stage, in our opinion, a specialized company should service the IHSs. After the large-scale introduction of IHSs in the buildings, I believe that the service company can also, in principle, deal with this maintenance. As for the maintenance, we believe it should be paid by consumers so as to have a stable and energy-efficient heat supply for as long as possible.*

MARIUPOL

In Mariupol, the HOAs themselves have the title to the installed IHSs. Maintenance of IHSs is performed by contractors chosen by HOAs for this purpose.

As for who exactly controls the temperature settings, we were told that it is definitely not the residents themselves. In a multi-family building with an IHS, a person responsible for this process is elected or this responsibility is assigned to the HOA chair. The service company in charge of maintenance is responsible only for technical support of IHS operation.

A representative of the Mariupol City Council gave us one more non-obvious advantage of IHS installation: it gives an incentive to repair the heating system in the basement of the buildings and balance the risers.

The opinion of HOA representatives is a topic for the Annex 3. However, a representative of the Mariupol City Council claimed that when communicating with HOA chairs, they hear only positive feedback about the operation of IHSs in their buildings. Thus, it is clear that, at least at the HOA level, there are positive results from installing IHSs, and they may inspire other HOAs to take steps toward installing IHSs in their buildings as well.

We were also told that some HOA representatives provided information on heat consumption in their buildings for previous years and for the year when the IHS was in operation in the building. The figures indicated **savings on heat consumption of up to 25 percent.** Given the heat tariff in Ukrainian cities, the savings are enormous.

POLTAVA

When asked, a representative of the Poltava City Council said that HOAs should have the title to the IHSs, making their operation more effective and beneficial for the residents of multi-family buildings. After all, in this case, people will fully understand their responsibility for the IHS's operation and will make all efforts to operate it so that it actually brings benefits and savings for consumers of heat energy.

This is also because Poltavateploenerho currently has large losses (of profits) due to the wear and tear of the heating systems in the city. Heating systems are repaired only when there are emergencies, and there is no planned modernization of heating systems. At the moment, the company's only source of income depends on the number of people connected to the DH system and consuming heat provided by Poltavateploenerho. The company depends on the number of consumers, not the reasonableness of the tariffs. The representative expressed his concern that if the local heating company has the title to the IHSs and can control the temperature itself, it may not do so in good faith. The heating company will not enjoy losing the financial benefit of heat sales and will make all possible efforts to ensure that the residents save money on their heat bills, but not too much.

Potential Problems and Complications During the Formation of the IHS Infrastructure

LUTSK

TARIFFS

The matter of interest was the formation of tariffs for heating in the case of larger-scale installation of IHSs in multi-family buildings in Lutsk and whether it will be a problem. When asked how the large-scale installation of IHSs and the tariffing of the cost of service will affect the amount of the tariff, a representative of the Lutsk City Council said the following:

> *Well, you know the situation with tariffs—everything depends on the price of gas... In fact, it [the price of gas] is almost 70–80 percent of the component... the rest there—salaries, materials costs, repairs, investment*

component—is not so much... So, I believe that for the maintenance and for these works, it [the tariff] will not be somehow very different; it will not be a large sum. It will be a small amount to the tariff.

Projects/initiatives to install IHSs in multi-family buildings could potentially be funded by heat supply companies.

According to 2019 amendments to legislation, tariffs for heat supply take into account the costs of maintenance and repair of IHSs owned and/or used by the licensee (considering part of the costs for providing heat supply services) but not the costs for maintenance and repair of IHSs (in the absence thereof or if they are not owned/used by the licensee).[31]

In addition, on July 7, 2021, the regulator finally transferred all the authority to set heat tariffs to local governments.[32]

This could be an impetus for heat supply companies to intensify activities to install IHSs in multi-family buildings.

CONFLICTS AMONG RESIDENTS

Before installing IHSs or meters, the district heat supply company in Lutsk issues technical specifications stating the required parameters, which is mandatory in Lutsk.

According to a representative of the Lutsk City Council, there are not many IHSs in Lutsk multi-family buildings that were installed at the initiative of the residents of these buildings—**about 20–30 for the entire city**.

When asked if there were any conflicts among the building residents during the meetings and discussions on the IHS installation, the representative replied that there were no such situations (or at least they are not known to him). So, according to the representative, the majority of residents of multi-family buildings in Lutsk have a predominantly positive attitude toward IHS installation in their buildings.

Note: *During a survey among representatives of HOAs in Lutsk, it turned out that conflict situations concerning the implementation of energy efficiency actions (including the installation of IHSs) occur quite often between residents of multi-family buildings. We will talk about this in more detail in the Annex 3.*

When asked what could spur larger-scale installation of IHSs in Lutsk, a representative of the Lutsk City Council answered as follows:

Well, it's hard to say here; we have to give [financial] opportunities to people because it's not cheap after all. Maybe we could come up with some kind of appropriate program, where, well, the state would partly undertake it, partly—the city, and partly, of course, the residents... So that they [residents] would save, not break the equipment, take no action there. Of course, it would be more stimulating, and people would again experience real savings.

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[31] Resolution of the Cabinet of Ministers of Ukraine dated June 1, 2011, No. 869 "On Ensuring a Unified Approach to Setting Tariffs for Housing And Utility Services."
[32] Resolution of the National Energy and Utilities Regulatory Commission dated July 7, 2021, No. 1085 "On approval of amendments to the Licensing Terms for engaging in economic activity in the heat supply sector."

The council believes that the main obstacle to wider installation of IHSs in Lutsk is the cost of IHS equipment itself as well as the price for its design and installation.

There are almost no technical problems, according to a representative of the the city council. There are isolated cases where the entire utility system of the building or some of its components located in the basement, where the IHS should be installed, requires modernization. However, these cases are not representative or so common as to include them in the list of obstacles to the large-scale installation of IHSs in Lutsk.

KHARKIV

Modernizing city heating networks, attracting credit funds and IFIs, and establishing an effective nationwide program to provide IHSs are the conditions that the Kharkiv City Council believe would spur the large-scale installation of IHSs in Kharkiv. Below is a quote from a Kharkiv City Council representative:

> *That is, if we talk, for example, about IFIs and about credit issues—they, in general, move forward somehow and somewhere... We see that in Ukraine, there are such processes. If we're talking about modernization of heating networks, which, as I believe, is a common [problem] generally in all Ukrainian large cities,—our heating networks need to be modernized. And, of course, the more they will be ready for the introduction of IHSs, the more we can work with them.*

The council also pointed out the necessity of a more effective mechanism to advance the large-scale installation of IHSs at the national level.

The local government has a certain interest in expanding the installation of IHSs in Kharkiv buildings and understands the benefits and advantages of such a mechanism to regulate the heat supply in buildings for both the residents and the local heat supply company. However, we did not see attempts to take active steps in this direction; rather, we saw expectations of more favorable conditions. Nevertheless, the council has shown readiness and willingness to support IHS programs and initiatives if they appear in Kharkiv.

MARIUPOL

FUNDING

As expected, one of the first problems mentioned in Mariupol was funding: HOAs lack funds to install IHSs in their buildings. Mariupol believes that without the assistance of the city, regional, and state programs, HOAs would not want to undertake such a financial burden or make decisions on the installation of IHSs by themselves and by their own efforts.

As a representative of the Mariupol City Council points out, **the minimum cost of installing an IHS is UAH 600,000 ($22,486)**, which is not a small sum for any HOA in any Ukrainian city. However, the costs do not end there. After all, the installation of IHS also affects the nearby section of the heating system, where something also needs to be changed and modernized. In such a case, the costs **increase to UAH 800,000 (about $30,000).** HOAs cannot afford such expenses.

The representative also pointed out the importance of using verified suppliers of shut-off valves and controllers during the installation. This helps to avoid problems with the set-up and operation of the equipment.

Mariupol has signed a memorandum on cooperation with Danfoss's representative office in Ukraine. Therefore, the use of high-quality equipment is probably another indicator of the potentially successful implementation of large-scale IHS installation.

ACCESS TO PREMISES

During the Tepli Kredyty program, the Mariupol City Council took part in the process of installing the IHSs with the loan money; it also provided money from the city budget to cover part of the costs. Representatives of the council directly participated in the quality control of works performed; i.e., they visited IHS installation locations (basements), controlled quality of installed equipment, and generally took an active part in this process.

In general, there are no problems with access to basement premises for IHS installation. Furthermore, a representative of the council said that there had been no particular problems with the condition of the basement premises either.

Note: *In Mariupol, IHSs are maintained by contractors, not the heating network. Also, the owners of IHSs installed in multi-family buildings are HOAs and not Mariupol Heat Network.*

POLTAVA

As noted by the Poltava City Council, representatives of HOAs established in the old housing stock simply have no desire to deal with the installation of IHSs and the repair of in-house utilities because they do not want to take responsibility. Only a few decide to take on this responsibility.

Representatives of the council blame the mindset of the people and their general passivity in such matters. They do not see the need for action and encouragement on the part of, first and foremost, the local governments in Poltava.

> *Well, look, first of all, the buildings—they are not on the books of the city. They are now owned by associations of co-owners. That is, to date, the city is out of all relations to the buildings. Accordingly, these programs, which partially [repaired] the roofs over the elevators, because the elevators are our responsibility. Partially, some minor funding, some programs, or something else. Or assistance to HOAs in [their] development. Because if someone like the HOA doesn't undertake it, there just won't be any other way.*

However, they confirm the need for more widespread awareness-raising campaigns about installing IHSs in buildings for city residents.

The responsibility for developing the housing stock and improving its energy efficiency, including through the installation of IHSs, is vested entirely in HOAs in Poltava. Below is a quote from a Poltava City Council representative:

> *Accordingly, if there are HOAs that gather as a community and address the issues of their buildings, they take some loans to improve conditions for their residents and to do something for their buildings. Such desires are supported, and we have support programs for them.*

The representative also pointed out the need for support to promote more widespread installation of IHSs at the state level, that is, to develop programs and provide assistance to heat supply companies.

ANNEX 2. KEY RESULTS OF THE SURVEY AMONG REPRESENTATIVES OF HEAT SUPPLY COMPANIES

ASSESSMENT OF IHS INSTALLATION PROGRESS BY HEAT SUPPLY COMPANIES

Overall Progress in IHS Installation in the City and its Impact on DH

KHARKIV

According to information received from CU Kharkiv Heat Networks, there is now steady progress on the installation of IHSs in Kharkiv, thanks to a joint project with the World Bank to modernize heating components in the city.

> *In terms of numbers, talking merely about IHSs, since the beginning of implementation, we have the dynamics of about **25 facilities annually**. Talking just about heating [meaning other heating components], from 2018 up to today, it's somewhere around 150 facilities per year. A total of 175 facilities are being modernized per year. What we're talking about now is that in four years, we've managed to modernize 700 heat substations.*[33]

Representatives of CU Kharkiv Heat Networks also noted that they are aware of isolated cases of IHS installation at the initiative of HOAs. They stated that such cases are mostly found in new buildings because HOAs are established and operate more actively there. At the same time, the activity and persuasiveness of HOAs play a crucial role in the further activation of IHS installation at their own expense:

> *Much depends on whether the person responsible for the building is able to convey all the benefits of modernization and investment and convince them that "you bring the money and we do better."*

They also noted the lack of resistance from residents regarding the installation of IHSs and, on the contrary, their interest in such opportunities:

> *There are absolutely no refusals and protests from the population. I visited many sites, and there was no such thing; on the contrary, many would like to get it [IHS]... and were running around saying, "why is it not for us"... People go to neighbors and find out that it is better.*

In general, the representatives of CU Kharkiv Heat Networks assess the dynamics of IHS installation in the city quite positively and see great prospects for and benefits of installing such equipment for both heat supply companies and residents.

LUTSK

IHSs are being installed in Lutsk with a loan from the EBRD. The contract with the EBRD was concluded directly with the participation of SCU Lutskteplo, which has the title to the installed IHSs and generally manages the process. Representatives of SCU Lutskteplo had this to say about installation progress:

> *In our opinion, the projects of cooperation with the European Bank [for Reconstruction and Development], in fact, the implementation of these grant funds is progressing successfully. Everyone, on the level from city*

[33] Individual and district.

leaders and users to consumers directly, has noted it. We believe that we are providing European quality services for district heating and heat supply.

***

During the past year, we installed 80 IHSs out of the 254 [contracted for]. The biggest challenge was balancing the hydraulics because the IHSs are in buildings next to other buildings that do not have IHSs installed. The IHS operation had a significant impact; at the same time, we understood that the project had to start, and we knew that we would not fully implement it. Somewhere, the right thing would have been to close the district heating substation locally, to install IHSs everywhere in order to ensure no imbalances. However, we could not achieve this also because of these pre-election moments. Candidates were asking for installing in "this house, that house," and somewhere it had an impact.

Indeed, SCU Lutskteplo representatives pointed to the pre-election campaign and some candidates' political motivation to use IHS installation as a weapon in the information campaign as an obstacle to implementing the EBRD-funded project:

I want to say that our experience with installing IHSs coincided partially with the time of the election campaign. It was during that campaign that we were installing IHSs. We had such competitors, who also installed IHSs at the expense of other reserves and at the expense of the residents themselves. We had a comprehensive media attack, there were planted articles.

Nevertheless, representatives of SCU Lutskteplo believe that they have gained useful experience since the beginning of the project and that they have already learned a lot.

Last winter gave us a lot of answers—as to equipment, savings, quality, approach to regulation, and so on. Therefore, if last year we installed 80 heat substations, this year we want to close, as much as possible... To date, about 140 IHSs are already installed. The work is being actively carried out.

TARIFFS

SCU Lutskteplo also noted the impact of IHS installation on the formation heating tariffs:

In February, we approved the tariff calculated according to the new procedure, where we introduced costs by category, by type—generation, transportation, and supply of heat energy. The costs of IHS operation [included in the tariff] are insignificant, and the consumer hasn't noticed them.

Regarding savings and IHS' impact on heating bills, SCU Lutskteplo told us the following:

During winter, every month our press secretary and the sales department made a detailed analysis of all 80 buildings and gave a comparative characteristic, a comparison of heat consumption with similar periods of consumption, and with a standard fee. For the most part, on average, we counted a 30 percent reduction in heat consumption. There are buildings where the savings are 40–45 percent, up to 50 percent—these are the buildings that are thermo-modernized, where HOAs proceed in terms of equipment, replacement of internal networks, insulation, etc.

MARIUPOL

Mariupol is making progress on IHS installation, although it only started recently. We asked Mariupol Heat Network representatives about the project's progress and for their assessment as a local heat supply company.

There are not many IHSs installed in Mariupol. Indeed, the situation is not rosy. The issue is a promising one. It is clear that it needs... well, probably, a detailed consideration in terms of the main pipeline system because, in all likelihood, it will be necessary to change the pipeline diameter, that's it. And I think the issue will directly relates the population and HOAs. We do not rule out the human factor. It will be a new thing for people. There will be a lot of questions, and I believe we will not always reach a consensus.

Indeed, the larger-scale installation of IHSs will require reviewing the structure of pipelines that provide heat to multi-family buildings. After all, when installing IHSs, the need for a pipe for hot water supply disappears—it is simply disconnected, and the preparation and supply of hot water to the premises take place directly in the building where the IHS is installed. As a result, the load on the heating pipes increases and the pipes must be expanded. Wider IHS installation will mean needing this kind of work along the entire length of the heating pipes.

And in general, of course, we are very interested in it, as well as are ready to be involved in considering this project [meaning the potential projects for the large-scale installation of IHSs], respectively, to provide all the initial data, give our suggestions... But we need to understand the process, how it will be done, what is what...

When asked what is necessary for each multi-family building in Mariupol to be equipped with IHSs, the representatives of Mariupol Heat Network told us the following:

Well, probably finances. Even in case of interest... We have quite a large number of consumers in HOAs. ***That is, out of 1,800 residential buildings serviced by Mariupol Heat Network, about 1,000 already [are] in HOAs****. That is quite a considerable percentage. Some HOAs are active, some are still waiting. But the installation of IHSs, as such, is somewhere* ***from UAH 1 million****.*

It is not the first time we in Mariupol were told it costs UAH 1 million to install IHS in a multi-family building, while the average price is UAH 400,000–600,000 (according to data on tenders for IHS installation on the ProZorro platform). Mariupol Heat Network commented on the difference in cost:

In some buildings, it is enough to install automated control units. While in others consuming hot water supply—there is also a need for heat exchangers for hot water with all automation. There, the cost, of course, differs slightly, so to speak. But nevertheless, this measure is expensive.

The automated control unit of the heating system is a kind of IHS and is designed to control the parameters of the heat carrier in the heating system depending on the outdoor temperature and operating conditions of the buildings.

It consists of a correcting pump, an electronic temperature regulator maintaining the set temperature schedule, and differential pressure and loss regulators.

We asked how Mariupol Heat Network assesses the impact of IHS installation on the overall quality of heating services in the city and how it affects the level of heat consumption.

IHS is, for sure, economically beneficial. Because people have a clear understanding of how much they need, they regulate their heat costs, and accordingly, they regulate the money they pay for that heat. They understand that by paying a certain amount, they have that heat. So they get the impression that they control the process, and to some extent, they do. It's a mentality, and that's a good thing.

As for efficiency—well, single IHSs are not indicative. You have to look at everything in the complex here. Because we understand, the IHSs will be in the buildings, and we'll see echoes here in the operations of the heating system. These are expenses for gas, coal, operation, and so on and so forth.

Consequently, Mariupol Heat Network understands that when IHSs save ordinary residents money on heat payments, the heat supply company will save too, by reducing the cost of providing heating services.

Also, Mariupol Heat Network assessed the impact of IHSs on heat consumption and made the following conclusions:

We monitored how the payment changes before the installation of IHSs and after. Well, let's say, not in 100 percent but in around 100 percent of cases, there is a decrease in unit costs. The amount of money per square foot decreases by about 15 percent in total. That's the trend. Where they operate properly, normally, where the heating system is more or less set up in new buildings, it has an effect, for sure. Where we don't have that, we have to keep working.

POLTAVA

After communicating with representatives of local governments in Poltava, it became clear that the situation of IHS installation in multi-family buildings in the city is quite complicated. The local government shifts all responsibility to HOAs and believes that the local heating company should not engage in installing IHSs in buildings because it will try to profit from it.

We were particularly interested in the opinion of Poltavateploenerho representatives on the progress of IHS installation in the city and the problems and obstacles to the larger-scale introduction of IHSs. Below is a quote from a Poltavateploenerho representative:

The city of Poltava is problematic in this respect from start to finish. And the main reason for that, the only reason is that no one needs it.

Poltavateploenerho has its own impression of progress on IHS installation in the city:

This trend is developing very, very slowly. During the last year, three HOAs turned to us for recommendations on equipment [to install IHSs]. Unfortunately, I have no information as to whether or not they have installed the IHS.

When asked for the reasons behind this slow progress, two of them answered as follows:

In order for any process to go ahead, there must be some interested party that cares about it and wants to implement this activity. At the moment, there is no such party, initiative person, institution, or anyone else. The residents are scattered, they are not aware of the need for this, and they have not developed the desire for it. Even where there are HOAs—we have hundreds of them in the city district, but not all of them have installed IHSs. Why is it so among the residents—well, maybe it is ignorance, or maybe it is some kind of indifference. Because these problems, well, they're somewhere far a bit.

***

As for the city authorities, traditionally in Poltava, the city authorities have always been alienated from issues of heat supply, and they have developed, so to speak, a steady reflex that heat is not their responsibility.

Hence the logical question arises—what about the interest of Poltavateploenerho itself in the large-scale installation of IHSs in Poltava? Are they interested in this process, and will they participate in relevant donor-funded projects, if there are any in Poltava? A representative of Poltavateploenerho answered this question as follows:

> *Strange as it may seem, we, as a company interested in selling the largest amount of heat energy, do have that interest. We would be interested if most of our consumers were equipped with IHSs. For a number of reasons: it is the process mode and the delivery mode and reduction of fuel consumption and so on. We would be interested.*

Informing the Residents of Multi-Family Buildings about IHS Installation

KHARKIV

In Kharkiv, there are virtually no actions to widely inform residents about the opportunities and benefits of installing IHSs. According to the representative of CU Kharkiv Heat Networks:

> *Several years ago, one NGO prepared an awareness-raising campaign, but it never got to the point, and these processes failed to launch.*

The main sources of information on this topic for Kharkiv citizens are publications on the news hubs, on the website of the city council, on the Internet, and in the media.

Most often, citizens learn the advantages of installing IHSs by word of mouth. As evidenced by the experience of the current project with the World Bank, residents perceive news about the possibility of installing IHSs positively and are willing to participate.

> *There have been no protests at any of the sites. On the contrary, people are making phone calls, shouting, saying "hurry up"... They really like that it started; they won't overpay for cubic meters when it's cold in the apartment, or vice versa in spring or autumn, when the temperature outside is high.*

At the same time, there are almost no initiatives concerning independent IHS installation, which would come from the HOAs. According to representatives of CU Kharkiv Heat Networks, this is mainly due to the lack of overall positive dynamics of establishing HOAs in the city—at least 350 such associations have been established so far.

