Improving the Energy Efficiency of Buildings in Kyrghyzstan

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This article presents the major findings of the project ‘‘Improving the energy efficiency of buildings in Kyrghyzstan’’ which was financed by the TACIS program (technical assistance for the CIS) of the European Union. The comprehensive project consisting of energy audits, demonstration projects, market studies, a public awareness campaign, training and a package for standardization was implemented in the period January 1995 to July 1996.

The energy audits revealed total energy consumption in multi-family houses of 240 to 360 kWh/m^2 a. Up to 58% of this is for domestic hot water.

After analyzing retrofitting strategies, a typical panel-type building was rehabilitated through insulation of the building and retrofits on the heating system.

In the demonstration building energy savings for space heating were measured at 40% of the consumption of the reference building in the heating period 1995/1996. Savings of 22% were recorded for domestic hot water.

The best economic results were achieved through consumption-based billing of DHW and through measures to the heating system. Insulation did not prove its economic viability at present.

Occupants often had difficulties in understanding the functioning of the control equipment. Frequent complaints were received about cold radiators when on warmer days the heat supply was reduced automatically, but inside the flats sufficient temperatures were maintained.

From the results it can be stated that rapid reductions in energy consumption in Kyrghyzstan are possible in the short and mid-term for a reasonable level of investment. Further substantial reductions are feasible but require much more considerable investment.

INTRODUCTION

The Kyrghyz Republic is a landlocked, largely mountainous country located in the center of Asia. The country is bounded by the People’s Republic of China to the east, Kazakhstan to the north, Uzbekistan to the west and Tajikistan to the west and south. With an area of 198,500 km^2 Kyrghyzstan is slightly larger than Austria and Hungary combined and represents slightly less than 1% of the former Soviet Union. About 90% of its territory lies at least 1,000 meters above sea level. Only about 7% of the land is arable.

The Kyrghyz Republic’s population of 4.5 million is somewhat bigger than Norway’s and represents about 1.5% of the population of the former USSR. The population is largely rural (65%) and in common with other former Soviet republics in Central Asia has a high birth rate. The population was almost entirely nomadic until the Kyrghyz Republic became a part of the former USSR and the collectivization program was introduced. Over the years, there has been large-scale immigration of ethnic Russians, Germans, Koreans and Ukrainians.

Kyrghyzstan plays a special role in Central Asia as a result of its stable and popular government and decisive economic reform policy. The government, led by President Akayev, has followed a policy of radical reforms to rapidly introduce a market economy. Monetary policy, with the introduction of the Som in May 1993 and a kind of gold standard, has led to Kyrghyzstan having the most stable currency in the former Soviet Union. The annual inflation rate was between 30% and 40% in 1994, well below all other NIS levels. The privatization policy is far-reaching.

Nevertheless, the national economy has been in deep depression during the last three years. The disruption of the traditional trade linkages with other parts of the former Soviet Union led to a sharp decline in external demand for Kyrghyz products. As a small republic highly integrated in the larger economy of the Soviet Union, the Kyrghyz economy had become narrowly specialized through trade with other regions of the Union. A further problem for the Kyrghyz economy is the lack of investment for new technology to produce competitive products.

The TACIS program (Technical Assistance to the CIS) of the European Union provides assistance to the transition process in NIS Countries. Consulting services are rendered in various fields and frequently the projects prepare the necessary background for financial co-operation.

This project, ‘‘Improving the energy efficiency of buildings in Kyrghyzstan’’, was financed by TACIS. The project was implemented in the period January 95 to July 96.

Beneficiaries of the project were the Kyrghyz State Energy Company, housing organizations and the national building administration. Project activities were implemented together with the KIAC (Kyrghyz Institute for Architecture and Construction).

Improving energy efficiency represents an urgent challenge for a country in transition towards a market economy such as Kyrghyzstan. This project provided feasible solutions on how to approach the problem of energy saving in buildings.

