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

DELIVERABLE 2.5

Twelve economic evaluation reports

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ABBREVIATIONS AND ACRONYMS

Acronym	Definition
CAPEX	CAPital Expenditure
BIPV	Building integrated photovoltaic systems
BMS	Building management system
Building skin	The exterior elements and semi-exterior elements of a building
EeB	Energy-efficient Buildings
ECB	European Central Bank
EBITDA	Earnings Before Taxes, Depreciation and Amortization
EBRD	European Bank for Reconstruction and Development
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracts
ESCO	Energy Service Company
EU	European Union
IRR	Internal Rate of Return
NPV	Net Present Value
KPI	Key Performance Indicators
nZEB	nearly Zero Energy Building
OPEX	OPerating Expenditure
PPP	Public Private Partnership
RES	Renewable Energy Source
VAT	Value Added Tax
VRV	Variable refrigerant volume (VRV) or Variable refrigerant flow (VRF) system

CERTUS PROJECT IN BRIEF

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

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

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

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

EXECUTIVE SUMMARY

Context

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

Objective of the deliverable

The aim of this deliverable is to provide a project evaluation methodology and some considerations for the implementation of nZEB projects, in particular for their economic and financial structuring and for the identification of the ways of financing (These aspects have been discussed in delivery 3.7).

Within this activity, 12 projects were analyzed, 3 for each Municipality, in some cases in cooperation with designers, with the aim of defining nZEB project solutions.

The analyzed building sample is interesting because it represents a differentiated and representative sample in terms of typology of building, starting conditions, size, geographic location and its impact on energetic consumption and identified technological solutions. However, the sample only represents some of the possible and differentiated feasible renovation options and thus should not be considered significant for a statistical purpose.

Methodology adopted

In order to develop a sustainability evaluation of the projects, a qualitative and quantitative analysis process has been carried out.

With this in mind, the project Partners firstly decided to adopt a common definition of "nZEB" solutions with following targets:

- 75% to 80% improvement of the overall energy efficiency or to the levels pointed out by the national regulations for nZEB if better;
- Use of RES (Renewable Energy Sources) in the interval of 70% to 90% of the current heat, cool and electricity demand.

In the development of the following analysis, different points of view will be considered in order to verify the sustainability of the projects and in particular:

- verify the sustainability of the projects for an ESCo
- verify the sustainability and benefits for the Municipality after the signing of an EPC contract

Once defined a common nZEB definition and a common point of view, the proposed project sustainability evaluation methodology was based on the following seven working stages:

1. Ex-ante sharing of the main project variables;

2. Analysis of the project's main risks and identification of the mitigation instruments;
3. Elaboration and analysis of the project data;
4. Identification of an EPC contract for each project;
5. Identification of the optimal financial resources on the basis of the identified technological solutions and the results of the risk analysis;
6. Development and finalization of the model with output evidence;
7. Presentation, for each project, of the key indicators and of the optimal financial structure.

Once identified the technological solutions and expected savings for each single project/layers, it was possible to apply the methodology of sustainability evaluation.

In line with the methodology adopted, the project partners has developed:

- A concept framework to check at the same time the sustainability and the nZEB profile of an energy efficiency project;
- A multidisciplinary analysis process and a set of data sharing and modeling tools (such as the Certus Matrix) capable of sharing in an efficient way the project variables and to evaluate the projects from every single point of view. Thus, the conceptual matrixes were developed. These matrixes were designed on the basis of the previous experiences of the Partners in energy efficiency projects.

This way of approaching the evaluation of a project creates an important added value because:

- It simulates the market practice and it can be understood by the market operators;
- It's based on analysis/communication standards commonly used in the market and, if used in a widespread way, it may facilitate the comparison between the interested subjects such as municipalities, construction and management companies (including ESCos) and financial institutions.

<u>Project evaluation</u>

For each of 12 projects undertaken was applied the project evaluation methodology, composed by these steps:

- Sharing of data input projects: the send of the Certus matrixes to the technical designers and the receipt of the project data
- Definition of economic and financial data input: the selection of the economic and financial input variables, both at specific country level and at European level (market, economic and financial variables)
- Definition of the EPC contract: the identification of the EPC standardized model, mainly implemented in the 4 countries under evaluation
- Financial modeling: Implementation of a cash flows' analysis for each project , developed following the steps explained in the previous paragraphs and hence through:
  1. The economic and financial analysis, firstly considering that the projects could be financed at market condition (with senior bank debt and private equity) in order to allow the evaluator to put the projects in the graph "Sustainability vs nZEB Energy Saving ";
  2. A layers' analysis in order to understand the share of the investment undertaken that has not been repaid in the time window considered and hence not able to repay the senior debt;
  3. The identification of further financial sources (such as grants or subsided funds) if required by the project analyzed, after the evaluation of the project at market condition.

Once implemented this sustainability evaluation methodology, some summary indicators are defined reflecting the overall evaluation of the project, through some output tables.

In order to reach the goal of this work, a common evaluation sustainability methodology, which takes into account several aspects, was developed as described in the previous paragraphs. The identified methodology processed discussion between subjects bearing complementary skills and belonging to different fields (technical, administrative, economic and risk management, contractual). This way of approaching the evaluation of each project creates an important value added because it simulates the market practice, it can be understood by the market operators since it's based on analysis/communication standards commonly used in the market and, if used in a widespread way, it may facilitate the comparison between the interested subjects such as municipalities, construction and management companies (including ESCos) and financial institutions.

As said before, in order to carry out an evaluation of the projects, the possibility of financing them at market condition by implementing the most widespread EPC contract among the four Countries (see Paragraph 3 "Project Evaluation") was first evaluated.

Then, when the above process is not implementable[1], a specific ad-hoc financial structure was implemented in order to make the project attractive for the market and for the ESCos.

This financial structure is structured trying, were possible, in order to favour subsidized funds while public grants were only used in a residual way only where necessary. A minimum percentage of equity invested by the ESCo was also assumed as a warranty of the effective contribution of the private subject for the development of the project. As far as subsidized funds are concerned, a standard instrument with a very competitive interest rate[2] is assumed just for example purpose[3]. In addition, ESCo were also supposed to have a good credit rating or a warranty system that should allow them to obtain these financing conditions.

This process was applied to the CerTus twelve-project sample, representing some of the possible solutions that can be applicable on public buildings and having its own characteristics.

<u>Results and recommendation</u>

According to the analysis developed, it was possible to ascertain that it's very difficult to reach the nZEB threshold by developing projects in public-private partnership at market conditions involving an ESCo. As a matter of fact, as verified in previous experience of the project Partners, the typical energy savings threshold typically obtainable at market conditions is around 30%-40%. Further energy savings are therefore achievable only by realizing more investments that are not always feasible at market conditions and that usually need to be financed with specific ad-hoc financial instruments or public grant.

[1] Such a situation is the case for the majority of the projects

[2] As shown in Paragraph 3, a 1,5% interest rate was assumed.

[3] The analysis of the different financial instruments will be carried out in WP3.

Given the analyzed sample, in the majority of the cases it emerged that, in order to make the projects attractive for the market, there was the need of structuring a very strong financial support with important percentages of public grant and subsidized funds while reducing the percentage of equity invested (this never lower than 8%/10%).

In summary, the results of the analysis of the twelve projects are the following:

- Only few projects have an Energy Pay Back Period lower than 10 years. Energy Payback period depends especially on three parameters: Energetic Baseline of the buildings, renovation options chosen and its costs/square meters and Energy savings achievable;
- In some case the renovation options lead to higher maintenance cost. Even if this means a reduction of the overall economic savings of the intervention, this also means higher quality of the service for the Municipality;
- In some case the results show that marginal contribution of each investment to energy savings is decreasing. The Euro amount invested to obtain a 1% savings starting from baseline is much lower than the Euro amount invested to obtain the same 1% savings with the last renovation option, starting, for example, from 70% savings;
- It can be observed that very high energy savings and at the same time high cost of investment, lead to an increase of the expected Payback Period. In this case, in order to ensure the feasibility of an ESCo intervention, a specific facility or grant should be provided by the Municipality;
- Given the analyzed sample, in the majority of the cases it emerges that, in order to realize the projects, there is the need of structuring a very strong financial support. In particular:
  - Only one project is market sustainable and attractiveness with a market financial structure
  - One project is feasible/sustainable on the market only if some subsidized funds have been added up
  - Subsidized Funds and Grant are needed for the other ten projects:
    - Percentage range for Subsidizes Fund: 24% to 50%
    - Percentage range for Grant: 15% to 88%
    - Five projects are feasible/sustainable on the market using both Subsides Funds and Grant
    - Three projects are partially feasible/sustainable using both Subsides Funds and Grant
    - Two project still remain not market sustainable even using Subsides Funds and Grant

On the one hand, these results underline some limits:

- the amount of public grant needed for the realization of nZEB projects is too high, also considering the current situation of Municipality's lack of financial resources
- the activation of a public-private partnership with an equity invested by the ESCo at 10% of total investment is not feasible at market conditions but should only be possible if subsidized lending is available.

On the other hand, these results highlight some guidelines that could be useful for the readers:

- In order to make the kind of investments more sustainable for the ESCo, the projects could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;

- For small size projects, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

In order to investigate some alternative scenarios and understand which could the financial solutions be, an analysis was made to verify if there are some projects:

a) whose investment could be realized in two complementary ways: investments that are not sustainable at market conditions to be covered by the Municipality with own capital while the others to be covered by the ESCo (Scenario 1)
b) that, given the involvement in the capital of the ESCo of some distinctive investors with lower return expectation (around 4% IRR), should be developed with a financial structure more feasible on the market (Scenario 2)

Case a) represents uniquely a theoretical example because the share of investment that should be taken in charge by the Municipality is very high. Thus, a public-private partnership is not likely to be activated just for a residual part of total investments. A simple reason is that in this moment one of the main problems of the Municipalities is the lack of financial sources. In addition, this solution needs major efforts to organize the realization of each layer of the project, which may depend on different subjects, and to manage different construction timing.

Case b) shows that the involvement of an investor with low return expectation, the increase in equity and subsided funds could avoid the recourse on public grant. In facts, the use of subsided funds is generally preferable with respect to grants because of the revolving mechanism that allows the lender to reinvest the proceeds from the loan in other projects.

Financial unsustainability, subject to market conditions, is mainly due to several factors:

- in the four countries, while using the same technologies, buildings' initial characteristic (e.g. construction year, size, use, climatic conditions, …) have led to different results;
- technological solutions, currently available in the market, are quite expensive if compared to savings (e.g. thermal insulation coating or windows replacing, etc.) with a negative impact on project's economic and financial sustainability;
- the cost of interventions with medium and long term payback time, for example interventions concerning the improvement of the building skin, passive or hybrid systems;
- the additional cost of special constructions or systems, compared with conventional, which are required for listed buildings;
- Energy efficiency interventions may improve the ability of Municipalities to identify appropriate maintenance frequency compared with the initial situation with an increase of maintenance annual costs entirely sustained by the ESCO. This aspect, although it initially increases public expenditure, is fundamental for the proper maintenance of the new plants.

Our evaluation highlights that **financial sustainable projects** must have the following characteristics:

- A **well-defined baseline of energy consumption and maintenance costs are clearly-defined**. It is crucial to carry out a careful audit action on buildings where it's possible to intervene with nZEB solutions establishing a close cooperation between the public administration and the engineering companies in charge of technical and economic evaluation. This is the starting point to identify a solid project pipeline both in energy and economic terms, in order to set clear targets and the best technological solutions. Furthermore, Municipalities, to improve energy efficiency, should pay attention both to energy savings (e. g. fuel consumption) but also to financial savings. In particular it must be carried out a detailed assessment of energy carrier costs, in order to identify whether these are aligned (or not) with current market conditions, indeed matching market conditions may generate immediate savings for the local authorities. Usually it is recommended to separate the supply of carriers from energy efficiency contracts;
- **Layers/project must have a short payback period.** In the CERtuS project some layers (such as building skin, passive or hybrid systems) have a long payback period. It must be said that this kind of solutions cannot be remove. Indeed Municipalities which implement nZEB interventions often sustain additional expensive refurbishment costs (such as windows substitutions if these are obsolete) to guarantee better public services, focus the entire refurbishment in a single period and ensure best results combined with other interventions. Therefore, in order to match public needs and economic/financial sustainability of nZEB interventions, from our point of view, it is fundamental to identify additional financial tools to support the entire building refurbishment;
- **Energy savings (compared to layers costs or full projects costs) should ensure a payback period less than ten years**. In fact, as seen in these twelve projects ESCos, which achieve nZEB interventions, often get savings that do not allow the repayment of the investment in less than 20 years. This is mainly due to the fact that municipality's fees are calculated on the basis of achievable savings in order to get lower energy costs than initial consumption;
- The municipality should **aggregate projects** in order to reach a critical mass especially when their size is small. This way the Municipality could reduce the structure costs and benefit from economies of scale during construction and management period. Therefore ESCo maybe better attracted by bigger project that could provide sufficient revenues to repay the investment.

In order to encourage nZEB interventions some observations should be done. Such observations were not directly implemented within the analysis because of their characteristics but represent some further food for thought for the recovering of sustainability and for the realization of the interventions. In this sense, a list of observations follows :

- interventions to activate public - private project governance between Public Authorities, financial institutions and private entities in order to achieve clear common targets;
- increase public buildings use (subject to nZEB interventions) during different times of the day with complementary activities (e.g. sport and social activities during the evening/night, office activities during the day). Consequently the government may pay more fees to the ESCOs, fostering projects' appeal on the market;

- increase ESCo services, which, in addition to hard facility management, could offer them the possibility to carry out ancillary services such as soft facility management, (e.g. cleaning services, green care ..). This would provide additional revenues to the ESCOs, enhancing the sustainability of the initiative;
- if the initial situation of public buildings makes it difficult to implement nZEB interventions (even with a grant), a possible solution could be the sale of part of the assets and the use proceeds to intervene on the remaining buildings, using them in a more efficient and rational way (e.g. fostering their use from morning until evening);
- either when the project reaches its maturity or after a few years since the beginning of the EPC contract, a further opportunity to increase energy efficiency interventions could be the entry of financial institutions (e.g. institutional investors, funds, etc.) injecting liquidity into the ESCO. Consequently the ESCo could recover additional resources to carry out extra projects. This scheme may solve ESCO's undercapitalization or decrease their need of financial resources.

1. OVERVIEW AND OBJECTIVES OF THE DELIVERABLE

This document represents a delivery of Work Package 2, more specifically Task 2.5, Delivery 2.5 “Twelve economic evaluation reports”.

The aim of this deliverable is to provide a project evaluation methodology and some considerations for the implementation of nZEB projects, in particular for their economic and financial structuring and for the identification of the ways of financing. These aspects will be further discussed in deliverable D3.7.

The identified sustainability evaluation methodology takes into account several aspects:

- Analysis of the context framework and the variables that impact on the economic, financial and risk analysis;
- Analysis of project features, obtained savings and achieved performances, pay-back period, etc…;
- Given project features and performances, the identification of the best ways to develop project and management by an ESCo;
- On the basis of project features, the implementation of a financial structure to support the development of the project.

Within this activity, 12 projects were analyzed, 3 for each Municipality, in some cases in cooperation with designers, with the aim of defining nZEB project solutions.

The analyzed building sample is interesting because it represents a differentiated and representative sample in terms of typology of building, starting conditions, size, geographic location and its impact on energy consumption and identified technological solutions. However, the sample only represents some of the possible and differentiated feasible renovation options and thus should not be considered significant for a statistical purpose.

In order to develop a sustainability evaluation of the projects, a qualitative and quantitative analysis process has been carried out. This methodology will be explained in details in the following paragraphs.

The project partners developed:

1) A concept framework to check at the same time the sustainability and the nZEB profile of an energy efficiency project;
2) A multidisciplinary analysis process and a set of data sharing and modeling tools capable of sharing in an efficient way the project variables and to evaluate the projects from every single point of view. Thus, the conceptual matrixes were developed. These matrixes were designed on the basis of the previous experiences of the Partners in energy efficiency projects.

The identified methodology, through the identified dialogue tools, starts a process of discussion between subjects bearing complementary skills and belonging to different fields:

- Technical field;
- Administrative field;

- Economic and risk management field;
- Contractual field;

From our point of view, this way of approaching the evaluation of a project creates an important added value because:

- It simulates the market practice and it can be understood by the market operators;
- It's based on analysis/communication standards commonly used in the market and, if used in a widespread way, it may facilitate the comparison between the interested subjects such as municipalities, construction and management companies (including ESCos) and financial institutions.

The activities of quantitative analysis concerned the single project with its features, energetic baselines and risk profile and considering the Country variables (cost of debt, cost of energy, inflation rate, etc).

In the following pages the methodology of sustainability evaluation of the projects will be shown in details and then the 12 selected projects will be analyzed.

2. PROJECT SUSTAINABILITY EVALUATION METHODOLOGY

2.1. PREMISES

As introduced in the previous paragraph, given the available sample, in order to carry on an economic and financial evaluation, some conceptual maps were used.

The conceptual graph **"Sustainability[4] vs nZEB Energy Savings"** was adopted on the basis of previous experience gained in the evaluation of energy efficiency projects. The graphs - see Figure 1 to 5 - are used to identify the sustainability of nZEB projects.

The graph aims to compare the three main factors that characterize nZEB project:

a) the energy efficiency achieved in the nZEB projects: **" Energy Savings "**

b) the sustainability of the project in terms of profitability for the ESCo that will take charge of the project: **"IRR[5] for the ESCo"**

c) the placement of the project in market: **3 Cluster were identified (Cluster 1 Market attractiveness – Cluster 2 Partial market attractiveness – Cluster 3 No market attractiveness)** and, consequently,

d) assumptions or expectations of investors who can effectively use their resources for the realization of the specific project.

An explanation of each variable is as follows:

a) "**Energy Savings":** the horizontal axis shows the results in terms of the energy savings achieved by the project. The vertical line is the threshold over which the project achieves nZEB level of efficiency "i.e. 75% to 80% improvement over the current operation as indicated by the national regulation for nZEB"

b) **"IRR for the ESCo":** The Internal rate of return for an ESCo was identified as one of the variables for placing the projects in the matrix. This indicator describes the shareholder returns that develops the project and then, in the final synthesis, the attractiveness of the initiative for a potential investor. The IRR was calculated on cash flows for the ESCo within the project during the construction and management period (contract duration EPC). Different ranges of IRR were identified and, as explained in the following paragraphs, a value equal to or greater than 8% was considered to be the target IRR for the ESCo under market condition. see paragraph 3. PROJECT EVALUATION.

c) **"Sustainability profile Cluster":** this variable is ideally located on a third axis (as seen from the next graph). In order to classify nZEB projects achievable on a building, it was decided to locate them on the basis of their placement relative to the market. For simplicity purpose, three Cluster were identified (but some more clusters may also be identified):

[4] In this work sustainability is especially related to the economic and financial sustainability.

[5] IRR: Internal Rate of Return

1) **Cluster 1- Market attractiveness**: Energy saving solutions fully capable to attract private sector investors and financiers and provide them with sustainable return on investment made; This type of project could be financed directly on the market (bank, private capital, etc.)

2**) Cluster 2 - Partial market attractiveness**: energy saving solutions only partially capable to attract private sector investors and financiers and provide them with sustainable return on investment made. This type of project should be financed through bank resources and subsidized funds / Guarantees, etc. These kind of projects may be included into Cluster 1 just with a small aid.

3) **Cluster 3 - No market attractiveness**: energy saving solutions not capable to provide private sector investors and financiers with a sustainable return on investment because they show high investment cost..These types of intervention need a strong support in term of grant funds.

Finally, we noted that different operators, (such as Investment Funds, ESCos, Industrial companies, etc.) operate into the various identified clusters, which have different expectations and which, by using funds of different origin, may have a different opportunity cost of capital and thus a different IRR equity target.

The project evaluation and the identification of the respective IRR allows to place these operators inside one of the clusters above defined on the basis of some range that were identified. These ranges are indicative for current general market conditions of the Countries and with a reduced counterpart risk. Therefore these ranges may be revised in the different specific cases of respective context.

Projects with an IRR equal to or higher than 8% may be placed in Cluster 1 - Market attractiveness. These rates of returns are normally required by ESCOs or other private entities interested in energy efficiency projects.

Projects with an IRR in a range between 8% and around 5% - 4% may be placed in Cluster 2 - Partial market attractiveness. Normally these returns are only required by financial players such as investment funds or institutional investors. Therefore, in order to make the project feasible for market participants such as ESCOs, private investment funds, developers with own funding etc . It's necessary to support the investment with subsidized funds or other financial instruments or public/state incentives.

Projects with an IRR in a range between 4% and zero may be placed in Cluster 3 - No market attractiveness. These types of project cannot be placed on the market and it's very hard to find private operators that would accept these type of returns. Therefore, in order to make the project feasible for market participants such as ESCOs, it's necessary to support the investment with subsidized funds but also with important injections of grant and public/state incentive.

Therefore, a project can be positioned in a particular cluster according to the fulfillment of the above conditions. So, in order to verify the reasons why a project is placed in one cluster or another, it was useful to make the same analysis for layers of design and implementation of layers. For each layer the following evaluation was made: we calculated the marginal profitability of each layers for an ESCo and we compared it with the results in terms of energy efficiency that each additional layers could give.

Overall, the layers analysis helps to understand how projects works, how they should be placed on the market and what specific resources should be used for every specific project in order to guarantee sustainability for the parties involved, both Public and Private.

Therefore, as you can see from the charts below, it was possible to verify that some type of intervention/layer (see later detailed in paragraph 3. PROJECT EVALUATION) having non-competitive prices on the market and very low contribution to saving need to be financed by grant.

The first logical step is the identification of the observation parameters for the evaluation of the project. The vertical line represents the ideal threshold of energy efficiency for nZEB projects.

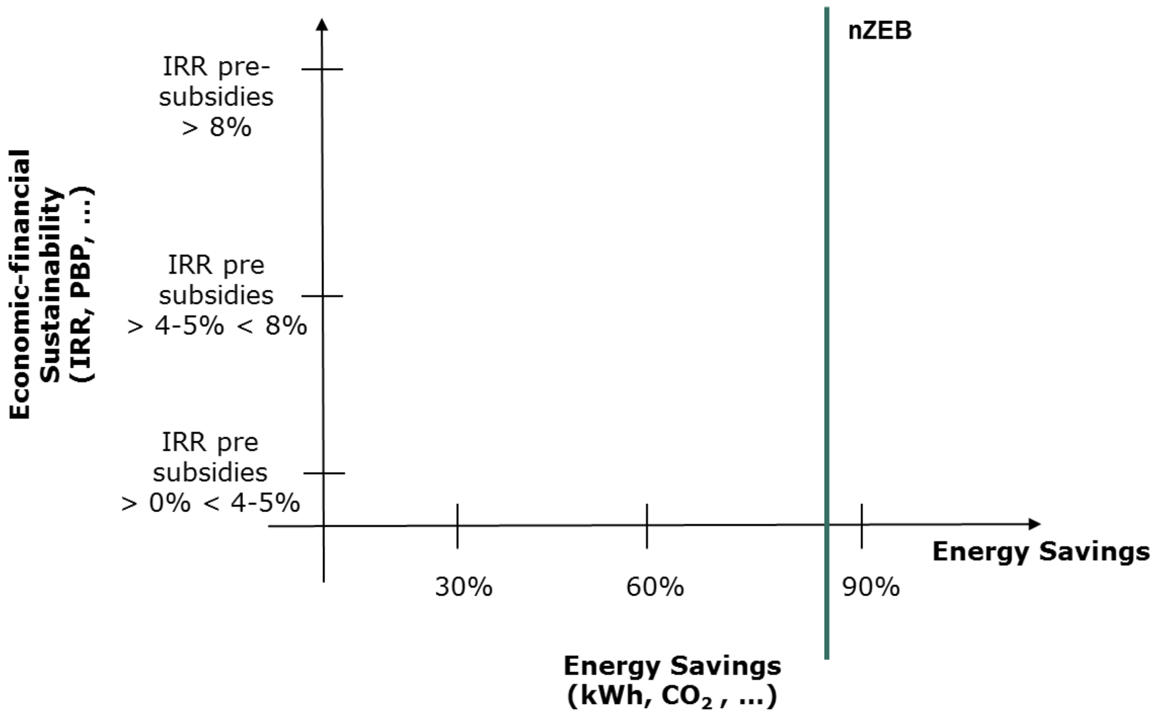


Figure 1. "Sustainability vs nZEB Energy Saving First step

A second step consists of placing, after having carried out the economic and financial evaluation, the projects or the layers inside the graph according to the relation between IRR and Energy Savings. Indeed, the analysis, as explained, may be carried out at both overall project and single intervention (layer) level.

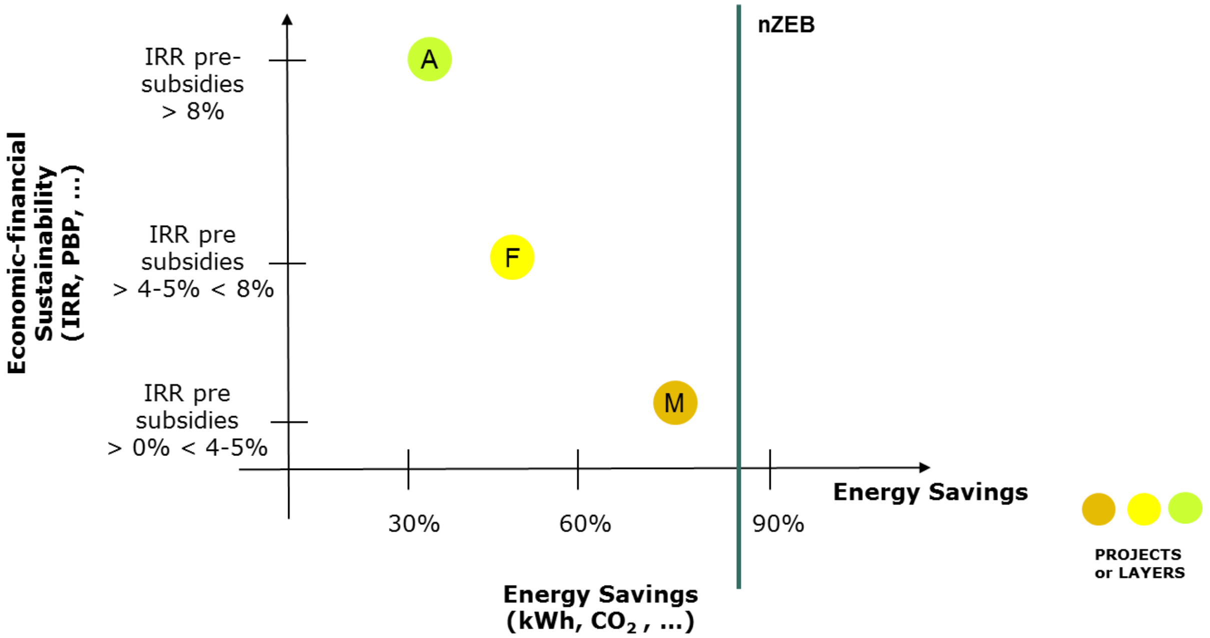


Figure 2. "Sustainability vs nZEB Energy Saving_ Second step

The following step is the matching/placing of each project/layer inside one of the identified Clusters according to its pre-subsidies IRR.

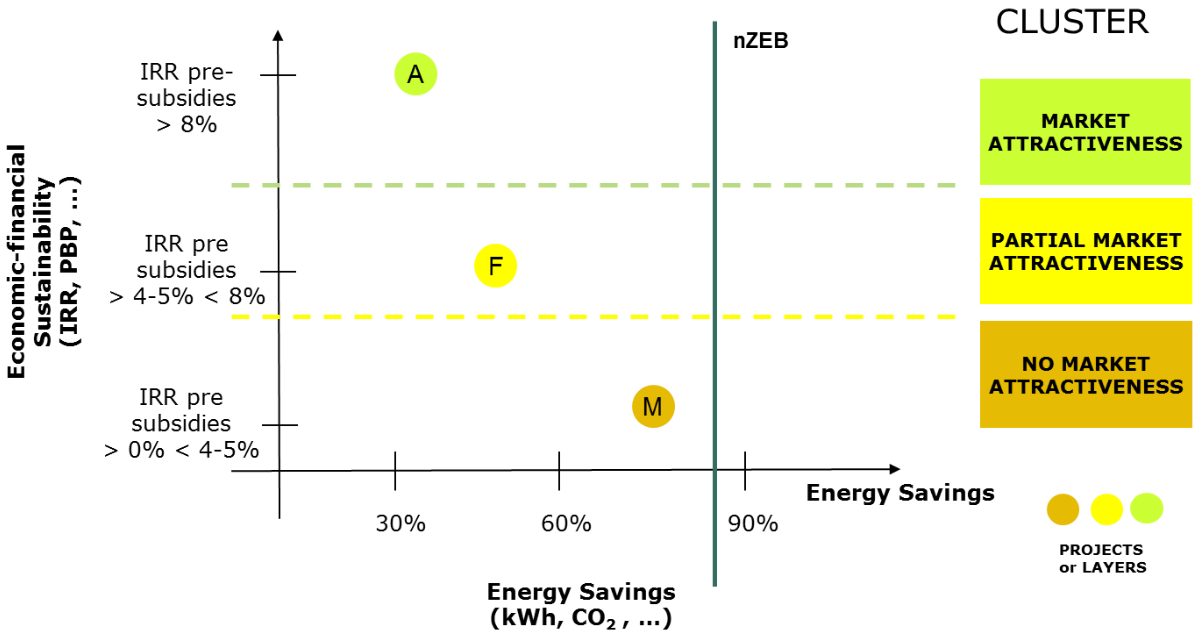


Figure 3. "Sustainability vs nZEB Energy Saving_Third step

Another step is the analysis of the sample of the projects and their placing into the graph. On the basis of previous experiences and under actual market conditions, the evaluation of a large sample allows to plot, even with regression tools, a curve that may describe the allocation of the projects into the graph. As an example, given the small sample of the CERtuS projects, an ideal blue line was plotted in the following graph.

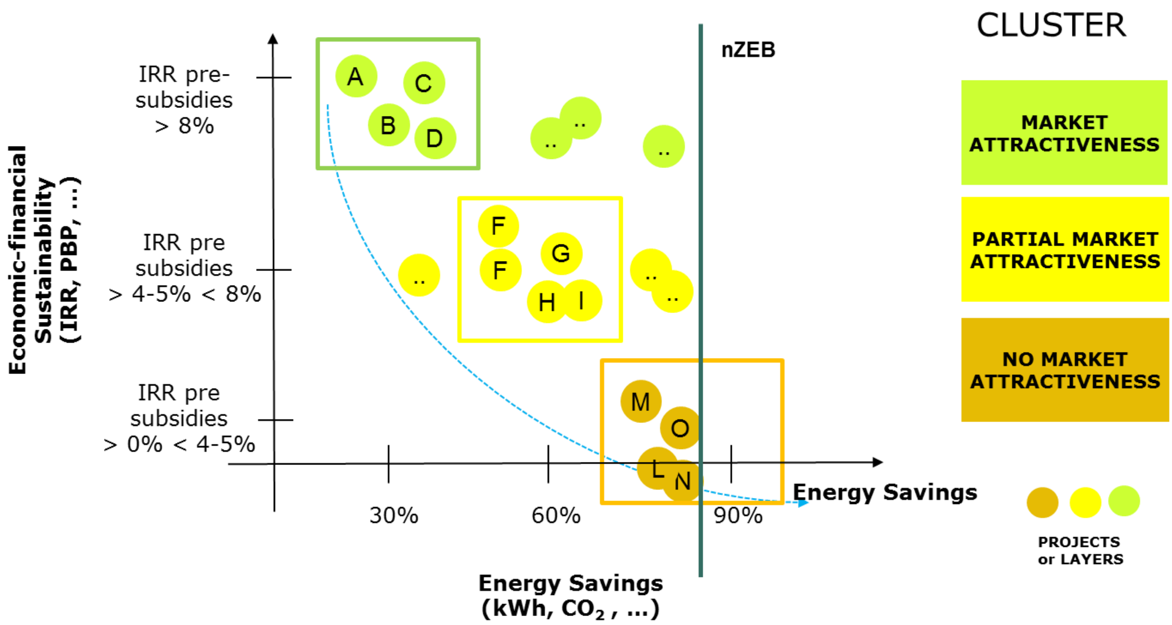


Figure 4. "Sustainability vs nZEB Energy Saving _ Four step

The last step (see red and blue arrows) shows how the identification and use of some financial support instruments (such as subsides funds, grant, fiscal incentives as it will be explained later) could make projects realizable for the market.