LUTSK

Every residential building that planned to install IHSs under the contract with the EBRD held a preliminary meeting. Meetings are also expected in other buildings where IHSs are to be installed. Below is a quote from representatives of SCU Lutskteplo on this issue:

> *At this awareness-raising meeting, we communicated all the information to our consumers. Starting with the fact that this equipment is beneficial, it will improve the quality of services. The equipment is free of charge, and it will be maintained by SCU Lutskteplo. And there are questions right away, "Won't you be driving up? Are you going to tamper with the meters," and so on. However, these informational meetings, the majority, the overwhelming majority, ended successfully.*

It is obvious that SCU Lutskteplo understands the need to inform the residents about the installation of the IHS and its benefits and does not wait for the residents themselves to learn about it. The representative went on to discuss awareness-raising campaigns:

It was quite difficult to install the IHS, but it was preceded by a fairly powerful awareness-raising campaign—this is the pre-election one, and in the media, on television—all the time. Within two to three years from the date of the tender procedure, we had quite a long phase. Information was constantly provided.

COMMUNICATION WITH HOAS

SCU Lutskteplo also commented on its interaction with HOAs while installing IHSs:

This winter, we were balancing the operation of our IHSs; we also had to negotiate with HOAs to inspect and properly adjust it and set the mode of the pumping equipment in order to balance the pressure. That is, we had cooperation, we cannot say that we didn't have access there in the middle of the winter, and so on. To a greater extent, we have cooperation with HOAs.

Also, SCU Lutskteplo says that at the initiative of the mayor, a meeting was arranged at which chairs of city HOAs could ask questions and SCU Lutskteplo representatives answered them. This helped improve cooperation between Lutsk HOAs and SCU Lutskteplo.

As SCU Lutskteplo mentioned, some HOAs in the city maintain about ten buildings, and their chairs and representatives have a rather strong influence on residents' opinions. They are trying to convey information about the benefits and necessity of installing IHSs to the residents of these buildings.

We've had virtually no complaints from residents since February in terms of billing, quality of service, and so on. We went through a relatively cold December, at the end of December—beginning of January, in the early days, our employees who communicate with representatives of HOAs noted that they positively perceive [the installation of IHSs], unheated houses began to be heated... There are those HOAs that have changed their opinion. There are those HOAs that have written us a letter saying that they refuse our proposal and will install IHSs at their own expense, and will regulate it themselves. There are those that have changed their opinion, and this is now a small problem because we have applied these IHS for other residential buildings. And now there are "I want yours" appeals, which means they want the IHS under the program.

MARIUPOL

The survey among local governments in Mariupol found that there are no comprehensive awareness-raising campaigns about the benefits of installing IHSs in buildings. Nevertheless, representatives of local governments attend meetings in buildings and try to convince residents of the need to install IHSs, using the example of a bill reflecting heating savings in a building equipped with IHS. When asked whether Mariupol Heat Network was informing people about the installation of IHSs in multi-family buildings, the representative responded:

Yes, I think such a rather large conference was held once based on the heating network. Representatives of the installation organization, which deals with this, came there. A lot of detailed and extensive information was communicated. But then again, people have to get around to this somehow.

At the same time, ways to inform people about IHS installation remain unclear or are absent altogether.

Another representative of Mariupol Heat Network agreed that there is a need to inform people. He confirmed the need to hold meetings, talk to the residents of the buildings, and explain the peculiarities of IHS installation and its necessity in detail. Of course, Mariupol Heat Network assumes that during such meetings, one of the first questions that people will ask is about savings due to the IHS. People will be concerned about how much less they will pay for heating if an IHS is installed in the building.

POLTAVA

Poltavateploenerho does not inform residents about the benefits and necessity of installing IHSs because the issue is out of its control, so the company cannot invest its resources and money in this.

Poltavateploenerho notes that it still trusts the word-of-mouth method more than comprehensive awareness-raising campaigns on the installation of IHS. Its representatives expect people to understand the necessity of IHS installation in the buildings of the old housing stock and initiate this process themselves.

LEVEL OF CURRENT FINANCIAL SUPPORT FOR HEAT SUPPLY COMPANIES TO INSTALL IHSs

Current Financial Support for the Installation of IHSs in Multi-Family Buildings and the role of DH Companies in this Process

KHARKIV

In Kharkiv, the main source of funding for IHS installation is an IFI, a joint project with the World Bank to modernize heating components in the city. It was quite a powerful impetus to start stepping up the process of IHS installation in multi-family buildings. The successful cases and positive experiences are also expected to spur interest in IHS installation in the city, even after the completion of the project.

Representatives of CU Kharkiv Heat Networks also informed us about other sources of funding:

> *In addition to the World Bank, we have two other sources of funding—the investment program and the city budget. Last year and the year before, the city budget funded these works. Under the investment program for 2022, proposals are being developed; there will be funding but for ten facilities maximum.*

There is a Tepli Kredyty program in Kharkiv, as in many other Ukrainian cities. As in other cities, this program provides an opportunity to install IHSs and receive reimbursement partly from the city budget. However, in Kharkiv, this program is used mainly to cover the cost of repairs to the roof, replacement of doors/windows, and repairs in the basements of multi-family buildings. IHSs are not installed under the Tepli Kredyty program in Kharkiv buildings.

Representatives of CU Kharkiv Heat Networks also noted that the availability of affordable programs and funding mechanisms is the most important prerequisite for the further large-scale installation of IHSs in multi-family buildings.

> *I understand that any enterprise would usually take up this idea. when on favorable terms. with a minimum rate, with some conditions on deferred payment. and so on. I even know that there are also grant programs from individual manufacturers to install IHSs, and even under such conditions, any municipality would take this opportunity to upgrade infrastructure, give people a quality service and remove a bunch of questions that come from the residents every day, minute and second (there is no pressure, it's cold, the water is not hot, etc.).*

CU Kharkiv Heat Networks representatives assured us that they are ready to cooperate with city authorities because they believe that the installation of IHSs is beneficial to all participants of the process—both implementers and end-users. For DH companies, the installation of IHSs will mean cost savings on heat carriers, so they also benefit.

CU Kharkiv Heat Networks itself currently does not provide funding for the installation of IHSs in multi-family buildings in Kharkiv.

LUTSK

There are 780 multi-story buildings in Lutsk that use DH services.

SCU Lutskteplo does not yet finance the installation of IHSs in multi-family buildings in Lutsk and installs IHSs in the city with EBRD loan funds. Also, SCU Lutskteplo is aware of about 50 cases when buildings in Lutsk have had their IHSs installed directly at the initiative of and co-financed by residents.

> *The IHSs installed by residents [themselves]—they are served under contracts by other companies. No one applies to the utility for maintenance. Although we popularize it at the meeting, show that we can do it. And during this heating season, we had two specialists providing proper maintenance for 80 IHSs. Recently we've hired another specialist—thus, we're going to service about 240 stations this winter. So we had the experience, no one just applies to us, but we have information, we respond to applications for poor quality service.*

As SCU Lutskteplo noted, IHSs installed at the initiative of residents are mostly of poor quality and do not perform their purpose because of poor-quality equipment and the lack of involvement of professional specialists:

> *Of course, there are shortcomings of those IHSs, which are installed not according to the program [funded by the EBRD]. IHSs, which are made, well, we do not know where. But there are HOAs, which invested money, ordered the residents not to apply, not to write appeals about substandard service, and we just know it is so, well, from reliable sources. It's 18 degrees in the apartments, essentially everyone is freezing, no one is contacting us. There is such an experience.*

MARIUPOL

Representatives said that the financial component is one of the biggest obstacles to the large-scale installation of IHSs. The city has effective funding mechanisms for IHS installation in buildings, but they function at the expense of city and state support programs. Mariupol Heat Network itself does not directly finance the installation of IHSs and currently plays practically no role in this process in Mariupol.

When asked if there are IHSs installed at the initiative of residents of multi-family buildings, Mariupol Heat Network said the following:

> *I cannot answer this question for sure. The communication there is more with city departments that are responsible for this. We receive a finished project for approval, and, in principle, we have nothing against it. But at this stage, there is more of a dialogue with the city.*

POLTAVA

According to a representative of Poltavateploenerho, 25 IHSs have already been installed in multi-family buildings in the city. Eleven of them were installed at the initiative of the heat supply company itself as part of NEFCO's DemoUkraina DH Project and were connected to the boiler house to supply heat in accordance with the needs of consumers. The project also included the replacement of networks—it covered the replacement of all heating pipelines in the project area and the

replacement of old boilers with new, efficient condensing boilers that can regulate heat production following heat demand. **The project was funded according to the following principle: 40 percent—loan, 40 percent—grant, 20 percent—local co-funding**. It was completed in the fall of 2015.

As Poltavateploenerho pointed out, there are also certain problems with IHSs installed under the DemoUkraina DH Project. These problems are not of a technical nature:

> *People have no understanding of these processes, why we need it, how it works. And in general, people often ask the question, "You've installed it for us, our tariff is going up, why do we need it?" No one wants to take part in their maintenance, no one wants to take them on their books... Well, in general, people do not want to work with them.*

However, representatives noted that there are exceptions, though rare:

> *Exceptions are those HOAs that have been established, that have, so to speak, according to our analysis, a fairly young group of residents who are able to understand, think through, and work through all these issues and agree to install them. But such HOAs are an overwhelming minority.*

The IHSs installed under the DemoUkraina DH Project are now on Poltavateploenerho's books. Representatives note that the company cannot transfer them to anyone else, even if it wished to, because no one needs them.

About 14 IHSs were installed in Poltava multi-family buildings without the involvement of Poltavateploenerho but at the initiative of residents.

Poltavateploenerho does not finance the installation of IHSs in multi-family buildings in Poltava.

THE HEAT SUPPLY COMPANY'S VISION OF THE FUTURE DEVELOPMENT OF IHS INFRASTRUCTURE

Title to IHSs and Problems with Access to the Premises

KHARKIV

In Kharkiv, HOAs themselves have the title to IHSs installed under the project funded by the World Bank, and CU Kharkiv Heat Networks provides technical support and maintenance. HOAs freely give access to the basements' premises and have the right to control the temperature regime of the IHSs.

We wanted to know the opinion of the representatives of CU Kharkiv Heat Networks on the title to the IHSs—who exactly should have it? The answer was unequivocal:

> *It's the property of the territorial community. As a result of the installation, it will be on our balance sheet, that is, all 700 units will be on our books. Everything will be serviced by our company: operating personnel, adjusters, etc.*

To the question of who should pay for IHS maintenance, we were told the following:

According to the laws, all these costs should be borne by the direct consumers of heat energy; thus, it will affect the price of energy and will be the consumer's burden. People, of course, probably do not like it very much because they want to get cheaper and more.

LUTSK

Because the owner of the IHSs installed in Lutsk multi-family buildings is SCU Lutskteplo, the company also maintains the IHSs. A representative of SCU Lutskteplo told us how this happens and what is needed for more efficient maintenance of IHSs in Lutsk buildings:

We created a subdivision that has successful technicians who already had experience with the installation and operation of IHSs, so there were no problems with the IHS maintenance during the winter. The only thing we understand is that our closing contract with the EBRD—[for the installation of] SCADA—will give us the opportunity and technical characteristics of IHSs, means of IHS remote control, the ability to more quickly and better approach the provision of quality services, and openly maintain IHSs, implement certain measures to keep the proper temperature and operation of IHSs.

As the representative noted, they had no problems with access to the basement to install IHSs:

We signed a contract with a contractor already experienced in installing IHSs in Ukraine, and we took advantage of its experience in terms of obtaining permits from owners and residents of residential buildings.

Although there were no particular problems with access to the basements, there were problems with the condition of the basements:

One of the main problems is the sanitary condition of the basement premises. When you go to the basement, unfortunately, we have Soviet-type buildings—those built in the 70A and 80s—and, unfortunately, it was impossible to find a separate room for IHS installation that would meet current standards. I mean a room with a separate entrance, ventilation, lighting, of appropriate height, and so on and so forth. This was and still is one of the main problems in installing IHSs.

When installing the IHSs, there were issues of common access with the owners and co-owners of the premises in the building. The basements did not meet sanitary standards, and SCU Lutskteplo had to ensure the possibility to install the IHSs. Building basements include critical building utilities, which means a need to agree on the rights of access to these premises and the performance of repairs and preparatory work there with the owners and co-owners of the building. According to representatives of SCU Lutskteplo, they managed to come to an agreement on this issue:

Nevertheless, we managed, through our structural subdivision that installs individual heating substations, to come to a certain agreement with the owners on the access to the premises and the preservation of our equipment.

SCU Lutskteplo responded to the question of regulating the temperature regime in multi-family buildings where IHSs have already been installed:

We regulate. We explained [this] at the meeting of all HOA chairs, and we have the keys from them. We regulate the temperature at their request. There is an official appeal that 19 or 18 degrees are not enough in the apartment—they want 22 degrees, and the HOA chair writes us, we raise the temperature to a comfortable one. The same reaction is to a decrease in temperature.

We asked if the building residents trust the heating company to regulate the temperature in the buildings and, in general, to control the IHSs' operation mode. After all, according to a survey among representatives of local governments, there is a lack of trust in heat supply companies on this issue. There are fears that the DH companies do not benefit from selling less heat energy, so they will do everything to ensure that the residents do not have significant savings with the installed IHS. However, SCU Lutskteplo assured us that this is simply impossible.

MARIUPOL

As we found out during our conversation with representatives of the Mariupol City Council, most of the IHSs installed in multi-family buildings in the city belong directly to the HOAs themselves. They are maintained by a contracting company that entered into a contract for such services with the HOAs. For these IHSs, Mariupol Heat Network has practically nothing to do with the installation and functioning—except the design documentation approval process for its installation. It was also pointed out to us that there are no problems with access to basement premises of multi-family buildings for IHS installation works there.

Nevertheless, some IHSs were installed by Mariupol Heat Network itself, although it was a long time ago. Below is a quote from a Mariupol Heat Network representative:

> *We serve only those facilities that were put onto the books of the heat network, let's say, many years ago. There are very few of them on our books.*

We were also told that the temperature regimes are also controlled directly by representatives of HOAs themselves.

> *You know, we increasingly encounter that HOAs control the temperature regime themselves. But I want to say that practically the layout of the installed equipment allows this to be done smoothly for the hydraulic regimes. Since there are not so many IHSs themselves, it has little effect on the temperature schedules and operation modes. If, say, all the buildings have IHSs installed and begin to regulate as they want—yes, there is such a negative point. You can't do that. When the number of installed IHSs is much more, then we will look at how many will affect the operation of external heating networks.*

Mariupol Heat Network plans to conduct awareness-raising activities on the control and regulation of temperature regimes with residents of the buildings where IHSs were installed. This should help prevent anyone from disturbing the operation modes set by the heat supply company and provide an opportunity for residents to set up the IHS effective functioning (i.e. the residents can set up operation mode but have to do this in line with technical recommendations and frame, provided by the heat supply company).

According to company representatives, the HOAs should decide the temperature regime in the buildings, but Mariupol Heat Network will have to control these processes.

> *If there will be a large number of IHSs, then, first of all, there should be channels of communication with them. I assume that it could be an Internet connection with a clear understanding of the state of the IHS, so, on what modes [they] work, and some restrictions on changing modes, this or that. For example, the minimum is so much, the maximum is so much, well, some limits. Well, and, accordingly, some regulatory documents will be needed. Joint agreements with HOAs that provide for HOAs being obliged to comply with our recommendations in order not to harm the networks of the city heating system.*

POLTAVA

Poltava has a special situation—the housing stock in the city is managed by the local government, but the heating company is subordinate to the oblast council. Even if there is funding for the installation of IHSs in the city's buildings—for example, credit or grant funds provided under a program financed by an IFI—who will have the title to the IHSs installed in such a case? And how will the issues of access to the basements be solved? In the city, there is a very small percentage of buildings have HOAs, and in many buildings, there are no appointed managers.

A representative of Poltavateploenerho pointed out that this is quite a serious and significant issue for the city, giving the following example:

> *In the first stage, we equipped apartment buildings with heat meters, in the second stage, we will equip buildings with hot water meters. As for heat meters, we managed—with pain and misery—to install them, but now with hot water meters, we have about 50 percent of denials to grant access to the basements. The same situation will be with the IHSs, it is for sure.*

As we can see, the problem of access to the basements to install equipment is significant in Poltava. This problem will have to be solved with co-owners of multi-family buildings. Otherwise, even if IHS installation in Poltava restarts, in the future, it may face an obstacle in the form of installers' inability to access basements.

However, if Poltava has a program with a large number of IHSs to be installed (for example, using grant funds), representatives of Poltavateploenerho consider the possibility of communicating with local governments to address the issue of access to the basements:

> *If it is, so to speak, an extensive program, then we can go to the local authorities and somehow negotiate so that the authorities contribute to this access. Today, for example, in order to get in and install an in-house meter for hot water, we are trying to get a wayleave through the court. So far unsuccessfully. It all drags on, it's all long, very long and bureaucratic.*
>
> *If it is going to be a large project, then it is possible to reach the level of local authorities, to attract their support, so it would be centralized, with some kind of media support, and so on. That could happen. But for now, it's like this.*

A List of Potential Problems and Complications during the Formation of the IHS Infrastructure

KHARKIV

In general, CU Kharkiv Heat Networks believes the most significant challenges on the way to large-scale installation of IHSs to be insufficient financial resources, the lack of modernization of heating networks, and the low number and activity level of HOAs for such a large city as Kharkiv.

CU Kharkiv Heat Networks assured us that heating companies are also interested in installing IHSs because this allows for savings and ensures an optimal temperature regime for the consumers (and hence helps reduce the number of complaints).

In addition, its representatives assured us of their willingness to cooperate with the city authorities and participate in other national/international programs to fund the installation of IHSs.

At the same time, we understand that CU Kharkiv Heat Networks does not conduct any awareness-raising campaigns to disseminate information about positive experiences with already-installed IHSs in the city, which could spark interest and make it more likely that residents of multi-story buildings would take the initiative to install IHSs.

LUTSK

SCU Lutskteplo borrowed the model of IHS installation from the state program for the installation of metering devices; however, according to its representatives, individual problems still arose:

> *The fact is that there is a certain misunderstanding on the part of the residents and on the part of HOAs about the transition to another type of regulation. To date, we have a qualitative regulation; we still want to achieve more accurate savings and reduction of energy consumption by qualitative and quantitative regulation. Thus, last winter, we encountered the problem when certain nuances in the start-up of some residential buildings resulted in the incorrect and substandard provision of services in other residential buildings (adjacent).*
>
> *This is why, in my opinion, we look at the installation of individual heat substations more globally than the HOA owner or property manager. We consider them from the position of district heating in a complex—boilers, utilities, the possibility of switching to a different temperature schedule, and the transition to another type of regulation.*

The representatives said that HOAs think more locally—within their building. They take energy efficiency actions only within their building and do not consider the issue of improving heating services as a whole.

Another nuance the representatives pointed out is the need to introduce a raft of actions on the thermo-modernization of multi-family buildings. Indeed, they know of cases in which **even after IHS installation, the amount of heat energy consumed did not fall but, on the contrary, increased**, which led to resentment among the residents of such buildings. Below is a quote from a representative of SCU Lutskteplo:

> *But we also have up to five houses, where the use of heat increased. We worked with a thermal imaging camera and showed consumers and authorities because there were a lot of appeals and negativity—the payment increased, even though we installed IHS. We have to deal with these issues. We took photos, showed where there is a lot of heat loss, and thus convinced the HOAs that the next steps are theirs. We made the step to install the IHSs; it's your turn to insulate and consume less heat.*

Consequently, one of the obstacles to the normal functioning of IHSs in multi-family buildings could be the lack of thermo-modernization measures for the building itself, such as replacement of windows and doors, insulation of basements and roofs, and repair of in-house utilities. In the old housing stock in Ukraine, most structures and utilities in buildings are outdated and retain almost no heat in winter. Therefore, there is a need for the fully-fledged thermo-modernization of multi-family buildings simultaneously with the installation of IHSs.

According to representatives of SCU Lutskteplo, there have been no direct conflict situations between residents on the issue of IHS installation, but there were conflict situations directly related to the installation process:

> *There was a difficult issue—the meters installed under the program when the city financed 60 percent and the residents financed 40 percent. These meters were on the balance of the company, and when it came to*

dismantling the meter to install the IHS, the residents did not want to give [the meters] back, resisted, closed [the premises], not allowed, prevented the transfer of the meter back to the company.

According to the representative of SCU Lutskteplo, other cities may also encounter this problem during the larger-scale installation of IHSs in their multi-family buildings.

Also, SCU Lutskteplo noted that the decision to install IHSs made by the heat supply company itself should be coordinated at all levels—local government and ordinary residents. This will help avoid problems with heat supply in the city in the first place.

If it is determined by strategic documents for the development of an enterprise or a city or the development of a region—well, then there is a need to accept and discuss.

As the representatives explained, it is rather hard to regulate the district system when everyone tries to make some adjustments.

MARIUPOL

Mariupol Heat Network has its own opinion on the technical barriers to the larger-scale installation of IHSs in multi-family buildings in the city:

This measure makes almost no sense without reconstruction of the in-house heating system. Without installing balancing valves on the risers, without replacing the modified (in some cases extremely modified) heating system itself. That is, people independently intervened, yes, at times when the heating was bad, when there was not enough heating, they installed other heating devices with a different number of sections, with some shut-off valves, which everyone installs in their own way... Without arranging the in-house eating systems properly, [the installation of] IHS does not make much sense, except for just hot water.

