D 4.1 Implementation of models of coordination

(Bulgarian Housing Association)

October 2012

PART I PILOT PROJECT TECHNICAL DESCRIPTION

1. Description of the pilot building

- General characteristics of the pilot buildings

Pilot	Pilot 1	Pilot 2	Pilot 3
Location	**Aleko Konstantinov Street 2** Building site XV in estate148 according to Sofia urban plan	**Asen Zlatarov Street 11** Building site XIII in estate 559 according to Sofia urban plan	**Tchataldja Street 54** Building site IX in estate 738 according to Sofia urban plan
Building general characteristics	Year of construction – 1950 Condominium apartment building consisting of four floor, each with three apartments and an attic area, partially used for living purposes – 16 dwellings	Year of construction – 1932 Condominium apartment building consisting of four living floors, each with three apartments, ground floor with one apartment and an attic area – 13 dwellings	Year of construction – 1954 Condominium apartment building consisting of two living floors, each with six apartments, ground floor with five apartments and an attic area with two apartments – 19 dwellings
Construction characteristics	Steel-concrete bearing structure of columns and floor plates, brick walls, pitched roof of wooden structure covered with ceramic tiles	Steel-concrete bearing structure of columns and floor plates, brick walls, pitched roof of wooden structure covered with ceramic tiles	Steel-concrete bearing structure of columns and floor plates, brick walls, pitched roof of wooden structure covered with ceramic tiles

- General construction characteristics of the pilot buildings

Pilot	**Built up area m^2**	**Total built up area m^2**	**Heated area m^2**	**Gross heated volume m^2**	**Net heated volume m^2**
Pilot building1	290	1 160	928	3 336	2 670
Pilot building2	254	1 275	1 120	3 770	3 020
Pilot building3	492	1 550	1 240	4 315	3 450

Pilot 1 Aleko Konstantinov Street 2 (renovation accomplished in November 2011)

Pilot 2 Assen Zlatarov Street 11 (renovation accomplished November 2011)

Pilot 3 Tchataldja Street 54 (renovation accomplished in November 2011)

- Energy initial situation

Description of the external walls of the pilot buildings

External walls of the pilot building are monolithic – from ceramic hard bricks with total thickness of 25 cm. The internal lime plaster is 2 cm thick. The external lime-cement plaster is 3 cm thick. The value U = 1.80 W/m^{2}K.

Description of heat resistance of windows and doors of the pilot buildings

Doors and windows of the pilots are from three types:

<u>Type 1</u> – PVC windows with double glazing **U value =2.63 W/m^{2}K**, <u>Type 2</u> – wooden double framed ordinary glazed windows **U value=2.32 W/m^{2}K**, <u>Type 3</u> – steel framed windows with 1/3 ordinary glazing **U value =6.66 W/m^{2}K**.

Description of the floor type above non-heated areas

Floors above non-heated areas are with 1) parquet, 2) cement levelling layer and 3) steel-concrete slab. The value U = 1.10 W/m^{2}K.

Description of the roof

The roof of the buildings is pitched with 4 parts, consisting of wooden frames with wooden coverage and finishing layer of ceramic tiles. The roof is above non-heated area. The value U = 0.84 W/m^{2}K.

Heating system

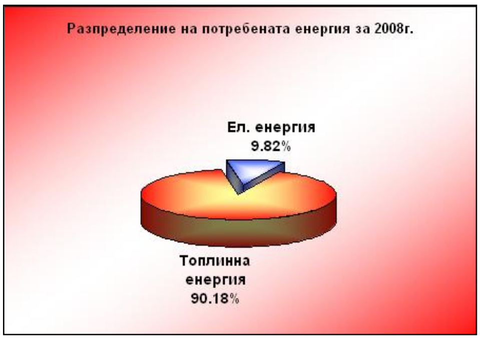
The heating of pilot buildings is from district heating hot water type with water temperature 140°/70°C. There is a heat exchanger located in the basement of each of the buildings.

