GRASPINNO

Transnational model, strategies and decision support for innovative clusters and business networks towards green growth, focusing on green e-procurement in EE/RES for energy refurbishment of public buildings.

Deliverable: 3.10.5

Evaluation of pilot site EE after the refurbishment

Prepared by:

University of Patras

with the contribution of all partners

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OVERALL INTRODUCTION

The scope of this report is to present the Energy Efficiency (EE) of GRASPINNO pilot sites after the refurbishment activities and the installation of the procured products and services. Even though some pilots were not arrived at the phase of the equipment installation due to several delays in the procurement procedure, all partners contributed to the development of the present report. As a result, some partners present the progress of their pilots and estimate the energy condition of the pilot buildings, while other partners present the buildings' condition after the refurbishment evaluating their pilot. Due to the differences between the pilots' progress, no specific template was followed by the partners. Great emphasis was given at the conclusions recorded by all partners and the energy condition of the buildings after the refurbishment for the pilots concluded on time.

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- **UNIVERSITY OF PATRAS (LP1)**

1. INTRODUCTION

The main aim of this report is to present the reasons why the energy refurbishment of the public buildings, which were GRASPINNO pilot sites for UPatras, has not been concluded yet.

More specifically, although the scope of GRASPINNO pilots was the support of real green tenders and their publication, it would have been really beneficial for the project if the procurement procedure had been finalized and the products/services had been procured. In that case, the energy refurbishment activities would had been done and after the refurbishment, special monitoring equipment would had been installed and several energy measurements recorded. These data would had been analyzed resulting in a detailed comparison between the energy class of the buildings before and after the refurbishment.

UPatras, in strict collaboration with Municipality of Kozani, which is the contracting authority, prepared the tender for the energy refurbishment of 13 public schools. The tender concerned the installation of net metering contracted PV roofs and included several green criteria, identified by the partnership during GRASPINNO. The tender was published in August 2017, but unfortunately some unpredicted parameters caused delays in the procurement procedure. These parameters are recorded in the present report in Chapter 2. Additionally, in Chapter 3 the estimations of the energy savings after the installation of the PV roofs are presented for each one of the 13 schools.

2. PROGRESS OF TENDER PROCEDURE

UPatras pilot involved 13 public schools of the Municipality of Kozani, which is the public procurer, and it concerns the installation of net metering contracted PV roofs. For all 13 public schools, one overall procurement tender was published involving all the necessary products and services for the realization of the installation of net metering contracted PV roofs. It is true that the procurement tender was an extended tender, since it concerned a variety of products and services and referred to a large amount of buildings. However, Municipality of Kozani, which is the contracting authority decided that this was the best way to procure the necessary products and services of the same category of energy refurbishment for the schools of the area of Kozani.

The declaration documents have been prepared by the procurement office of the Municipality of Kozani. All the documentation is available for free and can be found online on the sites of: the contracting authority (www.cityofkozani.gov.gr); the Central Electronic Public Procurement Registry (www.diavgeia.gov.gr); and the National System for Online Public Contracts, through Prometheus web portal (www.promitheus.gov.gr) (Systemic Number of the Declaration: 45.290).

The tender type was the open electronic procedure which is implemented in accordance with the Article 27 of the Directive 2014/24/EU. In the National legislation the open tender procedure is fully described in the Article 27 of the Public Procurement Law 4412/2016. The Law 4412/2016 consists an adaptation of the National legislation to the European Directive 2014/24/EU and the Directive 2014/25/EU. In the open procedures, any interested economic operator may submit a tender in response to a call

for competition. Thus, the invitation to bidders is addressed to an unknown number of participants which have to meet objectively described admissibility criteria. In national tenders, the Invitation to bidders is published in 'Prometheus' platform; in international tenders, the Invitation is publicized in the European Union Official Gazette, while the respective time limits for submission of bids are, in the first case, twenty-two (22), and in the second case, thirty-five (35) days.

In conducting an open procedure the contracting authority-public procurer is responsible for: preparing the tender documentation; publishing the declaration summary on the site of the contracting authority and on the Chamber of Commerce of Kozani, whilst the costs of publishing the announcements in the Greek press will be undertaken by the contractor (tender winner); providing the economic operators with tender documentation-declaration of the open electronic bid; carrying out the public opening of the tenders received on time; performing the verification of the economic operators' qualifications according to the criteria of the bid documentation; evaluating the tenders according to contract award criteria; informing the economic operators for the outcome of the public procurement procedure; signing the contract to the tender winner; and publishing the tender result. The invitation to the bidder, which has to be prepared by the contracting authority-public, has to include all the documentation that should be submitted for admissibility to the tender by the participants.

The open procedure is composed of the: tender request - the request for tender outlines on what is required, the contractual requirements and participation steps; invitation of tenders; suppliers' responses - all

relevant documentation obtained until a specific date and time strictly; evaluation and selection - each tender will be checked for compliance; notification and debriefing - successful tenderer will be advised; unsuccessful tenderers are disqualified; notification and debriefing for the technical offers - the technical and green criteria assessment is taking place. An evaluation grade is assigned; notification and debriefing for the economical offers - the economic assessment is taking place. An evaluation grade is assigned; the weighted result indicates the selected supplier. A period for objections is offered to the other suppliers; and contracts established and managed: formal agreement will be signed.

More specifically, the declaration title of the tender which is GRASPINNO pilot for Upatras is: "Supply, installation and operation of 13 net metering contracted PVs in public buildings and facilities of the Municipality of Kozani". The indicative budget is: 259.000,04 € (including VAT 24%) and the funding source for the contract is the Special Development Program of the Prefecture of Kozani 2012-2016, in the framework of the Development Fee. Moreover, in the common procurement vocabulary (CPV) which establishes a single classification system for public procurement aimed at standardising the references used by contracting authorities and entities to describe procurement contracts, the supplied products have CPV code: 31712331-9 (photovoltaic cells). All the economic operators should submit their tenders electronically (www.promitheus.gov.gr) in promitheus website which is the national procurement platform in Greece. The submission deadline for the tenders was the 14th of September 2017 at 16.00. Finally, the duration of the procurement of the products is set within a period of 190 days from the date of signing the contract.

The contract documentation is available to potential participants and includes: Agreement; general terms and conditions; specific terms and conditions; the contracting authority's detailed budget; technical specifications; the participants' financial offer, since it will be added to the contract documentation; the technical offer; the participants' rights; and respective time limits regarding complaints on the outcome of the tendering procedure.

In the page 40 of the full declaration document, it is clearly written that the published bid takes part in the pilot actions of GRASPINNO - Transnational model, strategies and decision support for innovative clusters and business networks towards green growth, focusing on green e-procurement in EE/RES for energy refurbishment of public buildings.

According to the law framework, the time limits for submission of bids are twenty two (22) days, in national tenders. GRASPINNO pilot declaration was published at 22nd of August 2017 and the submission deadline for the tenders was the 14th of September 2017 at 16.00. Moreover, the tenders submitted are valid and bind the economic operators for a period of six months. The Financial Council of the Municipality of Kozani had a regular meeting on 13th of November, 2017 at 13:30 and approved the decision of the regular meeting which take place at September 20, 2017. The date of the electronic opening of the tenders was the September 20, at 09:42. Early after opening the bidders' documents, the Council evaluated the participation supporting documents and the technical tender of the bidders. Three out of seven bidders who made their offers were selected as eligible to continue in the evaluation procedure.

The next step that had to be done by the contracting authority should have been the evaluation of the economic offers. However, the unexpected barrier that caused problems to the continuation of the procedures was the appeals that were lodged by some of the rejected bidders. This situation was not taken into consideration when the time planning of the pilot was estimated. The delays, caused by the procedure that has to be followed in order to examine the appeals, forced the contracting authority not to be able to take the decision for the final successful bidder.

As a result, the contracting authority cannot invite the successful bidder to sign the contract within twenty (20) days of notification of the relevant specific invitation, as it was supposed to be done according the national legislation. This means that all the next steps of the procurement procedure will be delayed, including the installation of the procured products and services in the pilot sites. For this reason, UPatras and Municipality of Kozani will not have the chance to install any monitoring equipment at the pilot sites after the refurbishment activities, as it was initially planned, and collect energy consumption data in order to analyze the final energy class of the buildings.

When the appeals will be resolved and the final successful bidder will be selected, the duration of the procurement of the products is set within a period of 190 days from the date of signing the contract. Thus, UPatras and Municipality of Kozani will then examine the opportunity of installing monitoring equipment and collect the respective energy consumption data.

3. ESTIMATION OF ENERGY SAVINGS AFTER THE REFURBISHMENT

Although, there are no energy consumption data collected for the pilot sites after the refurbishment, UPatras estimated the energy savings that will occur after the installation of the procured products and services for each one of the school buildings. The estimations are presented in the following tables:

- **3rd General Lyceum of Kozani**

Photovoltaic Maximum power	20 kWp			
Cover Electricity Consumption Rate	81%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
27940 kWh/year	3.000 €	19.200 €	6 years	19408 kgCO_2/kWh

- **4th General Lyceum of Kozani**

Photovoltaic Maximum power	20 kWp			
Cover Electricity Consumption Rate	81%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
27940 kWh/year	3.000 €	19.200 €	6 years	15636 kgCO_2/kWh

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- **Gymnasium at Ano Komi**

Photovoltaic Maximum power	18 kWp			
Cover Electricity Consumption Rate	89%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
25146 kWh/year	3.000 €	19.200 €	6 years	5683 kgCO2/kWh

- **1st Vocational Lyceum of Kozani**

Photovoltaic Maximum power	30 kWp			
Cover Electricity Consumption Rate	23%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
41900 kWh/year	4.510 €	28.800 €	6 years	81505 kgCO2/kWh

- **13th Primary School of Kozani**

Photovoltaic Maximum power	18 kWp			
Cover Electricity Consumption Rate	98%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
25146 kWh/year	2.500 €	17.000 €	6,5 years	8700 kgCO2/kWh

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- **17th Primary School of Kozani**

Photovoltaic Maximum power	10 kWp			
Cover Electricity Consumption Rate	85%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
13970 kWh/year	1.500 €	9.500 €	6 years	13850 kgCO2/kWh

- **18th Primary School of Kozani**

Photovoltaic Maximum power	9,5 kWp			
Cover Electricity Consumption Rate	88%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
13271 kWh/year	1.500 €	9.500 €	6 years	13703 kgCO2/kWh

- **Primary School of Aiani**

Photovoltaic Maximum power	10 kWp			
Cover Electricity Consumption Rate	140%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
13271 kWh/year	1.100 €	9.500 €	8 years	8950 kgCO2/kWh

- **Primary School of Ano Komi**

Photovoltaic Maximum power	6,5 kWp			
Cover Electricity Consumption Rate	80%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
9081 kWh/year	1.000 €	8.500 €	7 years	9044 kgCO_2/kWh

- **Primary School of Vatero**

Photovoltaic Maximum power	3 kWp			
Cover Electricity Consumption Rate	100%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
4191 kWh/year	600 €	5.000 €	6 years	4563 kgCO_2/kWh

- **Primary School of Lefkopigi**

Photovoltaic Maximum power	6 kWp			
Cover Electricity Consumption Rate	10%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
9081 kWh/year	600 €	8.500 €	8 years	3530,7 kgCO_2/kWh

- **Primary School of Petrana**

Photovoltaic Maximum power	6,5 kWp			
Cover Electricity Consumption Rate	126%			
Investment Performance				
Photovoltaic Energy Production	**Annual Savings Estimation**	**Estimated Investment Value**	**Repayment Period**	**Emitted Pollutants Reduction**
9081 kWh/year	600 €	8.500 €	8 years	2256 kgCO_2/kWh

4. CONCLUSIONS

In the present report, the progress of the procurement tender which is considered as GRASPINNO pilot for UPatras was recorded. The tender concerned the installation of net metering contracted PV roofs at 13 public schools in Kozani and included several green criteria, identified by the partnership during GRASPINNO. The tender was published in August 2017, but unfortunately some unpredicted parameters caused delays in the procurement procedure.

These parameters refer to the appeals that were lodged by some of the rejected bidders after the technical evaluation executed by Municipality of Kozani, which is the contracting authority of the tender. The appeals have not been yet resolved and for this reason the evaluation procedure cannot be continued to the economic offers. As a result, the contracting authority cannot take the final decision for the successful bidder and cannot proceed with the procurement and the installation of the procured products and services.

When the appeals will be resolved and the installation of the products and services will be concluded, UPatras and Municipality of Kozani will have the opportunity of installing monitoring equipment at the pilot sites, as it was initially planned, and collect energy consumption data in order to analyze the final energy class of the buildings.

The final conclusion concerning the public procurement procedures that derived from the tender published by Municipality of Kozani is that unpredicted factors, such as bidders' appeals can cause delays and change suddenly the time plan, not only of the whole procurement procedure, but also of the activities that involve the installation of the procured products/services.

Thus, the lesson learnt from the pilot is that the time planning of a procurement procedure has to be done taking into consideration unexpected parameters. The people in charge should not plan based only on the time period of each phase of the procurement procedure, as these periods are described by the national legislation. On the contrary, extended time periods should be taken into account, so as to ensure the successful results of the procurement procedure.

5. EQUIPMENT TO BE USED AFTER THE REFURBISHMENT

In the framework of WP3 and more specifically in the framework of pilots, special equipment was planned to be installed in the pilot sites after the refurbishment so as several energy data can be collected. The equipment, which is described in detail in the following annex, was

bought and installed in a building in Kozani. Since the pilot sites were not refurbished in the set time plan due to the appeals in the procurement procedure, the equipment was installed in a different building so as to be tested. After the refurbishment of the pilot buildings the equipment will be re-installed for collecting the needed data and further analyzing them.

The equipment is installed in the Technological and Research Center building (KTE), and more specific in the Renewable Energy Laboratory where a Photovoltaic grid power is installed for training purpose. It consists of KNX power supply 29V DC, a USB port, a line coupler, switch on-off actuators with current detection and security terminals. The equipment is used to expand the existing KNX installation in the laboratory and more specific to add functions and as energy consumption measurements in order to have maximum energy management and maximum energy saving.

The equipment measures and compares online the energy produced by the PV panels and the energy consumption in the laboratory. If energy from PV is sufficient then all consumables can be switched on and consume energy from PV installation.

Otherwise either the equipment turns down non-critical consumables in the installation or change the initial power source from PV panels to public grid.

This function will be a great advantage for the future as the energy will have more than two tariffs and these tariffs will be dependent from Renewable Energy Sources and weather conditions. Measurement data is stored in the laboratory's server for processing purpose and is available for uploading in the laboratory's website for the public.

Moreover, the telegram traffic in the installation can be exported to html or csv files. Identical equipment will be installed next month in 13 schools in Kozani's Municipality.

5.1 ANNEX (DESCRIPTION OF THE EQUIPMENT)

- **MTN684032**

For generating the bus voltage for a line with up to 64 bus devices.With integrated choke to decouple the power supply from the bus and a push-button to disconnect the power and reset the bus devices connected to the line. For installation on DIN rails TH35 according to EN 60715. The bus is connected using a bus connecting terminal; a data rail is not necessary. Nominal voltage: AC 110-230 V ±10%

Operating voltage: min. AC 92 V - max. AC 253 V

Mains frequency: 50-60 Hz ±10%

Output voltage: DC 30 V

Output current: max. 320 mA, short-circuitproof

Device width: 4 TE = approx. 72 mm

Contents: With bus connecting terminal and cable cover.

- **MTN681829**

For connecting a programming or diagnostics device with a USB1.1 or USB2 interface to the

KNX.

With integrated bus coupler. For installation on DIN rails TH35 according to EN 60715. The

bus is connected using a bus connecting terminal; a data rail is not necessary.

Device width: 2 modules = approx. 36 mm

Contents: With bus connecting terminal and cable cover

- **MTN680204**

For logical connection and electrical isolation of lines and areas.

For installation on DIN rails TH35 according to EN 60715. The bus is connected using a bus

connecting terminal; a data rail is not necessary.

KNX software functions: The device can be used as a backbone / line coupler or as a

repeater for forming line segments in existing or new KNX systems. The function as a coupler

or repeater can be parameterised.

Functions as coupler

Use as a backbone or line coupler depending on the physical address. Reduction of the bus

load through the filter function (filter table). Support of the full address area (Group 0-31) with

filter function. Forwarding of physically addressed telegrams (line => main line, main line =>

line) can be parameterised. Forwarding of group telegrams (line => main line, main line =>

line) can be parameterised. Telegram repetitions in the event of transmission errors can be
set separately for group telegrams, broadcast telegrams and physically addressed telegrams.
Telegram confirmation for group telegrams and physically addressed telegrams can be parameterised
separately.

Functions as repeater

Expansion of a line to max. 4 line segments with up to 64 participants each (incl. line coupler
or repeater). Telegram repetitions in the event of transmission errors can be set separately for
group telegrams, broadcast telegrams and physically addressed telegrams. With repeaters,
the telegrams are always forwarded.

Device width: 2 modules = approx. 36 mm

Note: With the coupler/repeater 7116/1.1 application, the entire group address range from 0
to 31 can be used for the filter function of the coupler (support for extended group addresses).
This application requires ETS 4.1 or higher.

Contents: With 2 bus connecting terminals.

- **MTN647395**

For independent switching of two loads via make contacts. The actuator has integrated current

detection that measures the load current on each channel. All 230 V switch outputs can be
operated with manual switches. With integrated bus coupling unit.
A green LED indicates that the device is ready for operation once the application has been
loaded. The load is connected with screw terminals.
For installation on DIN rails TH35 according to EN 60715. The bus is connected using a bus
connecting terminal; a data rail is not necessary.
KNX software functions: Operation as break contact or make contact. Staircase lighting
function with/without manual OFF function and switch-off warning. Delay functions. Scenes.
Logic function. Blocking or priority control. Feedback function. Status. Central function with
delay. Parameterisation for bus voltage failure and recovery. Behaviour for download.
Current detection function: Behaviour when value exceeds/falls short of the threshold value.
Energy, operating and switch on counter with limit value monitoring.
Flash function.
Nominal voltage: AC 100-240 V ±10%
DC 12-24 V, 0.1-16 A
Operating voltage: min. AC 90 V - max. AC 265 V
Mains frequency: 50-60 Hz ±10%
For each switching contact:
Switching current: 16 A, cosφ= 0.6
AC1 operation: max. 16 A

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AC3 operation: max. 10 A

AC5 operation: max. 16 A

DC current switching capacity: max. 16 A/ 24 V DC

Output life endurance:

Mechanical: >106

AC1/AC3/AC5 operation: >3x104

230V, 1A resistive: >8x105

Maximum peak inrush-current:

150µs: 600 A

250µs: 480 A

600µs: 300 A

Current detection (load current):

Detection range: 0.1 A to 16 A (sine effective value or DC)

Sensing accuracy: +/- 8% of the current value at hand (sine) and +/- 100 mA

Frequency: 50/60 Hz, for alternating current (AC)

Description: 100 mA

Device width: 2.5 modules = approx. 45 mm

Contents: With bus connecting terminal and cable cover.

- **MT/U 2.12.2**

The Security Terminal provides a compact security solution for KNX applications for detection and signalling of intrusion, personal attack and technical hazards. They are used as the
interface between the security technology sensors and KNX.

Depending on the configuration, the devices feature 2, 4 or 8 inputs – so-called detector circuits or zones. They are used for monitoring

connected passive detectors (e.g. magnetic contacts, glass break sensors, etc.) to the ABB i-busR KNX as well as for connection of floating contacts in applications with enhanced security requirements.
Through the connection of security technology and KNX, the detectors employed can, in addition to the security functions, also be used for heating control (e.g. window contact signal
for control of the heating valve) or lighting control (e.g. central switch off of the lighting when the alarm logic is set).
The Security Terminals can be used as autonomous systems with the integrated alarm logic, in conjunction with the Security
Module SCM/S or with an Intrusion Alarm Panel GM/A 8.1 or L240.
The application program offers several functions for security applications, such as

-- Direct and delayed setting
-- Internal setting with occupancy and external setting when absent
-- Setting of the connected detector types
-- Reset input and setting input
-- Detector monitoring
-- Zones (detector circuits) can be switched off
-- Different types of alarms
-- Setting for freely programmable relay outputs, e.g. for direct control of signalling devices.

