Best practice project of BEEN in Estonia

Paldiski Road 171, Tallinn: Reconstruction of an Apartment Building

Report

Tallinn 2008
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**Introduction**

BEEN or Baltic Energy Efficiency Network for the building stock project occurred within the framework of the European Union programme INTERREG IIIB. The duration of the project was 2.5 years, from July 2005 until December 2007. From the Baltic Sea Region there were five European Union member states involved: Germany, Poland, Estonia, Latvia, Lithuania plus Russia and Byelorussia. Altogether there were 26 partners included in the BEEN project, who are the representatives of important state levels and institutions and who are responsible for the energy efficient refurbishment in the residential areas of their state. There were 6 partners involved from Estonia: Credit and Export Guarantee Fund KredEx (hereafter KredEx), Tallinn University of Technology (hereafter TTÜ), Estonian Union of Cooperative Housing Associations (hereafter EKÜL), Association of Estonian Facilities Administrators and Maintainers (hereafter EKHHL). Ministry of Economic Affairs and Communications of the Republic of Estonia (hereafter MKM) and Tallinn City Government (hereafter Tallinna LV). BEEN project was financed in the range of 75% out of the European Union funds of the programme INTERREG IIIB.

The aim of BEEN was to develop the technical, legal, institutional and financial strategies and instruments to improve the energy efficient refurbishing of the residential buildings in the Baltic Sea Region, focussing mainly on the multi-storey housing stock erected between 1950–1990. Within the BEEN project there were three best practice projects carried out, including a model project of refurbishing of an apartment building.

The aim of the best practice project of a complex refurbishing of an apartment building carried out in Estonia was to gain maximum energy efficiency. Using this example, it would be possible to refer in the future to a specific apartment building and the energy efficiency that resulted from the refurbishing, which in turn affects significantly the monthly costs of the residents, mostly reducing the heating expenses. KredEx was responsible for carrying out the Estonian best practice project.

Also a movie-clip was ordered to cover the completion of the project, which can be used in the future as an introductory educational material. The clip is in Estonian, Russian and English.

This report focuses on the carrying out of the BEEN model project in Estonia, familiarizing the doings of Estonian partners of BEEN, the reconstruction works and their financing. As an annex, there is a separate report, containing the results of a contentment survey that was carried out among the residents „Changes in the Residential Environment: Buildings and Residents”.
1. Preconditions of the model project

In May 2006 KredEx announced a competition to Estonian apartment buildings „Turn Your Apartment Building More Energy Efficient“ (see picture 1). The main aim of the competition was to find one apartment building in Estonia that would be prepared to carry out complex reconstruction works in order to gain maximum energy efficiency. The reconstruction works of the winning apartment building are supported by a grant of 1 million kroons within the framework of the BEEN project.

It is the first project in Estonia of performing complex reconstruction works on an apartment building in order to gain energy efficiency and it was carried out within the framework of the BEEN (Baltic Energy Efficiency Network for the building stock) project with the help of KredEx, TTÜ, EKÜL, EKHHL, Tallinna LV, MKM and German partners.

All the apartment buildings in Estonia, built between 1955–1990, that were either built of panels, made of blocks or stone, could participate in the competition. There had been no significant renovation or reconstruction works carried out during the past 5 years. The owners of the apartments of the building had to be ready to invest in the reconstruction works (with the help of a bank loan, if needed) at least 5 million kroons, out of which the winning building was supported by a grant of 1 million kroons within the framework of the BEEN project.

It would be important to gain at least 30% energy efficiency as the result of the refurbishing works.

There were three applicants in the competitions:

- Paldiski 171 KÜ (Home Owners’ Association)
- KÜ Läänemere 66/68
- Apartment Ownership Sõpruse 219 (manager OÜ Elamu Haldus)

Out of the applications that were presented to the competition, the Estonian partners of the BEEN project selected the winner on their meeting that took place on June 20th, 2006. It was the Home Owners’ Association of Paldiski Road 171, and the cooperation agreement was signed on September 4th, 2006. According to the contract the following works are to be carried out in the apartment building within the framework of the BEEN project in 2006–2007: the reconstruction works of the heating system, roof, fassade (together with glazing the balconies and loggias and replacing all the windows not yet replaced) and ventilation system, the aim of which is to gain maximum energy efficiency. The partners wanted to involve a project manager to carry out the reconstruction project successfully and to perform owner supervision while helping the association to order plans, select the builders,
sign the construction contracts and accept of the construction works. To find the project manager, KredEx received tenders from 5 building contractors. The partners chose OÜ Ehitusseire on their meeting on August 2nd 2006. On September 4th, 2006 Kredex signed a contract with OÜ Ehitusseire to act as a project manager and performer of owner supervision.