Heating exchanger

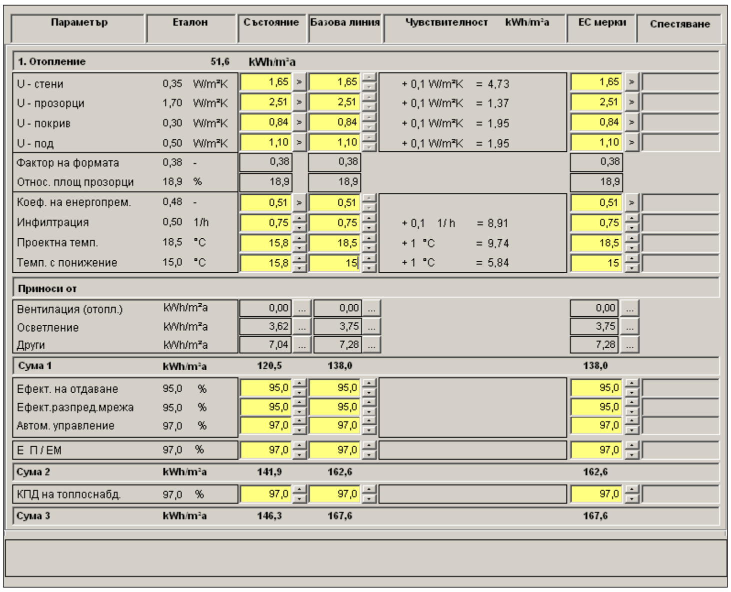
Heat exchangers are of indirect type, installed in 2007 and correspond to current requirements of the district heating company.

The power of the heat exchangers is of 200 kW for heating and 100kW for domestic hot water = Heat exchangers are equipped with heat meter and controlling devices including internal and external air temperature meters. Hot water is delivered with the help of circulation pump.

Analysis of energy consumption



Electrical energy (9.82%)
Heating energy (90.18%)



Параметър	Еталон		Състояние	Базова линия	Чувствителност kWh/m^{2}a	ЕС мерки	Спестяване
1. Отопление	**51,6**	**kWh/m^{2}a**					
U - стени	0,35	W/m^{2}K	1,65	1,65	+ 0,1 W/m^{2}K = 4,73	1,65	
U - прозорци	1,70	W/m^{2}K	2,51	2,51	+ 0,1 W/m^{2}K = 1,37	2,51	
U - покрив	0,30	W/m^{2}K	0,84	0,84	+ 0,1 W/m^{2}K = 1,95	0,84	
U - под	0,50	W/m^{2}K	1,10	1,10	+ 0,1 W/m^{2}K = 1,95	1,10	
Фактор на формата	0,38	-	0,38	0,38		0,38	
Относ. площ прозорци	18,9	%	18,9	18,9		18,9	
Коеф. на енергопрем.	0,48	-	0,51	0,51		0,51	
Инфилтрация	0,50	1/h	0,75	0,75	+ 0,1 1/ h = 8,91	0,75	
Проектна темп.	18,5	°C	15,8	18,5	+ 1 °C = 9,74	18,5	
Темп. с понижение	15,0	°C	15,8	15	+ 1 °C = 5,84	15	
Приноси от							
Вентилация (отопл.)		kWh/m^{2}a	0,00	0,00		0,00	
Осветление		kWh/m^{2}a	3,62	3,75		3,75	
Други		kWh/m^{2}a	7,04	7,28		7,28	
Сума 1		**kWh/m^{2}a**	**120,5**	**138,0**		**138,0**	
Ефект. на отдаване	95,0	%	95,0	95,0		95,0	
Ефект.разпред.мрежа	95,0	%	95,0	95,0		95,0	
Автом. управление	97,0	%	97,0	97,0		97,0	
Е П / ЕМ	97,0	%	97,0	97,0		97,0	
Сума 2		**kWh/m^{2}a**	**141,9**	**162,6**		**162,6**	
КПД на топлоснабд.	97,0	%	97,0	97,0		97,0	
Сума 3		**kWh/m^{2}a**	**146,3**	**167,6**		**167,6**	

The annual energy consumption for heating of the existing buildings is 167.6 kWh/m^{2}a while the norm is 51.6 kWh/m^{2}a. The results showed that the normalised consumption of heating energy is 3.25 bigger than the benchmark. The total annual average current energy consumption of the pilot buildings for heating domestic hot water, lighting, ventilation, etc., is 260kWh/m^2 while the norm is 95.4 kWh/m^2.

2. Description of the refurbishment project

- Description of general works

Complete refurbishment of the building envelope and the common areas (staircases, building installations, heat exchanger, etc.).

- Description of energy works

SHELTER renovation project includes the execution of energy efficient renovation measures such as insulation of the building envelope, improvement of the common parts and installation of RES (solar collectors). Building inspections and energy audits are executed prior to the energy efficient renovation works. The preliminary energy audits estimate that solar collectors will produce 50% of the needed hot water. The real data, however, will be available at a later stage when monitoring data will be collected and processed.

