Cost Efficient Options and Financing Mechanisms
for nearly Zero Energy Renovation
of existing Buildings Stock

DELIVERABLE 2.3

REPORT SUMMARIZING OBSTACLES, RISKS AND DIFFICULTIES FOR THE RENOVATION SCHEMES

Municipality of Alimos, Greece

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Co-funded by the Intelligent Energy Europe
Programme of the European Union

CERtuS Grant Agreement Number IEE/13/906/SI2.675068

DELIVERABLE SUMMARY SHEET

Deliverable Details		
Type of Document:	Deliverable	
Document Reference #:	D2.3	
Title:	Report summarizing the obstacles, risks and difficulties for the renovation schemes, Municipality of Alimos, Greece	
Version Number:	3.0	
Preparation Date:	February 27, 2015	
Delivery Date:	May 22, 2015	
Author(s):	Eva Athanassakos, Babis Nikopoulos, Evangelia Gklezakou - EUDITI LTD	
Contributors:	-	
Document Identifier:	CERtuS_D2.3 Municipality of Alimos, Greece	
Document Status:	Delivered	
Dissemination Level:	X	**PU** Public
		PP Restricted to other program participants
		RE Restricted to a group specified by the Consortium
		CO Confidential, only for member of the Consortium
Nature of Document:	Report	

Project Details	
Project Acronym:	CERtuS
Project Title:	Cost Efficient Options and Financing Mechanisms for nearly Zero Energy Renovation of existing Buildings Stock
Project Number:	IEE/13/906/SI2.675068
Call Identifier:	CIP-IEE-2013
Project Coordinator:	01. ENEA - Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile – Italy
Participating Partners:	1. ENEA – Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile – Italy 2. COMUNE MESSINA - Comune di Messina – Italy 3. ERRENTERIA – Errenteriako udala – Spain 4. CMC – camara municipal de coimbra – Portugal 5. ALIMOS – Dimos Alimou – Municipality of Alimos – Greece 6. ISR – Instituto de sistemas e robotica – Associacao – Portugal 7. SINLOC – Sistema Inizative Locali S.p.A.– Italy 8. ETVA VI PE – ETVA VI.PE. S.A. – Greece 9. TECNALIA – Fundacion Tecnalia Research & Innovation – Spain 10. EUDITI LTD – EuDiti – Energy and Environmental Design – Greece 11. INNOVA BIC – INNOVA BIC - Business Innovation Centre SRL – Italy 12. AAU SBi – Aalborg University – Denmark 13. AGESI – Associazione Imprese di Facility Management ed Energia – Italy
Funding Scheme:	Collaborative Project
Contract Start Date:	March 1, 2014
Duration:	24 Months
Project website address:	www.certus-project.eu

Deliverable D2.3: Short Description

Short Description: Presentation of the obstacles, risks and difficulties that have been found during the elaboration of the 12 renovation schemes done in WP2.
Keywords: obstacles, risk, difficulties, renovation, schemes

Deliverable D2.3: Revision History

Version:	Date:	Status:	Author:	Comments:
V0.1	14/01/2015	Draft	Pello Larrinaga	ToC
V2.0	27/02/2015	Final draft	Eva Athanassakos, Ch. Nikopoulos, Evangelia Gklezakou	Obstacles, risks and difficulties for the renovation schemes in Alimos Municipality
V2.1	22/04/2015	Final draft	Alessandra Gandini	Update and format. Sent to review committee
V2.2	05/05/2015	Final	Pedro Moura	1st Review
V2.3	08/05/2015	Final draft	Alberto Soraci	2nd Review
V3.0	12/05/2015	Final	Eva Athanassakos, Ch. Nikopoulos, Evangelia Gklezakou	Obstacles, risks and difficulties for the renovation schemes in Alimos Municipality Final version reviewed

Statement of originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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ABBREVIATIONS AND ACRONYMS

Acronym	Definition
AHU	Air Handled Unit
BEMS	Building Energy Management System
COP	Coefficient of performance
EPBD	European Performance Buildings Directive
HVAC	Heating Ventilation Air Conditioning
ICT	Information and Communication Technology
nZEB	Nearly Zero Energy Building
PUR	Polyurethane
PV	Photovoltaic
RES	Renewable Energy Sources
VRV	Variable Refrigerant Volume

CERTUS PROJECT IN BRIEF

Southern European countries undergo a severe economic crisis. This hinders the compliance to the latest Energy Efficiency Directive, demanding strict energy efficiency measures for the public sector. Investments required to renovate public buildings and achieve nearly zero energy consumption have long payback times. So the interest of financing entities and ESCOs is small, especially when banks have limited resources. Many of the municipal buildings in Southern Europe require deep renovations to become nZEB and this should not be regarded as a threat but rather as an opportunity for the energy service and the financing sector.

The objective of the proposed action is to help stakeholders gain confidence in such investments and initiate the growth of this energy service sector.

Municipalities, energy service companies and financing entities in Italy, Greece, Spain and Portugal are involved in this project. The plan is to produce representative deep renovation projects that will act as models for replication. Twelve buildings in four municipalities in each country have been selected. The partners will adapt existing energy service models and procedures and will work out financing schemes suitable for the 12 projects. Consequently, the partners will create materials, such as guides and maxi brochures, suitable to support an intensive communication plan.