2. Discription of an Apartment Building at Paldiski Road 171, Tallinn

The apartment building at Paldiski Road 171 was built in 1977 as a large-panel construction by Tallinna Majaehituskombinaat (Tallinn House-building plant). The apartment building that is situated in Õismäe, Tallinn is a typical flat-roofed 5-floor panel building with four stairways that has 60 apartments (see pictures 2 and 3).

![Picture 2. Paldiski Road 171 front view before the reconstruction](image)

<table>
<thead>
<tr>
<th>Tabel 1. Technical data of the building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function of the building:</td>
</tr>
<tr>
<td>Year of building:</td>
</tr>
<tr>
<td>Number of apartments:</td>
</tr>
<tr>
<td>Number of residents:</td>
</tr>
<tr>
<td>Cellar (yes/no, heated/not heated):</td>
</tr>
<tr>
<td>Number of floors:</td>
</tr>
<tr>
<td>Area under the building, m²</td>
</tr>
<tr>
<td>Area of the roof, m²</td>
</tr>
</tbody>
</table>
General area, m² 3870.2
Heated area, m² 3035.1
Area of residence, m² 3143.9
Cubic capacity of the building, m³ 12160
Inner heated cubic capacity of the building, m³ 8407.9
Height/width/length of the building, m 15.1 x 12.88 x 62.12

Picture 3. Paldiski Road 171 rear view before the reconstruction

Tabel 2. Materials of constructions of the building

<table>
<thead>
<tr>
<th>Part of the building</th>
<th>Material/type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation</td>
<td>concrete block</td>
</tr>
<tr>
<td>Sockle</td>
<td>block</td>
</tr>
<tr>
<td>External walls and flank walls</td>
<td>panel</td>
</tr>
<tr>
<td>Cellar ceiling</td>
<td>hollow-core slab</td>
</tr>
<tr>
<td>Roof</td>
<td>flat roof</td>
</tr>
<tr>
<td>Cellar windows</td>
<td>wood</td>
</tr>
<tr>
<td>Stairway windows</td>
<td>wood</td>
</tr>
<tr>
<td>Windows: apartment, balconies, loggias</td>
<td>PVC/wood</td>
</tr>
<tr>
<td>Front doors</td>
<td>metal</td>
</tr>
</tbody>
</table>
The apartment owners of Paldiski 171 formed the Home Owners’ Association (hereafter association) in 2001 and the association manages the building since 2002. Earlier it was managed by Haabersti Linnaosa Valitsus (Haabersti City District Government). As the apartment building has been used for 25 years or half of its expected life-time, the association decided to refurbish the building in order to lengthen the life-cycle, lower the maintenance costs and raise the quality of life.

3. Determining the existence risks of the building

3.1 Expert examinations

As the first step, the association ordered an expert examination of the roof in 2003, examination of the building’s construction in 2004 plus a rough draft for adding the 6th floor to the building. The expert examination of the roof detected that although the roof keeps away the rain, during the thaws following the winter the condensation water starts to flow from the dry roof and ceilings. As the roof constructions are continuously damp, it is not heatproof. Therefore the heating expenses of the apartment building are high, but the apartments on the fifth floor are cold. The expert recommended reconstructing the roof or drawing up a plan and add the 6th floor to the building.

The expert examinations of the constructions of the apartment building stated that by obstructing the corrosion of reinforcement bars of outer railings, the carrying capacity may persist until the year 2017 or longer. Sooner of later there may occur spot collapses of mainly balcony and loggia constructions unless the corrosion is stopped. The closing in of loggias and console balconies is rational, as it helps to avoid potential emergencies and lengthen the useful life-time of the building. It is recommended to insulate the outer walls additionally. As a conclusion it is noted that the refurbishing of the building in the recommended form should lengthen its life-time for at least 25 years or more.

Already the first modest calculations (in 2004) demonstrated that the reconstruction works that provide significant energy efficiency demand an investment in the amount of ca four million kroons. It means that it takes expenses in the amount of 1,273 kroons per square metre of a residential are or on the average 67 thousand kroons per apartment. The managing board of the association found that this kind of an additional financial burden is too much for most of the apartment owners. Also the bank loan limit was up to 1,000 kroons per square metre at that time.