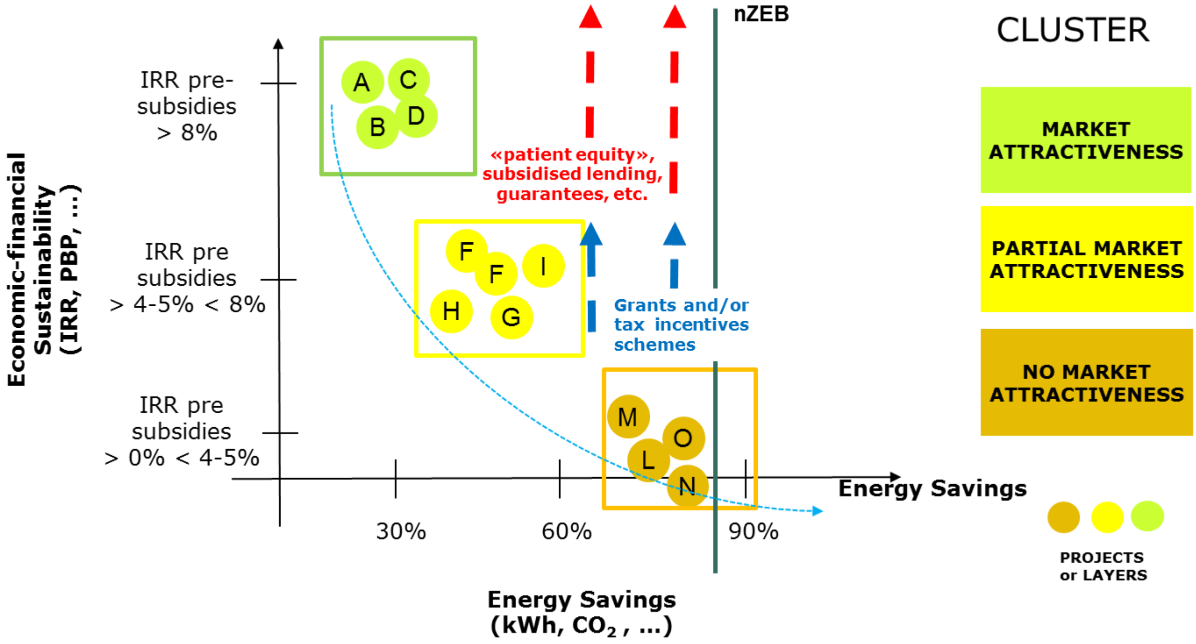


Figure 5. "Sustainability vs nZEB Energy Saving _ Final step

By following this frame of reference and in particular the project categories that could be created by analyzing the variables pointed out, the analysis methodology shown in the following paragraph was developed.

2.2. ANALYSIS PROCESS OVERVIEW

The identification of a common evaluation methodology is necessary in order to define and compare diversified sustainable financial nZEB schemes.

With this in mind, the project Partners adopted a common definition of "nZEB" solutions.

As described into deliverable D2.2, according to the Progress Report of Member States information on nZEB[6], more than half of the Member States already implemented a definition. Some of these are under approval while 2 Member States, namely Greece and Spain, have not send a national plan or the consolidated template yet. See delivery D2.2[7] for a brief description of the national definition of nZEBs in Greece, Italy, Portugal and Spain.

Regarding the detailed practical definition of nZEB, 13 Member States presented an applied definition which includes a numerical target, but numerical values differ widely across the various Member States and cannot be automatically comparable.

[6] ECOFYS, *Overview of Member States information on nZEB- Working version of the progress report-final report*, October 2014.

[7] Title of D2.2: "Report presenting the risks, difficulties and constraints envisaged by the stakeholders regarding nZEB renovations"

Therefore, in order to consider a common definition, CERtuS partner prepared the renovation options with following targets:

- 75% to 80% improvement of the overall energy efficiency or to the levels pointed out by the national regulations for nZEB if better;
- Use of RES (Renewable Energy Sources) in the interval of 70% to 90% of the current heat, cool and electricity demand.

Please refer to Delivables 2.1[8]for each Municipality, in which the project Partners analyzed the matching between the renovation options of each building and the nZEB targets stated above.

In the development of the following analysis, different points of view will be considered in order to verify the sustainability of the projects and in particular:

- verify the sustainability of the projects for an ESCo
- verify the sustainability and benefits for the Municipality after the signing of an EPC contract

In fact, projects are assumed to be realized by the Municipality with the identification of an ESCo with whom to sign an EPC contract. For each project, on the basis of the project features, geographic location and development of the EPC market, a standard EPC model was considered.

Once defined a common nZEB definition and a common point of view, the proposed project sustainability evaluation methodology was based on the following seven working stages:

8. Ex-ante sharing of the main project variables;
9. Analysis of the project's main risks and identification of the mitigation instruments;
10. Elaboration and analysis of the project data;
11. Identification of an EPC contract for each project;
12. Identification of the optimal financial resources on the basis of the identified technological solutions and the results of the risk analysis;
13. Development and finalization of the model with output evidence;
14. Presentation, for each project, of the key indicators and of the optimal financial structure;

Given these premises, once identified the technological solutions and expected savings for each single project/layers, it was possible to apply the methodology of sustainability evaluation.

The project evaluation methodology also has the aim of identifying a tool and an action plan for each phase of analysis.

[8] Add Title of D2.1 "Report presenting the 12 nZEB renovation schemes fully documented with technical and economic evaluation"

In particular, as illustrated in the following paragraphs, two main tools of dialogue and information sharing with the other project Partners were identified,:

- CERtuS_nZEB Sustanability Matrix
- CERtuS_nZEB Risk Breakdown structure

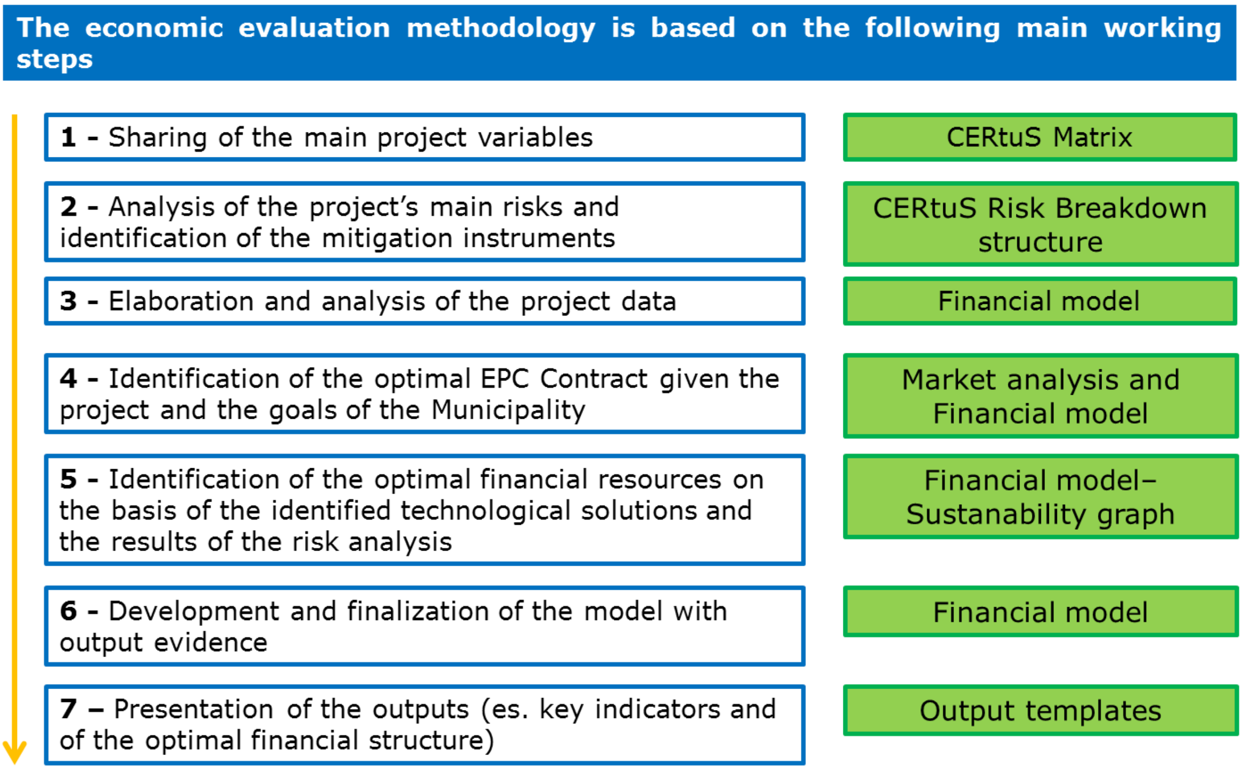


Figure 6. Economic evaluation methodology main steps

The methodology emphasizes a very important aspect for the evaluation of projects and their sustainability: the continuous dialogue between the team dedicate to design and the Municipalities interested into developing the initiative.

The development of an energy efficiency project has many objectives:

- Needs of the municipality in terms of energy expenditure restraint;
- Optimization services for citizens;
- Compliance with national and European regulations and goals;
- Improvement of public facilities and heritage;
- Reduction of costs of public administration in favor of services to citizens;

According to the identified mix of technologies, geographical location, risk analysis and market best practices, optimal financing schemes may be identified.

The sharing of information since the beginning, on the basis of a common methodology, also responds to the need of finding the most efficient solutions for the specific case examined. On the basis of the technological solution pointed out by the designers, a sustainability analysis was carried out. In particular, the following work consist of finding the optimal financial structure, the related financial instruments and the management contract (Energy Performance Contract).

The aim of the process analysis, based on market practice, is to help the Municipality to define:

- Costs and benefits from the implementation of the project;
- Sustainability of the project;
- Correct identification and calibration, where needed or appropriate, possible kinds of subsides for the project/single intervention/layer (facilities, energy efficiency funds, regional, national and European funds or financial sources provided by the Municipality itself)

The aim is also to show how an adequate financial and contractual structure may improve the sustainability of nZEB projects, thus facilitating their realisation through the involvement of an ESCo.

2.3. INPUT DATA TOOLS – CERTUS NZEB SUSTAINABLE MATRIX

One of the key issues for a successful evaluation methodology is the applicability of replication and standardization. Achieving this conditions in quite challenging since all building projects differ in various technical and financial parameters.

In order to address these challenges and provide with a tool that will encapsulate all individual conditions and unique characteristics, CERtuS Partners developed a detailed methodology to allow diverse building characteristics to be captured and further processed.

The technical, financial and qualitative information was collected in three excel files, called Matrixes. These files are not interrelated in the entered information but they share a common format and structure in order to be easily read and processed by all Partners. The reason for choosing three distinct matrixes is expressed in the following stepped approach:

1. File_1: Mapping of the current use
2. File_2: Mapping of proposed renovation actions
3. File_3: Quality characteristics of the proposed actions

File 1_CERtuS_Buildings Input Database_Current Status_(building name).xls

The first Matrix contains information on the current use and condition of the building and the relevant systems. This file requires information about:

- Building identification (Property, Building name, Address)
- Building features (Main intended use, Heating degree day, Year of construction, etc..)

- Energy data (Description of the HVAC [9]systems, Heating - Cooling - Electrical power of the installed system, Average consumption, Presence of management/maintenance contracts, etc..)

Table 1 contains the main categories and fields of the first Matrix.

Building current information	Main fields
Building identification	Building name & address Intended use
Building features	Heating and cooling degree days Year of construction and/or last renovation Heating / cooling surface Heating / cooling volume
Energy data	Description of HVAC systems Heating / cooling power of installed system 3 year-average thermal, cooling and electric consumption Percentage (%) variation of consumption
Maintenance contracts	Annual maintenance component and supplies cost Annual maintenance personnel cost
Control systems	Replacement of heating system Replacement of windows External insulation Energy optimization systems Any relevant actions

Table 1 Required information for the description of existing buildings

[9] HVAC system is the equipment, distribution systems and terminals that provide the processes of heating, ventilating and/or air conditioning to a building or part of a building.

File 2_CERtuS_Renovation options matrix_(building name).xls

The second Matrix contains information about the desired renovation measures, which was determined after a detailed study and that ensures that the renovated building is able to become an nZEB. The required information of the second Matrix is organized in three layers:

- Renovation category
- Type of intervention/layer
- Required technology and readiness

The File 2: **"CERTUS Renovation options matrix Project"** is structured in two sheet:

1) The sheet "**Renovation options building**" should be replicated for each building.

- For each Renovation option (and thus for each layer) it's required information about:
- Installed power or size of intervention/layer
- Working timing (Start date/Final date, Construction period, Compulsory connection with other technologies/layers, etc..)
- CAPEX - CAPital EXpenditure (Investment cost, Investment payback period, Lifetime)
- OPEX - OPerating EXpenditure (Energy consumption (after energy renovation options), Labor/Management and ordinary maintenance contracts, Extraordinary maintenance)
- Savings (Potential energy savings expected from the intervention/layer both Electric and thermal, Potential savings from maintenance post intervention, Potential savings of CO2)

The sheet **"Summary"** summarizes the identified renovation options for each building.

Category	**Main fields**
Renovation options	HVAC Building Envelope Windows Interior lighting systems Renewable energy Control systems Passive systems Elevators

Category	Main fields
	Etcetera
Work timing	Construction period Interconnection with other technologies Technologies – layers before Technologies – layers after
CAPEX	Investment cost Investment payback period Lifetime of new renovation Energy consumption type (electr/ fossil fuel)
OPEX	Energy consumption after renovation Labor / Management and ordinary maintenance costs Extraordinary maintenance costs
Savings	Potential energy savings from intervention/layer Actual energy saving per year (kWh) Percentage (%) savings per year Potential savings from maintenance (post intervention) Potential saving of CO_2

Table 2.The main categories and fields of the second Matrix

The outcome of Matrix_2 is a decisive step forward, towards clarifying the technical solutions that will need to be applied in order for the municipal buildings under consideration to become nZEB. It is a tool that allows the engineering services of a municipality to place into context the research and the technical information they have collected and relate it to the relevant cost parameters.

If we would like to summarize the information recorded in the matrix File_2, we would say that is the tool which gives three (3) key figures for the next steps, i) Initial Consumption, ii) Final Consumption and iii) CAPEX &OPEX costs related to these actions.

File 3_CERtuS_Qualitative Elements Project_(building name).xls

The third Matrix is a multifactor table that relates the technical and financial renovation options' characteristics with non-numerical information. This matrix provides a platform to the technical partners to present the renovation options in relation to the technology's maturity and also relate them to each country's current supporting scheme. This information is of great importance to the next step, which is the coupling with the most appropriate financing scheme.

This file requires information about:

- Presence of bonds by type of intervention (Architectural, etc.)
- Level of spread of technology (pilot, available in the market, widespread, mature)
- Presence or absence of incentives

This file requires information about:

Building identification (Property, Building name, Address)

- Building features (Main intended use, Heating degree day, Year of construction, etc..)
- Energy data (Description of the HVAC systems, Heating - Cooling - Electrical power of the installed system, Average, Presence of management/maintenance contracts, etc..)

Table 3 contains the main categories and fields of the third Matrix.

Building current information	Main fields
Type of intervention	Architectural Civil Engineering Electromechanical Engineering
Level of technology maturity	Pilot project Available in the market Widespread Mature
Presence of incentives	Yes / No Name of supporting tool Brief Description Link

Table 3. Qualitative Elements of the proposed renovations

These tools are an important preliminary verification of the correctness of data and project estimates and may facilitate the finalization of a feasibility study or other levels design.

2.4. RISK BREAKDOWN STRUCTURE FOR nZEB PROJECTS

A risk analysis will be carried out on the nZEB solutions that would be brought to the buildings. According to literature and to consolidated practice, risk analysis usually concerns the following macro-categories of risk:

- Governance: lack of control, change of control, etc…
- Political/Social: risk of facing changes in regulations or complication of authorization procedures, loss of reputation/credibility
- Economic/Financial: risk of incurring changes in market prices of electricity, raw material, etc…
- Environmental: risk of incurring limited availability of natural resources, possible damages to the fauna, flora, Earth, water, air, etc…
- Technical/ Construction: construction defects, change of technology, etc..
- Commercial/Operations: demand, supply, etc…

CerTus nZEB Risk Breakdown Structure (RBS)

Governance Risks
- Lack of control (management)
- Project sponsors cohesion / conflicts
- Decision process/rules (power of veto)
- Change of control
- …

Political / Social Risks
- Change of political agenda
- Change of law or regulation
- Residents' opposition
- Vandalism, riots, crime, terrorism
- Radical change of social habits
- Change of incentives mechanisms
- Planning consent
- Judicial challenge
- Reputation
- …

Economic / Financial Risks
- Funding (timing)
- Currency convertibility
- Currency transfer
- Creditors
- Redeposit risk
- Default of counterparts or project sponsors
- Inflation
- Interest rates
- Exchange rates
- Depreciation
- Taxes
- …

Environmental Risks
- Intrinsic to site characteristics
- Natural events
- Site preparation / dismissal
- Environmental performance
- Climate change
- …

Technical / Construction risks
- Specification and/or design errors
- Construction defects
- Construction timing
- Interference risk
- Change of technology
- Revamping
- …

Commercial/ operations risks
- Completion of the contract
- Energy Demand (price, volume..)
- Service supply
- Business processes, skills, etc under/over specification
- Site/equipment under/over specification or failure
- Operation quality
- Plant availability
- Change of technology
- …

Figure 7. CERtuS nZEB Risk Breakdown Structure

The focus of this study is the analysis of the economic and financial risks that determine the successful financing of the nZEB renovation actions. The licensing, technical, environmental and construction risks that present an important challenge have been addressed in the previous studies by CERtuS technical partners.

Technical Risks

The technological solutions proposed by CERtuS partners have been decided after a thorough research and according to market practices and have all been classified according to each technology's level of maturity. Technical barriers are in nZEB case inevitable since in order to achieve low energy consumption new technologies, construction materials and procedures are introduced. The current levels of knowledge and experience vary between different providers across projects and especially among different EU Member States. According to the POWER HOUSE[10] nearly-Zero Energy Challenge initiative it has been evident in many projects that it is difficult to identify the best technology mix to deliver nZEB and understand the cost-benefit of the renovation actions. In many EU countries and especially those of the south, there has been limited training in these systems.

Legislative Risks

At EU level, the energy efficiency Directive has been set along with the targets to be achieved. In the four Member States under investigation national targets and incentive policies are not in common allowing for same renovation actions to have different results.

Social & Organizational Risks

Post- renovation energy consumption is not always in line with the modelling expectations. The two main reasons for the deviation is a) The human factor, since home or office users adjust the operation conditions according to personal preferences and not always in line with the optimal conditions and b) Due to "rebound effect" in which users prefer higher comfort levels in contrast at the expense of energy saving. Such effect is more evident in cases where current conditions are below accepted standards.

Market Credibility

Development of new building renovation projects with nZEB character has not yet presented robust data and a strong example to the market. Therefore project users tend to be speculative and present holdbacks concerning the cost – benefit of such actions. All involved stakeholders present holdbacks regarding financing terms and durability of equipment and building parts for such long payback period.

Economic and Financial Risks

Securing the available finance to develop nZEB projects is a true challenge since nZEB buildings have higher upfront costs. Since not many building developers have experience with such deep renovations, extra cost goes to planning, knowhow and quality assurance. In addition, banks and ESCOs have a short investment plan and are reluctant in financing projects with long payback period. With limited understanding of the new technologies the perceived financial risk is higher than it truly is. A key difference of this kind of investment is the repayment scheme. Rather than creating additional income which can be pledged, it provides the building users with lower utility bills. There is always the challenge of how to secure that the energy cost saved will be channeled to the investment repayment.

'POWER HOUSE nearly-Zero Energy Challenge!' initiative, to provide a structure for a pan-EU knowledge exchange http://www.powerhouseeurope.eu/home/power_house_nearly_zero_energy_challenge_partners/the_project/

In our model we focused on the different financial and business environment that exists in each of the countries under investigation and to what extent this effects the financing terms that will allow for each project to be realized.

The technological solutions proposed by CERtuS partners have been decided after a thorough research and according to market practices and have all been classified according to each technology's maturity level.

The figure below, Figure 8, is a graphical and conceptual representation of risks related to the phases of the project implementation, i.e. planning, construction, start up and management. The blue line in the graph represents risk dynamics. As it can be noted, project risk reaches its peak between construction and the startup phases. Moreover, some risks such as regulatory, environmental and market risk occur throughout all project phases, while others (i.e. authorization, construction, financial and technological risks) occur in all the phases.

The risk analysis in the different implementation phase of a project is very important because, according to the phase in which the project is located, such risks will be bear by different parties (public or private entity, contractors or maintenance subject). These risks should be carefully identified, monitored and mitigated by the latter also through the use of "ad hoc" contracts.

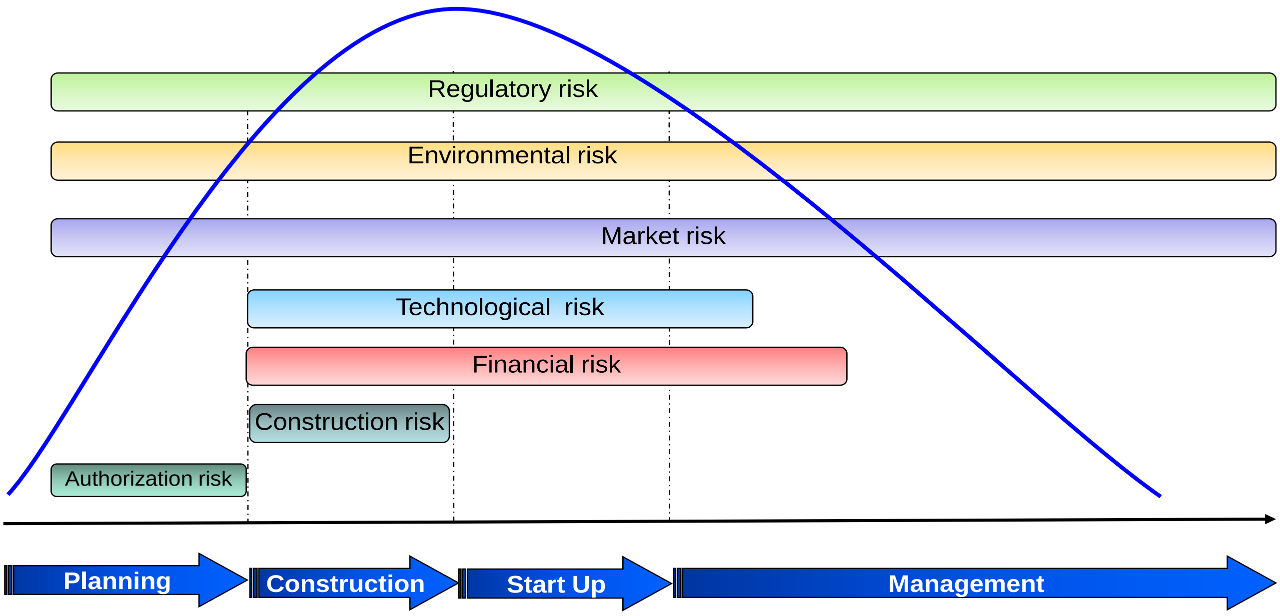
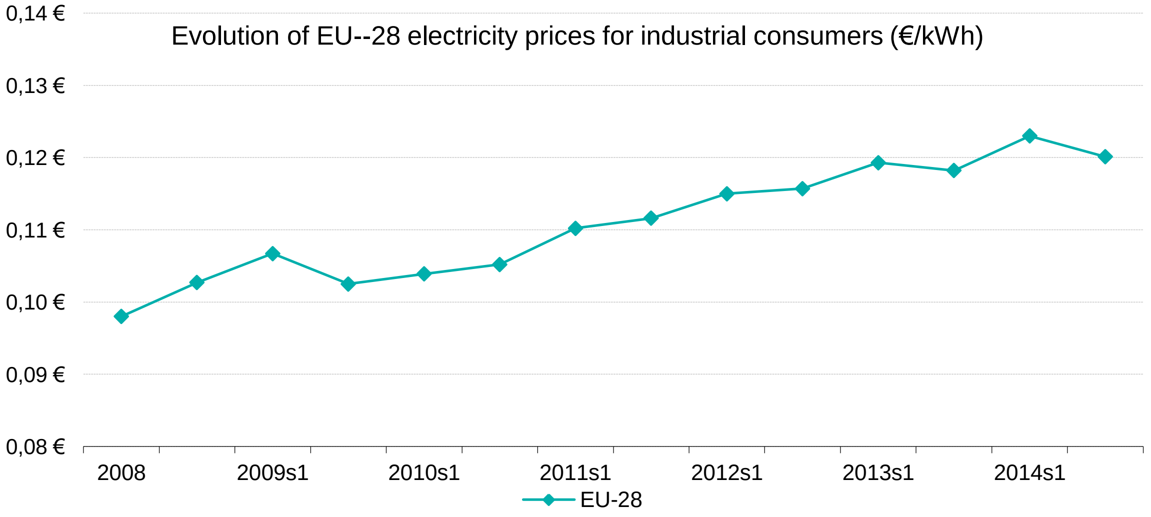


Figure 8. Risks clustering and project Development Phases

Cost factors risk

In our financial modeling a key input data is the evolution of the price of electric energy (€/kWh) which is assumed to increase annually at a rate of 2%. The assumption is based on the historical upward trend as shown in the following graph.



EU-28 = aggregated prices weighted by consumption for the EU countries:

Figure 9. Evolution of electricity prices for industrial consumers[11] (EUR/kWh)

Source: Eurostat (online data code: nrg_pc_205)
http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_and_natural_gas_price_statistics

The evolution of the electricity cost for the four countries under review (Greece, Italy, Spain, Portugal) the is presented in the following graph (€/kWh after tax for band IC -Industrial consumer)

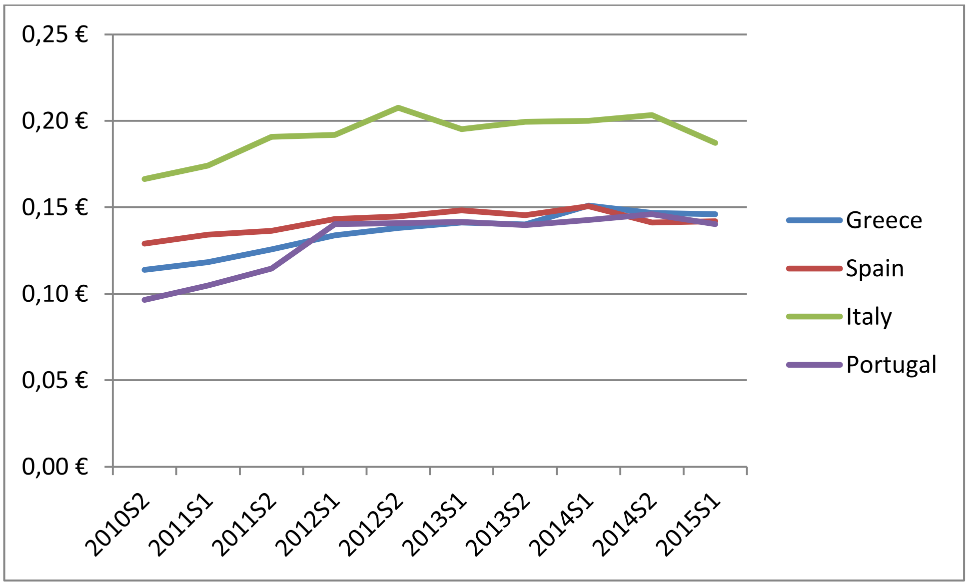


Figure 10. Evolution of electricity cost for industrial consumers (€/kWh)

Source:http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_price_statistics#Electricity_prices_for_industrial_consumers

[11] Industrial consumers: the medium standard industrial consumption band, with annual electricity consumption between 500 and 2 000 MWh

Commercial – Financial Risk

Each market has to face the political risk in the form of the change in agenda of the respective government. It is very clear in the markets under investigation (i.e. Italy, Greece, Portugal and to a lesser degree Spain) that the cost of electricity is not formed by each countries cost factors but instead by the taxes and levies that our charged on top (Figure 10).

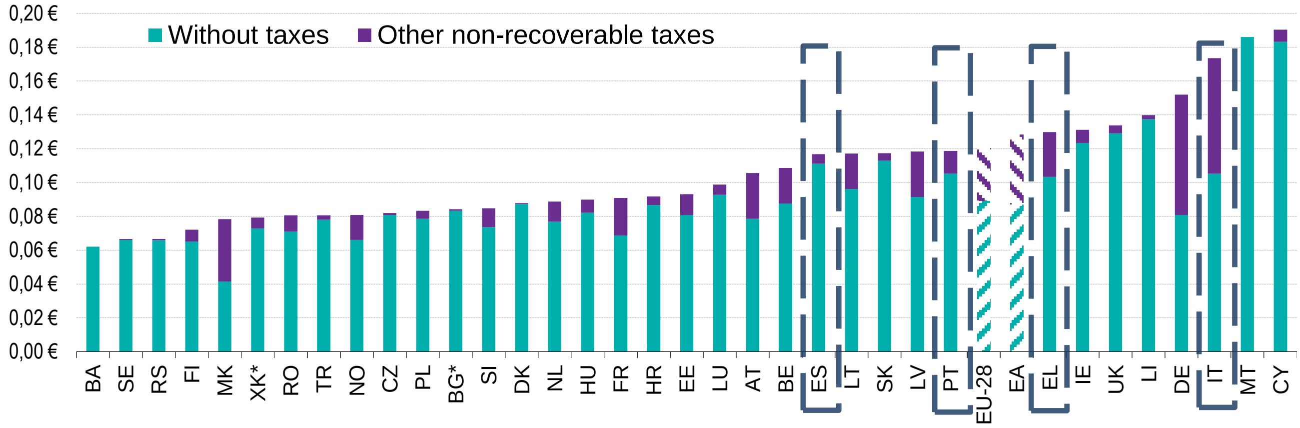
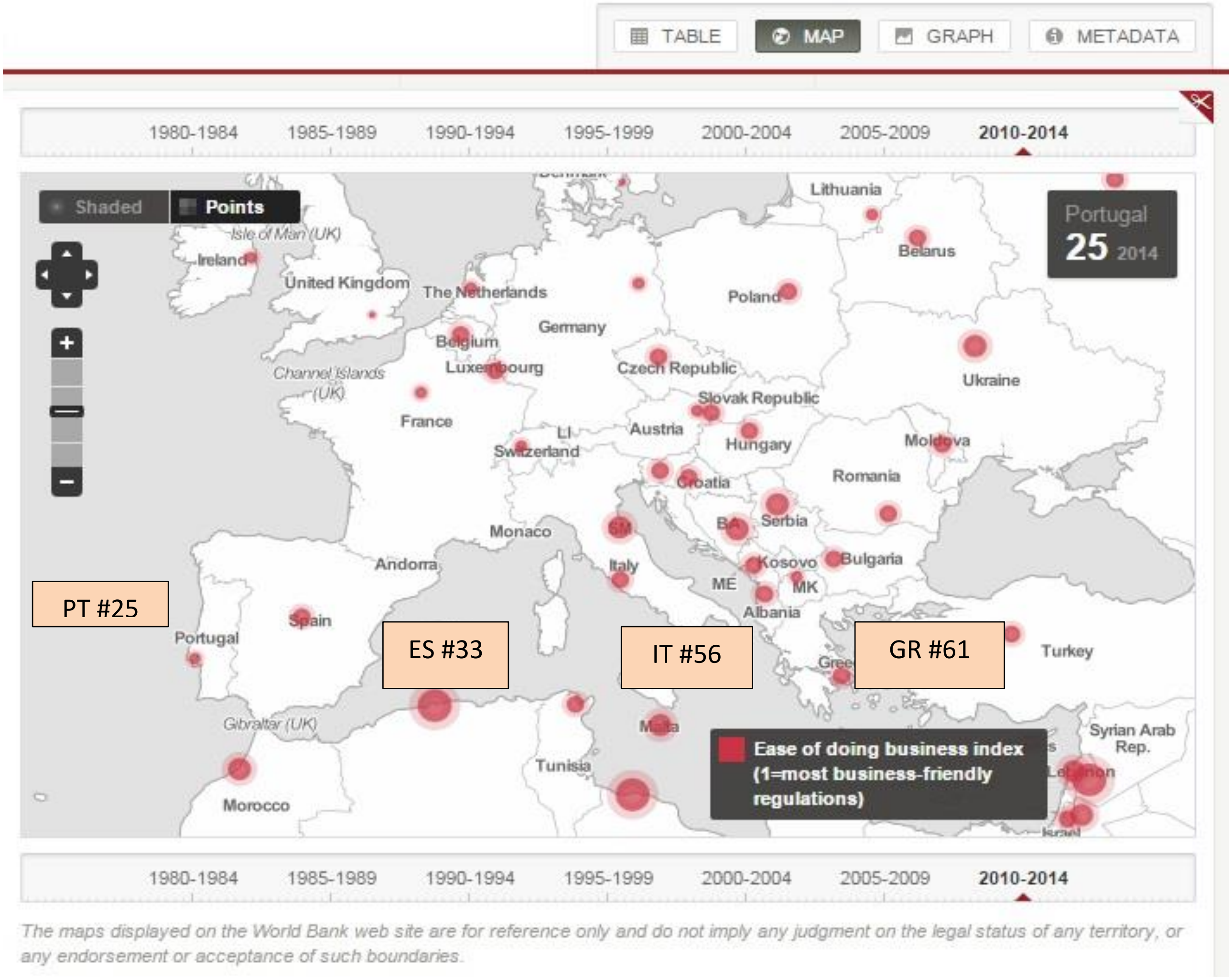


Figure 11. Electricity prices for industrial consumers, 2014 Q4 (€/kWh)

Source: Eurostat (online data code: nrg_pc_205)
http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_and_natural_gas_price_statistics

Operation Risks

Ease of doing business ranks economies from 1 to 189, with first place being the best. A high ranking (a low numerical rank) means that the regulatory environment is conducive to business operation.