Its representatives then clarified—they did not intend to state that the installation of IHS makes no sense. They only aimed to point to some technical prerequisites that must be in place to do so:

I don't think there is no point in IHS—there is a point. But the matter will be in its efficiency. Insulated window units and doors should accompany the IHSs—these are the main sources of [heat] losses. Of course, it would be desirable to consider as a whole. The installation of IHS means, respectively, the need for the insulation of windows, the entrance doors... Because not all people have replaced the windows.

When asked about conflict situations that may arise among the residents based on IHS installation in the building, the representatives replied that they had not encountered such a situation.

Let's say we have cases where automated regulation units were installed, and they were not fully set up. Considering the fact that also in-house systems are already quite "clogged" at the moment, no one particularly prepares them for the heating season. And there may be some failure in the operation of individual elements, leading to misoperation of something at the beginning of the heating season, during the heating season. And, of course, there are, let's say, not conflict situations but just situations when more people apply, and we have to respond to the complaints and bring it all back to life.

Another obstacle the heating company has observed is the indecisiveness of HOAs in terms of measures for IHS installation in their buildings:

I think that part of the problem will still be with HOAs. But it will be solved; you just need to give people examples, preferably from Mariupol, where IHSs have already been installed, how much the payment has changed. I think everyone will be absolutely for.

We also asked to what extent Mariupol Heat Network cooperates with local governments on the issues of IHS installation in the city and implementation of energy efficiency improvement measures in the buildings in general.

City authorities understand perfectly the acuteness of heating, getting heat issues, it is one of the most important issues. That is why this year we have an increased amount of investment. Mass investments in the heating network are planned for the next years in order to improve the situation, to increase the quality of services, so... City authorities understand us; they hear us.

POLTAVA

We already knew about the special situation in Poltava; the local heating company is not subordinate to the city. It is subordinate to the oblast, which creates a problem for developing and adjusting the heating system in Poltava in general. As the representatives of Poltavateploenerho observed:

We are a regional enterprise, which provides its main scope of services in the city of Poltava. The city has nothing to do with us, the city is not our owner. And traditionally, the city government elected during this time is clearly aware of the fact that it has nothing to do with heating, so all the issues that relate to heating, even a bit—they have nothing to do with it, and they never discuss them.

A representative noted another problem—in Poltava, in general, there is quite a small number of HOAs, and this also creates a problem when implementing measures to improve energy efficiency in multi-family buildings, such as the installation of IHSs.

At the moment, this issue is also not resolved. In Poltava, quite a few HOAs have been established, no managers [of buildings where no HOA is established] have been appointed, and in those buildings where no model has been chosen, the residents do not have this feeling that they own the building, and it depends on them how the building should function, develop, what processes should take place in it.

Poltavateploenerho sees the lack of interest from all stakeholders in installing IHSs (HOAs, Local government)—an element that is crucial for the process of installing IHS in the city. A representative described the IHS installation situation in the city as follows:

That is, the authorities alienate from this issue in every possible way, and the residents do not want to take any part in it. The oblast authorities, to whom we are subordinate, have no relation to these objects [referring to buildings in Poltava], and it makes no sense for them to spend money on not their objects. And this situation led to the fact that today, ***out of 1348 buildings that get district heating, IHSs are installed in 25 buildings.***

...today, in the city, we are the only organization that is interested in this, but that, unfortunately, is deprived of the opportunity to organize such activities because it is an in-house system, it is not our scope of responsibility, we have no right to spend our money there. Those IHSs that we installed with NEFCO funds—they were grant funds. We have no right to spend our own money there.

It is a kind of vicious circle—the city authorities are not interested in improving DH services because they have no influence on the heat supply company. The oblast authorities influence the

heat supply company, but they have no interest in investing funds and resources into the housing stock of Poltava because these are not their objects.

The heat supply company seems to have some interest in installing IHSs in multi-family buildings in the city, but it cannot contribute to this process in any way—at least not financially.

The residents have no interest in installing IHSs because they see no incentives to do so—they are simply almost never informed. Also, there is a small percentage of established HOAs in the city, which further complicates an already difficult situation.

When we asked what could improve the situation and give impetus for the larger-scale installation of such equipment, Poltavateploenerho replied as follows:

> *I doubt that the situation will be improved by any directive documents from the central authorities; they cannot oblige residents to do it. In my opinion, the best incentive is money. If a person sees and realizes that the use of such equipment will reduce their payment—that will be the best incentive. Now is the time when we are entering the next heating season with heat energy tariffs that are still undetermined. But the tariffs are unambiguously high. This situation, in terms of encouraging residents to install and agree to install the IHSs, may be just the right moment to act.*

According to these representatives, high bills for heating services will force people to think about ways to save money. The installation of IHSs should be their opportunity to pay less for heat consumption.

In this situation, we again see the shifting of responsibility to ordinary residents of multi-family buildings—in Poltava, they are expected to take the initiative in installing IHSs in their buildings. It is expected that at some point, they will understand the need to install IHSs and will take active steps in this direction. Nevertheless, the city has no effective and efficient mechanisms for informing residents about this possibility or about the benefits and advantages of installing IHSs.

ANNEX 3. KEY RESULTS OF THE SURVEY AMONG REPRESENTATIVES OF HOAS, HCOS, AND MANAGEMENT COMPANIES

ASSESSMENT OF EXPERIENCE IN THE IHS INSTALLATION IN MULTI-FAMILY BUILDINGS IN THE CITY

Overall HOA Experience of Installing IHSs in Multi-Family Buildings in the City

LUTSK

In general, representatives of HOAs in Lutsk indicate that the push to install IHSs in the city began with the more active establishment of HOAs and the creation of programs to support them. Below is a quote from an HOA representative:

> *There was a boost of HOA establishment in the city, and it started around 2014–2015. People began to shift away from housing maintenance offices (HMOs) and establish HOAs, and the city adopted an HOA assistance program, where it was possible to raise funds from the city. There was also a state program on co-funding; people could install the IHSs with the support from the city, about 20 to 80 (20 percent paid by the residents, 80 percent paid by the state program with the city). Some HOAs were afraid of borrowing money and decided to install the IHSs by themselves.*

Not all of the HOAs in Lutsk knew what an IHS was and how it could be beneficial in terms of saving on heat consumption:

> *The contractors who were installing the meters discovered for us such a concept as IHSs, and we started installing them. And we realized it's cool because we can shut off the supply, and the circulation in the house doesn't disappear. With pumps in place, the pipes in the house were already evenly heated.*

Subsequently, the city had the opportunity to install the IHSs for free—SCU Lutskteplo was installing them with a loan from the EBRD. However, not everyone decided to take advantage of this opportunity:

> *By 2020, many buildings had installed IHSs under these programs, and there was a rumor that there would be a free installation of IHS (under the EBRD loan). I have one building that waited a long time for the free installation of IHS but failed to do so and installed themselves. And they did not regret it—this IHS paid off in three months, but we have access to regulation ourselves.*

As for savings, the HOA representatives mention that IHSs certainly deliver:

> *We paid UAH 30 per square meter with the IHS, while an identical house without IHS paid UAH 50 per square meter.*

Another HOA representative from another building also confirms this figure:

> *If in the most expensive month, we paid UAH 52 per square meter, now it is about UAH 30 per square meter.*

KHARKIV

A representative of a Kharkiv HOA said that in one of the buildings, an IHS was installed at the initiative of the building residents, but it took two tries because a certain number of residents were indecisive about installing it. People were afraid because they had never encountered the Tepli Kredyty program and did not know how it worked.

> *So, somehow for the first time, we didn't succeed... But when the heating season came and the price [for heating service] started to increase, then they [the residents] themselves came running and said, "Let us do something!" And that's when we somehow started getting ready.*

When asked what exactly prompted the HOA representatives to decide to install the IHS in their building, we were told the following:

> *We have a 16-story building that was unbalanced. And if the temperature in the apartments on the lower floors was 28–30 degrees, the temperature on the upper floors was 13 degrees. And they paid for heating the same amounts. In 2017, we hold the meeting and decided to install the IHS. We chose a contractor with a lot of experience installing IHSs in Kharkiv. It was not so much about saving money as it was about the actual heating of all the apartments in the building.*
>
> *The residents paid a fee for the installation of the IHS—UAH 400, 600, 800, and 1000 (depending on the number of rooms in an apartment). All of these fees were paid off for one month of the IHS operation.*

Another HOA representative added that in her house, the fees were paid off within one and a half months of IHS operation.

Also, the HOA representative mentioned that other measures to improve energy efficiency were taken in the building—replacement of windows and doors, insulation of the technical floor, and more. She believes the installation of the IHS is a necessary measure to improve energy efficiency in the building:

> *People have seen the result, that there is already an opportunity to live like normal people. And they already believe that today it is necessary to do so.*
>
> *We have installed the IHS with the following goal: to avoid overheating at the beginning of the heating season and at the end of it; we extremely save on it. Let's say, my figures for last year:* ***in the city, the payment is UAH 39 per square meter, in my house—UAH 18 per square meter****.*
>
> *We have no contracts with heating networks. We have an HOA—a collective consumer. We buy this service at the inlet to the house. This time I paid them in advance. That means we pay, and the heating network does not care what happens in our building, how the heat is consumed. So the HOA was interested in actually paying for the service provided. And that is why we did all the work related to heating, including the installation of the IHS, we did it. When we installed an IHS,* ***a two-room apartment saved UAH 5,000, a three-room apartment—UAH 6,000, a four-room apartment—UAH 9,000 for heating during the heating season****, compared to other buildings in Kharkiv.*

A representative of another HOA pointed out that she also compared savings on heating between a building with an IHS and one without an IHS—if there is an IHS, the residents of a three-room apartment pay UAH 1,000 less per month than the residents of a three-room apartment in a house where there is no IHS.

Another representative pointed out that people are generally motivated to install IHSs:

> *We started with the fact that we wanted comfortable living, we wanted heat, we really wanted to pay for the actually consumed heat.*

POLTAVA

Representatives of Poltava HOAs were more reserved in their evaluation of IHS performance. In general, there are very few IHSs installed in Poltava's multi-family buildings (about 25). We surveyed those who had the opportunity to install an IHS in their multi-family building and asked about their experiences. We got the following response:

> *After we installed IHS, we did not discover considerable savings, about 8 percent, but we now have a balanced house, and our house stopped being underheated in some apartments, where we had 17 degrees. Now it is not below 20 degrees.*

A representative of another HOA in Poltava gave the following opinion on this issue:

> *The savings were noticeable almost during the first heating season, and actually, considering the amount that it cost us (about UAH 100,000 including compensation), we saved a lot more during the first heating season.*
>
> *What are the reasons for savings? Firstly, it is the opportunity not to take extra heat in the off-season—when in the fall, it is not needed because the temperature allows you to consume less. Secondly, it is the spring off-season—when you could already turn it off, and people open the windows because it's already hot, and they (heating system) continue to heat because they have their own schedule.*

One of the HOA representatives in Poltava said that they were experiencing significant benefits from the IHS:

> *Now, when the amount of heat is more than we need, we may not take it using this equipment. We have it automated, controlled through a smartphone. Now we're not overpaying unnecessarily. There are overall savings, if you take before and after,* ***the savings are somewhere around 20 percent****. But you can save more by setting the minimum temperature, but people will be uncomfortable. Now, we have an average temperature (we have a down-feed system) of 22 degrees on the upper floors and 18 on the lower ones (but where apartments are insulated—there is 20–21).*

In general, another HOA representative was satisfied with the results of his efforts:

> *We managed to convince. We provided calculations, everything before we had this meeting, explained that the increase in the amount of the fee they would pay would not be an additional burden on the budget, but at the expense of reducing the cost of heating. That's the way it is. The actual savings in heating is much greater than the amount by which we increased the fee.*

MARIUPOL

As we have already understood from the survey of representatives of local governments and Mariupol Heat Network, there has been certain progress on IHS installation in the city. Here is what HOA representatives in Mariupol say about it:

Well, of course, I assess positively, because it works well and saves us money. But our house is a failing building; we have this tile, with which the house is clad, it falls off, and we have the wind blowing into all the cracks. I wish it wasn't so ... but we have joints open, so how to keep the heat here. But of course, I like it.

Another HOA representative said the following about it:

The experience has been positive. The house was unbalanced—some were overheated, others were underheated. We had a temperature of 18–19 at the most in the first entrance hall. We eliminated that when we installed the IHS. We got warm, almost even temperature everywhere. Those who used to overheat think that their heat was stolen from them, but in fact, the heat is properly distributed to all risers. This is only possible with the installation of the IHS and balancing valves. One smart heat regulation unit does not have that effect. Plus, an M-base is used for the IHS, a program is installed on a phone and computer, and you can monitor and regulate no matter where you are.

We now set times when the temperature should be higher (evenings, weekends), when it should be lower (when people are at work). But for sure, ***a building should be insulated in order to really save up to 50 percent****.*

A representative of another Mariupol HOA noted:

There are three IHSs installed in my buildings. If you do not change the riser system and do not install balancing valves, the effect is insignificant—there is just redistribution of heat (distant apartments are heated), but the savings are not great.

If the heat supply system—pipes, risers—is changed in conjunction with the IHS, then the savings are from 10 to 12 percent. Not 30 percent, as they brag, but it is also good.

Consequently, the representatives of Mariupol HOAs agreed that IHS installation is a useful activity and that they benefit from it. However, without repair and replacement of in-house heating networks, the expected effect might not be achieved. Therefore, along with IHS installation, it is necessary to introduce other measures for the thermo-modernization of the building.

Concerning the savings on heat consumption due to IHS installation, HOA representatives in Mariupol responded as follows:

Well, 25 percent for sure.

***

There's a 30 percent savings in heat compared to when we didn't have a heat substation yet.

***

About 10 percent. But the building is not insulated, just the windows and doors were replaced.

***

40 percent savings.

***

27 percent last year. But the information was not presented correctly at first. They promised savings of up to 30 percent. But this requires insulating the building, and in this case, I agree that this is possible. And now there is just a redistribution of heat around the house. After installing the IHS there is about the same temperature for everyone now.

Attitude of Residents of Multi-Family Buildings Toward IHS Installation and Efforts to Inform Them

LUTSK

Unfortunately, the attitude of apartment owners in multi-family buildings toward IHS installation is not always positive:

They are hostile to it at first. They need to feel it out, to gain experience, to live with it for a year. They need neighbors and relatives to say that they did it for themselves and it's good.

We asked representatives of HOAs in Lutsk what awareness-raising campaigns they conduct with residents of their buildings or whether they conduct them at all. Here is what one HOA representative told us:

We collect signatures for this or that program—we hold a lecture in each apartment. It takes a week to collect signatures. They don't visit the meetings. The attendance of the meetings is very low; usually, the most active people come, about 10 to 15. And the others—you have to collect signatures. And everyone has to be told. At the meeting—two hours to persuade, to listen to all the aggression first, then proceed to the essence, and then visit all the apartments, and every one personally must be lectured, so that they voted "for."

Another HOA representative noted that in his house, the situation is somewhat different:

I have those who come to the meeting and listen to everything there, and then you go to collect signatures, and they say at home, "We will think about it."

We invite experts to the meeting. We have experts on energy efficiency in Lutsk, and they help, they can explain more professionally, show something, some examples, visual materials. It helps a lot. Because the HOA chair is usually the enemy. Everything that he says is not perceived. And when come unknown person explains it, the residents perceive this information better.

When asked whether there were conflict situations between building residents during the discussion on IHS installation or the introduction of thermo-modernization measures in general, we were told the following:

All the time. It came to insults and verbal skirmishes. They ask, "Why do I need such IHS, it's already warm for me?"

Representatives of Lutsk HOAs also have the following opinion about informing residents of multi-family buildings in Lutsk:

Media support should be in place, first of all, in the city. Without support in the city, without its advertising, the state cannot see the general level. A person cannot understand everything. For sure, they must be familiar with the matter for that. And for them to be familiar, there must be at least a few illustrative examples. Also, such topics should be covered by journalists who understand the matter. This matter cannot be described superficially You have to understand—how much the IHS costs, what actions are implemented, that there

*should not be only one IHS—**there should be the balancing of the whole system, then it will bring the maximum effect from this event**.*

KHARKIV

When asked about residents' general impression of IHS installation, one HOA representative told us the following:

> *The residents of my building are now happy that there are no overheats. We now have actually comfortable temperature in all apartments. Residents are already used to this comfortable temperature. At first, it was unusual for the residents who had a high temperature in their apartments because the temperature became a few degrees cooler (for example, it was 28 °C, and now it is 24–25 °C). However, everyone is already used to it.*

As for informing the residents about IHS installation, the representatives of Kharkiv HOAs assured us that meetings are sure to be held:

> *Depending on what bank we were negotiating with [to provide a loan for the IHS installation], we were given a specific protocol. According to this protocol, it was necessary to hold a meeting, to collect votes—two-thirds of the residents must be "for." I always try to collect more votes because more votes mean more people know about it.*
>
> ***
>
> *We had the meeting, but we didn't install the heat substation right away. We spent another year working on it, gathering people, gathering engineers, and as a result, the next year, we installed an IHS. A year and a half of discussions, and already after this year and a half, people heard about it.*

However, residents of some apartments did not pay the fee for IHS installation because the temperature in their rooms has become less comfortable since the installation. Previously, their apartments experienced overheating, and they were used to opening windows to make the temperature in the apartment more comfortable. Surprisingly, however, the residents of these apartments are hostile to the fact that they now have a more comfortable temperature in their apartment without having to open windows and pay for the extra heat.

Some residents of multi-family buildings flatly do not understand the principle of IHS functioning and how it benefits them, which leads to absurd situations:

> *We are telling people at the meeting that we saved UAH 500,000 in one house during the last heating season. But a person look at us and say, "Where did you spend them?"*
>
> *We have to work with such residents and explain to them how we save money on heating at the expense of the IHS installed in the building.*

Representatives of Kharkiv HOAs mentioned the need to implement awareness-raising campaigns for residents on the issue of IHS installation. They even pointed out the possibility of promoting energy efficiency improvement activities with a focus on children so that from a young age, everyone knows about the need to implement thermal modernization and does not prevent it.

Also, HOA representatives noted the need to promote social advertising, which would talk about the effectiveness and benefits of IHS installation in Ukrainian houses. In general, HOA representatives mentioned the general indecisiveness of multi-family building residents on this issue:

> *No one will take the responsibility to maintain this equipment, to service it. They want it to be cheap, but they want someone to do it for them.*

POLTAVA

We asked how the residents of multi-family buildings where IHSs were installed in Poltava felt about the introduction of this measure of energy efficiency improvement and received the following answer from HOA representatives:

> *For sure, [the residents are] happy, especially those who had underheating and 17 degrees in the apartments.*
>
> ***
>
> *At first, there were those who were against it. They said, "Why do we need it? It's expensive!" Our building is mostly warm; only the extreme entrances and the upper floors experienced discomfort. And even when we adjusted the temperature manually, it was 23–24 degrees in the middle of the building, and at the extreme risers, the temperature in the rooms was 17 degrees. And most live in the middle. Whoever shouts the loudest is listened to the most somehow. Even if they talk nonsense. That is why there were such people.*

But in general, representatives pointed out that the residents in their buildings were mostly not against IHS installation because they understood the need for it. Below is a quote from an HOA representative in Poltava:

> *There was never anyone against IHS because the problem of high heating bills frightened everyone, and everyone wanted some kind of solution to this problem. At first, we tried to regulate manually by tightening the valve. But that did not have the expected effect. People were not against IHS because they understood that the problem had to be solved. People were only stressed by the word "credit," people were afraid it was ball and chain.*

Of course, in such a process, an essential element is to inform the residents of multi-family buildings about what kind of measure is being implemented and for what purpose. Such awareness-raising meetings took place in Poltava buildings, according to representatives of local HOAs:

> *We held meetings at the stage when we tried to take the first loan (not yet for the IHS), and then we did not get the necessary number of votes. The next year we already decided to try to take a loan for the IHS, held meetings, had individual conversations, explained that it would be more comfortable and we would pay less. And we managed to collect the necessary number of votes. There were those who thought that their apartment would be taken away, such people are always and everywhere, but our main efforts were aimed not at them but at those who have common sense and will provide us with the necessary 2/3 of the votes. People understood that all the action was to improve the condition of the building, create comfortable conditions and capitalize on the value of the apartments and that there was no other way out.*

Like almost all participants in our survey, representatives of Poltava HOAs pointed to the need for awareness-raising campaigns to promote the installation of IHSs—this time, they mentioned the need to advertise such an event from TV screens:

The main point is, of course, advertising. The people who live in our buildings—they still watch TV. Not browse the Internet, but watch TV. And there's virtually nothing on TV about IHSs. Little or nothing, that is, no one tells the true benefits. And the benefits are balancing and actual savings. Of course, the authorities need to constantly perform these activities, because recently there was a loud statement from Poltavateploenerho that they plan to install IHS in every building, but it is unrealistic in my opinion, it takes a carload of money for that, and secondly—there should be such a project.

Note: During our communication with representatives of Poltavateploenerho, none of the company employees informed us about such a statement or about such plans.

MARIUPOL

Usually, residents have different attitudes toward IHS installation in their buildings. Mariupol was no exception, although, as HOA representatives pointed out, there were cases when people were in favor of such an event:

Yes, the residents are satisfied because the distribution of heat goes evenly. We have a building with a down-feed system, so we had the residents of the lower floors suffering. And now everybody has the same. No, there was no such thing as mass opposition.