For that reason the managing board of the association suggested to build the 6th floor and finance the reconstruction works of the building out of the profit gained from selling the new apartments.

Consequently a rough draft for adding the 6th floor to the building was ordered in May 2004 from the design and expert bureau OÜ Patiks to apply for design criteria. The estimated building price of a new floor was 7.1 million kroons, while the association hoped to earn 9.5 million kroons for selling the new apartments. This plan was not approved by most of the apartment owners. The managing board of the association did not get the design criteria from the Tallinna LV Department of Sustainable Development and Planning, for carrying out the application drawn up by OÜ Patiks.
In May 2006 OÜ EKE NORA drew up the forecast of the anticipated full renovation cost for the building at Paldiski Road 171 – 12 million kroož (total costs 3,811 kr/m²). The forecast was ordered by the managing board of the association, to get an expert assessment on which works might be included in the full renovation/reconstruction of a panel building, issuing from the design approach of individual works on single houses done so far and their estimated cost.

### 3.2 Energy audit

In April 2005 an energy audit was ordered from OÜ Energiasäästubüroo together with thermal inspection, which ascertained that by applying all the recommended measures, it would be possible to save in an apartment building ~50% of the heat energy (see table 3 and 4).

#### Table 3. The forecast resulting from the energy audit: perimeter constructions

<table>
<thead>
<tr>
<th>Part of the building</th>
<th>Heat losses before MWh/year</th>
<th>Heat losses after MWh/year</th>
<th>Saving per year MWh/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulating the sockle</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Insulating the front outer walls</td>
<td>68</td>
<td>22</td>
<td>46</td>
</tr>
<tr>
<td>Insulating the cellar ceiling</td>
<td>25</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Insulating the roof ceiling</td>
<td>37</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Replacing the windows of the rooms, balconies and loggias and replacing the doors</td>
<td>161</td>
<td>105</td>
<td>56</td>
</tr>
<tr>
<td>Replacing the windows of the stairways</td>
<td>29</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Replacing the windows of the cellar</td>
<td>14</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>381</td>
<td>197</td>
<td>184</td>
</tr>
</tbody>
</table>

#### Table 4. The forecast resulting from the energy audit: heating

<table>
<thead>
<tr>
<th>Proceeding</th>
<th>Heat saving kWh/m²</th>
<th>Saving MWh/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>To replace one-pipe heating system with two-pipe-system and to perform the hydraulic balancing of the heating system</td>
<td>20</td>
<td>61</td>
</tr>
<tr>
<td>To divide the heating system into service regions with different type load</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Insulating the heating pipes and valves in the rooms that are not heated</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>TOTAL</td>
<td>34</td>
<td>103</td>
</tr>
</tbody>
</table>

The thermal inspection showed that an intensive outflow of heat is taking place through the cold bridges in the corners of the wall panels, and simultaneously also the condensation of humidity. As a result, the intensive corrosion of structural irons is taking place in the region of welded seams that keep the panels together. In the region of thermal bridges on the inner sides of the walls the temperature is sometimes even below zero.
4. Preparations for the reconstruction process

4.1 The beginning of obstructing the dilapidation of the apartment building

As the general meeting of the association could not agree in the course of two years (2004–2005) which measures to take in order to obstruct the dilapidation of the building, the managing board of the association decided to act on the basis of the Apartment Ownership Act section 15 subsection 2 and the Law of Property Act section 72 subsection 4: “The apartment owner has a right to perform the necessary operations to preserve the object of common ownership without the agreement of other apartment owners and he can demand the compensation of necessary expenses from other apartment owners on the basis of the relation of covering the common ownership expenses.” This decision was based on the support of one quarter of all the members of the association (apartment owners), who agreed to the building of the 6th floor in order to renovate the building.

The managing board of the association raised the standard sums for repairs in the rental accounts from 4.60 kroons to 9.90 kroons per square metre a month beginning from July 1st, 2005. This standard grants the repayment of the 3.2 million kroons bank loan with the due date of fifteen years. The suspected increase of rental debts did not follow. On the contrary – the receipt of rental sums became even more regular.

On May 16th, 2006 the managing board of the association put to the written voting (on the basis of the statute, clauses 4.4 and 4.13) a proposal to participate in the BEEN project competition announced by KredEx. On the basis of July 31st, 2005 resolution of the managing board of the association, it was evident that the managing board had set into action the preparations for the complex renovation of the building. Thus the members of the association were informed that a large-scale renovation cannot be avoided, that it will be carried out in any case. That was the reason why several members of the association who had always voted against performing large-scale works, thought it sensible to join the project which promised to give support in the financing of the renovation.

