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

DELIVERABLE 2.3

REPORT SUMMARIZING THE OBSTACLES, RISKS AND DIFFICULTIES FOR THE RENOVATION SCHEMES

Municipality of Messina, Italy

Authors:

Alessandra Gugliandolo - ENEA
Maria-Anna Segreto - ENEA

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Contributors:	Maria Anna Segreto - ENEA (Co – Author)	
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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. ASSISTAL – Associazione Nazionale Costruttori di impianti e dei servizi di efficienza energetica ESCo e Facility Management– Italy
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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 Messina (Italy). 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, a summary of the actions is presented, as well as the main conclusions for the Municipality of Messina.

The main technical barrier is to operate without having to interrupt the normal work of the three buildings.
Many difficulties for Zanca Palace and Satellite Palace were observed in the internal distribution of space for offices because the existing structures are not very flexible and then possible interventions are limited by the presence of functional destinations very different from each other (offices, museum, theater etc.), and therefore it results very difficult to implement common interventions.

The main economic barrier is that The municipality has no specific financing to improve public buildings. They are therefore objective difficulties for the insertion of energy improvements.

The main regulatory barrier concerns Zanca palace, because it is a historic building bound by the Superintendence of Cultural Heritage.

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

1.1. PALAZZO ZANCA

1.1.1. INTRODUCTION

The building (Figure 2) consists of 2 storeys and a basement. Palazzo Zanca is the municipal building of Messina.

FIGURE 1 - PLAN VIEW OF THE BUILDING

The building is located at the historic town hall building, which was destroyed twice before by earthquake in 1783 and then definitively in 1908. Built after the earthquake of 1908, its construction is part of the reconstruction's plane of the city, that located public buildings nearby the sea. The surface area and volume are presented in Table 1 and Figure 1.

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

Total Area :	13500 m^2	Total volume:	95000 m^3

This Palace is constituted from a buildings of 2 floors above ground. The dimensions are the same for each floor. Palazzo Zanca is a municipal building, in which there are multiple functions of public utility. On the ground floor there is the access to the building with the hall and reception.

All rooms are now used as municipal offices, with the exception of bathrooms, deposits and some offices of municipal councilors. On the first floors there are numerous municipal offices, Mayor's and assessors rooms, municipal council hall, reception hall, a bar, bathrooms and archives. In the basement floor there are large rooms and many of them are intended for systems and server rooms.

FIGURE 2 - PALAZZO ZANCA

On the first floors there are numerous municipal offices, Mayor's and assessors rooms, municipal council hall, reception hall, a bar, bathrooms and archives. In the basement floor there are large rooms and many of them are intended for systems and server rooms.

The building usually has occupation between 0h00 and 24h00 from Monday to Sunday, since the registry office of the city is located in the building, but the public activities of employees are carried out only between 7h30 and 19h30. Public access depends on the type of service provided and is between 08h30 and 13h30 from Monday to Friday, and also between 14h30 and 16h30 on Tuesday and Thursdays. Palazzo Zanca has about 750 employees and it is visited by an indeterminate number of public. The building was divided in different areas, depending on the intended use, being created different usage profiles. For the simulation of Palazzo Zanca with Design Builder, the building was divided into 8 blocks (named 1,2,4,5,6,10,11,12).