Types of energy works performed in SHELTER pilot buildings						
Type of insulation element	Reference values of **U** [W/m^2K][1] according **Ordinance 7-2009**	**U** values [W/m^2K] according methodology **Ordinance 7-2009**	Used materials to achieve energy saving measures in accordance with **previous pilot projects**	**U** values [W/m^2K] in accordance with **previous pilot projects**	Achieved **U** values [W/m^2K] in accordance with **SHELTER project design**	Used materials to achieve energy saving measures in accordance with **SHELTER project design**
External wall	0.35	0.335	**8cm** EPS c λ = 0.034 W/mK	0.35	0.335	**8cm** EPS c λ = 0.034 W/mK
Ground surface above non-heated underground floor	0.50	0.49	**6cm** hard mineral wool plates impregnated with organic resin with λ = 0.038 W/mK	0.30	0.27	**12cm** hard mineral wool plates impregnated with organic resin with λ = 0.038 W/mK
Ground surface of heated space bordering external air, ground surface bordering passages or other open spaces or flat roof without aerial layer	0.28	0.30 0.32 0.30 0.32	- under the slab **8cm** XPS c λ = 0.030 W/mK - above the slab **8cm** hard mineral wool plates impregnated with organic resin with λ = 0.038 W/mK or - above the slab **8cm** XPS with λ = 0.030 W/mK; - under the slab **8cm** hard mineral wool plates impregnated with organic resin with λ = 0.038 W/mK	0.30	0.30 0.27 0.30 0.27	- under the slab **8cm** XPS c λ = 0.030 W/mK - above the slab **12cm** hard mineral wool plates impregnated with organic resin with λ = 0.038 W/mK or - above the slab **8cm** XPS with λ = 0.030 W/mK; - under the slab **12cm** hard mineral wool plates impregnated with organic resin with λ = 0.038 W/mK
Attic floor slab of non-heated, ventilated or non ventilated pitched roof with or without vertical external elements of the under roof space	0.30	0.28	On the attic floor slab above the last heated floor **10cm** roll mineral wool with λ = 0.040W/mK between wooden frame covered with OSB plates	0.30	0.28	On the attic floor slab above the last heated floor **10cm** roll mineral wool with λ = 0.040W/mK between wooden frame covered with OSB plates
External windows and glazed doors with PVC frame	1.7	1.7	Five cavity PVC profile with low emission glazing	1.60	1.60	Five cavity PVC profile with low emission glazing

[1] This is the value of the thermal conductivity (λ) of the expanded polystyrene that was applied to the external walls during renovation

The decrease in the energy consumption for heating is achieved by:

- → Decrease of thermal transmittance (U value) coefficient of the external walls;
- → Decrease of thermal transmittance (U value) coefficient of the roof;
- → Decrease of thermal transmittance (U value) coefficient of the building ground slab;
- → Decrease of thermal transmittance (U value) coefficient and the infiltration of the windows and the doors.

The technical design of the energy efficient renovation includes installation of solar collectors supplied with water boilers, heat exchanger, expanding vessel, circulation pumps and hydro-module for automatic management of temperature sensors. The technical design of solar thermal installation is coordinated with the utility provider for heating and hot water at district level. The technology used is a Bivalent solar installation (solar energy + district heating) for domestic hot water. According to the preliminary estimations the energy produced by the solar collectors will be at a level of 50%. However, further monitoring data will give information about the real share.

- **Energy performance objectives**

Pilot 1 Aleko Konstantinov Street 2

The value of the integrated energy characteristic – total specific energy consumption for heating, hot water, lighting and others is 195.9kWh/m^2 while the norm value for this type of building in the year 2005 is 82.6kWh/m^2 and the norm value in the year 1964 is 193.1kWh/m^2 . The building is **Class E** in accordance with Ordinance № РД-16-296 for the energy characteristics of buildings 193.1kWh/m^2 < 195.9kWh/m^2 ≤ 241.375kWh/m^2.

The energy consumption of the building for heating after the execution of the designed energy saving measures will decrease up to 37.4kWh/m^{2}y which means that in case designed measures are properly executed the annual energy consumption of the building for heating will be smaller than the norm value of 32.8 kWh/m^{2}y. The total annual energy consumption which includes all components of the energy balance of the building will decrease up to 83.9 kWh/m^{2}y which is smaller than the norm value of 85.7 kWh/m^{2}y.

№	ESM	Name of the energy saving measure	Saving		Necessary investment	Repayment period	Reduced CO_2 emissions
			kWh/year	EUR/year	EUR	years	t/year
1.	A1	Insulation external walls	50 075	3 620.42	24 012	6.6	13.61
2.	A2	Roof insulation	5 906	427.00	8 100	19.0	1.60
3.	A3	Ground slab insulation	10 414	752.93	9 900	13.1	2.83
4.	A4	Replacement of existing wooden window frames and metal external door frames	29 020	2 098.15	17 640	8.4	7.88
5.	B1	Installation of water saving equipment	14 083	1 018.20	1 440	1.4	3.83
		Total:	109 498	7 916.71	61 092	7.7	29.75

Pilot 2 Assen Zlatarov Street 11

The value of the integrated energy characteristic – total specific energy consumption for heating, hot water, lighting and others is 193.9kWh/m^2 while the norm value for this type of building in the year 2005 is 85.7kWh/m^2 and the norm value in the year 1964 is 194.8kWh/m^2 . The building is **Class D** in accordance with Ordinance № РД-16-296 for the energy characteristics of buildings 139.35kWh/m^2 < 193.9kWh/m^2 ≤194.8kWh/m^2.