The resolution of the management board of the association from June 1st, 2006 confirmed that 34 members of the association supported the reconstruction of the building. 33 members of the association agreed to the bank loan in the sum of 3.2 million kroons.

Picture 4. The thermal picture of the front of the building at Paldiski Road 171

-4.9 °C
-5
-10
-15
-20.2
4.2 Planning

The complex reconstruction plan of the building was ordered from AS Eesti Projekt (currently AS SWECO Projekt).

In June 2006 the first plan was ready – the design of roof renovation together with the recommendation of renovating the ventilation system. Additionally the renovation design for the heating system was drawn up, which prescribed to build the existing 1-pipe heating system into a 2-pipe heating system, and the reconstruction design for the front of the building. Besides insulating the building (with 150 mm styrofoam sheets), the problem of glazing the balconies and loggias with the frameless glass system was also resolved. Also the design prescribed the replacement of depreciated and not yet replaced windows of the apartments and stairways, and the replacement of balcony and loggia doors.

The cost of the planning works was 93,220 kroons.

4.3 Project management and building supervision

To find the project manager and to provide professional services of project management and owner supervision, KredEx received tenders from 3 building contractors. The partners chose OÜ Ehitusseire on their meeting on August 2nd, 2006.

Bids:
- Tallinna Linnaehituse AS 436,600 kroons
- Ahti Väin Konsult 175,000 kroons
- Ehitusseire OÜ 120,000 kroons

On September 4th, 2006 Kredex signed a contract with OÜ Ehitusseire to act as a project manager and performer of owner supervision. The total cost of the service was 120,000 kroons.

5. Reconstructing the apartment building

5.1 Renovation works performed before the BEEN project

The reconstruction of the building started out of repair fund already in 2002, when both flank walls were insulated with 100 mm styrofoam. In October-November 2004 the old wooden front doors were replaced with the insulated metal doors with large glass-surfaces. In August-September 2005 AS Balti Fonolukk replaced the old wooden mail-boxes with metal ones and designed a new set of mail-boxes and an advertisement shelf in the stairway. Instead of the old mail-boxes notice-boards were installed in the tambour.

5.2 Performing the Reconstruction Works in 2006-2007

After receiving the plan, it became the basis for calling building tenders from different construction companies. Tenders were called from mainly those companies that were recommended by KredEx, the project manager, EKÜL and Hansapank, as they had positive
information about cooperation with them. Many companies gave up the possibility to make an offer, as they had no free sources for a new contract in their tense work load during the current year.

The planning for the reconstruction works of the apartment building and the performance of these works merged with the building boom of 2006 in Estonia, which caused the dragging on of planning works, lack of workers in the construction companies and the increase of construction value. A characteristic feature was almost two-fold difference between the highest and lowest tender price.

Calling tenders for performing all the building works was done under the leadership of the project manager of OÜ Ehitusseire Mr Kuldar Käasper and with the participation of the managing board of the association of Paldiski 171.

5.3 Reconstructing the roof

In the end of June 2006 the association received the plan of roof renovation. By that time the construction companies had already made their plans for the current year and receiving tenders for building was complicated.

Only three price offers were received for the additional insulation of the roof:

- OÜ Brentex 777,297 kroons
- AS Laudon-S 827,291 kroons
- OÜ VivarEst 1,711,444 kroons

Out of the three offers, the one by OÜ Brentex met the requirements of the plan for the set of works best; also its price was most favourable. On October 3rd, 2006 a contract for construction services was signed with OÜ Brentex.

On October 20th, 2006 the roof material was delivered and lifted to the roof. Due to bad weather conditions the works on the roof were started only on November 7th, 2006. As the works started late, only the roof covering works were finished by the end of the year without the prescribed smoke hatches of the stairways. 200 mm Isover mineral wool for insulation was placed on the roof and it was covered with a two-layer SBS-material. Cutting openings in the roof panels for the smoke hatches had to wait for spring and better weather conditions. In the spring, while cutting openings in the roof panels for the smoke hatches it turned out, that the roof panels used in the original building were of poor quality – risk of a collapsing occurred during the cutting. The works had to be stopped, until metal beam constructions for supporting the ceilings of the stairways were designed and made. Their installation ended in the summer of 2007. Due to the additional works the final cost of the roof works was 818,714 kroons.