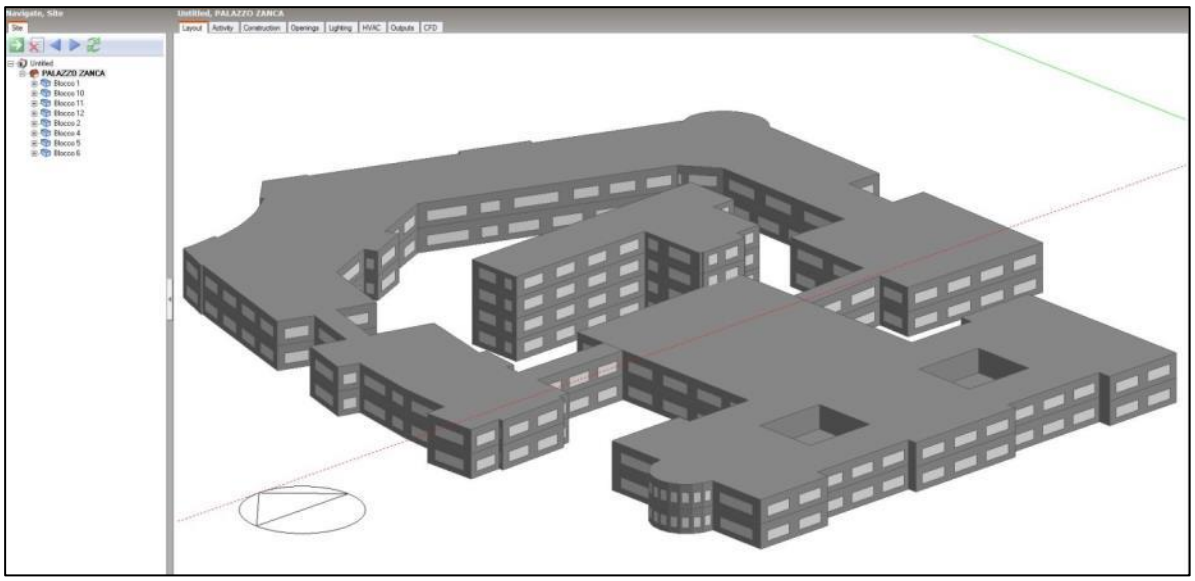

FIGURE 3 - HOME SCREEN OF THE SOFTWARE

For the Palazzo Zanca, historical building, there are: block 1 and block 4 at the ground floor; block 2 and block 6 at the first floor. While for the modern building, built in the seventies and placed in centre of monumental excavations, there are: blocks 5, 10, 11, 12. The building structure was built according to the "Hennebique" system in reinforced concrete (Portland cement), commonly used for the reconstruction the city of Messina. The diameter of the "smooth irons" is 25 mm. The pavilions 1, 2 and 5 are in continuous system in masonry in reinforced concrete (0,60-0,80 m), conversely, the pavilions 3 and 4 are in frame system (pillar 0,60 x 0,60) with bricks, as infill wall.
The external part of the envelope is in "fake stone", used mainly for decorations in "Liberty Style". All the windows have single glazing with wood frames. The doors have the same characteristics of the windows with the exception of 3 doors on the ground floor, which are in glass and metal. All the windows do not have rolling shutters but simple shutters. Almost all rooms have opaque cloth curtains, not light in color. The HVAC is ensured with several heat pumps, which were being installed gradually during the years. All energy needs of the building are covered by electricity and the annual consumption is shown in TABLE 2 and its disaggregation is presented in Figure 3.

TABLE 2 - ANNUAL ELECTRICITY CONSUMPTION

	Electricity [kWh]	District Cooling [kWh]	District Heating [kWh]
Heating	0.00	0.00	270143.40
Cooling	0.00	1254508.77	0.00
Interior Lighting	1061927.55	0.00	0.00
Interior Equipment	326353.11	0.00	0.00
Total End Uses	1388280.66	1254508.77	270143.40
Total	2912932,83		

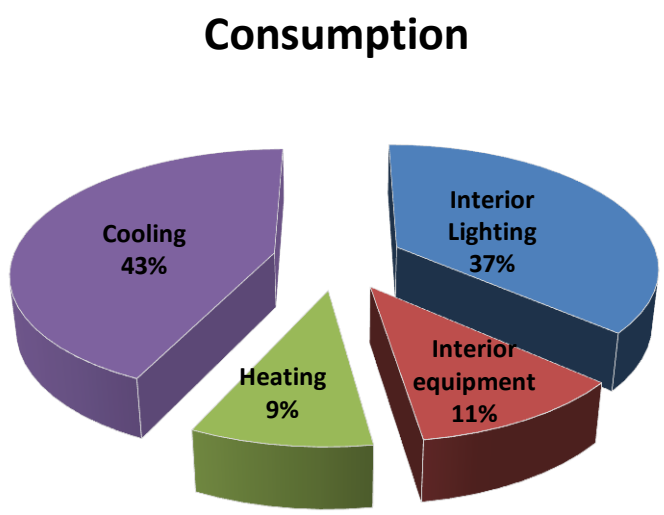

FIGURE 4 - DISAGGREGATION OF ELECTRICITY CONSUMPTION BETWEEN USES

1.1.2. Renovation Plan

- 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. Following a sensitivity analysis based on the results from the Design Builder simulations of the renovation design, it is expected inserting a high performance plaster that improves slightly envelope performance.
  - (ii) Glazing: Also, the existing glazing and frames with total U-value of 5,80 W/m^{2}K will be replaced selective glazing and thermal break frame in Corten steel with total U-value 1,6 W/m^{2}K, total solar transmissions 42,1 %, light transmission 0,682.
  - (iii) Shading: There is no shading fixed or mobile, because they integrate poorly with the historical memory of the building.

- Retrofit of the lighting system;
  The existing lighting system consists mainly by ceiling lamp with fluorescent lamps of 58W, 36W and 54W or incandescence lamps of 60W or 150W. After doing lighting analysis, it was decided to take advantage of the available daylight by adding daylight sensors on the upper first and ground floors' lighting system and change the location of the luminaires. Also, all the current lamps will be replaced by LEDs. It has chosen to place the LED lamps in the ceiling.
- Retrofit of the HVAC system;
  Currently, the heating and cooling of the building is provided by electricity. There is only one type of air conditioning systems: split systems. This system is quite old and not well-maintained, for this reason and, based on the instructions of the relevant regulation, the proposed HVAC systems are VRV (Ceiling-Mounted Cassette) with COP= 3,91 and EER= 3,46.
- Nighttime ventilation system;

Mechanical ventilation is scheduled throughout the course of the day, at night to recover the heat necessary to satisfy the values of thermal comfort of the rooms. The circulation system is integrated to the heating/cooling plant and is placed in the ceiling.

- Passive solar gains ;
  Appropriate ventilation openings are located both at monumental stair windows and at main atrium, so as to ensure an appropriate exchange of air and a constant ventilation.
- Energy management system;
  There will be a BACS system (Building automation control system) is the automatic centralized control of a building's heating, cooling and ventilation, lighting and other systems through a Building Management. These BACS are an example of a distributed control system, which includes networked computers, all electronic devices, useful to control security, lighting in general and emergency lights. In particular, these BACS will control rooms' humidity and temperature.
- Integration of renewable energy systems;
  In order to achieve 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 PVs (61 kWp) on the roof of the building.