Background

Today the building stock and the energy supply is a legacy of the former Soviet Union. It is characterized by densely populated settlements in urban areas and a central heat supply. Basic commodities such as housing and sufficient energy supply were considered as basic needs to be provided by society. Consequently these services were provided at artificially low prices, charged to the consumers on a flat-rate basis.

Large multi-family houses, either of brick or of prefabricated panels, prevail in urban areas. Energy supply is mainly based on CHP plants. In rural areas single-family houses are predominant. Today the fuels most used in these settlements are firewood, dung cake, LPG and electricity.

District heating and coal represent 50% of the energy sources for heat in urban areas, while coal, dung and firewood are the major fuels in rural areas. Electricity is not yet a major provider of space heating although its use is rising fast, covering 11% of households, and 9% of households for hot water provision. The increased use of electricity is explained by the rationing of the district heat supply.

During the years 1990–1994 the tripling of electricity consumption by rural households and doubling by urban households was the most striking development in the sector. At the same time coal consumption by households fell by 89%, LPG by 70%, and kerosene by 65%. It seems that in addition to electricity, consumption of dung cakes also grew in the same period, though less significantly.

The increase of electricity consumption was the result of the government policy to promote consumption of domestically produced electricity. This is facilitated by the high electrification rate in the Kyrghyz Republic. Furthermore, alternative fuels such as coal or LPG are priced more highly and are not always available. Also, it is easier for households not to pay their electricity bill while other fuels must be paid for first.

In rural areas a return to indigenous fuels such as wood and dung cakes can be observed. The use of wood in particular represents a significant threat to the already affected and sensitive forests.

The principles of a market economy require the allocation of cost-covering tariffs to the consumer. This is already the case for households using fuels like coal and LPG. In the last few years the Government and utilities have increased consumer prices significantly. Today consumer tariffs for district heating have reached 50% of full costs. The present tariffs represent about 30% of the average available income in multi-family houses supplied by district heating.

Nevertheless the present subsidization of tenants in district-heated flats is still a problem. The subsidization of this group is unfair as others who heat with coal and gas have to pay full prices. Natural gas and district heat, restricted to large urban areas, is mostly not available to the lowest income groups who live mostly in rural areas. The use of district heating and natural gas is more frequent in high income households who live in urban areas. Therefore, the current low tariffs of heat and gas translate into a subsidy of higher income households in urban areas.

To let tenants pay cost-covering tariffs would also be unfair as they normally had neither a choice of a heating system nor a choice regarding the energy efficiency of the building and would now be faced with the high costs of a system that was designed according to different economic considerations. Along with these tariffs people would have to bear the sins of mismanagement and oversized administration as well as the high energy consumption of badly constructed buildings and heat supply systems.

Although energy-saving measures on the end-user side are now demonstrating their economic efficiency, private and public investors lack the financial means to carry out such investments.

Scope of the project

The overall goal of the project was to improve the energy efficiency of buildings.

In the West, technologies and procedures to improve the energy efficiency of buildings are successfully implemented on a large scale. However, simply transferring this know-how is not the ultimate solution, for various reasons.

Energy-saving projects require a multi-disciplinary approach. This was taken into account in the layout of the project. The project was defined by six major work packages. (1) Energy audits in a representative sample of buildings, (2) Demonstration projects, (3) Market studies, (4) a Public awareness campaign, (5) Training and (6) Improvement of building codes and standards. The consultant placed considerable emphasis on the optimal combination of these work packages in order to achieve the maximum effect.

Furthermore, during implementation of the project the consultant added the issue of consumption-based billing to the project scope.

METHODOLOGY

In this section we describe the methodology of the entire project, but with emphasis on the energy audits, demonstration projects and monitoring of energy consumption.

The first step in the project was the execution of 12 energy audits in representative buildings. For this purpose a survey of the entire building stock was carried out. Based on the findings twelve typical buildings of the residential, public and commercial building stock were selected.