Thanks to the additional insulation of the roof the living conditions in the apartments of the fifth floor became normal – if earlier the room temperatures there had been 5-6 degrees less than in the apartments of the lower floors, then in the winter of 2006/2007 the room temperatures steadied.
5.4 Windows

Offers were received for replacing the windows from the following companies:

- AS Glaskek Tallinn 638,590 kroons
- OÜ Uued Aknad 649,470 kroons
- AS Plastmerk 892,656 kroons

On October 10th, 2006 all the offers were summarized. AS Glaskek Tallinn was declared the winner. The consultations were held with the winner regarding the complexity of supplies, organization of works and technical issues; also the number of windows/doors was slightly changed.

On November 9th, 2006 a contract was signed with AS Glaskek Tallinn to manufacture and install 47 sets of balcony/loggia doors/windows, 52 apartment windows and 20 stairway windows in the total sum of 669,709.28 kroons. In comparison with the initial tender the price increased, as the measurement turned out to be bigger than the calculated standard measurements and one balcony door with a window was added. The due date of manufacturing and replacing the windows was January 31st, 2007, but the works went faster and the windows were replaced by the end of January.

Initially the windows were not replaced in four apartments, as the apartment owners refused to let the workers in. The reasons were different: Some didn’t want plastic windows (for health reasons), some had their own special wishes. To solve the problem, KredEx had to be involved, who organized several meetings with the partners and the above-mentioned apartment owners, to negotiate and find ways to resolve the issues and achieve possible compromises. Thanks to the compromises, two apartments have had their windows replaced and the case of two apartments has been referred to the court. On the basis of the court decision, the compulsory replacement of windows will take place.

The final cost of the replacement of windows was 730,132 kroons.

Also the problem of paying for the windows was solved (every apartment owner had to pay for the windows himself/herself). Not all the apartment owners had necessary finances and the windows had to be replaced quickly, before the walls could be insulated. So the managing board of the association decided to lend a hand and give a 0-per cent loan for 10 years to those apartment owners who wished it. The apartment owners pay for the windows to the association according to the agreed schedule monthly together with all the other housing expenses.

5.5 Balconies

The tenders were reviewed by the designer of AS Eesti Projekt Mr J.Natka and the head of the OÜ Ehitusseire Mr K. Käsper, responsible for the owner supervision. Considering the constructive solution and price the tender by AS Felistra was announced the winner. The winner of the competition, AS Felistra could offer the general construction of the balconies, that followed the planning conditions approved by the Tallinna LV, but they did not have a solution for the case, when the balcony’s construction had to be fixed on the fifth floor, where the construction cannot be fastened to the balcony’s ceiling.
Bids:
- AS Felistra  1,557,600 kroons
- AS Glaskek Alumiinium  2,291,855 kroons
- OÜ Klaashoone  1,690,114 kroons
- OÜ HansaSystems  1,400,000 kroons

As all the structural irons necessary for fastening the balconies had to be fixed to the wall panels before the insulation of the outer walls and there was no solution for the structural irons, the reconstruction plan for the front and rear part of the building was also delayed, until the constructors of the building and of AS Felistra agreed upon the roof construction of the balconies for the fifth floor. The assembly of the balconies was complicated by the extremely bad quality of the initial assembly of the concrete panels of the balconies – inclinations in vertical and plan are up to eight centimetres, which had to be set right while placing the props and their pads. For that the props had to be treated at the work site.

In replacing the balcony rails and partition walls, toughened glass was used and over the balconies of the fifth floor the roofs made of toughened-laminated glass were erected. The balconies were glazed with the frameless glass system. As an additional task, the railings for the loggias were to be placed, as the old ones were depreciated.

The final cost for glazing the balconies and loggias was 1,688,735 kroons.

Out of the reconstruction works of the building, the building permit was necessary only for insulating the outer walls and reconstructing the balconies – only for works that alter the external design of the building. In 2007, in the beginning of June, the plan for reconstruction works of the front and rear of the building was ready and on the basis of it a competition was announced to find the builder and the building permit was applied to from the City Government. The building permit was received on June 12th, 2007.