1.1.3. Technical Difficulties

The following global constraints were taken into account in the design of the renovation plan:

- Since the building is inscribed on the List of building constrained of the Superintendence of Cultural Heritage, several strong restrictions are applied in the renovation of such building due to the protection rules, since it is not possible to implement any change in the building envelope able to cause any visual impact or modify historical integrity of the building. Therefore, the renovation option with a high visual impact avoided in the renovation plan.
- The building have an intensive utilization, receiving a large number of visitors, and is the working place for a large number of Municipal employees and such activities cannot be interrupted since it is not easy to temporarily move the services to another building. Therefore, renovation options requiring major construction works, so will be necessary to draw up a renovation plan that takes into account the needs of workers and visitors.
- For the simulation of Palazzo Zanca were found many operational difficulties. Given the size of the building, the computer equipment at ENEA of Bologna had to be adapted, with a new video card and a heat sink to speed up the calculations and to optimize the time required for the calculation.
- Many difficulties were observed in the internal distribution of space for offices because the existing structures are not very flexible.
- For the design of the ceiling a historical investigation was made, in order to know what material it was made the current ceiling. It is therefore a roof in pressed wood straws, it must then avoid making holes at the centerline.
- The building is in a densely built area and it is not possible the use district heating systems. The use of more environmentally friendly HVAC systems was investigated but VRV appeared to be the most suitable choice. It was studied different proposals for renewable energy systems but in the end it was decided to use a photovoltaic system.

- It is also thought to include wind energy as a renewable energy but the Superintendent did not approve this type of intervention, because it would alter building architecture.
- Finding information on materials and structures of the building was particularly complicated, as there is no database computerized or paper. Therefore, several inspections have been performed to obtain the data required for the simulation.

1.1.4. Economic/financial Risks

The municipality has no specific financing to improve public buildings. There are therefore objective difficulties for the insertion of energy improvements. Administration is trying to raise funds from national and regional funding programs.

1.1.5. Legislative obstacles

There were not regulatory obstacles identified in the renovation design. In Italy, the nZEB (nearly zero energy buildings) do not meet national specific legislation but this is now being defined, according to Directive 2012/27/UE. NZEB design is aimed at achieving high performance standards in terms of energy and environment.

However, Italy has adopted Energy Efficiency Directive 2012/27/UE through Legislative Decree No. 102 of July 4, 2014. This decree provides a fund for the energy efficiency of public buildings. It 'also planned the drafting of the national strategy for the redevelopment of public and private buildings, taking into account the National Plan to increase to nearly zero energy buildings.

- Since the building is inscribed on the List of building constrained of the Superintendence of Cultural Heritage, several strong restrictions are applied in the renovation of such building due to the protection rules, since it is not possible to implement any change in the building envelope able to cause any visual impact or modify historical integrity of the building. Therefore, the renovation option with a high visual impact avoided in the renovation plan.

1.2. PALAZZO SATELLITE

1.2.1. INTRODUCTION

Palazzo Satellite is the municipal building of Messina. The building is located in the historic center of the city, near the central station. Figure 5 shows the front facade of the building.

FIGURE 5 - PALAZZO SATELLITE

The building has no architectural value and in the original design was designed to residences (Figure 6).

FIGURE 6 - PALAZZO SATELLITE

The building includes many functions of municipal government, including the Local health Unit, the municipal Police management and several Municipal Departments.

Building style is modern and Palazzo Satellite is an example of a frame structure made of reinforced concrete. The walls are made of mansory and the floors are in slab and masonry. This Palace is

constituted by buildings with 5 floors above ground. The dimensions are the same for each floor. The building has a total area of about 6,870 m^2 (about 1,350 m^2 to plan) and a volume of about 18,550m^3.

Palazzo Satellite is a municipal building, in which there are multiple functions of public utility. On the ground floor (Figure 7) there is the access to the building with the hall and reception. All rooms are now used as municipal offices, with the exception of bathrooms and deposits.

FIGURE 7 - GROUND FLOOR

On the first floor there are the same functions of the others floor except ground floor, in which there are also some retail areas (stores). In the basement floor there are small rooms and many of them are intended for systems and server rooms.

The building usually has occupation between 0h00 and 24h00 from Monday to Sunday, because there is a municipal police management office, but the public activities of the employees are carried out only between 7h30 and 19h30. The public access depends on the type of service provided and it is between 08h30 and 13h30 from Monday to Friday, also between 14h30 and 16h30 on Tuesday and Thursdays.

The building has about 200 employees and it is visited by an indeterminate number of public.

Palazzo Satellite observes the seismic codes The building structure was built according to the frame system in reinforced concrete, commonly used for the Messina buildings.

The quantity of available information on the original design of the building is low, because it was built by a private contractor and then sold to the municipality, which has made it a public building.