The energy audits were executed in the following steps:

- site visit of the selected buildings, recording of data
- review of design documents
- setting up of an energy balance by means of a computer model
- identification of rehabilitation measures, both on the building envelope and the heating system
- economic and technical assessment of the different energy-saving measures

The computer model applied calculates the energy balance based on the following input data:

- construction characteristics (heat conductivity of structural elements)
- ventilation rates
- characteristics of the heating system
- consumption patterns
- climate data (heating degree days and solar radiation)

The calculation method is based on European and German standards. The computer model used is multi-lingual. A Russian version was employed in Kyrghyzstan to train counterparts in performing energy audits.

Demonstration measures were identified based on the findings of the energy audits. These measures were implemented in a typical panel building with 54 flats. Additionally, a reference building was equipped with heat meters. Both buildings are supplied by district heating. Table 1 shows the measures carried out in these buildings.

Measurements were taken on a regular basis starting with the installation of the heat meters in October and November 1995 respectively. Additionally, detailed monitoring was carried out in the period January 29 to February 5, 1996. During this period measurements were recorded on an hourly basis.

For the measurements approved commercial equipment was used from Germany and France.

In both buildings heat meters for space heating and meters for domestic hot water and circulation were installed.

The measurement plan is shown in Figure 1.

As the district heating system in Bishkek is designed as an open system, i.e. domestic hot water is directly tapped from the heating system, the cold water temperature fed in at the district heating plant had to be assumed. This temperature (approx. 12° C) had been simulated by a resistance in the heat meters for domestic hot water and circulation (HM2, HM3).

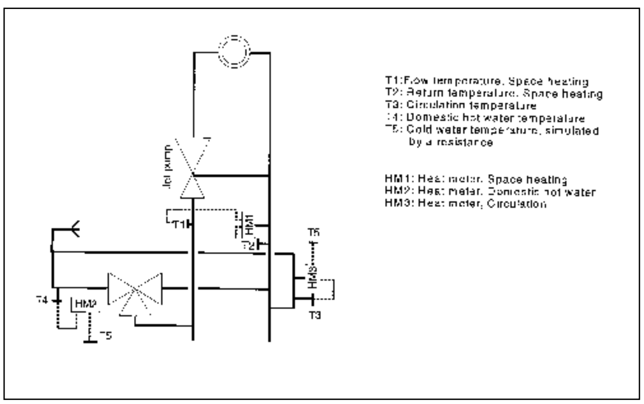
Additionally, in the reference building, heat allocation meters at each radiator and domestic hot water meters had been installed in each flat in order to allocate the share of the total consumption to each flat.

During the monitoring period indoor temperatures were measured in reference flats in both buildings. For control purposes the electricity consumption was recorded as well.

Table 1. *Installed Equipment in the Demonstration Building*

Type of Building	Use of Building	Equipment Installed
Panel Type 105	Residential	• Thermal insulation of facades and roof • Thermostatic values • District heating sub-station with weather compensation and controls for domestic hot water • Balancing valves and hydraulic alignment • Pipe insulation • Heat allocation meters at each radiator • Water meters for domestic hot water in each flat • Heat meters in the district heating sub-station
Panel Type 105	Residential	• Heat meters for space heating and domestic hot water

Figure 1. *Measurement concept*



The energy audits also formed the background of the other work packages of the project.

RESULTS

In this section we describe the main findings from the energy audits and the experiences made in implementing the demonstration project.

Energy audits

There are four categories of influence on energy consumption under given climatic conditions. The major findings of the energy audits in this respect are reviewed here.

Characteristics of the building envelope. The characteristics of the building envelope have a large influence on the heat demand of the building. The following highlight the main findings with regard to the heat losses through the building envelope:

- Heat transmission losses though prefabricated panels are high. This is attributed to the quality of the materials used or else design specifications are not met due to material shortage.

- Heat transmission losses through the double frame windows are comparatively low.