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- **TERRE DI SIENNA LAB (PP2)**

1. INTRODUCTION

The main objective of this report is to provide on overall description and evaluation of the pilot actions carried out by TSL for GRASPINNO.

With reference to the TSL pilot tenders, that had to be prepared by the end of the 2017 (extraordinary maintenance of the Staggia Senese Gymnasium and the Middle school «Leonardo da Vinci» in Poggibonsi), the timing for the tender implementation is changed partially. As regards the Extraordinary maintenance of the Staggia Senese Gymnasium", not only the tender is closed but also the refurbishment is completed.

For the other project, the Middle School «Leonardo da Vinci», the Municipality of Poggibonsi has decided to change the financial tool, using the National Plan for the School Building instead of the lifting of restrictions on the Stability Pact (the tool used for Staggia Senese Gymnasium) and the tender will have a delay; it allows to the Municipality to refurbish other buildings beyond those individuated as pilots.

2. PROGRESS OF TENDER PROCEDURE

As regards the Staggia Senese Gymnasium, the tender has been regular (in time) and the intervention is completed. It allows to have a general assessment of the tender procedure.

On the opposite, the intervention on the Middle School «Leonardo da Vinci» will be financed with the the National Plan for the School Building, a government decree that rules the plan will be published by the end of February; only immediately this step the municipality can prepare the call for tender. The project documents are already prompt and they don't have anything different from those prepared for the lifting of restrictions on the Stability Pact.

It means that a tender procedure analysis is possible only on the Staggia Senese Gymnasium. In particular, two are the analyzed aspects: the CAM (Minimum Enviromental Criteria), application and the impact on LCC. As regards CAM, the tender follows the new procurement code which requires the introduction of CAMs for building renovations, but the application of CAMs can be improved because it is not well detailed. In terms on environmental and economic impact, TSL has followed the new assessment procedure stated in GRASPINNO represented in the table:

Table 1. Measuring the efficiency of the LCC tools

Level	Order	Presence (score)	Absence (score)
Ex ante LCC application	I	Yes (3)	No (0)
New product with Lower LCC value	II	Yes (2)	No (0)
New product with lower CO2 emission value	III	Yes (1)	No (0)

As showed in the deliverable 3.10.4 the ex post analysis shows a reduction of energy consumption and CO2 emissions. This gives a score equals to 3, the level considered enough to have a positive result.

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3. ESTIMATION OF ENERGY SAVINGS AFTER THE REFURBISHMENT

At the moment, there are no official energy consumption data collected for the pilot sites after the refurbishment; it implies that only energy data audit are usable. Anyway, for the Staggia Gymnasium will be possible to verify real data very soon.

On the basis of energy audits the estimations are:

For the Staggia Senese Gymnasium:

- Energy saving in thermal kwh: 23854,347
- Avoided CO2 emissions in tons: 5,036
- Energy class before the refurbishment: D
- Energy class after the refurbishment: C

For the Middle school «Leonardo da Vinci»:

- Energy saving in thermal kwh: 45670,878
- Energy saving in electrical kwh: 104,79
- Avoided CO2 emissions in tons:

9,64(thermal)+0,042(electrical)=9,682

- Energy class before the refurbishment: B
- Energy class after the refurbishment: A2

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4. CONCLUSIONS

The final conclusion concerning the public procurement procedures is that the tenders for energy refurbishment of public buildings are very complicated and the financial sources play an important role on the time plan. Anyway, the presence of public financings is not enough for defining a time planning for a great numbers of pilots. In some cases the financial resources are stopped for other issues (for instance: the absence of energy audit or detailed projects). This is the explanation why TSL has opted for a long-term planning that uses the Public Private Partnership. Extended time periods should be taken into account, so as to ensure the successful results of the procurement procedure and increase the number of the interventions.

- **MOUNTAIN COMMUNITY ALTO BASENTO (PP3)**

1. INTRODUCTION

The main objective of this report is to provide on overall description and evaluation of the pilot action carried out by CMAB in the frame of GRASPINNO Project. As specified in the previous report (eg. Del 3.9.1) the main and common goal of the 3 pilot activities is to save electricity e reduce the energy consumptions, in order to improve the energy performance of the selected buildings. Specifically, the buildings are:

- Palabasento, sport building in Potenza (Pz);
- Swimmng pool of municipality of Campomaggiore (Pz);
- MCAB's headquarter in Potenza (Pz);

The main common features of those public buildings are:

- high public interest;
- district valence;
- high energy consumptions.

Below are introduced some basic information about the selected pilot sites:

1. PALABASENTO

It is one of the biggest sport buildings in Basilicata Region - Potenza. It's used for basket, volley, concerts, meetings and it is located in Potenza (Pz). It's capacity is about 2.500 seats. Its total surface is about 6.000 square metres (height of the building is 15 metres). Palabasento has a low usage but it is an energy-intensive building (annual average cost of electric energy is about € 10.000,00 / 13.000,00, it depends on frequency of use):

- Annual average consumption: 50.000 kw
- Voltage: 15.000 V
- Average operation: max 5-6 days per month (8-12 hours per day, depends on the kind of event, eg. sport, meetings, concerts)

2. SWIMMING POOL – Campomaggiore

It is a public swimming pool located in Campomaggiore (PZ). There are two pools: a big pool (24m x 12m) and a small pool (12m x 6m).

Its total surface is about 500 square metres (height of the building is 6 metres). Campomaggiore's Public Swimming Pool has high fixed costs for electricity (annual average cost of electric energy is about € 11.500,00):

- Annual average consumption: 30.070 kw
- Voltage: 380 V
- Average operation: 4 days per week (around 10 hours per day).

3. CMAB HQ

It is the headquarter of the Mountain Communiry Alto Basento. Its total surface is about 500 square metres and the annual average cost of electric energy is about 10.724,00

- Annual average consumption: 19.875 kw
- Voltage: 380 V
- Average operation: 5 days per week (12 hours per day).

The choosen public buildings are energy-inefficient but they have a key role in the frame of the district (public services to the local community). Therefore, the pilot activities have been implemented in order to improve the energy efficiency of the choosen public buildings and concerned the installation of a **static autotransformer with**

electronic control and PWM technology electricity saving (Pulse Width Modulation). The objectives of the pilots were:

- energy and costs saving (around 12% per year);
- interference reduction;
- lower maintenance costs;
- continuous voltage modulation;
- web based energy management system.

The Public Procurer was the CMAB – Central Purchasing body of Area Programma Basento Bradano Camastra.

2. PROGRESS OF TENDER PROCEDURE

The tender procedure has been completed on the **09th of March 2018**, date in which the contract with the service and product provider was signed. It's important to specify that CMAB opened one procurement procedure for the 3 selected buildings.

Below is described the overall tender procedure for the tree pilot actions.

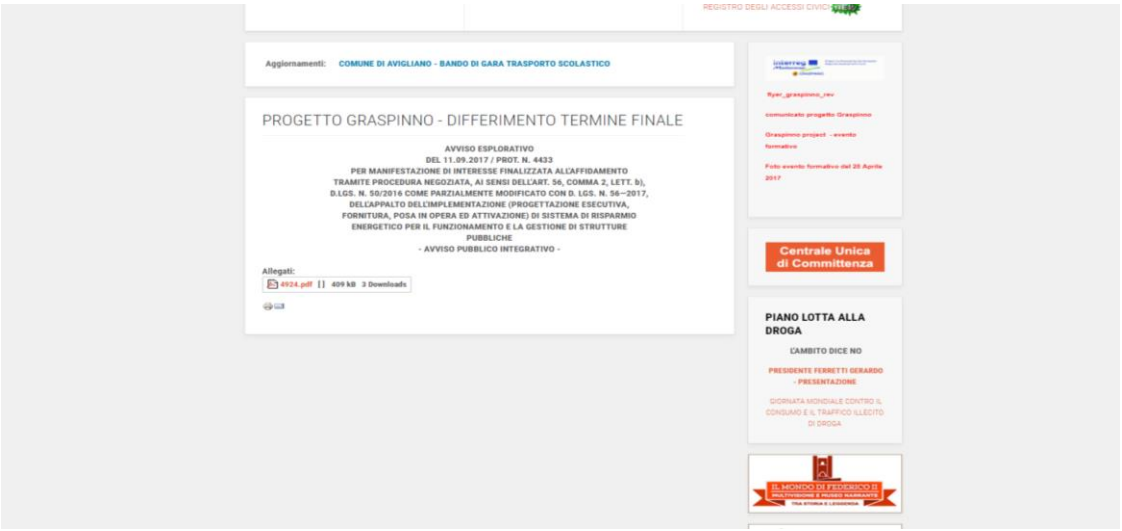
THE CALL FOR EXPRESSION OF INTEREST

The Public Procurer was the CMAB – Central Purchasing body of Area Programma Basento Bradano Camastra.

On 11th of September 2017 was opened the Call for expression of interest which was addressed to the ESCOs qualified under the Long List of the Central Purchasing Body of the Area Programma Basento Bradano Camastra. Info at: http://bit.ly/2jk5jx0

On the 2nd of October 2017 the deadline was postponed to the 6th of October 2017. Info at: https://goo.gl/PaAf2L

Below is pasted a screenshot of the Call for Expression of Interests on the CMAB's website.



Documents annexed to the report:

- Call_for_expression_of_interest
- Call_for_expression_of_interest_postponed

As specified in the intermediate report on the pilots projects, the fourth building / pilot project (Nursery School) was included in the call for the expression of interests but it will not be implemented because of the lack of financial resources.

The assessment against administrative, exclusion and eligibility criteria was completed on the **11th January 2018**. The three companies have met the minimum requirements for direct award, according to the, art. 36, comma 2, let. a), D.Lgs. 50/2016, as subsequently amended and supplemented.

It's important to consider that the CMAB's annual budget for the financial year 2018 has been approved with **Decree N.2 on the 31 of**

January 2018, according to the italian regulation for the public administrations.

CMAB, as specified before, despite not having a specific cost line for pilot activities in its annual budget 2017, decided to activate the procedure for the call for expression of interest in September 2017, according to the national law for Public Procurement (art. 98 D. Lgs. 50/2016). This solution enabled a kind of pre-selection of eligible partecipants and allowed CMAB to save time for the finalisation of the tender administrative procedures, which otherwise, would've been finalised too late and with a timing not compatible with GRASPINNO timeline.

THE NEGOTIATED PROCEDURE

- on the **05th of February 2018** CMAB started the negotiated procedure (invitation to the SMEs which applied to the call for expression of interest)
- on the **05th of March 2018** CMAB received one economic proposal received (Ecoclima SAS di Vincenzo Mattiace & Co.)
- on the **06th of March 2018** CMAB started the assestment against the received economic proposal
- on the **06th of March 2018** CMAB approved the economic proposal (eur 36.897,39)
- on the **09th of March 2018** the contract was awarded
- on the 13th of March 2018 the company Ecoclima SAS di Vincenzo Mattiace & Co. started the on-site inspections in order to start the installations

3. ESTIMATION OF ENERGY SAVINGS AFTER THE REFURBISHMENT

The installation of the products has still to be done, despite it was expected in April. More time than expected was needed to set-up the softwares in compliance with the building's features. Anyway, the installation will be performed no later than the end of June and probably before of the 10th of June.

Therefore, there are no energy consumption data collected for the pilot sites after the refurbishment. CMAB estimated the energy savings that will occur after the installation of the procured products and services for each one of the school buildings. The estimations are presented in the following tables:

BUILDING	**CURRENT ENERGY COSTS** (per year)	**KPI 1** FUTURE ENERGY COSTS (per year)	**CURRENT ENERGY CONSUMPION** (per year)	**KPI 2** FUTURE ENERGY CONSUMPTION (per year)
PALABASENTO	€ 13.000,00	€ 11.400,00 (- € 1.560,00)	50.000 KW	44.000 KW
CAMPOMAGGIORE'S S SWIMMING POOL	€ 11.500,00	€ 10.000,00 (-€ 1.380,00)	30.070 KW	26.462 KW
CMAB'S HQ	€ 11.000,00	€ 9.600,00 (- € 1.320,00)	19.875 KW	17.490 KW

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4. CONCLUSIONS

In the present report, the progress of the procurement tender which is considered as GRASPINNO pilot for CMAB was recorded. The tender concerned the installation of a static autotransformer with electronic control and PWM technology electricity saving (Pulse Width Modulation) on each selected bulding. CMAB included in tender several green criteria, according to the italian and EU regulation and GRASPINNO approach. The tender was published in September 2017, but unfortunately some administrative and financial parameters caused delays in the procurement procedure. Anyway, the technical and administrative arrangements made by the CMAB allowed to save a lot of time and to not affect the GRASPINNO Project proper implementation.

During the GRASPINNO project implementation CMAB acquired a strong awareness about the importance to set up an innovative joint management of the EE / RES energy policies and interventions, given that CMAB works on behalf of several small and rural villages which can't plan and manage mid and long term EE / RES strategies (because of the lack of funds and the lack of specific competences).
That's why CMAB will start to work to identify and to establish a permanent **Energy Manager** with district valence. The energy manager will take care of:

- Energy consumptions monitoring on behalf of the associated municipalities
- Feasibility studies
- EE / RES strategies
- Financial incentives

This important challenge has been focused during the Living Lab implementation.

Thus, the lesson learnt from the pilot is that it's not easy to ensure a quick implementation of the pilot projects through public procurement, therefore the time planning of a procurement procedure has to be done taking into consideration several unexpected parameters.

- **ASSOCIATION OF CHAMBERS OF COMMERCE OF VENETO REGION (PP6)**

INTRODUCTION

This document refers to the work of REFURBISHMENT WITH IMPROVEMENT OF ENERGY PERFORMANCE AND SEISMIC ADJUSTMENT OF THE "PADRE ANGELO CODELLO" ELEMENTARY SCHOOL IN THE LOCATION OF S. PIETRO DI BARBOZZA, to be carried out on behalf of the MUNICIPALITY OF VALDOBBIADENE, Veneto Region, Italy.

The building represents a volume consisting of two main floors, one of which is completely above ground, and a basement. The roof is made by two pitches, characterized by an impracticable attic. From an architectural point of view, the building is made up of five modules, that are placed against each other, with staggered floors, joined together to form a single body. The internal width of each module is constant and equal to 7 meters (corresponding to the light of the floors), while in length elements of 18.8 meters alternate with elements of 14.8 meters.

The building has 7 classrooms, as well as a multipurpose area and four toilet blocks, closets, laboratories and a teachers-room.

The structure of the building is in masonry, with two heads walls of a thickness of 25 cm. In addition to the masonry characteristic, the building, against the ground in the North side, is made in reinforced concrete with a thickness of 25 cm. The inter-floor slabs and the roof are in masonry.

Figure 1. School building front view

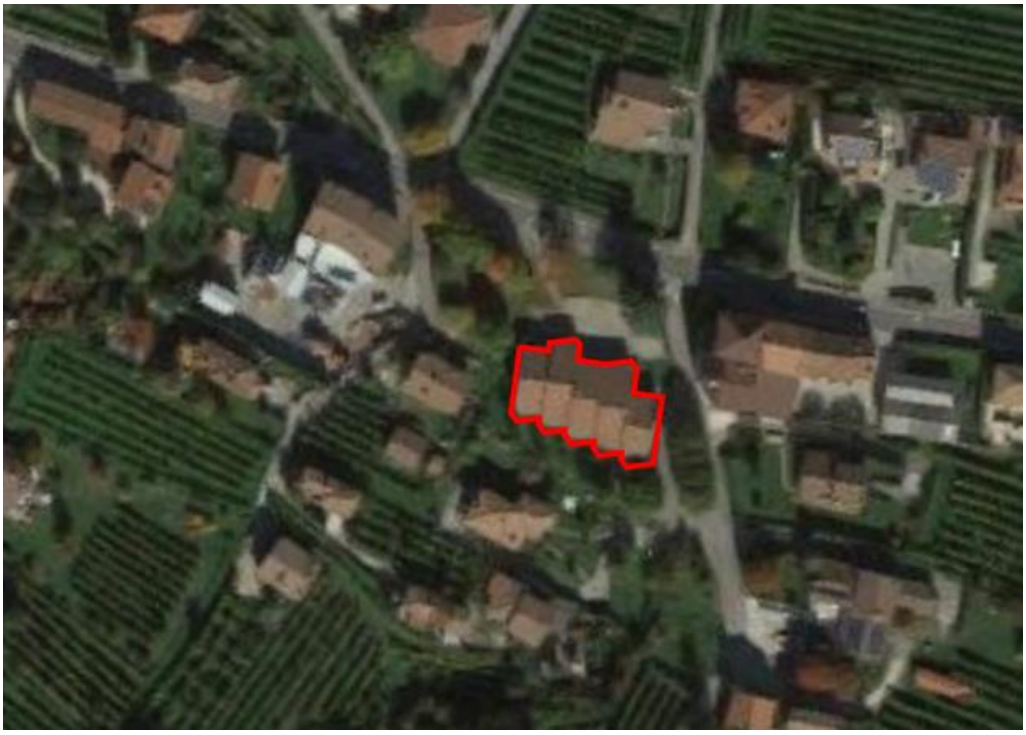

Figure 2. Aerial view

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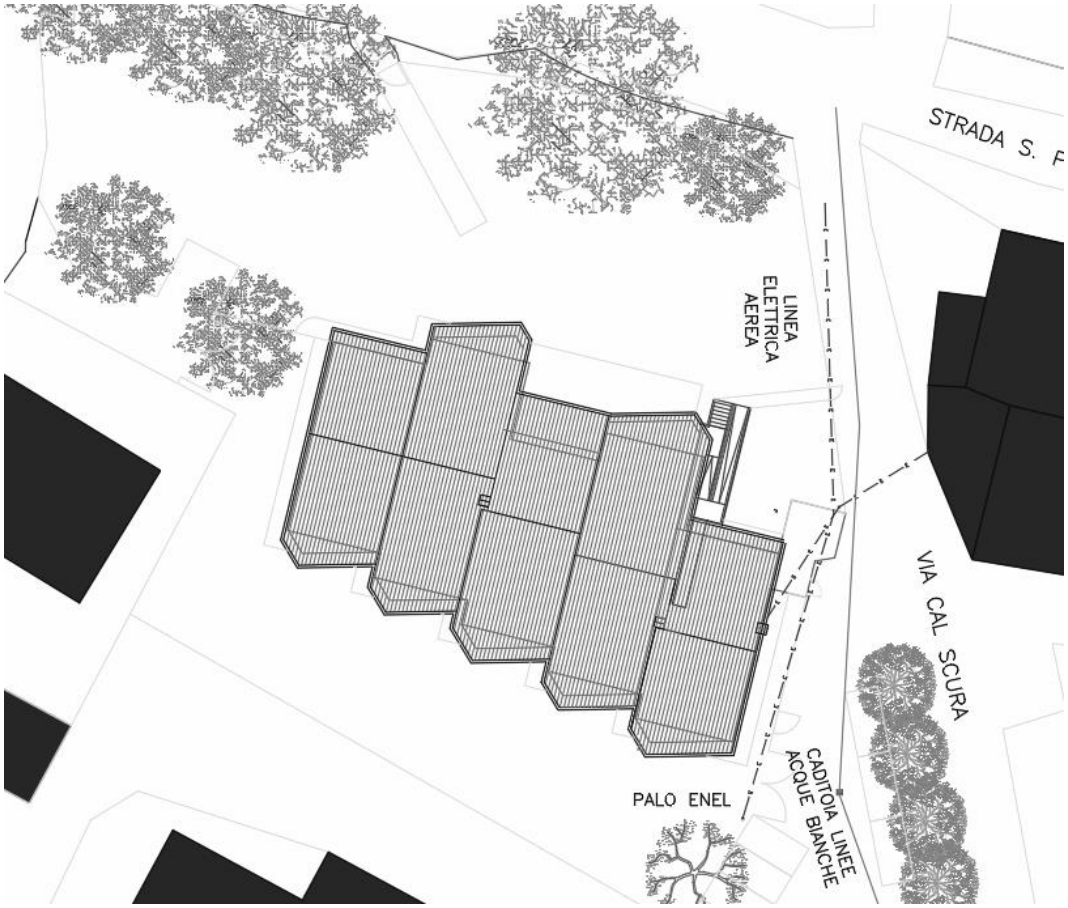