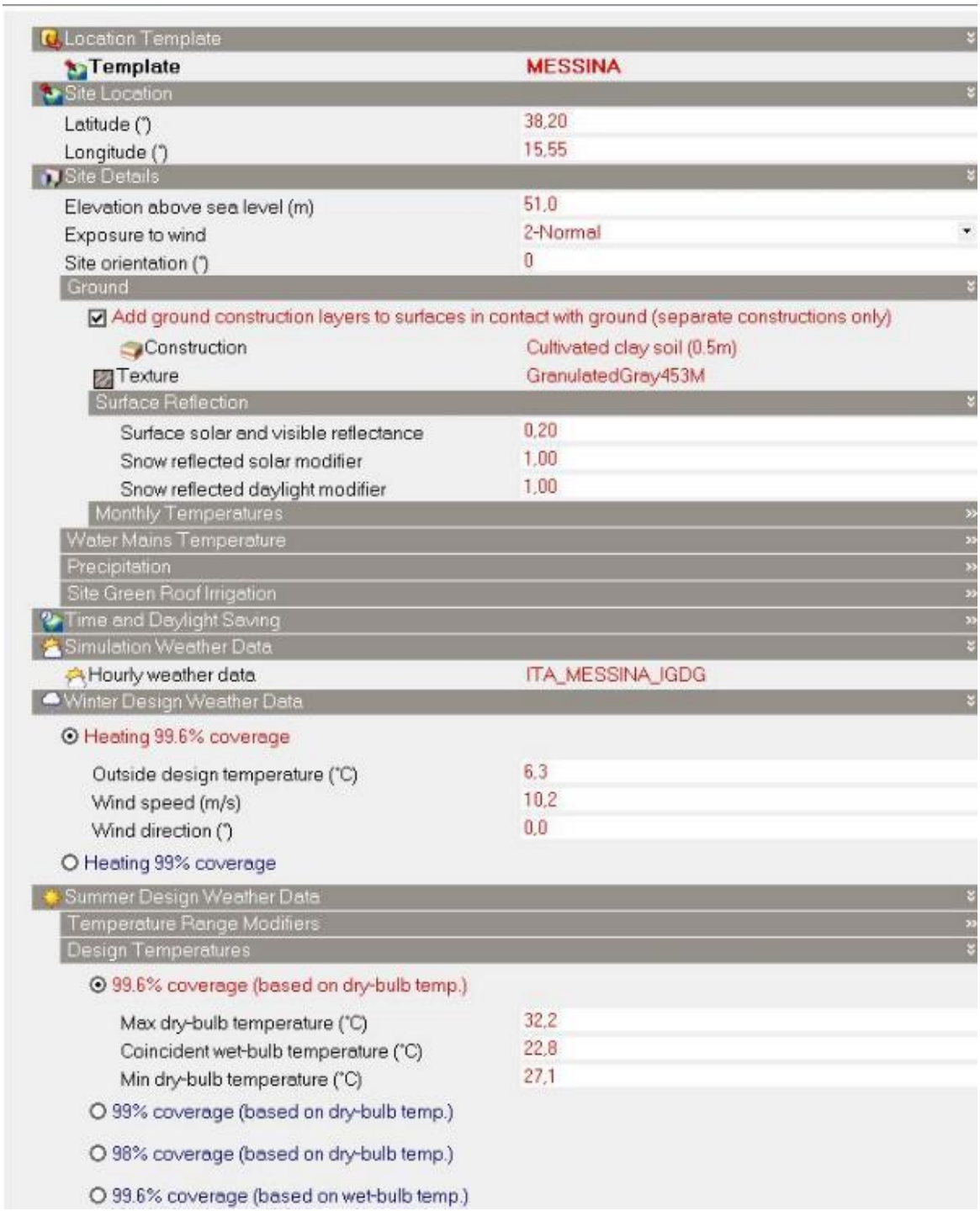

FIGURE 8 - DATA FOR THE SIMULATION WITH DESIGN BUILDER SOFTWARE

For the simulation of Palazzo Satellite with Design Builder software (Figure 8), the building was divided into 5 blocks.

All energy needs of the building are covered by electricity and the annual consumption is shown in Table 3 and its disaggregation is presented in Figure 8.

TABLE 3 - ANNUAL ELECTRICITY CONSUMPTION

	Electricity [kWh]	Natural Gas [kWh]	Additional Fuel [kWh]	District Cooling [kWh]	District Heating [kWh]	Water [m3]
Heating	0.00	0.00	0.00	0.00	2714.76	0.00
Cooling	0.00	0.00	0.00	790256.80	0.00	0.00
Interior Lighting	852503.17	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	222119.61	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	5349.45	143.97
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	1074622.78	0.00	0.00	790256.80	8064.20	143.97

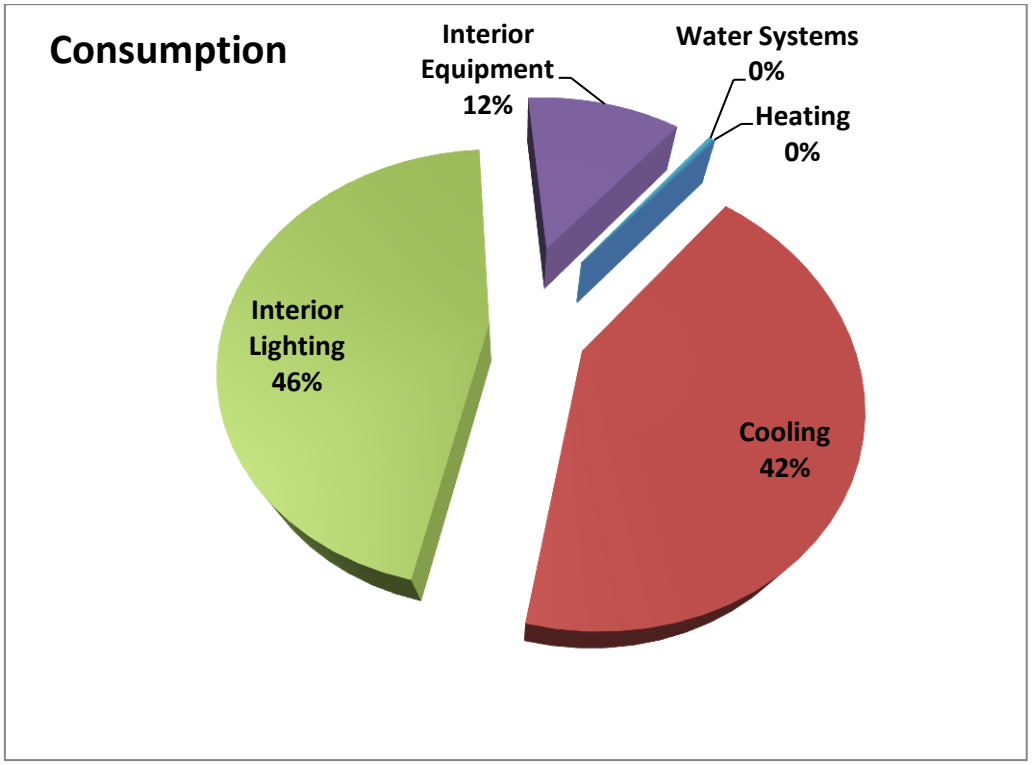

FIGURE 9 - CONSUMPTION

1.2.2. Renovation Plan

- Retrofit of the building's envelope;