The plan includes four workshops with B2B sessions targeted to municipalities, ESCOs and financing entities. These actions shall be complemented by four training activities targeting municipal employees and the participation in international events targeting all 3 stakeholders. We expect that our action will have a significant impact by triggering investments in renovations to achieve nZEB and the uptake of the ESCO market in Southern European member states.

Executive Summary

This deliverable is part of the work carried out in Work Package 2 "Technical and Economic Validation of the nZEB Renovation Schemes" and summaries the obstacles, risks and difficulties for the renovation schemes for each building addressed in the four Municipalities.

This document presents the obstacles, risks and difficulties for the renovation schemes in the Municipality of Alimos. The three buildings are presented, according to the following structure:

- Brief introduction to the building: main typological characteristics, location, use and energetic profile, etc.;
- Short presentation of the selected renovation scheme, including presentation of adopted measures;
- Technical difficulties envisaged for the implementation of the proposed solutions;
- Economic and/or financial risks to be considered;
- Legislative obstacles considered in the selection of the renovation schemes.

At the end of each Section, a summary of the actions is presented, as well as the main conclusions for the Municipality of Alimos.

The main technical difficulties arose due to the frequent changes on the interior spaces of the building. This problem is common in public buildings which house a large number of staff and services and for these reason the design of lighting and HVAC systems has to be flexible.

Also, the main economic/financing barrier in order to undertake energy performance improvements in public buildings is the lack of funds that municipalities face during the last years. For this reason subsidies by government or other sources for more innovative products and solutions are necessary. Finally, the main legislative obstacle is the lack of legislation regarding the definition of the nearly zero energy buildings (nZEB), but it is expected by the end of current year, 2015.

1. OBSTACLES, RISKS AND DIFFICULTIES FOR THE RENOVATION SCHEMES IN ALIMOS

1.1. CITY HALL

1.1.1. INTRODUCTION

The building (Figure 1) consists of 5 storeys and a basement. The first two levels and the basement were constructed in 1986 whilst the other 3 were added in 1996. The surface area and volume are presented in Table 1.

TABLE 1: SURFACE AREA AND VOLUME OF THE CITY HALL BUILDING

Total Area :	1286 m^2	Total volume:	4468.8 m^3
Heated surface:	1101 m^2	Heated volume:	3828.7 m^3
Air-conditioned surface:	1101 m^2	Air-conditioned volume:	3828.7 m^3
Average gross height of a typical floor:	3.4 m	Ground floor gross height :	3.55 m

FIGURE 1: ALIMOS CITY HALL – MAIN FAÇADE OF THE BUILDING (SOUTHWEST SIDE)

The building comprises the following areas:

- Ground floor: houses the reception desk and areas for servicing the citizens.

- Office floors 1-4: The interior is arranged as office areas. Meeting rooms are located in the third and fourth floors. The Mayor's office is located in the fourth floor where he also meets with citizens.
- Basement: houses the canteen and a stairwell room where the motor of the elevator is located.

Figure 2 presents the plan view of the building.

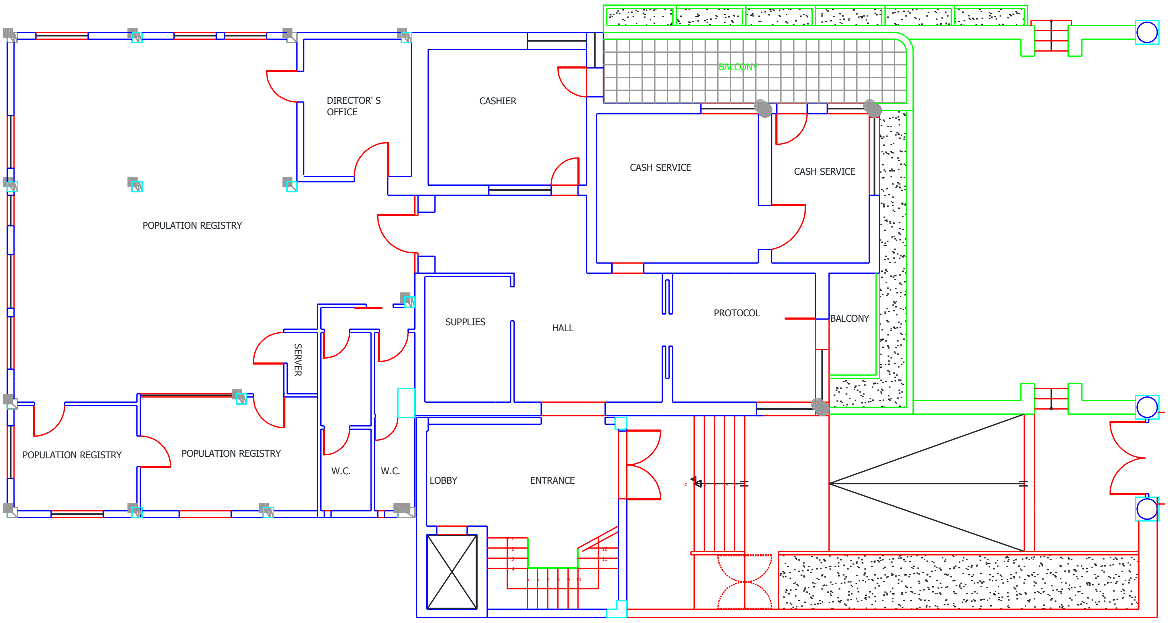

FIGURE 2: PLAN VIEW OF THE CITY HALL

The building operates the weekdays all year round with the following schedule:

- Offices: 7:00 – 15:00;
- Mayor's Office and secretary: 7:00 – 17:00.