Figure 3. Planimetry of the school building

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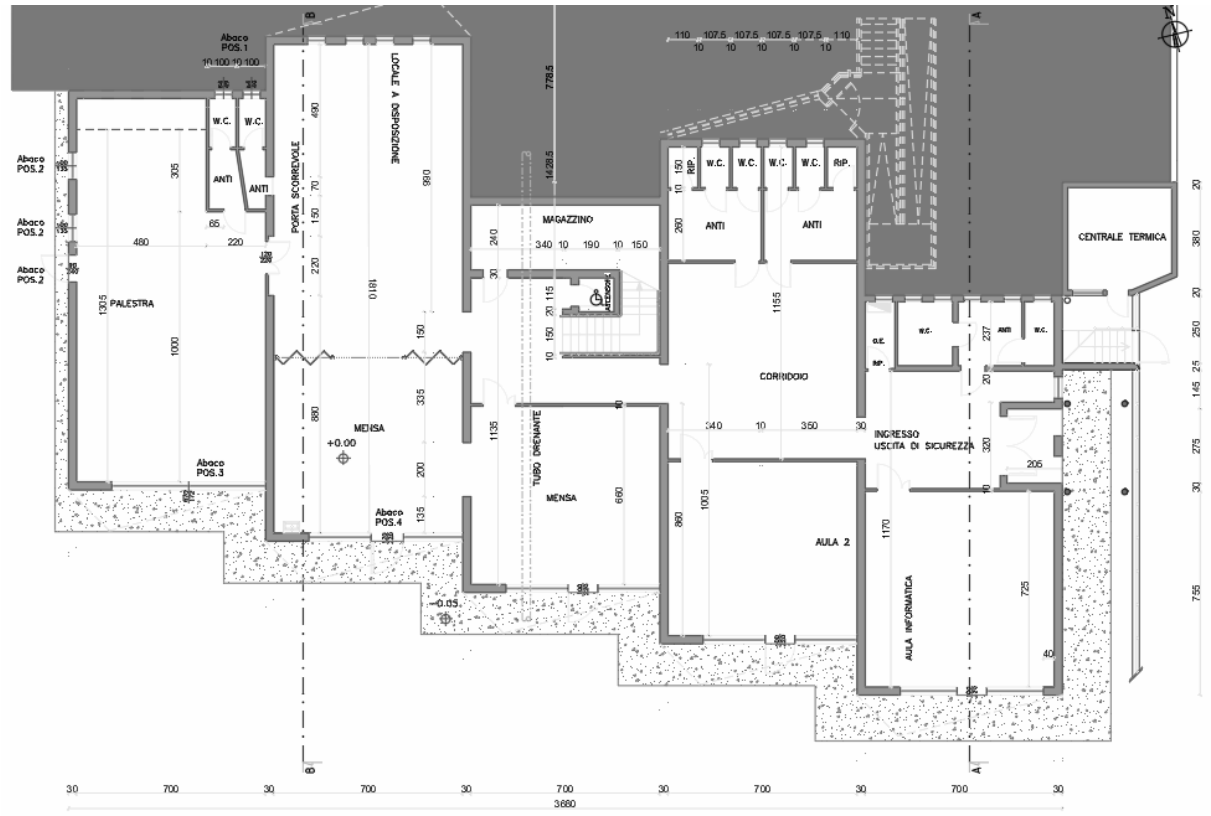

Figure 4. Basement floor plan

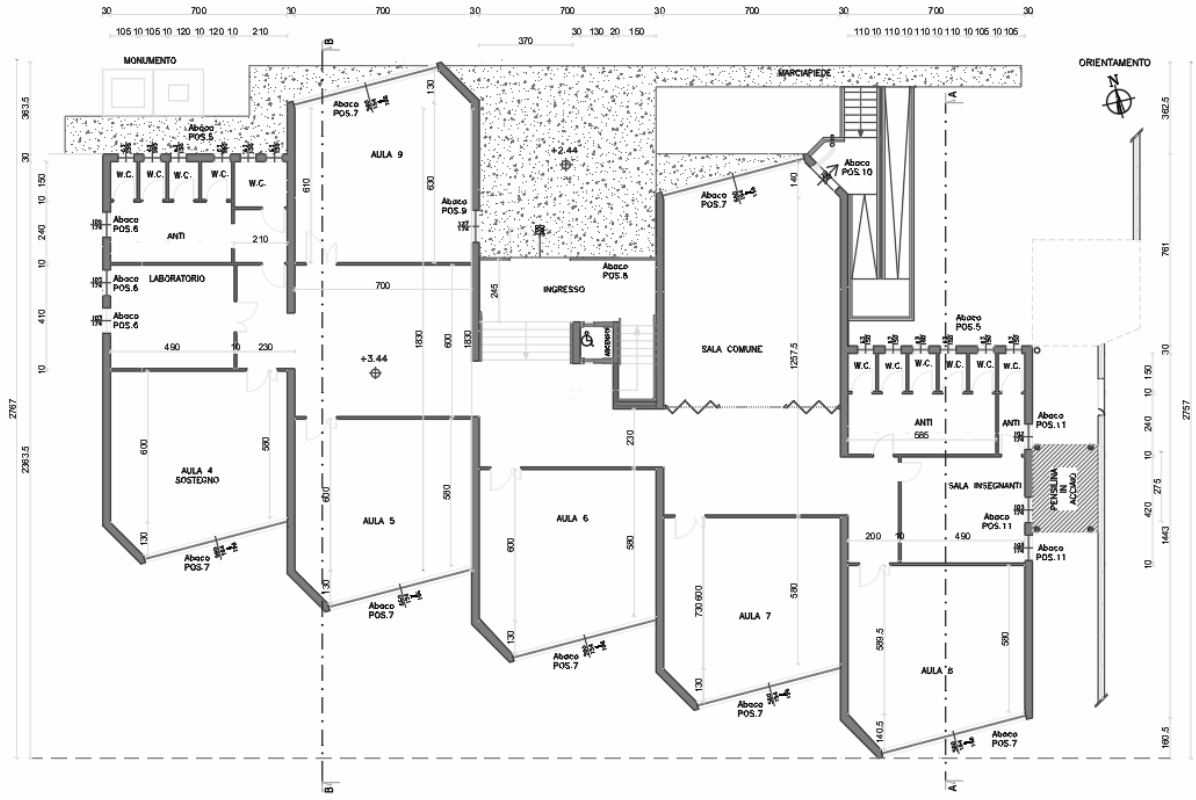

Figure 5. In-plan projection of the ground floor

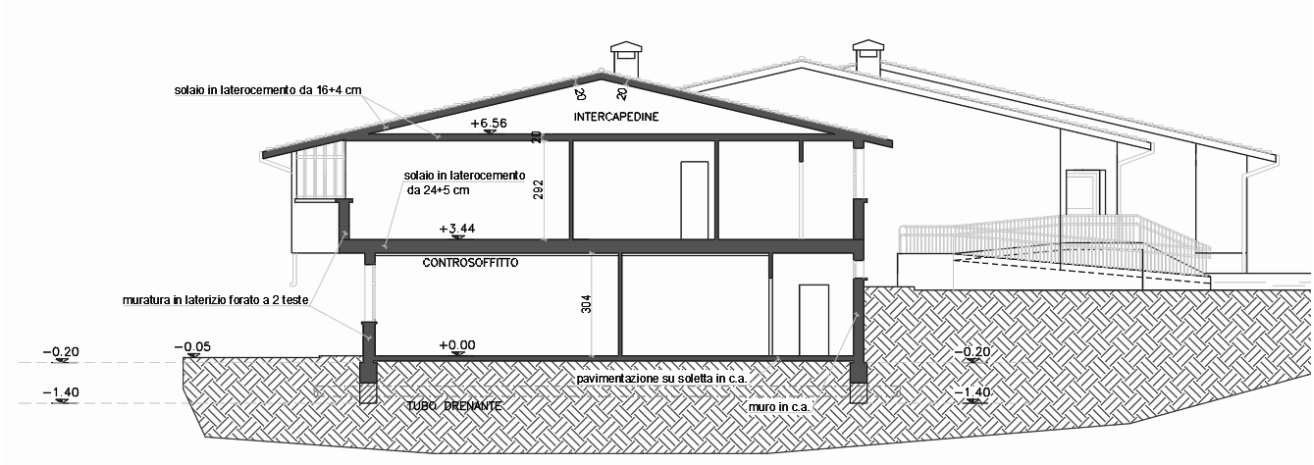

Figure 6. Altimetric section

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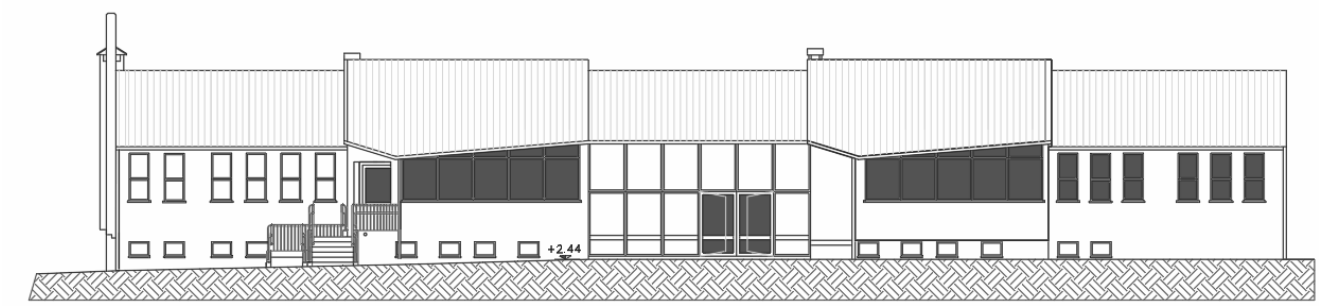

Figure 7. North side building elevation

Figure 8. South side building elevation

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1. PILOT SITE INITIAL CONDITION

Audits of pilot site

The primary result of the project is a satisfactory seismic adaptation of the building to current regulations and the simultaneous improvement of its energy performance, with methods that respect the minimum environmental requirements of products and materials used. As regards the energy performance of the school building, from an initial assessment of the state of the building, carried out keeping in mind the UNI 16247 part 1-2 and UNI CEI TR 11428 procedures, an estimated annual non-renewable energy consumption per unit of surface was calculated. The resulting number is located at the bottom of the energy scale of characterization of buildings (Class E). A second expected result is the acquisition of knowledge and skills to apply GPP procedures and tools in a systematic manner in other future renovations of public buildings, within a transnational competence network.

The following table contains the description of the main objectives of thermal improvement, which is to be achieved with the project, with reference also to the types of new materials to be used.

Pilot Objectives	The aim of the intervention on the Elementary School is to make a seismic adaptation of the structure to bring the risk level of the building within the values foreseen by the seismic classification of the area and at the same time to make improvements to the thermal performance of the building through the replacement of part of the fixtures, the roof thermal insulation and the realization of appropriate measures in the plastering of the walls subject to chaining and cording. From the point of view of energy performance

	of the building, the KPI (Key Performance Indicator), taken into consideration, is the total annual thermal dispersion of the building per square meter, used in Italian and European legislation to define the energy classes with reference to the certification of the energy performance of buildings. The goal is to reach the energy class C, which corresponds to a total annual energy consumption to heat the building per surface unit, between 116 and 145 kWh / m2 * year. Within this general objective the pilot intends to verify the application of the regional provisions in terms of minimum environmental criteria (CAM) for products and renovation works of public buildings, taking into consideration the tools developed by the GRASPINNO project, of which the Veneto Region is a partner, together with Unioncamere del Veneto.
EE/RES category	Energy efficiency
EE/RES subcategory	**Improvement of the thermal performance of the building envelope, with particular reference to non-opaque parts (glazing)**
product type	Insulating glass, double insulation consisting of: 4 + 4 stratified glass external sheet with interposed PVB layer (0.76); 16 mm chamber; inner plate: 4 + 4 laminated glass with interposed PVB layer (0.76).
product green characteristics	The overall thermal transmittance of the new frames must not exceed 1,30W / sq.m. * K. Materials and installation systems in accordance with the CAM (Minimum Environmental Criteria) for the external window frames.
Green evaluation system of characteristics and products	Energy performance values and characteristics of the materials below the minimum thresholds set by the applicable CAMs are not accepted. A specific score will weigh the values above threshold, both related to the

	mandatory and to the rewarding ones.
EE/RES subcategory	**Improvement of the thermal performance of the building envelope**
product type	replacement of fixtures
product green characteristics	The whole thermal transmittance of the wall must not exceed 0.23 W/sm*K
Green evaluation system of characteristics and products	Energy performance values and characteristics of the materials below the minimum thresholds set by the applicable CAMs are not accepted. A specific score will weigh the values above threshold, both related to the mandatory and to the rewarding ones.
EE/RES subcategory	**Improvement of the thermal performance of the building, with particular reference to the horizontal opaque parts**
product type	Creation of insulation layer at the attic floor
product green characteristics	The overall thermal transmittance of the roof wall must not exceed 0.20W / m²K.
Green evaluation system of characteristics and products	Energy performance values and characteristics of the materials below the minimum thresholds set by the applicable CAMs are not accepted. A specific score will weigh the values above threshold, both related to the mandatory and to the rewarding ones.
EE/RES subcategory	**Improvement of the energy performance of the heat generator.**
product type	Replacement of the existing Standard old Heat Generator with a Condensing new Heat Generator
product green characteristics	The generator, with a thermal power higher than 35 kWt, will have an effective efficiency ≥ 93 + 2 * log Pn.
Green evaluation system of characteristics and	Energy performance values and characteristics of the materials below the minimum thresholds set by the applicable CAMs are not accepted. A specific score will

products	weigh the values above threshold, both related to the mandatory and to the rewarding ones.
EE/RES subcategory	**Improvement of the energy performance of the lighting system.**
product type	Replacement of fluorescent lighting system with LED lighting.
product green characteristics	LED luminaires will have luminous efficiency of at least 110 Lumen / W. With an estimated energy saving of 50% of the installed electrical power.
Green evaluation system of characteristics and products	Energy performance values and characteristics of the materials below the minimum thresholds set by the applicable CAMs are not accepted. A specific score will weigh the values above threshold, both related to the mandatory and to the rewarding ones.
Estimated budget	The budget for the entire project is € 696,000.00, of which € 547,500.00 for works that will be based on public auction

Below are some photos of the actual state of the windows to be replaced and other details on which to intervene to improve the energy performance of the building.

The currently installed windows and doors have an estimated overall thermal transmittance of 2.80 W / m²K.

FOTO 1

FOTO 2

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Identifications of KPIs

From the point of view of energy performance, the KPI (Key Performance Indicator) is taken into account, the annual consumption per square meter of non-renewable energy, necessary to heat the building as a whole. This indicator is used in Italian and European legislation to define the energy classes in the energy certification of buildings. KPI = [KWh / mq * year].

KPIs implementation

Following the preliminary energy audit of the CODELLO school building and the assessment of improvement of energy performance resulting from the total planned interventions, the overall energy class objective of the building (EP gl, nren - according to UNI CEI EN 16247-1-2 , UNI CEI / TR 11428) is fixed in the B CLASS, corresponding to 49.08 KWh / m2 * year. The total number of planned interventions on the school building for energy improvement can be so summerized:

- Substrate ceiling insulation
- External building coat
- Thermal power plant efficiency
- Application of thermo-static valves to radiators
- Lighting system replacement
- Window replacement

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2. TENDERS

Preparation using the eGPP platform

For the preparation of the call for tender there has been a fruitful collaboration with Unioncamere del Veneto, partner of the Graspinno project, which has started to transfer to the municipal administration what has been developed in terms of tools and EGPP platform.

Publication of the real tender

The call for tenders was prepared in accordance with the laws in force:

• LEGISLATIVE DECREE 18 April 2016, n. 50 - Implementation of the directives 2014/23 / UE, 2014/24 / UE and 2014/25 / UE on the awarding of concession contracts, on public procurement and on the tender procedures of the supplying bodies in the water sectors, of the energy, transport and postal services, as well as for the reorganization of the current legislation on public contracts relating to works, services and supplies. (16G00062) (GU General Series n.91 of 19-04-2016 - Ordinary Supplement No. 10)

• The corrective decree to the code of public contracts (Legislative Decree No. 56/2017)

To participate in the call for tenders 20 companies were invited, with a negotiated procedure through an unofficial bid. The determination by the Manager (RUP - sole responsible for the procedure) of public works in the municipality of Valdobbiadene took place on 15-11-2017

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Tenders evaluation system

The evaluation of the responses to the announcement can be found in the minutes of the municipality of Valdobbiadene on 12.12.2017.

The award is made at the largest discount rate with the modalities, established by the letter of invitation, for the definition of the reference parameters for the calculation of the anomaly threshold, among those provided for in article 97 c.2 of the legislative decree 18-04-2016, No. 50 of Italian Government.

Results of the tenders

The assignment of the renovation activities took place through the contracting authority of the Feltrina Mountain Union in the presence of the RUP on 12-12-2017. The company CO.FA.M srl of Rome-Italy has been awarded with the contract.

The resulting economic numbers are as follows:

Auction-based amount including security charges	€ 554.113,71
Site security charges (not subject to auction discount)	€ 20.500,00
Discount rate (percentage)	14.966%

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3. INSTALLATION OF SUPPLIED PRODUCT/SERVICES

Carried out from the beginning of works to date

The works were delivered from the municipality of Valdobbiadene to CO.FA.M srl on 06.03.2018. On 08.04.2018 there was a partial suspension of the workings, because rock wool was found inside the false ceilings, which turned out to be carcinogenic, after analysis by an authorized laboratory. For these reasons, interventions on the building are currently suspended. The works carried out so far are related to some excavations for the construction of new foundations, the demolition of some walls and the removal of false ceilings (see photos below).

Photo 1 - Demolition of walls

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Photo 2 - removal of false ceilings

Photo 3 - excavations for the construction of new foundations

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Difficulties faced in the application of minimum environmental requirements

So far there has not been the supply of materials and components for which minimum environmental requirements are requested. However, the company winner of the tender shows itself not completely familiar with such topics.

The "environmental report" required in § 8.1 of the technical specification dedicated to the Minimum Environmental Requirements attached to the executive project, contemplating an inspection prior to the demolition, the delivery of the demolition and recovery plans and the signing of a commitment to treat the demolition waste or to give it to an authorized waste recovery facility, unfortunately, till now, has not yet been produced by the winner company.

Timeline

Probably the works of the refurbishment will end at the beginning of December 2018. The tender and the related contracts for the replacement of windows and doors and the lighting system have not been issued yet, because the Contracting Authority Feltrina Mountain Union is waiting for the reply from the italian authority GSE on the request, made in December 2017, for the thermal account 2.0 co-funding procedure, which guarantees the partial economic coverage of the intervention.

4. CONCLUSION

The energetic renovation works of the building of the Codello school of Valdobbiadene began as planned and, after a first start, which showed a quick completion of the intervention, the works stopped temporarily, due to the discovery inside the false ceilings of old rock wool, now considered dangerous. In any case, the end of the work is scheduled for December 2018. Only after this date we will be able to verify if the energy performance of the renovated school building will be such as to comply with the energy forecasts made.