Source: http://data.worldbank.org/indicator/IC.BUS.EASE.XQ/countries/GR-IT-ES-PT?display=map

It's important to underline that, given the economic, political and market differences in the different countries, in the following analysis (see paragraph 3. PROJECT EVALUATION) some important hypotheses have been done:

- stable market conditions during the whole project length are assumed;
- there is no Counterparty Risk. It is assumed that all the Municipalities are able to pay the annual fee to the ESCo for the whole project length and, more, they are able to fully accomplish obligations towards the ESCo;
- country and governance risks are fully embedded in the debt cost and they do not affect the project in other variables.

2.5. STEPS OF FINANCIAL ANALYSIS AND MODELLING

This paragraph shows the various steps of analysis that are suggested to follow to achieve the optimal financial structure for the realization of the projects.

The following list synthesizes the process:

- Elaboration and analysis of the project data
- Identification of an EPC contract for each project (chapter 3)
- Identification of the optimal financial resources on the basis of the identified technological solutions and the results of the risk analysis

The analysis of the project for each building will be carried out in three steps:

1. Market test: this analysis concerns the sustainability of the project by itself, in terms of ability to pay back the investment cost with annual savings. In addition, it investigated the sustainability of the project assuming a standard ESCo involvement with third party finance and the implementation of an EPC contract as described above.
2. Single renovation option convenience tests: in this simulation the impact on the project sustainability of the removal of some interventions/layers was analyzed. In particular, the removal from the renovation schemes of those single interventions/layers showing a very high cost/savings ratio was assumed. Those interventions/layers are represented by those technological solutions that are too expensive on the market and that may lengthen the payback period of the investment without improving energy savings significantly[12]. Please note that this analysis is just a theoretical exercise because every single intervention/layer proposed by technical partners should be implemented.
3. Financial structure optimization: in this simulation the financial structure of the project was changed in order to try to make it profitable for an ESCo. In order to do so, according to the level of sustainability of the project itself in the base case, some hypothesis of the previous model analysis was changed (i.e. the equity/debt ratio, the duration of the contract, the availability of subsided funds and public grants, etc.).

The multi-annual financial economic model for each project will be worked out. As already explained, the model will be fueled by a series of input data divided into:

- data resulting from the Certus Matrix, mainly referred to the definitive project;
- data resulting from the geographical, political, economic and financial context and that also depend on the identified technological choices:
    - financing resources
    - leverage
    - debt terms (interest rates, commissions, duration, amortization, etc…)
    - local taxation
    - fiscal facilities

[12] These interventions are considered to be too expensive nowadays at normal market conditions. Investments in this kind of technological solution may become feasible if some kind of specific financial support is implemented

- others

The data came from the joint work of the project partners, local administrations and stakeholders and from the collecting information with the tool and through the delivery 2.1, 2.2., 2.3. 2.4.

The financial model is made of a series of input and elaboration sheets:

- Project timing input
- Construction Input data
- Operating input
- Construction period elaboration
- Operating period elaboration (inflation, depreciation, financing…)
- Savings sheet
- others

And of a series of output sheets and graphs:

- Cash Flow
- EBITDA[13]
- Income Statement
- Balance Sheet

Further information about the output of the financial model will be provided in the next paragraphs.

The Chapter 3. PROJECT EVALUATION shows the implementation of the Financial Analysis for the twelve CERtuS projects. Indeed, once collected the data through the Certus Matrix, exchanged information with the design team in charge of the realization and closed the risk analysis, the economic and financial evaluation of the projects was carried out. In particular, the identification of the EPC contract was based on the work done by the other Partners in WP3 regarding the various forms of EPC contracts (the detail of our choices is described in Chapter 3 – Project Evaluation). According to the results of WP 3, some further reasoning could be made in terms of implementation of alternative and specific EPC contracts for the projects here analyzed.

2.6. FINANCIAL ANALYSIS OUTPUT TEMPLATES

The overall analysis will define the summary indicators that will express the overall evaluation of the project.

As an example, some indicators are reported:

- On the project's technical and performance features:
  - Plant power
  - Cost/power indicators
  - Annual energy savings (in terms of both percentage and kWh) for the project duration

[13] EBITDA: Earnings Before Interest, Taxes, Depreciation and Amortization

  - Residual energy savings at the end of the project
  - Useful life
  - …
- On the timing and connection with other interventions/layers:
  - N° of years of construction
  - N° of connection with other interventions/layers
  - …
- On the social and environmental impact of the projects:
  - Employment creation
  - CO savings/year
  - …
- On the sustainability and bankability of the project:
  - IRR (short description: The discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero. We can think of IRR as the rate of growth a project is expected to generate…)
  - NPV (short description: NPV is the algebraic sum of the cash flow generated by a project, discounted at a rate that represents the cost of capital or the rate of return of alternative investments, within a defined period)
  - Payback period (short description: The length of time required to recover the cost of an investment)
  - Leverage Equity/Debt (short description: the ratio of equity invested in the project by the ESCo and the senior loan provided by the bank at market conditions)
  - Savings (€)/year
  - Others

Some of the main summary final indicators are represented into the paragraph 3.6 PROJECT RESULTS.

In particular, we report the main chosen indicators and why we chose them:

- % Savings – kWh: represents a measure of benefits brought by the renovation options for each project in energetic terms. This is an important indicator because it gives a measure of how much does the projects comply with nZEB targets;
- % Savings – Euro: represents the economic impact of energetic savings obtained with the interventions/layers. This is an important indicator because savings in terms of kWh do not always match savings in terms of Euro. In fact economic savings depend on the price of the energetic source;
- Project Pay Back Period: represents a first indicator of the ability of the project to generate enough cash flows to pay back the investments. The shorter the Pay Back Period of a project, the better its sustainability;

- Equity Pay Back Period: represents an indicator of the ability of the project to pay back the capital invested by the ESCo. This measure depends on the financial structure of the project because it only considers cash flows directly invested by the ESCo and free cash flows to equity (after the payment of debt);

- Project IRR: represents an indicator of the sustainability/profitability of the project itself without considering its financial structure. In algebraic term, it calculated as the discount rate that makes the NPV of the project cash flows equal to zero;

- Equity IRR: represents an indicator of the sustainability/profitability of the investment made by the ESCo. This measure depends on the financial structure of the projects. In algebraic term, it calculated as the discount rate that makes the NPV of the equity cash flows equal to zero;

Where possible, even for a better comprehension of the projects, some graphs that elaborate and clarify the above indicators were developed. In particular, where possible and significant for the single project and following the indications reported in the paragraph 2.1 PREMISES, projects/layers were represented as in graph "ESCo IRR vs % savings" – see Figure 12. that shows the analysis described above applied to an example case of the Certus project. In this case, the analysis was carried out by layers. See Chapter *3. PROJECT EVALUATION* for further details.

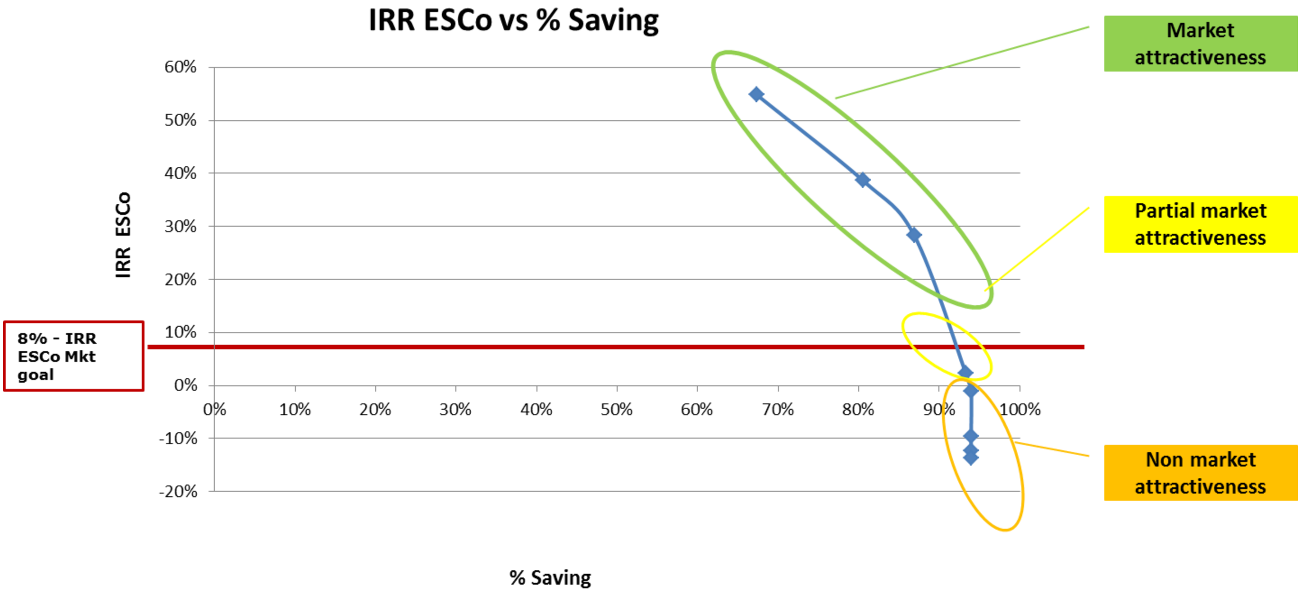


Figure 12. Example of ESCo IRR vs % Saving

2.7. DESCRIPTION OF THE TWELVE PROJECTS

The twelve CERtuS case building projects could be assumed to be representative of the existing municipal buildings in the South of Europe. The twelve buildings represent a diversified range of case studies.

Figure 13 shows the cumulative frequency distribution of the heating surface of the CERtuS buildings. It's clear that more than a quarter (approximately 27%) of the buildings have a surface smaller than 500m² and approximately 45% between 500 to 4000m². Less than 30% of the CERtuS buildings have a surface greater than 4,000m². So, CERtuS buildings can be characterized as mostly medium size buildings.

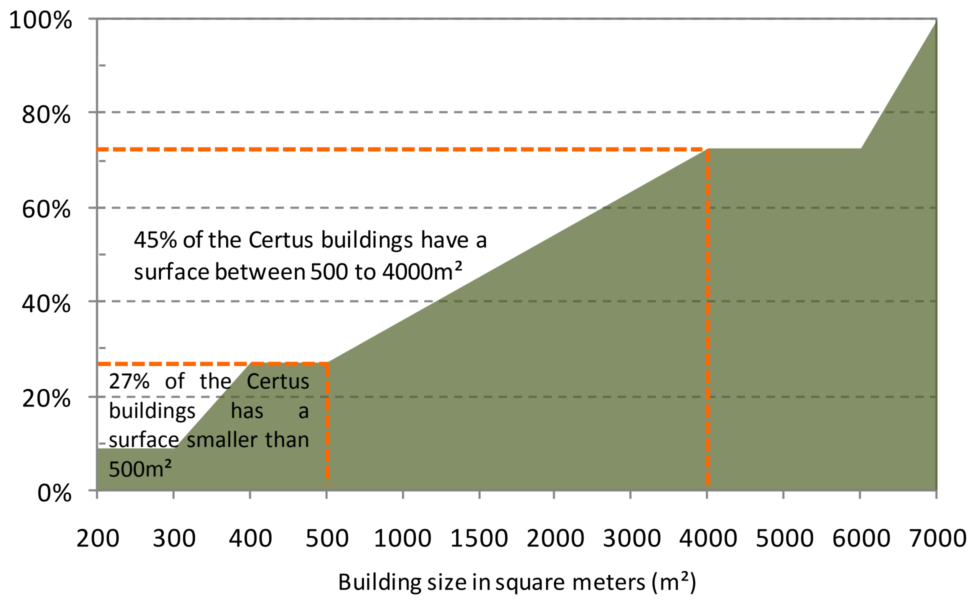


Figure 13. Cumulative frequency distribution of the CERtuS buildings

Figure 13 shows the distribution of the CERtuS buildings in accordance to their electricity consumption and taking into account their size and annual working hours. The sample of the CERtuS buildings was studied taking into account the electricity consumption per square meter of heating area and 1,000 working hours (KPI_1). [14]In the graph below, mean value and standard deviation of KPI (energy consumption per sq. meter of heated area for every 1.000 hours of operation)

- Mean value of KPI_1, 101.11 kWh_e per square meter and 1,000 working hours
- Standard deviation of KPI_1, 66.11 kWh_e per square meter and 1,000 working hours

[14] $KPI_{1:}$ Key Performance Indicators energy consumption per sq. meter of heated area for every 1.000 hours of operation

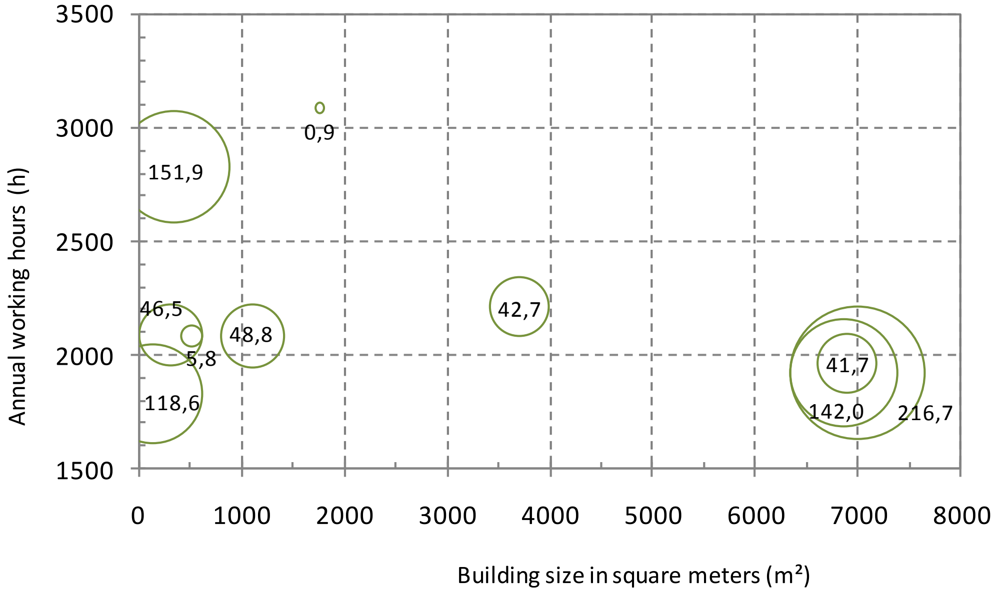


Figure 14. Electricity consumption per square meter and 1,000 working hours for the CERtuS buildings

Furthermore it has been investigated the distribution of the CERtuS buildings taking into account total final energy consumption per square meter of heating area and 1,000 working hours (KPI_2). The calculated mean value and the standard deviation of KPI_2 are:

- Mean value of KPI_2, 126.22 kWh per square meter and 1,000 working hours
- Standard deviation of KPI_2, 95.91 kWh per square meter and 1,000 working hours

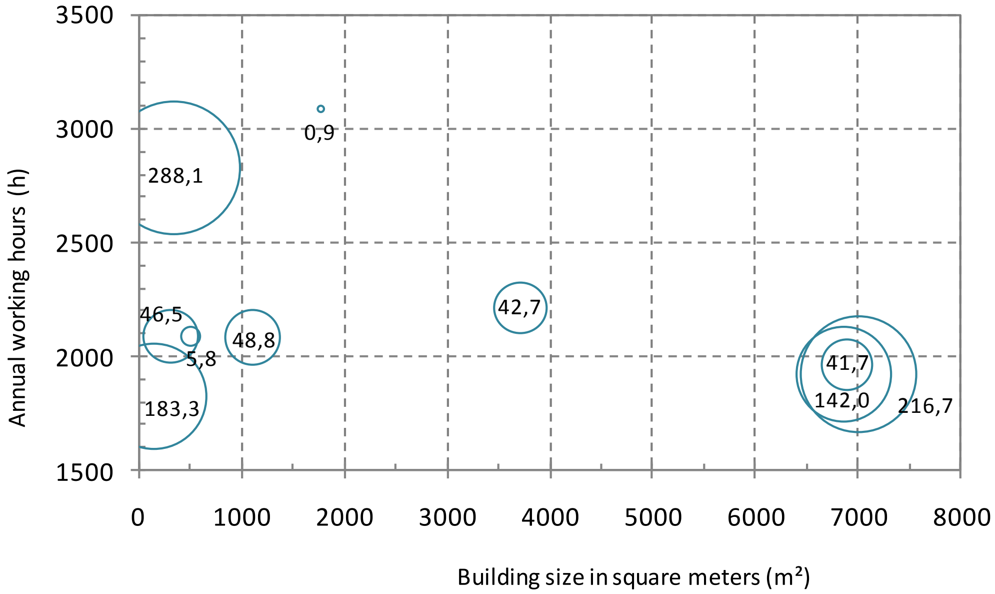


Figure 15. Total energy consumption per square meter and 1,000 working hours for the Certus buildings

Taking into account the actual final energy consumption it has been investigated a possible correlation with total cost of the renovation actions. It was not possible to find an acceptable correlation between the actual final energy consumption and the required cost of renovation actions in order to become nZEB, even they are many similarities of the proposed technical solutions Figure 16.

Municipality, Member country	Building's name	Total cost of the renovation actions
	City Hall	€ 252.599
Alimos, Greece	Municipal Offices	€ 101.842
	Library	€ 104.060
	Elementary School of Solum	€ 31.469
Coibra, Portugal	House of Culture	€ 396.656
	Town Hall	€ 723.949
	City Hall	€ 169.683
Errenteria, Spain	Kapitain Etxea	€ 111.636
	Lekuona	€ 126.587
	Palazzo Zanca	€ 3.507.135
Messina, Italy	Palacultura "Palantonello"	€ 2.622.437
	Palazzo Satellite	€ 954.410

Table 4. Total cost of the renovation actions for CERtuS buildings

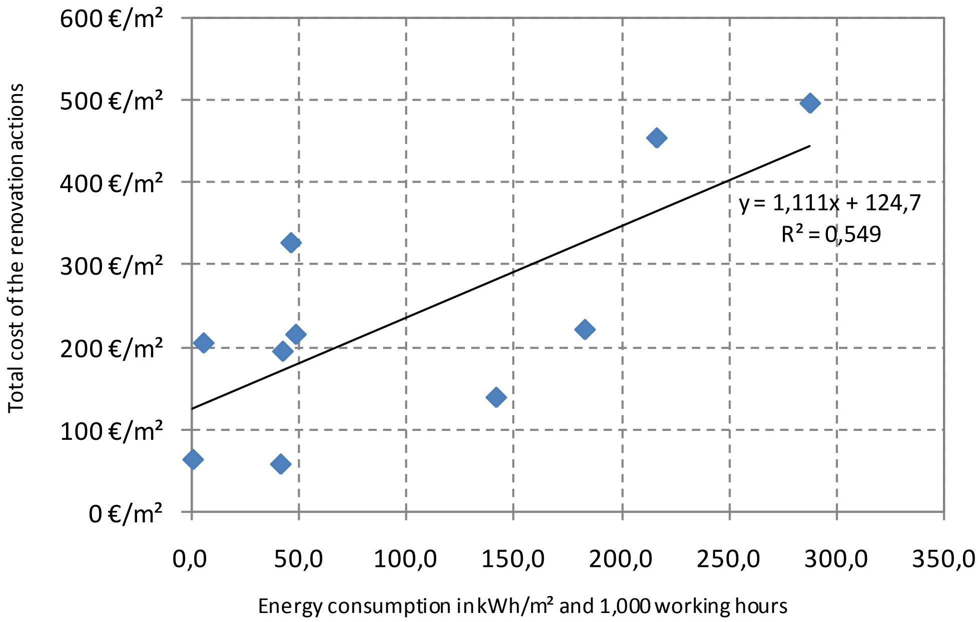


Figure 16. Correlation between the actual energy consumption and the total cost of the renovation actions

Project, building \ Technical solutions		Building skin: Opaque elements	Building skin: Transparent elements	HVAC	Lighting	Control	RES	Passive, Hybrid systems
Alimos	City Hall	X	X	X	X	X	X	X
	Municipal Offices	X	X	X	X	X	X	
	Library	X	X	X	X	X	X	
Coibra	Elementary School of Solum			X	X		X	
	House of Culture			X	X		X	
	Town Hall			X	X		X	
Errenteria	City Hall			X	X		X	
	Kapitain Etxea	X	X	X	X		X	
	Lekuona						X	
Messina	Palazzo Zanca		X	X	X	X	X	
	Palacultura "Palantonello"	X		X	X	X	X	
	Palazzo Satellite	X			X		X	

Table 5. Proposed renovation actions for the Certus buildings

The cases history refers to the current situation of the building projects and the energy renovation solutions which has been specified after detailed studies. The obvious need of having a description of cases history is of having an introduction to the financial analysis by giving:

- the key design strategy elements,
- the selected energy renovation solutions,
- key buildings data (for example the heated area, the installed power per use) and
- energy performance data, such as the actual final energy consumption per energy source

Furthermore, cases history gives the opportunity of clustering the existing separated building projects, into bigger Projects, which may make allocation of the risks, provide economies of scale and get the critical financial size to attract the appropriate investors.

Figure 7 gives an overview of the clustering procedure. One critical parameter that is difficult to be overcome, is the geographic location in terms of distance and country. A second critical parameter is the one that handles the type of technical solutions which generally results to energy conservation and payback periods that are in the same range.

So, Building 1 and Building i-1 could be clustered as they are located rather near to each other, which is not the case for Building 2. Furthermore, assuming that Building 1 and Building i-1 have a lot of interventions/layers related with the HVAC system, then a sub-project or contracting could refer to the

HVAC systems of the two buildings. So, it can may be achieved an economy of scale which could reduce the capital cost of the investment.

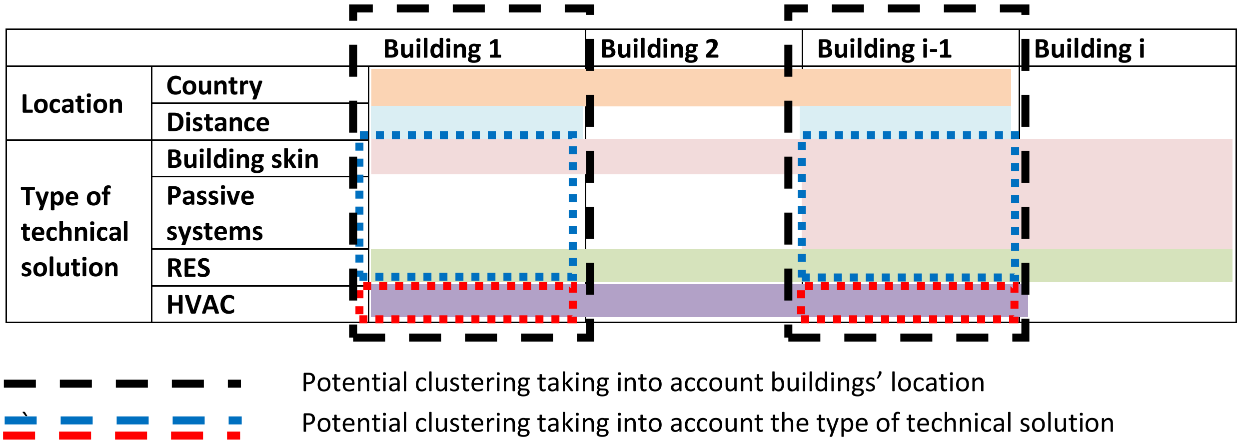


Figure 17. First approach of the potential buildings' clustering into projects

In the following list the most important information are provided. They are related to the location and the type of the desired technical solutions of twelve buildings located in four different South European countries. This file requires information about:

- Building identification (Property, Building name, Address)
- Building features (Main intended use, Heating degree day, Year of construction, etc..)
- Energy data (Description of the HVAC systems, Heating - Cooling - Electrical power of the installed system, Average Consumptions, Presence of management/maintenance contracts, etc..)

Main technical characteristics of the Projects

	Project Municipality, Member country	Name	Latitude	Longitude	Elevation above sea level	Climate[1]	HDD[2]	CDD[3]	Annual working hours	Actual annual energy consumption Oil (kWh_{th})	Electricity (kWh_e)
1	**Alimos**, Greece	City Hall	38°0'N	23°42'E	28 m	Dry-summer subtropical climate (Csa)	947	4840	2086		111,965
2		Municipal Offices							2086		30,160
3		Library							2086		6,152
4	**Coimbra**, Portugal	Elementary School of Solum	40°12'N	8°24'W	141 m	Mild with dry, warm summers (Csb)	1460	1200	1826	16,775	30,749
5		House of Culture							1967		565,980
6		Town Hall							2211		350,206
7	**Errenteria**, Spain	City Hall	43°29'N	3°47'W	59 m	Mild with no dry season, warm summers (Cfb)	1087	107	2829	131,408	146,541
8		Kapitain Etxea							3086		4,916
9		Lekuona							3086		
10	**Messina**, Italy	Palazzo Zanca	38°11'N	15°32'E	54 m	Dry-summer subtropical climate (Csa)	707	680	1920		2,912,933
11		Palacultura "Palantonello"							1920		
12		Palazzo Satellite							1920		1,873,087

[1] According to Köppen climate classification
[2] HDD : Heating Degree Days. Base temperature 18ºC
[3] CDD: Cooling Degree Days. Base temperature 26ºC

Main Climates	**Precipitation**	**Temperature**
A: equitorial	W: desert	h: hot arid
B: arid	S: steppe	k: cold arid
C: warm temperate	f: fully humid	a: hot summer
D: continental	s: summer dry	b: warm summer
E: polar	w: winter dry	c: cool summer
	m: monsoonal	d: extremely continental
		F: polar
		T: polar

Technical solutions / Project, building		Building skin[15]				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
Alimos	City Hall	External insulation € 67.890	Shading € 20.325		Fenestration replacement € 45.000	VRV[16] € 54.414	Heat recovery € 6.400	Ventilators € 4.500	Relighting € 15.370	BMS[17] € 17.000	Photovoltaic system € 20.900	Vent openings € 1.000
	Municipal Offices	External insulation € 21.707			Fenestration replacement € 10.000	VRV € 17.520		Ventilators, dampers €3.150	Relighting € 3.285	BMS € 8.800	Photovoltaic system € 37.380	
	Library	External insulation € 30.900			Fenestration replacement € 40.650	High efficiency Split units € 13.500	Biomass boiler € 1.850	Ventilators, dampers €4.000	Relighting € 2.150	Power meter Thermostats Lux sensors[1] € 3.010	Photovoltaic system € 8.000	
Coibra	Elementary School of Solum					High temperature heat pump € 6.556			Relamping € 2.920		Photovoltaic system € 21.993	
	House of Culture					High efficiency split unit systems € 156.142			Relamping € 21.059		Photovoltaic system € 219.455	

[15] Building skin or building envelop consists of the exterior elements and semi-exterior elements (that separate a conditioned space from an unconditioned space) of a building, including walls, windows, doors, roofs, and floors, including those in contact with earth.

[16] The variable refrigerant volume (VRV) or variable refrigerant flow (VRF) systems are HVAC systems that distinguish from conventional systems due to their ability of connect multiple indoor units to a common outdoor unit (single or combined modules), their scalability, variable capacity, distributed control, and simultaneous heating and cooling

[17] A building management system (BMS) is an energy management system which usually has additional features for building security, equipment monitoring and protection and other.

Technical solutions / **Project, building**		Building skin[15]				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
	Town Hall					High efficiency split unit systems € 98.657			Relamping € 20.808		Photovoltaic system €604.484	
Errenteria	City Hall					Condensing gas boiler € 9.760			Relamping € 10.493		Photovoltaic system € 149.430	
Errenteria	Kapitain Etxea	Wall insulation € 4.180	Roof insulation € 20.817	Floor insulation € 13.227	Glazing replacement € 12.646	AHU Air loop unitary with heat recovery € 21.540			Relighting € 26.624		Photovoltaic system € 12.602	
Errenteria	Lekuona										Photovoltaic system € 126.587	
Messina	Palazzo Zanca				Fenestration replacement € 1.519.150	VRV system (offices, new circulation area) € 1.200.000			Relighting € 321.000	BEMS € 25.000	Photovoltaic system € 122.000	
Messina	Palacultura "Palantonello"	External wall insulation € 1.014.929	New FV cover shelter € 360.000	Structural improvements € 316.308		VRV system (offices) € 500.000			Relighting € 101.200	BEMS € 20.000	Photovoltaic system € 310.000	
Messina	Palazzo Satellite	Internal insulation € 354.210	Fenestration replacement € 208.000						Relighting € 336.200		Photovoltaic system € 56.000	

[1] It is not referred as a BMS as there are missing the actuators

DESIGN, CONSUMPTION AND PERFORMANCE ASSUMPTIONS

This paragraph reports the most important information regarding the design, consumption and performance of twelve buildings located in the four different South European countries. The information is organized into four different projects, taking into account the location of the buildings. This is the first clustering which is focus to financial viable projects.

As the scope is to set up projects, rather than just trying to find financing instruments, the characteristics of the projects must be given. The most important characteristics are as follows:

i. A project should be implemented without pre-required and post-required actions. It involves renovation and financing actions.

For example, it is not wise to assume that the installation of wall and roof insulation and the replacement of the fenestrations are two different layers. One reason is that the replacement of the fenestrations has post-required actions (e.g painting) which affects the building skin and is related to the installation of wall insulation. Another reason is that the technical scope of such interventions is the reduction of the building losses and the improvement of the internal conditions. So the installation of wall insulation without the replacement of the fenestration:

- is not efficient for the reduction of the building losses;
- makes the replacement of the fenestrations a non-financiable solution as it will implemented later in time. In this case the potential energy reduction will also be estimated on a lower base case scenario (it is refers to the estimated energy consumption after the installation of the insulation).

The financing of single renovation actions is more related with bank loans and whether it is a bankable measure.

ii. A project should be profitable in all of its parts.

In order to be feasible, a project should be profitable in all of its parts. Otherwise it could be never implemented.

So, in order to set up a project, the vertical procedure shown in Figure 5 could be followed. The proposed clustering handles separately the energy optimization interventions and the pro and / or past required actions which are related with the installation of a missing plant system, aesthetic and structural works. Such a clustering is important for existing buildings because many of them need a general renovation or even a reconstruction rather than just an energy renovation. The allocation of the budget to the following categories is important to understand the reasons of a possible low financial efficiency.

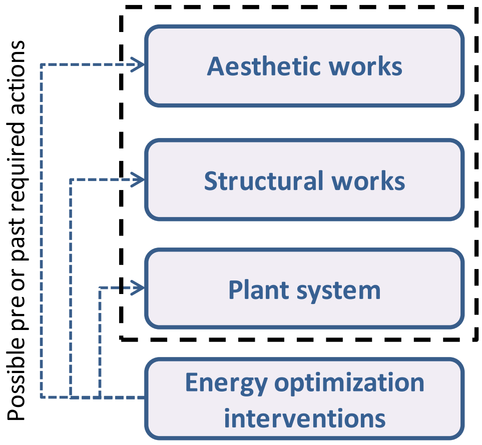


Figure 18. Second approach of the potential buildings' clustering into categories of layers

Figure 9 shows a potential third level of clustering which is focused on the set up technical projects, which have a clear start and end point without post and/or past required actions. For example, the installation / of a heat recovery system could require the installment of an air duct system and of an appropriate control system. Usually it is better to install the three systems under the same contracting agreement as it easier to control the deliverables and minimize the construction (i.e. insufficient duct flow for the relevant heat recovery ventilators) and technological risks (i.e. incompatible communication protocols between the heat recovery ventilators and the control system).

Theoretically, any intervention enclosed into a black dashed line of Figure 9 could be a single category of layers. One category of layer (layer enclosed into a black dashed line) could refer to more than one building which belongs to the same cluster taking into account their location. For example, the "Energy conservation" project (Figure 9) could refer to the three buildings of Alimos (Figure 7), or the "Energy Efficiency" project could refer to the three projects of Coimbra (Figure 7). Generally it is rather not appropriate to have one project with buildings from different Countries. This is because of the big differences in the macro and micro economic environment, the different legislation framework and the different users' behavior, which makes the setup of such project very complicated. An ESCO company to the contrary may prefer to develop projects in different countries to diversify the country risk.