The energy consumption of the building for heating after the execution of the designed energy saving measures will decrease up to 37.4kWh/m^{2}y which means that in case designed measures are properly executed the annual energy consumption of the building for heating will be smaller than the norm value of 32.8 kWh/m^{2}y. The total annual energy consumption which includes all components of the energy balance of the building will decrease up to 83.9 kWh/m^{2}y which is smaller than the norm value of 85.7 kWh/m^{2}y.

№	ESM	Name of the energy saving measure	Saving		Necessary investment	Repayment period	Reduced CO_2 emissions
			kWh/year	EUR/year	EUR	years	t/year
1.	A1	Insulation external walls	75 868	5 668,10	41 220	7.3	20.61
2.	A2	Roof insulation	6 214	464.25	9 900	21.30	1.69
3.	A3	Ground slab insulation	9 121	681.43	5 940	8.7	2.48
4.	A4	Replacement of existing wooden window frames and metal external door frames	34 478	2 575.85	19 740	7.7	9.37
5.	B1	Installation of water saving equipment	6 245	466.56	1 350	2.9	1.70
		Total:	131 926	9 856.20	78 150	7.9	35.84

Pilot 3 Tchataldja Street 54

The value of the integrated energy characteristic – total specific energy consumption for heating, hot water, lighting and others is 191.2kWh/m^2 while the norm value for this type of building in the year 2005 is 80.6kWh/m^2 and the norm value in the year 1964 is 180.8kWh/m^2 . The building is **Class E** in accordance with Ordinance № РД-16-296 for the energy characteristics of buildings 180.8kWh/m^2 < 191.2kWh/m^2 ≤ 226kWh/m^2.

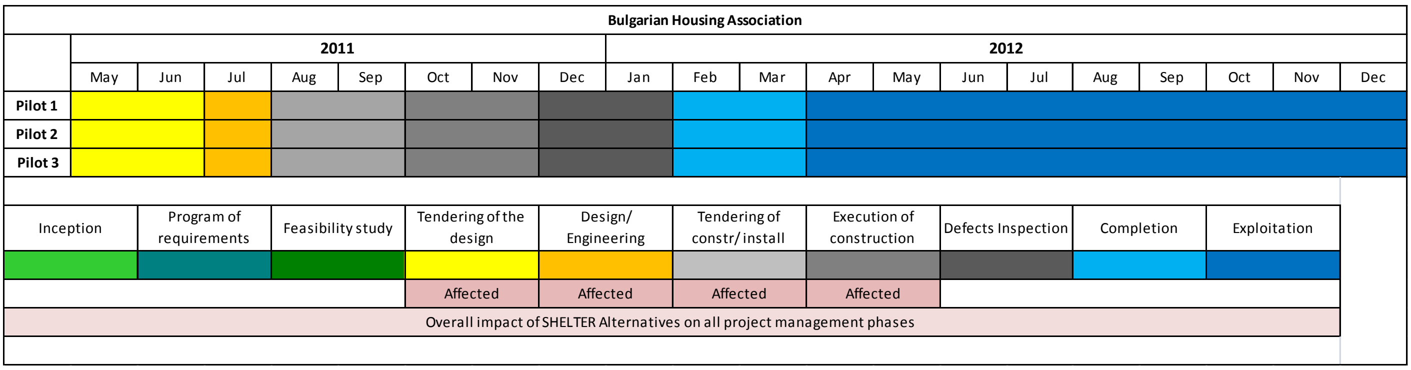
The energy consumption of the building for heating after the execution of the designed energy saving measures will decrease up to 31.3kWh/m^{2}y which means that in case designed measures are properly executed the annual energy consumption of the building for heating will be smaller than the norm value of 32.8 kWh/m^{2}y. The total annual energy consumption which includes all components of the energy balance of the building will decrease up to 79.1 kWh/m^{2}y which is smaller than the norm value of 80.6 kWh/m^{2}y.