Lastly, to be noted as Unioncamere Veneto, in close collaboration with partner Terre di Siena, has facilitated the application of the LCC tool of the eGPP platform to the the refurbishment calculations of the Codello school and at the same time was also tested the new version of the LCC tool, developed from the partner Terre di Siena.

Terre di Siena's LCC tool is structured in such a way as to calculate the LCC value in the initial pre-investment situation and compare it with the LCC calculated on the basis of the investments made for improving the energy performance of the school building.

The LCC tool also allows to evaluate the disjoint contribution of the single energy saving intervention (as if only the partial intervention was done and not the others) (eg only windows replacement, boiler replacement only, etc.). The Pay back period of the single intervention is also calculated.

Always using the LCC tool by Terre di Siena, it is possible to evaluate the Ex ANTE and Ex POST situations in a non-disjoint way, i.e. taking into account that the decrease in energy consumption with the

progressive application of several partial interventions produces a total contribution, which is not equal to the sum of the contributions, but follows a trend as they say "compound", not linear.

From the results of the LCC calculations, above mentioned, it can be seen that in the specific case of application of interventions, which safeguard the environment, there is also an economic advantage, even if not very appreciable, considering a life span of 30 years.

In our opinion, the economic results would have been better if two important factors did not persist:

The use of the Codello School is made only for the scholastic period from September to June for five days a week. For the remaining time the school remains inactive and is not used for other purposes;

The thermal insulation of the external walls of the Codello School and the change of the windows, has been foreseen with quality elements and finishes above the average, with a consequent cost not negligible. Usually it is known that these interventions, essential for the wellbeeing of the occupants in the winter period, are characterized by a pay back that goes well beyond 30 years, a situation that worsens if the cost is quite high.

It should also be noted (this is not the case of the Codello school of Valdobbiadene) that such interventions (especially if combined with anti-seismic interventions) in Italy can benefit from national and / or regional public contributions linked to the European Structural Funds. This of course would greatly improve the return on investment for the local authority. The result is further improved if additional contributions

are added, also by accessing the Thermal Account, managed by the Italian GSE.

- **VENETO REGION (PP7)**

1. INTRODUCTION

It is one of the most valuable palaces of Santa Lucia di Piave, a little village in North East of Italy. Ancilotto Palace is a Historical residence with a park of 7.000 square meters, dating back to the end of XIX° century. Recently it has become a building under monumental constraint by the spatial planning plan and bound by the Ministry of Cultural Heritage. Once the palace was used as a summer residence of the Venetian family Ancillotto

2. PILOT SITES INITIAL CONDITION

2.1 Audits of pilot sites

Vista d'insieme di Palazzo Ancilotto da via Crispi

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Vista del salone al piano terra

The historic building is made up of load-bearing stone masonry, wooden structure interfloors, roof in a pitched structure without insulation, wooden frame with single glazed windows.

The building is equipped with a natural circulation hot water system with radiators serviced by two methane boilers located in the basement.

The obsolete electrical system consists of luminaires with incandescent and fluorescent light sources.

Expected energy consumption for lighting: KPI: 0.186 kWh/m² per year

Expected energy consumption of heating: KPI: 267.5 kWh/m² per year

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Centrale termica esistente

Terminali esistenti

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Tipologia serramenti esistenti

Vista d’insieme del sottotetto

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Vista d’insieme del sottotetto

It is a historic building bound by the Italian law "Code of Cultural Heritage and Landscape". The areas of intervention concern:
upgrading of the heating system by installing as heat generator, an electric heat pump, the replacement of glazing with transparent surfaces with "low emissive" double glazing for windows and doors, while maintaining the original frames with the addition of specific seals; the thermal insulation of the roof; waterproofing of the roof; replacement of the electrical and lighting system with luminaires with LED sources.

The building belongs to energy class G.

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2.2 Identification of KPIs

From the point of view of energy performance of the building, the KPI (Key Performance Indicator), taken into consideration, is the total annual thermal dispersion of the building per square meter, used in Italian and European legislation to define the energy classes, of reference in the certification of the energy performance of buildings. The goal is to achieve, at the end of the energy renovation of the building, the energy class E, which corresponds to a total annual energy consumption to heat the building per surface unit,

116< EPH > 145 kWh/m² per year

2.3 KPIs implementation

Scheduled interventions include:

- installation of a heat generation system with heat pump generator;
- integral replacement of air conditioning distribution and supply terminals with convector fan installation;
- restoration of the existing doors and windows with the addition of new glass-chamber glass;
- thermal insulation of the roof covering through the installation of insulating material inside the cover package;

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- installation of a new electrical system with high degree of automation . The electrical system will be equipped with radio frequency devices. A control unit will manage the system functions: video door entry phone, scenarios, automations, burglar alarm, climate control, load control, remote communication, etc... The radio frequency allows to extend the system, adding control points, actuators, sensors to all areas where it is not possible to intervene with masonry works.
- Installation of new luminaires with LED source connected to presence sensors or timers in compartments with discontinuous use.

KPI	Initial CLASS	Final Class	Total energy saving expected
EPH	Class G = 220 <EPH> 280	Class E = 116 <EPH>145	> 20%

3. TENDERS

3.1 Preparation using the eGPP platform

During the preparation of the tender of the first excerpt, the eGPP platform was taken into consideration by the professionals responsible for drawing up the project of the building refurbishment. Even if the platform contents was judged interesting, no specific products and components were used in the design specifications and requirements.

3.2 Publication of the real tender

- Contracting authority: *Municipality of Santa Lucia di Piave*
- Total budget: *2,5 mln euro*
- National legislation: *Italian Code of Procurements*
- Tender type: *Negotiated procedure using an unofficial tender procedure, divided according to the lots provided for functional excerpts*
- National publicity of the tender: *In Municipality, Province and Regional web site -*
- National procurement platform: *joint procurement platform of Municipality of Santa Lucia di Piave, Municipality of Susegana, Municipality of Mareno di Piave.*

The restoration works of Palazzo Ancilotto will be carried out by splitting the overall intervention into the following functional lots:
I excerpt, I lot*: ground floor general works: thermal system and pipeline, heating pump; roof thermal insulation.*
I excerpt, II lot*: surfaces decoration and finishing; replacement windows glazing;*
II excerpt, Lot I*: first, second and attic floors general works: thermal pipeline, heating pump, windows glazing;*

II excerpt, Lot II*: decorated areas of immovable cultural heritage and movable cultural heritage of historical, artistic, archaeological and ethno-anthropological interest, located on the first and second floors. The following indication of the Graspinno project has been included in the Special Tender Specifications:"The restoration of Ancillotto Palace has been included, in partnership with the Veneto Region, in the "Graspinno Project", a consortium initiative that includes twelve partner countries in the Mediterranean area, program INTERREG MED 2014/2020, co-financed by the European Union. The "Graspinno Project" aims to provide innovative and "green" supply solutions for the renovation of public buildings in terms of energy efficiency and use of renewable energy. In this context, the specific characteristics of the restoration are the objectives of an "energy" restoration and re-functionalization with reference to current legislation, with the recovery and reuse of materials, solutions and traditional construction techniques. The uniqueness of Ancillotto Palace allows, in concrete terms, to develop and implement an extraordinary experience to improve the efficiency of the building by improving its energy class from G to E with solutions that respect the culture of construction tradition, the use of materials and the environment in the "conservative" spirit that a cultural asset requires both for the protection to which it is subjected and for the transmission of memory to future generations. The experience that will be developed can be enhanced by the Public Administration in complex interventions on existing national public buildings and in the partner countries of the "Graspinno Project" in the Med area as required by the European initiative. The sharing of the intellectual, technical and administrative commitment of the restoration of Palazzo Ancilotto within the "Graspinno Project" could be the viaticum to enhance the experiences and generate a project and a virtuous example. Furthermore, the Special Tender Specifications specify that the worksite sign must contain the following text: PROJECT INCLUDED IN PARTNERSHIP WITH THE VENETO REGION IN THE "GRASPINNO PROJECT" EUROPA MED AREA - 2014/2020 PROGRAMME.*

3.3 Tenders evaluation system

The tender evaluation system provides for the drawing up of the ranking according to the maximum reduction, proposed by the participating companies. These latter companies were selected by a "drawing lots" procedure from the list of companies, which had expressed their interest in being invited to take part in the tender procedure.

3.4 Results of the tenders

The tender was splitted into two functional excerpts. The first excerpt (made of two lots worth 1.295 million euro) was awarded at the beginning of March and works will start in May 2018. The first lot was attended by 11 companies and the award went to the company TERNA COSTRUZIONI srl. Fifteen companies participated in the second lot and the contract was awarded to ARTE E RESTAURO. The second excerpt will be placed on tender in the course of 2018.

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4. EVALUATION OF PILOTS SITE EE AFTER THE REFURBISHMENT.

As already explained, the work was divided into two functional parts, which in turn were divided into two functional lots (one relating to the general works and the other relating to the restoration of the decorative part). For the 1st and 2nd lots of the 1st excerpt, tenders have already been made and the works have been awarded. The handover of the works has been delayed by the municipal administration, as it is awaiting clarification on possible future regional/European funding. The timetable for the two sections is as follows: 300 days for the first section and 240 days for the second.

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- **DEPARTMENT OF PUBLIC WORK, MINISTRY OF TRANSPOR, COMMUNICATIONS AND WORKS (PP8)**

1. INTRODUCTION

The present report is developed to present the main outcomes and evaluate pilot's site energy efficiency of the pilot in Cyprus, which was carried out by the Department of Public Works (PWD). More specifically, the pilot referred to a three floor building (basement, ground floor, mezzanine, first floor and second floor – total area 2.500m^2) in Paralimni, Ammochostos district, that was built in 2013 by individual. Due to the fact that the Department of Town Planning and Surveys would move there, the ground and middle floor (970m^2) should be refurbished, in order to be in line with the regulations for thermal insulation of the buildings that are to be used by the public and for the comfort of the employees.

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2. TENDER PROCEDURE

The procurement procedure completed and the products and services procured both in the national procurement platform and in GRASPINNO's eGPP platform. Furthermore, PWD prepared the tender for the energy refurbishment of the pilot building, both using the usual procedure and by creating TPIs through GRASPINNO eGPP platform.

The tender concerned the 'Construction, transport and placement of windows and curtain walls from Aluminum, in a building which will hold governmental services in Paralimni' and included green criteria as requirements (U-Value of Windows < 2.90 W/m^{2}K). To succeed comfort thermal conditions and save energy, all the openings of the ground floor and mezzanine should be replaced with thermal ones. For that reason, and to match the openings of the 1st and 2nd floor (restriction in brand choice as it is an existing building), specific windows and curtain walls were chosen that were compiled the green criterion/requirement.

The real tender was published in 18/09/2017 through e-procurement platform, under open procedure regulations and the time given for submitting the appropriate documents was 3 weeks. As the Green Criteria were described as requirements, the award criterion was only the lowest price. The winner bidder was "Artemis Pittis", at the price of € 22.815,00 plus VAT, and the agreement between him and the Department of Public Works was signed on 17/11/2017.For the implementation/installation of the procured products, there was a deadline of 20 days. All the refurbishment procedure was completed on time.

3. ENERGY SAVINGS AFTER THE REFURBISHMENT

The energy refurbishment activities have been completed, but the energy savings were calculated before completing the activities through the iSBEM-cy tool (for choosing the appropriate aluminums). The same tool was also used to show the initial energy conditions of the building and to compare the energy class of the building before and after the refurbishment. Due to the fact that the pilot building hasn't been in use and the governmental services hasn't moved there yet, no monitoring and energy management equipment has been installed, so the results shown in this section are based on the calculations made through the iSBEM-cy. This kind of equipment may be installed in later stage for monitoring building's energy consumption and select data which will show the actual energy savings and the difference between real data and those given by the tool.

According to iSBEM-CY's calculation, the building's preliminary Energy Performance Certification (Image 3.1) showed energy category E with an annual consumption of 865 kWh/m^2 primary energy and 252.75kg CO_2 emissions/m^2/year.

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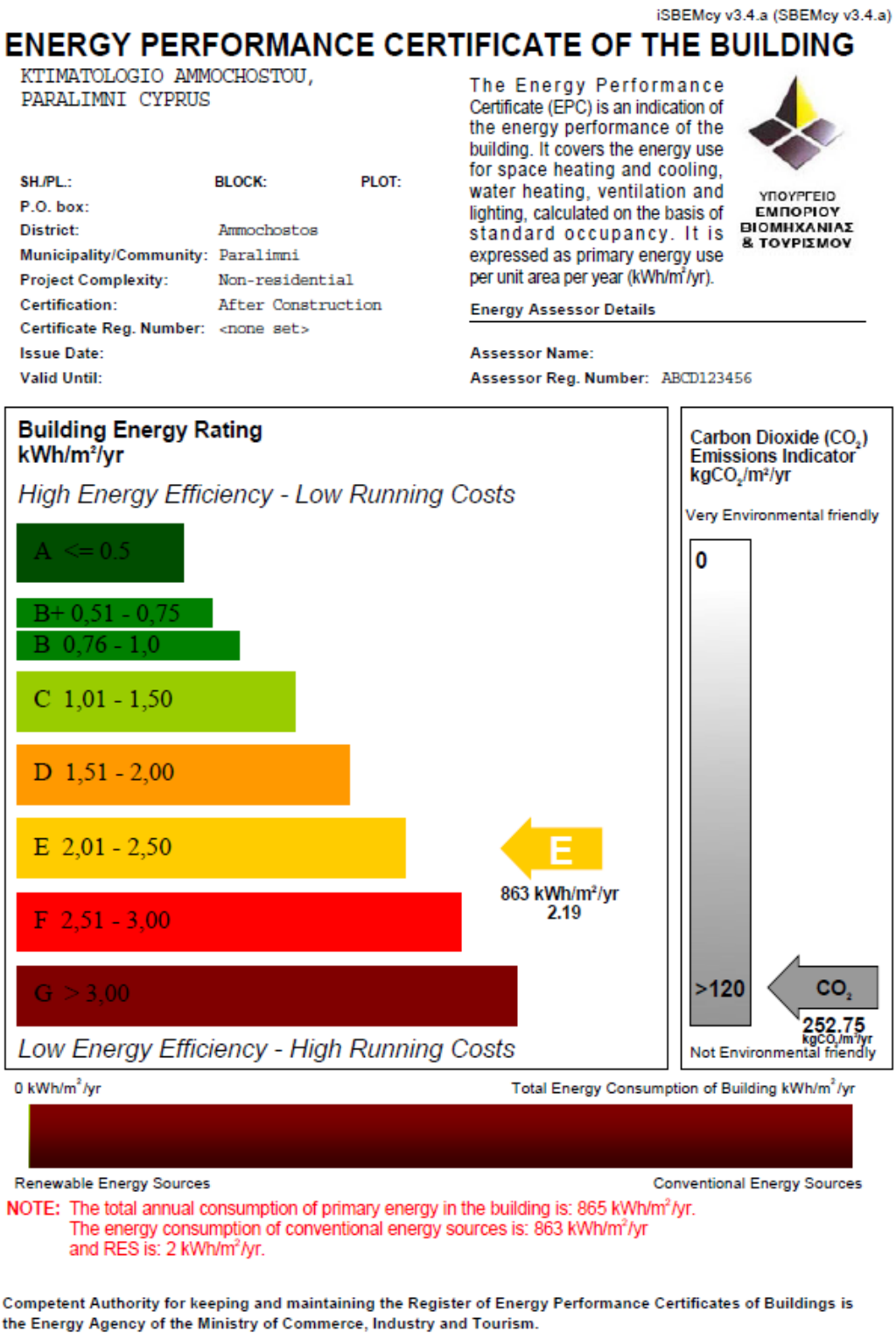

iSBEMcy v3.4.a (SBEMcy v3.4.a)

ENERGY PERFORMANCE CERTIFICATE OF THE BUILDING

KTIMATOLOGIO AMMOCHOSTOU,
PARALIMNI CYPRUS

The Energy Performance Certificate (EPC) is an indication of the energy performance of the building. It covers the energy use for space heating and cooling, water heating, ventilation and lighting, calculated on the basis of standard occupancy. It is expressed as primary energy use per unit area per year (kWh/m²/yr).

ΥΠΟΥΡΓΕΙΟ ΕΜΠΟΡΙΟΥ ΒΙΟΜΗΧΑΝΙΑΣ & ΤΟΥΡΙΣΜΟΥ

SH./PL.: BLOCK: PLOT:
P.O. box:
District: Ammochostos
Municipality/Community: Paralimni
Project Complexity: Non-residential
Certification: After Construction
Certificate Reg. Number: <none set>
Issue Date:
Valid Until:

Energy Assessor Details

Assessor Name:
Assessor Reg. Number: ABCD123456

Building Energy Rating kWh/m²/yr

High Energy Efficiency - Low Running Costs

A <= 0.5
B+ 0,51 - 0,75
B 0,76 - 1,0
C 1,01 - 1,50
D 1,51 - 2,00
E 2,01 - 2,50
F 2,51 - 3,00
G > 3,00

Low Energy Efficiency - High Running Costs

E
863 kWh/m²/yr
2.19

Carbon Dioxide (CO_2) Emissions Indicator kgCO_2/m²/yr

Very Environmental friendly

0
>120

CO_2
252.75
kgCO_2/m²/yr

Not Environmental friendly

0 kWh/m²/yr Total Energy Consumption of Building kWh/m²/yr

Renewable Energy Sources Conventional Energy Sources

NOTE: The total annual consumption of primary energy in the building is: 865 kWh/m²/yr.
The energy consumption of conventional energy sources is: 863 kWh/m²/yr
and RES is: 2 kWh/m²/yr.

Competent Authority for keeping and maintaining the Register of Energy Performance Certificates of Buildings is the Energy Agency of the Ministry of Commerce, Industry and Tourism.

Image 3.1: Preliminary Energy Performance Certification.

Table 3.1 and Figure 3.1 show the Energy Consumption per category both in kWh/m^{2}yr and in percentage (%) and the monthly consumption for all the categories. One can be seen that the largest share of energy consumption is on cooling, which was expected due to the big area of façade covered with simple glass for the reason that the building was initially to be used as commercial showroom.

Table 3.1: Total energy consumption per category.

Energy Consumption	
Category	**kWh/m^2 yr**
Cooling	553.6
Lighting	155.7
Equipment	112.45
Heating	34.6
Hot water	8.65
TOTAL	**865**

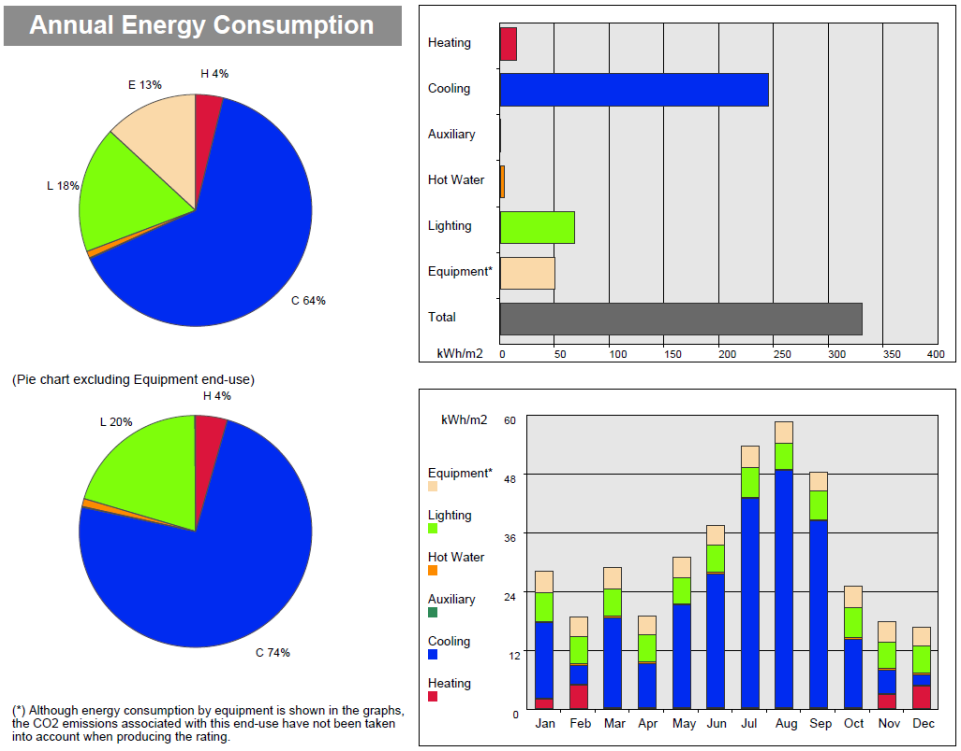

Figure 3.1: Annual Energy Consumption.

