SBi 2010:46

Paldiski Road

CREDIT Case EE01

Danish Building Research Institute
AALBORG UNIVERSITY

CREDIT©

Construction and Real Estate -
Developing Indicators for Transparency

Paldiski Road

CREDIT Case EE01

Roode Liias, Tallinn University of Technology

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1918
TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY

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Contents

Preface

This report describes the results of a case study undertaken as part of the Nordic/Baltic project *CREDIT: Construction and Real Estate – Developing Indicators for Transparency*. The case study is part of the work in work package 4-6 with respect to project assessment tools, application in firms and national benchmarking systems.

CREDIT includes the most prominent research institutes within benchmarking and performance indicators in construction and real estate, namely SBi/AAU (Denmark), VTT (Finland), Lund University (Sweden) and SINTEF (Norway). Further, three associated partners have joined CREDIT. The three associated partners are the Icelandic Center for Innovation (Iceland), Tallinn University of Technology (Estonia) and Vilnius Gediminas Technical University (Lithuania).

The project has been managed by a steering committee consisting of the following persons:
- Kim Haugbølle, SBi/AAU (project owner).
- Niels Haldor Bertelsen, SBi/AAU (project coordinator).
- Pekka Huovila, VTT.
- Päivi Hietanen, Senate Properties.
- Ole Jørgen Karud, SINTEF.
- Magnus Hvam, SKANSKA.
- Bengt Hansson, Lund University.
- Kristian Widén, Lund University.

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Danish Building Research Institute, Aalborg University
Department of Construction and Health
August 2010

Niels-Jørgen Aagaard
Research director

Summary

Buildings (WP4) summary

The current case-study describes the reconstruction project of a multi-storey apartment building carried out in Tallinn. This is a 5-storey apartment building built in 1977. There are 60 flats there and during the societal transition period – in the 1990ies – the flats where privatised to the sitting tenants. Therefore now the multi-flat building is in shared ownership and is managed by the Home Owners' Association founded in 2001.
In 2006 the cost estimates were done as for the feasibility of complex reconstruction of this building. During 2006-2007 the works were carried out targeted to increase the energy efficiency.

Technical data of the building:

Function of the building:	Apartment building
Year of building:	1977
Number of apartments:	60
Number of residents:	ca 180
Cellar (yes/no, heated/not heated):	yes, not heated
Number of floors:	5
Area under the building, m^2	ca 800
Area of the roof, m^2	ca 750
General area, m^2	3870.2
Heated area, m^2	3035.1
Living area, m^2	3143.9
Cubic capacity of the building, m^3	12160
Inner heated cubic capacity of the building, m^3	8407.9
Height/width/length of the building, m	15.1 x 12.88 x 62.12

Enterprises (WP5) summary

The buildings of this type have been designed by Eesti Projekt and built by Tallinna Majaehituskombinaat (Tallinn House-building Plant). By today these companies do not exist any more.
Tallinna Majaehituskombinaat was established in 1965 and it was one of the major highly industrialised house building companies until the end of 80ies. The production efficiency in these times was greatly compromised through reducing the quality level.

National benchmarking (WP6) summary

The majority of dwellings in Estonia have low energy performance level. It is the common knowledge that in Estonia dwellings use two to three times more energy than the Nordic countries even though the average temperature is higher.
Currently the whole construction and property sector is targeted to increase energy efficiency. Therefore all the national benchmarking is targeted to improve the energy performance of the buildings.

1. Introduction and objectives

1.1 Objectives and work packages of CREDIT

Sir Winston Churchill once said, “We shape our buildings, afterwards our buildings shape us” (28th Oct 1943). This quotation underlines how strong a building can influence an occupier or a user. Providing complex public facilities for example hospitals, schools, universities and libraries that are able to meet both the internal and external stakeholders’ needs and requirements is not without complications. The aims and demands of different stakeholders within a project can sometimes create conflict with each other’s interest. Understanding the needs and requirements of these stakeholders are essential to remain competitive in today’s market. A client that pays attention to the needs of the end-users will be rewarded with a high-performance property. Simultaneously, this shift seeks to solve many ills associated with inadequate building conditions and resulting in poor building function.