- Ventilation losses have a high share of the total energy consumption for space heating (up to 50%). This is attributed to the:

  — poor quality of the windows, i.e. buckled frames which do not close snugly

  — window panes are mounted without glazing putty

  — joints between window frames and walls are not suitably constructed, i.e. insulation material is missing or unsuitable

  — joints between panels are not draft-proof due to rotten or missing insulation material

  — a natural ventilation system (vertical air ducts through the entire building) is used in kitchen and bathrooms

Characteristics of the heating systems. The investigated buildings had central heating systems which were supplied by:

- district heat or
- individual boiler

The major deficiencies of the heating systems can be summarized under the following headings:

- insufficient control equipment in the district heating sub-station or at the boiler (i.e. weather compensation, night set-back)
- insufficient or no control equipment in the individual rooms (i.e. thermostatic valves or at least manual regulating valves)
- boilers in one-family houses are frequently self-made constructions and have a very low efficiency
- insufficient or non-insulation of distribution pipework in non-heated areas

Operation and maintenance. Regular and preventative maintenance of buildings and equipment was not emphasized in the former system. Today the saving potential through appropriate operation and maintenance schemes is recognized but in the absence of the necessary financing not carried out. Some examples are given as follows:

- Maintenance to windows and entrance doors is insufficient, e.g. broken entrance doors are not replaced. This in turn increases ventilation losses of a building significantly.
- Devices necessary to keep the heat consumption of a building within the design limits are not functioning or are missing. For example: throttle valves are installed at the bottom of the rising pipes. Frequently they are not serviceable or are wrongly adjusted. Pressure reduction valves are not serviceable. The malfunction of these devices leads to a deviation from the flow rates (and thus from the heat consumption) of a given building.
- Leaking water taps in the flats are not repaired.
- Mixing valves in district heating sub-stations to maintain a constant temperature for domestic hot water are usually not serviceable. In winter, consumers may be supplied with DHW temperatures of 80° C to 90° C.

User behavior. The use of the building and the consumption patterns of the occupants also have a large influence on the energy consumption of a given building. The energy-saving potential due to altered consumer behavior can only partly be tackled by technology. The main findings regarding user behavior are listed below:

- The specific hot water consumption has been estimated at between 120 and 140 liters per person and day (at 65° C). Due to this high water consumption the share of DHW in the total energy consumption per year is in the region of 50%. For comparison: German standards allocate 20 to 40 liters per person and day.
- Due to the significantly increased fuel prices the district heating utility has reduced the supply temperatures in the past few heating periods. The system has been calculated with a flow/return temperature of 150/70° C at a design outdoor temperature of −23° C in Bishkek. In the past heating periods, flow temperatures of between only 50° C and 70° C have been achieved in the district heating network in Bishkek. Consequently the design indoor temperature of 18° C in rooms could not be achieved. Room temperatures were between 8° C and 12° C on colder days in recent heating periods. However, occupants of flats successfully overcame this under-delivery by installing larger radiators in their flats or carrying out changes on the district heating sub-station. Additional electric heaters are also used.
- Occupants also carried out draft-proofing measures on the windows and ventilation system, e.g., sealing of air ducts in the kitchen and bathrooms and draft-stripping of windows.
- Occupants frequently use balconies as additional living space. For this purpose balconies are enclosed with single pane windows and frequently it was observed that additional radiators are installed. In some cases the main window and balcony door has been removed.

The status-quo of energy consumption (space heating and domestic hot water) in multi-family houses has been calculated at 240–360 kWh/m^2 a. The energy consumption for space heating is in the order of 140 to 175 kWh/m^2 a and between 110 to 210 kWh/m^2 a for domestic hot water. Between 45% and 58% of the consumption is for domestic hot water.

Energy consumption is highest for newer panel-type buildings. Average heat transmission values for this type of building have been calculated to be as high as 2.7 W/m^2 K as compared to brick buildings with an average heat transmission coefficient of 1.2 W/m^2 K.