The building construction is typical of the period and region. It consists of double brick walls and reinforced concrete for the load bearing structure. The walls are insulated with 4 cm of extruded polystyrene placed in between the two brick layers. The roof slab is insulated also with 4 cm extruded polystyrene while there is a mineral fibre suspended ceiling in the office space on each floor. In all working areas there are opening windows with double glazing in aluminium frame. Each floor is divided in two areas, namely the office space and the entrance hall separated with insulated walls as the latter is a non-heated area.

All energy needs of the building are covered by electricity and the annual consumption is shown in Table 2 and its breakdown in Figure 3.

TABLE 2: ANNUAL ELECTRICITY CONSUMPTION OF THE CITY HALL

Year	Total consumption (kWh)	Total cost (€)
Average	156.613	20.112,07

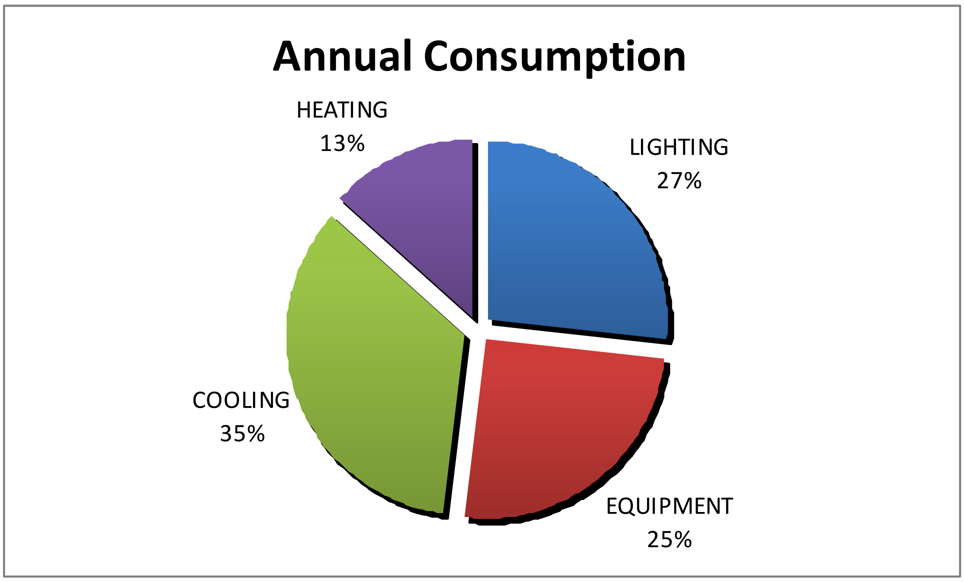

FIGURE 3: BREAKDOWN OF ANNUAL CONSUMPTION

The building has a modern architectural design and its constructional features are in line with the good practice standards of the time it was built. The south façade combined with the lay out of the internal space (as initially planned and constructed) enable the use of solar gains to reduce heating demand. However, both the current building standards and the technological improvements in building materials and equipment give rise to a substantial potential for improving energy efficiency and environmental performance.

1.1.2. Renovation Plan

In the renovation plan the following options were considered:

- Retrofit of the building's envelope;
  (i) Opaque Envelope: The envelope of the building is insulated according to the standards prevailing at the period of construction. According to the thermal insulation study of the building the current U-value of the external walls and roof is 0,526 and 0,451 W/m^{2}K, respectively. Following a sensitivity analysis based on the results from the Energy Plus simulations of the renovation design, it was concluded that the optimum choice is to add external insulation of 5 cm thickness for an insulation material with conductivity λ (k) = 0,036 W/mK. After this intervention the final U-value will be 0,272 W/m^{2}K for the external walls and 0,25 W/m^{2}K for the roof. These values are lower than the ones foreseen by the current Greek Regulation.
  (ii) Glazing: Also, the existing glazing and frames with total U-value of 3,49 W/m^{2}K will be replaced with low-e glazing and thermal break frame with total U-value 1,8 W/m^{2}K, 42% solar factor and high visible transmittance (VT).
  (iii) Shading: Finally, after doing shading analysis the best choice is to add external movable shades on the selected windows. These shades will be fully retractable in order not to affect the solar radiation penetration during winter.
- Retrofit of the lighting system;
  The existing lighting system consists mainly by ceiling lamp with T8 fluorescent of 18 W or 36 W. After doing lighting analysis, it was decided to take advantage of the available

daylight by adding daylight sensors on the upper three floors' lighting system and change the location of the luminaires. Also, all the current lamps will be replaced by LEDs.

- Retrofit of the Heating, Ventilation, Air Conditioning**,** HVAC, system;
  Currently, the heating and cooling of the building is provided by electricity. There are two types of air conditioning systems used: a) split systems b) floor standing units. These systems are quite old and not well-maintained, for this reason and, based on the instructions of the relevant regulation (KENAK), their performance is considered to be around 1,7, for heating and 1,5, for cooling. The proposed HVAC systems are VRV (Ceiling-Mounted Cassette) with COP of 4,05 and EER of 3,61.
- Night-time ventilation system;
  Fans will be integrated on the north side and suitable openings on the other elevations of the building in order to achieve cross ventilation on each floor. The fans will be connected with temperature sensors so as to operate only when the external temperature is lower than the internal. This system will be used for night ventilation to further reduce cooling energy consumption. Also it can operate during daytime if the external conditions are favourable.
- Passive solar gains ;
  Appropriate air circulation openings will be integrated on the partition walls separating the south and north spaces located on the second and third floor. This intervention will allow good distribution of the solar heat gains obtained through the south glazing.
- Energy management system;
  A Building Energy Management System (BEMS) will be integrated. The BEMS will control, monitor and record the required internal and external conditions and the energy consumption of all systems of the building. Simultaneously, it will control the HVAC and lighting systems for proper operation.
- Integration of renewable energy systems;
  In order a percentage of the final energy consumption to be covered by renewable energy systems several options were investigated. The optimum choice is the installation of PV (15,26 kWp) on the roof of the building.