Replacing the existing openings with the proposed ones and adding them in iSBEM-CY tool, a new Energy Performance Certification (Image 3.2) was created, which showed energy category C, with an annual consumption of 218 kWh/m^2 primary energy and 63.2 kg CO_2 emissions/m^2/year. This second Certification used as for selecting the appropriate Green Products and include them in the tender as requirements.

It was calculated that with replacing the existing openings with the proposed ones a reduction of approximately 75% will occur in annual primary energy consumption (from 865 kWh/m^2/yr to 218 kWh/m^2/yr), which will lead to an equal reduction of 75% to CO_2 emissions (from 252.75 kgCO_2/m^2/yr to 63.2 kgCO_2/m^2/yr). This means that for the specific renovated area of total 973.38 m^2 a total amount of approximately 630 MWh/year of primary energy will be saved, which translated to 184.5 tnCO_2/yr savings. Additionally, if the cost of primary kWh will be counted to € 0.16, an annual reduction of € 100.000,00 will occur.

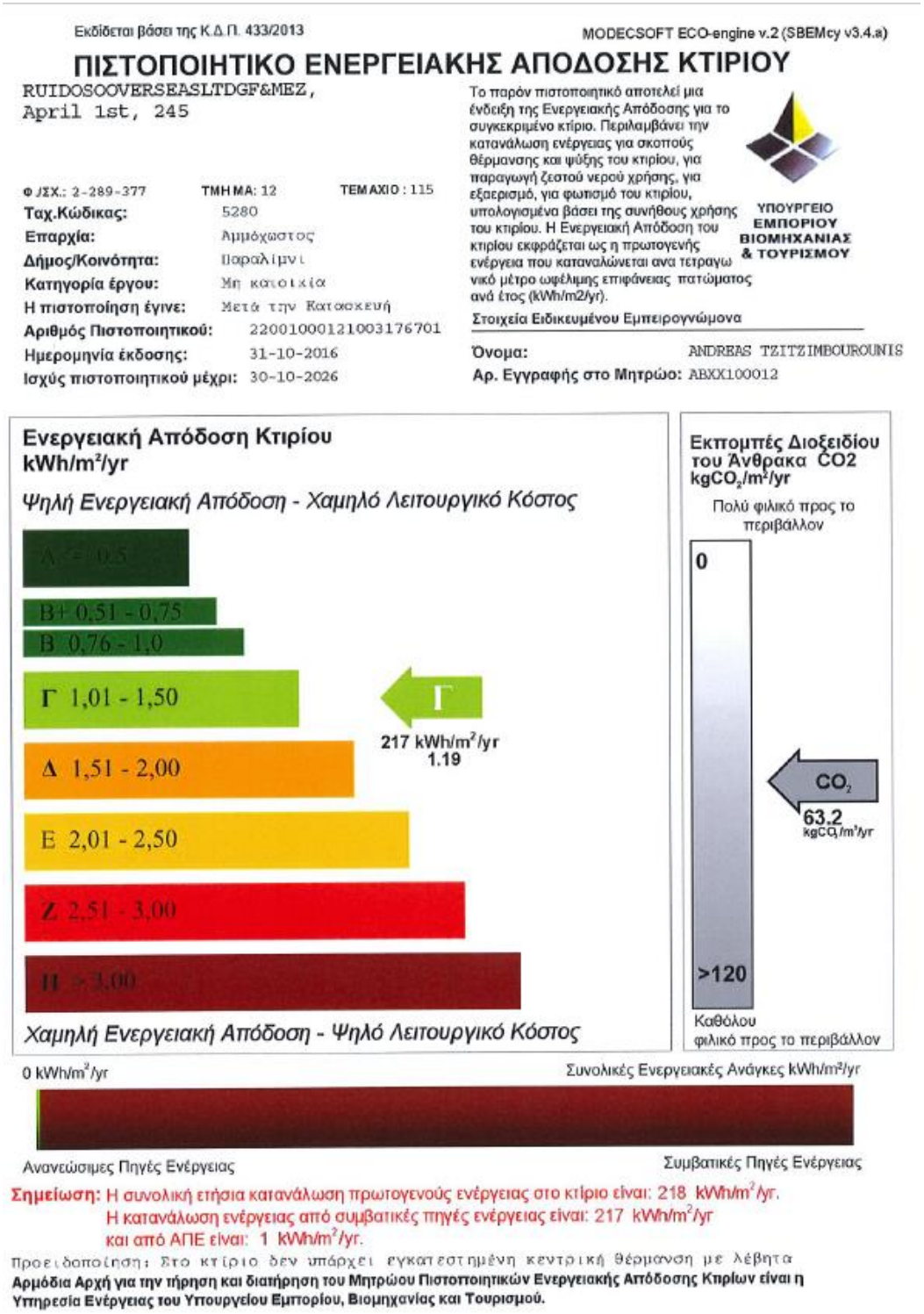

Image 3.2: Final Energy Performance Certification.

4. CONCLUSION

In the present report, the main results after the refurbishment activities of the pilot that carried out by the Department of Public Works were presented.

The procurement was published both in the national procurement platform and in GRASPINNO's eGPP platform as well as the tender documents were prepared both using the usual procedure and by creating TPIs through GRASPINNO eGPP platform. The tender was published in September of 2017 and the refurbishment activities finished 3 months later.

The building is now ready to be used for governmental services of the Department of Town Planning and Surveys making sure that all required lighting, ventilation and thermal comfort conditions are taken under consideration. Due to the fact, though, that the building hasn't been in use yet, there hasn't been installed any monitoring and energy management equipment for taking information about the actual energy consumption and savings. The presented results were based on the iSBEM-cy tool, which was used to show the energy consumption, the CO_2 emissions and the energy class of the building before and after the refurbishment. Finally, it was calculated that with the new aluminum openings a reductions of approximately 75% will occur both in annual primary consumption and in CO_2 emissions.

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- **GENERAL SECRETARIAT FOR COMMERCE AND CONSUMER PROTECTION (PP9)**

1. INTRODUCTION

The main aim of this report is to present the progress of the energy refurbishment of the public buildings, which were GRASPINNO pilot sites for GSCCP.

The two tenders, carried out by GSCCP, involved the energy refurbishment of the Ministries of the Hellenic Republic in Attica region (18 Ministries) through the replacement of the existing:

- air-conditioning machines with new energy efficient ones
- internal lighting with new energy efficient ones

in terms of the general scope of green public procurement policy.
Both tenders were published in the EU Official Journal on the 29th of March 2017.

The pilot site, which was selected for monitoring, is the building of the Ministry of Economy and Development on Kaniggos Square in Athens.

The progress of the procurement procedure and the installation process, along with the problems encountered and the lessons learned are described in Chapter 2.

Finally, an estimation of the energy savings after the installation of the LED lamps is presented in Chapter 3.

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2. PROGRESS OF TENDER PROCEDURE

2.1. TENDER FOR ENERGY EFFICIENT SPLIT-TYPE WALL-MOUNTED AIR-CONDITIONING MACHINES

The main points of the procurement process are the following:

Tender procedure: Framework Agreement (FA)

Number of procurement authorities participating in the FA: 18 Ministries

Duration of the contract: 2 years and 1 additional year, if necessary

Award Criterion: Most Economically Advantageous Tender Criterion

Total budget: 1.486.604,00 euro excluding VAT

Publishing dates:

- Publishing in the EU Official Journal: 29.03.2017
- Publishing in KIMDIS / ESIDIS: 31.03.2017
- Publishing in the daily Greek press: 04.04.2017
- Publishing in the Government GAZETTE: 07.04.2017

Deadline date for tenders: 28.04.2017

Results after the assessment of the administrative and the technical part of the tenders: There were four tenders submitted. Three of them were rejected and one of them was approved.

Reasons of rejection:

- Administrative reasons (e.g signatures)
- Energy Efficiency Class for heating

Appeals: One appeal has been submitted against the approval decision. The appeal was accepted and the procedure was cancelled. The tender will be repeated in June 2018.

2.2. TENDER FOR LED LAMPS FOR INTERIOR LIGHTING

The main points of the procurement process are the following:

Tender procedure: Framework Agreement (FA)

Number of procurement authorities participating in the FA: 18 Ministries

Duration of the contract: 2 years and 1 additional year, if necessary

Award Criterion: Lowest price

Total budget: 1.625.582,00 euro excluding VAT

Publishing dates:

- Publishing in the EU Official Journal: 29.03.2017
- Publishing in KIMDIS / ESIDIS: 31.03.2017
- Publishing in the daily Greek press: 04.04.2017
- Publishing in the Government GAZETTE: 07.04.2017

Initial deadline date for tenders: 28.04.2017

Final deadline date for tenders: 29.05.2017

1st step: Results after the assessment of the administrative and the technical part of the tenders: There were eight tenders submitted. Six of them were rejected and two of them were approved.

Reasons of rejection:

- Administrative reasons (e.g signatures)
- Lifetime L70F50<30.000 hours
- Test reports LM79 for luminous efficacy
- CE certification

2nd step: Results after the assessment of the economic part of the tenders which were approved at the first step: Both tenders were approved.

Appeals: No appeals have been submitted against the approval decision.

Next step: At the end of March 2018 the framework agreement contract was signed. After that each Ministry can make the order of the lamps needed and some of the Ministries have already made the first actions.

2.3. GOOD PRACTICES, PROBLEMS ENCOUNTERED AND LESSONS LEARNED

GSCCP chose the tender procedures to be framework agreements for the needs of the central government, because GSCCP is the national central purchasing body for goods and services and a policy maker authority.

Through this procedure all the Ministries of Greek Government have been stimulated to substitute the existing conservative lamps and air – conditioning machines with energy efficient ones. This procedure is a first step for the energy refurbishment of the Ministries' public buildings and it is important because it involves the change of the attitude of public officers on this subject. In addition, this procedure stimulated the market to promote energy efficient products.

Unfortunately, the initially estimated time period for the completion of the procurement process was enough only for the completion of one of the pilot framework agreements, because of legislation issues in the case of the tender for air-conditioning machines.

Regarding the pilot for LED lamps, though, the procurement procedure of the framework agreement is completed. The substitution process has slowly begun and it will be valid till the end of 2019.

The main lesson learned in the case of GSCCP is that the attempt to change the attitude of public officers and market representatives on

energy efficient products needs time and effort. The successful first results, though, of these attempts will strongly facilitate the next ones.

3. ESTIMATION OF ENERGY SAVINGS AFTER THE REFURBISHMENT

Since the installation of the energy efficient products has not yet taken place, consumption data collected from the pilot sites after the refurbishment cannot yet be registered.

At the same time, GSCCP is trying to procure an audit of the building and the deliverables will be a Certificate of Energy Efficiency and a study for the proposed type of overall refurbishment (windows, heating, electricity consumption). It has been a difficult task, because according to our procurement law a programme agreement with another procurement authority should first be signed, due to the lack of procurement competence of GSCCP for public works and technical studies.

Nevertheless, GSCCP has estimated the energy savings that will occur after the installation of the LED lamps in the pilot site. The building needs 11600 lamps per year for the lighting. The existing lamps are fluorescent tubes. The particular type of the needed lamps is shown in Table 1.

Table 1: Electricity consumption of fluorescent and LED lamps

Lamp type	Number of lamps	Electrical power (W)		Electricity consumption (kW/h)	
		Fluorescent lamps	LED lamps	Fluorescent lamps	LED lamps
T8 – 45cm	200	15	8	3	1.6
T8 – 60cm	9000	18	15	162	135
T8 – 120cm	2200	36	22	79.2	48.4
T8 – 150cm	200	58	25	11.6	5
SUM	**11600**	**127**	**70**	**255.8**	**190**
				Electricity consumption decrease (Kw/h) = 65.8 kW /h	

According to the data of Table 1, in case that all fluorescent tubes have been substituted with LED ones, the estimated electricity consumption decrease is 65.8 kW /h.

Considering that LED lamps will be in use during the working days and hours of the year, which are 260 days for 10 hours a day, the annual electrical power, which is needed for the internal lighting of the building of the Ministry of Economy and Development on Kaniggos Square in Athens, will decrease by 171080 kW.

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4. CONCLUSIONS

In this report, the progress of the procurement tenders which are considered as GRASPINNO pilots for GSCCP is recorded.

Both of the tenders were published in the EU Official Journal in March 2017.

In the case of the tender for energy efficient split-type wall-mounted air-conditioning machines, the procedure was cancelled because of an appeal against the approval decision. The tender will be repeated in June 2018.

In the case of the tender for LED lamps for interior lighting, the framework agreement contract was signed at the end of March 2018. After that each Ministry can make the order of the lamps needed. Some of the Ministries have already made the first actions.

When the ordering and installation procedures are completed, GSCCP will be able to collect energy consumption data in order to analyze the energy savings of the building after the replacement of the existing products.

The final conclusion concerning the public procurement procedures, which derived from the tenders published by GSCCP, is that the framework agreement procedure facilitates stimulation of public officers and enterprises to EE and GPP policies, though the initially estimated time period for the completion of the procurement process sometimes is not enough, because of long-lasting legislation issues.

The main lesson learned in the case of GSCCP is that the attempt to change the attitude on energy efficient products needs time and effort. The first successful results, though, of these attempts will strongly facilitate the next ones.

- **CHAMBER OF COMMERCE AND INDUSTRY OF TERRASA (PP10)**

INTRODUCTION

CCIT did two Pilots on two different buildings under GRASPINNO project.

1. UPC: Polytechnic University of Catalonia:

UPC-Terrassa Campus, is an urban campus, integrated in the city of Terrassa, Vallès Occidental region, Barcelona province, which generates the volume of industrial and economic activity higher of Catalonia. Therefore, the relation between the companies and the UPC in this territory is narrow and fluid.

In Terrassa Campus 3 study centres are located:

- ESEIAAT: school of Industrial, Aerospace and Audio-visual Engineering of Terrassa
- FOOT: Terrassa school of Optics and Optometry
- CITM: Image Processing and Multimedia Technology Center

Involving: 5000 students – 400 professors/investigators

Also, on Terrassa Campus there are 6 researcher's centers, located on GAIA building, one of them **SEER**: *research center on*

Renewable Electrical Energy Systems that promotes Solar Campus with ESEIAAT students.

Under Solar Campus project, UPC collaborates with CCIT on Pilots development with 2 photovoltaics plants to be installed on 2 buildings, TR11 (Robotic Faculty and Library)
Solar Campus is an initiative created by students of all the fields of engineering of the UPC in Terrassa that wants to convert the campus in a Smart Energy Campus, creating projects of renewable energies that help to improve the image and the efficiency of the university.

Background:

SEER: installed on GAIA building a photovoltaic plant makes this building the greater plant of self-consumption of the UPC, accumulating more than 83% of the renewable generation to the UPC, saving 6.000€ /year on electricity consumption.

Objectives of Project SOLAR CAMPUS 2017:

- ✓ Reduction on energy consumption.
- ✓ 40 students from engineering degree courses getting experience on energy field
- ✓ Disseminate the activities and results
- ✓ Make the Campus in a Smart Energy Campus

- ✓ Promote another projects under the Smart Energy Campus idea

Objectives on collaboration with GRASPINNO as one of CCIT Pilots:

- ✓ Promote the visibility to be replicated on another buildings
- ✓ Learn about eGPP
- ✓ Experience

Title:	SOLAR CAMPUS: Installation of Photovoltaic plant in two university buildings.
Pilot Site	UPC Campus: located at Terrassa city: ✓Library ✓Robotic Faculty – TR11
Objectives	✓ Reduce the consumption of power coming from the grid. ✓ Publish the results
EE/Category and Subcategory	Renewable energy: RES Energy source: Solar energy Photovoltaic system

1.1. PROCUREMENT PROCESS

The GRASPINNO pilot focused on solar panels materials.

(3 offers if the amount is ≥ 5.000€).

- ✓ Different suppliers
- ✓ Homologated Suppliers
- ✓ Contribution of local enterprises
- ✓ **Process:**

- Until 18.000€: 3 offers / material
- Technical specification document _ Preliminary Study (**Annex 1**)
- Adjudication body: Department director (SEER)

The product type:

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- ✓ **Solar panels**
- ✓ **Solar blocs**
- ✓ **Inverter**
- ✓ **Electrical material**
- ✓ **Energy measuring equipment**

Each material has to be buy on an individual way. Each potential provider receives the technical specifications with the preliminary study document where the different kind of material and characteristics were defined.

Information already upload on GRASPINNO database used as reference:

The technical criteria were fixed on preliminary study.

Following the study recommendation, the criteria was to present the same material (brand) or equivalent with better economic conditions, considering this project is part of students final works.

Using GRASPINNO platform, another kind of material with similar technical characteristics were evaluated.

The product type:

- ✓ **Solar panels: *2*** *providers evaluated offering the similar product.* **Provider_1:**

Luxor 100 M	M-21-006	100 Wp	36 cel. Mono	0+5W	12 V	Imax 5,87 A	7,8Kg	1194 x 542 x 35 mm.	MC4	162	145

Provider_2:

Nombre del producto		SCHOTT ASI™ 81	
		Potencia nominal	Potencia nominal inicial
Potencia nominal	P_{nenn}	81 Wp	98,8 Wp aprox.
Tensión en el punto de potencia máx.	U_{mpp}	17,1 V	19,0 V aprox.
Corriente en el punto de potencia máx.	I_{mpp}	4,73 A	5,20 A aprox.
Tensión en circuito abierto	U_{oc}	23,0 V	24,0 V aprox.
Corriente de cortocircuito	I_{sc}	5,82 A	6,00 A aprox.

- ✓ *The winner is the provider who present the low price following the preliminary study recommendation.*

- ✓ The winner is **Provider_2:** low price offering exactly the product recommended on study.
  This provider offered a very low price considering the project will be developed by student.

1.2. INSTALLATION

- ✓ The students have begun the works on both buildings and the prevision is to finish on the first semester of 2018.

1.3. IMPROVEMENTS

- ✓ The achieved until now (with the works done) is little less than the initial objective, but the economical result is a 2.396 €/year by Building.

- ✓ With this kind of material and considering the climatological situation is possible to estimate:

Objective	18400 kWh
Achieved	17118.09 kWh

2. CCIT: Terrassa building (headquarter)

The CCIT develop the activities on the central headquarters in Terrassa (5.000m2), and on an office in Sant Cugat the Vallès (100m2). The activities in both of the installations are developed with a low impact in regarding risks of pollution and are ranged to the surroundings centric and urban of the city.

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The GRASPINNO pilot is focused on CCIT Headquarters in Terrassa.

Building: 5000 m^2 distributed:

- ✓ Parking (-2)
- ✓ Floor -1
- Storage of Historical documents, Logistic department, machines room, staff place
- 2 rented offices
- ✓ Principal: staff offices and classroom
- ✓ 1st. Floor: Classrooms, Conferences room
- ✓ 2nd.Floor: Rented Offices, Plenary room
- ✓ 3rd. Floor: Meeting Rooms

The GRASPINNO pilot is focused on CCIT Headquarters in Terrassa.

That building was built between 1989 and 1991. After that on 2007-2008 CCIT did a big refurbishment to expand the 3rd. floor, gaining 2 classrooms and 2 meetings room more. Under that refurbishment the air-condition system was renovated by one more efficient.