***

Only the general meeting made the decision. There was no objection.

But there were cases of resistance from residents, as other HOA representatives from Mariupol told us:

Of course, they were against it, they said they did not need it and what for, we need to save money, so why should we take the loan. And now most people are satisfied.

***

I have it so, maybe because I live here and the residents see ... for 2.5 years, two loans under Tepli Kredyty Program, and lighting, and sewage, and hot and cold water, and the IHS, and joints, and the roof, and yet we have windows made ... they trust.

***

I'm afraid of the Energodim Program... Even when I took out a loan under Tepli Kredyty Program, I had some residents who were adamantly against this loan; they thought this loan meant that someone would buy out their apartments, that their apartments would be taken away, that I was mortgaging the building... And then, when they looked at the bill for one month, then looked at the second bill, then the third, and then in Viber, they already wrote me, "Anzhela Ivanivna, God bless you, I now see the bills of the neighboring houses and ours."

Another HOA representative voiced a similar opinion:

People didn't believe and were afraid to take out a loan under Tepli Kredyty Program—that apartments would be arrested, that apartments were mortgaged, that it was inefficient, that it was just money thrown away. I told them that if we did nothing, we would continue to quarrel because some said, "We pay for your heat,"

and others said, "We do not care." Well, we regulated the risers mechanically, but nevertheless, it did not give the same effect as IHS. Those unsatisfied were, well, maybe 15 percent.

We did not need 100 percent, the majority decides. In one building, the old ladies say, "We do not need it, it is enough for our age," and in another building, the old ladies say, "We have to do something, no one but us will do it, I'd rather buy cheaper bread, but I will pay this money for the building."

However, as some HOA representatives pointed out, holding a general meeting and informing the residents about the introduction of IHS installation gives its result:

In order to install it, it was necessary to hold a general meeting. People did not know what it was—so no one was against it. To do this, we held the general meeting, we explained to them. They agreed because they understood that it would not affect the tariff—we succeeded; we did not increase the tariff that year and raised it only from October 1. And the only reason is that we have to pay a thousand and a half for maintenance. Last year, it was free of charge under the contract for installation, but this year, we have to pay for it. But we explained it to people. Maybe one shouted there, everyone else understands that everything is ours and should be serviced, and people are calm about it.

***

We always have Baba Yaga, who is against it. We always have 15 percent for, 10 percent against, and the rest do not give a damn.

Also, representatives of Mariupol HOAs mentioned the need for awareness-raising campaigns to promote the introduction of IHSs in multi-family buildings in the city:

Yes, of course, it is necessary, because you know how it is in most cases. And ***even the problem now is that about 40 percent are renters****. I mean, when most of the owners live in the building, it's easier to work, but when there are more renters, and the owners may not even be in the country but live somewhere overseas, here's the problem. And renters—it is not their problem, they rent an apartment here today, and tomorrow they do not rent, they pay rent/lease payment to the owner, and that's it, they are not interested, as a rule, it is very, very rare when a renter takes some part in the life of the building.*

Furthermore, they pointed to the need to involve experts and specialists in the following processes:

We also had the first time, the first meeting, people did not know, did not understand, and I, as a non-specialist, could not explain to them. They voted against it. But then I took the effort and gathered the second meeting, invited a specialist from the company, from the energy efficiency sector, he came with a flip chart, told, showed, drew all the savings, invited the building head where this smart heat regulation unit already operates—and they voted "for."

They also pointed to the need to establish a dialogue with the residents of multi-family buildings:

We will not get rid of the people against us, and the best way to influence it is collectivization—when there is a collective, when there is a common opinion, you explain to people correctly, people understand, it's the best. We made explanations, invited experts, this is also important. People understood that there were already some benefits in this effort—they listen. So, the main thing is the communication with people.

ASPECTS OF IHS INSTALLATION IN MULTI-FAMILY BUILDINGS

Source of Funds for Installing IHSs in Multi-Family Buildings

LUTSK

One of the Lutsk HOA representatives said that the cost of installing IHSs (under the Tepli Kredyty program) ranged from UAH 500,000 to 700,000.

> *The following plays a role—is the balancing installed on all valves? If it is just IHS, it is cheaper. But IHS exactly, without balancing by entrances, risers, it is less effective. Therefore, we can say, half the price is for IHS, and half the price is for balancing.*
>
> *And if you install an IHS through the Energy Efficiency Fund, there is a requirement to insulate the in-house heating network completely. This increases the cost of this measure by another UAH 200,000.*

Another representative pointed out the difficulties in going through all the stages necessary to receive funds under a particular program for energy efficiency improvement:

> *I wish the system were simplified, even to take a loan... First, you should do that energy audit, it is money again. Then comes another stage, stages, stages, stages... Perhaps if it were simpler, there would be more those willing to install an IHS under such programs.*

A representative assessed the functioning of the Tepli Kredyty program in the city:

> *I think the Tepli Kredyty program is definitely over. It was popular, and it didn't control the work that much, but at the same time, it gave us a stimulus to make people realize that without investing something, you won't be able to save money.*

HOA representatives in Lutsk believe that the **residents of multi-family buildings themselves are willing to invest no more than 40 percent of the cost of IHS installation** (or no more than UAH 8 per square meter). Consequently, it is necessary to take funds from somewhere to cover the remaining 60 percent.

KHARKIV

According to HOA representatives in Kharkiv, the Tepli Kredyty program does not operate in the city now. It was mostly used for replacing windows, doors, and other repairs, not for installing IHSs, because IHS installation costs a lot of money. That is why most HOAs in Kharkiv simply did not take the risk and used the funds provided by the program for simpler energy efficiency measures in their buildings.

Furthermore, an HOA representative mentioned that they did not know there was also compensation from the city or oblast under the Tepli Kredyty program. They believed that only the state would compensate them, at 40 percent of the costs.

That HOA took a loan of UAH 230,000 for to install IHS in a Kharkiv building, installing it without the module for the hot water supply system. To repay the loan, the HOA collected UAH 600 per two-room apartment and UAH 1,000 per apartment with more than two rooms from residents. However, as it turned out, the state and the city compensated them for 85 percent of the loan. Therefore, the HOA only owed about UAH 40,000 under the loan.

The collected money still came in handy—the building utilities were repaired for their cost.

As for the cost of installing IHSs in other buildings, the HOA representatives said as follows:

> *The cost of installing IHS was UAH 230,000, this is together with the installation works.*
>
> ***
>
> *And in my building—UAH 500,000.*
>
> ***
>
> *I installed IHS in 2017, and the price was UAH 117,000. We paid UAH 20,000 for the IHS in total, all the rest was compensated by the state.*

POLTAVA

We touched on the issue of including the cost of IHS installation and maintenance in the fees for building maintenance, and representatives of Poltava HOAs answered the following:

> *For owners, this amount is not noticeable because the city still compensates the interest on this loan, so a few tens of kopecks that we pay additionally are not noticeable.*

However, there are residents who complain about the cost of building maintenance increasing by several hryvnias per month:

> *People always complain, 6–7 percent do not pay, there are always a lot of problems. We start with 3.50 UAH/m^2. And now we took out a loan for insulation, now it is UAH 7 per square meter, and now people are definitely unhappy with such a price per square meter. But there is no way out, we have to do so.*

As we learned from the survey of representatives of Poltavateploenerho, some of the IHSs in the city were installed with the help of a program funded by NEFCO—DemoUkraina DH. However, the city's multi-family buildings are have IHSs installed under other initiatives and programs:

> *We installed it in 2018 under the Tepli Kredyty program. The building is nine stories, two entrances, 90 apartments. At the time, the cost of the IHS was about UAH 220,000 and some kopecks. More than half, somewhere between 56–58 percent, was returned to us in the form of compensation under the Tepli Kredyty. The rest is a loan for five years, and we pay.*

Another HOA representative in Poltava said that the IHS in her house was installed under the Poltavateploenerho program, which was effective for the entire city. In another building in Poltava, the IHS was installed under the Energodim program (70 percent of the cost of IHS installation was reimbursed). The IHS installation with balancing valves cost UAH 647,000 under this program.

MARIUPOL

HOA representatives confirmed that in Mariupol, a large number of IHSs were installed in the buildings they manage with loan funds from the Tepli Kredyty program and funds from city support programs. Below is a quote from an HOA representative in Mariupol:

> *I manage several buildings. In one building, the IHS was funded by the Tepli Kredyty (complete set with balancers), two other buildings were funded by oblast funding.*

Financed with a loan repaid by the city and state. So we had good help, now they don't give us those loans anymore. About UAH 700,000 was the cost of installing the IHS.

Installed through the Tepli Kredyty. It was a very good program; we would really like to get it back. In the Energodim program, the procedure is very complicated, you need a lot of documents, the process is long-lasting, and people are waiting and don't understand—they pay a higher rate, and nothing happens, because the duration of the whole process takes half a year, or even more. And as I know, someone entered the program last year, and this year, nothing is done yet; everything is delayed.

The IHS installation cost UAH 645,000. Installed under the Tepli Kredyty program (got it only on the third try). The city pays interest on the loan (we pay only half percent, and the city takes 17 percent for itself).

Technical Features of Installing IHSs in Multi-Family Buildings

LUTSK

One HOA representative pointed out the following technical feature of the IHSs that are predominantly installed in Lutsk:

All of our IHSs in Lutsk have one solution parameter—the outdoor temperature. The equipment analyzes the temperature of the outside air, and accordingly, there is a heat schedule, and that schedule is used to feed. But I would also include one more parameter—moisture analysis. Many of our buildings are built of sand-lime brick. And I notice that brick is very water-absorbing, and the building cools more at +2 °C than it does at -5 °C. I've noticed that we benefit more when it's freezing outside. I change the schedule in those cases, and I change it by a couple of degrees because people start complaining that it's cold. And when it's freezing, I change that schedule back. Therefore, those free IHSs, which Lutskteplo installed for us, do not suit us a little bit—because there is no opportunity to regulate the temperature regime themselves.

It [the sensor] was fixed on the wall, and the wall gives an error of two degrees. When we unfixed it from the wall and installed it on the bracket, it became accurate.

Representatives of Lutsk HOAs noted that the local heat supply company (SCU Lutskteplo) is not interested in installing IHSs in multi-family buildings, and they are quite skeptical about the installation of IHSs under the program funded by the EBRD and implemented by SCU Lutskteplo.

It is illogical—when the seller of the goods installs the equipment, which will save him his own money. It was not planned so at all; it was supposed to be under the Tepli Kredyty program at that time; it was also planned to be supported by the Energy Efficiency Fund. That is, one of the measures is the IHS installation at the expense of the EBRD, and respectively further HOAs take the subsequent actions, which are not so much to save money, but maintain the building and do a certain thermo-modernization.

Well, first of all, it is a problem of heat generating company. In Lutsk, they generally came up with the idea that the IHS installation requires getting technical specifications, the commission fee, for the shut-off, for sealing the meters... I counted, in 2019, this all needed UAH 4,000–4,500 (for one building). The requirement was illegal, and thanks to the fact that we had the opportunity to get clarification from the Ministry of Regional Development, today, no heat generating company no longer requires such documents. But it still exists in small towns.

Representatives noted the importance of a professional approach to the introduction of IHSs in Ukrainian buildings to avoid the unprofessional handling of equipment or the purchase of cheap equipment to save money. Below is a quote from a representative of a Lutsk HOA:

There are specialists who have to calculate the loads, who have to balance the system as much as possible, and that is something that should be talked about everywhere. We still have vestiges of the post-Soviet period, we understand that we can install something cheap, and it will or will not bring benefit—as if you have already done something there in the building. Perhaps, you can save some money somehow, but these savings are due to reducing the heat load in the outermost risers where there is absolutely no heat. That is why the right approach must be in place.

Another representative pointed out that the HOA chair is not entirely responsible for the installation of equipment and the percentage that the house will save on heat as a result of the IHS installation. This responsibility should be borne by the designers and installers of the IHS.

According to HOA representatives, there is no need to coordinate IHS installation with the heat supply company:

Our networks are designed so that every building can have an IHS. We will not "drop" the neighboring house. If the pressure supply to them is hydraulically correct, we won't. The only thing is that they have leakage in the network or some other problems.

Representatives of HOAs mentioned the following technical problems with IHS operations:

Imagine the heat carrier gives less than scheduled in the boiler house; let's say, an IHS wants to supply 60 degrees to the building, the computer calculated that it wants 60 degrees, but the heat gives 58 degrees at this time, the valve opens to the maximum. Thus, the boiler must give the parameters according to the approved schedule, which does not always happen.

KHARKIV

As HOA representatives in Kharkiv pointed out, IHSs were installed by contractors. One of the representatives said that she had signed a contract with the contractors for IHS maintenance because, although she understood the principles of IHS operation, she did not want to take responsibility for its proper functioning. This service costs UAH 5,000 per year.

The representative of another HOA said that for a month and a half, the contractor that installed the IHS was also responsible for maintenance. However, later the representative decided not to sign a contract with them, and now the plumber takes care of IHS maintenance in her building.

Another representative said that no one in her building is in charge of IHS maintenance, so she performs this function herself:

I maintain all the electronic stuff. And everything related to mechanics is serviced by the plumber.

When asked if a plumber is qualified to perform maintenance for an IHS in a multi-family building, we were told the following:

Is it hard to maintain it? We have Danfoss equipment there, so it's not a problem to maintain it at all. And in general, of course, you need to maintain it.

We asked HOA representatives whether they needed to obtain any approvals from the heat supply company—Kharkiv Heat Networks—in order to install IHSs. One responded:

Yes, it was necessary. My contractor, who installed an IHS in my building, signed everything in Kharkiv Heat Networks very quickly. Because the contractor also worked directly for them. But when we began to approve the project for the house in another raion—they did not sign it. Everything was already installed, but the certificates hadn't been signed. There were all kinds of excuses, until the general director approved it. We were the first in Moskovskii raion (a district of Kharkiv), and it was very unprofitable for them.

Another representative said that she had refused to approve anything regarding IHS installation from Kharkiv Heat Networks, referring to the Law of Ukraine "On Peculiarities of Property Rights in a Multi-Family Building" (Bulletin of the Verkhovna Rada 2015, No. 29, p. 262[34]). However, other representatives reported that they were not very familiar with these issues, and that all approval documents, including technical specifications for IHS installation, had been handled by the contractors who installed the IHSs in their buildings. They did not have particular problems with these processes.

One representative pointed out how long it took to get certain documents approved for IHS installation with Kharkiv Heat Networks:

It took two months... First, they [Kharkiv Heat Networks] forgot something, then they lost something, then they didn't understand... But finally, later we got it, and they approved. But it took two months to approve...

POLTAVA

There are certain problems with reaching stable heating in the buildings, and the reason for this is the residents themselves, according to one of the HOA representatives from Poltava:

This difference in temperature is also due to changes made by people in an unauthorized manner. Our one-pipe system is designed so that with each floor below, the size of the radiators increases in order to compensate for the drop in temperature of the heat carrier, as it gives the temperature on the upper floors. People began to install additional heating devices, more than was provided by the project, so the fact that heat is withdrawn causes uneven heating. And there is no possibility to influence this by making changes in the in-house networks because the changes are caused by intra-apartment interventions. We will have the next stage of energy modernization for this—the installation of a distributional metering system for in-apartment radiators, i.e. metering through radiator distributors and thermal heads, allowing to regulate the amount of heat that people can consume at every radiator.

Another HOA representative also expressed his opinion on IHS functioning in multi-family buildings:

IHS is a good thing, but it's not just a machine that you plug into the socket, and it works. It's a complicated system, it requires maintenance, and it requires people who understand how to set it up. We have a board member who has been delegated these functions—his smartphone displays the parameters, and he keeps records and analyzes the parameters. We have one temperature regime for the night, another regime during the day to optimize the savings as much as possible. These savings are a financial resource, which goes to the further facade insulation of the building.

MARIUPOL

When asked who installed the IHSs and who maintains them, we were told the following:

[34] https://zakon.rada.gov.ua/laws/show/417-19#Text

If you enter into a loan under the Tepli Kredyty, the bank recommends a contractor. The project was designed by PE Olnait. And where there was oblast funding, the heat network was involved in the project.

In the building of another HOA, the same company designed and installed the IHS:

So, they did everything, this company called Olnait. They did everything from the beginning to the end, and now they also maintain it because I said right from the start that if they did it qualitatively, it would be easy to serve.

According to another HOA representative, in cases where the design of the IHS installation was carried out by the heat network itself, there were problems:

At first, we had the first IHSs done by an oblast program, and there were a lot of wrong things, as I believe because I'm an engineer myself. Operating them, I concluded that the equipment was chosen wrongly. When you ask the heat network for inputs for designing, they give the design ones, not the actual inputs coming into the building. When the designer designs, it turns out that they provide for improper equipment, which logically should ensure a regular circulation, and I had to redo something. ***Almost all of the IHSs that were supplied under the oblast program were rearranged because there was not much effect***.

Usually, the contractor who installed the IHS maintains it, and HOA representatives enter into a contract with such a company. Below is a quote from a representative of a Mariupol HOA on this issue:

IHS is serviced under contract by Mariupol firm Olnait during seven months of the year (six months is the heating season, and one month is mothballing at the end of the heating season). We have not had any problems with service; they fix it all at once, control it, so there don't seem to be any problems.

The company (Olnait) maintains equipment; I'm very afraid to do it myself and damage it, and they handle the system rather well. We always have a person from Olnait coming, turning it on, making adjustments, the internet is connected, everything is turned on via the internet.

However, not everyone is satisfied with the work of the contracting company:

Olnait did it, but honestly, I wouldn't work with that company right now; I would prefer to work with other people because Olnight burdens us a lot. The reason to install the IHS was to save money; however, how can I save with the company Olnait if this year, their invoice for servicing the smart heat regulation unit amounts to UAH 12,000. And there is almost no alternative, we have a few in the city doing it.

HOAs do not even consider the possibility of having IHSs maintained by the local heat supply company—they do not trust it. They believe that Mariupol Heat Network representatives could intentionally set IHSs to operate so as not to save much money. Of course, the representatives did not give reasons for these fears; their opinions are based on the general impression that local heat supply companies gain no profit when people save money on heating.

However, one of the HOA representatives explained that they had a negative experience of cooperation with Mariupol Heat Network during the adjustment of their IHS:

After adjusting the IHS, within a year, I had four commissions, adjusting engineers; after that, the consumption increased by 20 percent. After that, I terminated the access for Mariupol Heat Network, engaged another firm, they set everything up, and more or less, it operates normally. And everything came back. Have you ever

seen... a heat network adjusting so to have losses for themselves. They sell heat, the more they sell, the more profit they have.

Other HOA representatives pointed out that they did not have any problems with Mariupol Heat Network during the installation of IHSs. Some received technical specifications for the equipment installation, but this process ran well, and none of the surveyed representatives encountered obstacles.

We also asked about the duration of the IHS installation process in buildings under different programs:

Under the Tepli Kredyty, about a month or two. Under the oblast funding, the chairs wrote an application, the heat network came and made measurements of the premises for installation, next a project was prepared, and finally, funding was allocated. It must have taken two or three months.

Other HOA representatives confirmed that it really takes a month or two to install an IHS, except in some cases the process can take up to three months. Furthermore, the duration of the HOA loan approval process also affects the process of installing the IHS, and this may take some time.

ASSESSMENT OF PRACTICAL HINDRANCES TO IHS INSTALLATION IN MULTI-FAMILY BUILDINGS

Title to IHSs and Regulation of their Operation

LUTSK

HOA representatives have an unambiguous answer to the question of who should hold the title to the IHS. In their opinion, it should be the co-owners of the building. As for IHS maintenance, they believe that a specialized company should do it and that they can choose any company that has this specialization. This option seems better to them than the possibility of using the services of SCU Lutskteplo technicians.

As for regulating IHS operation mode, one of the HOA representatives admitted that he does it himself by turning off the power for the valve. He said it does not harm the system and that he did it because he had to wait a long time for help from SCU Lutskteplo employees.

Therefore, representatives of HOAs with IHSs installed in their buildings under the EBRD-funded program and maintained by SCU Lutskteplo believe that the title to the IHSs and the right to choose who should maintain the equipment should be transferred to them.

Lutsk HOAs are skeptical about the technicians and the general interest of SCU Lutskteplo in the effective operation of IHSs installed in multi-family buildings. They believe that if HOAs directly control IHS operation, the savings could be more significant because the heating company does not seem to benefit from residents making notable savings on heat consumption.

Building residents have no particular influence on temperature control on the premises. A certain temperature is set, and the IHS operates to maintain this temperature. If residents have any questions, they turn to the maintenance company, which adjusts the IHS's operation mode so that the set temperature regime is constantly maintained. To change the temperature regime by one degree, HOA chairs can use an app on their phones.

Our people are ready to pay some share if there is help. Also, if people contribute in some way, they will be more careful about it. They won't open the window and let the heat out.

KHARKIV

According to HOA representatives in Kharkiv, it is the widespread establishment of HOAs that could give impetus to the larger-scale installation of IHSs in the city. They echo the rhetoric of their colleagues from other cities and argue that heat supply companies simply do not benefit from such a measure, so they should not do it:

When the owners themselves start controlling, they will control every gigacalorie in the house. First of all, they need to pay these funds.