1.1.3. Technical Difficulties

General

The selection of the energy efficiency measures was made based on the following two constraints:

- the architectural style of the building should remain as is;
- the implementation of the renovation design should be made without interrupting the services provided to the public or transferring the employees to another building. Partial transferring of both services and employees can be done within the building for a small period.

So the design should allow implementation under these two aforementioned conditions.

HVAC

Many difficulties arose in the renovation design of both the lighting and HVAC systems due to the frequent changes on the interior spaces of the building. This problem is common in public buildings which house a large number of staff and services. So the design of both HVAC and

lighting systems has to be flexible in order to facilitate internal partitioning according to changing needs.
The use of more environmentally friendly HVAC systems was investigated but VRV appeared to be the most suitable choice.

Renewable generation

The building being located in a densely built area offers limited opportunities in integrating renewable energy systems other than a small (app. 15 kWp) PV system. More specifically the following systems were investigated:

- the small scale wind turbines cannot be integrated because of the disturbance they cause on the neighbouring buildings and because of the reduced wind potential.
- a geothermal heat pump cannot be installed as the surrounding space of the building cannot accommodate the entrance of the drilling rig due to its size.
- solar heating and cooling is not a potential option due to the limited sunlit space available for such installation.

1.1.4. Economic/Financial Risks

This building hosts numerous services and employees but the current situation can change depending on the needs of the municipality. A potential increasing of the number of the services or the employees of the City Hall will increase the energy consumption and the payback period of the investment as well.

The required investment for simultaneous implementation of all the foreseen energy efficiency measures is quite large and, this presents a serious difficulty for the Municipality. So, in order for the Municipality to proceed with this renovation plan, inflow of capital from third parties is required.

1.1.5. Legislative Obstacles

There were not regulatory obstacles identified in the renovation design. However, as discussed above a major difficulty is the integration of renewable energy systems when the building is located in a densely built area. This is due to the lack of space availability, the reduced solar potential due to shadowing, the reduced wind potential etc. In Greece the legislation defining the levels of nZEB and the expected contribution of RES is under development. So, it is important the “nearby areas”, as indicated by the Energy Performance of Buildings Directive, EPBD, to be defined as flexibly as possible in order to facilitate the integration of RES and make nZEB levels achievable.

1.2. Municipal Library

1.2.1. Introduction

The building (Figure 4) was constructed in 1984. It is a five-storey building with a basement. The Municipality rents the first three storeys and the basement and houses the Municipal Library, offices, school activities and dancing courses. The rest of the building is residential.

The surface area and volume are presented in Table 3.

TABLE 3: SURFACE AREA AND VOLUME OF THE LIBRARY BUILDING

Total Area :	611 m^2	Total volume:	2185 m^3
Heated surface:	507 m^2	Heated volume:	1821 m^3
Air-conditioned surface:	507 m^2	Air-conditioned volume:	1821 m^3
Average gross height of a typical floor:	2,9 m	Ground floor gross height :	5,3 m

FIGURE 4: ALIMOS MUNICIPAL LIBRARY – MAIN FAÇADE OF THE BUILDING (SOUTHEAST SIDE)

The building construction is typical of the period and region. It consists of double brick walls and reinforced concrete for the load bearing structure. The walls are insulated with 5 cm of extruded polystyrene placed in between the two brick layers. The roof slab is insulated also with 8 cm extruded polystyrene while there is a mineral fibre suspended ceiling in the office space. In all working areas there are opening windows with double glazing in aluminium frame.

Figure 5 presents the plan view of the building.

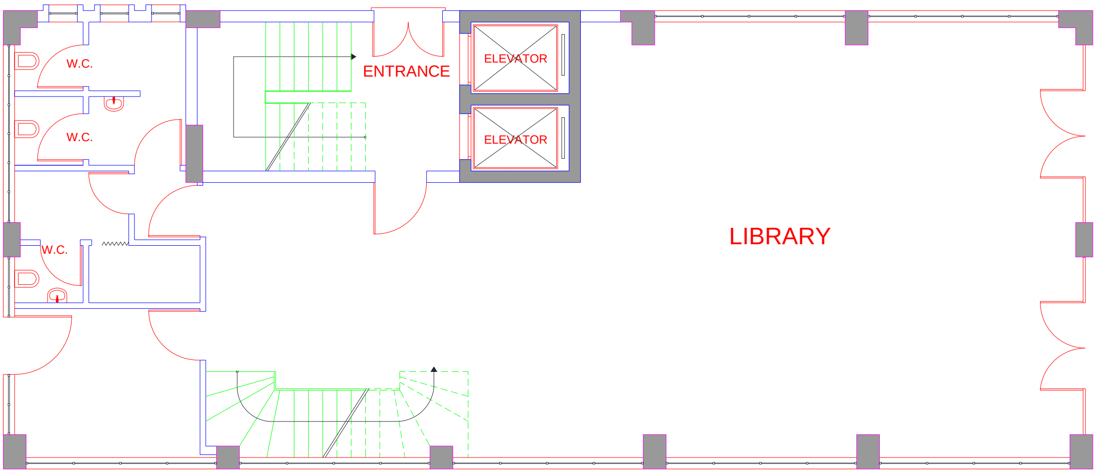

FIGURE 5: PLAN VIEW OF THE MUNICIPAL LIBRARY

The part of the building occupied by the municipality comprises the following uses:

- Ground floor: it houses the Library.
- First floor: the interior is arranged as area for gymnastics and school activities. Kids every day are visiting the place for creative activities such as reading, painting, dancing etc.
- Second floor: it houses offices and a meeting room.
- Basement: a second area for gymnastics is located in the southeast side of the basement. The northwest side is used as a warehouse.

The building operates on the weekdays with the following schedule:

- Offices - 7:00 – 15:00 all year round;
- All other activities - 7:00 – 15:00 & 17:00 – 20:00

During the summer, Christmas and spring holidays the areas housing the citizens' activities remain close in the afternoon.

All energy needs of the building are covered by electricity and the annual consumption is shown in Table 4 and its breakdown Figure 6.

TABLE 4. ANNUAL TOTAL ELECTRICITY CONSUMPTION OF THE MUNICIPAL LIBRARY

Year	Total consumption (kWh)	Total cost (€)
Average	42.136	7.584,48

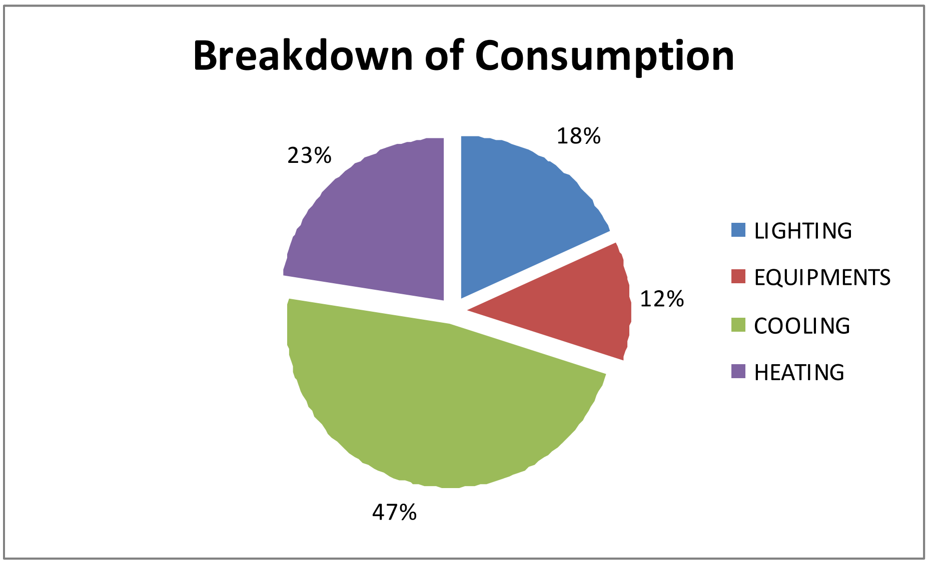

FIGURE 6: BREAKDOWN OF ANNUAL CONSUMPTION OF MUNICIPAL LIBRARY

1.2.2. Renovation Plan

- Retrofit of the building's envelope;
  The envelope of the building is insulated. According to the thermal insulation study of the building the current U-value of the external walls is 0,616 W/m^{2}K. The optimum choice is to add external insulation of 5 cm thickness with conductivity λ (k) 0,036 W/mK. After this intervention the final U-value will be 0,272 W/m^{2}K for the external walls and 0,34 W/m^{2}K for the roof.
  Also, the existing glazing and frames with U-value of 3,49 W/m^{2}K will be replaced with low-e glazing and thermal break frame with total U-value 1,8 W/m^{2}K, 42% solar factor and high visible transmittance.
- Retrofit of the lighting system;
  The existing lighting system consists mainly by ceiling lamp with T8 fluorescent lamps. Following the lighting analysis, it was decided to replace all current lamps with LEDs.
- Retrofit of the HVAC system;
  Currently, split unit air conditioning systems and floor standing units are used for heating and cooling the building. These systems are quite old and not well-maintained, for this reason and, based on the instructions of the relevant regulation (KENAK), their performance is considered to be around 1,7, for heating and 1,5, for cooling. The existing split units will be replaced with new more efficient [EER 3 – 4,4] and they will be used only for cooling. Regarding the heating of the building, there is central system with oil boiler which is currently out of use but it will be reactivated after the renovation. The optimum choice is the replacement of it with a pellet boiler.
- Add ventilation system;
  Fan assisted ventilation openings will be integrated on the North elevation on each floor. In order to achieve cross ventilation vent openings will be integrated on the other façades too. The fans will be connected with temperature sensors so as to operate only when the external temperature is lower than the internal. This system will be used for

night ventilation to further reduce cooling energy consumption. Also it can operate during daytime if the external conditions are favourable.

- Add energy management system;
  Power meters will be connected in each electrical board of all four floors in order to monitor and record the energy consumption of all systems of the building.
- Integration of renewable source systems;
  In order for a percentage of the energy consumption to be covered by renewable energy several options were investigated. Based on space availability and cost criteria, the selected option was the combination of a small PV (5,52 kWp) system for electricity generation and a pellet boiler for space heating.