Due to the amount of both public and private money being invested in delivering public and private facilities, strong actions must be adopted. Collaboration with the relevant stakeholders will help building owners in identifying the required performance indicators to create high-performance facilities. The project aims to define a model for the implementation of performance requirements, which ensure the fulfilment of the various types of users’ and stakeholders’ needs and demands. The model shall also allow for the continuous measuring of the effectiveness of the used requirements and the model as such so that it may be improved as more knowledge and experience of it is achieved.

Following the themes of the ERABUILD call closely, the aim of CREDIT is to improve transparency on value creation in real estate and construction. Thus, the objectives of CREDIT are:

– To capture end user needs and requirements in order to identify and quantify – where possible – value creation in real estate and construction.
– To develop compliance assessment and verification methods.
– To define and develop benchmarking methods and building performance indicators in real estate and construction.
– To set out recommendations for benchmarking internationally key building performance indicators.

Consequently, the deliverables of CREDIT are:

– 1. The establishment of a network of Nordic and Baltic researchers for benchmarking and performance indicators through frequent interactions in workshops across the Nordic and Baltic countries.
– 2. A State-of-the-Art report, that will identify and critically examine a number of existing tools, databases, mandatory reporting, approaches and benchmarking schemes to capture and measure end-user needs, client and public requirements on performance and value creation.
– 3. A strategic management and decision making tool to guide the definition and development of benchmarking methods and building performance indicators in different business cases.
– 4. A comprehensive performance assessment and management tool with associated key performance indicators to capture end-user requirements and to continuously measure and verify the compliance of performance

throughout the lifecycle of an actual building project and linked to building information models.
– 5. Recommendations as to how sectoral and/or national indexes for performance indicators can be designed in order to allow for international benchmarking of construction and real estate.
– 6. Dissemination of the lessons learned and tools developed through news articles, press releases, workshops with actors in the real estate and construction cluster etc.

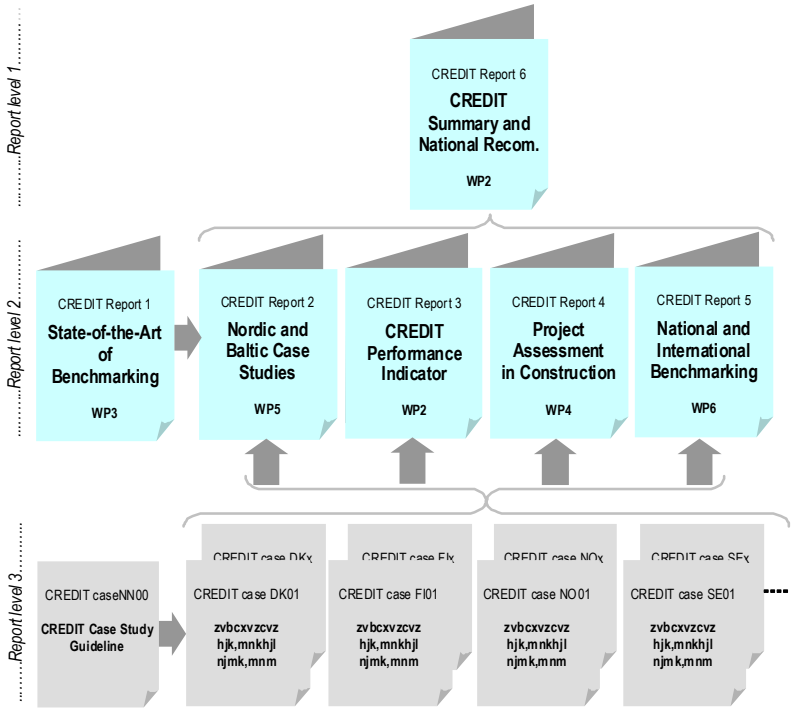
1.2 Background, purpose and focus of the case study

This case describes details from complex refurbishment project in Tallinn Estonia. The main interest in the project has been to reduce heating energy consumption.
The case shows the possibilities, bottlenecks and outcomes of this refurbishment. There is also the follow-up information available about the outcomes.

