Center for Energy Efficiency

(CENEf)

SECTION # 5: IRKUTSK

Case Studies of Successful and Replicable Success Stories of Energy Efficiency Programs on the Municipal Level

This report is part of a work plan under

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SECTION # 5: IRKUTSK	Population of 1.01.2001 – 593,7 thou. people
	City housing resources – – 10627 thou. m^2, of which: municipal – 7097 тыс. $м^2$
	Official home page: http://www.irkutsk.ru
City Administration address:	14, Lenina St., Irkutsk, 664000
Mayor	Vlarimir V. Yakubovsky
Phone/fax:	(395-2)27-56-90, (395-2)27-47-98, fax (395-2)27-56-90

1. IRKUTSK

In Irkutsk, a heat supply renovation project was implemented in a separate district. The project results included:

Reduction of heat consumption by facilities heated by an electric boiler-house;

Improvement of heat network hydraulics;

Reduction of the total heat load in the district;

Closing down of two disadvantageous coal-fired boiler-houses with simultaneous switch of their consumers to the electric boiler-house

Considerable reduction of the costs of the heat utility which implemented the project.

The table below shows a brief description of the project.

Table 7. BRIEF PROJECT DESCRIPTION

Brief Project Description:	***Renovation of District Heating System in Novo-Lenino District of Irkutsk, based on Energy Efficient Technologies*** 1. Installation of 43 heat meters in 33 buildings (including residential buildings, housing communities, and public buildings). The total heat load is 18.3 Gcal/h. 2. Heat network renovation providing heat load transfer 3. Installation of heat meters at three boiler-houses. Hydraulic checkout. 4. Creation of local project implementation group.				
Sponsor				**Partners (if any):**	
Name:	"Irkutskteploenergo"			(consultants, suppliers, local bank, etc.)	
Status:	Municipal enterprise			1. "Irkutsk Energy Center"	
Contact person:	S.I. Kotov, Director, "Irkutskteploenergo"; V.M. Nikitin, Director, Irkutsk Energy Center			2. General contractor: "Seteterm" (Finland), subcontractors: Swedish and Russian companies ("Energima" and other)	
Address:	N/A			3. Municipal Unitary Enterprise for Housing Service, Leninsky District	
Tel.:	(7-3952) 465-412 (Nikitin)				
Fax:	(7-3952) 510-511 (Nikitin)				
Country: Russia	**Region**: Irkutsk Oblast			**City**: Irkutsk	
Project targets:					
Energy efficiency project	☑	Public subsidies restructuring	◊	Other (specify):	◊
District heating reform	◊	Setting up energy conservation fund	◊		◊
Water utilities reform	◊	Housing reform	◊		◊
EFFECT: Reduction of heat supply costs: closing down two inefficient boiler-houses; heat savings due to control and load transfer; electricity savings; feed water consumption reduction; thermal comfort improvement.					
Sources of financing (thou. USD):				**Type of external financing:**	
Sberbank loan	3,200			loan	☑
Irkutskteploenergo's own funds	N/A			equity	◊
IBRD loan	N/A				

Table 7 Cont'd

Project schedule		
Project lifetime:	15	years
Project implementation time:	22	months
Project start-up:	Jan/1997	(day/month/year)

PROJECT SUCCESS CRITERIA:				
Indicators	**Before the project**	**After the project**	**Savings**	**Share, %**
Total heat load, GCal/h	17.3	13.8	3.5	20%
Heat consumption by buildings equipped with individual heat points, GCal/year	59,140	42,620	16,520	28%
Total heat supply from electric boiler-house "Bytovaya", GCal/year	134,350	111,510	22,840	17%
Hot water consumption by residents, liters/day	150 (standard)	119 (metered)	31	20%
Temperature difference, °C	30	60	30	66%
Feed water consumption, m^3/h	228	139	89	39%
Average heat carrier flow, m^3/h	890	640	250	28%

Reduction of heat supply costs (fixed prices of 2001):		
Electricity consumption for heat generation at electric boiler-house "Bytovaya"	3,684	thou. Rbl
Maintenance costs at two inefficient boiler-houses	1,190	thou. Rbl
Electricity used to pump heat carrier	131	thou. Rbl
Total costs reduction:	5,005	thou. Rbl

PROJECT MONITORING			
Was a local project implementation group created?	yes ☑	no ☐	
Institution, where it was created:		**Responsibility:**	
municipality	☐	Announcing tenders (competitions)	☐
energy (heat, water) utility	☐	Equipment purchasing	☐
housing maintenance company	☑	Project monitoring	☑
independent group	☐	Managing project development and implementation	☑
		Hydraulic checkout and system maintenance	☑
Is special software used for program monitoring? (if yes, specify):	Yes ☑ own design	No ☐	