№	ESM	Name of the energy saving measure	Saving		Necessary investment	Repayment period	Reduced CO_2 emissions
			kWh/year	EUR/year	EUR	years	t/year
1.	A1	Insulation external walls	56 569	4 089.94	26 325	6.4	15.37
2.	A2	Roof insulation	22 837	1 651.12	18 216	11	6.20
3.	A3	Ground slab insulation	10 134	732.69	10 638	14.5	2.75
4.	A4	Replacement of existing wooden window frames and metal external door frames	37 450	2 707.64	22 110	8.2	10.18
5.	B1	Installation of water saving equipment	16 596	1 200	1 710	1.4	3.96
		Total:	143 586	10 381.27	78 999	7.6	39.01

- **Tendering procedure**

Separate tenders for contacting of the construction works on the insulation of the building envelope and for installing the RES (solar collectors) on the roofs of the pilot buildings. The main reason to divide the project tendering phase into two sub-phases is the difference in the terms of the considerable subsidy component which is crucial for the affordability of the project financial scheme. The attention of professionals involved was focused on adjusting the different tendering requirements and thus, to support the efficiency of the project management model in terms of costs and timing. The main goal during the implementation of the pilots is to test a project management model for renovation of multi-story condominium housing which is based on a combination of subsidies from different national and EU sources.

- **Planning**



SHELTER project implementation in Bulgaria is going in accordance with the approved project progress timeline.

- **Project budget and part of the budget dedicated to energy efficiency measures**

Pilot name	Renovation cost (EUR)	Whole renovation cost per dwelling (EUR)	Energy renovation investment (EUR)	% of renovation dedicated to energy saving measures	Energy renovation investment per dwelling (EUR)	RES installation (EUR)
Pilot building1	61 092	3 818.25	61 092	100%	3 818.25	23 500
Pilot building2	78 150	6 011.54	78 150	100%	6 011.54	23 500
Pilot building3	78 999	4 157.84	78 999	100%	4 157.84	23 500

- **Financing scheme**

60% of the costs for the building design and the insulation of the building envelope were covered by a subsidy from the state budget. The remaining 40% were covered by the apartment owners. 80% of the costs for RES (solar collectors) were covered by EU FP6 Concerto program. The remaining 20% were covered by the apartment owners.

PART II IMPLEMENTATION OF THE ALTERNATIVES TO THE CURRENT COORDINATION MODEL

1. Reminder of main conclusions from TU Delft study and targeted problems that the pilot project will try to overcome

SHELTER project implementation in Bulgaria focused on tackling the targeted problems encountered in the conclusions from the energy renovation process overview prepared by TU Delft from TU Delft. The recommendations emphasized on the following main issues:

- Concerning the project organization – need for professional project management: search for funding, selection of contractors and architect, and supervision of the works;

In fact, BHA has put considerable efforts to elaborate and successfully implement an efficient and innovative project management model for subsidy based renovation of multi-story apartment buildings. SHELTER project implementation in Bulgaria let to the creation of a project management unit involving representatives of all stakeholders.

- Current renovation practice has in most part of the cases no design phase. The contractor is involved directly and develops standard solutions to the needs established in the program of requirements. Without design phase there is no room for alternatives.

SHELTER project implementation strongly emphasized on the design project phase and the involvement of professional designers for all parts of the project design. The task was even more complicated due to the installation of RES (solar collectors) in the three pilot buildings and the need to involve engineers specialized in designing of heating and ventilation building systems. In fact, the design phase was one of the most complex project phases with serious impact on contracting, construction and maintenance/ exploitation phases.

- Current renovation practice is characterized by the lack of knowledge and experience in contracting of construction works.

SHELTER project implementation developed and successfully implemented an extensive tendering project phase with two separate sub-phases related to the subsidy requirements involved. The tendering phase was fully in accordance with the public procurement rules. Serious efforts were put to overcome possible delays due to the heavy and time consuming administrative procedures.

- The involvement of homeowners and the influence of their behaviour

SHELTER project implementation strongly relied on the active involvement of tenant especially during the project preparation phase. Such pro-active involvement during the maintenance/ exploitation phase is subject of extensive preparation and special tool-kit for the homeowners and their associations is under preparation.

2. Analysis of the chosen alternatives (phase by phase)

The chosen three main alternatives are entirely compatible with the recommendations in the report WP3.1 Coordination of professionals Energy renovation process overview of SHELTER SHOs prepared by TU Delft.

Project management of subsidy based renovation pilots

The main goal during the implementation of this alternative in the operational applications is to test a project management model for renovation of multi-story condominium housing, which is based on a combination of subsidies from different national and EU sources.

The main result achieved is the clear understanding that a coordinating project management unit is needed especially in regard to:

- → The coordination in terms and time of targeted subsidies from different donors;
- → The coordination of subsidy requirements with the project management phasing and the technology requirements of renovation works;
- → The coordination with local authorities;
- → The involvement of residents as end users;

The achieved project management model is highly important because the co-subsidized renovation of multi-story condominium housing is in the current agenda of the central government through the National Housing Renovation Program to be launched in July 2012.