As the need is to set up Categories of layers, the simplified approach that recognizes the four different categories of actions, which potential could be separated projects or different tasks of a bigger project. Following we will refer to the four categories as being single projects. So, the single projects are related to:

i. energy conservation,

ii. energy efficiency,

iii. renewable energy systems,

iv. hybrid and passive systems,

should be flexible enough in order to involve into one project all the similar actions, including the pre and past required actions. So, for example:

- Even a waste heat recovery ventilator provides a reduction of the ventilation heat losses, in case that it can be installed without the need of new ducting or a false ceiling, then it would be better to be involved into the "Energy efficiency" project.
- Even a solar chimney is a passive construction, in case the architecture design takes provision of a new opening (post-requirement) in order to enforce the ventilation effect of the solar chimney, then it would be better to be involved to the "Energy conservation" project. So, it would be able to provide a project with a clear start and a clear end.

Finally, for existing building where there is a need of a general renovation the implementation of the energy performance design studies and even the construction is better to give priority as following:

1) to energy conservation actions,
2) to the improvement of the energy efficiency and following
3) to RES and hybrid or/and passive systems

This is depicted to Figure 19 with big blue array.

In the following paragraphs are given the information of the twelve municipality buildings using the three clustering approaches presented above. It is obvious, even from that early stage of the study, that there is a big difference between the financing possibilities of a single action (e.g. fenestration replacement) and group of actions which could have a project concept (start, end and clear deliverables).

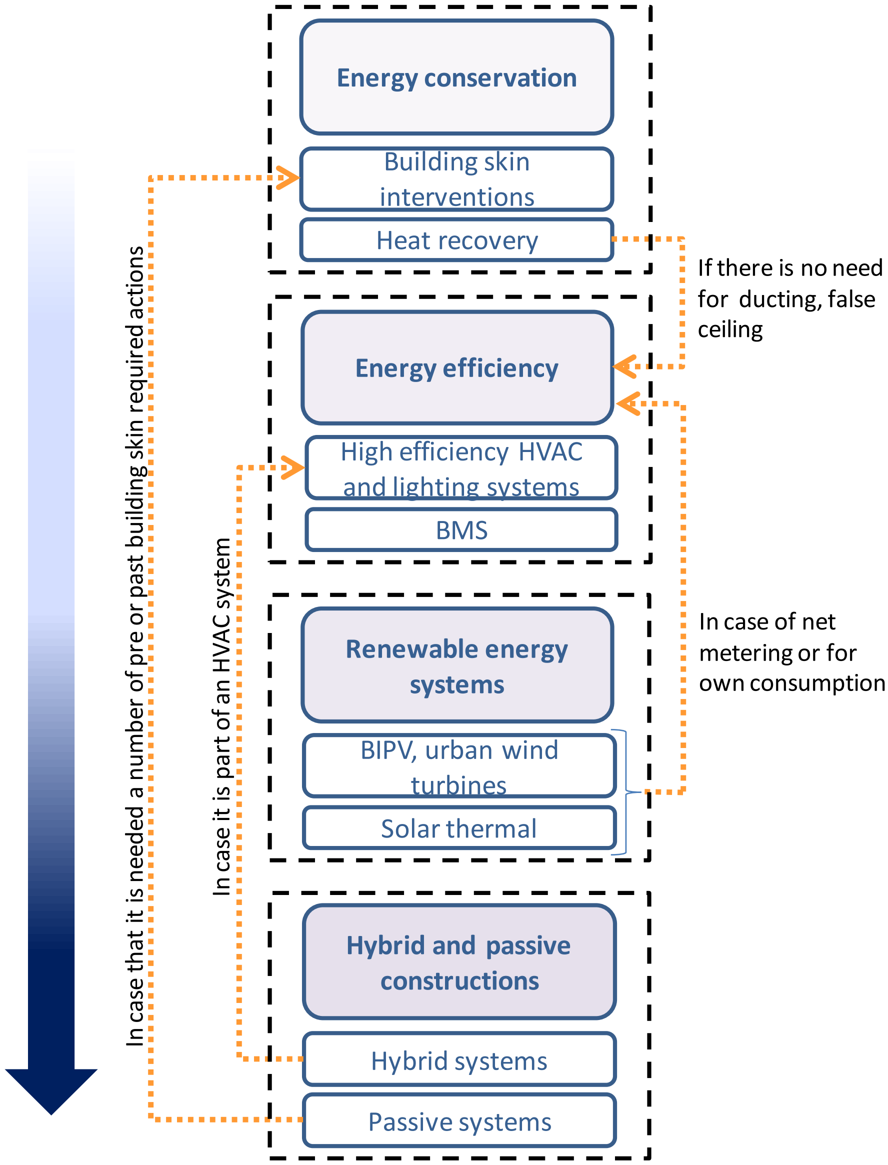


Figure 19. Third approach of the potential buildings' clustering into projects

2.8. KEY CONCEPTS AND INTRODUCTION TO PROJECT EVALUATION

As regards the methodology presented, it is organized according to a detailed analysis process. The methodology's focus is on economic and financial side, but at the same time it is strictly linked to the identification of projects' solutions, given that the economic and financial analysis uses the technological solutions undertaken as main input data of the projects.

The project sustainability evaluation methodology is articulated in several steps, starting from the sharing of project data to the identification of the optimal financial structure for the realization of the projects, taking into account the main risks evaluation.

In line with the analysis implemented, it is crucial to define instruments that facilitate the share and the transfer of the information in a clear and detailed way. Instruments such as the Certus matrixes or the identification of a common definition of nZEB are aimed to obtain a successful applicability and standardization of the project evaluation methodology, understandable by both technical and financial agents.

The following main factors are focused on: first, the energy efficiency achieved in the nZEB projects according to the common definition of nZEB adopted, second the sustainability of the project in terms of profitability for the ESCo that will take charge of the project and third, the placement of the project in market and the identification of the financial structure to realize the project.

In the next chapter, for each of 12 projects undertaken was applied the project evaluation methodology. In order to facilitate the reading of the next paragraph the following main steps of the methodology are summarized:

- Sharing of data input projects: The send of the Certus matrixes to the technical designers and the receipt of the project data
- Definition of economic and financial data input: The selection of the economic and financial input variables, both at specific country level and at European level (market, economic and financial variables)
- Definition of the EPC contract: the identification of the EPC standardized model, mainly implemented in the 4 countries under evaluation
- Financial modeling: Implementation of a cash flows' analysis for each project , developed following the steps explained in the previous paragraphs and hence through:
  4. The economic and financial analysis, firstly considering that the projects could be financed at market condition (with senior bank debt and private equity) in order to allow the evaluator to put the projects in the graph "Sustainability vs nZEB Energy Saving ";
  5. A layers' analysis in order to understand the share of the investment undertaken that has not been repaid in the time window considered and hence not able to repay the senior debt;
  6. The identification of further financial sources (such as grants or subsided funds) if required by the project analyzed, after the evaluation of the project at market condition.

Once implemented this sustainability evaluation methodology, some summary indicators are defined reflecting the overall evaluation of the project, through some output tables.

3. PROJECT EVALUATION

For the development of the economic, financial and risk analysis we made some assumptions related to:

- Market variables: inflation rates, VAT rates, energy prices of each Country;
- Economic variables: typology of EPC contract, duration of the contract, operating costs;
- Financial variables: leverage (equity/debt), interest rates of the specific Country, loan duration.

On the basis of Deliverable D3.5[18] and of the indication of the Partners concerning EPC contract features (average durations, % savings, risk allocation, etc.), the implementation of the "shared savings" EPC contract was chosen. This contract is considered to be the most widespread among the four CERtuS countries and, according to normal practice in this sector, a 15 years duration of the contract and a 5% percentage of savings shared with the Municipality was assumed.

According to the results of WP 3[19], some further reasoning could be made in terms of implementation of alternative and specific EPC contracts for the projects here analyzed.

To analyze the sustainability of the projects from the ESCo point of view, the following standard financial assumptions are considered:

- Leverage (equity/senior debt): 30/70 of the investment excluding VAT. This means that, given the resources to carry out the investment, 30% of them will be paid from its own ESCO resources, the remaining 70% through bank financing. The entire VAT amount will be financed by a specific short-term VAT facility. Critical issues and considerations on risk analysis of the projects and the actual availability of the banking system to finance initiatives, etc. will be further discussed in other Deliverables[20] of the project;
- Loan duration: 12 years.

According to the typical features of the selected EPC contract:

- The ESCo makes the investments for renovation (with own capital for 30% of the total amount) and is financed by a third party (bank, for the remaining 70%);
- The ESCo guarantees the performances in terms of energy savings (kWh);
- The Municipality pays the ESCo an annual energy savings fee equal to the energy savings less the percentage of shared savings (5%) and pays the energy bill. In the following analysis the energy savings and the respective monetary savings deriving from the projects was calculated. The annual

[18] Deliverable D3.5: "Report on exiting performance contracting examples and energy service models"

[19] WP3: " Energy Service Models and Optimal Financing Schemes"

[20] Deliverable D2.2 " Report presenting the risks, difficulties and constraints envisaged by the stakeholders regarding nZEB renovations" and Deliverable D3.7 "Financial Mechanism for nZEB"

energy savings fee was thus calculated as the monetary savings less the 5% shared savings that the ESCo leaves to the Municipality;

- A main assumption is that in every year of the contract the target level of energy efficiency is actually achieved and that, therefore, the ESCo has an annual right to receive the entire expected fee. Actually, an accurate structuring of contractual mechanisms will allow to define a system of monitoring and calculation of expenditures for the Municipality, so that the ESCo remuneration can be correctly calculated on the basis of actual energy savings achieved;
- The Municipality pays the ESCo an annual fee for maintenance equal to the estimated post-intervention maintenance cost. Thus, the Municipality takes charge of the payment of maintenance and benefits from cost savings if post-intervention maintenance costs are lower;
- In the EPC contract, supply of heating and electricity is not included. The Municipality buys gas and electric energy by its own, even buying from year to year at the lowest price. Consumption of gas and electricity is measured every year and their accounting is explicit and separated, thus supporting the mechanism for calculating the remuneration for the ESCo.

For every project, the ESCo is supposed to invest through a Special Purpose Vehicle[21] (SPV). Thus, the IRR of the investment made by the ESCo was calculated on the basis of the cash flows for and from the SPV (i.e. equity invested by the ESCo into the SPV and dividends paid to the ESCo by the SPV).

It's important to underline that this way of realization of the projects is an example hypothesis developed in order to check the sustainability of the projects under the CERtuS proposed hypothesis of realization. Indeed, it's true that some of the projects have a very small budget and that they are not sustainable individually and that they won't likely be individually developed through an ESCo. Instead, it's more likely and preferable for a Municipality to aggregate projects on different buildings and to ask an ESCo to operate on a larger critical mass in order to reduce the structure cost of the initiative.

In addition, in order to make a realistic evaluation of the sustainability of a project for an ESCo, some administration, general and insurance costs were considered, in line with the investment made.

The analysis of the project for each building was carried out in three steps:

1. Market test: this analysis concerns the sustainability of the project by itself, in terms of ability to pay back the investment cost with annual savings. Then, the sustainability of the project is investigated assuming a standard ESCo involvement with third party finance (30/70 leverage excluded VAT facility) and the implementation of a standard "shared savings" EPC contract as described above. The project sustainability is then verified by checking if the operative margin (in terms of EBITDA, equal to revenues less costs) is sufficient enough to pay the debt service (equal to interests and capital of Senior debt [22]and VAT facility). A project is considered to be sustainable and

[21] Special Purpose Vehicle (SPV): is a legal entity created to carry out a specific business purpose or activity

[22] Senior debt: A class of debt that has priority with respect to interest and principal over other classes of debt and over all classes of equity by the same issuer.

adequately remunerative for an ESCo at market conditions if the Internal Rate of Return (IRR) of the capital invested by the ESCo is higher than 8%. An 8% IRR is generally considered adequate at European level for the energy efficiency sector. The actual target IRR for the ESCo should also take into consideration a specific Country-risk and thus should be different among different Countries. This value is indicative for current general market conditions of the Countries and with a reduced counterpart risk. Therefore this value could be revised in the different specific cases of respective context.

2. Single renovation option convenience tests: with this simulation the impact on the project sustainability of the removal of some interventions/layers was analyzed. In particular, the removal from the renovation schemes of those single interventions/layers showing a very high cost/savings ratio is assumed. Those interventions/layers are represented by those technological solutions that are too expensive on the market and that may lengthen the payback period of the investment without improving energy savings significantly[23]. Please note that this analysis is just a theoretical exercise because every single intervention/layer proposed by technical partners should be implemented.

3. Financial structure optimization: in this simulation the financial structure of the project was changed in order to make it profitable for an ESCo. In order to do so, according to the level of sustainability of the project itself in the base case, the equity/debt ratio (with around 10% minimum equity) was changed, the duration of the contract was lengthen and the availability of subsided funds and public grants that could improve the sustainability for the ESCo investment (i.e. to reach the target equity IRR of around 8%, if possible) was assumed. The simulation was carried out by preferring the use, in order, of equity, senior debt, subsided funds and, where necessary, Public Grant.

   The interest rate on the generic subsided funds is assumed to be 1,5% for every Country and the amount of public grants was kept as low as possible. A 1,5% interest rate should be considered theoretical. In fact it may be different among the different countries according to the specific financial instruments. This interest rate was assumed on the basis of the projects' profile and of similar initiatives proposed by operators of this sector. This interest refers anyway to initiatives based on a solid structure of warranties in support of the development of the project (both internal and external to the ESCo). Please note that specific financial instruments available in each Country will be analyzed in Delivery 3.7. In that delivery, in addition to a review of the existing subsidized financial instruments, some food for thought will be offered for the development of ad-hoc financial tools for this kind of projects. Anyway, facilitated interests rate should always be consistent and in line with the respective regulation, both local and international.

[23] These interventions are considered to be too expensive nowadays at normal market conditions. Investments in this kind of technological solution may become feasible if some kind of specific financial support is implemented

Please note that in the following paragraph we will consider the following definitions:

- **Annual savings**: sum of annual economic energy savings and annual maintenance savings;
- **Cash flows for debt service**: cash flows available for the ESCo to pay the debt service as described above. In general, it's equal to the net cash flows generated by the normal corporate operation (revenues less costs less taxes) in a specific period;
- **Cash flows to equity**: cash flows related to the equity invested by the ESCo into the project/SPV. Therefore the cash flows for the equity disbursement made by the ESCo at the beginning (negative) and the cash flows resulting from the distribution of profits in terms of dividends (positive) are considered. The Internal Rate of Return (IRR) for the ESCo is calculated on the basis of these cash flows;
- **Debt service**: the sum of interests and capital reimbursement for all the loans that the ESCo should pay the bank in a specific period;
- **Energy savings**: the difference between pre-intervention and post-intervention consumption of electric and thermal energy in terms of kWh;
- **Economic energy savings**: the difference between pre-intervention and post-intervention expenditure for electric and thermal energy in terms of Euro. It's equal to the product of energy savings for the energy price;
- **Energy savings fee**: the annual fee that the Municipality pays to the ESCo as a remuneration for the investment. It's calculated as the economic energy savings less the percentage of shared savings (5% under our hypothesis of standard EPC contract);
- **Equity NPV**: the Net Present Value of cash flows to equity (calculated as described above) calculated at a discount rate of 7%;
- **Intervention/s**: the term is used, depending on context,: as synonymous of layers or renovation options, or to identify project as a whole;
- **Maintenance fee**: the annual fee that the Municipality pays to the ESCo as a remuneration for the maintenance activities. This fee is considered to be equal to the post-intervention maintenance cost for the ESCo so, from the point of view of the ESCo, revenues for maintenance are offset by costs for maintenance, thus generating a neutral economic effect;
- **Project cash flows**: the cash flows generated by the project itself in terms of revenues and costs without considering any financial structure.

In the following box are reported some input data were taken for the analysis:

Inflation rate	It is assumed to be 2% according to the ECB indication	**Source:** https://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html
Senior Debt interest rate	It is calculated as follows: **EUROIRS - 12 years = 1,2% + Spread**	**EUROIRS 12 years** source consulted on July 27: http://finanza-mercati.ilsole24ore.com/reddito-fisso-e-tassi/tassi/irs/irs/irs.php?refresh_ce **Spread source** consulted on July 27: 1. Italy: https://infostat.bancaditalia.it/inquiry/#eNqdjjELwjAQhf9Qud7Z1BAhg9EbAo2WJllcjg4tCIKDog798QbByc3tfe%2BDx7uPr%2Btmlx1HTrbP%0AznWCuHyD4EqQBNVvI9gsKfkGCbHyiUPkjk82uK0EP0AAahCLhEKtIgLSYFoEtYbovNbAeQAq3hhd%0AHXs%2B2Hm83Kb6cZ6en0N%2BH%2F9bq9%2FjWDcE 2. Portugal: http://www.bportugal.pt/Mobile/BPStat/Serie.aspx?IndID=826874&SerID=2028208&sr=2028200&SW=1680&Show=1 3. Spain: http://www.bde.es/webbde/es/estadis/infoest/e0903e.pdf http://www.bde.es/webbde/en/estadis/infoest/indeco.html 4. Greece: http://www.bankofgreece.gr/Pages/el/Statistics/rates_markets/deposits.aspx
Tax rate and VAT source	**Source:** http://ec.europa.eu/taxation_customs/tedb/taxSearch.html	

Please note that in all the economic and financial analysis, all economic figures expressed in Euro are considered excluding VAT. Thus, across the document there is some mismatching between the figures, it may be due to the inclusion/exclusion of VAT.

For the compliance of the renovation options with the nZEB targets, please refer to Deliveries 2.1 for each Municipality.

3.1. MUNICIPALITY OF ALIMOS

3.1.1. *PROJECT ASSUMPTIONS*

Taking into account the energy study of Alimos buildings, the information given to the relevant Matrixes and the three clustering approaches which have been descripted above, the three buildings renovation action could be organized into two groups called Category of Layers 1A and Category of Layers 2A. Category of Layers 1A includes all actions related with the building skin and Category of Layers 2A all actions related with the systems.

The vent openings, declared as a passive element, has been included to Category of Layers 1A (Energy conservation) as technically it required a lot of building envelope works and furthermore its' results to energy conservation rather than improving the energy efficiency of any electromechanical system. The energy optimization design study rakes provision for installing photovoltaic systems to all buildings. As the photovoltaic systems will be connected for implementing net metering, it has to be designed taking into account the existing systems in order to estimate the optimum size and operation. The photovoltaic systems will contribute to improve the effective energy performance of the systems. Therefore, the provided photovoltaic systems have been included to Category of Layers 2A (Energy efficiency). The total cost of the projects is:

- Category of Layers 1A € 237,562.00
- Category of Layers 2A € 221,229.00

Technical solutions / Project, building		Building skin				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
Alimos	City Hall	External insulation € 67,890	Shadind € 20,325		Fenestration replacement € 45,000	VRV € 54,414	Hear recovery € 6,400	Ventilators € 4,500	Relighting € 15,370	BMS € 17,000	Photovoltaic system € 20,900	Vent openings € 1,000
	Municipal Offices	External insulation € 21,707			Fenestration replacement € 10,000	VRV € 17,520		Ventilators, dampers €3,150	Relighting € 3,285	BMS € 8,800	Photovoltaic system € 37,380	
	Library	External insulation € 30,900			Fenestration replacement € 40,650	High efficiency Splt units € 13,500	Biomass boiler € 1,850	Ventilators, dampers €4,000	Relighting € 2,150	Power meter Thermostats Lux sensors[1] € 3,010	Photovoltaic system € 8,000	

[1] It is not reffered as a BMS as there are missing the actuators

Table 6. Actions included in Category of Layers 1A and are related direct or indirect to energy conservation

Building skin→ building envelope

Technical solutions / Project, building		Building skin				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
Alimos	City Hall	External insulation € 67,890	Shadind € 20,325		Fenestration replacement € 45,000	VRV € 54,414	Hear recovery € 6,400	Ventilators € 4,500	Relighting € 15,370	BMS € 17,000	Photovoltaic system € 20,900	Vent openings € 1,000
	Municipal Offices	External insulation € 21,707			Fenestration replacement € 10,000	VRV € 17,520		Ventilators, dampers €3,150	Relighting € 3,285	BMS € 8,800	Photovoltaic system € 37,380	
	Library	External insulation € 30,900			Fenestration replacement € 40,650	High efficiency Splt units € 13,500	Biomass boiler € 1,850	Ventilators, dampers €4,000	Relighting € 2,150	Power meter Thermostats Lux sensors[1] € 3,010	Photovoltaic system € 8,000	

[1] It is not reffered as a BMS as there are missing the actuators

Technical solutions / Project, building		Building skin				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
Alimos	City Hall	External insulation € 67,890	Shadind € 20,325		Fenestration replacement € 45,000	VRV € 54,414	Hear recovery € 6,400	Ventilators € 4,500	Relighting € 15,370	BMS € 17,000	Photovoltaic system € 20,900	Vent openings € 1,000
	Municipal Offices	External insulation € 21,707			Fenestration replacement € 10,000	VRV € 17,520		Ventilators, dampers €3,150	Relighting € 3,285	BMS € 8,800	Photovoltaic system € 37,380	
	Library	External insulation € 30,900			Fenestration replacement € 40,650	High efficiency Splt units € 13,500	Biomass boiler € 1,850	Ventilators, dampers €4,000	Relighting € 2,150	Power meter Thermostats Lux sensors[1] € 3,010	Photovoltaic system € 8,000	

[1] It is not reffered as a BMS as there are missing the actuators

Table 7. Actions included in Category of Layers 2A and are related direct or indirect to interventions indenting to improve the energy efficiency of the systems

The following table represents the savings that each single layer/intervention can bring to the project. <u>In this case each layer is considered to be developed alone without considering the others.</u>

Property	Building name	Interventions/Layers	Savings						% risparmio	Cost of Planned Investments	Payback period
			Electric Energy		Thermal Energy		Total				
			kWh	€	kWh	€	kWh	€	kWh	€	year
Municipality of Alimos	Municipal City Hall	VRV	43.066	6.288	0	0	**43.066**	**6.288**	**38%**	54.414	**9**
		Heat recovery	5.723	836	0	0	**5.723**	**836**	**5%**	6.400	**8**
		night ventilation	9.709	1.418	0	0	**9.709**	**1.418**	**9%**	4.500	**3**
		Lighting systame (internal)	21.518	3.142	0	0	**21.518**	**3.142**	**19%**	15.370	**5**
		Renewable energy	95.573	13.954	0	0	**95.573**	**13.954**	**85%**	20.900	**1**
		External insulation - EPS or mineral wool	9.054	1.322	0	0	**9.054**	**1.322**	**8%**	67.890	**51**
		Shading elements	11.041	1.612	0	0	**11.041**	**1.612**	**10%**	20.325	**13**
		Windows - Low e Thermo Break	3.789	553	0	0	**3.789**	**553**	**3%**	45.000	**81**
		Passive sistem	244	36	0	0	**244**	**36**	**0%**	1.000	**28**
		Control system	32.089	4.685	0	0	**32.089**	**4.685**	**29%**	17.000	**4**
	Municipal Offices	Replacement of heating/cooling plants	12.942	1.890	0	0	**12.942**	**1.890**	**43%**	17.520	**9**
		External insulation	1.014	148	0	0	**1.014**	**148**	**3%**	21.707	**147**
		Windows	2.126	310	0	0	**2.126**	**310**	**7%**	10.000	**32**
		Replacement of lamps (and luminaries, ballast)	4.080	596	0	0	**4.080**	**596**	**14%**	3.285	**6**
		Renewable energy	30.160	4.403	0	0	**30.160**	**4.403**	**100%**	37.380	**8**
		BMS	8.755	1.278	0	0	**8.755**	**1.278**	**29%**	8.800	**7**
		Night Ventilation	666	97	0	0	**666**	**97**	**2%**	3.150	**32**
	Municipal Library	A/C splits	12.174	1.778	0	0	**12.174**	**1.778**	**29%**	13.500	**8**
		Pellet boiler (central heating system)	10.740	1.568	-9.589	-1.098	**1.151**	**470**	**3%**	1.850	**4**
		External insulation	60	9	0	0	**60**	**9**	**0%**	30.900	**3.470**
		Windows	-492	-72	0	0	**-492**	**-72**	**-1%**	40.650	**-567**
		Replacement of lamps (and luminaries, ballast)	5.223	763	0	0	**5.223**	**763**	**12%**	2.150	**3**
		Renewable energy	8.041	1.174	0	0	**8.041**	**1.174**	**19%**	8.000	**7**
		Power meter/Thermostats/Lux sensors	26.991	3.941	0	0	**26.991**	**3.941**	**64%**	3.010	**1**
		Night Ventilation	3.674	537	0	0	**3.674**	**537**	**9%**	4.000	**7**

Table 8. Alimos_ Savings generated by each layer

3.1.2. *Country specific cost factors*

Electric energy price (excl. VAT 23%): 0,146 Euro/kWh

Electric energy price (incl. VAT 23%): 0,180 Euro/kWh

The following table presents the key financial assumptions which are taken into consideration in the financial modeling and their respective outcome.

		General Assumptions		
Municipality	**Project**	**Inflation rate**	**VAT rate**	**Senior debt interest rate**
Alimos	*Municipal City Hall*	2,00%	23%	7,16%
Alimos	*Municipal Library*	2,00%	23%	7,16%
Alimos	*Municipal Offices*	2,00%	23%	7,16%

3.1.3. *Some elements of Risk analysis*

Operating in the Greek market has certain drawbacks compared to the group of the four countries. The most significant cost factor that differentiates the financing of projects in Greece is the cost of capital which also affects the target IRR for an ESCO company to operate.

The cost of electricity remains above the EU average which is a strong incentive for Public and Private Companies to undertake energy saving renovations supported from the increased consumption related to the increased need for cooling during the extended summer period

Greek companies face with a more challenging business framework since Greek is 61st in the world's easiest place to do business, while the aggregate taxation rate is at 50% the below the average of the group of the 4 countries.

3.1.4. *Sustainability evaluation – Municipal City Hall*

3.1.4.1 Renovation Scheme and Market Test

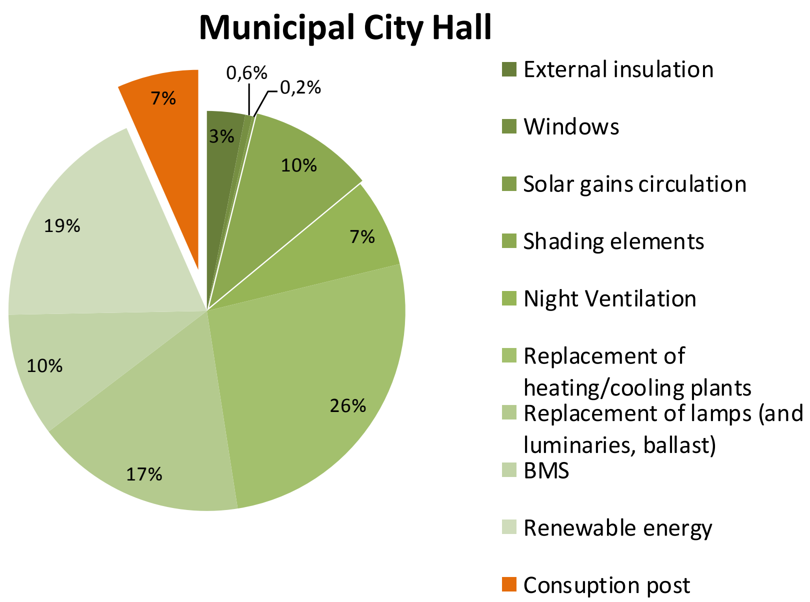
Total investment estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
HVAC	65.314
Lighting system (internal)	15.370
Renewable energy	20.900
Casing Building skin	88.215
Windows - Low e Thermo Break	45.000
Control system	17.000
Passive sistem	1.000
Investment for renovation	**252.799**

The identified technological solutions lead to energy savings of 104.537 kWh, equal to 93%. The detail of the energy savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
External insulation	3.475	3%
Windows	632	0,6%
Solar gains circulation	251	0,2%
Shading elements	11.388	10%
Night Ventilation	8.024	7%
Replacement of heating/cooling plants	29.434	26%
Replacement of lamps (and luminaries, ballast)	19.234	17%
BMS	11.199	10%
Renewable energy	20.900	19%
Total	**104.537**	**93%**

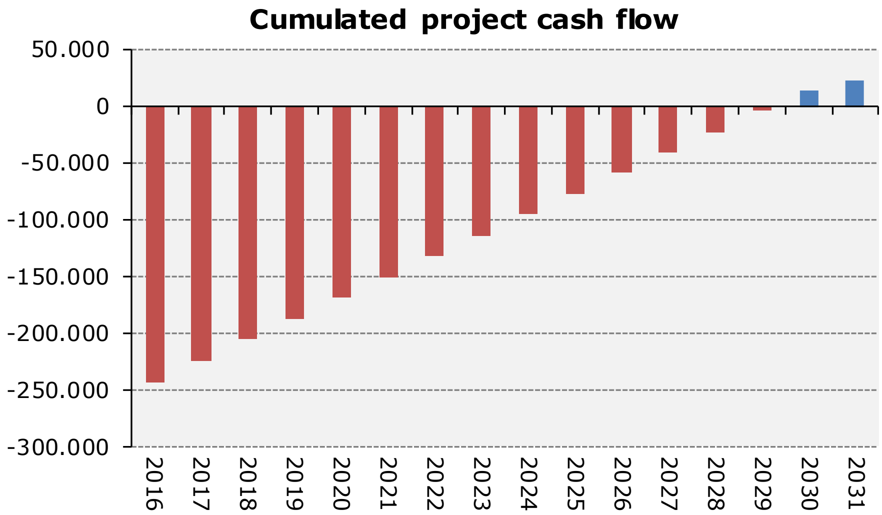
The following graph represents the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, total economic savings amount 18.672 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	16.324	
Thermal Energy	0	
Maintenance	6.491	
Total expenditure pre-intervention	**22.816**	
Electric Energy	1.083	-93%
Thermal Energy	0	0%
Maintenance	3.060	-53%
Total expenditure post-intervention	**4.143**	**-82%**
ANNUAL SAVINGS	**18.672**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project pay-back is 14 years.

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
HVAC	65.314
Lighting system (internal)	15.370
Renewable energy	20.900
Casing Building skin	88.215
Windows - Low e Thermo Break	45.000
Control system	17.000
Passive sistem	1.000
Investment for renovation	**252.799**
Starting liquidity	0
Interests and Banking Fees	3.614
Total investment exc. VAT	**256.413**
VAT	58.144
TOTAL INVESTMENT	**314.556**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	76.924	24%	30%
Senior Debt	179.489	57%	70%
Total Financial Sources exc. VAT	**256.413**	**82%**	**100%**
VAT Facility	58.144	18%	
TOTAL FINANCIAL SOURCES	**314.556**	**100%**	

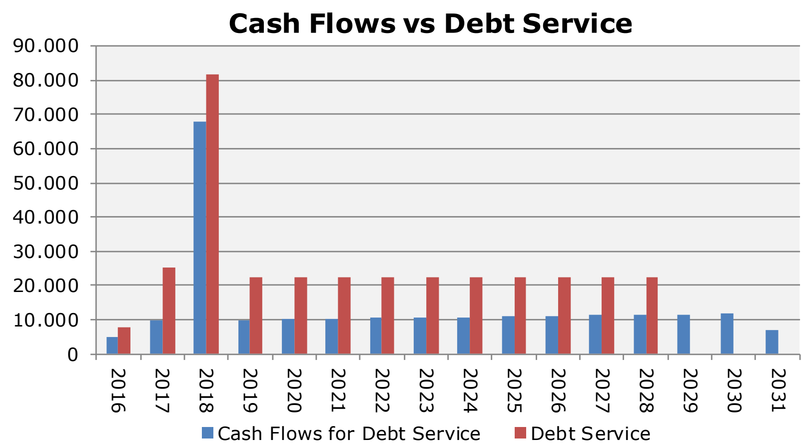
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 17.564 Euro, resulting from 14.499 Euro of energy savings fee and 3.064 Euro maintenance fee, and pays annual costs for 7.994 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 16.324 Euro less post-intervention expenditure of 1.083 Euro) less the 5% shared savings (742 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	14.499
Maintenance fee	3.064
Total Revenues	**17.564**
Maintenance	3.064
Administration costs	3.666
Insurance	1.264
Total Costs	**7.994**
EBITDA	**9.570**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 9.570 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's evident that ESCo involvement is not possible at market conditions because the project is not able to generate enough cash flows to pay back the loan and to remunerate the invested capital.