Altogether there were seven price offers, the difference between the lowest and the highest one was 1.86 million kroons. Only one of the offers was under two million kroons. Several companies answered to the proposal for presenting the price offer with a stipulation of their own. Namely that they would not bother to prepare a price offer, unless they get a guarantee that at least a two million offer would be accepted.
Bids:

- Sandra Grupp OÜ 1,870,807 kroons
- Dominos Projekt OÜ 2,062,007 kroons
- AM Partnerid OÜ 2,703,389 kroons
- Rowanto Ehitus OÜ 3,734,653 kroons
- Talivain OÜ 2,177,862 kroons
- Lexi Ehitus OÜ 2,200,000 kroons
- OÜ Deckol Ehitus 2,275,000 kroons

The winner of the competition, OÜ Sandra Grupp insulated and finalized the rear of the house – placed 100 mm styrofoam and mineral wool, which is covered with thin-coat plaster; replaced the weather-mouldings of the windows, fixed the damage on the lower surface of the balcony slabs caused by the mounting of the balcony footings and painted the slabs below; tightened the window reveals. The company also finished and painted the flank walls, which had dilapidated in time and were covered with graffiti.

The insulation of the rear part of the house was significantly disturbed by the mounting of structure irons by AS Felistra. Their delivery to the site lingered, the openings left in the insulation for them had to be widened and filled afterwards and the openings had to be additionally reinforced.

The rainwater drainage system for directing it away from the building and the reconstruction of a pavement will be done during the next years according to the financial opportunities.
5.7 Heating System

The plan for reconstructing the heating system was ready in October 2006. When tenders were called, the recommended period for work was marked as spring – summer of 2007, more particularly „before the beginning of the 2007/2008 heating period“. The vendors of radiators were also involved in organizing the competition. Despite everything the first offer was received only on April 4th, 2007. In the end there were seven offers, with the price difference of 1.7 times (max/min).

Bids:

- AGR OÜ 846,844 kroons
- OÜ Acron Grupp 1,012,440 kroons
- OÜ Vekont Ehitus 812,442 kroons
- AS RIP 1,144,600 kroons
- AS Magma 1,010,834 kroons
- AKM Eritööd OÜ 1,048,371 kroons
- Lasmar Grupp 1,400,660 kroons

The winner, OÜ AGR, dismantled the 1-pipe heating system of the whole building and erected a new, 2-pipe heating system. The existing boiler room was put in order, the circulation pump of the heating water was replaced with a pump of smaller capacity, but with a frequency converter, as the capacity of the new heating system is ~50% of the previous one. The existing heaters were replaced with modern radiators. All the radiators were supplied with preset thermostat valves. To grant the maximum heat efficiency the radiators were supplied with sensors (heating costs distributors) to determine heat consumption and the house was equipped with electronic heating calculator system (MESA system).

The heating system was ready for operation in October 2007. As there was no need to mount/replace all the valves of the line setting, the total cost of the works was even less than estimated – 808,040 kroons.

5.8 The system of individual calculation of heating expenses (MESA system)

All the radiators were equipped with heating costs distributors and the device was sealed, so it could not be removed without damaging it. The heating costs distributor measures the temperature on the surface of the heater and takes into consideration the temperature of the surrounding room. The useful consumption of every heater is formed according to the heat output of the heater, which is the basis of heating expenses that is divided in the end of the month. The whole data communication of the heating costs distributor takes place via radio signals. The collection centre of the data was installed in the hall of the building. The service contract was signed besides the delivery contract and the service of calculating the heating expenses is also used.

The whole system with the total cost of 176,480 kroons was delivered and installed by MESA Eesti OÜ.

5.9 Electrical power system
The big and rusty compartment of the electrical board that „decorated“ the front of the building, has been replaced with a modern compartment which contains the electric-supply meter for the whole building.

Picture 8. Paldiski Road 171 front view after the reconstruction

Picture 9. Paldiski Road 171 rear view after the reconstruction
6. Financing the Reconstruction Project

6.1 The Cost of the Reconstruction Project

The total cost of the project together with the project manager, planning and reconstructing was 6.3 million kroons (403,000 euros), which is 2,006 kroons (128 euros) per square metre of residential area. Investment of this size is extremely high in comparison to the usual investments in the maintenance works of apartment buildings. The investment of this size was carried out with the help of the grants by the European Union and the Republic of Estonia in the total amount of 1.5 million kroons (96,000 euros) or 484 kroons (31 euros) per square metre of a residential area.