1.2.3. Technical Difficulties

General

A major problem for the elaboration of the renovation plan was the difficulty to gather the required bills regarding the electricity consumption. These data are essential for the evaluation of the current situation and the energy savings resulting from the energy improvement of the building.

The implementation of the renovation design should be made without interrupting the services provided to the citizens or transferring the employees to another building. Partial transferring of both services and employees can be done within the building for a small period.

The main difficulty regarding the interventions of this building is that the Municipality rents only a part of it and the three upper floors are residences. For this reason it is not easy to make changes if not all the owners agree.

HVAC and lighting

Regarding the design, many difficulties arise due to the frequent changes on the use of the different spaces of the buildings. This problem is very common in public buildings which house a large amount of staff and services. So the lighting system and HVAC has to be as flexible as it gets in order to satisfy future needs.

PV

There is limitation on the size of the PV plant that can be installed on the roof because of the shading generated by the two chimneys and other structures on the roof. Also there is no unshaded space to install PVs elsewhere than the roof of the building.

1.2.4. Economic/Financial Risks

The fact that the municipality rents this building gives rise to risks as the relocation of the library might take place before the end of the payback period. However, this is considered a medium to low level risk.

The total cost of the energy consumption is low and this fact affects the final payback period of the investment which is quite long for certain interventions see Fig.7. This happens because the daily operation is short and the energy demand of the services/activities taking place in this building is modest.

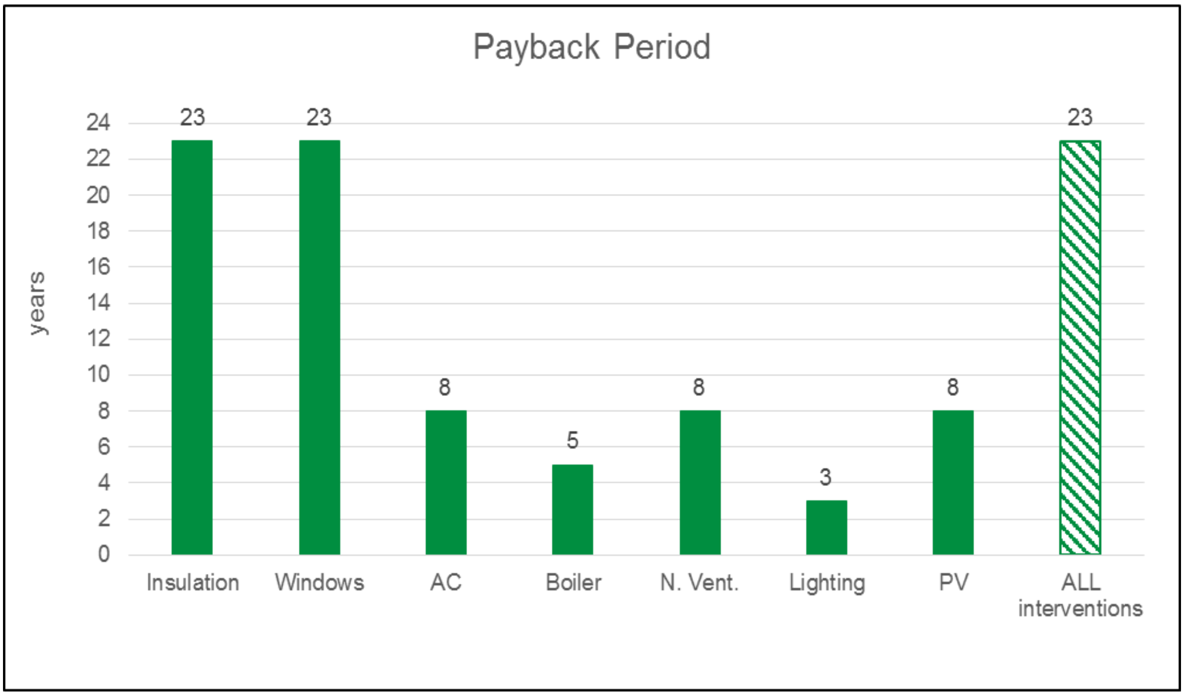

FIGURE 7: PAYBACK PERIOD FOR EACH INTERVENTION AND AS A TOTAL

1.2.5. Legislative Obstacles

In a building which has central heating system it is not always easy to abolish this system and/or replace it with more flexible ones. This obstacle appears when there are more than one owner and not all of them agree with this change. In this case the regulation regarding multi – owner buildings applies that requires either a unanimous vote or a majority vote. For this reason the most feasible choice is to improve the existing central heating system. Likewise, the installation of PVs on the roof has to be approved by all owners of the building.

1.3. Municipal Offices

1.3.1. Introduction

The building (Figure 8) was constructed in 1986 and is owned by the Municipality of Alimos. It houses the environmental and hygiene services of the Municipality.