One representative said that they set up the IHS in their house so that the temperature in the apartments is at least 23 °C. To change the temperature regime, an HOA representative applies to a contractor that can remotely adjust the amount of heat distributed by the IHS to set a certain temperature regime in the apartments.

We were also told that there were attempts to set a certain temperature regime for greater savings:

From 10 p.m. to 5 a.m., we made sure the indoor temperature was 18 °C. Then, from 5 a.m. to 9 a.m., while people were still at home—the temperature had to be 22 °C. From 9 a.m. to 4 p.m., the temperature was supposed to be 18 °C. On Saturday and Sunday, the temperature was a steady 23 °C.

But this idea was abandoned after just one week—in some apartments, it was too cool at night because of this regime. At the moment, the temperature is a stable 23 °C, which is comfortable for almost all residents of the multi-family building where the IHS is installed.

Residents of the upper floors began to notice that it was cooler but much better at their place. We have an overhead [heat] supply. So there was such a phenomenon as overheating in the apartments on the upper floors. In their apartments, the temperature reached 28 °C, while in the apartments on the lower floors, the temperature could reach 18 °C. Now there is no such phenomenon, and the temperature in the rooms on each floor is comfortable, which results in resource savings. There are savings because don't take too much—only what we need.

POLTAVA

In cases where IHSs were installed under the Tepli Kredyty or Energodim programs, the design and installation were carried out by a contracting organization under a contract with an HOA. In the case of IHS installation under the Poltavateploenerho program, the design and installation of IHSs were carried out by Poltavateploenerho itself.

As for IHS maintenance, the situation is somewhat similar to other cities covered by the survey—in some buildings, IHS maintenance is performed by the company that installed the equipment. The HOA signs a contract with the company, which maintains the IHS for a fee, which is paid by the building residents.

As one HOA representative in Poltava noted, in his building, the IHS is maintained by a responsible person—a board member—to save on payments to the contracting company.

In buildings with IHSs installed under the Poltavateploenerho program, the heat supply company itself maintains IHSs. HOA representatives had no complaints about their work.

In general, HOA representatives noted Poltavateploenerho has behaved in a trustworthy manner to those HOAs that decided to install IHSs in their buildings, and Poltavateploenerho did not put any obstacles to IHS installation".

In Poltava, HOAs themselves hold the title to IHSs installed under Tepli Kredyty, Energodim, and other programs.

Regarding the regulation of the temperature regime, representatives of Poltava HOAs told us the following:

> *In the beginning, the adjustments were very frequent until I understood the system. The fund representative has helped for a very long time and still helps; we adjusted the IHS and the valves so that the same temperature was in all the risers.*
>
> *Sometimes there were worries; once or twice, there were situations when it got sharply cold, the IHS triggered, but it was impossible to heat the house immediately, and at night people experienced discomfort. And then, I wrapped my mind around the issue and realized that from 11 p.m. to 5 a.m., we had to set a different temperature.*

Poltava HOAs are interested in residents' opinions, but they rely more on their own experience and knowledge:

> *We launched the system, we adjusted it, asked people on the top floors, on the lower floors, but we ourselves are living here and so know the weaknesses of our building (these are the apartments along the end wall, first floors, the place where the foundation ends and the walls begin). There is no point in asking all the time. We control the system parameters for each riser; we have the balancing valves installed. So that the temperature is the same for all raisers. The system is balanced, and we control the temperature at the outlet of each riser.*

MARIUPOL

HOAs themselves hold the title to IHSs installed in multi-family buildings under the Tepli Kredyty program. Below is a quote from a Mariupol HOA representative:

> *Those IHSs installed under the Tepli Kredyty Program are owned by the HOAs. Those installed using oblast funding are owned by the heat network.*

The question of temperature regulation received a lot of different answers from HOA representatives because everything depends on the type of building and the equipment itself:

> *First, the temperature was set to 24 degrees. One of the buildings was set to 22 degrees, and then the practice revealed that in wintertime, 22 degrees is a bit cold, and they decided to increase it to 24 degrees at the general meeting. It is decided by us collectively. In another building, where there is a complete set, the regulation is done through a mobile app; other smart heat regulation units need to be set in manual mode. The equipment there is not as advanced as that installed under the Tepli Kredyty Program.*

Some HOA representatives ask the opinion of the building residents:

I ask people what temperature to set. Most say 21 degrees, or 20. And it is adjusted on the phone, and the firm can do it.

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Before the heating season, we ask whether to save or spend. In one building, people told me, "Let it be more expensive, but we want it to be warm," they collected signatures, prepared a protocol, and we set the temperature to 24 degrees. In another building, they said, "We have to save money because there are few people receiving subsidies, people pay their own money."

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It is decided by the general meeting what temperature schedule we set. Before the heating season. And we ask every apartment against a signature. There was a house where the pipes were old, and we had to raise the temperature by one degree to warm up the building.

However, not everyone does this:

In my house, no decision is made. I stipulate that we will have 21 degrees, and it will give such savings. They do not agree in another way. In any case, ... the smart heat regulation unit is such a device that if you set 21 degrees, depending on the temperature outside, it regulates the heat to be supplied.

***

There was no discussion with the residents, they (the contractor) installed everything themselves. I called the residents and asked, "What do you think?" they said, "Great!" During the day, we have 21.5 degrees, and at night, a degree less—20.5 degrees. People said, "Thank you, we're getting less sick."

Problems and Complications During IHS Installation in Multi-Family Buildings

LUTSK

Representatives of Lutsk HOAs pointed out the importance of having HOAs in the city that already have experience installing IHSs and to whom one can turn for advice. They are happy to talk to everyone who is interested in their experience because they understand the importance of this issue.

In my opinion, there must be a parliamentary commission, so that at least one of these deputies would be interested in understanding the topic of energy saving. Otherwise the programs in the city will not be effective. That is why it is imperative to have a parliamentary commission. And then, after the deputies have discussed it—it should be the mayor.

As the representatives mentioned, the previous mayor of Lutsk was interested in improving the city, including introducing energy efficiency measures in buildings:

Nothing happens without the mayor's response because the mayor is the top figure in the territorial community.

One representative, who said the IHS in her building was installed under the Tepli Kredyty program, reflected on the appropriateness of such programs in general:

*Broadly speaking, the programs have done more harm than good. If you treat the Tepli Kredyty program unfairly, **install an IHS without design documentation, without expertise, without technical supervision—you can buy a lot of equipment, which will not bring benefits**. It was the case for us and not only for us. It was so in Rivne, Dnipro and Zaporizhzhia. There was a problem when they took, for example, a loan for UAH 200,000, started to pay the interests, but had no savings. That is why I do not advise anyone to install the IHS without a professional approach, and I believe that it is even a kind of a crime.*

Another representative mentioned that military members live in his house, which has a specific influence on attitudes toward saving on heating consumption:

In my house, 60 percent of the residents are persons entitled to benefits. I have 102 apartments, of which 20 pay full price and are interested in savings. The others don't show that interest. I even have those residents who are entitled to 100 percent cover of utility bills. Those who have a benefit for utilities, including heating—they do not need it.

There is another building where the residents got together and decided that they needed to insulate. They chipped in together—UAH 700 from a two-bedroom apartment, UAH 900 from a three-room one. And began to solve this problem. I have a completely different situation.

He also pointed out that the people in his building are hostile to any initiatives to improve energy efficiency, refusing to pay even for roof repair. Therefore, we can conclude that if a large number of residents in a building have utility bill benefits, the issue of promoting energy efficiency measures, including installing IHSs, may come to a standstill.

In the worst month, I had a savings of UAH 9 per square meter. But all my radiators are warm.

I have all my buildings clustered in the same area. And the first IHS was very hard. We also wanted to take [funds to install an IHS] under the Tepli Kredyty program. People were afraid, first of all, afraid of this credit. They were afraid of the word "credit." When I said it, there was a scandal; everybody was afraid that they would take the apartments away if we didn't pay the interest. We installed the first IHS, and people noticed the savings right away. And everyone had neighbors, acquaintances in that neighborhood, and people from other houses began to compare payments. And so this mechanism of "neighbor told neighbor" became effective. Last year, they paid UAH 40 per square meter; this year, with the IHS installed, they paid UAH 30. So it is cheaper.

According to the representative, during the first year of IHS operation, people change their opinion and notice significant savings on heat consumption. With this result, people see that the money is not spent in vain. It also encourages residents from neighboring buildings to think about introducing such a thermo-modernization measure.

We were also told that the coronavirus pandemic affected the process of promoting energy efficiency measures. For example, one HOA representative said that he had collected the necessary signatures to install an IHS in the building. However, the COVID-19 pandemic began, and people began to withdraw their signatures. Also, the process was affected by people returning from working abroad. The reason—they were simply afraid to invest their money in such an insecure period.

People do not understand that they make the insulation not to have more heat but to heat less. People don't understand that insulating a building is not to make you warmer, it's to make it cheaper. Some people say, "I already have insulation." But they do not understand that due to the fact that they insulated their apartment, they may become more comfortable, but not cheaper.

However, representatives of Lutsk HOAs have not lost their optimism and continue to promote measures to improve energy efficiency in their buildings:

> *I conducted an analysis, showed people that we paid so much for heating. And if we installed an IHSs, we would have saved so much. We would have paid a thousand and a half less for heating. A river cuts through rock.*

One of the preconditions for the larger-scale installation of IHSs, according to representatives of Lutsk HOAs, is the need to update the city heating scheme and to generally improve and repair the heating systems in Lutsk:

> *Usually, [the repair of heating systems is] necessary. You know how it is done here—where there is a breakthrough, there they replace the system. But the pipe mains have a great length in Lutsk. And it is probably impossible to replace them all at once. I wish they replace at least where repairs are planned. However, in most cases, the heating season starts on time.*

KHARKIV

In general, representatives of HOAs in Kharkiv noted that they are satisfied with the decision to install IHSs in their buildings and believe that this measure has met their expectations.

> *Even those who were against it, they began to understand. I explained to the men what it was because they could not understand for a long time. Men were more against [the IHS installation] than women.*

In general, HOA representatives in Kharkiv pointed out the following obstacles to the larger-scale installation of IHSs in their city:

> *First, it is authorities. The city is politicized, so the establishment of centers of democracy here is problematic. And an HOA is a very democratic structure. It is one of the tools to bring people together.*

Also, they noted the cost of equipment as one of the obstacles to the larger-scale installation of IHSs in Kharkiv. Because the vast majority of buildings install Danfoss equipment, which is manufactured in Denmark and imported to Ukraine, the cost of IHSs is not cheap. Below is a quote from an HOA representative in Kharkiv on this issue:

> *If Ukraine starts similar production or starts manufacturing Danfoss equipment in Ukraine. The production capacity of the city of Kharkiv allows us to arrange such a production.*
>
> *For example, we waited for two months for the heat exchanger because they transferred the production to Poland.*

There are only 800 buildings in Kharkiv organized as building cooperatives, HMOs, and other associations. Only a small percentage of buildings in Kharkiv have established HOAs, and one of the HOA representatives in the city gave the following explanation:

> *About 100 HOAs have been established in Kharkiv, but none have been dismissed [i.e., HOAs do not have the capacity to operate independently]. It happened because the city authorities were afraid that people would see that servicing is better this way, and they would shift from the city budget to self-sufficiency.*

As a representative noted, other factors are also important for saving on energy and maintaining a comfortable temperature indoors:

Well again, what windows are there, what radiators... Well, I have a woman who lives on the 10th floor, she constantly complained that she was cold. And I say that she cannot be cold, since we have overhead distribution. And she just has old radiators. Last year, she installed good radiators. I ask her how she feels now, and she says, "Oh, gorgeous! I finally realized how it is when it is warm. Now in my apartment, the temperature is 23–24 °C." So, it still depends on what kind of radiators are in an apartment, what windows are installed, and so on.

Another HOA representative pointed out the complexity of obtaining a loan for IHS installation in his building:

It took us a very long time, probably about half a year to get this loan. It was just the beginning, and it was quite problematic to get that loan. But we managed to get the IHS turned on before the heating season started.

POLTAVA

One of the problems Poltava residents face when installing IHSs is the use of low-quality equipment:

We still have the so-called "do-it-yourself wizards" in the city who make Chinese versions of IHSs, where there are just valves, some pumps; and they have equipped more than one building, but nevertheless, it all comes out crooked and short-lived in my opinion. It is necessary to do it wisely—for a long time, properly and correctly.

Representatives also mentioned the insufficient number of HOAs in the city:

People establish HOAs only when something cracks. We established HOAs when there was no hot water in half of the building. We had a private HMO who said, "Give us money, we will do everything," and we said why to pay someone if we could do it ourselves—so we established an HOA. Other buildings began establishing HOAs when the HMOs raised the tariffs, and where the tariffs were low, people said, "We don't need anything."

The majority, unfortunately, is very inert; ***we have 400 HOAs and HCOs in the city****, and of this huge group,* ***only about three or four are active****. Now we are waiting for management companies to come, and there will be more HOAs because many are waiting. Some have even established HOAs, but they don't work. When people see the difference in buildings where we are doing something and buildings that are deteriorating...*

HOA representatives have offered to do some promotion, which should give impetus to more active efforts by HOAs in Poltava, such as holding workshops:

What if to gather the HOA chairs for workshops? It would also be an impetus, but again, unfortunately, there are not many active chairs; we have already held the meeting. And of the total number (400), about sixty people gathered. It's not a few, but... They don't even attend what they need to attend. The hardest thing in the HOAs is who to take care of this process.

Also, the HOAs pointed out the problem of having a certain number of residents receiving subsidies, which in some way prevents the more widespread installation of IHSs in the city's multi-family buildings:

The fact that subsidies are granted regardless of whether people support energy efficiency measures or not is a mistake. Because people who receive subsidies that close heating problems, are not interested in changing

anything, they're fine as they are. If the fact of granting/not granting subsidies were somehow related to the moment of energy modernization, it would probably have played an additional positive role; people would understand that without modernization of the building—you would not get money. Thus, it turns out that the state budget stimulates the actions of those who are detrimental to the national scale.

In general, Poltava HOAs noted the passivity of all stakeholders in the city in the matter of promoting IHS installation and implementing energy efficiency measures in general:

The carrot and stick approach should be in place; however, we have neither stick nor carrot because subsidies are granted for free, and HOAs are not stimulated in any way at all. For those who are better, who have already managed to implement something, we still have to work harder to make the programs that support us become effective. We constantly negotiate with the deputy corps and the local governments to be included somewhere; that is, we have to put pressure on them to implement something.

They also mentioned another problem for the larger-scale installation of IHSs:

There is still the support of state-paid buildings of the former communal property. There is still a communal HMO subsidized from the budget; there are repair programs for these buildings and the fact of repair of these buildings at the expense of the budget. Therefore, people who see such a story believe that there is no point in taking responsibility for their building because there is a building next to it repaired by the HMO. "It is better to wait until it is its turn and they will repair ours," plus there are people receiving subsidies, who do not care much about the price of heating, and they all are waiting for manna from heaven when it all happens.

Another obstacle to the larger-scale installation of IHSs in Poltava was said to be the practical lack of assistance from the city:

The city authorities simply do not initiate anything themselves; we—the HOAs—initiate it. I even now head the board of Poltava HOA chairs. So we, the active heads, actively prompt all these activities.

Some cities even have a Deputy Mayor for Energy Efficiency. We do not. Even the management of our housing and utilities sector does not understand some simple things. And elected deputies don't even know what an HOA is. It's hard when people don't really know everything.

Once, in 2010, there was another program where part of the money should be provided by us, part—by the IFI, and part—by the city; so we arranged everything then, but the city failed—they did not go for it.

But there is another opinion—some argued that the city does help in the process of installing IHSs in multi-family buildings in Poltava, although it does not really promote it:

In our city, we knew that there was a program of partial reimbursement of interest on loans, and at that time, there was also an oblast program of partial reimbursement of interest on energy efficiency under the Tepli Kredyty Program. As of today, the oblast program doesn't work. And the city one is still effective, and it repays interest on the loan for us.

The city budgets the necessary amounts each year to reimburse that interest. Of course, they don't walk around with banners by the buildings, but the program works.

We hope that the interest reimbursement program will work. Well, in our city, we have established, even if minimal, but adequate communication between the HOA community and the city authorities. I would like more, of course, more support and assistance.

MARIUPOL

In general, the HOA representatives in Mariupol described their experience with the installation of IHSs as predominantly positive:

> *There were no problems with the city or the contracting firm. Do you know why not everyone's experience is positive? Because people don't believe it. Here were the first ones called smart heat regulation units or individual substations, and they were installed for free at the expense of the oblast budget. And the heat network installed it just as a gift. And of course, they are not very good specialists, they did not install very well, and they do not work well there. So these people are not satisfied. And I immediately said that we needed to have specialists, specialists who had studied abroad as well (this private firm Olnait has such), and I was only for the work of specialists, not just for nothing. It was probably such a pilot project, and then they started offering loans, and it was good; the chairs chose contractors, and that's good as well.*

Furthermore, they emphasized the available support from the city to improve energy efficiency in multi-family buildings, including the installation of IHSs:

> *For some reason, everything happened well for us—we have a lot of support from the city. I was in different cities: Lutsk, Kharkiv, Lviv, Zaporizhzhia, Dnipro. There is no such financial support of HOAs there; that's why Mariupol is, as a rule, on top in Ukraine. Lutsk was the first to start, we studied there. They didn't have the same support, so they took loans under the Tepli Kredyty program, self-financed, looked for other sources. The cost of IHS is 350,000, if a large house—500 (depending on the equipment set), well, in this respect, it is unlikely that the residents themselves would cope with it.*
>
> *On our own, we would not install; I calculated several options. I calculated the insulation of the building as a whole. People from Kyiv visited us, calculated, and said, "Well, is it hard for you to pay 1,350 per apartment during a year so that we insulate..." and I said, "Guys, are you kidding, people have subsidies here, 70 percent are pensioners, 30 percent are employed."*
>
> *It's hard without the support of the city. We could not do it on our own. It cost 1,400,000, and 900,000 were "presented" to us, you know? How could we managed without the city... Just think, if we had done it ourselves, what would have been the tariff...*

Some HOA representatives pondered the HOA assistance programs available in the city:

> *I wish they had not removed the Tepli Kredyty program. The option is to join the Energodim program, Energodim is not so good... When people hear that they have to take 8–9 million for a building and at the same time raise the tariff to ten, it's very hard. And when the tariff was 5.50—we quietly made the windows and repaid, then quietly bought the IHS—bang, completed and repaid.*

Also, HOA representatives pointed out certain difficulties with the approval process for taking out a loan from the bank:

> *The biggest problems arose with PrivatBank, with their legal department, constant shortcomings, driving back and forth, signing their contracts.*

They also expressed their thoughts on what exactly is needed to give impetus to the larger-scale installation of IHSs in Mariupol:

People just need to be educated. People think that everything is done for free, you know, they don't need to pay money for this work, the fund should do everything for free. But this does not happen, the apartments are privatized, and the building should be kept in order.

The main thing is to have support; if people do it on their own—it's very challenging. Now we have all the money remaining at the local level, and the city is much easier to work with people. They should pay attention to the fact that the city should take care of people. Our city is doing well in that regard, very well.

There's only one incentive—the cost savings. We have to work with people and show everything in figures. And not just in words, show examples, here is such "before" and "after," you should go there and talk to people. It is the best agitation; when people see a positive effect, and there is a reduction in payments—it is the best argument. Whatever the lecturer, the convincing speaker—a practical example is always better.

In addition, they noted the necessity of a proper, systematic approach to the IHS installation process in multi-family buildings:

It is mandatory to prepare a project. You definitely need to survey the building. And when you choose a contractor, continue working with it because everything happens, conclude a contract for the guarantee with it so that it monitors. So that there is no such thing as some have installed, others maintain, and they shove on each other.

RESULTS AMONG HCOS AND MANAGEMENT COMPANIES IN LUTSK AND KHARKIV

IHS Impact Assessment

In general, representatives of HCOs and management companies showed less interest in the issues of IHS installation and operation than HOA representatives.

About 20 percent of HCO representatives in Lutsk were not able to assess the impact of IHSs on the amounts of utility payments and savings on heat consumption:

I do not see the impact as such because the residents pay the money for heat to SCU Lutskteplo. For the manager, they pay for the building management; I do not have a column for heating or hot water.

Considering the information that I hear from people—if it's all set up, and it all operates, then there are savings. There is a better distribution of heat carrier in the building. Parameters there comply with all standards—both for the supply and the return, the computer already regulates there.

However, about 60 percent of the HCO representatives surveyed have asked building residents for their opinions regarding IHS functioning and their impressions of its impact on the amount of their utility payments and the overall level of comfort in the multi-family building. They noted the positive impact of IHSs and residents' satisfaction:

In some cases, even the residents themselves ask to install them. So there is a result, so they notice it in those buildings where the IHS has already been installed. Therefore, I would say that it is positive. I would like to have IHSs installed in all buildings, I think then the result will be very promising.

One of the representatives of the management company in Lutsk did not provide detailed information about IHS operations in the buildings on the company's balance sheet about feedback from residents, merely providing generalized feedback:

The assessment is positive. We like everything.

In the vast majority of multi-family buildings where IHSs were installed under programs financed by IFIs, implemented by local heat supply companies, and subordinated to HCOs or management companies, the IHSs were installed at no cost to the HCOs or management companies themselves.

In these cases, the HCOs or management companies agreed to the installation but did not engage in the process, nor they do collect information on IHS performance.