Contracting

The tendering project phase is considerably affected due to the fact that:

- → Each subsidy has specific donor requirements;
- → Different subsidy requirements need to be adjusted in order to avoid conflicting subsequences;
- → Each subsidy component requires specific tendering procedure. In the concrete pilots there were two tenders for the renovation of the building envelop and for the installation of RES on the building roof;
- → Important role of the coordinating project management unit during the tendering project phase as well as the public procurement procedure which was done in accordance to donors' requirements and the relevant Bulgarian legislation;

The achieved results clearly confirm the need of preliminary analysis of the compatibility of subsidies to be used. The operational implementation of alternative 2 additionally shows the crucial importance of the contracting project phase where the coordination between professionals is guaranteed by the coordinating project management unit.

Design decisions

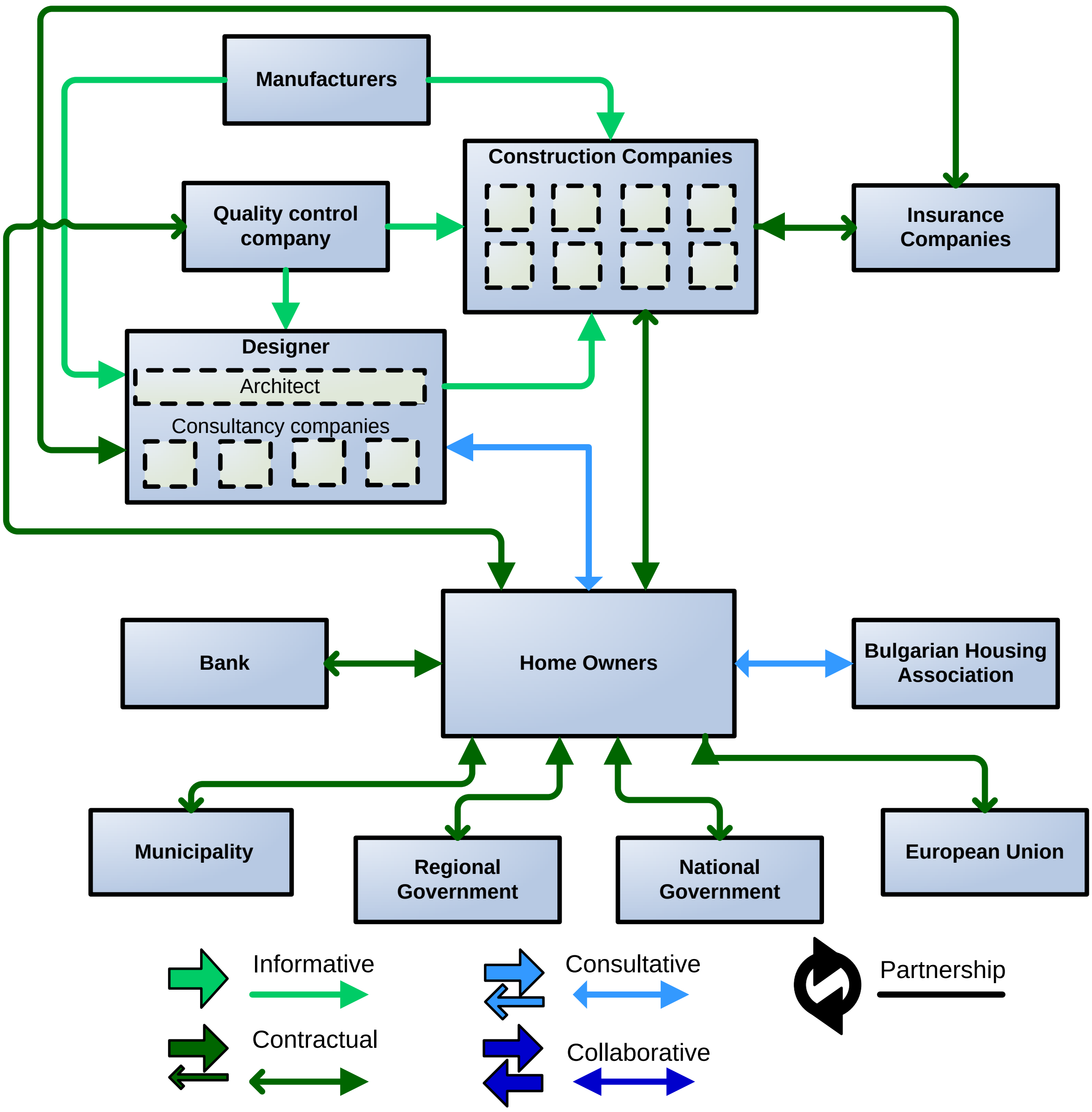
(Design engineering project phase affected)

The operational application of this planned alternative is guided by the provisions of the specific Bulgarian legislation namely the Urban Development Act. BHA contributed as part of the coordinating project management unit to enlarge the role of the technical designers in the design engineering project phase. Since the combination of two sources of subsidies is used it affected also the design phase due to the fact that each subsidy was followed by specific rules of utilization.