1.3 Research design and methods applied in the case study

The pilot project of energy efficient refurbishing was carried out during 2006-2007.
It has been 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 (www.kredex.ee), Tallinn University of Technology (www.ttu.ee), Estonian Association of Co-operative Housing (www.ekyl.ee), Association of Estonian Facilities Administrators and Maintainers (www.ekhhl.ee), Tallinn City Government (www.tallinn.ee), Ministry of Economic Affairs and Communication (www.mkm.ee) and the German partners of the BEEN (www.been-online.net).

Figure 1: Graphical illustration of the hierarchy of the CREDIT reports.



2. Buildings – assessments in construction or real estate processes

2.1 The actual building, building parts and processes

The case is based on the results of complex refurbishing of an apartment building carried out in Tallinn to gain maximum energy efficiency, which in turn affects significantly the monthly costs of the residents. The apartment building at Paldiski Road 171 was built in 1977 as a pre-cast unit construction by Tallinna Majaehituskombinaat (Tallinn House-building Plant). Flat-roofed 5-storey building with four stairways is situated in Õismäe, one of the major estates for large scale housing.

Figure 2: Façade of the apartment block pre and after reconstruction

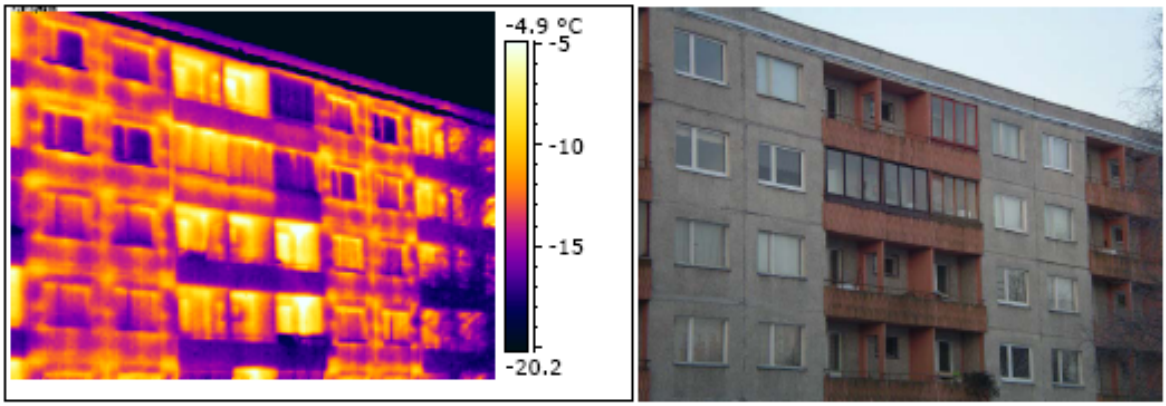


Figure 2: Thermal picture of the front of the building before reconstruction.

Figure 3: Balconies under construction.

Figure 4: Balconies before renovation and after.

2.2 The applied assessment methods and tools in the processes

In Paldiski road, 60 apartment owners formed the Home Owners' Association in 2001 and that institution as a legal entity has managed the building since 2002. Due to 25 years of use, that is about half of its expected lifetime when designed, the owners of the flats decided to refurbish the building in order to lengthen the lifecycle, lower the maintenance costs and raise the quality of life. By today the reconstruction works have been finished, but maintenance related data and energy consumption data are still carefully

monitored and analysed. Further, surveys of resident satisfaction have been carried out.