The surface area and volume are presented in **TABLE 6.**

TABLE 5: TABLE 6: SURFACE AREA AND VOLUME OF THE ENVIRONMENTAL SERVICES OFFICE BUILDING

Total Area :	446 m^2	Total volume:	1518 m^3
Heated surface:	311 m^2	Heated volume:	1086 m^3
Air-conditioned surface:	311 m^2	Air-conditioned volume:	1086 m^3
		Ground floor gross height :	3,2 m

FIGURE 8: ALIMOS MUNICIPAL OFFICES – MAIN FAÇADE OF THE BUILDING (NORTHEAST SIDE)

The building construction is typical of the period and region. It consists of double brick walls and reinforced concrete for the load bearing structure. The walls are insulated with 5 cm of extruded polystyrene placed in between the two brick layers. The roof slab is insulated also with 6 cm extruded polystyrene while there is a mineral fibre suspended ceiling in the office space. In all working areas there are opening windows with double glazing in aluminium frame. Figure 9 presents the plan view of the building.

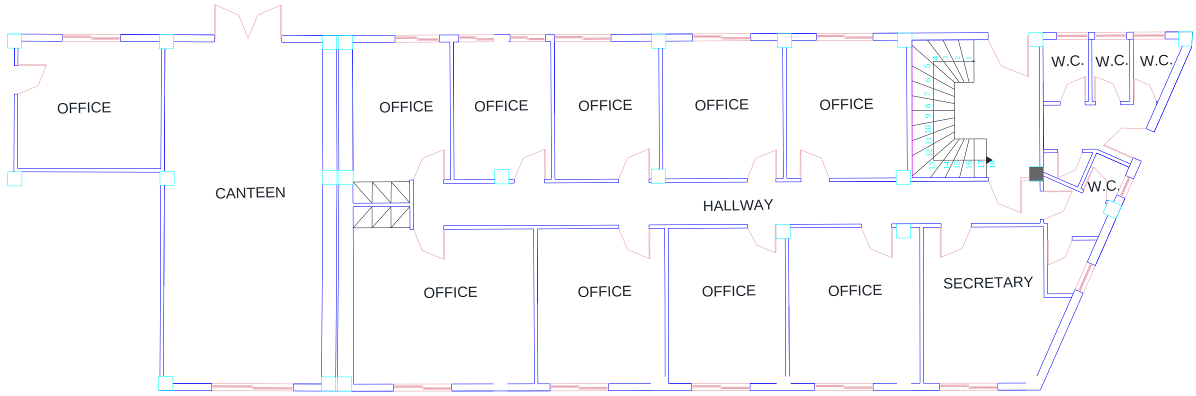

FIGURE 9: PLAN VIEW OF ALIMOS MUNICIPAL OFFICES

The Alimos Municipal Offices building consists of the main building with a ground floor and a basement and two separate small buildings with the following arrangement and uses:

- Ground floor: consists of offices and houses various public services. It also houses the canteen serving the employees and visitors.
- Basement: The basement is used as a warehouse.
- Building 1: houses a registration/protocol office.
- Building 2: is used as a guardhouse.

FIGURE 10: ALIMOS MUNICIPAL OFFICES SURROUNDING FREE SPACE

A parking area for municipality's refuse collector trucks is located on the northeast and northwest sides of the building. The total area of the free space around the building is 2.000 m^2.

The building operates the weekdays, all year round, with the following schedule:

- Offices and Building 1: 7:00 – 15:00
- Building 2 - 24 hours per day

All energy needs of the building are covered by electricity and the annual consumption is shown in Table 7 and its breakdown in Figure 11.

