Energy efficiency projects and greenhouse gas emissions in Ukrainian district heating systems

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Keywords

energy efficiency, district heating, greenhouse gas emissions, international financial institutions, investment projects

Abstract

Heat supply problems in Ukraine are caused by growth of fuel prices to the world level with tariffs lagging behind, decrease in payment collection, and worsening of financial situation of the district heating (DH) companies.

Major DH equipment is partially broken down or has exhausted its service life due to insufficient funds for infrastructure upgrades. This is one of the reasons for inefficient fuel and energy use, and insufficiently satisfied heat demand. At the same time, inefficient DH systems have significant potential for fuel and energy saving, and greenhouse gas (GHG) emission reduction.

Wide-scale energy efficiency projects for supply and demand side improvements of DH systems, which were developed with involvement of international financial institutions, are described in the paper.

Introduction

Notorious heat supply problems in Ukraine are similar to the problems encountered by all the former USSR countries. With the fuel prices increasing up to the world level, heat tariffs lagging behind and decreasing payment collection, the financial state of all, without exception, DH companies has worsened. As a result, renovation allocations for the heat supply system have reduced.

Due to insufficient funds for infrastructure upgrades the equipment is partially broken down, while the equipment with poor technical and economical indicators and exhausted service life is still operating. This is one of the reasons of inefficient fuel and energy use, and insufficiently satisfied heat demand. Low efficiency and significant heat losses are characteristics of the entire chain of supply from generating facilities to the end heat consumer. Average efficiency of the boilers does not exceed 75-80%, heat losses during its transportation and distribution reach 20-25%, level of buildings and constructions' heat insulation is 2-2.5 times lower than the requirements of the modern codes and specific standards of hot water consumption 1.5-2 times exceed the similar standards in the developed countries.

Low energy efficiency of the heat supply system and insufficient payments collection resulted in heat undersupply for: heating – 25-35%, hot water supply – 60-70% (in some cities there is no hot water supply at all).

Worsening situation with heat supply services leads to underpayments, and indebtedness of the DH companies to the fuel suppliers.

While currently the quality of services is improving and payment collections are gradually growing, the general situation is still pessimistic.

At the same time, inefficient DH systems have significant potential for fuel and energy saving, and GHG emission reduction. DH is among key GHG emission sources in Ukraine. According to the national statistics and climate change related researches it accounts for 6-7% of total GHG emissions.

Table 1. Energy Efficiency Investment Projects in Ukrainian DH Systems.

Project	Investments, $ million	Payback, years	Annual energy saving,	Reduction of GHG emissions, tCO_2/year	Financing sources	Project phase
Energy Efficiency in Kyiv Public Buildings	30.4	5	58 100 t c.e.	92 960	World Bank, municipality, Sweden government	Development 1997-1999 Implementation 1999-2003
Integrated Supply and Demand Side Improvement of Rivne DH System	23.7	6.1	52 million m^3 of gas; 4.8 million kWh;	97 980	GEF, municipality, private investors, banks	Development 2000-2001 Implementation 2002-2006
Kharkiv Heat Supply Improvement	173.0	5.0	203 400 t c.e.	334 100	World Bank, municipality, DH company	Development 2000-2003 Implementation 2003-2010
Energy Efficiency Improvement of Ivano-Frankivsk DH System	19.0	4.5	23 million m^3 of gas; 3.4 million kWh	43 920	DH company, municipality, government, private investors	Development 2001-2002 Implementation 2003-2006

Energy efficiency investment projects

Wide-scale energy efficiency projects for supply and demand side improvement of DH systems that involve international financial institutions have been developed in Ukraine. Some of these projects developed and implemented with ARENA-ECO's participation are listed in Table 1.

As a rule these projects were developed using the following algorithm:

- project identification;
- pre-feasibility study;
- preliminary agreement with the investors;
- full-scale feasibility study;
- financing agreement with the investors;
- implementation.

Energy audit is the most efficient measure for the projects identification. Energy saving measures identified during the energy audit were assessed and selected based on the estimated level of cost savings, payback, criteria and requirements of the potential investors. To accelerate achievement of the financing agreement for energy efficiency projects representatives of the potential investor conducted project expertise during the pre-feasibility study.

Energy saving opportunities.