TARIFF DESIGN AND PAYMENTS COLLECTION REFORM		
Was tariff design system amended?	yes ☐	no ☑
Were new methods of billing and payments collection implemented?	yes ☐	no ☑

PUBLIC SUBSIDIES RESTRUCTURING		
Were public subsidies restructured?	yes ☐	no ☑
Are public subsidies saved channeled into efficiency investments?	yes ☐	no ☑

SOCIAL EFFECT	
Creation of jobs:	**Jobs**
at energy utilities	
at municipal heat utilities	1
at energy audit group	
at project implementation group	3
other	

Table 7 Cont'd

ENERGY CONSERVATION FUND		
Was a municipal energy conservation fund created?	yes ☐	no ☑
Does the city receive financing from the regional energy conservation fund?	yes ☐	no ☑
ADDITIONAL INFORMATION		
	Rbl	USD
Industrial heat tariff, per GCal	165	5.5
Industrial electricity tariff, per kWh	0.17	0.006

1.1. Description of technical measures and their results

There are three large sources in Novo-Lenino district heating system – Northern Industrial Boiler-House which uses coal and two electric boiler-houses Novo-Lenino and Bytovaya. They all are incorporated into a joint network. But efficient heat supply cannot be provided because of deficient bypass diameters and lack of control. For these reasons all heat sources work separately.

Apart from large heat sources, there are 18 small inefficient boiler-houses of various enterprises. As additional capacity at large boiler-houses releases, these small heat sources will be taken out of operation.

The following measures were incorporated into the project:

1. Elevators substitution by automatic building-level heat distribution points;
2. Heating stands balancing;
3. Heat network reconstruction;
4. Northern Industrial Boiler-House upgrade;
5. Pumps upgrade to control heat carrier flow and pressure;
6. Heat meters installation at property boundaries;
7. Creating control center to manage district heating system of Novo-Lenino;
8. Staff education and training;
9. Implementing market mechanisms in the system of heat supply management;
10. Tariff policy change;
11. Innovative activity.

By now, the first stage of the project is completed. Separate heat network of Bytovaya electric boiler-house has been reconstructed. In 1998, 43 building-level heat distribution points equipped with plate-type heat exchangers were constructed at buildings. These 33 buildings are both residential (municipal, building societies) and public (orphanage, kindergarten, old people's home). Their total head capacity accounts for 18.3 Gcal/hour. Heat meters were installed at large boiler-houses. Heat network is being reconstructed to get an opportunity to switch heat loads.

Below are data on the scale of energy efficiency measures aiming at reconstruction of heat supply system.

Table 8. Renovation of heat-, water-, and power supply systems

Facilities	**Number of renovated buildings**	**Details (brief description of implemented energy efficiency measures)**
Boiler-houses	1	Installation of heat meters, improvement of heat chart of the system
Transportation and distribution system (replacement of pipelines, m)	N/A	Renovation of heating networks so as to set up a united network for all heat sources and further closing down inefficient boiler-houses
Residential buildings	33	Replacement of hydroelevators with automated individual heating points; balancing water stands; installation of meters
Public buildings		
Other facilities (specify)		Setting up a central dispatch to manage local heat network in Irkutskteploenergo; setting up Heat- and Water Supply Service (project management group), personnel training

Building-level heat distribution points before and after reconstruction are presented below (see Fig. 7).

a) before reconstruction

b) after reconstruction

Fig. 7. Building-level heat distribution points

1. ***Reduction of heat load***. Installation of an individual heating point allowed for a 20 percent reduction of heat consumption by buildings, as compared to the hydro-elevator scheme. For some buildings this reduction amounted to 25 percent and more. Reduction of heat consumption allowed for the reduction of current heat capacity shortage of the electric boiler-house and close down two small coal-fired boiler-houses.
2. ***Reduction of heat consumption*** in renovated buildings amounted to 28 percent compared to heat consumption with a hydro-elevator scheme. The biggest savings are achieved immediately before and after the heat supply period: 30-40 percent and more; in winter and summer they go down to 20 percent. During the 1999-2000 heat supply period heat savings amounted to 29 percent due to a better regulation of heating systems with the help of balancing valves and heat points automation. Heat consumption reduction is presented below.