2.3 Cost and performance indicators applied in the assessments

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 system for monitoring the heating expenses. This all is done to check the target – can the estimated 40% energy saving gained. The general payment burden of the residents (housing expenses) has increased, but thanks to the energy saving the residents will be able to fulfil their obligations.
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 perform economically. Considering all the changes that were rated positively, it is presumed that also the market value of the apartments has increased.
There has been the active monitoring scheme introduced to check the changes in energy performance of the building. The energy-data performed the following table are adjusted with degree-days to make the data fully comparable.

Consumption of heating energy	**2005**	**2006**	**2007**	**2008**
Heating consumption, MWh	**392**	**452**	**352**	**228**
Price per unit in Estonian kroon	**169 082**	**200 758**	**187 925**	**212 305**
Costs per m^2 per month in kroon	**4,48**	**5,32**	**4,98**	**5,63**
Average costs per flat in month in kroon	**234,84**	**278,83**	**261,01**	**294,87**

Consumption of energy for heating has been reduced in 2008 compared to 2005 about 42 per cents, but the costs for heating have been increased about 25 per cents due to dramatic increase of price for the energy.
But in any case it can be stated that when having will to act jointly and exercise reasonable competence energy consumption can be reduced up to 40-50 per cents easily, but only when implementing complex measures for reconstruction.

2.4 Relation to different enterprises and national benchmarking

According to current statistics on, there are about 640 thousand dwelling units in Estonia, mostly in private ownership. About 70 per cents of these units are located in different types of blocks of flats. The national housing stock of Estonia consists of dwellings inherited from different eras; the largest of which as for influence has been the Soviet era.

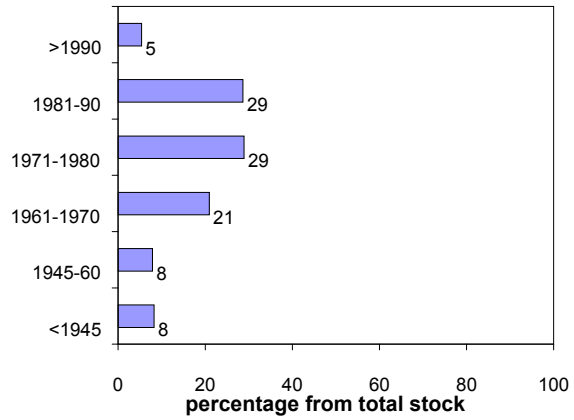


Figure 6: Structure of Estonian housing stock.

Though the publicly built housing stock of this period was developed according to strict rules and standards, the works were performed and maintained on low level of quality.

2.5 Visions and innovation for future improvements

Using the current case-study as an example, it is possible to refer in the future to this specific apartment building and to the energy efficiency level that resulted from the reconstruction. This in turn affects significantly the monthly costs of the residents, especially reducing the monthly heating expenses.
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.
In the future it has to be studied from the time consuming process of negotiating between the apartment owners in the building as consensus for the favour of carrying out the works had to be gained. Anyhow the house will become as the sample case to promote different associations for complex renovation.

3. Enterprises – assessments and indicators internally applied

3.1 The actual enterprise, company and firm

Tallinna Majaehituskombinaat (Tallinn House-building Plant) is the history by today. The Plant was founded in 1965 and the major aim of the plant was to provide quickly and cheaply housing for the residents in Tallinn. The buildings were standardised to 5, 9 and 16 storey ones. In the 60ies up to 80ies these quite well-known sub-districts as Mustamäe, Õismäe and Lasnamäe, but also several some smaller ones were developed.
The all-Soviet-Union programme for housing the households was targeted – to provide elementary housing conditions for the residents and to give the privacy. Though Tallinna Majaehituskombinaat was amongst the most advanced ones in the former USSR the pre-fabricated elements had reasonable tolerance from 20 up to 60 mm; sometimes even more. The company was closed down at the end of 80ies when the technology became fully updated and there was no more need for the buildings of this type.