(iv) Opaque Envelope: The envelope of the building is insulated according to the standards prevailing at the period of construction. Among the actions planned, there is the facades

renovation, it is planned to ensure the safety of unsafe parts and, where necessary, to do an important refurbishment. Another change concerns the reconstruction of the plaster of the facades, using a thermal insulation plaster. There are plasters with better performance but with the same texture and the same color of plaster used previously. Among other interventions there is waterproofing of the roof, so it is expected to enter under the floor of a fiber-reinforced bituminous membrane.

(v) Glazing: Also, the existing glazing and frames with total U-value of 5,80 W/m2K will be replaced selective glazing and thermal break frame in PVC with total U-value 1,32 W/m2K, Regarding the frames is chosen to include window frames with thermal break, in this case the value of frame transmittance (Uf) significantly improves. It is however chosen for the simulation that provides for total replacement of the old frames. It is chosen to use windows with PVC frames. Glasses chosen are selective double glazing with air chamber 6/13 mm. It has chosen to enter as many shadings, internal and external.

- Retrofit of the lighting system;
  The existing lighting system consists mainly by ceiling lamp with fluorescent lamp or incandescence lamp. It is expected to replace the existing lighting with the introduction of LED lamps and, where it is possible, to insert intelligent on/off system, which adapt depending sunlight.

- Retrofit of the HVAC system;
  Almost all working rooms, as well as all the rooms receiving, the circulation area have any air conditioning system. It is expected to insert a false ceiling in all circulation area and, where is possible in all rooms of the building. The results are: decrease net height to be heated and creation of a channeling of heating and lighting plants. The proposed HVAC systems are VRV (Ceiling-Mounted Cassette) with COP= 5.05 and EER= 6.5.

- Nighttime ventilation system;
  Mechanical ventilation is scheduled throughout the course of the day, at night to recover the heat necessary to satisfy the values of thermal comfort of the rooms. The circulation system is integrated to the heating/cooling plant and is placed in the ceiling.

- Passive solar gains/insulating ;
  It is hypothesized the inclusion of a green roof that will give two great advantages: at first it will decrease heat loss during winter season working as thermal insulation, and then it will hinder heat input during summer season working as a reflecting system for sunlight.

- Energy management system;
  There will be a BACS system (Building automation control system) is the automatic centralized control of a building's heating, cooling and ventilation, lighting and other systems through a Building Management. These BACS are an example of a distributed control system, which includes networked computers, all electronic devices, useful to control security, lighting in general and emergency lights. In particular, these BACS will control rooms' humidity and temperature.

- Integration of renewable energy systems;
  In order to achieve a percentage of the final energy consumption covered by renewable energy systems several options were investigated. The optimum choice is the installation of PVs (155 kWp) on the roof and on the walls of the building.

1.2.3. Technical Difficulties

The following global constraints were taken into account in the design of the renovation plan:

- The building have an intensive utilization, receiving a large number of visitors, and is the working place for a large number of Municipal employees and such activities cannot be interrupted since it is not easy to temporarily move the services to another building. Therefore, renovation options requiring major construction works, so will be necessary to draw up a renovation plan that takes into account the needs of workers and visitors.
- For the simulation of Palazzo Satellite many operational difficulties were found. Given the size of the building, the computer equipment of ENEA of Bologna had to be adapted, with a new video card and a heat sink to speed up the calculations and to optimize the time required for the calculation.
- Many difficulties were observed in the internal distribution of space for offices because the existing structures are not very flexible.
- The building is in a densely built area and it is not possible the district heating systems. The use of more environmentally friendly HVAC systems was investigated but VRV appeared to be the most suitable choice. Different proposals for renewable energy systems were studied but in the end it was decided to use a photovoltaic system.
- Finding information on materials and structures of the building was particularly complicated, as there is no database computerized or paper. Therefore, several inspections were performed to obtain the data required for the simulation.
- The building is very close to the sea and its foundations have severe problems due to the ascent of moisture, therefore, during the implementation of the energy improvement it must take into account these issues.

1.2.4. Economic/Financial Risks

The municipality has no specific financing to improve public buildings. They are therefore objective difficulties for the insertion of energy improvements. Administration is trying to raise funds from national and regional funding programs.

1.2.5. Legislative obstacles

There were not regulatory obstacles identified in the renovation design. In Italy, the nZEB (nearly zero energy buildings) don't meet national specific legislation but this is now being defined, according to Directive 2012/27/UE. NZEB design is aimed at achieving high performance standards in terms of energy and environment. However, Italy has adopted Energy Efficiency Directive 2012/27/UE through Legislative Decree No. 102 of July 4, 2014. This decree provides a fund for the energy efficiency of public buildings. It is also planned the drafting of the national strategy for the redevelopment of public and private buildings, taking into account the National Plan to increase to nearly zero energy buildings.