Table 5. The cost of the reconstruction project

<table>
<thead>
<tr>
<th>Cost of the project</th>
<th>EEK</th>
<th>EURO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager/building supervision</td>
<td>120,000</td>
<td>7,669</td>
</tr>
<tr>
<td>Planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof and ventilation</td>
<td>27,140</td>
<td>1,735</td>
</tr>
<tr>
<td>Heating system</td>
<td>35,400</td>
<td>2,262</td>
</tr>
<tr>
<td>Reconstruction of the front</td>
<td>30,680</td>
<td>1,961</td>
</tr>
<tr>
<td>Renovation works</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof</td>
<td>818,714</td>
<td>52,325</td>
</tr>
<tr>
<td>Windows</td>
<td>730,132</td>
<td>46,664</td>
</tr>
<tr>
<td>Balconies and loggias</td>
<td>1,688,735</td>
<td>107,930</td>
</tr>
<tr>
<td>Front</td>
<td>1,870,807</td>
<td>119,566</td>
</tr>
<tr>
<td>Heating system</td>
<td>808,040</td>
<td>51,643</td>
</tr>
<tr>
<td>The system of individual calculation of heating expenses</td>
<td>176,480</td>
<td>11,279</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,306,128</strong></td>
<td><strong>403,035</strong></td>
</tr>
</tbody>
</table>

6.2 Financing the project

The payment of the repair fund for the apartment owners was raised on 01.07.2005 from 4.60 kroons to 9.90 kroons per square metre a month, to prove to the bank and to oneself that the association is capable of fixing the building with the help of a bank loan. As a result the number of arrears did not increase, the payment discipline even improved – in September 2006 the debt of the apartment owners to the association was ca 14 000 kroon, which had been stable during the last year. Negotiations with the Hansapank lasted for four-five months, while the bank was monitoring the payment discipline of the association and confirmed that the association was solvent. That was also proved by the continuously growing balance of account – as from September 15th, 2006 there were 320,000 kroons on the association’s bank account.

On August 8th 2006 a loan agreement was signed with Hansapank for the total amount of 3.2 million kroons. The loan was taken for 15 years, the first five years on fixed interest 6.937% per year, during the rest of the period the interest is EURIBOR+3% per year.
Contracts for construction services that were signed as a result of building competitions it turned out that the association is short of one million kroons to finance all the works. The apartment owners were not convinced that all the planned works were necessary and that it would be sensible to make such a large investment into the apartment building. The managing board of the association organized a general meeting on May 31st, 2007 to explain the idea of the whole project, carrying it out and financing it. The project manager and the representatives of KredEx also took part in it. The project manager explained the content of the reconstruction works and technical solutions; KredEx gave an overview of the BEEN project, the grant for reconstructing an apartment building within its framework and the terms of the grant. The feedback on the above-mentioned meeting was positive and changed the attitudes of the apartment, concerning the reconstruction works (see the annex of the report).

For the purpose of complex reconstructions of the apartment it was decided at the general meeting on July 16th, 2007 to take an additional loan of 1 million kroons, which meant that beginning from July 1st, 2008 the payment of the repair fund would be raised by the consumer price index or at least by 50 cents. On 17.08.2007 an additional loan agreement was signed with Hansapank for the amount of 1 million kroons for 14 years, the first five years on fixed interest 7.536%, further 5 months EURIBOR + 3%. The repayment amount of the loan of the apartment building is 39,590 kroons per month or 12.60 kroons per square metre, which is paid out of the payments of repair fund (9.90 kr/m²) and the repayments of the loans that was given to some apartments to replace the windows/doors.

In addition to its own funds, the association took into account also the grants by the BEEN project 1.017 million kroons) and by the Republic of Estonia (507,000 kroons). The grant by the BEEN project was paid to the association on December 20th, 2007 (see table 6).

**Table 6. Financing the reconstruction project**

<table>
<thead>
<tr>
<th>Financing the project</th>
<th>EEK</th>
<th>Euro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own funds</td>
<td>581,993</td>
<td>37,196</td>
</tr>
<tr>
<td>Loan from Hansapank</td>
<td>4,200,000</td>
<td>268,429</td>
</tr>
<tr>
<td>Grant of the BEEN project</td>
<td>1,017,135</td>
<td>65,007</td>
</tr>
<tr>
<td>Grant of the Republic of Estonia</td>
<td>507,000</td>
<td>32,403</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,306,128</td>
<td>403,035</td>
</tr>
</tbody>
</table>
7. **The Result of the Reconstruction project**

As a result of the reconstruction project, the apartment building has a modern look, it is well insulated and has a heating system with individual calculation of heating expenses, where the estimated 40% energy saving can be expected. The general payment burden of the residents (housing expenses) increased, but thanks to the energy saving the residents will be able to fulfil their obligations.

The first heating period after the reconstruction works is not over yet and so it is not possible to say how big energy efficiency was actually achieved, but the heating cost in November and December, 2007 constitutes 71% of the heating costs in November and December, 2006. At the same time the room temperatures of the fifth floor steadied in comparison with the temperatures in the apartments on lower floors. An overview of the heat consumption of the apartment building is given in the table 7; an overview of the changes in heating expenses is given in figure 1.