The use of the building is for offices, classrooms for training courses, meeting rooms, events rooms, and offices rented by external companies.

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The energy used is electricity, and the consumption control is centralised for this reason is not possible to have data about the energy consumption on a separate way.

Objectives:

- ✓ Reduction on energy consumption: 10%
- ✓ Reduction of IND_12: 5% (KPI)
- ✓ Improve the health conditions for people increasing the light lumens and quality at each workstation.
- ✓ To Continue with the plan for change all light system for LED technology

Title:	Installation of Leds lights
Pilot Site	Terrassa building
Objectives	✓ Reduce the consumption of power coming from the grid. ✓ Improve the health conditions for workers increasing the light lumens and quality at each workstation.
EE/Category and Subcategory	Energy Efficiency: EE Building renovation

Concretely for the Pilot: in function of the budget the renovation includes

Installation	Project scope
-1 Floor	1-Rented office: 90 m^2 2-Rented office: 40 m^2
2nd. Floor	1 rented offices: 50 m^2
1st. Floor	5 classrooms/meeting rooms

2.1 PROCUREMENT PROCESS

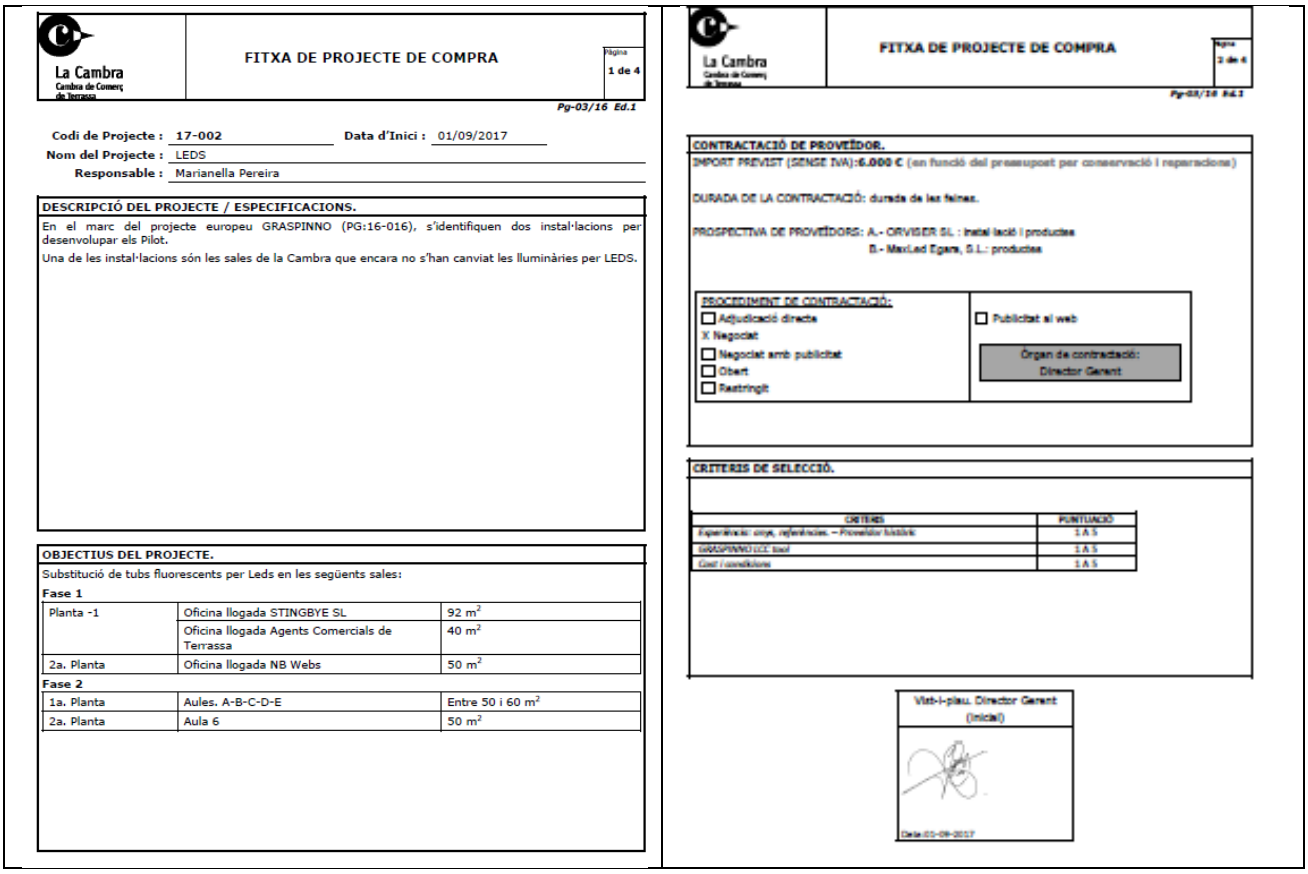
The GRASPINNO pilot is focused on different size of Tubs Leds.

Under CCIT contracting official procedure if the amount doesn´t exceed 18.000€, the procedure is negotiate (3 offers if the amount is ≥ 5.000€). Following the internal instruction, CCIT develop an internal document with all relevant information and the evaluation criteria.

At this moment CCIT have 2 offers of two different brands of material. The decision is not finish yet because we don´t have the final budget information.

The offers was evaluated using LCC tool (as defined on internal document)

Internal Contracting Document:



La Cambra
Cambra de Comerç de Terrassa

FITXA DE PROJECTE DE COMPRA

Pàgina 1 de 4

Pg-03/16 Ed.1

Codi de Projecte : 17-002 **Data d'Inici :** 01/09/2017

Nom del Projecte : LEDS

Responsable : Marianella Pereira

DESCRIPCIÓ DEL PROJECTE / ESPECIFICACIONS.

En el marc del projecte europeu GRASPINNO (PG:16-016), s'identifiquen dos instal·lacions per desenvolupar els Pilot.

Una de les instal·lacions són les sales de la Cambra que encara no s'han canviat les lluminàries per LEDS.

OBJECTIUS DEL PROJECTE.

Substitució de tubs fluorescents per Leds en les següents sales:

Fase 1

Planta -1	Oficina llogada STINGBYE SL	92 m^2
	Oficina llogada Agents Comercials de Terrassa	40 m^2
2a. Planta	Oficina llogada NB Webs	50 m^2

Fase 2

1a. Planta	Aules. A-B-C-D-E	Entre 50 i 60 m^2
2a. Planta	Aula 6	50 m^2

La Cambra
Cambra de Comerç de Terrassa

FITXA DE PROJECTE DE COMPRA

Pàgina 2 de 4

Pg-03/16 Ed.1

CONTRACTACIÓ DE PROVEÏDOR.

IMPORT PREVIST (SENSE IVA):**6.000 €** (en funció del pressupost per conservació i reparacions)

DURADA DE LA CONTRACTACIÓ: durada de les feines.

PROSPECTIVA DE PROVEÏDORS: A.- ORVISER SL : instal·lació i productes
B.- MaxLed Egara, S.L.: productes

PROCEDIMENT DE CONTRACTACIÓ:

- ☐ Adjudicació directe
- X Negociat
- ☐ Negociat amb publicitat
- ☐ Obert
- ☐ Restringit
- ☐ Publicitat al web

Òrgan de contractació: Director Gerent

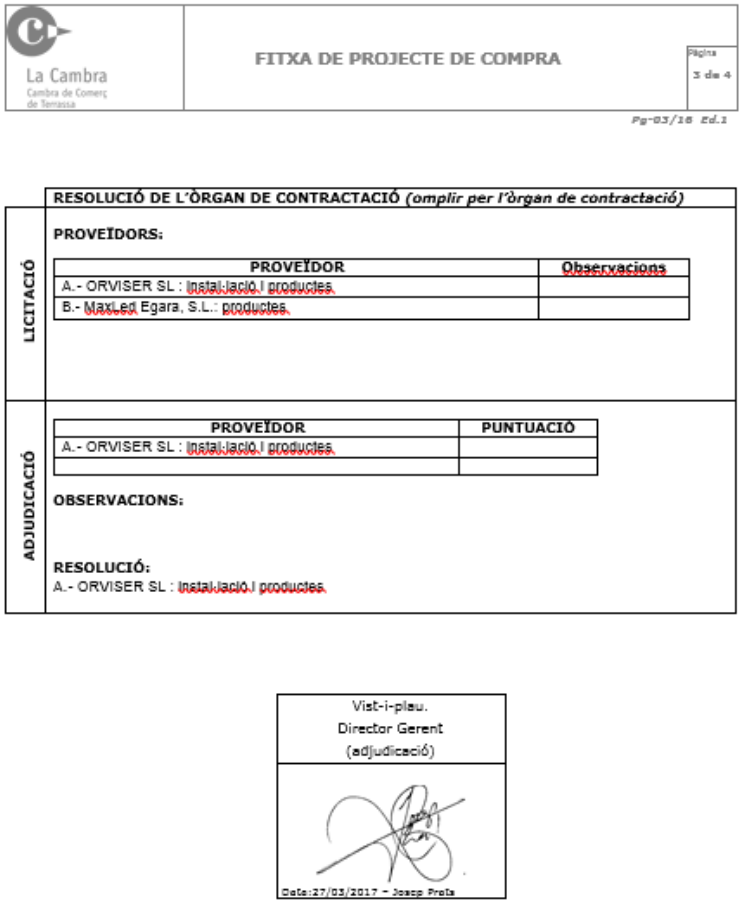
CRITERIS DE SELECCIÓ.

CRITERIS	PUNTUACIÓ
Experiència: cirys, referències. – Proveïdor habitual	1 A 5
GRASPINNO (CC tool	1 A 5
Cost / condicions	1 A 5

Vist-i-plau. Director Gerent
(Inicial)

Data 01-09-2017

Adjudication Document:



La Cambra
Cambra de Comerç de Terrassa

FITXA DE PROJECTE DE COMPRA

Pàgina 3 de 4

Pg-03/16 Ed.1

RESOLUCIÓ DE L'ÒRGAN DE CONTRACTACIÓ ***(omplir per l'òrgan de contractació)***

LICITACIÓ

PROVEÏDORS:

PROVEÏDOR	Observacions
A.- ORVISER SL : instal·lació i productes	
B.- MaxLed Egara, S.L.: productes	

ADJUDICACIÓ

PROVEÏDOR	PUNTUACIÓ
A.- ORVISER SL : instal·lació i productes	

OBSERVACIONS:

RESOLUCIÓ:
A.- ORVISER SL : instal·lació i productes

Vist-i-plau.
Director Gerent
(adjudicació)

Data:27/03/2017 - Josep Prats

At the beginning of April, the provider selected is informed about the final resolution in order to plan the installation.

During May the first place was renovated and during the rest of the month and June the works will be finished.

2.2. INSTALLATION

To plan the installation, using the LCC analyse a prioritisation was done.

INSTALLATION		Units	LCC TRADITIONAL Result	LCC LEDS Result	Save
Floor: -1	RENTED_1	48	6,187.27 €	1,934.09 €	4,253.18 €
	RENTED_2	16	2,062.42 €	644.70 €	1,417.72 €
2nd. Floor	RENTED_3	20	2,013.41 €	747.92 €	1,265.49 €
	Aula 6 - rented in mid-term	20	1,178.17 €	346.62 €	831.55 €
1st. Floor	Aules. A - rented in mid-term	20	4,161.56 €	1,213.12 €	2,948.44 €
	Aules. B	20	4,161.56 €	1,213.12 €	2,948.44 €
	Aules. C-D	60	4,340.18 €	1,273.35 €	3,066.83 €
	Aules.E				

		May	June
Floor: -1	RENTED_1		
	RENTED_2		
2nd. Floor	RENTED_3		
	Aula 6 - rented in mid-term		
1st. Floor	Aules. A - rented in mid-term		
	Aules. B		
	Aules. C-D		
	Aules.E		

Considering the biggest room is at the same time one of the places with more hours working, is the first place to do the renovation.

That first renovation was done during May.

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2.3. IMPROVEMENTS

One of the objectives with the light renovation is to improve the health conditions for people increasing the light lumens and quality at each workstation.

Before renovation

After renovation

With this change of kind of lights, the works conditions for the people who rent this place is better than the "yellow" or "hot" lights.

Concerning the **electrical energy consumption**, we can estimate a % of saving considering the use of the different places (offices, classrooms and meeting rooms).

Is not possible to have this dates at this moment, after the renovation, we have to compare the consumption to determinate the real electricity consumption saving achived with this renovation.

To have quantitative data is necessary to evaluate 1 complete year realizing a comparison with data of years before.

The CCIT has a single consumption control is not possible to measure separately each place. However globally, for the building, with all work done, the estimation is a 10% of reduction of annual energy consumption.

3. CONCLUSIONS

From two point of view, after GRASPINNO Pilot implementation is possible to conclude:

- ✓ From the benefit won on public buildings improving the energy management. Public buildings are among the largest consumers of energy, many of them with old facilities that require refurbishment, not only to comply with current regulations but primarily to optimize the use of energy resources.
  GRASPINNO provides a successful example to be replicated on others kinds of buildings, not only public ones, where the energy consumption is a relevant part on budget, promoting green technology through good practices.

- ✓ On green public procurement, GRASPINNO facilitates the process promoting the knowledge on green technology, green criteria, good practices examples centralized on an integrated platform where is possible to find information and recommendations on energy efficiency and renewable energy sources.

- **INTERNATIONAL PROJECTS OF GOVERMENT OF ZENICA-DOBOJ CANTON (PP11)**

INTRODUCTION

This report can be used as preliminary information on the technical references used to show the realized energy savings on the buildings of the Health Care Centre Tešanj and the General Library located in the building of PI Cultural Centre Maglaj. Its intent is to inform about the possibilities of energy saving after the changing of the windows on the envelope of the buildings in question. The purpose of the calculation and the recommendation is to determine whether the implemented energy efficiency measures are sufficiently effective. In addition, the Technical Report itself is intended as a basis for the adoption of engineering recommendations that can help assess undertaking of future energy efficiency improvement measures.

1. I Public Institution Health Care Centre Tešanj

1. Basic data about the object

The Health Care Centre Tešanj was founded on 30th October 1945 as a health center and in 1955 it turns into a Health Care Center. All medical branches of primary health care have been organized at the Health Care Center. Technical equipment is at a satisfactory level and has been specially upgraded in recent years through the supply of modern diagnostic equipment. The basic information about the pilot building is given in Annex A.

Figure 1. Public institution Health Care Centre Tešanj building – East and South side

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Figure 2. Public institution Health Care Centre Tešanj building - West side

Figure 3. Wooden (old) windows of the Public Institution Health Care Centre Tešanj building

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Figure 4. Public institution Health Care Centre Tešanj building appearance after the installation of new PVC windows

Based on an analysis of the aspect of the most important architectural and urbanistic characteristics, the subject building of Health Care Centre Tešanj belongs to the typology of non-residential buildings in Bosnia and Herzegovina for the *1st construction period* from 1945 to 1960, which was later upgraded. The Health Centre in Tešanj building according to the periodization of construction, the design of the building and its dimensions can be classified into the class of smaller public buildings of the typology of the monolithic block.

Since 2017, the neighboring buildings of Emergency Assistance and the Physical therapy, which was physically separated from the PI Health Care Centre building has been added to the PI building which makes the total useful area of the Health Centre complex increased to 3.056 m^2.

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1.1. Constructive system of the object

The PI Health Care Centre Tešanj was constructed and started working in 1955. The outer overall dimensions of the layout and the grid completely changed compared to the time when it was built. From the South and North side, the building was upgraded, and the 2nd floor was upgraded over the old part of the building so that today it has a basement + ground floor + 1st floor + 2nd floor.
The height of the old part: the basement is h=2,75 m, the ground floor h=3,29 m, 1st floor h=3,25 m and 2nd floor h=2,87 m.
The height of the upgraded part: the basement is h=3,07 m and the height of the ground floor 1st and 2nd floors is h=2,92 m. On the layout, the outer overall dimension of the building is the gross space area of 793 m^2. Useful area of the object was 2,722 m^2.

In the context of the energy characteristics of the interior surfaces are designed as heated spaces, and the outer envelope of the building consists of:

- Outer wall
- Floor on the ground
- Roof panel - narrow roof over the heated space
- Ceiling to the attic
- Outer openings

Outer walls - The walls of the old part of the building were built in a combination of full brick and reinforced concrete with a layer of cement mortar on the outer and a lime-cement layer of plaster on the inside of the wall. The walls of the upgraded section are combined with brick

blocks and reinforced concrete with a layer of cement mortar on the outside, a layer of 5 cm EPS and a lime-cement layer of plaster on the inside of the wall. The load-bearing construction of the upgraded section consists of reinforced concrete cornices - dimensioned 35x30 cm, interconnected by reinforced concrete beams, which are also the primary supporting structure to which the reinforced concrete plate is leaned on.

Wall against the ground - is partially or completely buried and surrounds the basement floor of the building. The walls are of full brick with a layer of hydro-insulation and an additional protective layer of full brick. All the walls facing the ground are in a satisfactory condition without visible damage, but with large losses to the ground due to lack of thermal insulation.

Roof - The object is covered with a multi-sided narrow roof. The load-bearing roof construction above the entire building is made of wood beams with a board roof and a final layer of bituminous "shingles" without heat insulation. The bad condition with the roof covering has led to leakage, and damage to the wooden structure.

Floors - the final layers on the floors are in accordance with the function of the rooms and consist of: concrete glazing, ceramic tiles, PVC under structures. The floor structure on the upgraded part has a layer of 30 cm thick gravel leaning on the concrete plate of 10 cm thickness, hydro-insulation, 5 cm EPC thermal insulation, PE foil, 5 cm cement screed and a finishing layer. All floors on the ground are in a satisfactory condition without visible damage.

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Ceiling to the attic - the ceiling structure under the unheated ceiling of the upgraded part is thermally insulated and consists of 2 cm thick cement mortar, reinforced concrete boards of 14 cm thickness, PE foil, thermal insulation board of 10 cm thickness, PE foil and cement screed. Ceiling construction to the unheated upgraded ceiling above the old part of the building is thermally insulated and consists of 2 cm cement mortar, 2,5 cm combined panels, 2,5 cm wooden boards, steam dams, 12 cm thermal insulation panels, PE foil, air layer of 4 cm, with a 2,5 cm wooden boards and cement screed as a finishing layer.

Outer openings - During the construction of the building, a wooden wing type "wing on wing" was installed with a single plain glass, and later wooden windows with double glazing were installed. The largest number of openings is located on the East and West side of the building. The observed elements were in poor condition with a heat transfer coefficient of 2,9 W/m^2K and as such were replaced with new PVC windows with a heat transfer coefficient of 1,4 W/m^2K.

The basic feature of the outer envelope of the building is the construction using traditional techniques and materials, without the application of thermal protection. Insuficient thermal insulation results in increased thermal losses in the winter, cold fringes, damage caused by condensation (moisture), and overheating of the space in the summer. Warming up of the object requires a greater amount of energy, which leads to an increase in the price of use and maintenance of the building, as well as to a greater environmental pollution.

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1.2. Thermal characteristics of the envelope of the building

It can be seen from the above mentioned the period of construction of the building of the Health Care Centre Tešanj, is characterized by a massive constructive system of brick walls, which are plastered on both sides without thermal insulation. Horizontal and vertical reinforced concrete cornices are the load-bearing parts of the between floors structure leaning on the reinforced concrete panels. On this type of object, even heat losses appear on the entire envelope, but are higher in the position of reinforced-concrete horizontal cornices and lintels. The data calculated from the heat transfer coefficient of the Health Care Centre in Tešanj given in Table 1 shows that the maximum exceeding allowed U_{max} values were in the position of the windows, the floor on the ground and the outer wall.