3.2 Assessment methods and tools applied in the enterprise

When initiated and run Tallinna Majaehituskombinaat followed the traditional Soviet-era schemes for performance – quickly and constant reduction of production costs.
Both of these targets had their negative outcome – increasing the speed of production rather often ends up to not following the proper technology with the relevant consequences. There was also the constant pressure to reduce input of resources at least for 2 percents per year. This goal could have open up the gateway for innovation, but in the general shortage of materials and limited variety of them this did not happen, rather the consumption of materials was reduced physically consequently reducing the quality of production and assembling the elements on the sites.

3.3 Costs and performance indicators applied in the enterprise

In the current situation we have to look rather on the building and the home-owners' association founded there as the enterprise – this is the institution responsible for its own existence, but they have incentive to change the building to have better economic performance.

The apartment owners of Paldiski 171 formed the Home Owners' Association (hereafter association) in 2001 and the association has managed the building since 2002. This association is based on condominium ownership; the exact regulation of acting is available in national legislation. Earlier the building was managed by Haabersti Linnaosa Valitsus (Haabersti City District Government). As the building has been in use for 25 years or at least for half of its expected life-time, the management of the association proposed the members to discuss about possible reconstruction schemes of the build-

ing. Discussion about reconstruction was started where the major target was to refurbish the building in order to lengthen the life-cycle, but also to reduce the maintenance costs and raise the quality of life. The decision was done to carry out reconstruction.

As the first step, the management board of the association ordered an expert examination of the roof in 2003, examination of the building's structures 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 structures of the apartment building stated that by obstructing the corrosion of reinforcement bars of outer railings, the carrying capacity may persist only until the year 2017 or slightly longer. Sooner or later there may occur spot collapses of mainly balcony and loggia structures 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 for 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 Estonian kroons. It means that it takes expenses in the amount of 1,273 kroons per square metre of a residential area or on the average 67 thousand kroons per apartment. The managing board of the association found that this kind of an additional financial burden will be too much for most of the households, 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 6^{th} floor and finance the reconstruction works of the building out of the profit gained from selling the new apartments in the property market.

In May 2006 OÜ EKE NORA drew up the forecast of the anticipated full reconstruction costs for the building at Paldiski Road 171 – 12 million kroons (total costs 3,811 kr/m^2). 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 reconstruction of the building. These calculations were based on the design approach of works carried out on different single houses done so far. The prices for construction works in the market have gone up considerably in a short period of time.

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 about 50% of the heating energy.

The forecast resulting from the energy audit about the envelope structures

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

Forecast resulting from the energy audit: heating system

Proceeding	Heat saving kWh/m^2	Saving MWh/year
To replace one-pipe heating system with two-pipe-system and to perform the hydraulic balancing of the heating system	20	61
To divide the heating system into service regions with different type load	6	18
Insulating the heating pipes and valves in the rooms that are not heated	8	24
TOTAL	**34**	**103**

The thermal inspection showed that an intensive outflow of heat is taking place through the thermal bridges in the corners of the wall panels, and simultaneously also the condensation of humidity can be followed. As a result, the intensive corrosion of structural irons has started in the places where welded seams keep the panels together. In the region of thermal bridges on the inner sides of the walls the temperature is sometimes even below zero.

3.4 Relation to building cases and benchmarking organisations

There is no any clearly defined benchmarking organisation there in Estonia. There is Ehitisregister (Registrar for Buildings), but the data collected in it is not complete, there are reasonable gaps there and the data is not performance based, rather structure and space based.

Eesti Korteriühistute Liit (Estonian Association of Co-operative Housing) when organising training for the managers of single Home Owners' Associations and when publishing the monthly Elamu (Dwelling) gives the possibility for wider forum to discuss about the performance indicators for apartment buildings.

To make the data comparable there are several National Standards (Eesti Vabariigi Standard – EVS) to be followed. The most complex of them is EVS 807:2004 Kinnisvara korrashoiu tegevused (Facilities maintenance activities). This standard will have its updated version from January 2010.