Single-family houses have the highest specific energy consumption (320–350 kWh/m^2a) for space heating due to the unfavorable ratio between building envelope and enclosed volume, although the average heat transmission value is not too bad.

Demonstration projects

Based on the results of the monitoring, Table 2 gives an overview of energy saving, investment and pay-back periods for the demonstration building.

For the calculation of saved energy costs a district heating tariff of 220 Som/Gcal gradually rising over the next 10 years to 270 Som/Gcal has been assumed. Investments are calculated on the basis of the actual expenditures for the demonstration projects. Expenditures for material and services that would not arise in a normal project are deducted. Furthermore, we have applied a reasonable discount rate assuming such rehabilitation would be executed on a larger scale.

The total energy consumption for space heating and domestic hot water in the demonstration and reference building is shown in Table 3.

Energy saving for space heating has been measured at approximately 40% as compared to the reference building in the heating period 1995/1996. On the domestic hot water side, savings of 22% were recorded.

Looking at the measures implemented in the demonstration building, the recordings during the monitoring periods are commented on as follows:

Table 3. *Annual Energy Consumption, Space Heating and Domestic Hot Water*

	Reference Building	Demonstration Building
Space heating [MWh/year]	622	382
Domestic hot water [MWh/year]	539	419
Total [MWh/year]	1,161	801
Share of DHW [%]	46	52
Share of space heating [%]	54	48

Table 2. *Economics of Investment Strategies for the Demonstration Building*

Measure	Investment [Som]	Energy Saving [kWh/a]	Dynamic Pay-back Period [years]	Internal Rate of Return [%]	Net Present Value [Som]	Annual Capital Costs per Flat [Som/year]
Insulation of the building envelope	367,200	132,000	more than 10 years	− 2.9	− 155,000	1,040
Retrofitting of the heating system	135,000	108,000	6.8	15.4	38,700	381
Consumption based billing of domestic hot water	62,100	210,600	0.7	152	245,000	175
All measures combined	564,300	450,600	7.2	14.3	136,000	1,596

Note: Exchange rate: 1 US$ = 11.5 Som
Interest rate: 8.5%
Considered period: 1996–2006

The savings attained by the insulation of the building envelope are estimated to be 20% to 25% and about 15% to 20% through measures applied to the heating system.

Savings in space heat were attained by (a) outdoor temperature control in the district heating sub-station (b) hydraulic alignment of the heating system (c) pipe insulation (d) thermostatic valves at the radiator.

Equipment for consumption-based billing of space heating for each household was installed for demonstration purposes, but occupants were still billed on a flat-rate basis. The partly measured high room temperatures indicate that further savings, in the order of 10% to 15% can be expected once occupants are billed individually.

As regards DHW the saving achieved (22%) is attributed to the temperature control of domestic hot water in the new district heating sub-station. Through constant temperature control consumers are provided with a suitable water temperature (65° C). Mixing losses at the taps are therefore reduced. In the reference building the water temperature depended on the temperature in the district heating network, as the control valve was not serviceable. Furthermore, during installation of the water meters in flats leaking taps were repaired.

Whether the installation of the water meters in the flats has changed the attitude of the occupants is difficult to assess. However, comparing the specific consumption (120 to 145 liters per person and day, during the monitoring period) with consumption figures in western Europe (20 to 50 Liters per person and day) it can be assumed that a further 40% to 50% can be saved once tariffs are increased and households are billed individually.

With regard to the billing for hot water we have assumed in the economic calculations, for example, a 50% reduction of the present specific hot water consumption, which means a specific consumption of 60 liters per person and day. In comparison with western European standards this would still represent a high comfort level.

Table 4 shows the energy costs for a typical flat.

In order to attain the lower energy costs of 237 Som in the demonstration building, a typical household would have to pay an additional 133 Som in capital costs per month if the measurements are fully financed by the occupants.