1.3. PALACULTURA

1.3.1. INTRODUCTION

Palacultura (Figure 10) is an important building of Messina. The building is located in the near of marina of the city. The Palace of Culture (or more simply Palacultura) is a multifunctional center in the city of Messina, composed of three buildings, in which there are an auditorium, an outdoor theater, a library, an exhibition center located, the latter, on the terrace.

FIGURE 10 – PALACULTURA

Located in the central part of the avenue Boccetta (Figure 10), which is for the city of Messina the first access road for motorists coming from the highways, it is therefore necessarily a visiting card on architectures that the city offers to visitors.

FIGURE 11 - PALACULTURE FROM AVENUE BOCCETTA

This Palace is constituted by a building with 6 floors above ground. The dimensions are very different for each floor. The building has a total area of about 10,300 m^2 , this area is divided in different levels, which are however different in height and shape.

It consists of three buildings used to house offices for culture, the largest town public library, a museum, a theater with 850 seats with 4 audiences, orchestra pit and booths for television direction of events, an auditorium for music outdoors among the largest and most modern of Italy, and even an exhibition hall located on the terrace of the second body of the building.
The inverted pyramid structure was obtained by exploiting the considerable flexibility of materials such as concrete and steel, of course taking into account that Messina is a seismic zone of first category.
On the ground floor (Figure 11) there is the access to the building with hall, reception of the theater. All rooms are now used as offices for culture, with the exception of the bathrooms, deposits and some offices of municipal councilors.

FIGURE 12 - GROUND FLOOR

On the first floors there are numerous municipal offices, meeting rooms, a museum (Figure 12), a public library, bathrooms and archives.

FIGURE 13 - MUSEUM

In the basement floor there technical rooms and garage for employees of the Palace of Culture.

The building is usually busy with public activities and on the occasion of the museum exhibitions or theater performances. The public activities of employees are carried out only between 7h30 and 19h30. Public access depends on the type of service provided and is between 08h30 and 13h30 from Monday to Friday, and also between 14h30 and 16h30 on Tuesday and Thursdays.
The building hosts about 200 employees and visitor numbers change according to the activities taking place at the palace.