In conclusion, it was difficult for representatives of HCOs and management companies to assess the impact of IHS operation on heat consumption and consumer savings or on the level of comfort in apartments:

> *It's hard to say about comfort. Someone installed a warm floor in their apartment; someone replaced the pipes—it all affects the performance of the in-house heating system.*

However, some HCO representatives in Lutsk receive feedback from building residents:

> *It is still unclear to the end. Some shout that it is hot; others shout that they are fine. Maybe it needs to be adjusted once more or some way.*

In Kharkiv, only one company—CU Zhylkomservis—manages a building that was equipped with IHSs under the project funded by the World Bank. Here is what is stated about the company's activities on its official website:[35]

> *The main goals and objectives of the enterprise are to provide profit-driven building management services, that is, to engage in business activities to meet the needs of owners and co-owners for efficient management of their property, maintenance of the facility (an individual residential building, structure or group of buildings and structures that constitute an integrated residential complex, together with the adjacent territories) in proper technical and sanitary condition, organization of meeting the needs of the facility residents in housing and utility services.*

Representatives of CU Zhylkomservis in Kharkiv provided almost no information about their IHS impact assessment or other aspects of its functioning. They also have practically no opinion about who should hold the title to an IHS, who should install it, and who should be responsible for and pay for its maintenance.

Who Installed It and How Much It Cost

All representatives of HCOs and management companies in Lutsk confirmed that IHSs in their buildings were installed by SCU Lutskteplo under the EBRD-funded project. However, SCU Lutskteplo did not do this itself but through contractors:

> *Contractors who have a contract with SCU Lutskteplo installed them. I know that the firms that entered into contracts under the tenders install them, and so on.*

None of the HCO representatives were able to estimate the cost of the IHSs installed in their buildings:

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[35] https://zhks.kharkov.ua/kontent/o-predpriyatii

SCU Lutskteplo installed them at the expense of the EBRD. I cannot say the exact amount, it is better to ask SCU Lutskteplo, they know better.

***

I know that SCU Lutskteplo was installed under the EBRD program. They installed a lot of such IHSs in the city. I was not interested in how much they cost; it is not paid by the building residents and us.

The IHSs installed in Kharkiv's multi-family buildings under the project funded by the World Bank were arranged in buildings managed by CU Zhylkomservis. Representatives of CU Zhylkomservis do not know how much it cost to install the IHSs in their buildings and were not interested in this question. For more information on this issue, they advised contacting CU Kharkiv Heat Networks, which installed IHSs in their buildings under the project.

Who Maintains Them, and Who Pays for It

Information varies about who maintains IHSs in multi-family buildings in Lutsk run by HCOs and management companies. Most representatives of HCOs and management companies said that SCU Lutskteplo provides IHS maintenance services. There are no complaints about their services; on the contrary, HCO representatives mentioned the promptness of the company's response and the overall positive experience of cooperating with it:

There is a normal cooperation, so there are no problems. I do not see any remarks about the heat supply company. Although this company is like that, they also have their own problems. But they react very promptly. I like the work of their head; it is a pleasure to work with them.

A brigade of workers of the heat supply company responds both to our requests and residents' requests promptly. Masters appear immediately, help, fix if something is wrong.

For their part, the HCO representatives noted that they do everything possible to ensure that the process of installation and maintenance of IHSs occurs without obstacles and that the technical condition of the basements complies with sanitary norms:

We do everything possible to ensure that the premises where the IHSs are installed are equipped with everything necessary, repaired.

The representative of the management company noted that in their buildings, IHS maintenance services are provided by SCU Lutskteplo and paid for by the building residents. The additional cost of IHS maintenance services is added to the heating tariff:

The IHS maintenance is done by SCU Lutskteplo, and paid for by the building residents.

About 30 percent of HCO representatives in Lutsk do not know who pays for IHS maintenance in their buildings.

Representatives of CU Zhylkomservis know that IHS maintenance is provided by CU Kharkiv Heat Networks, but they could not either evaluate the company's services or provide information on who pays for this service.

Who Controls the Temperature Regime, and Who Should Do It

About 50 percent of HCOs in Lutsk whose buildings have IHSs installed do not know who controls the temperature regime and whether there are complaints from residents on this issue. They also do not know whether residents have any influence on this process in their buildings. Below is a quote from one of the HCO representatives in Lutsk:

> *We don't know that, but our understanding is that they operate depending on weather conditions. We have no remarks on this.*

Some HCO representatives are totally unfamiliar with this issue and could only say that the temperature in the apartments is regulated automatically. Below is a quote from one of the HCO representatives in Lutsk:

> *I know that a computer monitors it [the IHS].*

A representative of the management company in Lutsk noted that the contractor who installed the IHS under a contract with SCU Lutskteplo is in charge of regulating the IHS temperature regime. Changing the temperature regime takes place at the request of the residents of the multi-family building where the IHS is installed:

> *Residents send us a request. We inform the contractor that, for example, there are complaints or comments about the IHS operation. Who wants colder, or who wants warmer. And that's it, we give the information, it [the contractor] adjusts.*

According to the majority of HCO representatives in Lutsk, it is the heat supply company that should regulate the temperature regime of the IHS, and the building residents should initiate changes in the temperature regime:

> *The heat supply company should do this. It is on their balance sheet. But residents should gather a meeting to decide what temperature they are comfortable with, to reach a joint decision. And then, we already order services of the heat supply company so that they come and adjust.*

Representatives of CU Zhylkomservis in Kharkiv do not know who regulates the IHS temperature regime in their buildings; they assume it is done by CU Kharkiv Heat Networks. However, they could not provide exact information on this issue.

Representatives of CU Zhylkomservis have no opinion as to who should be responsible for regulating the temperature regime of the IHSs or what role the building residents have in this process. The common opinion of CU Zhylkomservis representatives is that the residents should probably somehow participate in this decision.

Opinions of Building Residents

In most cases, the representatives of HCOs and management companies in Lutsk are not aware of residents' impressions and opinions regarding IHS installation and their willingness to pay additional funds for it. Below is a quote from an HCO representative in Lutsk:

> *We do not poll the residents. In each building, there are 1–2 people who will say, "eww," under any circumstances.*

Some HCO representatives in Lutsk do not know the opinions and attitudes of the residents of their buildings but point to the following technical features of large-scale IHS installation:

There are nuances, of course. If you install an IHS, then it should be installed in all buildings, which are along the main from the boiler house. IHS takes heat primarily, it violates the hydraulics. If the boiler house supplies heat to 20 buildings, and two of them have IHSs installed, then where the heat carrier will flow? To the place where these two IHSs are installed. And in other buildings, everything needs to be re-adjusted, the whole hydraulic system, so that other buildings without the IHS also have the heat carrier.

A representative of the management company in Lutsk assured us that the residents in their buildings are satisfied with IHS installation and have no complaints either about its operation or the need to pay additional money for its maintenance:

Everyone likes it; there have been no complaints during the period that the IHS is functioning in our buildings. Everyone is satisfied.

Representatives of CU Zhylkomservis in Kharkiv did not say whether they ask residents about their satisfaction or dissatisfaction with IHS operation in their buildings, and they do not know whether they pay for IHS maintenance service.

Who Should Have the Title, and Who Should Maintain It

Sixty percent of the Lutsk HCO representatives surveyed have no clear opinion as to who should hold the title to IHSs and who should maintain them. Some HCO representatives even pointed out that it is better to reach the heat supply company with this issue and did not want to discuss this topic.

The remaining 40 percent believe that the heat supply company should hold the title to IHSs and maintain them:

The heat supply company should have the title to the IHS. If the supplier wants to have proper payments, it must contact the consumer. If the heat carrier is adequate, the consumer is satisfied and pays. The more transparent is the connection between the supplier and the consumer, the better is the trust.

The representative of the management company in Lutsk said the question depends on who was responsible for installing the IHS and who funded the purchase of the equipment:

Here is a moot point. If it is done by HOAs, it's better to have it on the HOA's balance sheet. But if an HOA did not procure the IHS equipment, then it is logical that the IHS should be on the balance sheet of the heat supply company.

Representatives of CU Zhylkomservis did not give a definite opinion as to who should hold the title to IHSs or who should technically maintain them.

Problems During Installation and Commissioning

In Lutsk, no HCO representatives reported problems with the installation or commissioning of IHSs.

The representative of the management company in Lutsk said that even if there were problems, they were solved, and there were no serious obstacles to IHS installation.

As I understand, everything was solved. There was only one building where the residents could not agree whether they needed IHS or not. But all the issues were solved in due course. There were no critical moments.

Representatives of CU Zhylkomservis in Kharkiv were not aware of any problems or obstacles during the installation or commissioning of IHSs. All issues with IHS installation were raised at the buildingwide meetings and resolved appropriately. No serious complaints or problems mentioned by the residents were recorded.

ANNEX 4. KEY RESULTS OF THE SURVEY AMONG CONSUMERS OF DISTRICT HEATING SERVICES

IMPRESSIONS OF IHS OPERATION AMONG DISTRICT HEATING CONSUMERS

LUTSK

In multi-family buildings in Lutsk, IHSs are installed either at the initiative of the residents themselves or through the EBRD-funded project under which they are installed by SCU Lutskteplo.

DH consumers predominantly evaluate the impact of IHS on the overall comfort in apartments and the payments for heating as positive:

> *I know, they installed it a long time ago... As long as we have it—first of all, we pay less, it is profitable. These years we have been paying a lot less.*
>
> ***
>
> *They gathered the whole building and told us that they would install the IHS, asked whether we agreed. Well, we said let us install it so that they and we got profit.*
>
> ***
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> *In the apartment, the temperature is 22–23 degrees in the winter. It's not cold, it's okay.*

In general, positive changes were noted by residents in both types of buildings—those where IHSs were installed at residents' initiative and with the help of programs such as Tepli Kredyty, and those where IHSs were installed by SCU Lutskteplo.

> *Well, what are the impressions... Considering that we pay half as much for heat as compared with the time when the IHS was not installed—how can we assess? Only positively. For example, last year; I have an apartment of 55 square meters. I did not pay more than UAH 1000 for heating per month.*
>
> ***
>
> *Well, what has changed... We pay a lower price. I see that people pay more, and we pay a little cheaper.*
>
> ***
>
> *My impression is positive. If you compare with those who don't have [the IHS], they pay twice as much for heating. And there are such residents in our building who don't like anything at all. But I like everything.*

Some Lutsk DH consumers initially found it hard to get used to the new temperature regime after the installation of IHSs. Previously, they had been used to overheating, when the temperature in their radiators was significantly higher than necessary, so the temperature in their apartments could reach 26–28 °C. At such a temperature, they had to open their windows (and still pay for the heat consumed).

After IHS installation, some building residents felt unusual from the change in the temperature:

It was unusual because the temperature schedule in the apartments changed... But then people got used to the temperature. We have somewhere around 20 degrees.

In some multi-family buildings in Lutsk, as well as in buildings of other cities, IHS installation became part of a comprehensive set of measures for the thermo-modernization of the building. Such an approach can be considered optimal—in fact, IHS installation in the absence of other measures to improve energy efficiency may not give the expected effect in a multi-family building from the old housing stock. This is because in such buildings, windows, doors, and utilities are already outdated and require replacement. Therefore, IHS installation can be the most profitable when complemented by other energy efficiency measures, as confirmed by DH consumers from Lutsk:

There were meetings; we decided everything at the meeting... We took a loan, so...for the repair of the building and for the IHS... About two million [UAH] or two-odd... I do not remember exactly. We installed windows, doors, we changed the valves in the basement, that's it. Now the sewage system is repaired. We also replaced the risers. Because the building is 50 years old.

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The IHS does not give much when there is no insulation... Our building is completely thermo-modernized. We installed both windows and doors. Everything together gives a result.

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We spent UAH 670,000 on the thermo-modernization of our building. The state reimbursed UAH 400,000. Because in the first entrance where the IHS was installed, it was warmer; and it was colder in the next entrances. Our building dates back to 1967; our pipes were so rotten... But we have taken measures, and the effect is evident. We can already notice that the heat reaches us faster.

IHS functionality depends on the steadiness and continuity of heat supply in the multi-family building and the temperature regime. If there are interruptions in the operation of heat carriers, the stable operation of the IHS is disturbed, which was also noted by DH consumers in Lutsk:

In order to commission the IHS, you need to have a boiler house properly operating. And our boiler house does not operate properly. One day, there were two such breakthroughs that they repaired these failures within four days. And what does it mean? It means interruptions [in the IHS operation].

Some DH consumers are dissatisfied with IHS and believe that it has become colder in their apartments. These consumers do not notice or refuse to notice the savings on heating fees and claim that they have become uncomfortable living with the set temperature schedule:

Now the average temperature in the apartments is 21–22 degrees, which corresponds to the standards. At the same time, some consumers are still very dissatisfied and convinced that the temperature is insufficient ("I am cold, I am freezing!").

KHARKIV

In some multi-family buildings in Kharkiv, residents and HOA board members initiated IHS installation following the example of other buildings where IHSs were already installed. After seeing the real opportunity to save on heating bills, building residents became more open to this and began to promote the process of installing the IHS.

IHSs in Kharkiv are installed under a project funded by the World Bank, which aims to reconstruct the heating system in the city. IHS installation is a component of this project. Residents living in buildings with IHSs already installed under this project are mostly satisfied with or neutral about them and virtually unfamiliar with the installation and operation of IHS.

In Kharkiv, the vast majority of multi-family building residents who were DH consumers learned about the initiative to install an IHS in their building through a meeting of the building residents. At these meetings, the HOA chairs informed them of the details—the cost, the features of IHS operations, how the residents would pay back the cost of installing the IHS (if necessary)—and described the benefits and advantages of this energy efficiency measure. Such meetings were also held in order to collect the necessary signatures in favor of IHS installation—at least two-thirds of the building residents must agree to this measure:

> *We gathered a meeting, discussed everything in advance... [We were] told about the economic effect that can be achieved by installing the IHS. All the residents learned in this way that the IHS would be installed in the building.*

Generally, in Kharkiv, about 70 percent of surveyed consumers from multi-family buildings with IHSs installed noted their positive impact on the overall comfort in apartments and the savings on heating bills:

> *We have a temperature of 21–22 degrees, and such a temperature is in the apartments on the first floor and on the sixteenth... And in other buildings, it is hot on the first floors, and on the higher floors, people freeze. And they pay the same as we used to pay. And now, with this IHS, it is good, comfortable in our apartment.*
>
> ***
>
> *When the temperature raised from 14–16 degrees to 21 degrees, we felt much warmer and more comfortable.*
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> ***
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> *In three-room apartments, the difference in payment for heating is about UAH 1000 in the colder months and UAH 800 in the warmer months, as compared with the time when there was no IHS. This difference is considerable.*

We can conclude that a family living in a three-room apartment in a building where an IHS was installed can save more than UAH 4,000 on heating costs during the heating period.

On average, residents of multi-family buildings in Kharkiv can save 20–30 percent on heating costs due to the installation of IHSs in their buildings.

Along with IHS installation, other energy efficiency measures were implemented in some Kharkiv multi-family buildings; these also had an effect and led to significant savings on heating bills for residents of these buildings:

> *A number of measures have been implemented in the building. Definitely, for the third year in a row, we pay for heating half as much as the city pays. And it is already the plus and savings that we notice. The improvement from the IHS installation can only be noticed in your wallet.*

...To keep the heat, we had to replace all the windows in the building; the windows in the entrance hall were changed as well.

We can conclude from this that IHS installation has the best effect when implemented as one of a comprehensive set of measures to improve energy efficiency—for example, replacement of windows and doors, thermal insulation of basements, and repair of roofs. Without these measures, IHS installation may not have the expected effect and may not contribute to significant savings on heating bills.

Among some DH consumers in Kharkiv, there was a certain distrust of such measures as IHS installation—people did not believe that it was possible to equalize the temperature on each floor of the building and to provide the same temperature in each apartment during the heating period.

But now, in general, they see the positive impact of the IHS on, above all, comfort in the apartments:

When I came to live here 20 years ago—it was very cold here. When the IHS appeared here—now it is warm and more or less comfy for me.

***

The building has become more comfortable. When the radiators are cold, the temperature in the apartment is quite comfortable. For example, in my apartment, it is 22 degrees.

In some Kharkiv buildings where IHSs have been installed, the in-house heat supply network is not balanced. In these instances, the heat carrier is unevenly distributed by floor, even with the IHS installed. As a result, apartments on one floor may be cooler than apartments on the floors below or above, depending on whether the heat supply flows up or down. In such situations, DH customers may notice a difference in temperatures between apartments on different floors and may feel discomfort when their apartment is several degrees cooler than it should be.

Saving on payment for heat consumption is the main engine motivating people to install IHSs. DH consumers who have IHSs already installed in their buildings mention significant savings and are quite satisfied with them:

We have very considerable savings. During the heating season, we can save UAH 3,000–4,000 or even UAH 5,000 on heating payments in some apartments.

***

...I remember that in 2017, I paid for heat more than UAH 3,500 a month for a two-bedroom apartment, and last year, the largest bill had was UAH 1,900 for a month. Well, of course, it was not immediately noticed; while we got used to it, while we adjusted it all.

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If there is a possibility—you need to install the IHS.

POLTAVA

In Poltava, the majority of DH consumers reported an improvement in the general comfort and level of heat supply services in their apartment buildings after IHS installation. There are also buildings in

Poltava where IHS installation was part of fully-fledged activities to improve energy efficiency, which resulted in a positive effect on the residents:

> *It definitely became warmer. As I understand, in addition to the IHS installation, we also replaced the pipes. My impressions are extremely positive. After that, it is better in my apartment.*

Such a situation also occurred in another multi-family building, where residents decided not only to install the IHS but also to completely insulate the building in order to maximize benefits and savings on heat consumption at the expense of the city program for reimbursement of funds for building thermo-modernization:

> *We have quite a big building—eight entrances, nine floors. The building is of the block type, and we have very large payments for heat. We currently have one of the highest tariffs for HOA. Nevertheless, we installed the IHS and now also perform modernization and insulation of the building.*

Residents of multi-family buildings in Poltava mentioned the importance of insulating not only the building itself but also each apartment; they expressed delight with the effect such measures have had on the amount they pay for heating.

> *My apartment is already insulated from the very beginning and has been for a long time. In principle, with a sufficiently high temperature in the apartment, our payments are much lower than those of the residents from other buildings with no IHS installed. For example, we have a three-room apartment—we pay for heat UAH 300 less per month than the residents of a two-room apartment in a building without the IHS.*

Reducing the amount of money paid for heating remains the main expectation of IHS installation, and this expectation has been quickly met for the residents of multi-family buildings in Poltava.

> *I am paying less—UAH 500 less than before. I have a two-room apartment; before the IHS installation, I paid UAH 1,200 for heating per month, and now the largest monthly payment for heat was UAH 860.*
>
> ***
>
> *We are very happy with the payments, we now have a lot less, noticeably. We pay about UAH 400 per month for heating; it is in a one-room apartment. And it is much warmer now. We also insulated ourselves, and in our apartment, it is around 20 degrees.*
>
> ***
>
> *We are very satisfied with the IHS, the savings are insane. We save about 30 percent now. And when we are totally insulated, I think we will even save 50 percent. I pay for heating by UAH 400–500 less now.*

MARIUPOL

In most cases, DH consumers are satisfied with IHS installation in their buildings in Mariupol. They also noted the active support of the city on this issue and the high activity of HOAs in Mariupol. Thanks to these two factors, consumers have noticed substantial improvements in the old housing stock in the city. Residents of multi-family buildings with IHSs also claimed that they do save on heat consumption:

> *There are times when we pay less. So far it seems normal.*

In Mariupol, as in all other cities covered by this survey, IHS installation has become part of a broader set of measures to improve thermo-modernization in buildings. The Tepli Kredyty program was very active in the city and allowed HOAs to pay back only a certain percentage of the amount allocated for the thermo-modernization measures in their buildings (15–20 percent of the total amount).

Furthermore, the mere installation of IHS without other energy efficiency measures may not have the desired effect in terms of savings on heat consumption. When it comes to multi-family buildings of the old housing stock, it makes sense to introduce a set of energy efficiency measures, such as replacement of windows and doors as well as insulation of basements and roofs. This was confirmed by the residents of multi-family buildings in Mariupol, where in addition to IHS installation, a set of measures for building thermo-modernization was introduced.

> *All our pipes were replaced, now they are plastic. The basement was repaired, also many things were replaced... Everything was insulated, everything is fine now.*

In general, the residents of multi-family buildings in Mariupol were not against IHS installation in their buildings and had a positive attitude toward this measure. As in the buildings of other cities, residents of buildings in Mariupol were informed about the intention to install the IHS with the help of fees:

> *There was a meeting; we discussed it all... And we decided to do it while there was such a program.*
>
> ***
>
> *My impressions are good. We were saving UAH 10–12 per square meter per month. And it means something. Automatics does its job; the temperature is the same in each apartment.*

In Mariupol, DH consumers reported that the general comfort in their buildings has improved and the temperature has become more comfortable:

> *For example, now the heating is turned off because it's warm outside. It's all automated, we don't pay for heat if we don't need it. As it gets colder—the automation turns on, and the heat appears in the radiators.*
>
> *As for me, this is the future. It used to be that Petya the locksmith was running 20 times from the HMO. He came, maybe closed, maybe opened the heating. But here everything works automatically.*

There was one case of negative consumer experiences with IHS operations:

> *We did not notice any relief. I pay UAH 1,300 per month for heating of a one-room apartment. I am not even talking about the temperature in the apartment. The radiators are hot at the top and cold at the bottom. Last fall, we replaced the risers in the house, replaced the pipes. We replaced the door, windows in the entrance and basement.*

The reasons for this situation are unknown—it may be due to the lack of qualified experts at the company that installed the IHS in this building or the low-quality equipment that was purchased and installed.