The economic efficiency of the implemented measures differ significantly as shown in Table 2. The best results are produced by consumption-based billing of DHW and by measures to the heating system.

Table 4. *Comparison of Monthly Heating Costs*

	Reference Building	Demonstration Building
Costs for space heating [Som/month]	207	127
Costs for DHW [Som/month]	180	110
Capital costs [Som/month]	—	133
Total [Som/month]	387	370

Improvement of the insulation standard of the building envelope offers great savings potential. However, carrying out such measures for energy saving alone do not prove to be economically viable at present.

Such improvements should therefore be considered with necessary rehabilitation measures, e.g. if the building needs to be renovated, insulation measures should be included. In this way only a part of the investment costs are attributed to the energy-saving measure which will improve the economic efficiency of the measure in question. Such requirements were also proposed in the work package standardization of this project.

Furthermore, rehabilitation measures of the building facade improve the quality and comfort conditions as well as prolonging the life-time.

Equipment used for retrofits on the heating system and consumption-based billing is virtually unknown in Kyrghyzstan as in other CIS countries. Consequently, comprehensive training had to be carried out for the local contractors.

Of interest was also the reaction of the occupants in the demonstration building. Occupants were very satisfied with the insulation of the building, since an acceptable comfort level was achieved after rationing of the heat supply took place in 1991. On colder days in the reference building indoor temperatures were recorded as low as 14° C.

Occupants often had difficulty understanding the functioning of the control equipment. Complaints were received about cold radiators in cases where the thermostatic valve had closed due to an adequate indoor temperature.

Another problem was that occupants expected hot radiators. Due to the installed outdoor temperature control, radiators were only luke-warm on hot days, although indoor temperatures were maintained at 20° C. This also gave rise to complaints by the occupants.

CONCLUSIONS

The project carried out proved to be very appropriate to meet the needs of the changing energy sector in Kyrghyzstan. Feasible solutions to save a significant amount of energy in the building sector were able to be demonstrated.

Close co-operation was established with relevant organizations and Government institutions.

During project implementation the Kyrghyz Government embarked on the first steps towards a market-oriented energy economy. This encompassed substantial price increases for district heating, gas and electricity. Furthermore, a law on consumption-based billing and stipulations on improved energy efficiency of buildings were drafted and are presently under discussion. At the same time social welfare schemes are being introduced to protect low-income groups.

Traditionally, utilities had pursued mainly supply-side strategies. With the transition process these utilities also started to consider demand-side measures, for instance the introduction of consumption-based billing for DHW.

Nevertheless, apart from structural reforms the question remains as to which strategy can be employed under the present circumstances in order to successfully implement the economic investment and to achieve the possible energy savings.

A hierarchy of actions is recommended by the consultant in Table 5.

The high energy consumption, which is particularly marked for district heating, does not necessarily lead to comfort. This is particularly true for the domestic hot water consumption that accounts for almost half of the total energy consumption in households in multi-family houses. Most of this energy is simply wasted.

The scarcity of financial resources means investment in improving housing must be done carefully, so that there is a real economic return that will finance yet more energy-saving investment.

From the aforesaid the options in the short term are:

- avoiding energy waste
- low-cost measures to the building envelope and the heating system

For the first item the reduction of hot water use appears the most relevant measure, for several reasons:

- it can be achieved without reducing comfort
- it causes no damage to the buildings, which is likely to happen if buildings are not heated sufficiently
- the economic parameters are favorable
- related equipment can be produced locally
- consumption-based billing for hot water would educate people and make them aware of energy waste and thus prepare them for consumption based billing for space heating

Bills based on actual consumption of hot water are easily understandable for occupants. The water meter shows directly how much they have used and this can easily be converted into the amount of money due. Also, the consumption of hot water can be directly influenced by the occupants for no or little additional investment. Methods of how to reduce hot water consumption can easily be explained in a public awareness campaign.