The construction phase was mainly affected by the necessary coordination of contractors' activities implemented by the two selected contractors. Such coordination was vital in order to efficiently optimize the sequence of building works and thus, to save time and money.

The maintenance/exploitation of the renovated buildings is related to the use of the extended heating systems which include newly incorporated RES (solar collectors). This differs very much from the maintenance and operation of the existing few examples of renovated condominium buildings. In addition, the maintenance and operation of the heating installations needs the cooperation between the HOA (homeowners association at building level) and Sofia District Heating Company.

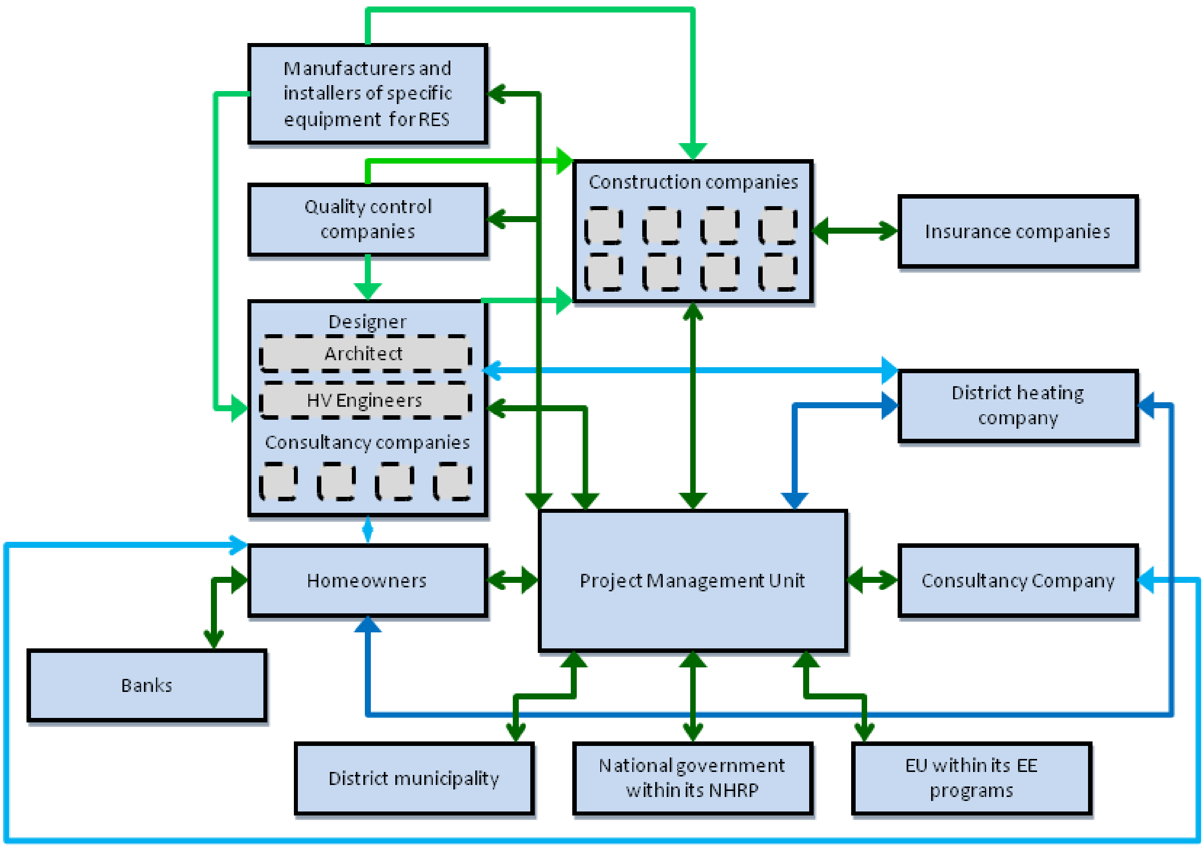
Project collaboration scheme of past renovation projects of multi-story apartment buildings



The implementation of SHELTER project in Bulgaria let to the development of a new project collaboration scheme. Following the recommendations made by the team of TU Delft in the report BHA Renovation process overview a Project Management Unit was created in order to professionally lead the overall project development process. The newly created Project Management Unit took the project lead instead of the Homeowners association and was formed by representatives of the donor program, district municipality, consultancy company and the homeowners. The Project Management Unit was entitled to guarantee the integrity of the project process phase by phases, to govern the

relations between the different actors in the energy renovation of condominiums, to provide the efficiency of the project development in terms of costs and timing.