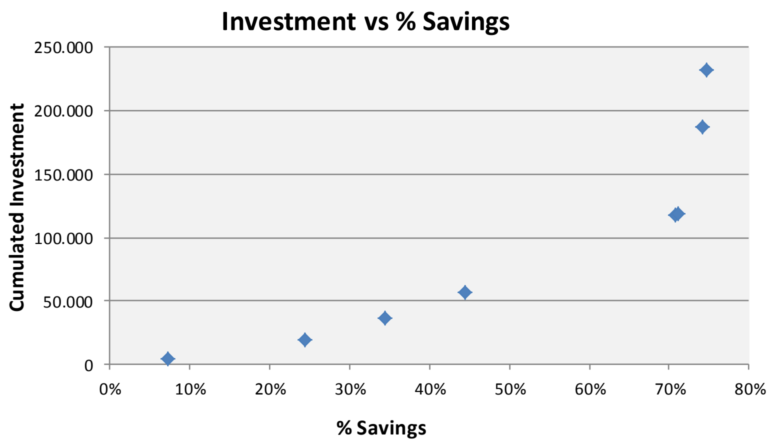
Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions. To do so, a convenience test was implemented to check which a single renovation option is sustainable at market conditions and which is not. For those renovation options that are considered non sustainable at market conditions, alternative financial solutions should be identified.

3.1.4.2 SINGLE RENOVATION OPTION CONVENIENCE TEST

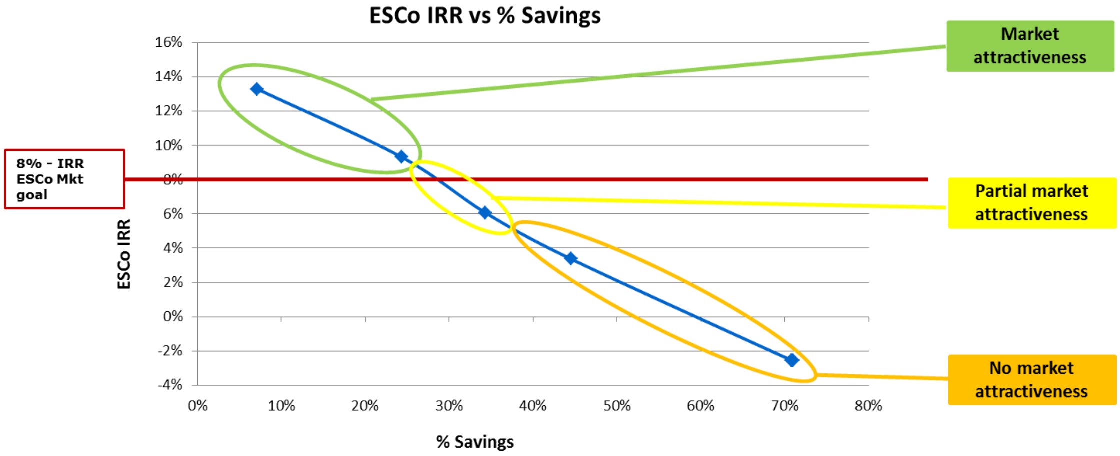
On the basis of the marginal contribution of each intervention to energy savings described in Delivery 2.1, some further elaboration were made in order to represent the relationship between cumulated investment (net VAT) and cumulated savings.

In practice, each intervention was sorted by economic convenience, expressed in terms of lower investment/savings ratio. Then, a XY scatter chart was plotted to express the relationship between the cost of each renovation option and its contribution to energy savings.

As a result, the marginal contribution of each investment to energy savings is decreasing. In particular, the Euro amount invested to obtain a 1% savings starting from baseline is much lower than the Euro amount invested to obtain the same 1% savings with the last renovation option, starting, for example, from 70% savings.



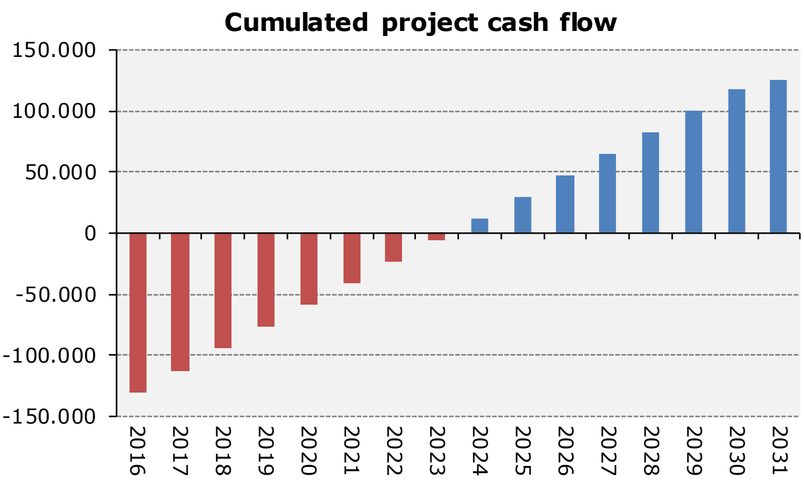
As a consequence of this evidence, another XY scatter chart was plotted to represent the relationship between project IRR and energy savings. The graph allows to observe that very high energy savings (>70%) lead to a significant reduction of the expected IRR of the intervention. In this case, in order to ensure the feasibility of an ESCo involvement, a specific facility or grant should be provided by the Municipality. Please note that the following graph does not consider renovation of "External insulation" and "Windows" because their IRR is not significant.



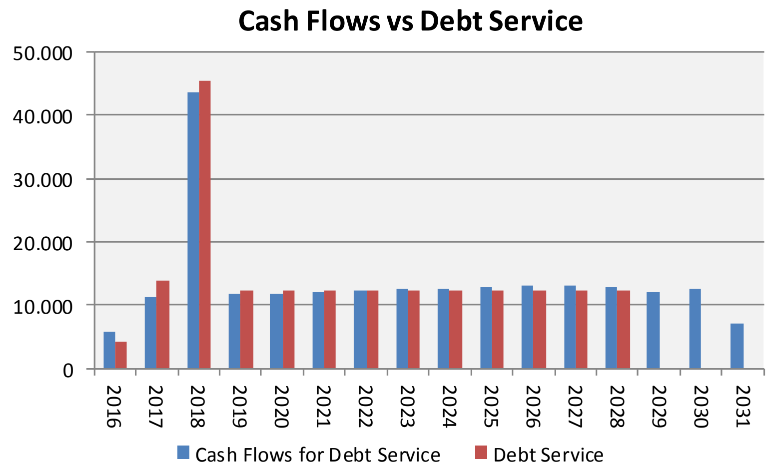
The following table shows the list of the interventions proposed for the building sorted by investment/savings ratio:

Intervention	Investment (€)	Savings (€)	Investment/ Savings ratio	Cumulated Savings
Night Ventilation	4.500	1.172	4	7%
Replacement of lamps (and luminaries, ballast)	15.370	2.808	5	24%
BMS	17.000	1.635	10	34%
Shading elements	20.325	1.663	12	45%
Replacement of heating/cooling plants	60.814	4.297	14	71%
Solar gains circulation	1.000	37	27	71%
External insulation	67.890	507	134	74%
Windows	45.000	92	488	75%

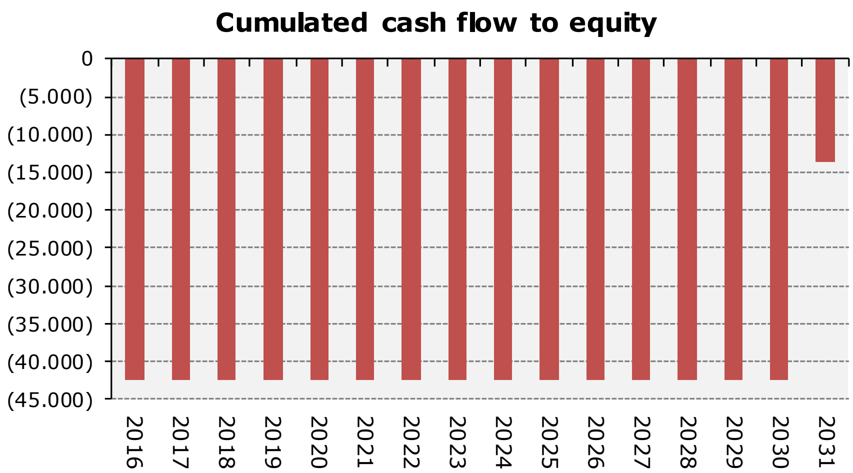
In order to improve the sustainability of the project, analyzed the impact of the removal of the external insulation and windows interventions was analyzed, thus reducing the investment costs by 49% while keeping savings at 71%. In this case, the project achieves payback after 9 years, as shown in the following graph:



From the ESCo point of view, the project remains non sustainable at market conditions and under the assumption of implementation of the standard EPC contract. As shown in the following graph, the project does not generate enough cash flows to pay the loan during the first years:



As a consequence, cash flows to equity are not sufficient to pay back the invested capital and the project remains non sustainable at market conditions.



3.1.4.3 *Financial Structure Optimization*

In order to make the project desirable for an ESCo, some financial support should be given to the project. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 26.840 Euro;
- Subsided Funds for 117.000 Euro (duration 14 years);
- Grant for 134.100 (incl. VAT);
- Duration of the contract: 25 (10 more than base case)

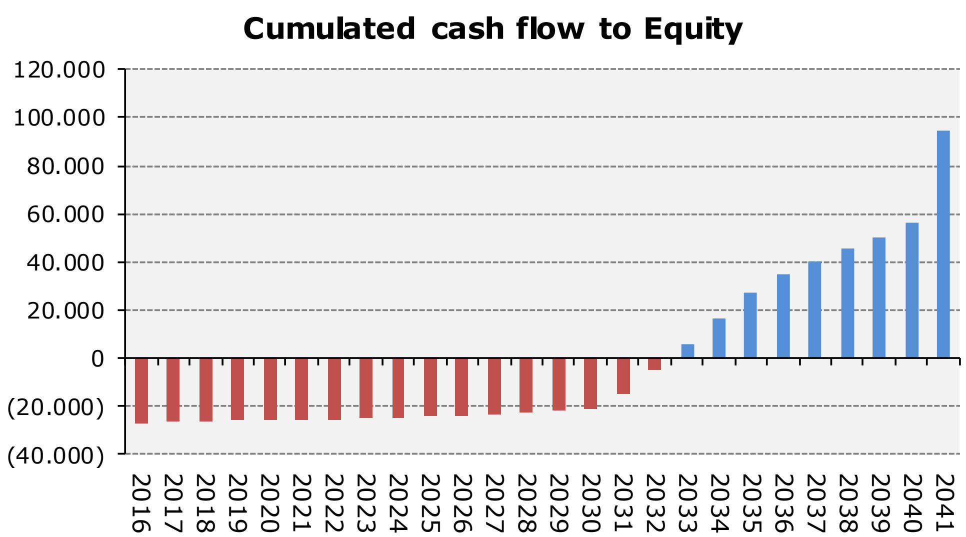
FINANCIAL SOURCES (ESCo)	€	%
Equity	26.840	9%
Senior Debt	0	0%
Grant	134.100	43%
Subsided Funds	117.000	38%
Total Financial Sources exc. VAT	**277.940**	
VAT Facility	33.068	11%
TOTALE FINANCIAL SOURCES	**311.009**	**100%**

As a consequence, the amount of total investment is slightly reduced because the elimination of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCo)	€
HVAC	65.314
Lighting system (internal)	15.370
Renewable energy	20.900
Casing Building skin	88.215
Windows - Low e Thermo Break	45.000
Control system	17.000
Passive sistem	1.000
Investment for renovation	**252.799**
Starting liquidity	0
Interests and Banking Fees	66
Total investment exc. VAT	**252.865**
VAT	58.144
TOTAL INVESTMENT	**311.009**

With this financial structure an ESCo involvement is possible and the remuneration of the invested capital, in terms of IRR, should be considered adequate for this kind of projects.

The following graph shows the cumulated cash flows to equity.

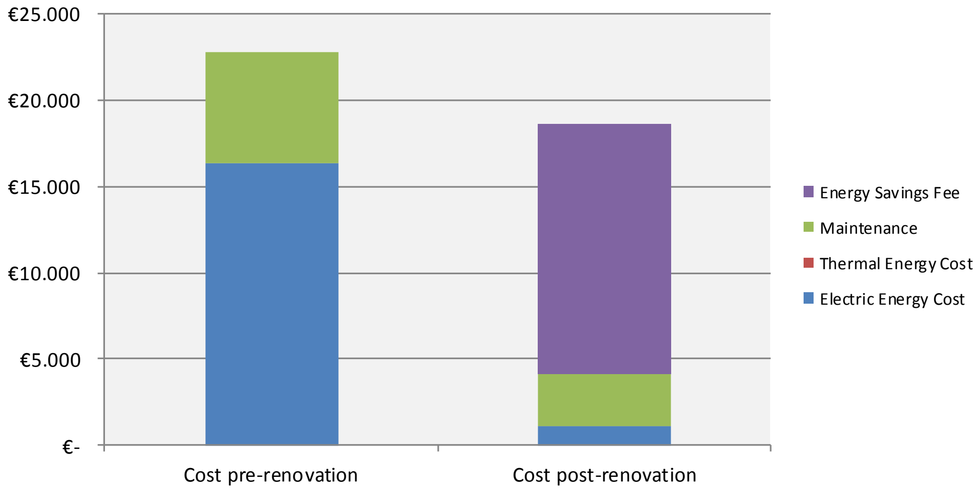


Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered sustainable and profitable. Main indicators for the ESCo investment are:

- Equity Pay-back period: 17,5 years
- ESCo IRR: 8,0%
- Equity NPV: 5.201 Euro

3.1.4.4 *Impact on the Municipality*

The implementation of this EPC contract leads to a reduction of expenditure for the Municipality of around 4.193 Euro/year, resulting from the 5% shared energy savings of 762 Euro and the reduction of maintenance costs of 3.431 Euro. At the end of the contract, the Municipality will benefit from the whole energy savings generated by the renovation.



3.1.4.5 *Project Conclusion*

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 23% (€/kWh)
Greece	Alimos	Municipal City Hall	1.302	252.799	194,2	2,00%	23%	0,180

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
16.347	111.965	86	1.084	7.428	6	15.263	104.537	17

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
6.500	3.064	3.436	18.698	82%	14

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	11%	38%	43%	25	14	23	1%	18	8%

(*) Interest rate= 7,16%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a single renovation option convenience test and a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 1.302 m2;
- The total Investment cost is equal to 252.799 Euro, that means an investment cost per square meter of 194,2 Euro/m2;
- The energy consumption before renovation is equal to 111.968 kWh/year and the energy consumption on square meter is equal to 86 kWh/m2;
- The energy consumption savings are equal to 104.537 kWh/year, that means an energy expenditure saving of 15.263 Euro/year;
- The maintenance expenditure post renovation is lower than before of 3.436 Euro/year. This situation affects positively, at economic level, on the total savings achievable by the intervention, in fact the economic saving both energy and maintenance is about 18.698 Euro/year;
- The Project Pay Back period is long and the project cash flows are not sufficient to support a market financial structure. This have a negative impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;
- The amount of public grants is relevant and it should be found in the availability of funds by the public administration;
- The amount of Subsided Fund is not maximized because the cash flows are not sufficient to increase this value in substitution of part of the grant amount;

- The duration of the EPC contract is higher than the normal market condition (normally 15 years maximum).This duration is due to the fact that the project has a long payback period (14 years);
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;
- In addition, given the small dimension of the project, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.1.5. *SUSTAINABILITY EVALUATION – MUNICIPAL OFFICES*

3.1.5.1 RENOVATION SCHEME AND MARKET TEST

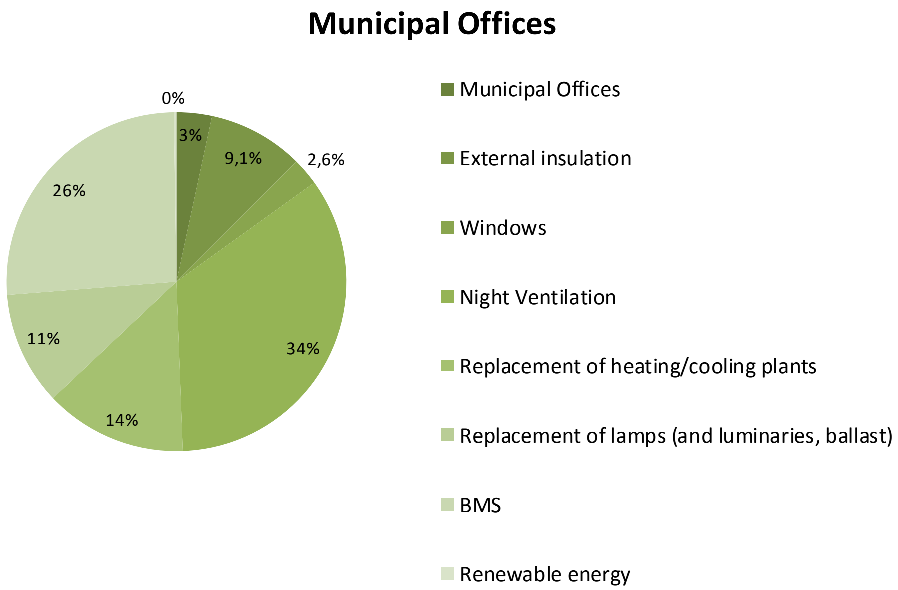
Total investment estimated to realize the interventions are shown in the following table:

INVESTMENTS (ESCo)	€
HVAC	17.520
Lighting system (internal)	3.285
Renewable energy	37.380
Casing Building skin	21.000
Windows - Low e Thermo Break	10.000
Control system	8.800
Ventilation systems	3.150
Investment for renovation	**101.135**

The identified technological solutions lead to an energy savings of 59.543 kWh, equal to 100%. The detail of the energy savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
External insulation	1.014	3%
Windows	2.746	9,1%
Night Ventilation	782	2,6%
Replacement of heating/cooling plants	10.360	34%
Replacement of lamps (and luminaries, ballast)	4.080	14%
BMS	3.261	11%
Renewable energy	37.300	26%
Total	**59.543**	**100%**

The following graph represents the marginal contribution of each intervention to the energy savings (kWh)

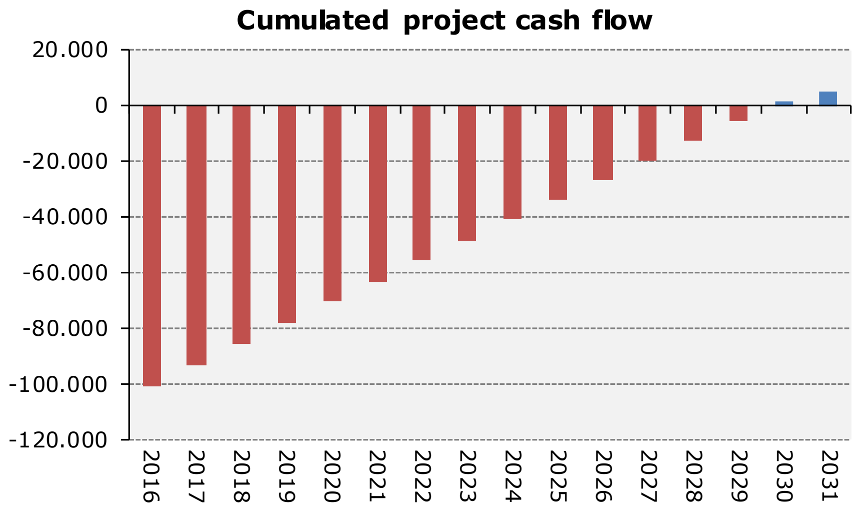


In this particular case, the renovation scheme contains the installation of a photovoltaic plant that, according to the data supplied by the partners, should be able to produce more energy than is required by heating and lighting systems. The energy produced in excess could be used by the Municipality to cover the consumptions of other equipment in the building but, in the following analysis, <u>it won't be considered in the calculation of the of the energy efficiency fee to be paid to the ESCo</u>.

According to the proposed renovation scheme, total economic savings amount 7.712 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	4.397	
Thermal Energy	0	
Maintenance	599	
Total expenditure pre-intervention	**4.996**	
Electric Energy	-4.284	-197%
Thermal Energy	0	0%
Maintenance	1.568	162%
Total expenditure post-intervention	**-2.716**	**-154%**
ANNUAL SAVINGS	**7.712**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project pay-back is 14 years

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
HVAC	17.520
Lighting system (internal)	3.285
Renewable energy	37.380
Casing Building skin	21.000
Windows - Low e Thermo Break	10.000
Control system	8.800
Ventilation systems	3.150
Investment for renovation	**101.135**
Starting liquidity	0
Interests and Banking Fees	1.446
Total investment exc. VAT	**102.581**
VAT	23.261
TOTAL INVESTMENT	**125.842**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	30.774	24%	30%
Senior Debt	71.806	57%	70%
Total Financial Sources exc. VAT	**102.581**	**82%**	**100%**
VAT Facility	23.261	18%	
TOTAL FINANCIAL SOURCES	**125.842**	**100%**	

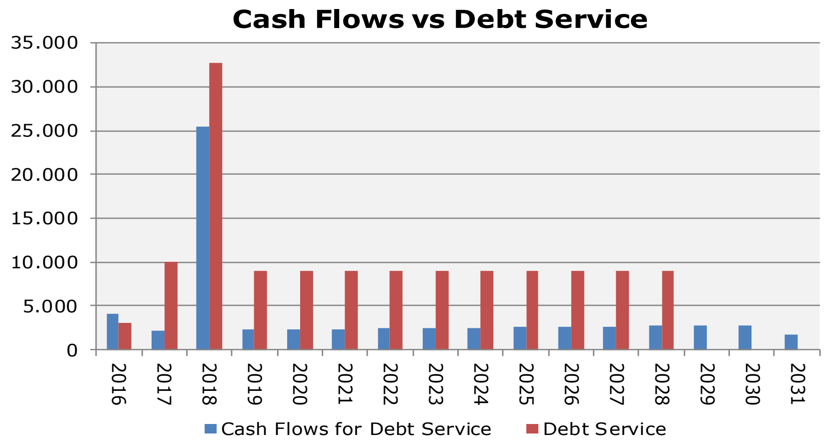
By implementing the EPC contract, the ESCo receives annual fees from the municipality (that don't consider the extra savings from the PV) for 5.745 Euro, resulting from 4.177 Euro of energy savings fee and 1.568 Euro maintenance fee, and pays annual costs for 3.540 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 4.397 Euro less post-intervention expenditure of 0 Euro) less the 5% shared savings (220 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	4.177
Maintenance fee	1.568
Total Revenues	**5.745**
Maintenance	1.568
Administration costs	1.466
Insurance	506
Total Costs	**3.540**
EBITDA	**2.205**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 2.205 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's evident that ESCo involvement is not possible at market conditions because the project is not able to generate enough cash flows to pay back the loan and to remunerate the invested capital.

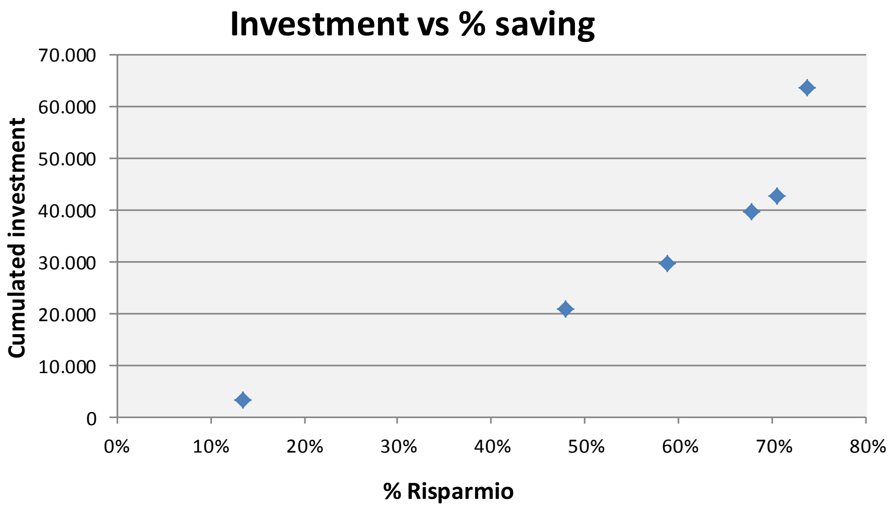
Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions. To do so, a convenience test was implemented to check which a single renovation option is sustainable at market conditions and which is not. For those renovation options that are considered non sustainable at market conditions, alternative financial solutions should be identified.

3.1.5.2 SINGLE RENOVATION OPTION CONVENIENCE TEST

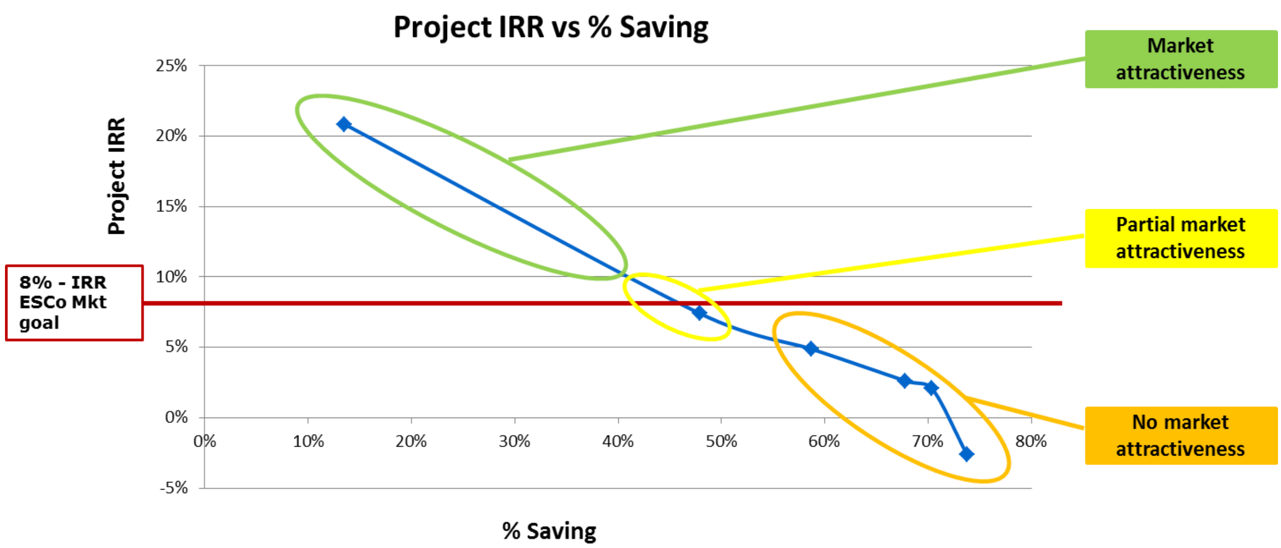
On the basis of the marginal contribution of each intervention to energy savings described in Delivery 2.1, some further elaboration was made in order to represent the relationship between cumulated investment and cumulated savings.

In practice, each intervention was first sorted by economic convenience, expressed in terms of lower investment/savings ratio. Then, a XY scatter chart was plotted to express the relationship between the cost of each renovation option (net VAT) and its contribution to energy savings.

As a result, the marginal contribution of each investment to energy savings is decreasing. In particular, the Euro amount invested to obtain a 1% savings starting from baseline is much lower than the Euro amount invested to obtain the same 1% savings with the last renovation option, starting, for example, from 70% savings.



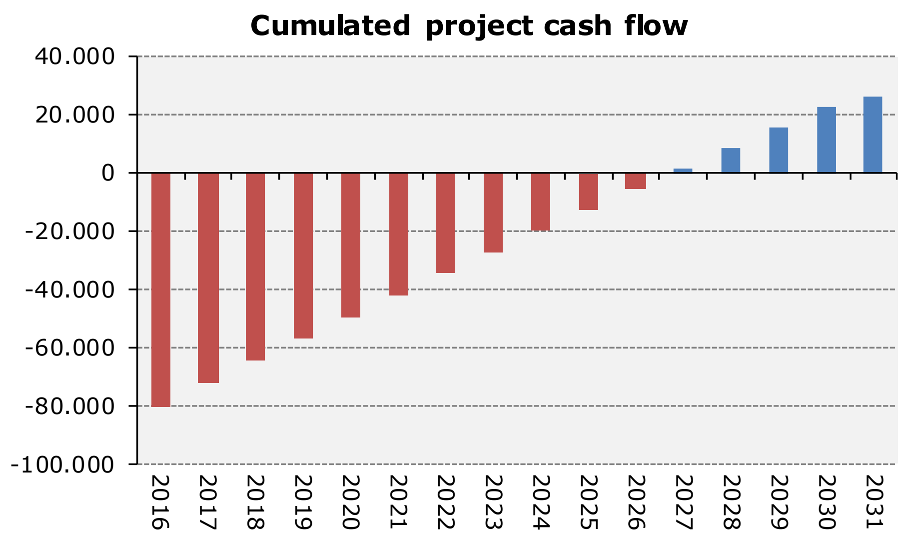
From the graph you can observe that very high energy savings (>70%) lead to a significant increase of the investment. As a consequence of this evidence, another XY scatter chart was plotted to represent the relationship between project IRR and energy savings. From the graph it can be observed that energy savings over 50% lead to a significant reduction of the expected IRR of the intervention. In this case, in order to ensure the feasibility of an ESCo involvement, a specific facility or grant should be provided by the Municipality



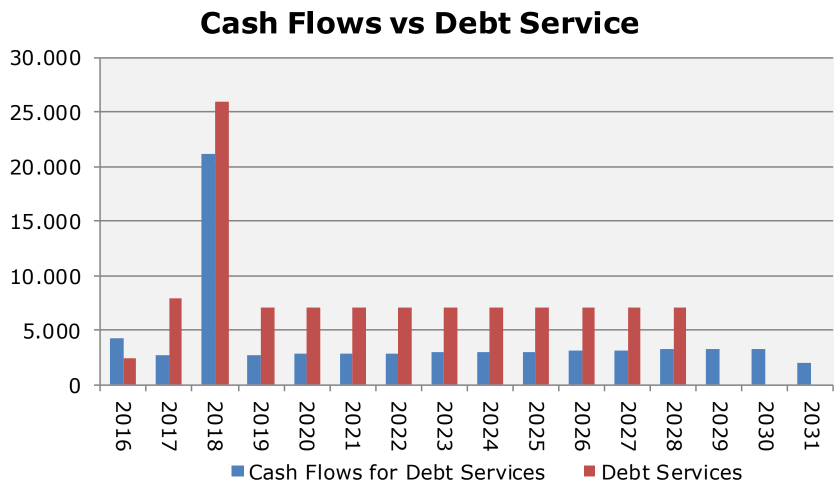
The following table shows the list of the interventions proposed for the building sorted by investment/savings ratio:

Intervention	Investment (€)	Savings (€)	Investment/ Savings ratio	Cumulated saving
Replacement of lamps (and luminaries, ballast)	3.285	596	6	14%
Replacement of heating/cooling plants	17.520	1.513	12	48%
BMS	8.800	476	18	59%
Windows	10.000	401	25	68%
Night Ventilation	3.150	114	28	70%
External insulation	21.000	148	142	74%

In order to improve the sustainability of the project, the impact of the removal of the external insulation intervention was analyzed, thus reducing the investment costs by 33% while keeping savings at 70%. In this case, the project achieves payback after years, as shown in the following graph:



From the ESCo point of view, the project remains non sustainable at market conditions and under the assumption of implementation of the standard EPC contract. As shown in the following graph, the project does not generate enough cash flow to pay back the loan.



3.1.5.3 *FINANCIAL STRUCTURE OPTIMIZATION*

In order to make the project desirable for an ESCo, some financial support should be given to the project. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 10.991Euro;
- Subsided Funds for 30.000 Euro (duration 15 years);
- Grant for 74.000 (Incl. VAT);
- Duration of the contract: 25 years (10 more than base case)
- Percentage of shared savings: 2,5%

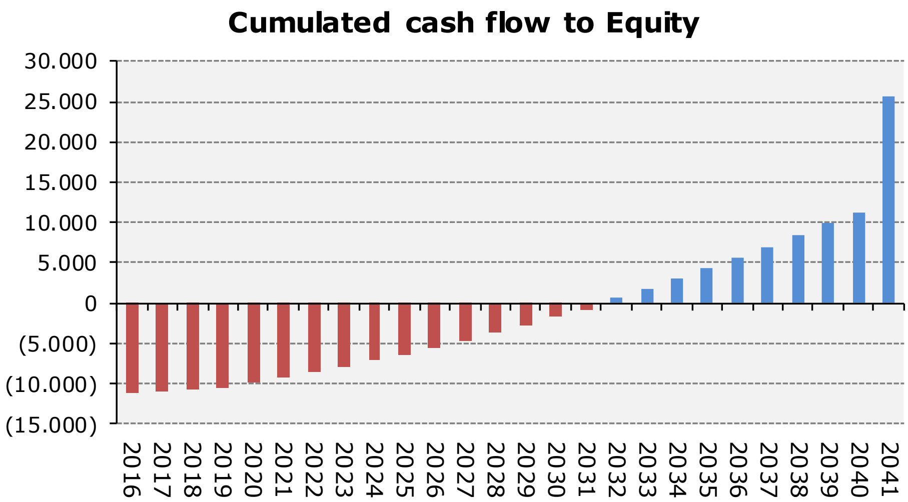
FINANCIAL SOURCES (ESCo)	€	%
Equity	10.991	9%
Senior Debt	0	0%
Grant	74.000	59%
Subsided Funds	30.000	24%
Total Financial Sources exc. VAT	**114.991**	
VAT Facility	9.424	8%
TOTALE FINANCIAL SOURCES	**124.415**	**100%**

As a consequence, the amount of total investment is slightly reduced because the elimination of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
HVAC	17.520
Lighting system (internal)	3.285
Renewable energy	37.380
Casing Building skin	21.000
Windows - Low e Thermo Break	10.000
Control system	8.800
Ventilation systems	3.150
Investment for renovation	**101.135**
Starting liquidity	0
Interests and Banking Fees	19
Total investment exc. VAT	**101.154**
VAT	23.261
TOTAL INVESTMENT	**124.415**

With this financial structure an ESCo intervention is possible but the remuneration of the invested capital, in terms of IRR, is lower than the average expectation of the market.