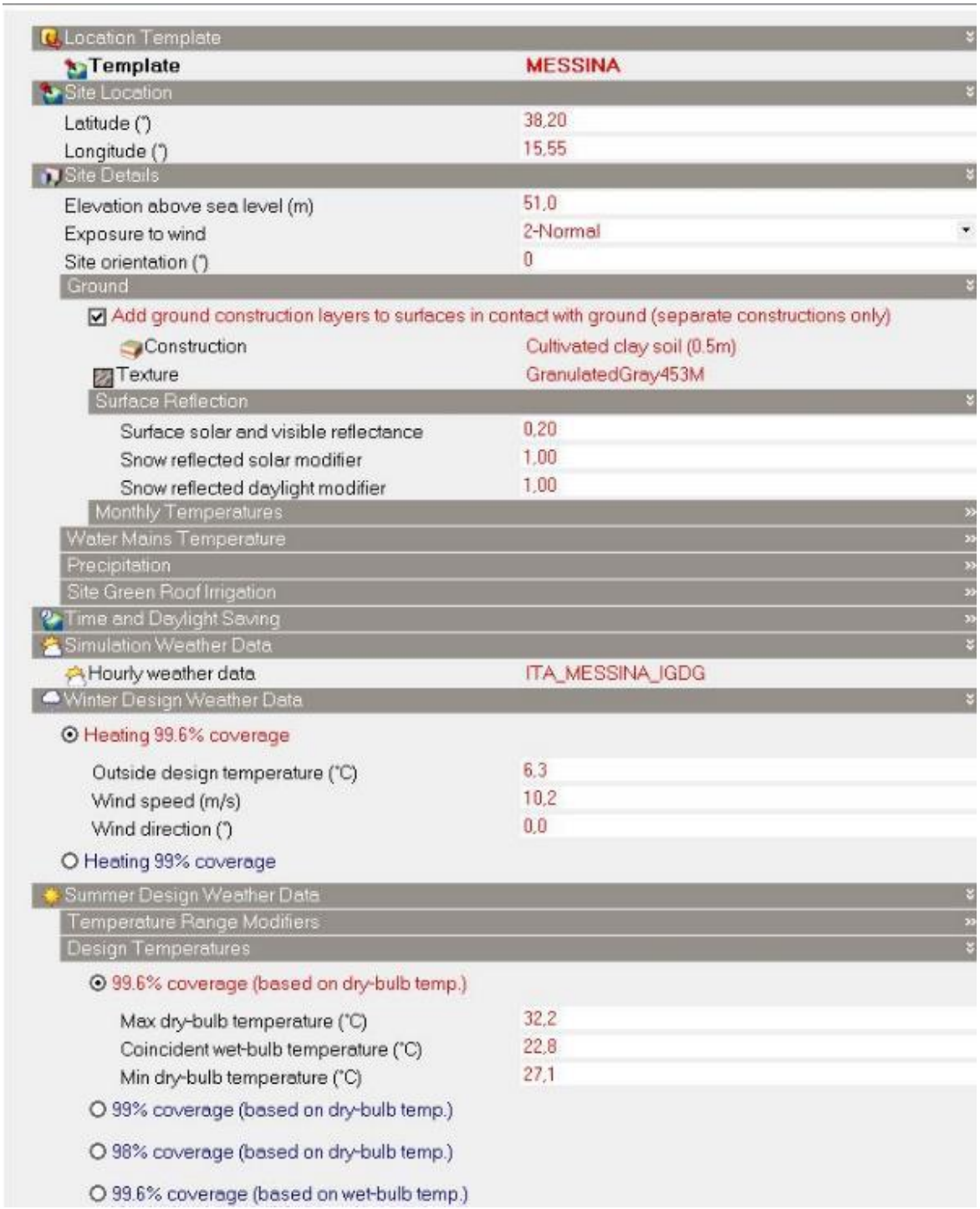

FIGURE 14 - DATA FOR THE SIMULATION WITH DESIGN BUILDER SOFTWARE

For the simulation of Palace of Culture of Messina with Design Builder (Figure 13), the building was divided into 11 blocks (named 11,12,13,14,16,2,3,4,5,6,7) (Figure 14).

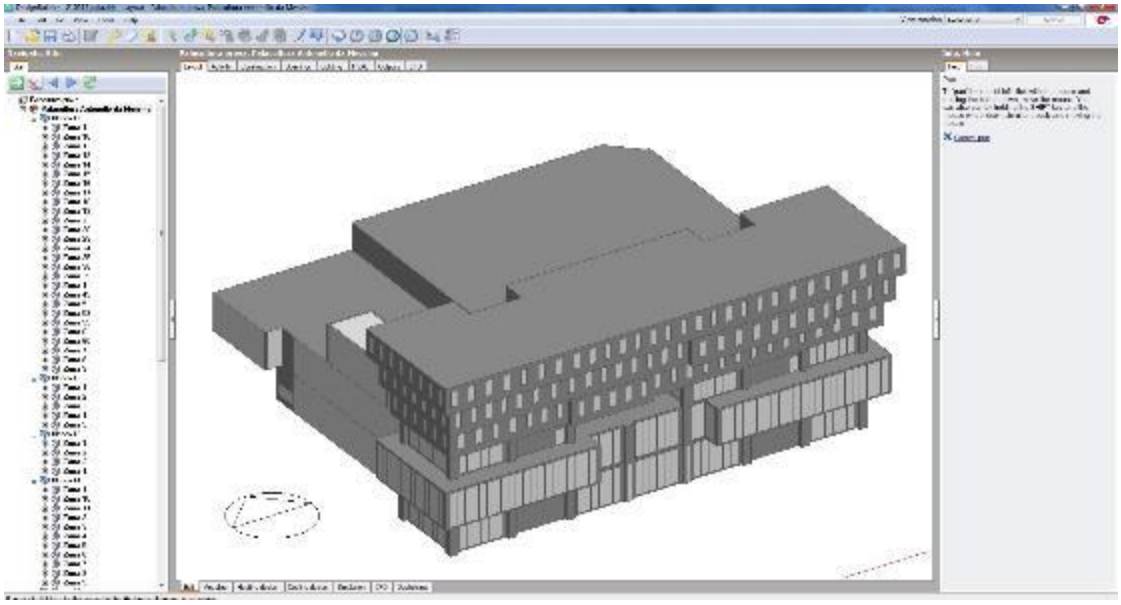

FIGURE 15 - HOME SCREEN OF THE SOFTWARE

All energy needs of the building are covered by electricity and the annual consumption is shown in table 4.

TABLE 4 - ANNUAL ELECTRICITY CONSUMPTION

	Electricity [kWh]
Heating	223362.48
Cooling	217049.09
Interior Lighting	196858.13
Interior Equipment	120275.15
Fans	127924.50
Total End Uses	885469.36

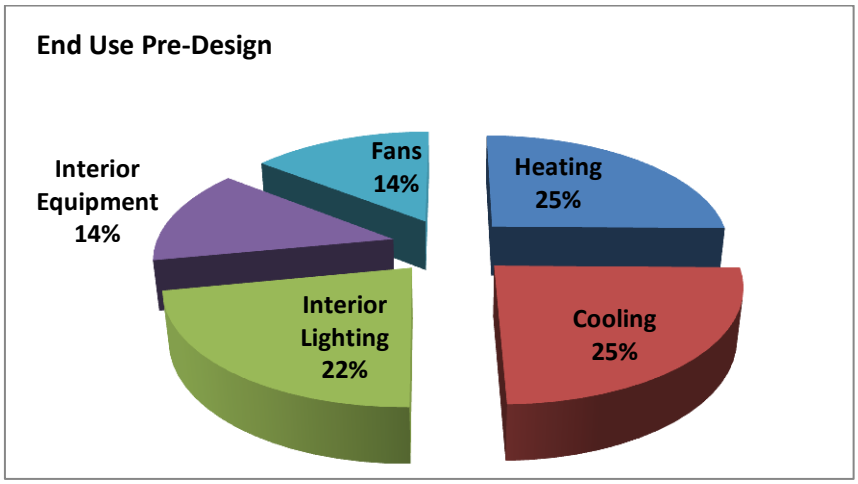

FIGURE 16 - END USE CONSUMPTION PRE DESIGN

1.3.2. Renovation Plan

- Retrofit of the building's envelope;

(iv) Opaque Envelope: An important task in the renewal plan is targeted to envelope. Where it is possible, it will insert an internal insulation of the walls. The internal coat it will be possible with a new layer with high insulation value. Actuals walls are not properly put in place for an error due to the workers (thermographic surveys conducted prove it). The insertion of an internal insulation decreases the floor area of the building but it is the only possible solution in the case of a prospectus with the external geometry as difficult as that of the Palace of Culture.