Project collaboration scheme of SHELTER project implementation



The impact of the three chosen alternatives on the project phases can be summarized as follows:

→ The impact of Alternatives 1&2 implementation on the **Tendering and Contracting project phase** let to the introduction of the public procurement rules to their full extent.

→ The impact of Alternative 3 implementation on the **Design project phase** let to the fact that the project design is fully fledged and is based on the previously executed energy audit of the pilot building.

→ The impact of Alternative 1 implementation on the **Management project phase** let to the requirements of a coordination and collaboration between the homeowners and the district heating company.

3. Legal/technical expertise

In accordance to the current public procurement rules and regulations the legal department of Oborishte District Municipality was responsible for the preparation and the execution of the tendering and contracting procedures. In addition, external legal experts were involved by BHA in order to support the process.

PART III CONCLUSIONS

Large scale energy efficient renovation of existing condominium buildings in Bulgaria has been a complicated issue due to the tenure structure and long term lack of proper building management legislation. Therefore very few pilot projects were developed and the renovation activities in Bulgaria are lagging behind that in most EE countries. Thus a special attention must be drawn to investigate and optimize the operations chain related to housing refurbishment. Certain time perspective is needed however, in order to draw the specific conclusions from SHELTER project implementation especially regarding the energy savings and emissions as far as one year exploitation period is needed to measure the real energy consumption and to compare with the designed one.

1. Impact of the implementation of SHELTER alternatives

The impact of the successful implementation of the alternative SHELTER project management model can be summarized within its vital contributions on the following aspects of the energy efficient building renovation process:

- → The implementation of SHELTER alternative let to an increased energy efficient performance of the renovated buildings versus the previous pilot projects. The expected savings according to the preliminary energy audits account approximately 10% more compared to previous projects. This is mainly due to the extended energy efficiency program including the application of RES (solar collectors for domestic hot water) on the roof of the renovated buildings.
- → A higher cost effectiveness of the renovation is achieved in terms of better energy savings for the same cost for renovation which means better value for the investment. This is mainly due to the improved bidding procedure for the different type of construction works.
- → A better quality of the construction works is performed mainly due to the improved coordination between the different contractors.
- → A shorter construction period is achieved through the improved model for collaboration between the different stakeholders involved in the process.

2. Lessons learnt from the implementation of SHELTER alternatives

The elaborated and successfully tested project management model for subsidy based renovation of multi-story apartment buildings within SHELTER project is to be used in the newly launched National Housing Renovation Program of the Ministry for Regional Development and Public Works.

A. The lessons learnt from the implementation of SHELTER alternatives within the energetic renovation of the three pilot multi-story condominium buildings can be summarized as follows:

- → The coordination of all project related activities is time and resource consuming due to the large number of stakeholders involved, diverse sources of available financing and the unique and complex nature of the activity.

→ The possible multiplication and upscaling of the tested project management model will reduce the time and resources needed and thus, will increase the effectiveness in technical and financial terms.

→ The upscaling of the energetic renovation activities will not only increase the financial efficiency but will enable residents' involvement and satisfaction from the improvement of their homes and living environment.

B. The barriers encountered during the implementation of SHELTER alternatives can be summarized as follows:

→ Concerning the current legislation

The most difficult barrier to deal with during the implementation of SHELTER alternatives is the heavy, complicated and often ambiguous procedure for public procurement involving national subsidies and targeted EU funds. In the same time, the newly adopted Condominium Act needs further improvements especially in its part dedicated to incentivize the overall activity and the financial input on behalf of the homeowners' associations in condominium buildings to be renovated.

→ Concerning the financing of the energetic housing renovation in Bulgaria

Considerable barrier is the lack of available and sufficiently flexible models for financial engineering that are needed to create tailor made mixture of different sources of funds including subsidies to cover the renovation costs.

→ Concerning the training of professionals

There is still missing capacity of professionals with knowledge and experience in financial engineering and contracting of construction works financed by public funds including subsidies.

3. Possible improvements and future upscaling of SHELTER alternative

In order to apply and upscale the alternatives proposed under SHELTER project to a larger scale of the energetic renovation of existing condominium buildings in Bulgaria the government has to undertake the following major steps:

→ To establish the legal frame for the selection of national and regional Project Managers (project management units) that can guide, coordinate and channel the larger scale of renovation projects of condominium buildings in the respective regions of the country.

→ To elaborate a series of tools in order to guide and enable the upscaled housing renovation projects to a more integrated design approach assuring the quality of the works and influencing the energy efficient homeowners' behaviour.

These tools incorporate recommendations to promote the interaction between designers and constructors, a tool-kit for model work specifications and contracts with construction professionals, a list of recommended professionals/companies, average energy performance and technical layouts of typical condominium buildings and campaigns to influence the energy efficient homeowners behaviour.