3.5 Visions and innovation for future improvements

For more than a decade after the massive privatisation of flats in apartment buildings the formed Home Owners' Associations have initiated reconstruction projects of different scale. There have been the funding limits from the banks, but also from the households. The projects have been mainly of limited scale to tackle especially with the issues on emergency or purely targeted to increase the aesthetic outlook ob the building.

The most frequently initiated projects have been related to reconstruction of ceilings and heating systems, also changing the windows and improving the entrances. Rather often the envelope structures (walls) have been partly insulated. Still hardly one can find projects where works are carried out in full complex – single works done during different times give certain performance for the owners of the flats in the block, but this is not sufficient to advocate about reasonable feasibility-level in long-term.

The current project can be used as a sample case-study for all the other similar Associations when planning and executing the works of this scale. The energy-performance data may become also certain national sample to be followed by the others.

4. National benchmarking – indicators, assessment and organisation

4.1 The actual benchmarking organisation and it's purpose

On the national level in Estonia the most advanced scheme for benchmarking is based on assessing energy efficiency. As the energy prices have been increased dramatically and will continue to increase so there is the most direct incentive for any owner of the property to reduce costs for energy, primarily costs for heating. Similar is the incentive for the users – high energy costs will become reasonable burden for them and create the preconditions to influence these parties in the construction and property sector, who in fact are responsible for improvements of the housing facilities.

The national Energy-efficiency Act has been adopted and the Efficiency sign has been introduced to assess the energy consumption in any of the buildings. The relevant amendments have been done in the national Construction Act.

ENERGIAMÄRGIS

Hoone kategooria: ELAMUD **Hoone kasutamise otstarve:** Muu kolme või enama korteriga elamu **Soojusvarustus:** kaugküte **Energiaallikas:** soe vesi **Tellija:** KÜ Energiamärgise 5 **Aadress:** Tallinn, Energiamärgise tänav 5, 11232	**Ehitusaasta:** 1988 **Ehitisregistri kood:** 109021215 **Köetav pind, m²:** 2441
Energiamärgis on koostatud: Tellijalt saadud andmete alusel	

Kaalutud energiaerikasutus (KEK)	Vähe kulutav	Klass:
KEK≤100	A	
101≤KEK≤120	B	
121≤KEK≤150	C	
151≤KEK≤200	D	D
201≤KEK≤250	E	
251≤KEK≤300	F	
KEK≥301	G	
	Palju kulutav	

Kaalutud energiaerikasutus *, kWh/(m²·a):			193
Väljastamise kuupäev:	27.05.2009	**Kehtib kuni:**	26.05.2019
Märgise väljastaja:			
Ettevõte või FIE: EM Energiamärgis OÜ		**Reg nr:**	11592206
Vastutav spetsialist:		**Allkiri:**	

* arvutatud energiamuundamisseadmetesse sisse antava energiakoguse ja kaalumisteguri järgi

4.2 Assessment applied in the benchmarking organisation

The objectives for the Estonian housing sector for the years 2008-2013 are:

- to create access to housing for all inhabitants of Estonia
- to improve high quality, energy efficient and sustainable housing stock
- to ensure diversified residential areas developing in a balanced and sustainable manner

Clearly, when introducing any schemes for benchmarking in the sector the KPI should depict listed above aim and sub-aims.

The main objectives as for the dwelling stock arise from the need to extend the life-time of the existing dwellings. For this primarily, by not allowing the apartment buildings to fall into disrepair because of poor maintenance and repairs, to increase the energy efficiency of dwellings, to improve the quality of the living environment, to raise residents' awareness about housing maintenance and to broaden the financing possibilities of social target groups for housing.

Following the above presented statement one will see the necessity of compiling a list of criteria that will depict the current status and the changes that will take place during the agreed time-lag.