Will be using the panels of cork and plasterboard thickness up to 4 cm. The installation of the outer coat doesn't create particular problems in terms of physical and technical. Instead, the installation of the inner coat requires careful attention to avoid the risk of formation of interstitial condensation, mold and / or the onset of potential events of decay of the structures.

The cork self-expanded, having a structure "closed cell", it is rot-proof and, therefore, the risk of decay is almost insignificant. To understand the origin of this event it can start looking at the development of the internal temperatures to the wall in three conditions: pre-intervention wall, wall with inner coat (4 and 6 cm) and with outer coat (4 and 6 cm).

(v) Glazing: Also, the existing glazing and frames (with Ug-value of 5.80 W/m2K and Uf-value of 2.8 W/m2K) will be replaced by selective glazing and thermal break frame in PVC with total Uf-value of 2.0 W/m2K and Ug-value of 1.9 W/m2K. Regarding the frames, they were chosen to include window frames with thermal break. In this case the value of frame transmittance (Uf) improves. Glasses chosen are selective double glazing with air chamber of 6/13 mm. It has chosen to insert as shadings, internal and external.

- Retrofit of the lighting system;

The existing lighting system consists mainly by ceiling lamp with fluorescent lamp or incandescence lamp. It is expected to replace the existing lighting with the introduction of

LED lamps and, where it is possible, to insert intelligent on/off system, which adapt depending sunlight.

- Nighttime ventilation system;
  Mechanical ventilation is scheduled throughout the course of the day, at night to recover the heat necessary to satisfy the values of thermal comfort of the rooms. The circulation system is integrated to the heating/cooling plant and is placed in the ceiling.

- Passive solar gains/insulating ;
  It is hypothesized the inclusion of a green roof that will give two great advantages: at first it will decrease heat losses during winter season working as thermal insulation, and then it will hinder heat input during summer season working as a reflecting system for sunlight.

1.3.3. Technical Difficulties

The following global constraints were taken into account in the design of the renovation plan:

- The building have an intensive utilization, receiving a large number of visitors, and is the working place for a large number of Municipal employees and such activities cannot be interrupted since it is not easy to temporarily move the services to another building. Therefore, renovation options requiring major construction works, so will be necessary to draw up a renovation plan that takes into account the needs of workers and visitors.
- For the simulation of Palace of Culture many operational difficulties were found. Given the size of the building, the computer equipment of ENEA of Bologna had to be adapted with a new video card and a heat sink to speed up the calculations and to optimize the time required for the calculation.
- Many difficulties were observed in the analysis of the building, since the size is so large that made it impossible to analyze the entire building within the deadlines set by the project.
- The thermographic analysis of the building was quite difficult because of the small temperature differences between inside and outside.
- Two simulations of the building (pre and post operam) have about 3 months longer than expected, due to the difficult in setting data. They were created eleven for different blocks.
- Finding information on materials and structures of the building was particularly complicated. Therefore, it were performed several inspections to obtain the data required for the simulation.
- Possible interventions are limited by the presence of functional destinations very different from each other (offices, museum, theater etc.), and therefore it results very difficult to implement common interventions.

1.3.4. Economic/financial Risks

The municipality has no specific financing to improve public buildings. They are therefore objective difficulties for the insertion of energy improvements. Administration is trying to raise funds from national and regional funding programs.

1.3.5. Legislative obstacles

There were not regulatory obstacles identified in the renovation design. In Italy, the nZEB (nearly zero energy buildings) do not meet national specific legislation but this is now being defined, according to Directive 2012/27/UE. NZEB design is aimed at achieving high performance standards in terms of energy and environment.

However, Italy has adopted Energy Efficiency Directive 2012/27/UE through Legislative Decree No. 102 of July 4, 2014. This decree provides a fund for the energy efficiency of public buildings. It is also planned the drafting of the national strategy for the redevelopment of public and private buildings, taking into account the National Plan to increase to nearly zero energy buildings.

1.4. Summary

Two of the three buildings that were examined do not face particular technical difficulties that impede their deep renovation. However, there is a difficulty with regard to the integration of renewable energy systems when the building is situated in a densely built and in the case of Palazzo Zanca, because it is a historic building bound by the Cultural Heritage. The other two buildings do not have major legislative obstacles.

One of the main issues of renovation projects of Public Administration in the Italian context is public financing, due to the economic crisis. For this reason it would be essential to declare that the renovation project would be both important from the point of view of sustainability and from the economical point of view since it would generate an energy and cost saving. Additional risks that all investors face in Italy 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. One of the main issues related to the early design phases is indeed the gathering of all the necessary data about the state of art (drawings, bills, system maintenance documents, etc. However, all the necessary information should be gathered in order to develop the project: the support of all the actors (designers, municipalities, public energy managers and societies…) would be surely favored by an appropriate national legislation which would empower the involved subjects.

ENEA – Italian National Agency for New Technologies, Energy and Sustainable Economic Development (IT)

Municipality of Messina (IT)

Municipality of Errenteria (ES)

Municipality of Coimbra (PT)

Municipality of Alimos (EL)

ISR – University of Coimbra (PT)

SINLOC - Sistema Inizative Locali Spa (IT)

ETVA VI.PE. S.A. (EL)

TECNALIA Research & Innovation Foundation (ES)

EUDITI Energy and Environmental Design LTD (EL)

Innova B.I.C. Business Innovation Centre S.r.l. (IT)

Danish Building Research Institute, Aalborg University Copenhagen (DK) - SBi/AAU

ASSISTAL (IT)

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