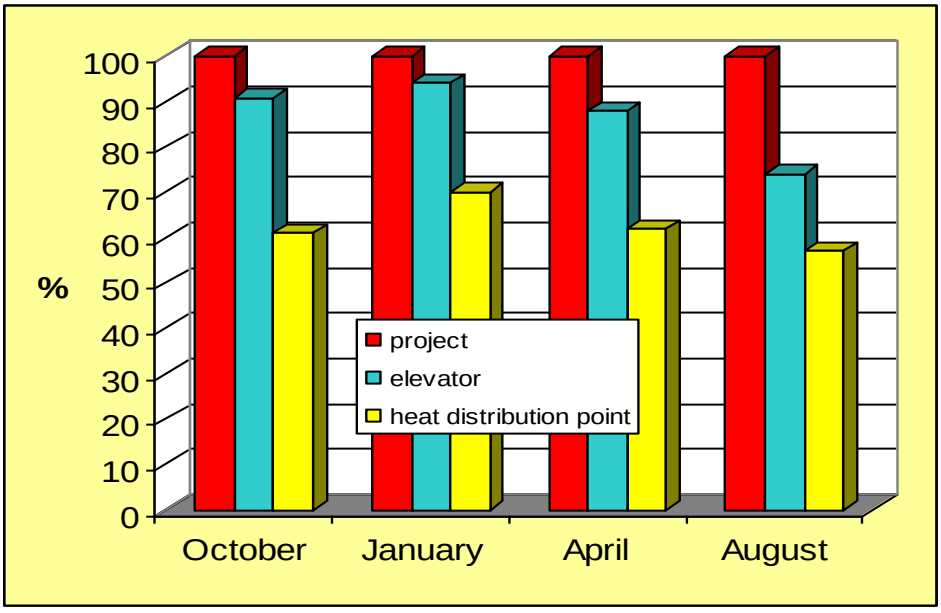

Fig. 8. Heat consumption reduction, 1999-2000

3. ***Regulation of DHW system***. Before renovation, buildings with hydro-elevator scheme had the so-called "open-type hot water consumption", i.e. domestic hot water was taken from the heat supply system. Because of poor regulation, hot water temperature amounted to 90^{o}C, and water pressure was kept at 6-8 atmospheres, which lead to excessive heat and water consumption, and also resulted in potential danger for people. In the individual heat point, water is heated up in the heat exchanger and supplied at a constant temperature of 55-60oC and more, at a lower pressure of 2.5-3 atmospheres. This resulted in a considerable reduction of feeding water and improved operation of the electric boiler-house. At the same time, due to the improved parameters of hot water, daily residential consumption dropped from 150-160 to 115-119 liters per person.

4. ***Avoiding distribution heat losses***. Preventive repair of the heating system was followed by installation of an individual heat point. Average daily leaks in renovated buildings amounted to 0.63 m3 per building, and the highest level was 1.36 m3 (some experts estimate leaks at a 7-8 times higher level amounting to 30 percent of the total hot water consumption). Modern techniques of detecting leaks with the help of flow meters allow it to considerably reduce time needed to eliminate them.

5. ***Improvement of the hydraulic mode***. Installation of an individual heat point improved the efficiency of heat carrier distribution between consumers through regulation of their heat consumption, and allowed for the reduction of feeding water through transition to a "closed-type hot water consumption". Improved parameters of heat carrier (pressure, temperature, pressure drops) resulting from heat consumption regulation in the individual heat point reduced water waste determined by a common practice of opening a tap and waiting until the water becomes hot enough. The amount of heat carrier in the system reduced by 28 percent, thus reducing electricity consumption for pumping.

6. ***Improvement of heating modes***. Improvement of hydraulics and reduction of return water temperature allowed it to increase the temperature of heat carrier (while before installation of individual heat point it did not exceed 104^{o}C with the outdoor air temperature -37oC, after the installation it increased up to 115^{o}C). The temperature of return water dropped by 6-8^{o}C and approached the design value in the temperature chart. This allowed it to have additional

capacity of 5 Gcal/h (12 percent of installed capacity) and use it efficiently. Capacity shortage was eliminated, consumers of closed down coal-fired boiler-houses started to receive heat, and there was reserve for heat supply to new construction.