For the second item, simple measures on the building envelope, e.g., replacing worn-out windows and draft-stripping of windows can improve thermal comfort and reduce energy consumption. In addition, specific parts of the building envelope can be insulated (e.g., roofs, gable walls).

Short-term measures on the heating system include the upgrading of the district heating sub-stations and the installation of valves at the radiators.

Based on the experience gained, one can state that it is possible to make quick reductions in energy needs in Kyrghyzstan in the short and mid-term for reasonable amounts of investment. Further substantial reductions over the following decades will be feasible, but will, however, require considerable investment. Such measures would encompass complete insulation of the building envelope and replacement of windows.

In market economies changes in consumer behavior towards energy savings are primarily driven by higher fuel costs reinforced by individual metering and billing. Therefore the introduction of a proper metering scheme for residential, public and commercial buildings is one of the most important tasks in the building sector.

Table 5. Hierarchy of Actions for the Improvement of Energy Efficiency

Measure	Result	Responsible Organization/Person	Economic Efficiency	Remarks
Public awareness campaigns	avoidance of energy waste, rational use of energy	Government, supply utilities	high	This is particularly relevant for the reduction of hot water consumption.
Improving operation and maintenance	avoidance of energy waste	housing organizations, supply utilities	high	This is particularly relevant for buildings supplied by district heat.
Check occupants' flats for changes to the heating systems	avoidance of energy waste	occupants, housing organization	high	Dismantling of radiators installed by the occupants on balconies or replacement of radiators with radiators of the correct size.
Introduction of consumption-based billing for domestic hot water	incentive for energy saving by the user	housing organization, district heating utility	high	Consumption-based billing produces the greatest economic efficiency.
Introduction of consumption-based billing for heat energy	incentive for energy saving by the end-user	supply utilities, housing organizations	high	Consumption-based billing for heat energy is only possible if retrofits are carried out on the heating system.
Improving the controllability of the space heating system (outdoor temperature control, valves at radiators)	avoidance of energy waste, energy use only to user requirements	housing organizations, owner	high	
Improving the insulation standard of the building envelope	reduction of transmission and ventilation losses	housing organizations	medium	Such measures should be carried out in conjunction with general renovation measures, in order to improve economic efficiency. Such measures must be carried out *together with hydraulic alignment of the heating system.* Consumption-based billing is recommended.

While individual metering and billing for hot water consumption can be implemented at low cost, it must be pointed out that with consumption-based billing for space heat the heating system must simultaneously be equipped with control valves at the radiators in order to give the end-user the ability to adapt the heat demand to the individual requirement and to save energy. As radiator valves are not installed in most multi-family houses in Kyrghyzstan the end-user would be charged for a service which he or she cannot adjust to personal needs.

Looking at average cash income few Kyrghyzians can afford better housing or to pay their energy bill once full cost-coverage tariffs are charged and energy is billed according to individual consumption. For any improvement being envisaged, the mid-term economic situation is therefore a constraint.

Looking at the individual households in the demonstration building, average monthly energy costs for space heating and domestic hot water have been calculated at approximately 387 and 237 Som respectively. In order to attain these lower energy costs a typical household would have to invest between 12,000 and 14,000 Som. One can safely assume that such levels of investment cannot be borne by a majority of households in the present economic situation. This is becoming the case more and more as households are additionally burdened with a generally rising cost of living.

Furthermore, interest rates of commercial banks are at such a level that loans for such improvement measures are not attractive for individuals.

From the aforesaid it is clear that households alone cannot trigger the process of energy-efficient investment. Initiatives should therefore be developed by state or semi-state organizations or occupants' organizations. This is even more desirable as such institutions can attract loans under bilateral or multilateral financial co-operation.

Finally, it is important to incorporate concerns about the short-term heat problem in a longer-term strategy to upgrade the condition of the housing stock in Kyrghyzstan, and to avoid strategies that save energy today but that could also damage buildings or otherwise lower their value in the future.