REIMBURSEMENT OF THE IHS INSTALLATION COST

LUTSK

In Lutsk, a resident of one of the multi-family buildings claimed that they paid a lump-sum fee to cover the cost of IHS installation in their building. The amount was approximately 200–250 per two-room apartment.

> *We installed at people's expense. It was about UAH 218,000 [meaning the cost of the IHS]. We took a loan, and in about two years, we paid it back.*

Another resident pointed out that the implementation of such measures for improving energy efficiency in buildings has become feasible thanks to the possibility of establishing HOAs in cities across the country. The HOAs organize repairs in multi-family buildings and manage the cash resources available to improve the building.

In another building, payments to the building repair fund include a portion to repay the loan for IHS installation. However, not everyone is willing to pay such fees, according to one resident:

> *There are 5–6 apartments, which, shall we say, are not happy with such a decision. Even now there are about 25 apartments for rent. So there are debts [for the building repair fund]. And it's not about UAH 5. But about dozens of thousands! We need some kind of law to deal with such debtors. And we have no such law in our legislation.*

A resident of another building also claimed that the loan for IHS installation is being repaid by including additional amounts in the bill for the repair fund. The amount, UAH 2.75 per month, is paltry, especially compared with the savings that residents of multi-family buildings have thanks to the installation of IHS:

> *We took a loan. Part of it was paid by the state, part of it was paid by the residents. We repaid the loan in two years.*

According to one resident, it is not a question of people agreeing or not agreeing to contribute additional money for building maintenance to go to IHS installation. After all, during the meeting, people signed a document consenting to the IHS installation; therefore, they automatically agreed to pay additional money to the account of, for example, the repair fund, which should cover the cost of installing the equipment.

Residents of buildings where IHSs were installed by SCU Lutskteplo under an EBRD-funded project did not pay any additional funds. The IHSs in such buildings were installed free of charge for the residents.

KHARKIV

In some cases, DH consumers in Kharkiv paid lump-sum fees for IHS installation directly to the bank account upon requisites for the loan repayments taken under the Tepli Kredyty program. In general, this process proceeded quickly, and the building residents paid their part of the funds for the IHS installation on time.

The reimbursement period for IHS installation in multi-family buildings can be two months; it all depends on how much the state or the city reimburses for the IHS installation.

In other cases, an HOA board chair or another person responsible for such processes in the building organized the collection of funds from the residents of each apartment. Part of the cost of IHS installation in those buildings was reimbursed using such fees:

> *We joined the Tepli Kredyty. We paid 30 percent, the other 70 percent was reimbursed by the city. We made contributions; I don't remember exactly how much... We sure made them. And with those contributions, that 30 percent was covered.*

Residents of multi-family buildings where IHSs were installed by CU Kharkiv Heat Networks did not pay any additional funds. The IHSs in these buildings were installed free of charge for the residents of the building.

POLTAVA

In 15 multi-family buildings in Poltava, IHSs were installed under DemoUkrainaDH. In several buildings, the IHSs were installed by Poltavateploenerho itself, and in some buildings, the IHSs were installed at the initiative of the residents of the building:

> *The decision was made at the meeting, we took part in the Energodim program. And installed the IHS for this money. We partly they took a loan; the cost was partly reimbursed by this program.*

In one of the buildings the loan was paid back by including additional funds in the building maintenance tariff. Most people were not against this measure because they discussed it at the meeting and made the decision collectively.

In another multi-family building, people pay UAH 7.75 as the housing maintenance tariff—this tariff is considered higher than the average tariff in Poltava. However, the savings on heating costs are much higher, so they believe that this tariff is justified and do not mind paying it:

> *People pay such a tariff because they see how this money is spent and what it is spent on. But not without indignation. People are willing to pay such tariff if they see where it is used.*

In another multi-family building, the residents owed UAH 103,000 to pay back the loan for IHS installation. The money, according to the residents of that building, was repaid very quickly through a lump-sum fee paid by each resident of the building.

MARIUPOL

Because the majority of IHSs in Mariupol were installed under Tepli Kredyty, building residents must pay back a certain part of the loan (about 20–30 percent). Most often, this is done by increasing the building maintenance fee or the subscription fee paid by residents of HOA buildings.

> *I pay a monthly fee of UAH 254. I have a two-room apartment; those who have a three-room one pay more; those who have a four-room one pay even more. We still owe a certain amount under the loan, so the funds are somehow sent to the bank to pay off the loan.*
>
> ***
>
> *We did not pay lump-sum fees, but we've had the cost of the subscription fee go up now.*

In general, people are not against such a measure because they understand that this way, they save significantly on heating costs. A few extra hryvnias for the subscription fee cannot outweigh thousands of hryvnias saved on heating payment for the heating period:

> *I made the calculation, so considering the increase in fees, I still pay less than I would have paid in the old way, without the IHS. Benefits are noticeable in any way.*

In one of the multi-family buildings in Mariupol, the residents did not pay any fees for IHS installation and now do not pay the increased cost of the subscription fee. In this building, a share of the IHS installation cost was reimbursed from funds accumulated by the HOA.

IHS INSTALLATION, TITLE TO THE IHS, AND MAINTENANCE

LUTSK

According to Lutsk residents, HOAs should be directly responsible for IHS installation in multi-family buildings—it is they who are responsible for building maintenance. HOAs should deal with these issues, arrange the search for or collection of funds, and negotiate with the contracting company that installs IHSs and has the relevant specialists.

But some believe that HOAs cannot deal with these issues themselves and that the state or city should provide support for IHS installation:

> *Well, listen, HOA is a non-profitable organization... It should be at least 60 to 40. That is, the community and the state pay 60 percent, and the people pay 40 percent.*

Furthermore, most residents of Lutsk multi-family buildings argue that HOAs should have the title to the IHSs. They view the local heat supply company, SCU Lutskteplo, with some hostility. Throughout the cities surveyed, there is a distrust of local heat supply companies among DH consumers, and Lutsk is no exception. Residents of multi-family buildings do not believe that district heat supply companies will take measures that will benefit consumers and save them money.

Some consumers in Lutsk believe that the local heat supply company could have the title to an IHS if it installed the equipment at its own expense. But if the IHS was installed at the initiative and at the expense of the building residents, their opinion is unequivocal—the HOAs should have the title:

> *If we bought it, we installed it—who should be the owner? There is no question here.*

IHSs installed in multi-family buildings are mainly maintained by the companies that installed them under contract with HOAs and have a certain warranty period—mostly three years, sometimes less. DH consumers who live in buildings with IHSs do not consider it an option for SCU Lutskteplo to maintain the IHSs:

> *If we hand over that IHS to Lutskteplo—there would be no point in installing it. They [Lutskteplo] are interested in selling more heat. We bought it, we wanted to install it—we're not going to gift it.*

In general, Lutsk DH consumers believe that the companies that have experience installing IHS in multi-family buildings should maintain the IHSs.

KHARKIV

In Kharkiv, some DH consumers are not versed in the issues of the IHS installation and the title to the IHS. Residents of some multi-family buildings could only say that the IHSs in their buildings were installed by contracting companies under a contract. However, they did not know who the company entered into this contract with or who held the title to the installed equipment in the end. These residents also could not answer the question of who should install IHSs in multi-family buildings or who should hold the title to them.

In Kharkiv, a certain number of DH consumers believe that the residents themselves should be responsible for IHS installation. At least, they should initiate the process.

Some DH consumers also believe that the building residents or the HOA should hold the title to the IHS:

> *I have already encountered heating companies, so I believe that the building residents themselves should have the title to the IHS. It is very hard to understand the principle of how it will work if the heat networks will remain a communal utility and at the same time will have the title the IHSs installed in the buildings.*

DH customers in Kharkiv are distrustful of the local heat supply company, CU Kharkiv Heat Networks, so most residents of Kharkiv multi-family buildings do not consider the company to be an entity that can hold the title to the IHS installed in their building.

> *If it is heat companies [having the title to the installed IHS]... It will be a case where it [IHS] will be nobody's, and no one will be responsible for it.*
>
> ***
>
> *The heat company cannot have the title to the IHS in no event. Because they will tamper with that heating for their benefit.*

With regard to IHS maintenance, Kharkiv DH consumers believe that it must be done by the company that installed the IHS. These companies, according to the consumers, have the required specialists who understand the specifics of the IHS functions and can accurately regulate its operation and eliminate malfunctions.

POLTAVA

A certain percentage of DH consumers, who know what IHS is and how it functions, are virtually unversed in such issues as who should be responsible for IHS installation in multi-family buildings and who should hold the title to the equipment.

Some residents of multi-family buildings with IHSs installed believe that the building residents or, if there is an HOA established, the HOA should hold the title to the IHSs. This is because residents spend money to cover part of the cost of installing IHSs, so they should hold the title:

> *It is our property, and only the residents who live in this building can see the problems and describe them. The Soviet Union is over, so no one will come to you and repair anything. But it would be good if there was a state program of some kind. If there are a lot of pensioners in the building and not many residents at all, they just cannot afford the IHS installation.*
>
> ***

People need to gather and worry about what is happening in their house.

Several DH consumers in Poltava also believe that the residents should be the ones who decide to install the IHS.

The opinion expressed by the majority of DH consumers living in multi-family buildings in Poltava is that a specialized company should be involved directly in the installation and maintenance of the IHSs.

In some Poltava multi-family buildings, this was exactly how it happened—an HOA signed a contract with a contracting firm that installed the IHS and performed technical maintenance during the warranty period. To renew the contract with the firm or to take over the technical maintenance is a decision that is mostly made by the building residents and HOA board members themselves. Sometimes, the reluctance to pay extra money annually to the maintenance company leads to maintenance being carried out by the ordinary residents of the building on a voluntary basis or by the HOA board members.

MARIUPOL

In Mariupol, some DH consumers are not versed in the issues of IHS installation and the title to installed IHSs. They could not express their opinion on who should be responsible for the installation of the IHSs or who should hold the title to them.

Other consumers expressed that the people should initiate and organize the process of IHS installation. It is clear that ordinary consumers of heat supply services do not always understand how exactly the process of IHS installation occurs and what is necessary for this. Therefore, some consumers expressed somewhat simplified considerations on these issues:

> *For this, there must be, first of all, people, like board chairs, who have to work with people. If the people decide to do so, then further it is necessary to somehow promote this matter. There may be some opportunities, maybe from the city, maybe from the oblast, because it all costs a lot of money.*

Maintenance of IHSs installed in multi-family buildings in Mariupol is mainly done by the installation companies within the warranty period. When the warranty period expires, the house concludes a contract with the company for further maintenance, with annual payment. In Mariupol, there have been cases when people were not willing to conclude a contract with the company; in these cases, IHS maintenance may be performed by an ordinary resident without the necessary qualifications.

According to some DH consumers in Mariupol, IHSs should be maintained by a qualified company with the necessary expertise and ability to ensure smooth operation:

> *In my opinion, it should be done by specialists. Even the company that is engaged in the installation; they have specialists who perform the setup and subsequent maintenance.*

TEMPERATURE CONTROL

LUTSK

Regarding the regulation of IHS operation and control of the temperature regime, in one of Lutsk's buildings, this is done directly by the residents and by technicians:

There is a person in the house who can go down to the basement to adjust the IHS operation once a month or more... We have such a log, where everything is recorded—indicators, input and output temperatures, water pressure. Well, everything in that sense. And the plumber also takes care of that, he is on the know.

***

We are responsible for the temperature regime. We have a sensor outdoors; it shows the temperature.

IHS maintenance is also done mostly by the people who live in the building and are authorized to do it by the HOA board chair.

And now we maintain the IHS by ourselves. Well, there have been no questions or problems yet. There are different pumps, emergency pumps... If something goes wrong, it all triggers.

***

...So far, I'm in charge of temperature control on a voluntary basis. If there are complaints, someone is cold, we usually raise the temperature. We especially listen to those residents who have young children.

In a large number of cases, setting the correct temperature regime is done by trial and error, and either the building residents themselves (on their own initiative) or HOA representatives do it:

We raised the temperature, lowered it, changed the temperature schedule in different ways. We were looking for what suits us best. But it is over time, it is not overnight.

***

I control the temperature regime, I took it on myself. Until I undertook it, people adjusted as they wanted. And I know what needs to be done, already in so many years... The IHS now gives 21 °C in the apartment.

Situations in which either the residents or the HOA board members control the temperature regime in multi-family buildings are typical for buildings with HOAs established. However, in multi-family buildings serviced by HMOs, the situation is sometimes quite different:

They installed an IHS in the building where there is an HMO. I ask them, "Who is in charge of this at your place?" and they say, "Well, no one." And now they say they understand why I asked that question. One says, "I have 25 degrees in my apartment, all the windows are open, I cannot reach anyone to adjust the temperature regime of the IHS."

In general, Lutsk consumers believe that temperature control should be performed by the person responsible for it—whether the HOA board chair or the building resident who has undertaken such a responsibility.

None of the DH consumers living in multi-family buildings in Lutsk expressed the opinion that temperature regulation should be performed by the local heat supply company.

KHARKIV

In Kharkiv, in some multi-family buildings with IHSs installed, the building managers or HOA chairs control the temperature. The residents of these buildings do not participate in this process, as they have unreasonable requirements for the temperature regime:

In the first year, we set up, as it was announced at the meeting—21 degrees. The board chairs decided that. Because people say, "It's cold in our apartment!" They are asked, "How many degrees is it?" They say, "22 degrees." They are asked, "How much do you need?" They say, "27 to 28 degrees." But there's no such thing. Then why did we install that IHS if someone needs such a temperature in the apartment?

Excluding residents from regulating the temperature regime when there is an IHS installed is also explained by the peculiarities of building utilities, as well as non-standard temperature regimes of the heat carrier:

We have a problem with balancing. One of the entrances is warmer, the other is cooler. Due to this peculiarity, the temperature control settings were set appropriately. We have another problem—the heat carrier itself does not reach us at a standard temperature. Because we are located 15 kilometers away from the heat network. And at the inlet to our building, the temperature is not 90 degrees, as it should be, but 40–50 degrees. We have a low-quality heat carrier.

In some buildings with IHSs, the HOA board chairs have almost the sole right to regulate the temperature regime. One person controls this process, and the residents do not participate.

In other cases, the residents have influence on the temperature, but there are individual cases when the residents demand to increase the temperature:

We had one temperature set for everyone at the meeting—21–22 degrees. It is generally a comfortable temperature. However, we have one family who likes when it is warmer, and they are cold with this temperature. They are told, "We can make it 30 degrees in the apartment. But who will pay for it?"

In other Kharkiv multi-family buildings, the issue of control and regulation of the temperature regime is agreed upon with the building residents, who influence such decisions:

It [temperature schedule] was agreed with the residents. If it is +10—+15 °C outside, the heating inside the house turns off.

In general, most Kharkiv consumers believe that an authorized person should deal with the issue of regulating the temperature regime in the building. In their opinion, taking into account the wishes of all the multi-family building residents is inappropriate.

POLTAVA

In some multi-family buildings in Poltava, residents have some influence on temperature control in their apartments and have an opportunity to express their opinion at the general meeting where the decision about the temperature regime is made:

We made a decision at the general meeting. The temperature there should be so-and-so. That's it.

***

...22 degrees is our minimum temperature. 24 degrees is the maximum. We regulate, we decide this issue at the meeting. In general, most people are happy with this temperature regime, most people do not complain.

In several buildings, residents have no such influence on temperature control, and they agree that the HOA board chair assumes this responsibility:

We have a large house; you can't please everyone. We have an average temperature of around 22 degrees. People don't get cold, but the bills don't go up high. This solution is optimal.

***

We have a board member responsible for controlling the temperature regime in the building. The residents are not involved. We have a person in charge of the IHS who understands it.

In general, the average temperature regime in these buildings is 21–22 °C. Most of the residents are not against such a temperature regime, nor do they mind the fact that they are almost not involved in the process of setting it. In some buildings, such issues are solved by holding a general meeting. In other cases, the residents leave this decision to the discretion of the people responsible for building management.

MARIUPOL

Not all DH consumers living in multi-family buildings in Mariupol are versed in the issue of who exactly controls the temperature regime in their building and who should be responsible for it. However, in cases when there are failures in IHS operation, the residents can resolve these issues themselves. It is not clear why this situation occurs and why there is no responsible person with appropriate qualifications performing IHS maintenance:

Last year, the heating turned off. I called and called, but no one came. The boiler house was shut down, and the IHS was operating. I went and connected the IHS myself. This year, they launched the boiler houses, so it was time to launch the IHS as well. I called and called; nobody came again. And I just launched it myself, set it up. So far, it's operating.

Furthermore, most consumers do not take part in discussions about the temperature regime and do not try to influence it. They stated that the company responsible for IHS maintenance sets the temperature regime, but few had answers about who exactly decides what the temperature will be in the apartments:

As far as I know, it is set in the IHS operating scheme. If people say they're cold, it means someone from the firm comes here and adjusts the process.

The vast majority of Mariupol consumers mentioned that they do not want to interfere in the process of controlling the temperature regime and believe that it should be handled by either the HOA board chair or another person responsible for it.

INFORMATION ABOUT THE EXPERIENCES OF OTHER RESIDENTS

LUTSK

DH consumers living in multi-family buildings in Lutsk receive mainly positive feedback from other building residents. They noted significant savings on heating bills and improved overall comfort in apartments.

There are several dissatisfied residents per house, but the reason for their dissatisfaction is that the temperature in the apartments has dropped to a more optimal level:

I talked to an elderly lady yesterday, asking her how it was, how the temperature was in the apartment. She said, "It's fine!" No one rush to the charge, of course.

***

They saw the result. They saw how much we pay—we have a 50 percent savings on our heating bill.

***

There [in IHS] are pumps that disperse heat evenly throughout the apartments. There is no such thing as before when somewhere it is warm, and somewhere it is cold in the apartments.

***

In every building, there is someone who does not like that, who is cold. Maybe some pensioner or maybe people of middle, let's say, age, who is also dissatisfied... But most people understand that 20–22 degrees are adequate. And yet it's all about pricing.

***

They're mostly satisfied. Last year we paid about UAH 20 less per square meter for heating.

KHARKIV

In general, Kharkiv residents said that their neighbors and other building residents commonly report IHSs' positive impact on overall comfort and savings on heating bills. Although some residents remain against it, they are a minority, and the majority remains satisfied:

Someone is always against it. Some are hot, some are cold.

***

I hear that the neighbor says that it's good, it became warm in the apartment.

***

For sure, it became warmer. Whether on the first floor or above—people have the same temperature. Everyone is satisfied.

***

All note that it is warm now, it's good. On our floor, people say that. There were no such people who were strongly against it. But in every building, there is someone who does not need it all and who believes that it would be better not to pay such money.

***

At this stage, we do not have anyone who is cold or unhappy.

***

At first, there were those who wanted it to be warmer in the apartments, 28 degrees. But then they quickly realized that this is impossible.

***

On the lower floors, the temperature became lower, so they were a little offended. They had more than 25 degrees of heat in their apartments.

POLTAVA

Information received by DH consumers from other residents of multi-family buildings with IHSs installed can be described as largely positive. Residents shared their impressions of such an event, and the feedback, in most cases, is good; they reported generally improved comfort in apartments and the ability to save more on heating bills:

Definitely, everyone got warmer, this is also noted by other residents in the house. In general, everyone is satisfied with this measure, there are almost no complaints from anyone.

***

In principle, given that our payments for heating are not exorbitant, people are generally satisfied. They see that our payments are smaller in comparison with other houses.

***

Only a few speak negatively about the IHS installation and its effect on the overall comfort in the apartment. There are just people who do not want anything at all.

***

Of course, people are happy with it. If you monitor the houses in our neighborhood, we have the lowest heating bills. We have the lowest payments.

MARIUPOL

In general, DH consumers in Mariupol receive neutral feedback about IHSs from other building residents. Some residents virtually do not comment on or discuss the functioning of the IHSs in their buildings:

So far, nothing is being said.

There is a certain percentage of residents accustomed to the phenomenon of overheating in their dwellings, and they are quite hostile to changing the temperature regime. Even saving on payment for heat supply does not force such consumers to change their opinion about IHSs. Such residents do not want to live with a cooler temperature in their apartments, which is the reason they give negative feedback regarding IHS operation:

If you talk to adequate people and young people—they all react adequately. Everyone is satisfied. And if a person needs 26 degrees in the apartment—then, of course, he will be dissatisfied.

***

When there are savings, it is not noticeable, and when the batteries were hot—it was, of course, good.

***

People are different. Someone is fine with 20–22 degrees, and someone needs 24–26 degrees.