7. ***Heat and electricity savings***. Total heat production of the electric boiler-house reduced by 17 percent, and in some months by 23 percent. Importantly, only 44 percent of the total heat consumption goes through the individual heat point. Therefore, energy savings in buildings with individual heat points are supplemented by distribution heat savings at other consumers, determined by improved heat and hydraulic modes. Respectively, electricity consumption for heat generation and heat carrier pumping is reduced (the latter by 15 percent).
8. ***Personnel training***. 10 experts of Irkutskteploenergo heat utility had a training in Sweden.
9. ***Starting new productions***. In 1999-2000, Irkutskteploenergo launched its own assembling production of individual heat points.
10. ***Monitoring***.
    a. Heat consumption of buildings equipped with individual heat points is analyzed by dispatcher UTS-3 of Irkutskteploenergo heat utility. On a monthly basis the dispatcher takes the readings of more than 40 parameters reflecting heat capacity; heat consumption; heat carrier consumption, temperature, and pressure; feed water consumption; cold water consumption for DHW; electricity consumption by pumps; etc.
    b. In November 1997, housing maintenance company MUPZhKh set up Heat&Water Supply Service to collect and process the necessary data; accomplish installation of shutoff and balancing valves; together with Irkutskteploenergo heat utility to control contractors, and during the operation phase to control over the work of equipment, collect and analyze information of failures, do the adjustment and balancing of equipment, take note of residents' complaints, do the personnel training for the house maintenance and emergency services;
    c. based on results obtained the article was published in «Energy Conservation» Journal No. 2, 2001 (see http://www.abok.ru/for_spec/en020158.htm - Russian). The presentation was made at the conference "Innovations Applied when Communal Energy Systems Reconstructing" held in Irkutsk in 2000.

1.2. Problems

Social and economic. Project popularization could have been more active. It was important to promote the idea of heat- and water efficiency, simple weatherization methods, and water savings, through TV, radio, newspapers, and booklets. Careful popularization was important, because most houses where individual heat points were installed were located near the heating point, and therefore, indoor air temperature amounted to 28^{o}C. After temperature regulation was launched, indoor temperature dropped, and residents became non-comfortable. Residents started to complain. A follow-up energy audit of flats revealed a poor insulation of the buildings envelopes: chinks in balcony doors and window frames, lack of the second frames, etc., as well as dismantling of radiators. These practices are primarily determined by irrelevance of the communal bills of actual heat and DHW consumption and lack of energy efficiency motivation.

Technical. Energy audits revealed unsatisfactory thermal insulation of buildings and internal engineering systems. The problems root in the construction and installation failures, especially

in 9-storey buildings of 135 series; scale deposits in heat pipes and heat equipment resulting from poor water quality; increased resistance of standard cast iron radiators; unsatisfactory insulation and glazing of doorways. Replacement of heating stands in flats allowed for a reduction of residents' complaints: only 28 complaints remained of the initial 293. Some residents complained of insufficiently hot towel rails; a decision was made to insulate DHW mains and balance DHW stands and heating in bathrooms.

Various factors determining deterioration of comfort of living were revealed: penetration of air from stairwells into flats resulting from poor insulation of doors; application of gauze or paper to air inlet screens; low quality of windows; poor installation of windows into walls; lack of window sash insulation; reduced air exchange in bathrooms resulting from insufficient distance between the door and the floor; inefficiency of radiators caused by furniture standing close-by, or drapery with textile or polyethylene films; high humidity in sanitary facilities located by the doorway walls resulting from insufficient, or even lack of heating in the doorway.

In spite of their number, technical problems turned out the easiest to address. How quickly they were addressed was only a matter of availability of determination, materials, and financing.

Institutional. Lack of unified institutional mechanism to promote cooperation between all agents in heat and water supply and consumption, results in the fact that each agent has his own interests, not necessarily connected with, or even contradicting, the final result. In spite of obvious importance of the project, it did not receive the status of the municipal "test field" for new technologies, relations, or approach to high quality and timely providing residents with communal services. The municipal program of heat supply reform was never adopted, and the project remained just an investment of Irkutskteploenergo heat utility. Heat&Water Efficiency Service of MUPZhKh is the only organization trying to combine the interests of Irkutskteploenergo, MUPZhKh, and consumers.

The company responsible for housing maintenance (MUPZhKh of Leninsky county) is not in the least interested in the project success. Housing maintenance estimation practices do not include development of economic motivation to the reduction of energy consumption. Any financial and/or labor investments made by a housing maintenance organization in the reduction of residential heat- and water consumption do not pay back.

At this point, the quality and efficiency of preventive and current repairs of water taps, lavatory pans and radiators cannot be assessed for lack of both criteria and methods. Repair plans are developed based on standard time intervals, with no account of current specifics. When (or if) customer acceptance of accomplished repair work takes place, reduction of heat- or water consumption is not taken into account, because this reduction is not a requirement of standards or regulations in force.

Regulatory. There is no corresponding regulation support: municipal program of energy and water meters installation in public buildings, or executive order on introduction of energy services for residential and public sector, or municipal energy efficiency program.

There is no legislation base to regulate contractual relations between providers and consumers of communal services and energy service companies, including sharing achieved savings. There is no regulation act approved by the city mayor to economically motivate those taking part in energy efficiency projects.

There is no mechanism to cooperate with residents. Possibly, part of achieved savings must go back to residents in the form of energy bills reduction, providing residents are responsible for weatherization of doors and windows, filling chinks, saving heat in doorways, etc.