Sustainable development (as defined in the national housing sector related documents) is a concept for development that meets the needs and aspirations of the present generation without compromising the ability of future generations to meet their own needs. In Estonia the following elements comprise sustainable development:

- enhanced quality of life, to be achieved through preserving the Estonian cultural space
- significantly increasing coherence of the society
- maintaining ecological balance

The main problem areas for the housing sector

Housing is not accessible to every resident in Estonia. Problems related to accessibility of housing have become more topical year-by-year. They concern mostly new households with lower incomes about to enter the housing market. Less competitive groups also face difficulties in accessing housing in the market due to lower income. Purchase prices and rents on the private housing market are not affordable for the majority of such persons and the public sector offers only a very limited number of dwellings.

Limited number of apartments adapted for person with special needs. Almost one-third of the disabled require adapted accommodation units for independent coping. Given that disabled persons often belong to lower income groups they need public sector support for the modification of their dwellings.

Deterioration and decreasing quality of the housing stock. Residential construction volumes of the past decade are considerably lower than the average in 1950-1989 and the houses built half a century ago are gradually reaching the end of their life-time, as prescribed by the applicable standards. Although, there is no direct danger of falling into disrepair the apartment buildings still are in need of reconstruction. Any delay in commencing reconstruction will allow the situation to deteriorate further and result in higher costs in the future.

High energy costs of housing stock. The issue of energy conservation of the housing stock has come to the limelight with the transposition of the EU directive on the energy performance of buildings. The average energy consumption per square meter is higher in Estonian residential buildings in comparison with the other EU member states (in Estonia ca 250 kWh/m^2; in Finland and Sweden this number is below 150 kWh/m^2).

Inefficient planning of built environment. Estonia is currently lacking a comprehensive and established plan on how to combine the technical, social, environmental and economic aspects when designing the living environment and urban space. This has led to chaotic development and has not always been the most efficient.

Problems with awareness among the residents. The majority of management and maintenance tasks have been placed on the owners of the buildings but they are lacking the required knowledge and professional skills to carry out such tasks. As a result decisions are taken that may not be the best ones for improving the residential buildings and ensuring its sustainability; often materials of poor quality and workers with no professional skills are used.

4.3 Cost and performance indicators applied in benchmarking

Given the problems of the Estonian housing sector and in line with the mission and vision of the housing policy the objectives and measures are the following ones.

ACCESSIBILITY OF HOUSING
Objective: To make housing accessible to every resident in Estonia
Measures:
1. Improving access to dwellings
2. Improving possibilities for acquisition of housing
3. Improving housing conditions
4. Ensuring compensation of housing costs to persons with coping difficulties
5. Improving the legal environment and increasing administrative capacity

HOUSING STOCK
Description of the current situation
Objective: To achieve high quality and sustainable housing stock
Measures:
1. Increasing the quality and energy efficiency of the housing stock
2. Increasing awareness to improve the housing stock
3. Mapping the condition of the housing stock
4. Improving the legal environment and increasing administrative capacity

LIVING ENVIRONMENT
Description of the current situation
Objective: to ensure diversity, and balanced and sustainable development of residential areas
Measures:
1. Improving the quality of the living environment
2. Tidying up apartment building areas
3. Developing urban areas
4. Valuing milieu valuable residential areas
5. Shaping a secure living environment
6. Improving the legal environment and increasing administrative capacity

Though, Estonia is relatively well stocked with housing as regards the number, but its quality and energy consumption leaves to be desired in comparison with the more developed EU member states. Dwellings in Estonia are smaller, older and in some cases have poorer standard amenities and the share of apartments is dominating, compared to the share of detached (single family) houses. In addition to depreciation of the structures and technical systems of the buildings the supporting infrastructure and utility systems are rapidly becoming obsolete.

National objective is to achieve high quality and sustainable housing stock. The following benchmarks have been set up on the national level.