Table 1 - Heat Transfer Coefficient [W/m^{2}K] of the envelope of the Health Care Centre in Tešanj

Number	Name of the construction part	Heal transfer coefficient	
		U [W/m^{2}K]	U_{max} [W/m^{2}K]
1.	Outer wall1 –block brick, EPS	0,49	0,60
2.	Outer wall 2 – reinforced concrete + EPS	0,64	0,60
3.	Outer wall 3 – block brick + bituminous „shingle“	0,41	0,60

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4.	Outer wall 4 – reinforced concrete + bituminous „shingle“	0,52	0,60
5.	Outer wall 5 – brick	1,15	0,60
6.	Outer wall – reinforced concrete	2,65	0,60
7.	Wall against the ground - upgrade	0,49	0,50
8.	Wall against the ground – old part	1,05	0,50
9.	Floor on the ground – upgrade	0,58	0,50
10.	Floor on the ground – old part	2,21	0,50
11.	Ceiling to the attic - upgrade	0,35	0,40
12.	Ceiling to the attic – old part	0,26	0,40
13.	Windows	1,4/(2,9)	1,4

2. Energy systems

There are no integrated systems such as heating, cooling and ventilation (HVAC) in the building in question, but there are different separate energy systems:

1. Heating system,
2. Cooling system and
3. Electric system.

There are no automatic heating and cooling systems in the building to ensure air quality and increase energy efficiency.

Table 2. – Heating, cooling and ventilation system

HVAC system			
Object	Air heating	Air ventilation	Air cooling
Health care	District	None	Indivitual/split

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center		(natural)	devices

2.1. Energy performance of the heating system

The heat energy for the heating of the building is provided by JP "TOPLANA" d.d. Tešanj via a heat substation located in the basement of the building (Figure 5). The heat substation consists of a spiral heat exchanger installed in 1990 and other related equipment. The equipment that was installed is mainly from the time of construction of the building. Closing the heating circuit is manually operated by ball valves. Designated heating elements - radiators do not correspond to the number of radiator ribs.

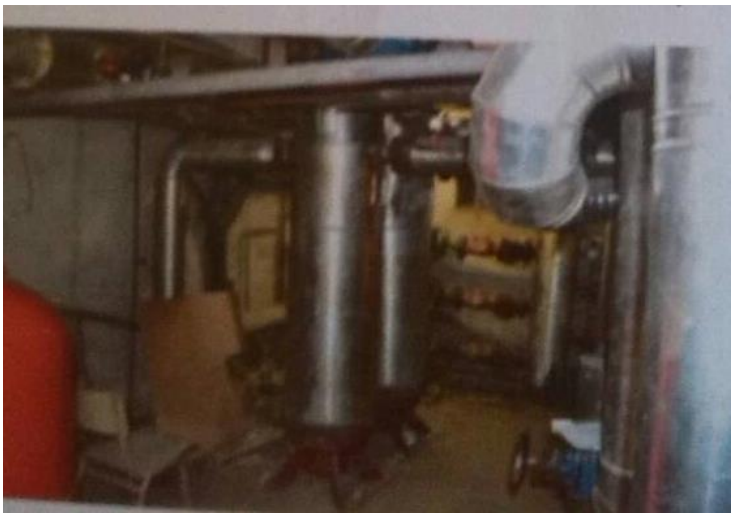


Figure 5. – The heat substation located in the basement of the Health Care Center

The primary circuit from the city boiler comes in the heat exchangers where heat exchange with a secondary circuit designed for the 70/90 °C

mode is performed. Operating pressure meters are older and quite unreliable. The heat exchanger and the complete heating system are poorly maintained, and the water parameters control are done manually. Three circular pumps are installed on the dashboard, one of which is the working one and the other two are spare ones (Figure 6). The radiators are in fairly good condition. However, there are no thermostatic valves on the radiators, with a few exceptions (12 pieces).

Figure 6. – Circular pumps on the dashboard

Efficiency of the heating system - The installation of the heat substation has been carried out during the construction year of the building, and insulation on the pipeline is in good condition. The measuring equipment is older, so it is difficult to monitor and adjust the hot water parameters. The heat exchanger is in poor condition and was installed 30 years ago. Therefore, it is assumed that there are large losses of heat energy on the exchanger itself and the absence of an automatic regulating system to the external temperature. The circular pump that is constantly in operation is in a very poor condition. Most radiators do not have thermostatic valves. According to the experience of the users, the area of the radiators in the building is not sufficiently

heated while in the second part the radiators are overheated. This indicates that the water flow is not balanced.

The greatest losses of heat energy are realized on the side of the supplier of heat energy. Secondary losses are estimated at about 5% due to the lack of automatic regulation. Also, conduits passing through the heated spaces are not isolated, so the losses of about 7% are estimated. Based on the exposure and the calculation, the efficiency of the entire heating system is 85%.

2.2. Energy performance of the electricity system

Electricity supply of the Health Centre is performed on a low voltage level of 0,4 [kV] from the public electricity distribution network. Electricity supplier is JP "Elektroprivreda BIH" through its subsidiary "Elektrodistribucija" Tešanj. The following elements are used for the calculation of electricity:

- Calculated energy VT [kWh],
- Calculated energy MT [kWh],
- Calculated power [kW],
- Excessive reactive energy [kVAh] and
- Measuring spot [pcs].

The object itself is multifunctional, so the low-voltage network installation is adapted to the individual parts. Testing and measuring of standard electrical installation parameters, such as pile resistances, insulation resistances, grounding resistances and the like were not the subject of this overview.

Overview has established that all electricity consumers according to their function can be classified into 5 groups:

- Lighting
- Medical equipment
- IT equipment
- Hot water equipment (PTV)
- Kitchen and other equipment
- Other electrical consumers

In Annex B, an overview of electricity consumers with an installed power of 255,26 [kW] is given.

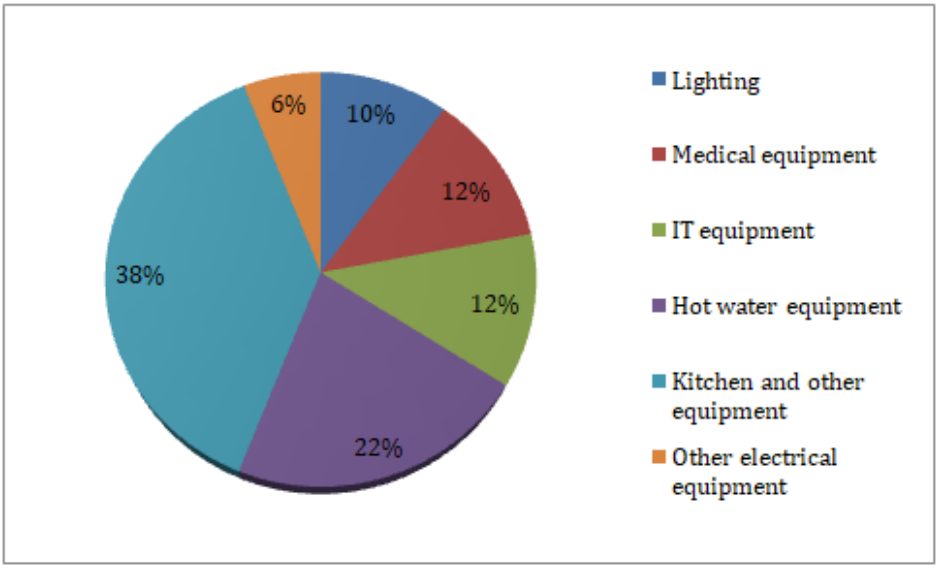


Figure 7. – Distribution of installed power of electricity consumers

The main consumers of electricity are medical and IT equipment, electrical lighting and kitchen appliances. An exceptionally high share goes to the installed power of hot water preparation equipment (22%). Electrical lighting with installed power of 10% is mostly made with fluorescent lamps and incandescent lamps (replaced with LED bulbs in

early 2018). Lighting is a big consumer of electricity because of its great time of use.

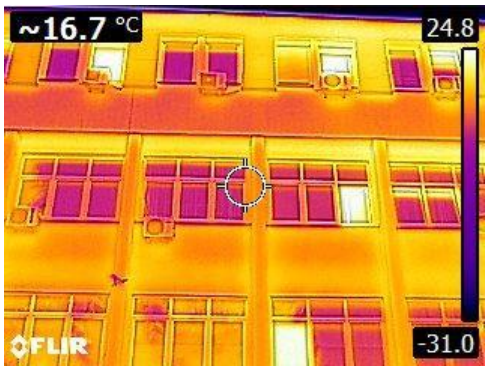
2.3. Energy performance of the cooling system

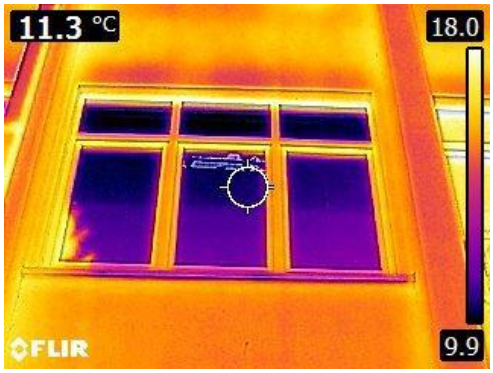
The Health Center does not have a central space cooling system, but cooling is performed locally by separate „split" systems. There are 35 Beko and Carrier air conditioning devices installed in the building (Figure 7). These systems are placed in doctor's offices, laboratories and offices. All devices are used intently in the summer period for cooling the space, and occasionally for heating purposes during the winter period. The air conditioning devices' power while cooling is 1.300 [W] and while heating 1.250 [W].

Figure 7. – An overview of outer and inner „split" unit sistem

2.4. Thermal vision recordings

East side





West side

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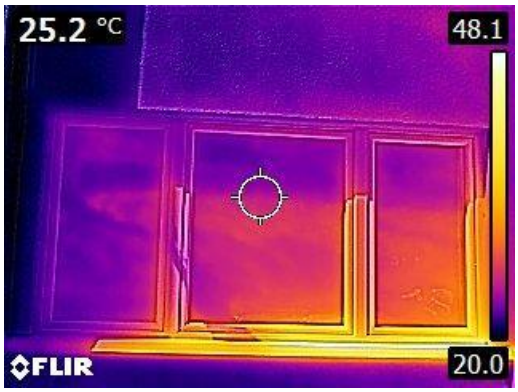
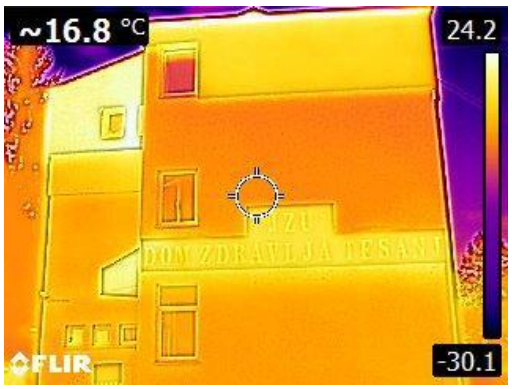


North side and roof



South side

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3. Energy sources and energy consumption analysis

In this chapter, energy consumption in the observed period before will be analyzed and after the implementation of the replacement of external windows at the PI Health Care Center Tešanj building.
For comparison, energy consumption data will be used for the period of 2016, where wooden windows with a U_w=2,9 W/m^{2}K heat transfer coefficient are available. Data on the consumption of heat energy in 2017 will be used as an indicator of the energy efficiency of the implemented replacement of wooden windows with new PVC windows.

To meet the energy requirements of the building the following forms of energy are used:

- Heat energy
- Electricity

The heating of the object is done by the heat energy from the brown coal fuel provided by JP "TOPLANE" d.d Tesanj. Calculation of the heat energy at the measuring site is done by the delivered heat of 79,82

[€/MWh] and the fixed part of 0,77 [€/m^2] of usable area. Electricity is supplied by JP "Elektroprivreda BiH" d.d Sarajevo, subsidiary of "Elektrodistribucija" Zenica for medical consumers, hot water preparation, lighting, IT equipment, kitchen equipment and other electricity consumers. There is a metering point of electricity within the building whose collection is charged according to the cost, and for the purpose of calculating the average price of 0,12 [€/kWh].

3.1. Heat and electricity consumption – before the implementation of the measure

The initial energy consumption data includes the reference period of 2016 when wooden frame windows (U_w=2,9 W/m^{2}K) were on the building. In order to ensure the validity of the calculation of efficiency, the energy consumption indicators (KPI01 - Energy Consumption per Year and KPI11 - Energy Consumption per m^2/user) that cover most of the various aspects of energy efficiency of the building concerned have been considered. The indicators are expressed by the average number of users (1.200 and 119 employees) and the useful surface of the object of 2.727 m^2. The data for this period and consumption indicators are presented in Table 3.

Table 3 - Indicator KPI01 - Annual Energy Consumption [kWh]

Year	Electricity [kWh]	Heat energy [kWh]
2016	110.427	174.996

For the purposes of energy consumption analysis or classification of the object in an energy class, the most important indicators of energy consumption for the state of the object and comparison after the implementation of the energy efficiency measure were given in table 4.

Table 4. - INDICATOR KPI11 – Specific energy consumption [kWh/m^2, kWh/user]

Energy	2016
Delivered heat energy	174.996 kWh/year
	64 kWh/m^2
	133 kWh/user
Electricity	110.384 kWh/year
	40 kWh/m^2
	84 kWh/user
Total energy	285.380 kWh/year
	104 kWh/m^2
	217 kWh/user

3.2. Heat energy consumption – after the implementation of the measure

The initial energy consumption data covers the period of 2017 when new windows with PVC frame (U_w=1,4 W/m^{2}K) were placed on the building. In order to ensure the validity of the calculation of the efficiency of the measure taken, only the indicators of heat energy consumption have been taken into account. The indicators were

expressed by an average number of users (1350 and 130 employees) and increased useful area of the object. Since 2017, as a part of the PI building, the Health Care Center additionally enters a physically separated adjacent building of Physical therapy of a useful surface of 334 m^2, so today the total usable area of the complex of these two buildings is 3.056 m^2. Collected data of annual heat energy consumption is 187.400 [kWh] for the year 2017.

Table 5. - INDICATOR KPI11 – Specific energy consumption [kWh/m^2, kWh/user]

Energy	2017
Delivered heat energy	187.400 kWh/year
	61 kWh/m^2
	126 kWh/user

3.3. Comparison of heat energy consumption – before and after the implementation of the measure

After the replacement of wooden windows (U_w=2,9 W/m^2K, 25-50 years old) with better PVC windows (U_w=1,4 W/m^2K), using a simple calculation tool, the annual savings would be around 31.800 [kWh/year].

The *ENCert-HR 2010* program used to calculate the required energy quantity for the heating and cooling of buildings according to EN ISO

13790:2008. The program is in compliance with the Technical Regulation on rational use of energy and thermal protection in buildings and the Rulebook on energy certification of buildings. According to the results of the program, the replacement of wooden windows with better PVC windows (U_w=1,4 W/m^{2}K) would bring savings of 31.800 [kWh/y].

In order to compare the heat energy consumption in the reference year 2016 and heat energy consumption in 2017, Table 6 and Figure 9 show the total and specific consumption of heat per square meter and the space user, as well as the annual level differences.

Table 6. - INDICATOR KPI11 - specific heat energy consumption [kWh/m^2, kWh/user]

Year	2016	2017	The difference in consumption indicators
Heat energy consumption indicators	174.996 kWh/year	187.400 kWh/year	12.404 kWh/year
	64 kWh/m^2	61 kWh/m^2	3 kWh/year
	133 kWh/user	126 kWh/user	7 kWh/user

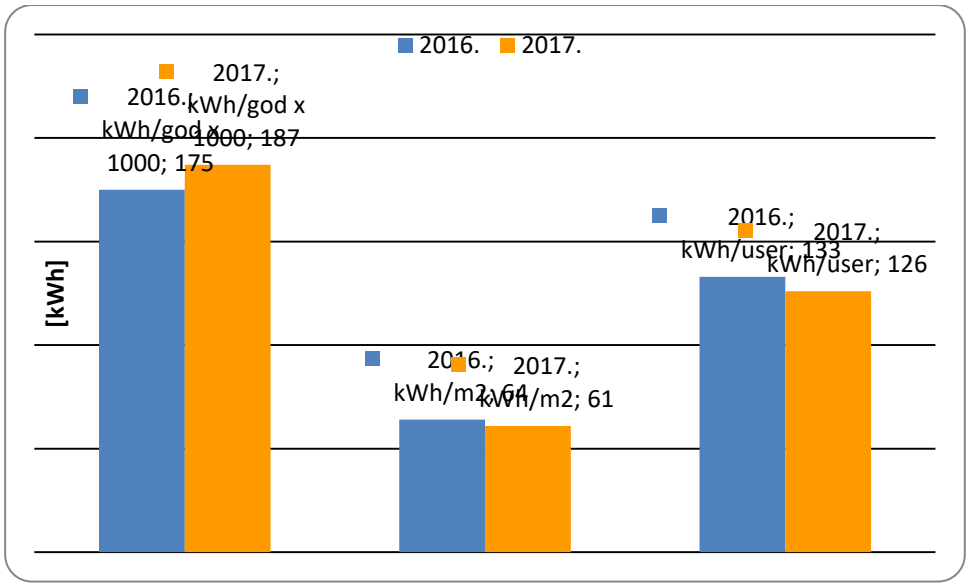

Figure 9. – Graphic display of the energy consumption of the PI Health Care Center before and after the implementation of the window replacement measure

The calculated differences data presented in Table 6 and Figure 9, show an increased amount of consumption of the delivered heat energy and after the replacement of the windows. For the purpose of collecting relevant facts for the Technical Report and finding the reasons for increase of the consumption of heat requirements, the Preliminary overview and the information gathered by the building usera were performed. The facts show that the increase in consumption of the delivered heat energy in 2017 was not due to the worsening of the envelope of the building or some other change in the generation, distribution or heating regulation system.

The reason for the "seemingly" increase in the consumption of heat energy can be attributed to the following circumstances:

- Large thermal transmission losses associated with the added building of Physical therapy: large areas of metal garage doors in

the basement (heat transfer coefficient of approx. 5,9 W/m^{2}K), heat losses on the walls to the ground, heat losses through outer walls,

- Increase of usable area from 2.727 m^2 to 3.056 m2 (approx. 11%), after joining the Physical therapy building complex of the Health Center
- Reasonable increase of the warmth comfort of the users

Therefore, it is necessary to correct the energy consumption in 2017 and then approximate the heat energy savings (ΔE_{HE}) after the implementation of the window replacement measure. Total heat savings before and after implementation of window replacement measures are calculated as follows:

$$\Delta E_{HE} = E_{2016} - E_{2017K}$$

Where:

ΔE_{HE} – Saves energy after improving the energy efficiency of the building by means of a replacement of windows

E_{2016} – Consumed thermal energy for the reference period **before** the replacement of the windows,

E_{2017K} – Consumed heat energy (corrected) **after** the replacement of the window.

In this expression, it is necessary to correct the spent energy E_{2017} by increasing the usable area (E_{KP}) of the building by about 11%

$$E_{KP} = 174.996 \text{ [kWh]} \times 0,11 = 19.250 \text{ [kWh]}$$

$$E_{2017K} = E_{2017} - E_{KP}$$

$$E_{2017K} = 187.400 \text{ [kWh]} - 19.250 \text{ [kWh]} = 168.150 \text{[kWh]}$$

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From the data of total heat demand before (E_{2016}) and after the replacement of windows (E_{2017}), the calculated annual energy savings are:

$$\Delta E_{HE} = E_{2016} - E_{2017K} = 174.996 \text{ [kWh]} - 168.150\text{[kWh]} = 6.846 \text{ [kWh]}$$

The result obtained shows a small saving of 6.846 [kWh/year] compared to the expected value of approximately 31.800 [kWh/year] according to the ENCert-HR 2010 computer program.

It should also be taken into account that the heat energy consumption is read on a single calorimeter - the metering point for the entire complex, while the energy efficiency of window replacement is implemented only on the Health Care Center building. For an accurate insight into the reduction of heat energy consumption compared to the earlier period, it would be necessary to have separate calorimeters and data for consumption: a separate one for the Health Care Center building and another for the Physical therapy and Emergency assistance building.