The following graph shows the cumulated cash flows to equity.



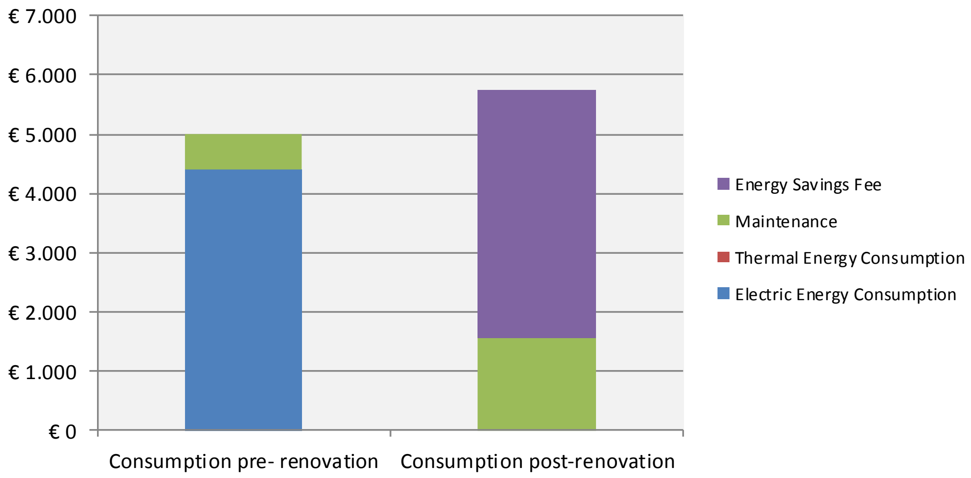
Main indicators for the ESCo investment are:

- Equity Pay-back period: 19 years
- ESCo IRR: 5,9%
- Equity NPV: -1.816 Euro

The hypothesis of a larger amount of Grant could ensure the ESCo the achievement of the target Equity IRR of around 8%. However, a larger amount of Grant should not be considered consistent with market practice.

3.1.5.4 IMPACT ON THE MUNICIPALITY

The implementation of this EPC contract, without considering the extra savings from the PV, leads to an increase of expenditure for the Municipality of around 749 Euro/year, resulting from the 5% shared energy savings of 220 Euro less the increase of maintenance costs of 969 Euro.



If the extra savings from the PV, that amount 4.284 Euro, is considered, the Municipality will benefit from a reduction of expenditure of 3.535 Euro.

3.1.5.5 *Project Conclusion*

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 23% (€/kWh)
Greece	Alimos	Municipal Offices	446	101.135	226,8	2,00%	23%	0,180

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
4.403	30.160	68	0	0	0	4.403	30.160	23

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
600	1.570	-970	3.433	69%	29

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	3%	37%	49%	25	15	>D	<0%	19	6%

(*) Interest rate= 7,16%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a single renovation option convenience test and a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 446 m2;
- The total investment cost is equal to 101.135 Euro, that means an investment cost per square meter of 226,8 Euro/m2;
- The energy consumption before renovation is equal to 30.160 kWh/year and the energy consumption on square meter is equal to 68 kWh/m2;
- The energy consumption savings are equal to 30.160 kWh/year (the renovation options make the building energy self-sufficient), that means an energy expenditure saving of 4.403 Euro/year;
- The maintenance expenditure post renovation is higher than before of 970 Euro/year. This situation affects negatively, at economic level, on the total savings achievable by the intervention, in fact the economic saving both energy and maintenance is about 3.433 Euro/year;
- The Project Pay Back period is too long and the project cash flows are not sufficient to support a market financial structure. This have a negative impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;
- The amount of public grants is very relevant and it should be found in the availability of funds by the public administration;

- The amount of Subsided Fund is not maximized because the cash flows are not sufficient to increase this value in substitution of part of the grant amount;
- The duration of the EPC contract is very higher than the normal market condition (normally 15 years maximum). This duration is due to the fact that the project has a long payback period (29 years);
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;
- In addition, given the small dimension of the project, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.1.6. *Sustainability Evaluation – Municipal Library*

3.1.6.1 Renovation Scheme and Market Test

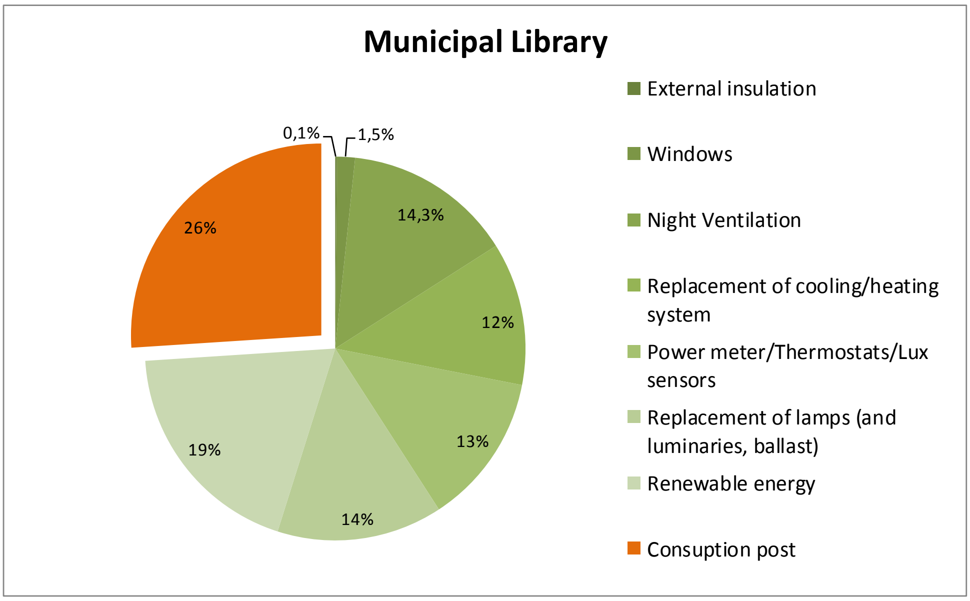
Total investment estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
HVAC	15.350
Lighting system (internal)	2.150
Renewable energy	8.000
Casing Building skin	30.900
Windows - Low e Thermo Break	40.650
Control system	3.010
Ventilation systems	4.000
Investment for renovation	**104.060**

The identified technological solutions lead to an energy savings of 31.171 kWh, equal to 74%. The detail of the energy savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
External insulation	60	0,1%
Windows	648	1,5%
Night Ventilation	6.039	14,3%
Replacement of cooling/heating system	5.072	12%
Power meter/Thermostats/Lux sensors	5.382	13%
Replacement of lamps (and luminaries, ballast)	5.929	14%
Renewable energy	8.041	19%
Total	**31.171**	**74%**

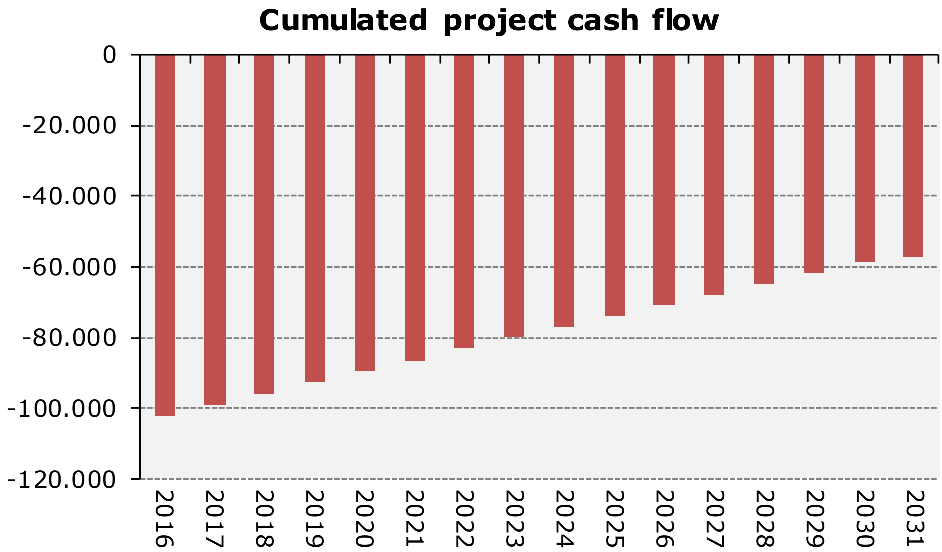
The following graph represents the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, total economic savings amount 3.264 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	6.144	
Thermal Energy	0	
Maintenance	0	
Total expenditure pre-intervention	**6.144**	
Electric Energy	285	-95%
Thermal Energy	1.096	n.a
Maintenance	1.498	n.a
Total expenditure post-interventior	**2.879**	**-53%**
ANNUAL SAVINGS	**3.264**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project is not able to pay-back the investment in 15 years by itself.

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
HVAC	15.350
Lighting system (internal)	2.150
Renewable energy	8.000
Casing Building skin	30.900
Windows - Low e Thermo Break	40.650
Control system	3.010
Ventilation systems	4.000
Investment for renovation	**104.060**
Starting liquidity	0
Interests and Banking Fees	1.488
Total investment exc. VAT	**105.548**
VAT	23.934
TOTAL INVESTMENT	**129.481**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	31.664	24%	30%
Senior Debt	73.883	57%	70%
Total Financial Sources exc. VAT	**105.548**	**82%**	**100%**
VAT Facility	23.934	18%	
TOTAL FINANCIAL SOURCES	**129.481**	**100%**	

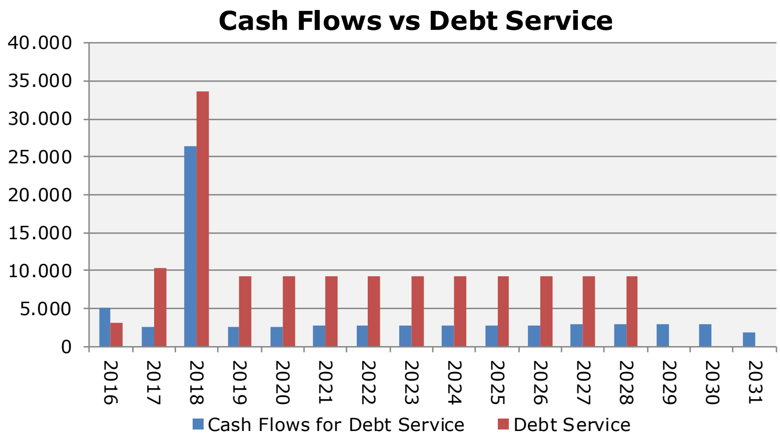
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 6.030 Euro, resulting from 4.530 Euro of energy savings fee and 1.500 Euro maintenance fee, and pays annual costs for 3.529 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 6.144 Euro less post-intervention expenditure of 1.381 Euro) less the 5% shared savings (232 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	4.530
Maintenance fee	1.500
Total Revenues	**6.030**
Maintenance	1.500
Administration costs	1.509
Insurance	520
Total Costs	**3.529**
EBITDA	**2.501**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 2.501 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's clear that an ESCo intervention is not possible at market conditions because the project does not generate enough cash flows to pay the loan and to remunerate the invested capital.

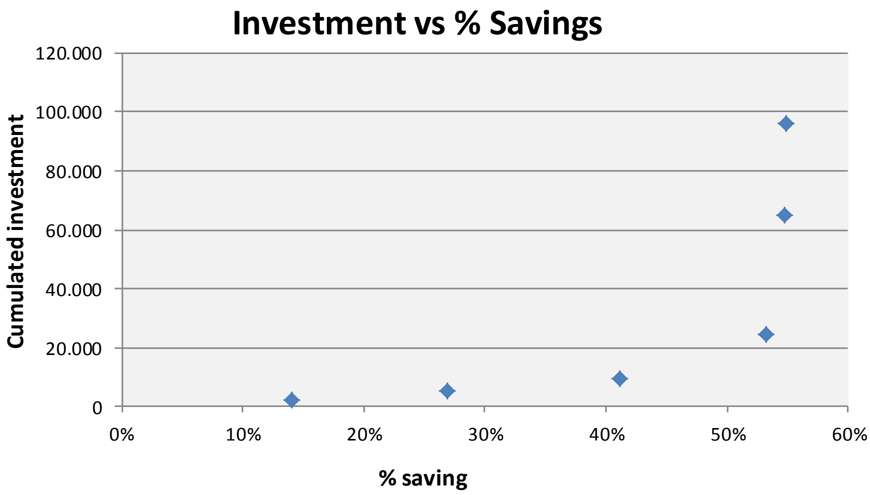
Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions. To do so, a convenience test was implemented to check which a single renovation option is sustainable at market conditions and which is not. For those renovation options that are considered not sustainable at market conditions, alternative financial solutions should be identified.

3.1.6.2 Single Renovation Option Convenience Test

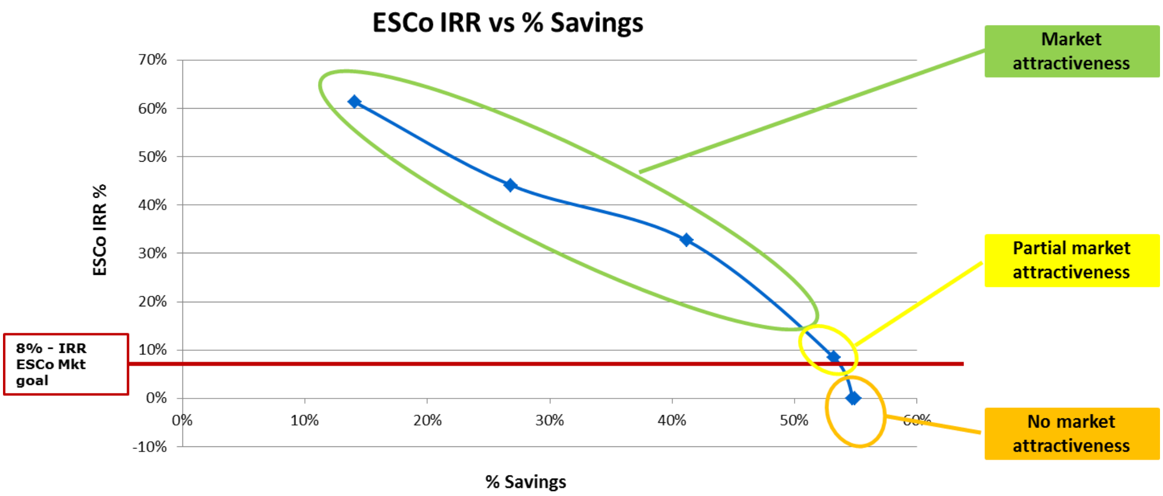
On the basis of the marginal contribution of each intervention to energy savings described in Delivery 2.1, some further elaboration was made in order to represent the relationship between cumulated investment (net VAT) and cumulated savings.

In practice, each intervention was first sorted by economic convenience, expressed in terms of lower investment/savings ratio. Then, a XY scatter chart was plotted to express the relationship between the cost of each renovation option and its contribution to energy savings.

As a result, the marginal contribution of each investment to energy savings is decreasing. In particular, the Euro amount invested to obtain a 1% savings starting from baseline is much lower than the Euro amount invested to obtain the same 1% savings with the last renovation option, starting, for example, from 70% savings.



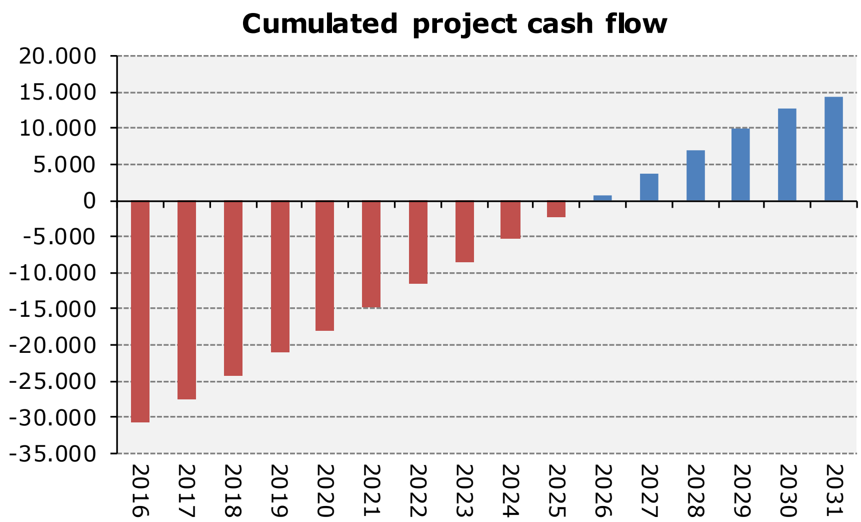
As a consequence of this evidence, plotted another XY scatter chart was plotted to represent the relationship between project IRR and energy savings. From the graph it can be observed that energy savings over 50% lead to a significant reduction of the expected IRR of the intervention. In this case, in order to ensure the feasibility of an ESCo intervention, a specific facility or grant should be provided by the Municipality.



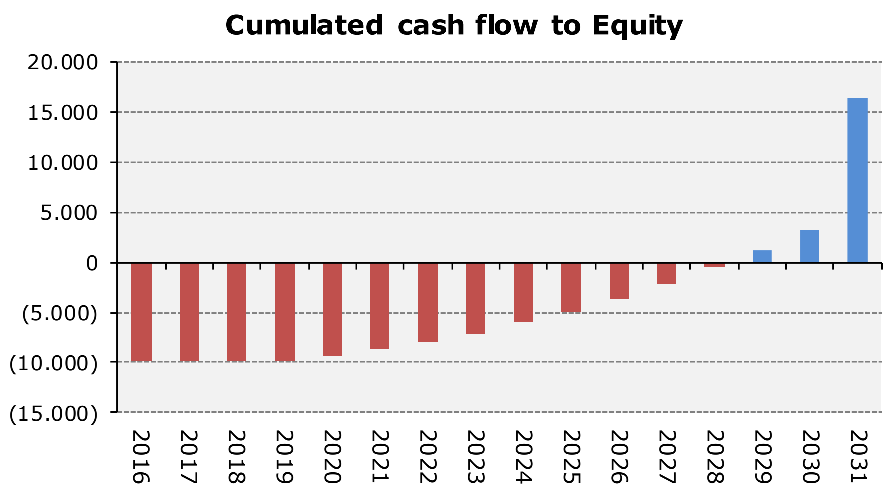
The following table shows the list of the interventions proposed for the building sorted by investment/savings ratio:

Intervention	Investment (€)	Savings (€)	Investment/ Savings ratio	Cumulated saving
Replacement of lamps (and luminaries, ballast)	2.150	866	2	14%
Power meter/Thermostats/Lux sensors	3.010	700	4	27%
Night Ventilation	4.000	882	5	41%
Replacement of cooling/heating system	15.350	1.128	14	53%
Windows	40.650	95	430	55%
External insulation	30.900	9	3.470	55%

In order to improve the sustainability of the project, the impact of the removal of the external insulation and windows interventions, thus the reduction of the investment costs by 74% while keeping savings at 53%, was analyzed. In this case, the project achieves payback after 10 years, as shown in the following graph:



From the ESCo point of view, the project is sustainable at market conditions under the assumption of implementation of the standard EPC contract. As shown in the following graph, the pay-back of the equity invested by the ESCo is 13,5 years.



In this case, the project should be considered sustainable and profitable for the ESCo as the IRR is 8,4%.

3.1.6.3 *Financial Structure Optimization*

In order to make the project desirable for an ESCo, some financial support should be given to the project. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 11.291 Euro;
- Subsided Funds for 31.000 Euro (duration 15 years);
- Grant for 76.000 (Incl. VAT);
- Duration of the contract: 25 years (10 more than base case);

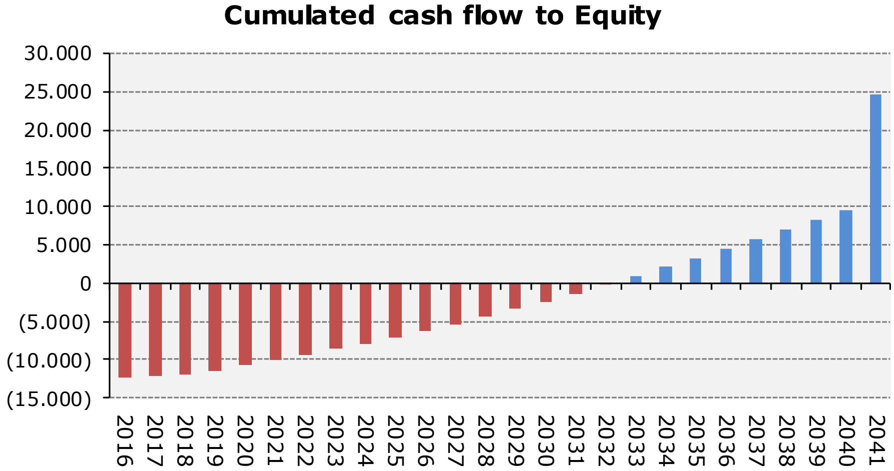
FINANCIAL SOURCES (ESCo)	€	%
Equity	11.291	9%
Senior Debt	0	0%
Grant	76.000	59%
Subsided Funds	31.000	24%
Total Financial Sources exc. VAT	**118.291**	
VAT Facility	9.722	8%
TOTALE FINANCIAL SOURCES	**128.013**	**100%**

As a consequence, the amount of total investment is slightly reduced because the elimination of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
HVAC	15.350
Lighting system (internal)	2.150
Renewable energy	8.000
Casing Building skin	30.900
Windows - Low e Thermo Break	40.650
Control system	3.010
Ventilation systems	4.000
Investment for renovation	**104.060**
Starting liquidity	0
Interests and Banking Fees	19
Total investment exc. VAT	**104.079**
VAT	23.934
TOTAL INVESTMENT	**128.013**

With this financial structure an ESCo intervention is possible and the remuneration of the invested capital, in terms of IRR, should be considered adequate for this kind of projects.

The following graph shows the cumulated cash flows to equity.



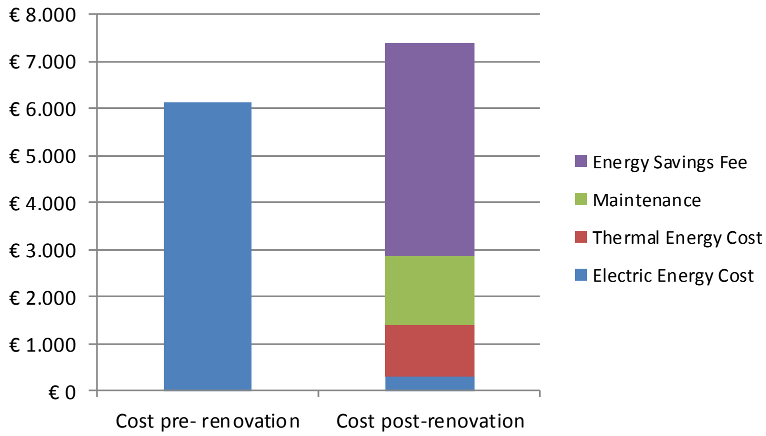
Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered sustainable but its profitability, in terms of IRR, is slightly below the expected cost of capital. Thus, the project, given these assumptions, presents a negative NPV and would not be attractive for an ESCo. Main indicators for the ESCo investment are:

- Equity Pay-back period: 19 years
- ESCo IRR: 5,9%
- Equity NPV: -1.774 Euro

The hypothesis of a larger amount of Grant could ensure the ESCo the achievement of the target Equity IRR of around 8%. However, a larger amount of Grant should not be considered consistent with market practice.

3.1.6.4 *IMPACT ON THE MUNICIPALITY*

The implementation of this EPC contract leads to an increase of expenditure for the Municipality of around 1.260 Euro/year, resulting from the 5% shared energy savings of 238 Euro less the increase of maintenance costs of 1.498 Euro. After the end of the EPC contract, the Municipality would benefit of the whole energy savings and the overall expenditure would thus be reduced.



3.1.6.5 *PROJECT CONCLUSION*

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 23% (€/kWh)
Greece	Alimos	Municipal Library	611	104.060	170,3	2,00%	23%	0,180

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
6.152	42.136	69	1.383	11.543	19	4.769	30.593	22

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
0	1.500	-1.500	3.269	53%	32

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	8%	24%	59%	25	15	>D	<0%	19	6%

(*) Interest rate= 7,16%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a single renovation option convenience test and a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 611 m2;
- The total investment cost is equal to 104.060 Euro, that means an investment cost per square meter of 170,3 Euro/m2;
- The energy consumption before renovation is equal to 42.126 kWh/year and the energy consumption on square meter is equal to 69 kWh/m2;
- The energy consumption savings are equal to 30.593 kWh/year, that means an energy expenditure saving of 4.769 Euro/year;
- The maintenance expenditure before the renovation is equal to zero. So post renovation maintenance is higher than before of 1.500 Euro/year. This situation affects negatively, at the economic level, on the

total savings achievable by the intervention. In fact the economic saving both energy and maintenance is about 3.269 Euro/year;

- The Project Pay Back period is very long, 32 years considering the maintenance, and the project cash flows are very low. This situation have a very negative impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;
- The amount of public grants is very relevant (59%). This kind of tender is not a market practice for Public Private Partnership logic. In addition the amount of grant should be found in the availability of funds by the public administration;
- The amount of Subsided Fund is not maximized because the cash flows are not sufficient to increase this value in substitution of part of the grant amount;
- The duration of the EPC contract is higher than the normal market condition (normally 15 years maximum). This duration is due to the fact that the project has a long payback period (32 years);
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;
- In addition, given the small dimension of the project, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.2. MUNICIPALITY OF COIMBRA

3.2.1. *PROJECT DESCRIPTION*

As in Alimos case studies, the photovoltaic systems will be connected for implementing net metering and therefore they have to be designed taking into account the existing systems in order to estimate the optimum size and operation. The photovoltaic systems will contribute to improve the effective energy performance of the systems. So, the provided photovoltaic systems have been included to Category of Layers 2C ("Energy efficiency"). The total cost of the project is:

- Category of Layers 2C € 1,152,074.00

Technical solutions / Project, building		Building skin				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
Coibra	Elementary School of Solum					High temperature heat pump € 6,556			Relamping € 2,920		Photovoltaic system € 21,993	
	House of Culture					High efficiency split unit systems € 156,142			Relamping € 21,059		Photovoltaic system € 219,455	
	Town Hall					High efficiency split unit systems € 98,657			Relamping € 20,808		Photovoltaic system €604,484	

Table 9. Actions included in Category of Layers 2C and related direct or indirect to actions indenting to improve the energy efficiency of the systems

The following table represents the savings that each single layer/intervention can bring to the project. In this case each layer is considered to be developed alone without considering the others.

Property	Building name	Interventions/Layers	Savings						% risparmio	Cost of Planned Investments	Payback period
			Electric Energy		Thermal Energy		Total				
			kWh	€	kWh	€	kWh	€	kWh	€	year
Municipality of Coimbra	Town Hall	HVAC	57.334	7.627	0	0	**57.334**	**7.627**	**16%**	80.209	**11**
		Lighting systems (internal)	48.799	6.507	0	0	**6.242**	**6.507**	**2%**	16.917	**3**
		Renewable energy	143.311	20.665	0	0	**143.311**	**20.665**	**41%**	534.942	**26**
	Municipal House of Culture	HVAC	118.311	13.300	0	0	**118.311**	**13.300**	**21%**	126.945	**10**
		Lighting systems (internal)	101.157	11.363	0	0	**101.157**	**11.363**	**18%**	17.121	**2**
		Renewable energy	254.200	28.674	0	0	**254.200**	**28.674**	**45%**	194.208	**7**
	Elementary school of Solum	HVAC	-4.902	-901	16.775	3.742	**11.873**	**2.842**	**25%**	5.330	**2**
		Lighting systems (internal)	3.099	569	0	0	**3.099**	**569**	**7%**	2.374	**4**
		Renewable energy	17.216	2.906	0	0	**17.216**	**2.906**	**36%**	19.463	**7**

Table 10 Coimbra_ Savings generate by each layer

3.2.2. COUNTRY SPECIFIC COST FACTORS

Electric energy price (excl. VAT 23%): 0,133 Euro/kWh

Electric energy price (incl. VAT 23%): 0,164 Euro/kWh

In the following table which can be found in greater detail in we have the key financial assumptions which are taken into consideration in the financial modeling and their respective outcome (i.e. project IRR and payback period).

		General Assumptions		
Municipality	**Project**	**inflation rate**	**VAT rate**	**Senior debt interest rate**
Coimbra	*Town Hall*	2,00%	23%	6,22%
Coimbra	*Municipal House of Culture*	2,00%	23%	6,22%
Coimbra	*Elementary school of Solum*	2,00%	23%	6,22%

3.2.3. SOME ELEMENTS OF RISK ANALYSIS

Technical, climate and financial terms are in principal uniform in the southern countries of the EU. Nonetheless specific market conditions affect the viability of each renovation scheme under consideration and may differentiate the success or not of a nZEB renovation in any of the countries under consideration.

Following the collective analysis in the Risk Breakdown Structure (chapter 2.3) we need to emphasize the key risks associated with operating in the Portuguese market. The cost of electricity follows the upward trend evident in the EU starting from a high level due to high market cost and a small tax levy.

An aggravating factor against a project financing is the 2nd highest spread on the cost of financing in the group which affects the project IRR. On the positive side, portuguese companies face with a more supporting business framework since Portugal is 25th in the world's easiest place to do business, while the aggregate taxation rate is at 42% the lowest among the group of the 4 countries.

3.2.4. SUSTAINABILITY EVALUATION – TOWN HALL

3.2.4.1 RENOVATION SCHEME AND MARKET TEST

Given the features and actual conditions of the building, designers identified some simple renovation options concerning heating and lighting system.

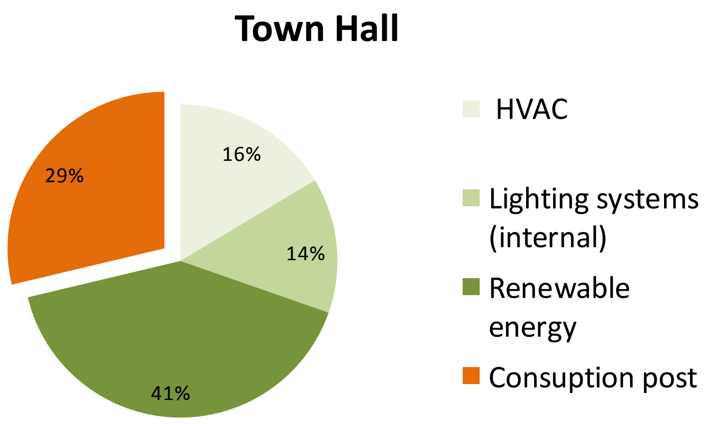
Total investment estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
Heat pump of high temperature	80.209
LED	16.917
Photovoltaic panels	534.942
Investment for renovation	**632.068**

The identified technological solutions lead to energy savings for 249.600 kWh, equal to 71% compared to baseline. The detail of energy savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
HVAC	57.372	16%
Lighting systems (internal)	48.917	14%
Renewable energy	143.311	41%
Total	**249.600**	**71%**

The following graph represents the marginal contribution of each intervention to energy savings (kWh)



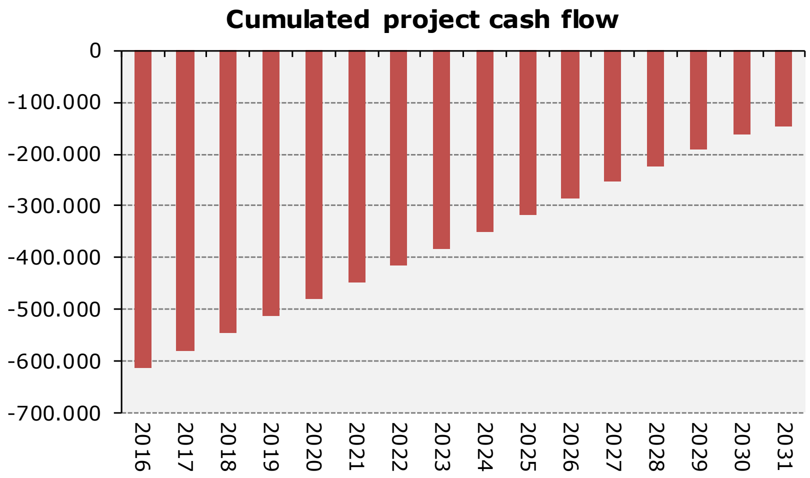
According to the proposed renovation scheme, total economic savings amount 34.160 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% Savings
Electric Energy	46.504	
Thermal Energy	0	
Maintenance	868	
Total expenditure pre-intervention	**47.371**	
Electric Energy	11.735	-75%
Thermal Energy	0	n.a.
Maintenance	1.477	70%
Total expenditure post-intervention	**13.212**	**-72%**
ANNUAL SAVINGS	**34.160**	

In this specific case, designers consider a self-consumption of 90% of the overall energy produced by the photovoltaic panels while the remaining 10% is considered to be sold on the grid at market price (0,05 €/kWh). Thus, economic savings brought by the photovoltaic panels are calculated using a weighted average price given by the following formula:

0,9*AcquisitionPrice+0,1*0,05

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project is not able to pay-back the investment in 15 years by itself. The pay-back of the project is 18 years.