Criteria/measure	result
The average expected life-time of the housing stock (especially as to the apartment buildings) has increased by	30%
The share of apartment buildings falling into the highest energy efficiency category will be	10%
The number of apartment buildings renovated with the help of renovation support	8 000 (increase)
The share of residential buildings that have undergone energy audits, implemented the recommended measures and reduced their energy consumption	20%
Technical condition of the different types of apartment buildings has been mapped nationally	95%
The percentage of expert analyses conducted in the apartment buildings of the target group	50%
The percentage of energy audits conducted in apartment buildings	30%

4.4 Relation to enterprises, building project and real estate

The listed above KPIs are for national level, but may be used also for municipal level assessments. Currently there are more than 9000 Home Owners' Associations founded in Estonia. Though not all of them are active and have initiated any reconstruction projects it can be still expected that reasonable number of them will be involved in the national campaign to improve energy efficiency at least 30, but also possibly 40 percentages.

4.5 Visions and innovations for future improvements

The energy efficiency level based motivation system is currently mainly based on voluntary drivers, rather than compulsory. Though energy efficiency is the national priority, considerable improvements here require reasonable investments from the owners of the dwellings, e.g. households.

5. Discussions and conclusions

5.1 Buildings - lessons learned and recommendations

The current case study is presented about a multi-flat apartment building assembled of concrete slabs slightly more than 30 years ago. This is the case that can be a sample for the majority of homes in Estonia – about 70 percentages of Estonian households are inhabited in different types of blocks of flats. Massive building of apartment buildings started at the end of the 50ies; therefore the oldest of them are reaching their service time of 50 years.

The case of Paldiski road 171 can be declared as an example for several other Home Owners' Associations as for technical solutions and as for possible conflicts when joint decision-making by the owners of the flats is required.

5.2 Enterprises - lessons learned and recommendations

Massive flat-by-flat privatisation of housing stock has created the society of condominiums – nearly in each block of flats where the flats have been privatised the owners may have found a condominium, which is the legal entity targeted to manage and maintain the building. Condominiums have become small property management enterprises where the managers are mostly acting on voluntary bases and too often having no experience in the field.
Initiating the renovation programme for the block at 171 Paldiski Road has been a complicated process primarily for the split of attitudes between residents/flat owners and unusual management practice. The latter is characterised by relative weakness of the board and a controversial mix of autocratic and responsible leadership style of the chairman.
Only stable national support schemes for assisting the initiatives by condominiums and households are required to carry out the actions for improving the energy efficiency of the blocks.

5.3 National benchmarking - lessons learned and recommendations

Quality of buildings and business activities are always driven by different objective and subjective drivers – the owners of the buildings may like their property (incl. dwellings) to be more prestigious and attractive to have certain tangible preferences in the market place. At the same time the drivers may be related also to ambitions of certain individuals or group of people to show their role and advanced competence.

For the national housing sector it is rather questionable to introduce a compulsory system of KPI-s for the accommodation units. All the improvements that will be needed to keep up the buildings to meet the current standards (e.g. benchmarking system set goals) require reasonable investments to be done by the responsible individuals, in our case by the common households.

Introducing the energy-label system may become a reasonable driving force in the society when principles of voluntary acceptance will be balanced by the public interest and pressure.

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Construction and Real Estate -
Developing Indicators for Transparency

This report represents the finding and results from the first Finnish case study (FI01) called Tulli Business Park. Work belongs to Nordic project Construction and Real Estate – Developing Indicators for Transparency (CREDIT), that represents a sectional view to case studies from varied building types in Nordic and Baltic countries: offices, housing, schools and nursery, shopping centres and hospitals. The work has been undertaken by the most prominent research institutes within benchmarking and performance indicators in construction and real estate, namely SBi (Denmark), VTT (Finland), SINTEF (Norway) and Lund University (Sweden), and partners from Icelandic Center for Innovation (V), Tallinn University of Technology (Estonia) and Vilnius Gediminas Technical University (Lithuania).

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SINTEF VTT LUND UNIVERSITY SBi Danish Building Research Institute AALBORG UNIVERSITY