ANNEX 5. RESULTS OF THE SURVEY AMONG CONSUMERS PLANNING TO INSTALL IHSs (IN ALL CITIES)

EXPECTATIONS OF DISTRICT HEATING CONSUMERS PLANNING TO INSTALL IHSs IN THEIR BUILDING

In general, DH consumers who plan to install IHSs in their buildings have optimistic expectations. They want to have IHS installed and are happy about the initiative. Consumers have a predominantly personal interest—they want to pay less for heat:

> *As with any user, I expect only a reduction in the cost of heat. That we will pay for the services actually consumed. For example, my apartment is on the sunny side, and it is warm in my apartment. I can even shut off the heating sometimes, and I pay the same as everyone else. Plus the savings, of course.*

A stable comfortable temperature in buildings is another reason. If the temperature in the apartment is above 24 ˚C or below 20 ˚C, it is not comfortable for the residents. In this case, the IHS gives them the opportunity to set a comfortable temperature in the apartments and to avoid paying for extra heat or for heat they do not actually get.

> *We always have those complaining that it's hot on the upper floors and cold on the lower floors. We hope that installing an IHS will even out this imbalance, and we will have the same heat. Hopefully, we will pay for what we actually consume, rather than for the air.*

The main factor pushing DH customers to install IHSs remains the opportunity to save on heat consumption payments, as demonstrated by the majority of residents in multi-family buildings in the cities surveyed:

> *With prices the way they are now, we think we're going to have extremely pleasing savings. I've asked other people, they've just installed IHS, and they have very good savings. And we think we're going to have very good savings.*

The majority of consumers who plan to install IHSs do not have a definite opinion on who should install the equipment, who should hold the title, and who should maintain it. Some say that HOAs or appropriate building managers should deal with IHS installation.

WILLINGNESS TO PAY EXTRA MONEY

The issue of paying extra money due to IHS installation, in general, has proven to be controversial for many DH customers in each of the cities. About 70 percent of the surveyed consumers are ready to pay the additional funds in the form of a subscription fee or payment for building maintenance or the additional funds included in the heating tariff:

> *We already have an increase in the tariff for the building maintenance—it is now UAH 8.50. UAH 4 goes to the needs of the building, and UAH 4.50 are set apart to pay for all of this work to improve energy efficiency*

Consumers predominantly pay such tariffs and are not against increasing them, provided that the comfort of the building is improved and the bills for heating are reduced. A certain number of consumers do not pay tariffs for building maintenance and have debts:

> *Of course, we are ready. And what are those UAH 100 per month compared with when we received a heating bill for UAH 2,000 and a little more.*

The remaining 30 percent of consumers are not willing to pay the additional funds included in the heating tariff or as a subscription fee/building maintenance fee/payment to the building repair fund/additional funds included in the heating tariff:

> *I think it would be a service charge... So I think those amounts should be paid for specific actions. For example, do an audit once a year, pay for some kind of result. And just paying UAH 2 per month, as we do for the gas transportation, for something unclear—I do not agree.*

> *For example, this IHS has operated for five years, and the time came to replace something. They billed us, and we paid for the actual costs. According to that estimate, we pay the money. And just paying for air is not something I want to do.*

INFORMATION FROM OTHER RESIDENTS

When talking to other building residents who are planning to install IHSs, consumers hear mostly about positive expectations. Some such residents have a hostile attitude toward installation and are against it. However, as noted by the consumers, such residents are few and have no significant influence on the decision-making process for IHS installation in the buildings.

> *There is always someone who is dissatisfied. There are just those who do not understand their benefits in this matter. All the same, there are those who are distrustful. But our HOA chair send reports in Viber, every kopeck is accounted for. People trust such chairs and already have less doubts.*

> ***

> *They already started to insulate our building. The process went on, and people began to calm down. But most are still "in favor."*

> ***

> *There are, of course, those unhappy, as usual. There is no such thing as everyone being satisfied with everything. In principle, the majority is "in favor" such an event, and we have already initiated this process.*

> ***

> *We had those against it, people are afraid of innovation. Now we are all for, for and only for!*

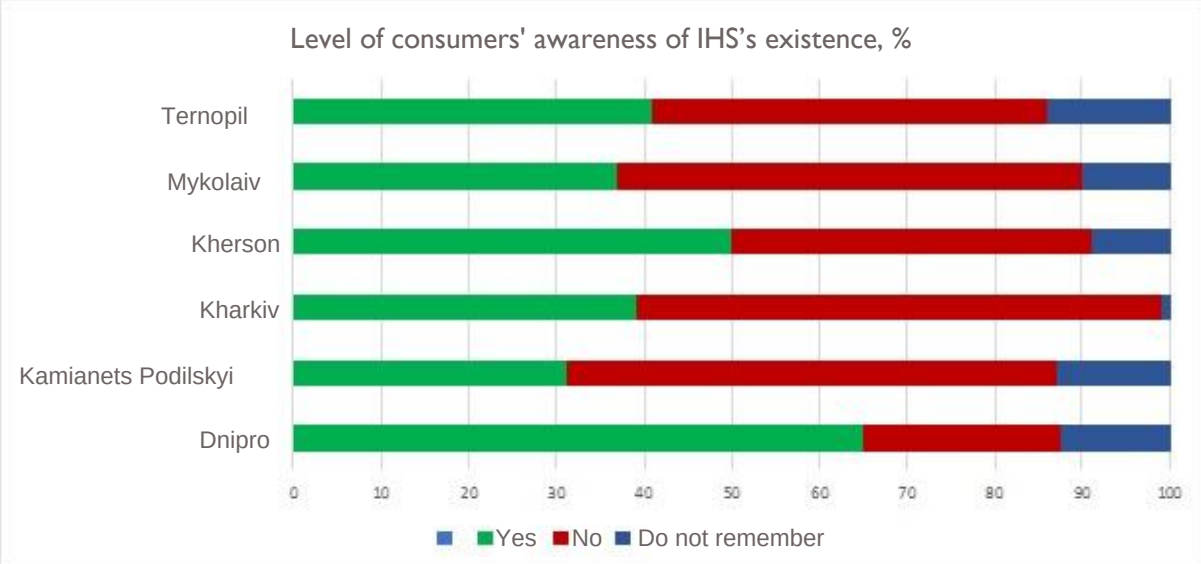
ANNEX 6.ANALYSIS OF MATERIALS FROM THE "IMPROVING CONSUMER SERVICES AND INCREASING THE LEVEL OF CITIZEN INVOLVEMENT IN THE GOVERNMENTAL PROGRAM TO INSTALL HEAT METERS IN RESIDENTIAL BUILDINGS, BUILD OR UPGRADE BOILER HOUSES, AND INSTALL AND REPAIR HEAT SUBSTATIONS" RESEARCH PROJECT

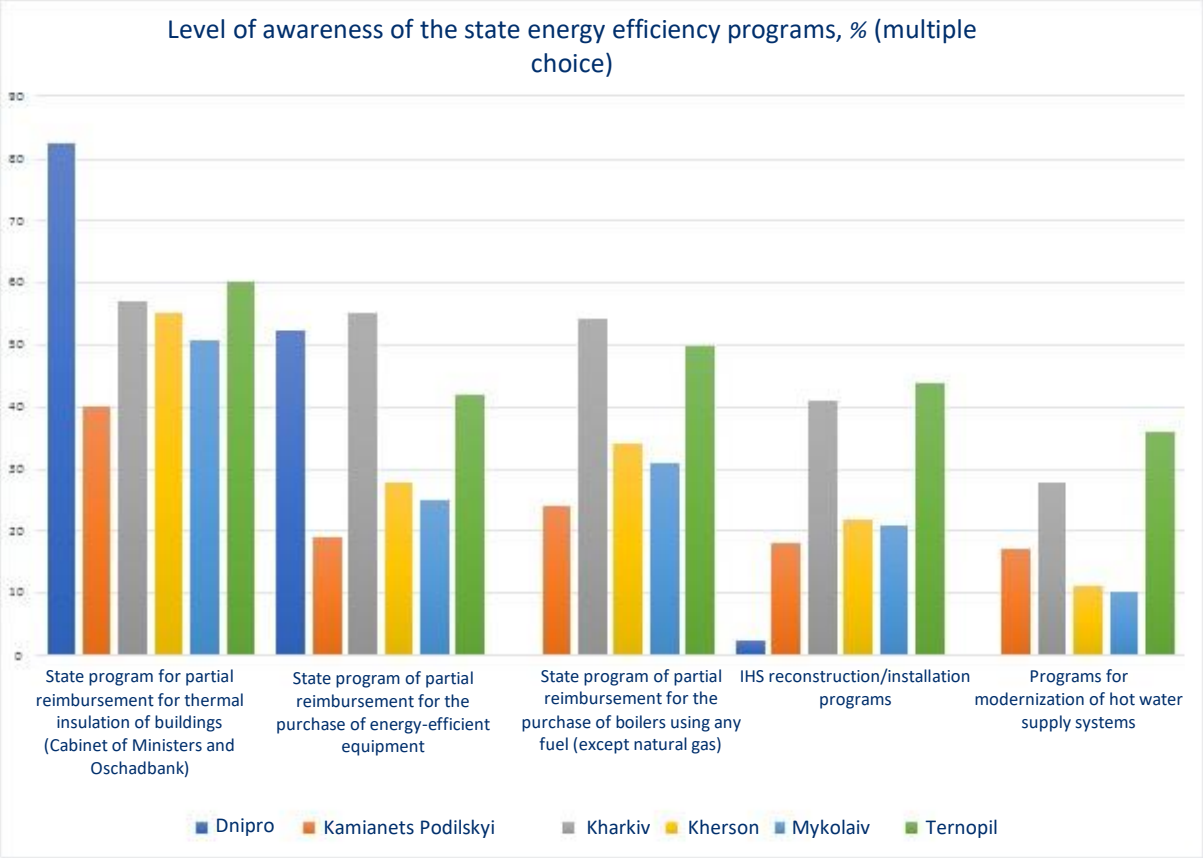
To receive more accurate data, we analyzed the materials produced by the sociological research project "Improving consumer services and increasing the level of citizen involvement in the governmental program to install heat meters in residential buildings, build or upgrade boiler houses, and install and repair heat substations" implemented in 2018 as part of the IBRD-funded UDHEEP project to increase energy independence.

This research was conducted in six cities (Dnipro, Kamianets Podilskyi, Kharkiv, Kherson, Mykolaiv, and Ternopil) using a quantitative method and included a survey of 3,000 respondents-consumers. Moreover, there were focus groups held among consumers, representatives of local authorities, utility companies, NGOs, and media in each of the cities.

The surveys and focus groups examined consumers' level of satisfaction with heating and hot water systems and services, the level of awareness about IHSs, the level of awareness of energy efficiency programs (including IHS installation), the level of interaction with utility companies and availability of information, the level of satisfaction with the validity and transparency of bills as well as the responsibility of the supplier for the funds received for services, and other topics.

The research found a low level of awareness of IHSs' existence among all surveyed consumers. On average, less than 44 percent of respondents know what an IHS is. Awareness level by city is shown in the graph below. The respondents also showed a lack of awareness of energy efficiency programs in general, with the lowest level of awareness about programs aimed at reconstructing or modernizing IHSs and modernizing hot water supply systems—on average, only 25 percent are aware. The survey revealed that two groups of consumers are worse informed—the older population (>56) and young people (18–35). As a consequence, there is a low level of interest in IHS installation and few active efforts by consumers and HOA representatives to drive it forward.





At the same time, focus groups among representatives of the city authorities, suppliers, NGOs, and the media showed a high level of awareness of IHS in only four cities out of six—Kamianets Podilsky, Kharkiv, Mykolaiv, and Ternopil. Representatives of these target groups in Dnipro and Kherson demonstrated a low level of awareness of IHS.

Representatives of local authorities and suppliers mentioned mainly online resources, including websites of service providers and local government websites, national and local TV, and social media as the main sources of information about energy efficiency programs and IHS installation.

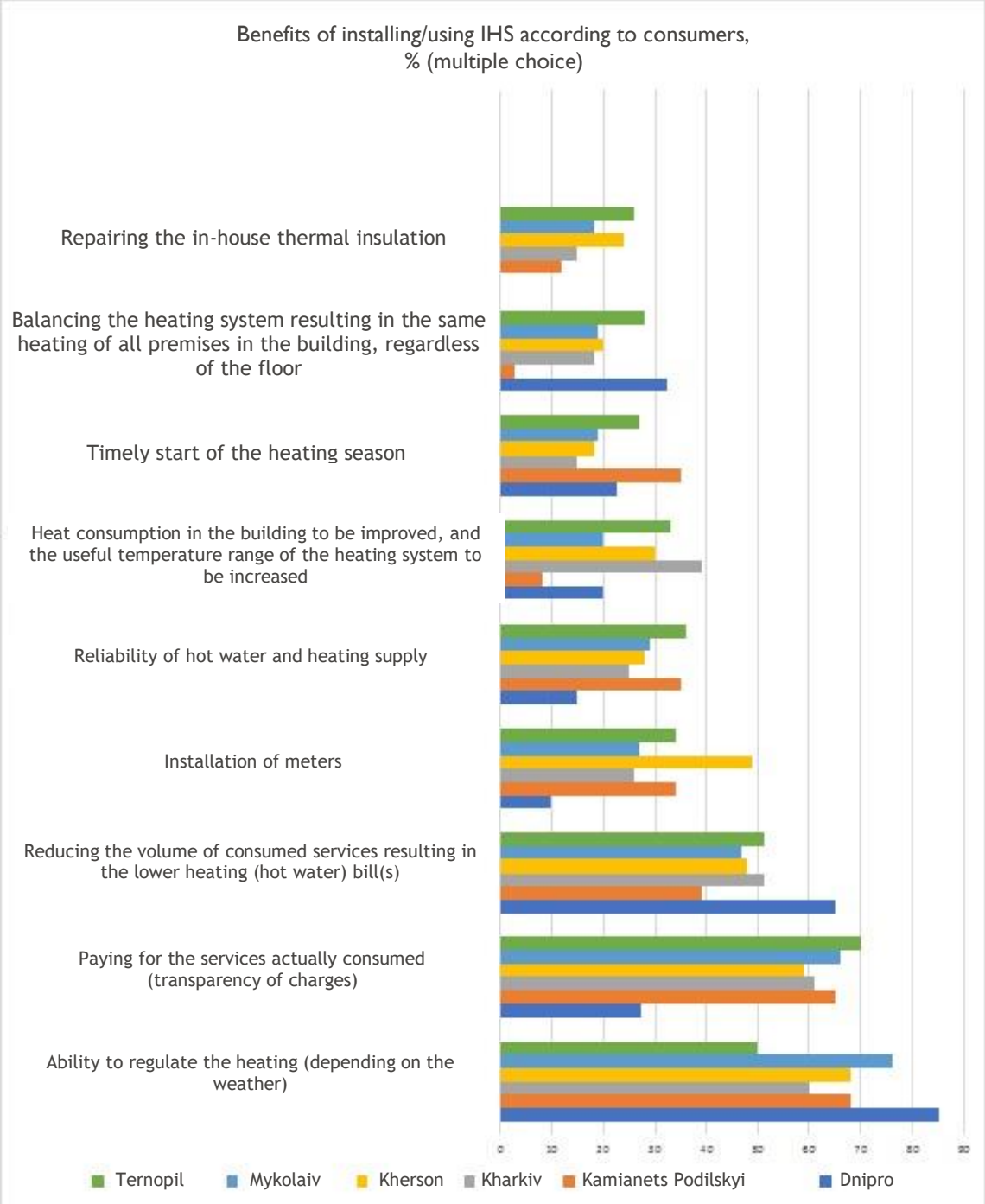
At the same time, there were few mentions of specifically targeted awareness-raising campaigns. A large-scale campaign to raise awareness about the possibility to install IHSs and their benefits was held in Ternopil with the help of media and the Internet, according to representatives of the authorities and the service provider. At the same time, less than half of Ternopil residents are aware of IHSs and the IHS reconstruction/installation programs. Consumers also revealed their lack of information about the IHS installation and maintenance process, despite the awareness-raising campaign.

The research also reported that in Kherson and Kharkiv, awareness-raising meetings were held for representatives of HMOs and HOAs to provide all available information on IHSs, their advantages, and obstacles for installation. Representatives from Mykolaiv also noted that regular awareness-raising activities were held among consumers and separately among HOA representatives; however, they could not provide details on the format and frequency of such events. This research shows that awareness among consumers in these cities is insufficient—less than half know about IHSs, and only one-fourth know about the IHS installation programs. There was no information about special awareness-raising campaigns in other cities.

Consumers consider the experience of friends/acquaintances, television, and the Internet as the primary sources of information about IHSs, but there is a direct correlation between the consumers' interest, as people aware of IHSs only if they were already interested in receiving information about them.

We can conclude that the level of communication and dissemination of information on IHSs was insufficient, and this has influenced and restrained the large-scale promotion of IHS installation.

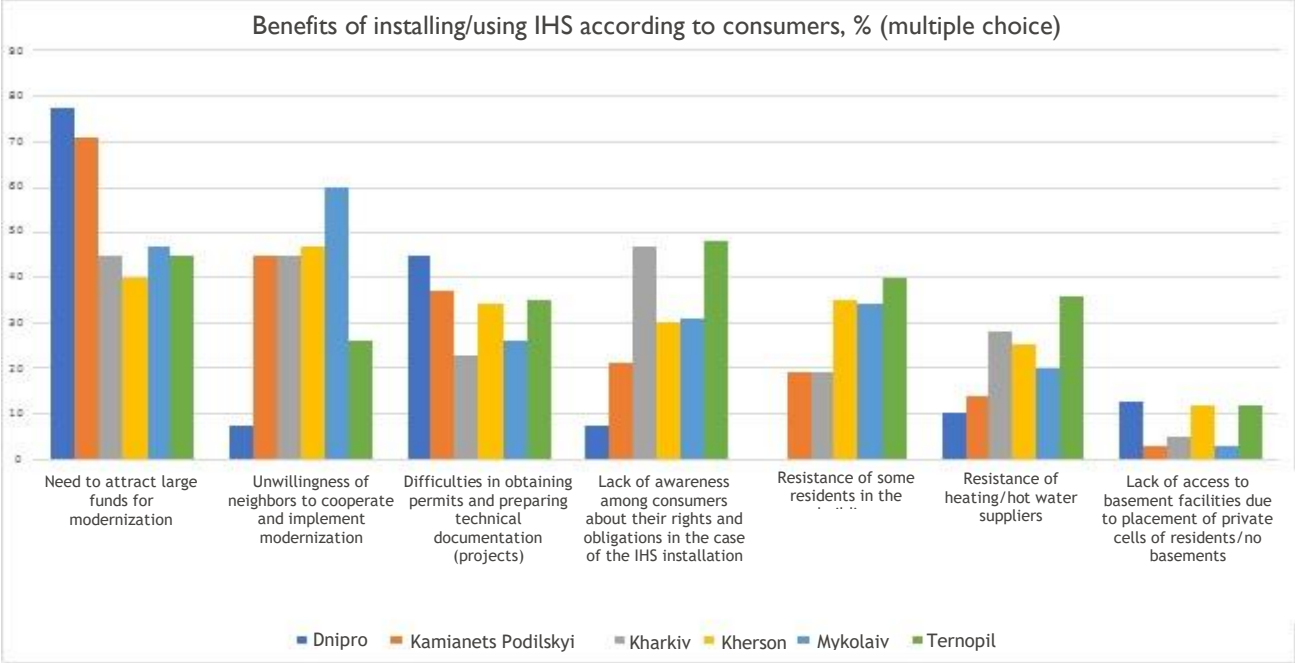
In general, the results of the research showed a positive attitude toward IHS installation among all respondents. It is interesting that consumers were often more interested in the advantage of being able to regulate the heating rather than the financial benefits (payment based on consumption or reduction of bills).



Among the main barriers, consumers most often singled out the need to raise large sums of money for modernization. This is particularly true given that the majority of respondents (71 percent) have low incomes.

The second most frequent problem is the unwillingness of neighbors to cooperate and implement modernization programs.

Among the cities surveyed, between 10 and 36 percent of respondents believe that heating and hot water suppliers can resist IHS installation.



Furthermore, according to the results of focus groups among representatives of local authorities, utility companies, NGOs, the media, and consumers, in each of the cities, respondents considered the following to be the greatest difficulties in IHS installation:

- High cost of equipment
- Need to replace in-house networks to ensure the proper operation of the IHS and minimize costs
- Lack of space for the installation of equipment, because basements in old buildings cannot be adapted for this purpose, as they require the connection of water, electricity, and drainage systems
- Bureaucratic procedures and corruption
- Low consumer awareness of the benefits of installing IHSs

Representatives of heat supply companies in Dnipro emphasized the problem of obtaining a technical report from equipment suppliers and then the report after IHS installation. In addition, suppliers have to certify and document the availability and operability of the IHS.

Representatives of target groups in Kherson, considering the low level of awareness about IHSs, named the following possible obstacles in addition to the high cost of equipment:

- Lack of awareness among consumers about their rights and obligations in the case of IHS installation
- Resistance of some residents in the building
- Difficulties in obtaining permits and preparing technical documentation (projects)

Representatives of target groups in Ternopil also saw problems with IHS installation due to the following:

- Installation companies themselves are poorly organized
- Lack of comprehensive preparation, insulation of facades and windows, and replacement of doors
- Additional costs that will be incurred by either the HOA or individual residents of the building

Despite the difficulties of IHS installation, all focus group participants expressed high interest in introducing IHSs because they should allow the modernization of heating and water supply systems and should significantly affect the possibility of savings.