4. Suggestions and recommendations of other energy efficiency improvement measures

An examination of the building was performed and the condition of the outer envelope of the object was analyzed and a comparison of the obtained values for the allowed specific heat load was performed. After caring out the analysis, it was concluded that it is necessary to continue

to work on the activities of improving the energy efficiency of the Health Care Center complex and implement the following additional measures:

- architectural-construction measures,
- measures of thermal-technical systems, and
- measures of energy management system

An overview of the proposed measures to improve energy efficiency at the Health Care Center building is presented in Table 7.

Table 7. – An overview of proposed measures of energy efficiency improvement

Energy efficiency improvement measures	**Measure 1**	**Thermal insulation of outer walls** - The measure refers to the improvement of the thermal properties of the outer envelope, the outer wall with an additional thermal insulation layer of expanded polystyrene, EPS, of 10,00 cm thickness and a final layer of silicate plaster.
	Measure 2	**Thermal insulation of the ceiling and roof** - The measure refers to the improvement of the thermal properties of the outer envelope, the ceiling above the heated space with an additional layer of thermal insulation of mineral wool, of 10 cm thickness.
	Measure 3	**Replacement of circular pumps** - The measure refers to the replacement of existing and installing new equipment of the district heating system in

		order to increase the efficiency degree.
	Measure 4	**Hydraulic system balancing** - The measure refers to the replacement of the existing and the installation of new equipment of the district heating system in order to increase the efficiency degree.
	Measure 5	**Heat Exchanger Replacement** - The measure refers to the replacement of the existing and the installation of new equipment of the district heating system in order to increase the efficiency degree.
	Measure 6	Simple energy efficiency measures, organizational – educational measures
	Measure 7	Introduction of energy management at the building complex level

Improving the energy efficiency will be achieved through individual measures: improving the heat characteristics of the outer envelope (measures 1 and 2), improving the energy characteristics of the heating system (measures 3, 4 and 5) and introducing energy management (measure 7).

Collective examinations of energy and economic savings after the implementation of architectural - construction measures and measures for improving the thermal - technical systems are presented in Tables 8, 9 and 10.

Table 8. – Heat energy and electricity savings after the implementation of measures 1,2,3,4 and 5

Measure	Description	Heat energy savings [kWh]	Electricity savings [kWh]
Measure 1	Thermal insulation of outer walls	23.179	-
Measure 2	Thermal insulation of the ceiling and roof	891	-
Measure 3	Replacement of circular pumps	-	7.776
Measure 4	Hydraulic system balancing	10.632	-
Measure 5	Heat exchanger replacement	25.518	-
	Total	60.220	7.776

Table 9. – Energy and economic savings of the thermal insulation of the outer walls

Part of the envelope	Surface [m^2]	Heat transfer coefficient [W/m^2K]		Heat requirements [kWh]	Savings	
		before	after		[kWh]	[EUR]
Outer wall 1	517	0,49	0,30	174.996	23.179	1.848
Outer wall 2	138	0,64	0,35			
Outer wall 3	165	0,41	0,27			
Outer wall 4	32	0,52	0,31			
Outer wall 5	374	1,15	0,30			
Outer wall 6	191	2,65	0,35			

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Table 10. Energy and economic savings of the measures of thermal insulation of the ceiling and the roof

Part of the envelope	Surface [m^2]	Heat transfer coefficient [W/m^2K]		Heat requirements [kWh]	Savings	
		Before	After		[kWh]	[EUR]
Ceiling to the attic - upgrade	206	0,35	0,18	174.996	891	71
Ceiling to the attic – old part	587	0,26	0,15			

Table 11. Comparing of the investments and energy savings measure

Measure	Investm. evaluation [EUR]	Savings of the heat energy / electricity[kWh]	Savings of the heat energy / electricity [EUR]
Thermal insulation of outer walls	27.601	23.179	1.848
Thermal insulation of the ceiling and roof	11.760	891	71
Replacement of circular pumps	1.278	7.776	938
Hydraulic	256	10.632	848

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system balancing			
Heat exchanger replacement	10.226	25.518	2.035
Total	51.121	60.220	5.740

Table 11 shows that combined heat system recovery measures (replacement of circular pumps, heat exchanger replacement and hydraulic system balancing) in the amount of EUR 11.760 can be repaid in about 3 years only through the savings of heat energy.

5. Conclusion

The improving the energy efficiency by replacing the outer windows was done on the building of the Health Care Centre. The technical report is based on heat energy consumption data after replacing wooden windows (U_w=2,9 W/m^{2}K, 25-50 years old), with better PVC windows (U_w=1,4 W/m^{2}K). According to the energy consumption data, which were previously read at the metering point - the calorimeter of the heat substation, the average energy consumption for the reference 2016 is 174.996 kWh/year. Heat energy consumption data after the replacement of windows is 187.400 kWh/year. The reason for the "seemingly" increase in the consumption of heat energy can be referred to the connection of the Physical therapy building to the complex of Health Care Center (large transmission heat losses, an increase in usable surface area of 2.727 m^2 to 3.056 m^2, etc.) and the absence of calorimeters in the separate adjacent buildings.

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After the window replacement work has been carried out, the information of the users of the building and the employees indicates a significant increase in the user's heat comfort, indicating the efficiency of the implemented measure.

In order to further increase the energy efficiency of the building of the Health Care Center, additional architectural and construction measures can be proposed to improve the envelope of the building and measures to improve the thermo-technical heating system, as well as simple measurements of the daily energy management system.

Annex A – General data about the buiding

General Data	Name	Dom zdravlja Tešanj
	Address	Braće Pobrića 17, 74260 Tešanj
	Telephone	+387 32 650 677
	E-mail	domzdravlja.tesanj@bih.net.ba
	Type	Public health institution
	Construction year	1955, upgraded in 2011
	Type of the building	Buliding block
	Useful surface area	2.727 → 3.056[m^2]
Construction	Flooring	Basement + ground floor +2 floors
	Orientation	North – South
	Wall consturction	Brick, reinforced concrete
	Roof consturction	Bituminous shingles
	Ceiling consturction	Reiforced concrete
	Floor consturction	Ceramics, vinyl plates
Heating system	Type	District heating system
	Energy source	Brown coal
	Efficiency	85%
	Water temperature	70/90°C
	Air temperature	20 - 22°C
	Installed power	-
	Control and management	Manual
Cooling system	Type	Individual/split system
	Control and management	Manual
	Installed power	1.250, 2.000 [W]

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Lighting	Type	Fluorescent, LED
	Installed power	-
	Control and management	Manual

Annex B – Installed power of electric appliances

Type of appliance - lighting	Pieces	Power [W]	Installed power [W]
Filliament light bulbs and lamps	24	60,75,150	1965
Fluorescent lighting body, 1 × 18	3	18	54
Fluorescent lighting body, 2 × 18	1	36	36
Fluorescent lighting body, 1 × 36	63	36	2.268
Fluorescent lighting body, 2 × 36	198	72	14.256
Fluorescent lighting body, 3 × 36	69	108	7.452

Type of appliance – medical equipment	Pieces	Power [W]	Installed power [W]
Biochemica counter	1	250	250
Logopedic set	1	150	150
EEG appliance	1	300	300
De-ionator	1	250	250
Heater	2	1.000	2.000
CTG appliance	1	350	350
Ultrasound device	1	1.350	1.350
Sterilizer	1	1.800	1.800
Records reader	3	80	240
EKG appliance	2	600	1.200
OXYMAT 3	1	510	510
Water bathroom	1	1.000	1.000
Hematological counter	1	210	210
Running track	1	1.500	1.500
HEINE EN 100	1	150	150

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X-RAY appliance	1	2.000	2.000
Biomicroscope	1	45	45
Inhalor	1	1.500	1.500
Uređaj za centrifugu	1	500	500
Ophthalmology appliance	1	20	20
Coagulation device	1	500	500
X-ray appliance	2	2.000,3.000	5.000
Dental chair	3	250	750
Heliomat	1	100	100
Microscope	1	100	100
Ultrasound device	1	100	100
Water destilator	1	600	600
Electrotherapy device	5	80	400
Sedimentation device	1	150	150
Compressor	1	800	800
Stablizer	6	900	5.400

Type of appliance – IT equipment	Pieces	Power [W]	Installed power [W]
Video surveliance	1	150	150
Server	2	500	1.000
Printer	43	350	15.050
Scanner	4	150	600
Copy machine	2	200	400
Computer	52	275	14.300

Type of appliance – PTV	Pieces	Power [W]	Installed

equipment			power [W]
Boiler 80 l	2	2.000	4.000
Boiler 50 l	1	2.000	2.000
Boiler 5 l	29	1.000,1.200,5.000	40.300
Boiler 6 l	1	1.500	1.500
Boiler 7,5 l	1	2.000	2.000
Boiler 8 l	2	1.200	2.400
Boiler 10 l	2	2.000	4.000

Type of appliance – kitchen and other equipment	Pieces	Power [W]	Installed power [W]
Electric stove	2	2.000	4.000
Microvave	2	1.000	2.000
Air conditioning appliance	33	1.250	41.250
Air conditioning appliance	2	2.000	4.000
Radio	2	100	200
Cooker	6	2.000	12.000
Ventilator	4	35,100,150	585
Hot plate	9	1.000	9.000
Iron	2	2.000	4.000
Heater	3	1.000,2.400	6.000
Vacuum cleaner	1	2.000	2.000
Dryer	5	200,2.500	7.700
Washing machine	2	2.000	4.000
TV	2	150	300
FAX	1	150	150

Type of equipment – other equipment	Pieces	Power [W]	Installed power [W]
Circular pump	1	3.000	3.000
Other consumers	-	-	15.119

Total installed power	-	-	255.260 [W]

3. II Public Institution Cultural Centre Maglaj – General Library

1. Basic data about the object

The building of the Cultural Centre in Maglaj, according to the dimensions and design of the construction, can be classified into the class of smaller public non-residential buildings. The building consists of two connected buildings: 1. Cultural Centre + General Library and 2. Cinema (Figure 1). The subject of the Technical Report is the General Library located on the ground floor of the Cultural Centre (Figures 2,3).

Figure 1. Building PI Cultural Centre before installing the outer windows

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Figure 2. General Library after the replacement of windows – East side

Figure 3. General Library after the replacement of windows – West side

Based on an analysis of the aspect of the most important architectural and urbanistic characteristics, the building of the PI Cultural Centre Maglaj belongs to the typology of non-residential buildings in Bosnia and Herzegovina for the second period of construction from 1960 to 1980 which was later upgraded to the second floor in the attic.

1.1. Constructive system of the object

The Cultural Centre in Maglaj has completely changed in relation to the time it was upgraded. The second floor has been upgraded over the old part of the building so that today it has: ground floor + 1st floor + 2nd floor. On the layout, the building gross area is 719 m^2 and the useful area of the Cultural Centre in Maglaj is 1.687 m^2, of which the useful area of the General Library is 405,36 m^2.
In the context of energy characteristics all interior spaces are designed as heated spaces. As the General Library is located on the ground floor of the Cultural Centre and has a separate heating system, in the context of the outer envelope of the energy characteristics, only the outer wall, the floors and the exterior openings were observed.

Outer walls - the walls of the ground floor in which the General Library is located are made of: stone and reinforced concrete and a lime-cement layer of plaster on the inside of the wall. The load-bearing structure of the completed part consists of reinforced concrete poles - cornices - dimensions 35×35 cm, interconnected with reinforced-concrete beams, which are also the primary load-bearing structure on which the reinforced concrete plate is leaned on.

Floors - The finishing layer on the floors is in accordance with the function of individual rooms and consists of: PVC substrates or ceramic tiles. The floor construction on the ground of the upgraded part consists of: a layer of 30 cm thickness gravel on which the concrete plate of 10 cm thickness, hydro insulation, a 5 cm cement screed and a finishing

layer. All floors on the ground are in a satisfactory condition without visible damage.

Outer openings - During the nineties, the installation of the openings with a wooden frame and double glazing was carried out on the building. The largest openings are located on the East and West side of the building. The observed elements were in satisfactory condition with a heat transfer coefficient of 2,9 W/m^{2}K and replaced with new aluminum windows with thermal breaks (2-part insulating glass (4/16/4mm) with gas filling, low-e coating and triple sealants, heat transfer coefficient of 1,8 W/m^{2}K).

The basic feature of the outer envelope of the building is the construction of traditional techniques and materials without the application of thermal protection.

2. Energy systems

There is no integrated heating, cooling and ventilation system (HVAC system) in the building; there are 2 separate energy systems: the heating system and the electrical system.
There is a device for automatic control and heating system regulation by setting the parameters of the internal air temperature and program control of the biomass furnace.
The heat energy for the heating requirements of the building is provided by its own heating system on biomass - pellets with a boiler installed in 2014, of 50 kW power.

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Figure 4. – Pellet furnace 50 kW of power

The radiators are in a fairly good condition with no thermostatic valves. According to the experience of the users, space comfort is satisfied and the radiators in the building are sufficiently heated. Based on the presented data it is estimated that the efficiency of the entire heating system is 100%.

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3. Thermal vision recordings

East side

South side

West side

4. Energy sources and energy consumption analysis

This chapter will analyze the heat energy consumption (energy sources) in the observed period before and after implementation of the replacement of outer windows on building of the Cultural Centre - General Library Maglaj.

As input data the amount of energy consumption (pellets [t/y]) for 2016 when the wooden windows with U_w=2,9 W/m^{2}K coefficient of heat conductivity were on the building. For comparisons and indicators of the energy efficiency of the projected replacement of windows with aluminum windows, the data of the same energy source consumption will be used in 2017. In order to calculate the annual heat requirements, the pellet heating power of 4,8 [kWh/kg] was taken by 100% degree of utilization of the heating system of the General Library of useful area of 405,36 m^2.

Table 1. - INDICATOR KPI11 – specific heat energy consumption [kWh/year, kWh/m^2]

Year	2016	2017	Energy savings
Heat energy consumption indicators	12 t /year	9 t/year	3 t/year
	57.600 kWh/year	43.200 kWh/year	14.400 kWh/year
	142 kWh/m^2	107 kWh/m^2	35kWh/year

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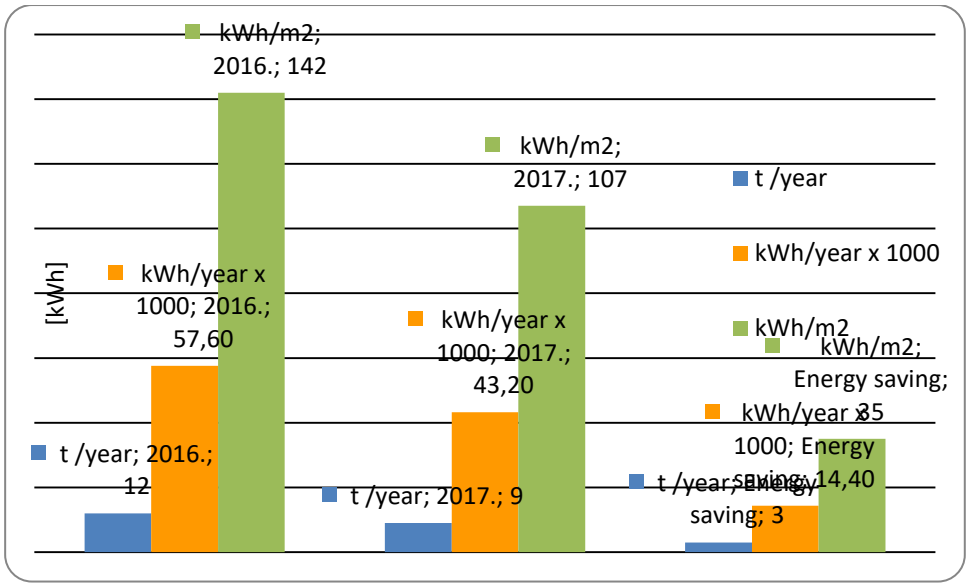

Figure 5. – Graphic display of heat energy consumption of the General Library before and after the implementation of the window replacement measure

Table 1 and Figure 5 show an increase in energy efficiency in the General Library as a part of the Cultural Centre building after improving the thermal characteristics of the outer envelope. Replacing the wooden windows with bad heat characteristics with better aluminum windows brought savings of 3 t of biomass a year or 14.400 kWh/year.

5. Suggestions and recommendations of other energy efficiency improvement measures

Preliminary energy overview of the building and condition of the outer envelope of the building was done. After carrying out the analysis, it was concluded that the architectural-construction measures on the envelope can only be performed on the entire complex of the Cultural

Centre. As the General Library premises are located in one part of the Cultural Centre, an analysis of these measures has not been the subject of this report. Improving energy efficiency of The General Library can, however, is carried out by improving the thermo-technical system by installing thermostatic valves. This would result in an increase in the level of heating system regulation and fuel economy savings estimated at around 2% per year.

6. Conclusion

At the building of the Cultural Centre in Maglaj, an energy efficiency improvement measure was done by replacing the outer windows. The technical report is based on heat energy consumption data after replacing wooden windows (U_w=2,9 W/m^{2}K, aged 15 years), with better windows with aluminum windows (U_w=18 W/m^{2}K). According to energy consumption data, the average energy consumption (biomass - pellet) for the reference 2016 is 12 t/year. The data of heat energy consumption after the replacement of the windows amount to 9 t/year, thus saving 3t of biomass annually.

After the replacement of the windows and the realized savings, the information of the users of the building and employees indicates a significant increase in the user's heat comfort, indicating the efficiency of the implemented measure.
In order to further increase the energy efficiency of the Cultural Centre, it is necessary to continue working on improving present condition.

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7. Reference

- **Rulebooks and laws**

Rulebook on technical requirements for thermal protection of the building and rational use of energy (Official Gazette FBiH No. 49/09)
Guidelines for conducting energy audits for new and existing buildings (August 2009)
Rulebook on the technical properties of heating and cooling of buildings (Official Gazette of the FBiH No. 49/09)
Rulebook on Technical Properties for Windows and Doors (Official Gazette FBiH No. 6/09)
Law on Construction Products (Official Gazette FBiH No. 78/09)
Law on Spatial Planning and Land Use at the level of Federation of BiH (FBiH Official Gazette No. 2/06, 72/07, 32/08, 4/10, 13/10, 45/10),

- **Standards for calculating the delivered energy**

BAS EN 15316-2-3 Heating systems in buildings - Method of calculation of energy requirements and system efficiency - Part 2-3: Distribution of district heating systems
BAS EN 15316-3-1 Heating systems in buildings - Method of calculation of energy requirements and system efficiency - Part 3-1: Hot water preparation systems
BAS EN 15316-4-5 Building heating systems - Method of calculation of energy requirements and system efficiency - Part 45: Heat production

systems for space heating, indicators and quality of district heating and large volume systems

BAS EN 15241 Ventilation in buildings - Methods of calculation of energy losses due to ventilation and infiltration in business buildings

BAS EN 15193 Energy performance of buildings - Energy requirements for lighting

- **Standards for energy calculation required for heating and cooling**

BAS EN ISO 6946:2005 Building components and building elements - Thermal insulation and conductivity - Calculation method

BAS EN 15242 Ventilation in buildings - Methods of calculation for determination of airflow in buildings including infiltration

BAS EN ISO 10077-: 2011 Thermal window, door and screen characteristics, calculation of heat transfer coefficient

EN ISO 13790: 2008 Energy performance of buildings Calculation of required energy for space heating and cooling (EN ISO 13790: 2008)

BAS EN 15243 Ventilation in buildings - Calculation of temperature, load and energy in room buildings with air conditioning systems

BAS EN ISO 13789: 2009 Thermal performance of buildings - Transmission and ventilation heat transfer coefficients - Calculation methods

BAS EN 13162:2002 Thermal insulation products for buildings Factory made mineral wool products (MW) Specification (EN 13162: 2001)