From an ESCo point of view, an extra investment of 8.927 Euro is considered in order to provide the project with sufficient liquidity to pay interests, banking fees and to finance initial working capital.

INVESTMENTS (ESCo)	€
HVAC	80.209
Lighting system	16.917
Renewable energy	534.942
Investment for renovation	**632.068**
Starting liquidity	0
Interests and Banking Fees	8.927
Total investment exc. VAT	**640.995**
VAT	91.881
TOTAL INVESTMENT	**732.876**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	192.299	26%	30%
Senior Debt	448.697	61%	70%
Total Financial Sources exc. VAT	**640.995**	**87%**	**100%**
VAT Facility	91.881	13%	
TOTAL FINANCIAL SOURCES	**732.876**	**100%**	

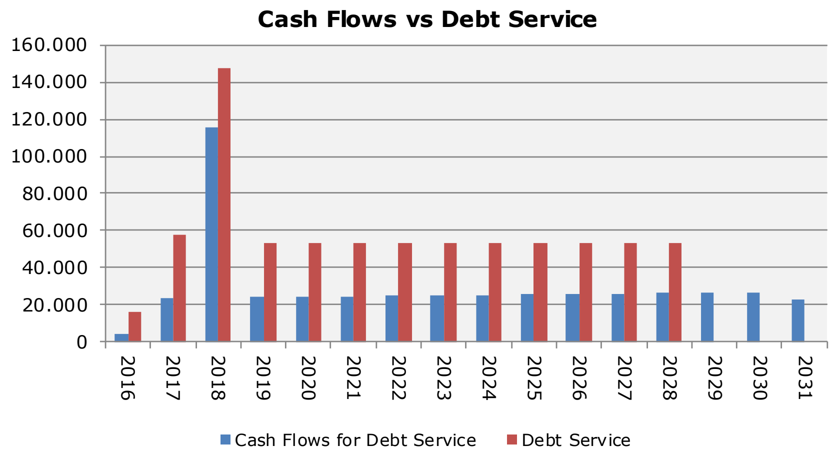
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 34.509 Euro, resulting from 33.030 Euro of energy savings fee and 1.479 Euro maintenance fee, and pays annual costs for 10.960 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 46.504 Euro less post-intervention expenditure of 11.735 Euro) less the 5% shared savings (1.738 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy Savings Fee	33.030
Maintenance Fee	1.479
Total Revenues	**34.509**
Maintenance	1.479
Administration costs	6.321
Insurance	3.160
Total Costs	**10.960**
EBITDA	**23.549**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 23.549 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's evident that an ESCo intervention is not possible at market conditions because the project is not able to generate enough cash flows to pay back the loan and to remunerate the invested capital.

Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions.

3.2.4.2 Single Renovation Option Convenience Test

In this case, since only two generic renovation options have been identified to reduce energy consumption, it's not possible to say if there is the possibility to remove some expensive intervention in order to shorten the payback of the project.

3.2.4.3 FINANCIAL STRUCTURE OPTIMIZATION

In order to make the project desirable for an ESCo, an important financial support should be given to the project and the duration of the EPC contract should be extended. In this case, a specific financial structure was implemented assuming:

:

- Equity investment by the ESCo for 72.060 Euro;
- Subsided Funds for 270.000 Euro (duration 15 years);
- Grant for 358.000 (Incl. VAT);
- Duration of the EPC contract: 25 years (10 more than base case)

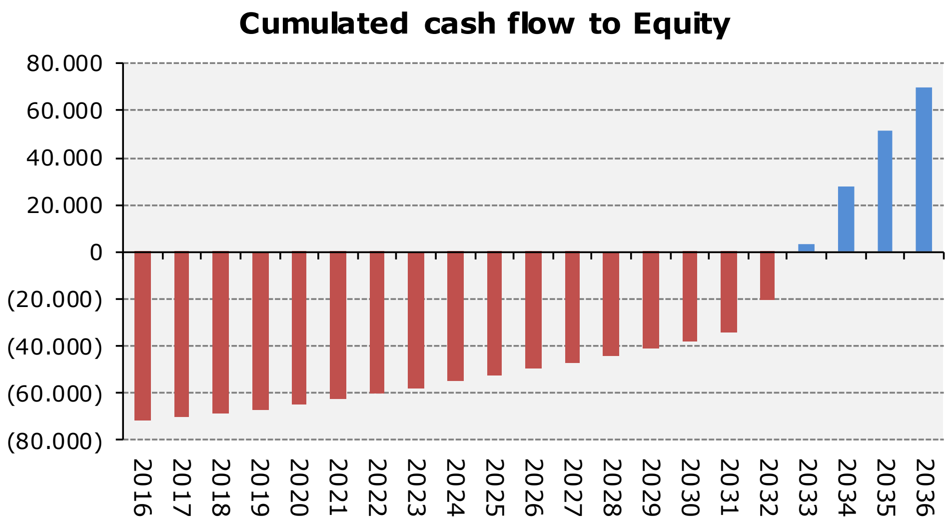
FINANCIAL SOURCES (ESCo)	€	%
Equity	72.060	10%
Senior Debt	0	0%
Grant	358.000	49%
Subsided Funds	270.000	37%
Total Financial Sources exc. VAT	**700.060**	
VAT Facility	24.938	3%
TOTALE FINANCIAL SOURCES	**724.999**	**100%**

As a consequence, the amount of total investment is slightly reduced because the elimination of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
HVAC	80.209
Lighting system	16.917
Renewable energy	534.942
Investment for renovation	**632.068**
Starting liquidity	1.000
Interests and Banking Fees	50
Total investment exc. VAT	**633.117**
VAT	91.881
TOTAL INVESTMENT	**724.999**

With this financial structure an ESCo intervention is possible and the remuneration of the invested capital, in terms of IRR, should be considered adequate for this kind of projects.

The following graph shows the cumulated cash flows to equity.

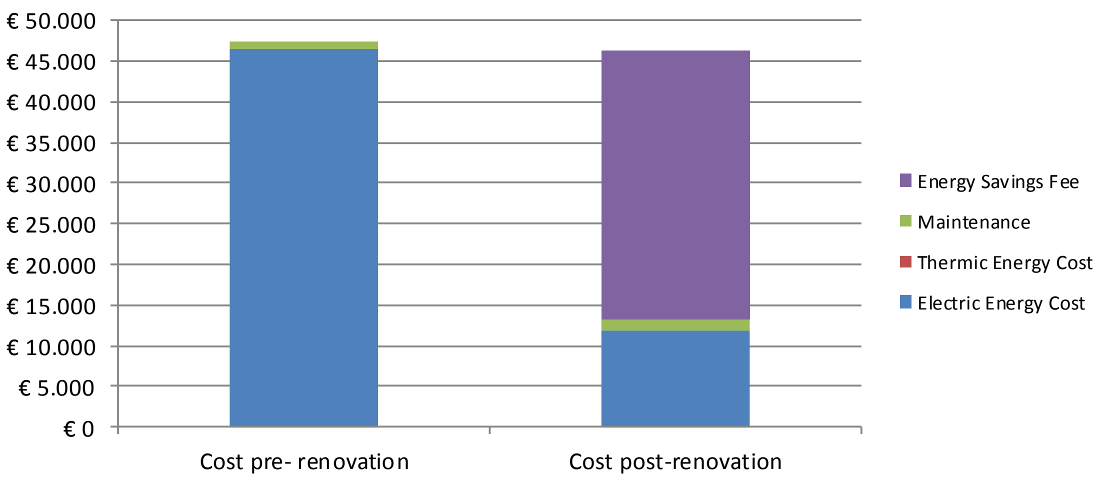


Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered sustainable and profitable. Main indicators for the ESCo investment are:

- Equity Pay-back period: 18 years
- ESCo IRR: 7,5%
- Equity NPV: 5.806 Euro

3.2.4.4 *IMPACT ON THE MUNICIPALITY*

The implementation of this EPC contract leads to a reduction of expenditure for the Municipality of around 1.130 Euro/year, resulting from the 5% shared energy savings of 1.738 Euro less the increase in maintenance costs of 609 Euro. At the end of the contract, the Municipality will benefit from the whole energy savings generated by the renovation.



3.2.4.5 PROJECT CONCLUSION

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 23% (€/kWh)
Portugal	Coimbra	Town Hall	5.880	632.068	107,5	2,00%	23%	0,164

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
46.568	350.206	60	11.688	100.606	17	34.880	249.600	18

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
869	1.479	-610	34.270	72%	18

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	11%	38%	43%	25	15	23	1%	18	8%

(*) Interest rate= 6,22%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a single renovation option convenience test and a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 5.880 m2.
- The total investment cost is equal to 632.068 Euro, that means an investment cost per square meter of 107,5 Euro/m2.
- The energy consumption before renovation is equal to 350.206 kWh/year and the energy consumption on square meter is equal to 60 kWh/m2;
- The energy consumption savings are equal to 249.600 kWh/year, that means an energy expenditure saving of 34.880 Euro/year;

- The maintenance expenditure post renovation is higher than before of 610 Euro/year. This situation affects negatively, at economic level, on the total savings achievable by the intervention but the impact is light. In fact the economic saving both energy and maintenance is about 34.270 Euro/year;
- The Project Pay Back period is too long (18 years) and the project cash flows are very low. This have a negative impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;
- The amount of public grants is very relevant and it should be found in the availability of funds by the public administration;
- The duration of the EPC contract is higher than the normal market condition (normally 15 years maximum). This duration is due to the fact that the project has a long payback period (18 years);
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.2.5. *Sustainability Evaluation – Municipal House of Culture*

3.2.5.1 Renovation Scheme and Standard Market Test

Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

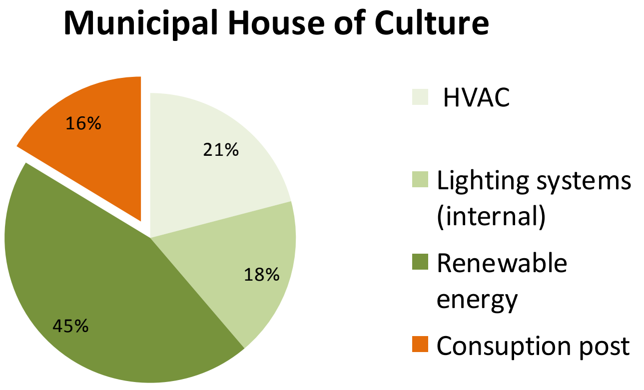
Total investment estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
HVAC	126.945
Lighting system	17.121
Renewable energy	194.208
Investment for renovation	**338.274**

The identified technological solutions lead to energy savings of 473.750 kWh, equal to 84%. The detail of the energy savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
HVAC	118.393	21%
Lighting systems (internal)	101.157	18%
Renewable energy	254.200	45%
Total	**473.750**	**84%**

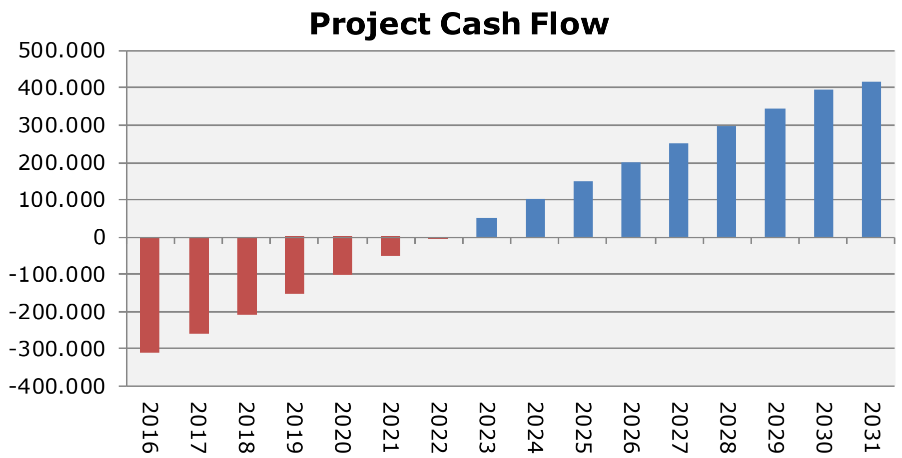
The following graph represent the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, total economic savings amount 52.957 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	63.492	
Thermal Energy	0	
Maintenance	479	
Total expenditure pre-intervention	**63.971**	
Electric Energy	10.210	-84%
Thermal Energy	0	0%
Maintenance	804	68%
Total expenditure post-intervention	**11.014**	**-83%**
ANNUAL SAVINGS	**52.957**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the pay-back of the project is 7,5 years.

From an ESCo point of view, some extra investment is considered in order to pay interests and banking fees.

INVESTMENTS (ESCo)	€
HVAC	126.945
Lighting system	17.121
Renewable energy	194.208
Investment for renovation	**338.274**
Starting liquidity	500
Interests and Banking Fees	4.803
Total investment exc. VAT	**343.577**
VAT	58.382
TOTAL INVESTMENT	**401.959**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	103.073	26%	30%
Senior Debt	240.504	60%	70%
Total Financial Sources exc. VAT	**343.577**	**85%**	**100%**
VAT Facility	58.382	15%	
TOTAL FINANCIAL SOURCES	**401.959**	**100%**	

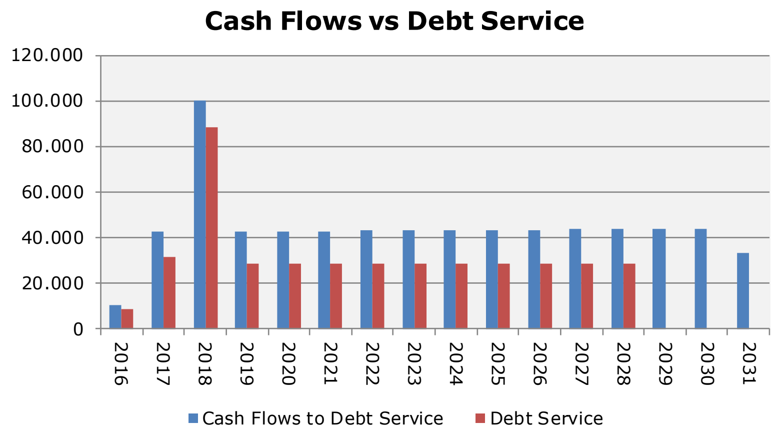
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 51.423, resulting from 50.618 Euro of energy savings fee and 805 Euro maintenance fee, and pays annual costs for 7.402 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 63.492 Euro less post-intervention expenditure of 10.210 Euro) less the 5% shared savings (2.664 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

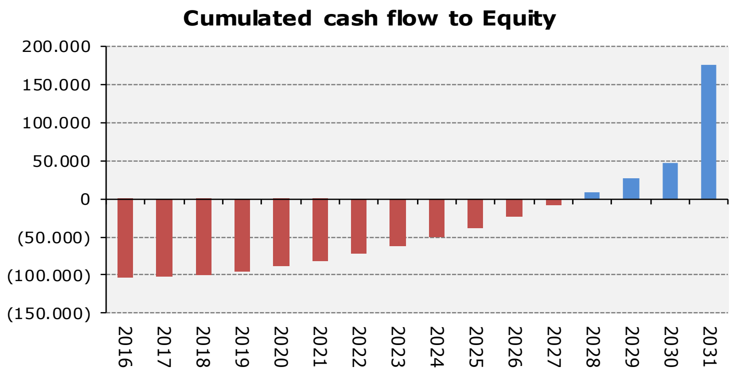
REVENUES & COSTS (ESCo)	€/year
Energy savings fee	50.618
Maintenance fee	805
Total Revenues	**51.423**
Maintenance	805
Administration costs	4.905
Insurance	1.691
Total Costs	**7.402**
EBITDA	**44.022**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 44.022 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, an ESCo intervention is possible at market conditions because the project is able to generate enough cash flows to pay back the loan and to remunerate the capital invested by the ESCo.



Given the structure of this EPC contract, the investment made by the ESCo should be considered sustainable. Main indicators for the ESCo investment are:

- Pay-back period: 12,5 years
- IRR: 9,06%
- Equity NPV: 23.946 Euro

3.2.5.2 *Single Renovation Option Convenience Test*

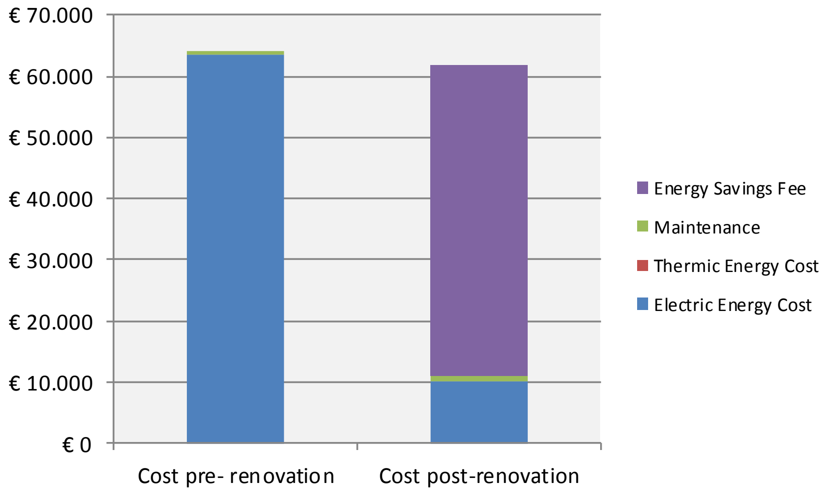
In this case, since the project is sustainable and profitable by itself, no improvement is needed.

3.2.5.3 *Financial Structure Optimization*

In this case, since the project is sustainable and profitable by itself, no improvement is needed.

3.2.5.4 *Impact on the Municipality*

The implementation of this EPC contract leads to a reduction of expenditure for the Municipality of around 2.339 Euro/year, resulting from the 5% shared energy savings of 2.664 Euro less the increase in maintenance costs of 325 Euro. At the end of the contract, the Municipality will benefit from the whole energy savings generated by the renovation.



3.2.5.5 *Project Conclusion*

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 23% (€/kWh)
Portugal	Coimbra	Municipal House of Culture	13.225	338.274	25,6	2,00%	23%	0,164

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
63.492	565.980	43	10.411	92.230	7	53.081	473.750	6

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
591	991	-400	52.681	82%	6

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
26%	60%	15%	0%	0%	15	0	9	10%	13	9%

(*) Interest rate= 6,22%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is possible at current market conditions** considered because the project is hypothetically feasible for an ESCo, without the necessary implementation of a single renovation option convenience test and the financial structure optimization.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 13.225 m2.
- The total investment cost is equal to 338.274 Euro, that means an investment cost per square meter of 25,6 Euro/m2.
- The energy consumption savings are equal to 473.750 kWh/year, that means 53.081 Euro/year.
- The maintenance expenditure post renovation is higher than before of 400 Euro/year. This situation affects negatively, at economic level, on the total savings achievable by the intervention but the impact is light. In fact the economic saving both for energy and maintenance is about 52.681 Euro/year;
- The Project Pay Back period is very short (6 years) and the investment is pay back during the EPC Contract duration (15 years). This have a positive impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;
- The Project could be developed at market condition, without considering Grant or Subsided Funds.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.2.6. *SUSTAINABILITY EVALUATION – ELEMENTARY SCHOOL OF SOLUM*

3.2.6.1 RENOVATION SCHEME AND MARKET TEST

Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

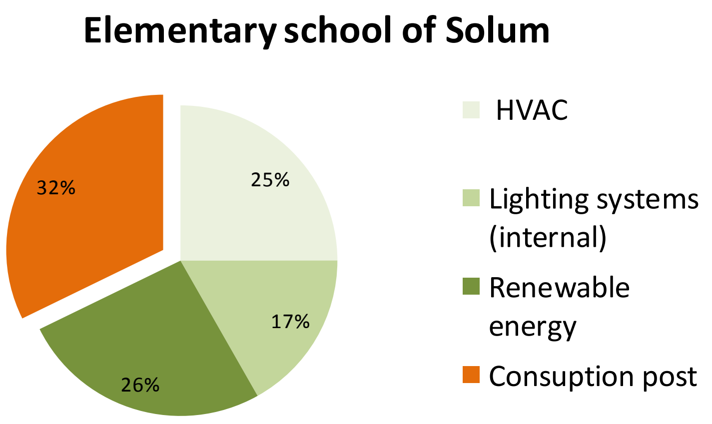
Total investment estimated to realized the interventions are shown in the following table:

INVESTMENTS	€
HVAC	5.330
Lighting system	2.374
Photovoltaic panels	19.463
Investment for renovation	**27.167**

The identified technological solutions lead to energy savings of 32.188 kWh, equal to 68%. The detail of the energy savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
HVAC	11.873	25%
Lighting systems (internal)	8.001	17%
Renewable energy	12.314	26%
Total	**32.188**	**68%**

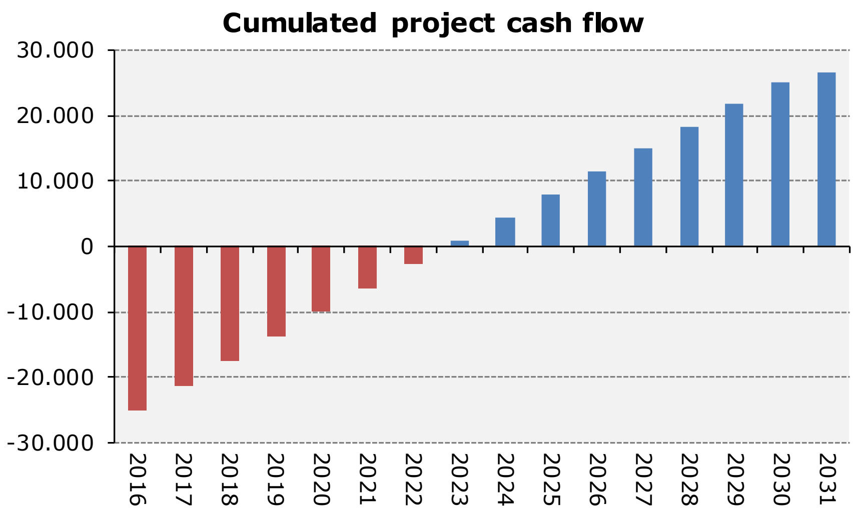
The following graph represent the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, total economic savings amount 3.854 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	5.553	
Thermal Energy	1.444	
Maintenance	0	
Total expenditure pre-intervention	**6.997**	
Electric Energy	2.079	-63%
Thermal Energy	902	-38%
Maintenance	162	n.a.
Total expenditure post-intervention	**3.143**	**-55%**
ANNUAL SAVINGS	**3.854**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the pay-back of the project is 8 years.

From an ESCo point of view, some extra investment is considered in order to pay interests and banking fees.

INVESTMENTS (ESCo)	€
HVAC	5.330
Lighting system	2.374
Renewable energy	19.463
Investment for renovation	**27.167**
Starting liquidity	0
Interests and Banking Fees	384
Total investment exc. VAT	**27.551**
VAT	4.302
TOTAL INVESTMENT	**31.853**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	8.265	26%	30%
Senior Debt	19.286	61%	70%
Total Financial Sources exc. VAT	**27.551**	**86%**	**100%**
VAT Facility	4.302	14%	
TOTAL FINANCIAL SOURCES	**31.853**	**100%**	

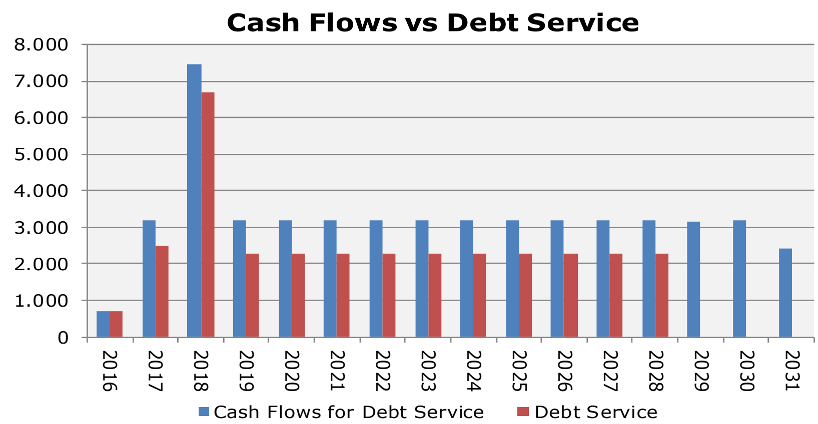
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 3.978 Euro, resulting from 3.815 Euro of energy savings fee and 163 Euro maintenance fee, and pays annual costs for 692 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 6.997 Euro less post-intervention expenditure of 2.981 Euro) less the 5% shared savings (201 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

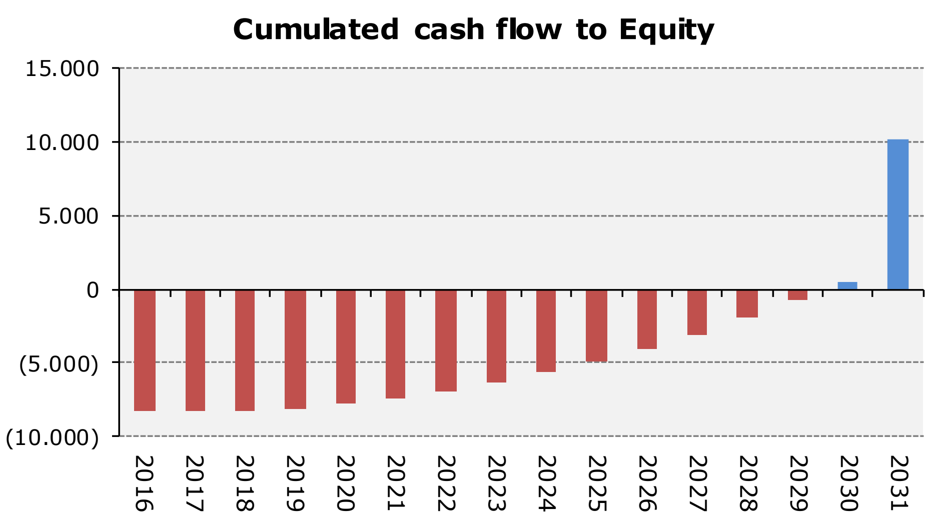
REVENUES & COSTS (ESCo)	€/year
Energy savings fee	3.815
Maintenance fee	163
Total Revenues	**3.978**
Maintenance	163
Administration costs	394
Insurance	136
Total Costs	**692**
EBITDA	**3.286**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 3.286 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, the project generates enough cash flows to pay the debt but it's not able to remunerate sufficiently the capital invested by the ESCo. As a consequence, an ESCo intervention at market conditions should be considered sustainable but not profitable enough. The following graph shows the cumulated cash flows to equity:



Main indicators for the ESCo investment are:

- Pay-back period: 14,5 years
- IRR: 6,75%
- Equity NPV: 6,75% Euro

Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions.

3.2.6.2 *SINGLE RENOVATION OPTION CONVENIENCE TEST*

In this case, since the project is sustainable and profitable by itself, no improvement is needed.

3.2.6.3 *FINANCIAL STRUCTURE OPTIMIZATION*

In order to make the project more desirable for an ESCo, some financial support should be given to the project. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 10.447 Euro;
- Senior debt for 6.964 Euro;
- Subsided Funds for 9.900 Euro (duration 12 years);

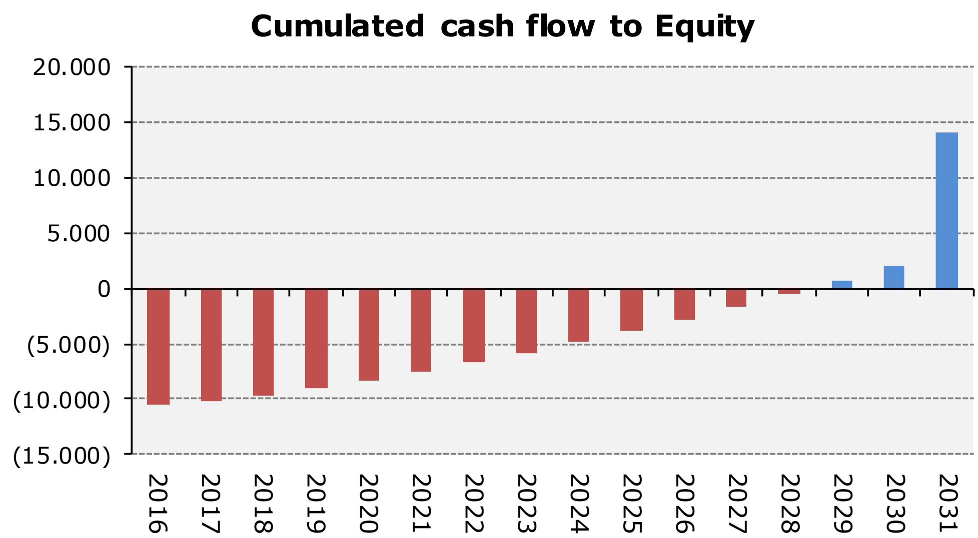
FINANCIAL SOURCES (ESCo)	€	%
Equity	10.447	33%
Senior Debt	6.964	22%
Grant	0	0%
Subsided Funds	9.900	31%
Total Financial Sources exc. VAT	**27.311**	
VAT Facility	4.302	14%
TOTALE FINANCIAL SOURCES	**31.613**	**100%**

As a consequence, the amount of total investment is slightly reduced because the decrease of Senior Debt implies the reduction of interests and banking fees.

INVESTMENTS (ESCOs)	€
HVAC	5.330
Lighting system	2.374
Renewable energy	19.463
Investment for renovation	**27.167**
Starting liquidity	0
Interests and Banking Fees	144
Total investment exc. VAT	**27.311**
VAT	4.302
TOTAL INVESTMENT	**31.613**

With this financial structure, an ESCo intervention is possible and the remuneration of the invested capital, in terms of IRR, should be considered adequate for this kind of projects.

The following graph shows the cumulated cash flows to equity.

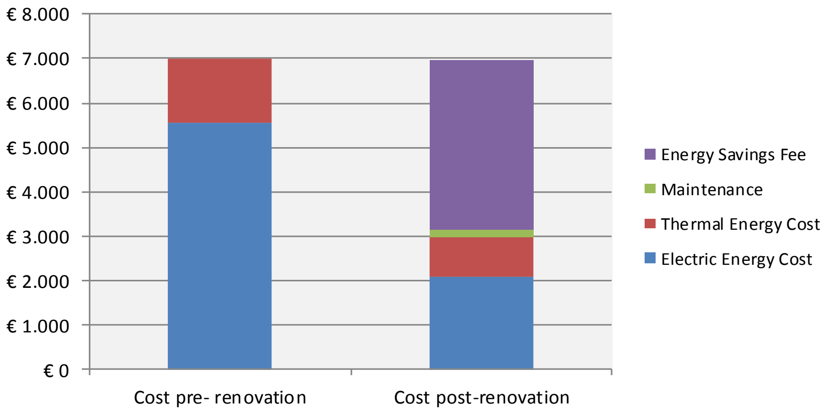


Given this financial structure and under the hypothesis of availability of subsided funds for this amount, the investment made by the ESCo should be considered sustainable and profitable. Main indicators for the ESCo investment are:

- Equity Pay-back period: 13,5 years
- ESCo IRR: 8,0%
- Equity NPV: 1.054 Euro

3.2.6.4 *Impact on the Municipality*

The implementation of this EPC contract leads to a reduction of expenditure for the Municipality of around 38 Euro/year, resulting from the 5% shared energy savings of 201 Euro less the increase in maintenance costs of 162 Euro. While the immediate savings for the Municipality is not relevant because the 5% shared savings from the interventions is offset by the higher costs of maintenance, at the end of the contract, the Municipality will benefit from the whole energy savings generated by the renovation.