Experience of investment projects development and implementation in the district heat supply systems shows that improvement of their efficiency requires implementing a series of organizational and technical measures, specifically:

1. *Implementation of building-level heat metering* in every building, as well as apartment-level hot water metering to provide switch to the consumption based billing. To induce consumers to install meters (especially apartment hot water meters) it is necessary to introduce tariff incentives. Such incentives were successfully introduced in Ivano-Frankivsk and Lviv. City authorities and DH companies should be initiators of such measure;
2. *Introduction of two-tier heat tariff.* For the first time in Ukraine this tariff was introduced in the city of Ivano-Frankivsk. There the DH company collects payments from the residential consumers in such proportion: 64% – payment for actual heat consumption and 36% – payments for connected load. The fixed payments for connected heat load cover the invariable cost component that includes make-up water, materials, depreciation, wages and repairs. Tariff for actual heat consumption covers the variable cost component, which includes cost of fuel and electricity consumed by the boiler plants. Two-tier tariff is feasible for the DH company and, at the same time, it creates incentives for consumers to implement heat saving measures;
3. *Improvement of the payments discipline* to cover old debts and perform timely payments of new heat bills by the municipality. In Kyiv and Kharkiv this measure is implemented on the one hand through wide informational campaign and activation of the administrative pressure and, on the other hand, through improvement of heat supply quality;
4. *Provide improved comfort to the consumers*, who are ready to pay for this, conform in accordance with higher tariffs. If such a consumer wishes, for example, to start the heating season earlier than the date established for the city as a whole, this should be provided for additional payment. Exceeded normative limit of heat carrier consumption, which is indicated by a meter, should not be considered as the violation of heat consumption rules, but as the legal intention of the consumer to get higher comfort for higher price.

To improve efficiency of heat generation, transpiration and distribution it is possible to recommend the following measures, which are the most efficient on our opinion:

- at the heat sources – replacement of obsolete boilers having low efficiency (which exhausted their service life) by modern efficient ones, retrofit of the boilers using modern burners, utilization of exhaust gases heat, implementation of the modern automated water treatment and anticorrosion treatment of the make-up water, installation of automated burning control system, installation of variable speed drives at the network pumps, fans and smoke exhausters, implementation of co-generation, creation of the automated information and technological process management systems of the boiler plants;
- in the heat transportation and distribution system – replacement of the transmission and distribution pipelines using pre-insulated pipes, modernization of a part of heat distribution substation with installation of state-of-the-art heat exchangers and automated controls, partial decentralization of DHW through installation of individual heat substations.

It is hardly possible to implement in full the aforementioned energy saving measures in the heat supply systems of the large cities within the short period, that is why it is advisable to begin with the demonstration district (with high level of payments collection) with district (block) boiler plant. It is in this system where it is necessary to implement energy efficiency measures involving the whole technological chain and create comfortable indoor temperature at the consumers' and provide quality hot water supply. It is necessary to charge corresponding payment for these services.

The main result expected from the implementation of these measures is that the DH company will get enough money from consumers to cover their heat demand purchasing required amount of fuel for its generation. Even if some consumers with low incomes are not able to pay bills for consumed heat there will appear the opportunity to attract additional money from consumers with high incomes ready to pay much enough for improved heat comfort. These consumers still spend money to purchase imported boilers installing them in the apartments or on the roofs of the buildings. However, once the technical opportunity to provide necessary comfort from the district heat supply system appears, their money will work for the DH company that will speed up renovation of the fixed assets in order to improve energy efficiency of fuel consumption and provide reliable and quality heat supply. In these conditions the main task of the DC company will be generation of the required amount of heat and reduction of production cost, while the main task of the consumer will be energy saving. It will be expedient for the consumers to invest their money (or to get loans if they don't have enough money) into energy saving. The consumers in this case will need technically justified recommendations to invest their money into really efficient equipment.

ARENA-ECO's experience in development and implementation of the project proves that individual projects for heat supply and demand side improvements do not allow using full energy saving potential. The more feasible is integrated approach to the entire chain of heat supply – from generating facilities through transmission and distribution systems to the end heat consumers in buildings. This means that higher quality provided owing to retrofit of generating facilities and heat networks is not worsening due to inefficient heat consumption in buildings and, on the other hand, energy savings achieved in buildings result in fuel savings at the sources and corresponding reduction of harmful emissions into the environment.

Energy efficiency projects for heat supply systems of the cities reduce not only fuel and energy consumption, but greenhouse gas emissions as well. Emission reduction potential for projects presented in Table 1 is 25-30%.

Flexible mechanisms under Kyoto Protocol (JI and emission trading) would be considered as a possible way of financing or co-financing of energy efficiency projects in Ukrainian DH systems.

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