TABLE 7: ANNUAL ELECTRICITY CONSUMPTION OF THE ENVIRONMETAL SERVICES OFFICE

Year	Total consumption (kWh)	Total cost (€)
Average	35.478	6.956,5

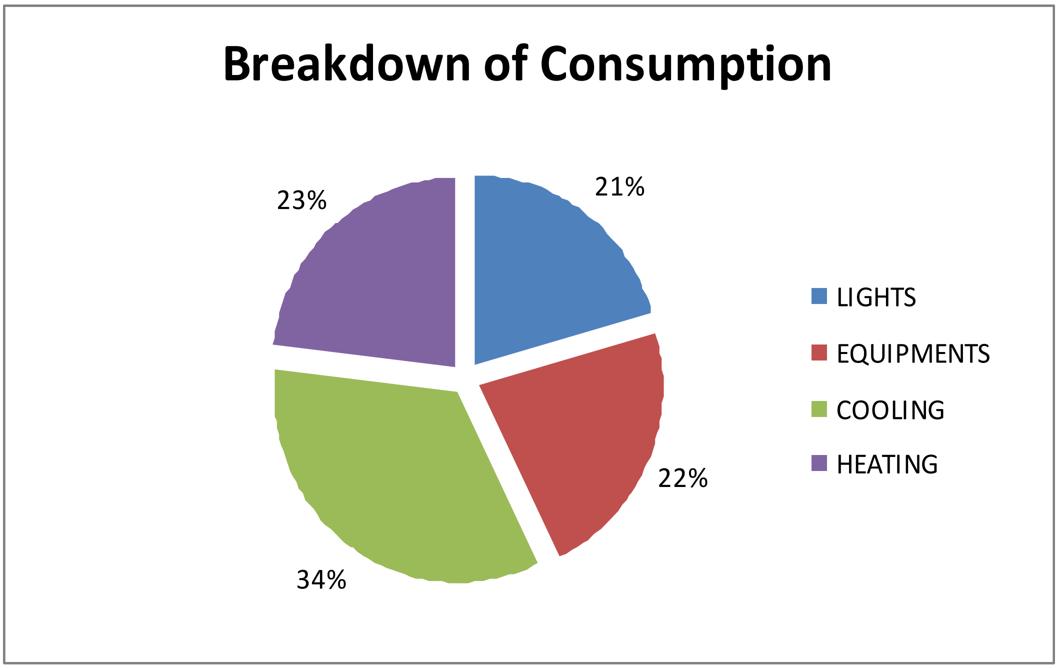

FIGURE 11: BREAKDOWN OF ANNUAL CONSUMPTION

1.3.2. Renovation Plan

- Retrofit of the building's envelope;
  According to the thermal insulation study of the building the current U-value of the external walls and roof is 0,587 and 0,45 W/m^{2}K, respectively. The optimum choice is to add external insulation of 5 cm thickness and conductivity λ (k) 0,036 W/mK. After this intervention the final U-value will be 0,359 W/m^{2}K for the external walls and 0,272 W/m^{2}K for the roof.
  Also, the existing glazing and frames with total U-value of 3,49 W/m^{2}K will be replaced with low-e glazing and thermal break frame with total U-value of 1,8 W/m^{2}K, 42% solar factor and high visible transmittance (VT).
- Retrofit of the lighting system;
  The existing lighting system consists mainly by ceiling lamp with T8 fluorescent of 18W or 36W. After doing lighting analysis, it was decided to take advantage of the available daylight by adding daylight sensors in selected luminaires. Also, all the current lamps will be replaced by LEDs.
- Retrofit of the HVAC system;
  Currently, split unit air conditioning systems are used for heating and cooling the building. These systems are quite old and not well-maintained, for this reason and,

based on the instructions of the relevant regulation (KENAK), their performance is considered to be around 1,7 for heating and 1,5 for cooling. The proposed HVAC systems are VRV (Ceiling-Mounted Cassette) with COP of 4,05 and EER of 3,61.

- Add ventilation system;
  Ventilation openings assisted by fans will be integrated on the North and South elevation of the building in order to achieve cross ventilation on each floor. The fans will be connected with sensors of the external temperature so as to operate only when the external temperature is lower than the internal. This system will be used for night ventilation to further reduce cooling energy consumption. Also it can operate during daytime if the external conditions are favourable.
- Add energy management system;
  A Building Energy Management System will be integrated. The BEMS will control, monitor and record the required internal and external conditions and the energy consumption of all systems of the building.
- Integration of renewable source systems;
  In order a percentage of the final energy consumption to be covered by renewable energy systems several options were investigated. The optimum choice is the installation of PV (26 kWp) on the roof and surrounding space of the building. Additionally, another 15 kWp system may be accommodated to supply electricity to other municipal buildings if this will be permitted by the regulations (defining nZEB levels) that are currently under development.

1.3.3. Technical Difficulties

General

Regarding the design, many difficulties arise due to the frequent changes on the interior spaces of the buildings. This problem is very common in public buildings which house a large amount of staff and services. So the lighting system and HVAC has to be as flexible as it gets in order to satisfy future needs.

HVAC

The use of more environmentally friendly HVAC systems was investigated but VRV appeared to be the most suitable choice. A solar heating/cooling system combined with heat pump was studied but its cost appears to be quite high. Furthermore, the solar coverage of the annual load (for both heating and cooling) was around 30% as the available space did not suffice to accommodate larger areas of solar collectors.

1.3.4. Economic/Financial Risks

The cost of more innovative systems (solar cooling, geothermal, etc.) is considerably high and so their integration in the building is not a feasible solution unless they are eligible for subsidies by state or other sources.

As the building operates during the daytime only, the energy consumption is low compared to buildings with 24h operation. This fact affects the final payback period of the investment which is quite long, reaching 23 years for certain interventions such as thermal insulation and replacement of windows.

1.3.5. Legislative Obstacles

There is a restriction regarding the total power of the PVs which can be installed in public buildings. For public buildings the installed capacity of the PV system can be 100% of the maximum capacity which the customer has agreed with the Utility network and it is stated in the Power Supply Contract.

1.4. Summary

In general, the three buildings which are examined do not face particular technical difficulties that impede their deep renovation.

However, there is a difficulty regarding the integration of renewable energy systems when the building is located in a densely built area. This is due to the lack of space availability, the reduced solar potential due to shadowing and the reduced wind potential. In Greece the legislation defining the levels of nZEB and the contribution of RES in the energy performance of nZEB is under development. So, it is important the "nearby areas", as indicated by EPBD, to be defined as flexibly as possible in order to facilitate the integration of RES and make nZEB levels achievable.

The main problem in order to undertake energy performance improvements in public buildings is the project financing. The lack of funds that municipalities face during the last years affects the whole process of the energy efficiency interventions. This fact can block the completion of the renovation and will result to lower savings than the expected ones. For this reason it is very important the economic support in order the interventions to be feasible. For example building envelope improvement appears to need this kind of support as the payback period is still too long. Also, subsidies by government or other sources for more innovative products and solutions will help their penetration in the market and at the same time will eliminate the financial risk for the investors.

Additional risks that all investors face in Greece are the frequent changes in legislation and in taxation system which have an enormous effect on the economic evaluation of the energy projects.

Another main obstacle regarding deep energy renovation of public buildings is the lack of legislation regarding the nearly zero energy buildings (nZEB). It is expected however, that the legislation will be in force by the end of current year, 2015.

Finally, other difficulties which have to be overcome during the energy efficiency renovation of public buildings are the difficulties in gathering all the data (drawings, bills, system maintenance documents, etc.) which are required for the study and the whole bureaucratic procedure in order for the project to be approved by the authorities.

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