**Table 7. The data of consumption costs of the apartment building**

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured heat consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>incl. hot water MWh/year</td>
<td>652</td>
<td>580</td>
<td>561</td>
<td>453</td>
</tr>
<tr>
<td>Heat tariff EEK/MWh</td>
<td>430.91</td>
<td>430.91</td>
<td>445.35</td>
<td>533.48</td>
</tr>
<tr>
<td>Heating expenses EEK/year</td>
<td>240,448</td>
<td>249,927</td>
<td>249,841</td>
<td>241,666</td>
</tr>
</tbody>
</table>

Opinions of the residents concerning the results of the renovation are mainly positive, especially those concerning the aesthetics, living comfort (warm rooms) and expenses that correspond to the increase in living standards. The apartment owners appreciate highly the changes in the outer look of their building and the significantly improved heating system: adjustability according to the individual needs; it is hoped that the new system would be efficient and economical. Considering all the changes that were rated positively, it is presumed that also the market value of the apartments has increased. This understanding has not increased the residents’ housing mobility.

The housing conditions of the residents have improved considerably – it is beautiful, clean, warm and safe.

Generally positive assessments to the results of renovation allow to presume that the residential identity of the people would extend to the wider level and would form a solid basis to the formation of sustainable individual and collective housing strategies.
Figure 1. Paldiski Road 171 heating expenses
8. **Obligations of the Association at the End of the Project**

Within the framework of the BEEN project the EKHHL compiled the Good Practice Guide of the Maintenance of the Immovable and the association is obligated to follow it for at least 10 years after the performance of reconstruction works.

Also the association is obligated to present quarterly data about the costs of consumed services to KredEx for at least 5 years beginning with the year 2006.

In addition, the association shall grant access to KredEx or to persons authorized by it to see the building and perform the inspection of the condition of the construction.
9. **Summary**

BEEN or Baltic Energy Efficiency Network for the building stock project occurred within the framework of the European Union programme INTERREG IIIB. The duration of the project was 2.5 years. There were 6 partners involved from Estonia: KredEx, TTÜ, EKÜL, EKHHL, MKM and Tallinna LV.

The aim of the best practice project of a complex refurbishing of an apartment building carried out in Estonia was to gain maximum energy efficiency. Also a movie-clip was ordered to cover the completion of the project, which can be used in the future as an introductory educational material. The clip is in Estonian, Russian and English.

This report gives an overview of the carrying out of the BEEN model project in Estonia, familiarizing the doings of Estonian partners of BEEN, the reconstruction works and their financing. In addition to the report, there is an annex, containing the results of a contentment survey that was carried out among the residents „Changes in the residential environment: Buildings and Residents”.

As a result of the reconstruction project, the apartment building has a modern look, it is well insulated and has a heating system with individual calculation of heating expenses, where the estimated 40% energy saving can be expected. The general payment burden of the residents (housing expenses) increased, but thanks to the energy saving the residents will be able to fulfil their obligations.

The first heating period after the reconstruction works is not over yet and so it is not possible to say how big energy efficiency was actually achieved, but the heating cost in November and December, 2007 constitutes 71% of the heating costs in November and December, 2006. At the same time the room temperatures of the fifth floor steadied in comparison with the temperatures in the apartments on lower floors.

Opinions of the residents concerning the results of the renovation are mainly positive, especially those concerning the aesthetics, living comfort (warm rooms) and expenses that correspond to the increase in living standards. The apartment owners appreciate highly the changes in the outer look of their building and the significantly improved heating system: adjustability according to the individual needs; it is hoped that the new system would be efficient and economical. Considering all the changes that were rated positively, it is presumed that also the market value of the apartments has increased. This understanding has not increased the residents’ housing mobility.

The housing conditions of the residents have improved considerably – it is beautiful, clean, warm and safe. We hope that it would be a good role model for others to fix their apartment building.

Generally positive assessments to the results of renovation allow to presume that the residential identity of the people would extend to the wider level and would form a solid basis to the formation of sustainable individual and collective housing strategies.

Using this example, it would be possible to refer in the future to a specific apartment building and the energy efficiency that resulted from the refurbishing, which in turn affects significantly the monthly costs of the residents, mostly reducing the heating expenses.
Annex: Resident’s involvement and behaviour with the BPP– case study at Paldiski 171.