3.2.6.5 PROJECT CONCLUSION

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessement of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 23% (€/kWh)
Portugal	Coimbra	Elementary school of Solum	1.655	27.167	16,4	2,00%	23%	0,164

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
7.006	47.524	29	2.981	15.336	9	4.026	32.188	7

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
0	200	-200	3.826	55%	7

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
33%	22%	14%	31%	0%	15	12	9	9%	14	8%

(*) Interest rate= 6,22%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement should be considered **sustainable but not profitable enough at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 1.655 m2.
- The total investment cost is equal to 27.167 Euro, that means an investment cost per square meter of 16,4 Euro/m2.
- The energy consumption before renovation is equal to 47.524 kWh/year and the energy consumption on square meter is equal to 29 kWh/m2;
- The energy consumption savings are equal to 32.188 kWh/year, that means 4.026 Euro/year.
- The maintenance expenditure post renovation is higher than before of 200 Euro/year. This situation affects negatively, at economic level, on the total savings achievable by the intervention but the impact is light. In fact the economic saving both for energy and maintenance is about 3.826 Euro/year;
- The Project Pay Back period is short (7 years) and the investment is paid back during the EPC Contract duration (15 years). This have a positive impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;
- The Project could be developed considering the introduction of Subsided Funds;
- In addition, given the small dimension of the project, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solution.

3.3. MUNICIPALITY OF ERRENTERIA

3.3.1. *PROJECT ASSUMPTIONS*

Taking into account the results of the energy study of Errenteria buildings, the information given to the relevant Matrixes and the three clustering approaches descripted above, the three buildings' renovation action have been organized into two groups. The first group of Actions which called Category of Layers 1E involves all actions related to the building skin and intends to reduce the energy losses. The second group of Actions, called Category of Layers 2E, involves all actions which are focus to improving the energy efficiency. The provided photovoltaic systems are included to the second group. The total cost of the projects is:

- Category of Layers 1E € 50,870.00
- Category of Layers 2E € 357,036.00

Technical solutions / Project, building		Building skin				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
Errenteria	City Hall					Condensing gas boiler € 9,760			Relamping € 10,493		Photovoltaic system € 149,430	
	Kapitain Etxea	Wall insulation € 4,180	Roof insulation € 20,817	Floor insulation € 13,227	Glazing replacement € 12,646	AHU Air loop unitary heatcool with heat recovery € 21,540			Relighting € 26,624		Photovoltaic system € 12,602	
	Lekuona										Photovoltaic system € 126,587	

Project 1E
Project 2E

Table 11. Actions included Layers 1E and Layers 2E

The following table represents the savings that each single layer/intervention can bring to the project. In this case each layer is considered to be developed alone without considering the others.

Property	Building name	Interventions/Layers	Savings						% risparmio	Cost of Planned Investments	Payback period
			Electric Energy		Thermal Energy		Total				
			kWh	€	kWh	€	kWh	€	kWh	€	year
Municipality of Errenteria	City Hall	HVAC	0	0	26.320	1.263	**26.320**	**1.263**	**9%**	9.760	**8**
		Lighting systems (internal)	49.080	6.503	-39.330	-1.888	**9.750**	**4.615**	**3%**	10.493	**2**
		Renewable energy	143.650	19.033	0	0	**143.650**	**19.033**	**51%**	149.430	**8**
	"Kapitain Etxea"	HVAC	-14.717	-2.275	54.383	2.991	**39.667**	**716**	**57%**	21.540	**30**
		Casing - Building Skyn	36.541	5.649	0	0	**36.541**	**5.649**	**53%**	38.224	**7**
		Lighting systems (internal)	3.727	576	-2.118	-116	**1.610**	**460**	**2%**	26.624	**58**
		Glass windows	0	0	2.172	1.043	**2.172**	**1.043**	**3%**	12.646	**12**
		Renewable energy	11.214	1.734	0	0	**11.214**	**1.734**	**16%**	12.602	**7**
	"Lekuona"	Renewable energy	35.745	4.493	0	0	**35.745**	**4.493**	**11%**	126.587	**28**

Table 12 Errenteria_Saving generate by each layer

3.3.2. COUNTRY SPECIFIC COST FACTORS

Electric energy price (excl. VAT 21%): 0,132 Euro/kWh

Electric energy price (incl. VAT 21%): 0,160 Euro/kWh

Gas price (excl. VAT 21%): 0,048 Euro/kWh

Gas energy price (incl. VAT 21%): 0,058 Euro/kWh

In the following table the key financial assumptions which are taken into consideration in the financial modelling and their respective outcome are shown.

		General Assumptions		
Municipality	**Project**	**inflation rate**	**VAT rate**	**Senior debt interest rate**
Errenteria	City Hall	2,00%	21%	5,64%
Errenteria	Building "Kapitain Etxea"	2,00%	21%	5,64%
Errenteria	Building "Lekuona"	2,00%	21%	5,64%

3.3.3. SOME ELEMENTS OF RISK ANALYSIS

The Risk Breakdown Structure in chapter 2.3 is an important reminder of how many challenges have to be dealt in order to have a successful project both in technical and financial terms. The three projects in Spain have achieved to reach nZEB status with limited renovation actions compared to the more challenging projects in Alimos and Messina.

This actions also have a strong incentive to be realized due to the highest cost (before taxation) of the electricity compared to other southern European countries. A support to this action is the positive business framework which is ranked #33 in the world listing but with a heavy taxation scheme raised aggregate taxation to 58% only to be surpassed by Italy.

3.3.4. SUSTAINABILITY EVALUATION – CITY HALL

3.3.4.1 RENOVATION SCHEME AND MARKET TEST

Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

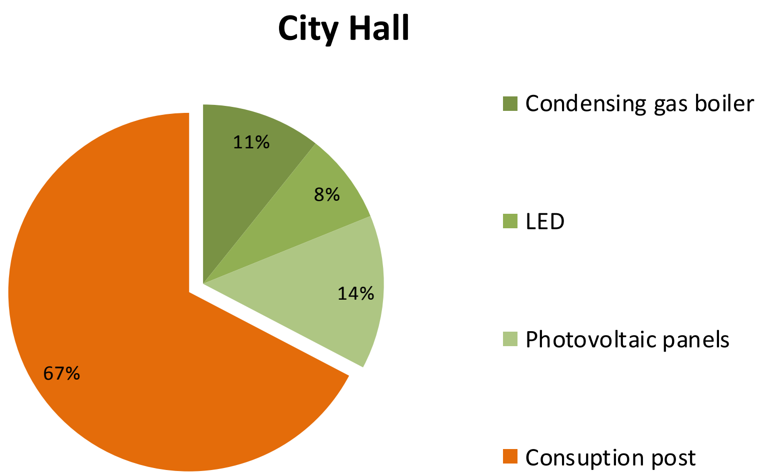
Total investment estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
HVAC	9.760
Lighting system (internal)	10.493
Renewable energy	149.430
Investment for renovation	**169.683**

The identified technological solutions lead to energy savings of 91.337 kWh, equal to 33%. The detail of the energy savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
Condensing gas boiler	29.857	11%
LED	22.723	8%
Photovoltaic panels	38.757	14%
Total	**91.337**	**33%**

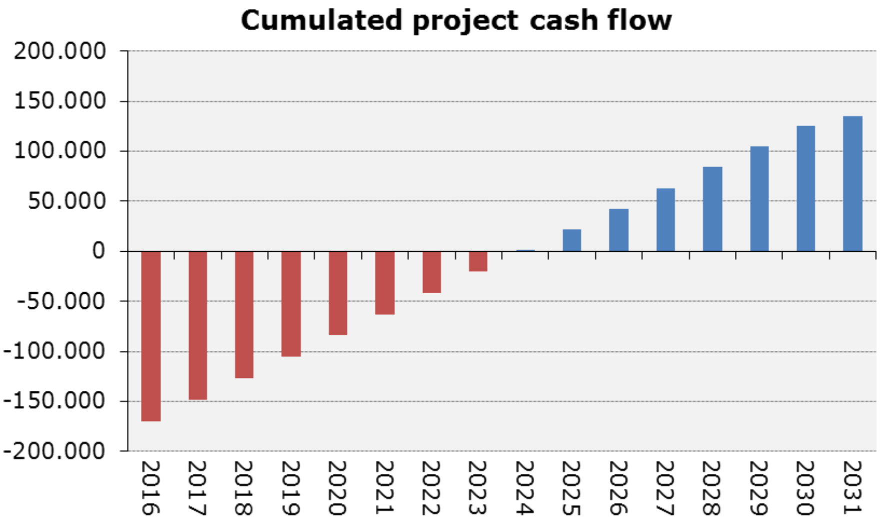
The following graph represents the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, even though energy savings is relevant, total economic savings is 21.478 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% Savings
Electric Energy	19.520	
Thermal Energy	6.310	
Maintenance	13.276	
Total expenditure pre-intervention	**39.106**	
Electric Energy	8.042	-59%
Thermal Energy	6.090	-3%
Maintenance	3.495	-74%
Total expenditure post-intervention	**17.627**	**-55%**
ANNUAL SAVINGS	**21.478**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project achieves pay-back in 9 years.

From an ESCo point of view, some extra investment is considered in order to provide the project with sufficient liquidity to pay interests, banking fees and to finance initial working capital.

INVESTMENTS (ESCo)	€
HVAC	9.760
Lighting system (internal)	10.493
Renewable energy	149.430
Investment for renovation	**169.683**
Starting liquidity	0
Interests and Banking Fees	2.419
Total investment exc. VAT	**172.102**
VAT	35.633
TOTAL INVESTMENT	**207.735**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	51.631	25%	30%
Senior Debt	120.471	58%	70%
Total Financial Sources exc. VAT	**172.102**	**83%**	**100%**
VAT Facility	35.633	17%	
TOTAL FINANCIAL SOURCES	**207.735**	**100%**	

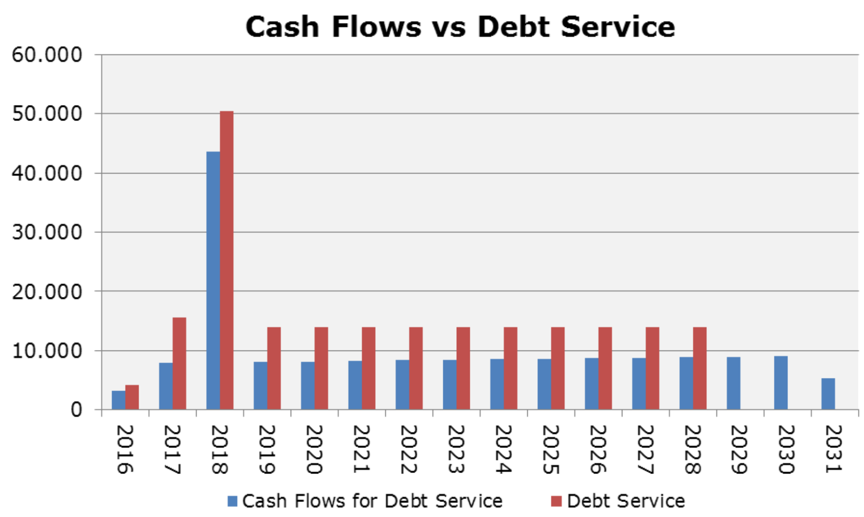
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 14.628 Euro, resulting from 11.128 Euro of energy savings fee and 3.500 Euro maintenance fee, and pays annual costs for 6.809 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 25.830 Euro less post-intervention expenditure of 14.132 Euro) less the 5% shared savings (570 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	11.128
Maintenance fee	3.500
Total Revenues	**14.628**
Maintenance	3.500
Administration costs	2.460
Insurance	848
Total Costs	**6.809**
EBITDA	**7.820**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 7.820 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's clear that an ESCo intervention is not possible at market conditions because the project does not generate enough cash flows to pay the loan and to remunerate the invested capital.

Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions.

3.3.4.2 *Single Renovation Option Convenience Test*

In this case, since only three generic renovation options have been identified to reduce energy consumption, it's not possible to say if there is the possibility to remove some expensive intervention in order to shorten the payback of the project.

3.3.4.3 *Financial Structure Optimization*

In order to make the project desirable for an ESCo, an important financial support should be given to the project and the duration of the EPC contract should be extended. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 19.040 Euro;
- Subsided Funds for 83.000 Euro (duration 15 years);
- Grant for 81.900 Euro (Incl. VAT);
- Duration of the EPC contract: 20 years (5 more than base case)

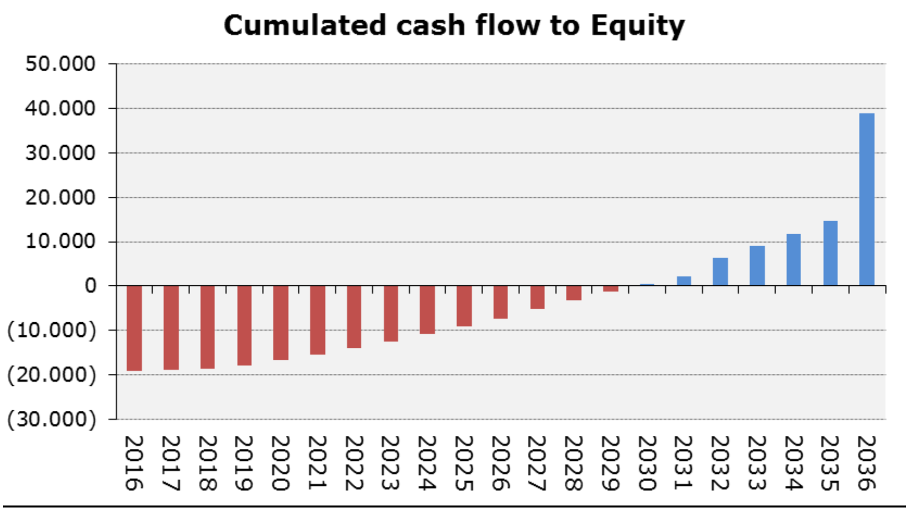
FINANCIAL SOURCES (ESCo)	€	%
Equity	19.040	9%
Senior Debt	0	0%
Grant	81.900	40%
Subsided Funds	83.000	40%
Total Financial Sources exc. VAT	**183.940**	
VAT Facility	21.419	10%
TOTALE FINANCIAL SOURCES	**205.359**	**100%**

As a consequence, the amount of total investment is slightly reduced because the elimination of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
HVAC	9.760
Lighting system (internal)	10.493
Renewable energy	149.430
Investment for renovation	**169.683**
Starting liquidity	0
Interests and Banking Fees	43
Total investment exc. VAT	**169.726**
VAT	35.633
TOTAL INVESTMENT	**205.359**

With this financial structure an ESCo intervention is possible and the remuneration of the invested capital, in terms of IRR, should be considered adequate for this kind of projects.

The following graph shows the cumulated cash flows to equity.

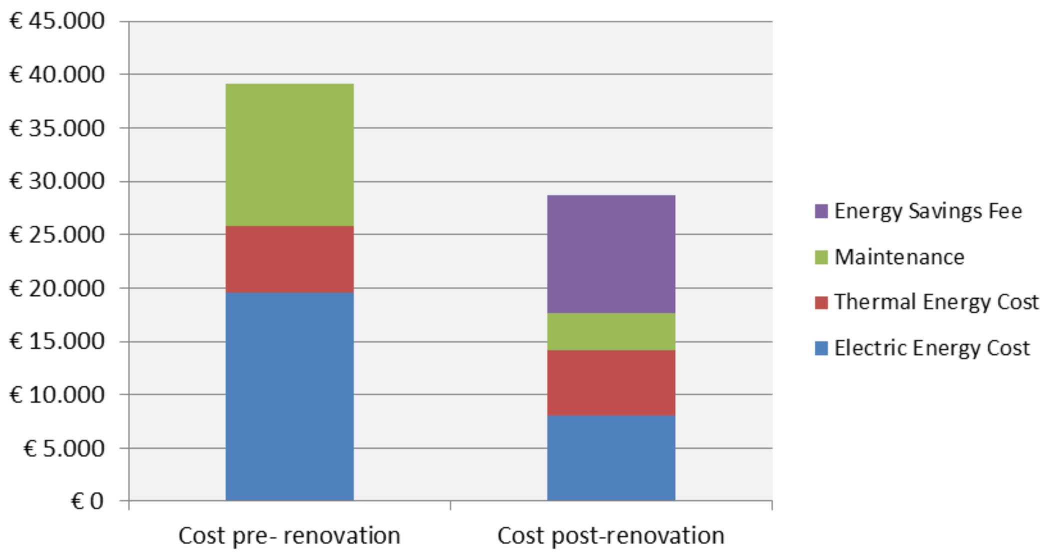


Given this financial structure and under the hypothesis of availability of a public grant and subsided funds for this amount, the investment made by the ESCo should be considered sustainable and profitable. Main indicators for the ESCo investment are:

- Equity Pay-back period: 14,5 years
- ESCo IRR: 8,0%
- Equity NPV: 2.585 Euro

3.3.4.4 *Impact on the Municipality*

The implementation of this EPC contract leads to a reduction of expenditure for the Municipality of around 10.365 Euro/year, resulting from the 5% shared energy savings of 585 Euro less the reduction in maintenance costs of 9.781 Euro. In this case the increase of the maintenance costs overtakes the saving shared with ESCo (5%) and total costs post-interventions are higher than pre-intervention costs even without considering the energy savings fee to be paid to the ESCo. As a consequence, the Municipality would face an important increase of overall expenditures even after the end of the EPC contract.



3.3.4.5 *PROJECT CONCLUSION*

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors			
			a	b	b/a				
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	GaS energy price (incl. VAT21%)	Electric energy price - incl. VAT 21% (€/kWh)
Spain	Errenteria	City Hall	2.961	169.683	57,3	2,00%	21%	0,058	0,160

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
25.866	279.160	94	14.151	187.823	63	11.715	91.337	14

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
13.294	3.500	9.794	21.509	55%	8

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	16%	38%	37%	20	15	>D	<0%	15	8%

(*) Interest rate= 5,64%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, given that it's not possible to say if there is the possibility to remove some expensive intervention with a single renovation option convenience test, a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 2.961 m2.
- The total investment cost is equal to 169.683 Euro, that means an investment cost per square meter of 57,3 Euro/m2.
- The energy consumption before renovation is equal to 279.160 kWh/year and the energy consumption on square meter is equal to 94 kWh/m2;
- The energy consumption savings are equal to 91.337 kWh/year, that means 11.714 Euro/year.
- The maintenance expenditure post renovation is lower than before by 9.794 Euro/year. This affects positively, at economic level, on the total savings achievable by the intervention and also on the payback period;
- The Project Pay Back period is 8 years;
- The amount of public grants is very relevant and it should be found in the availability of funds by the public administration;
- The duration of the EPC contract is higher than the normal market condition (normally 15 years maximum). This duration is due to the fact that the project has a long payback period;
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;
- In addition, given the small dimension of the project, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solution.

3.3.5. *Sustainability evaluation – Kapitain Etxea*

3.3.5.1 Renovation Scheme and Market Test

Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

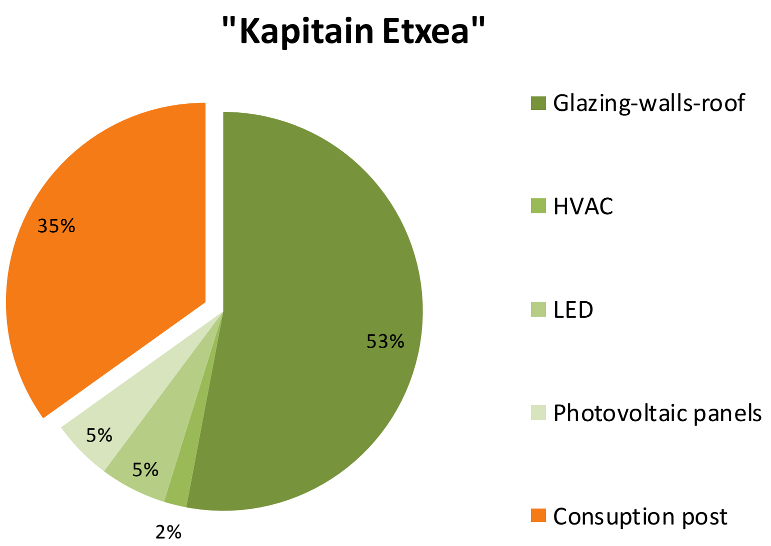
Total investment estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
HVAC	21.540
Lighting system (internal)	26.624
Renewable energy	12.602
Casing Building skin	38.224
Windows - Low e Thermo Break	12.646
Investment for renovation	**111.636**

The identified technological solutions lead to an energetic saving of 41.530 kWh, equal to 65%. The detail of the energetic savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
Glazing-walls-roof	36.541	53%
HVAC	1.262	2%
LED	3.727	5%
Photovoltaic panels	3.389	5%
Total	**41.530**	**65%**

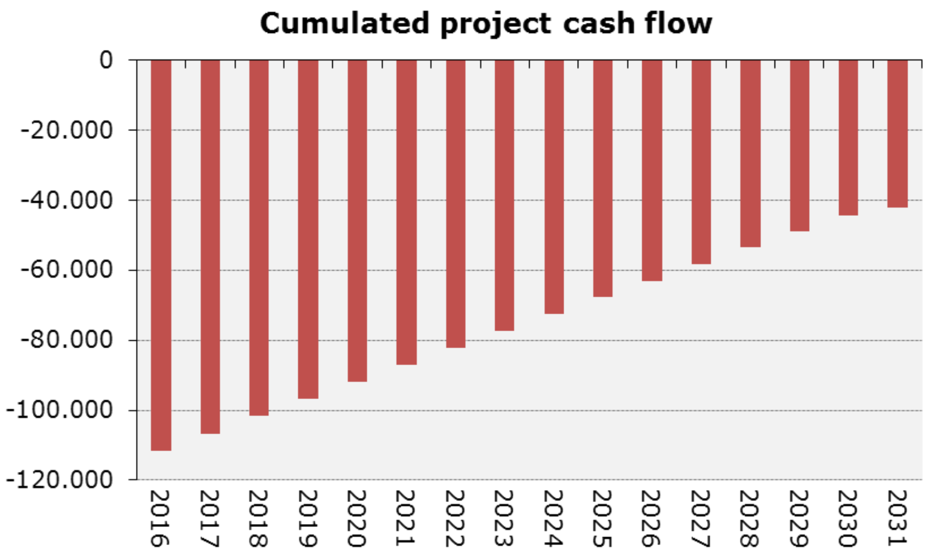
The following graph represents the marginal contribution of each intervention to the energy saving (kWh)



According to the proposed renovation scheme, total economic savings is 4.971 Euro/year, equal to 55%. The difference between energetic (kWh) and economic (Euro) savings is due to the change of energetic source for heating system from gas to electricity. This leads to minor energy consumption in terms of kWh but to higher expenditures in terms of Euro because electricity prices are much higher than gas prices. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	2.254	
Thermal Energy	2.987	
Maintenance	3.795	
Total expenditure pre-intervention	**9.036**	
Electric Energy	3.716	65%
Thermal Energy	0	-100%
Maintenance	350	-91%
Total expenditure post-intervention	**4.065**	**-55%**
ANNUAL SAVINGS	**4.971**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project is not able to pay-back the investment in 15 years by itself because economic savings from the identified renovation options are minimal compared to investment costs.

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
HVAC	21.540
Lighting system (internal)	26.624
Renewable energy	12.602
Casing Building skin	38.224
Windows - Low e Thermo Break	12.646
Investment for renovation	**111.636**
Starting liquidity	0
Interests and Banking Fees	1.591
Total investment exc. VAT	**113.227**
VAT	23.444
TOTAL INVESTMENT	**136.671**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	33.968	25%	30%
Senior Debt	79.259	58%	70%
Total Financial Sources exc. VAT	**113.227**	**83%**	**100%**
VAT Facility	23.444	17%	
TOTAL FINANCIAL SOURCES	**136.671**	**100%**	

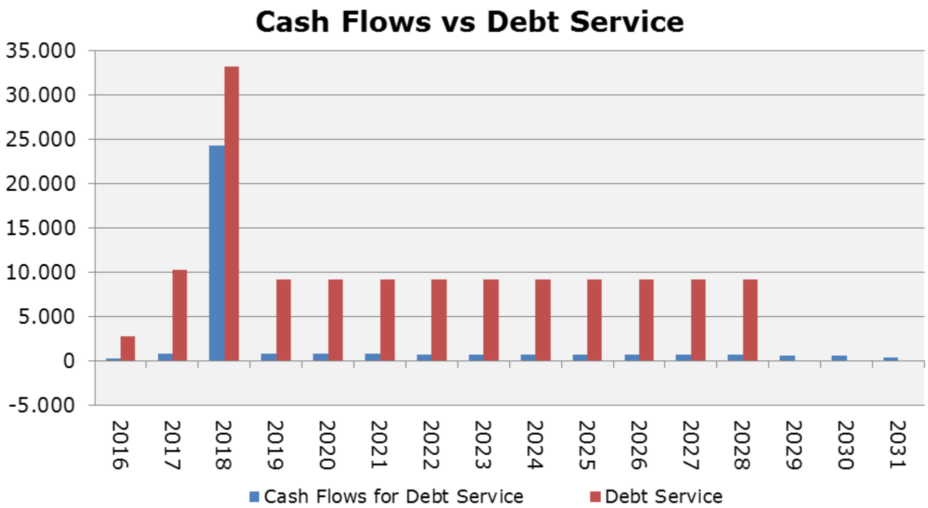
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 1.802 Euro, resulting from 1.452 Euro of energy savings fee and 350 Euro maintenance fee, and pays annual costs for 981 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 5.241 Euro less post-intervention expenditure of 3.716 Euro) less the 5% shared savings (74 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	1.452
Maintenance fee	350
Total Revenues	**1.802**
Maintenance	350
Administration costs	73
Insurance	558
Total Costs	**981**
EBITDA	**821**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 821 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it’s clear that an ESCo intervention is not possible at market conditions because cash needed to pay the debt service is much more than cash generated by the project.

Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions.

3.3.5.2 *Single Renovation Option Convenience Test*

In this case, since only two generic renovation options have been identified to reduce energy consumption, it's not possible to say if there is the possibility to remove some expensive intervention in order to shorten the payback of the project.

3.3.5.3 *Financial Structure Optimization*

As shown in the previous paragraph, this project leads to very little economic savings in relation to the investment required. As a consequence, the implementation of an EPC contract is very difficult because, in order to make the project desirable for an ESCo, almost the whole amount required by the renovation options should be given as public grant. In particular, as an exercise, a possible way of implementation of a theoretical EPC contract should have the following features:

- Equity investment by the ESCo of 13.294 Euro;
- Grant for 119.000 Euro (Incl. VAT);
- Duration of the EPC contract: 25 years (10 years more than base case)
- Percentage of shared savings: 0%

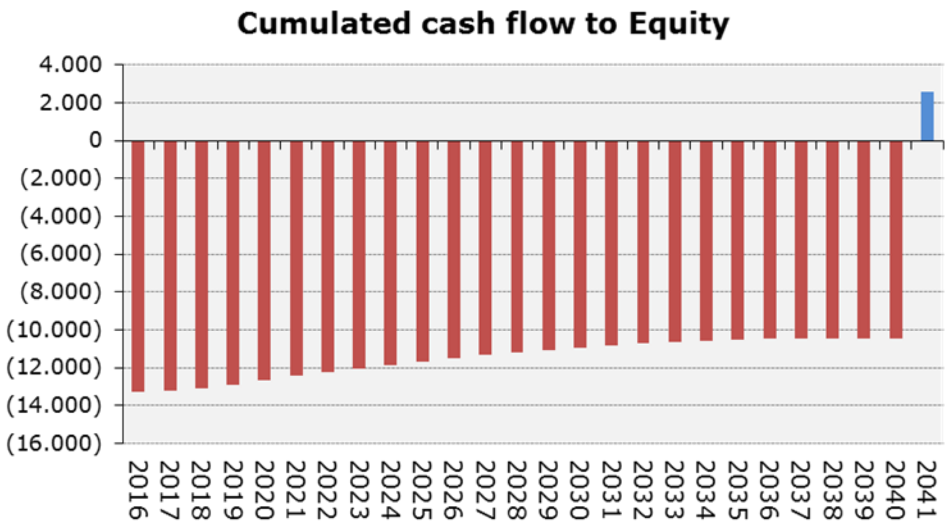
FINANCIAL SOURCES (ESCo)	€	%
Equity	13.294	10%
Senior Debt	0	0%
Grant	119.000	88%
Subsided Funds	0	0%
Total Financial Sources exc. VAT	**132.294**	
VAT Facility	2.791	2%
TOTALE FINANCIAL SOURCES	**135.085**	**100%**

As a consequence, the amount of total investment is slightly reduced because the elimination of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCo)	€
HVAC	21.540
Lighting system (internal)	26.624
Renewable energy	12.602
Casing Building skin	38.224
Windows - Low e Thermo Break	12.646
Investment for renovation	**111.636**
Starting liquidity	0
Interests and Banking Fees	6
Total investment exc. VAT	**111.642**
VAT	23.444
TOTAL INVESTMENT	**135.085**

With this financial structure an ESCo intervention is possible but the remuneration of the invested capital, in terms of IRR, is lower than the average expectation of the market.

The following graph shows the cumulated cash flows to equity.



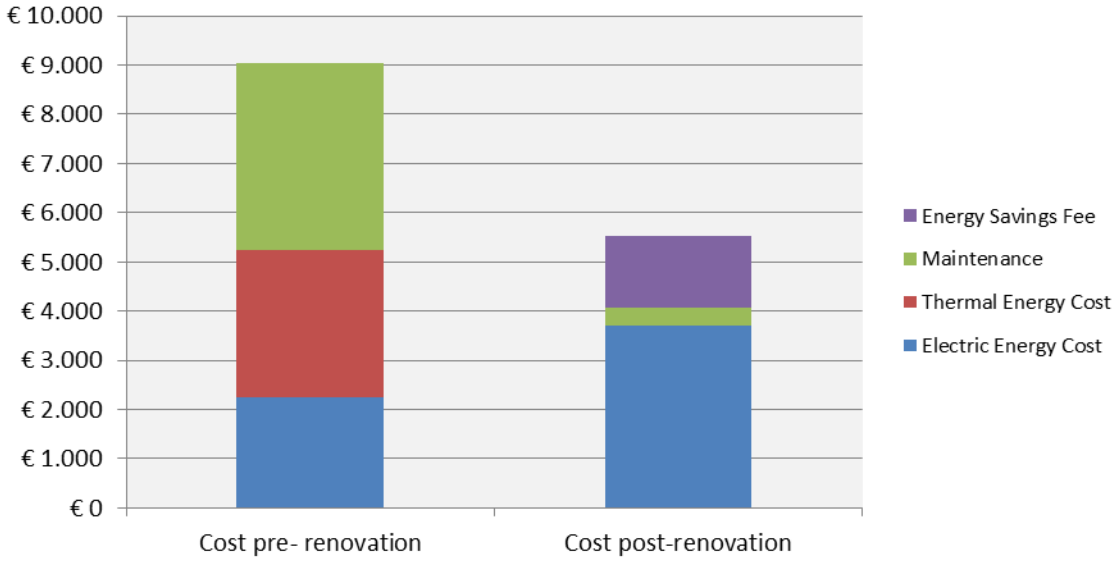
Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered hardly sustainable and not profitable. The project presents a negative NPV and, given these conditions, an ESCo intervention is highly improbable. Main indicators for the ESCo investment are:

- Equity Pay-back period: 25,5 years
- ESCo IRR: 0,82%
- Equity NPV: -9.264 Euro

In practice, the feasibility of an EPC contract for the realization of these interventions should be actually evaluated also in terms of convenience for the Municipality and not only from the point of view of the ESCo.

3.3.5.4 *Impact on the Municipality*

The implementation of this EPC contract leads to a reduction of expenditure for the Municipality of around 3.522 Euro/year (around 39%), resulting from the 5% shared energy savings of 76 Euro less the reduction in maintenance costs of 3.445 Euro. In this case the reduction of maintenance costs are much higher than saving shared with ESCo (5%). At the end of the EPC contract, the Municipality would benefit of a reduction of overall costs.



3.3.5.5 PROJECT CONCLUSION

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors			
			a	b	b/a				
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 21% (€/kWh)	GaS energy price (incl. VAT21%)
Spain	Errenteria	Building "Kapitain Etxea"	395	111.636	282,7	2,00%	21%	0,160	0,058

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
5.249	68.985	175	3.721	24.067	61	1.528	44.919	73

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
3.800	350	3.450	4.978	55%	22

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	15%	0%	76%	25	12	>D	<0%	26	1%

(*) Interest rate= 5,64%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, given that it's not possible to say if there is the possibility to remove some expensive intervention with a single renovation option convenience test, a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 395 m2;
- The total investment cost is equal to 111.636 Euro, that means an investment cost per square meter of 282,7 Euro/m2;
- The energy consumption before renovation is equal to 68.985 kWh/year and the energy consumption on square meter is equal to 175 kWh/m2;
- The energy consumption savings are equal to 44.919 kWh/year, that means 1.528 Euro/year;
- The maintenance expenditure post renovation is lower by 3.450 Euro/year, this affects positively, at economic level, on the total savings achievable by the intervention and also on the payback period. In fact the economic saving both for energy and maintenance is 4.978 Euro/year;
- The Project Pay Back period is very long (more than 22 years) and the project cash flows are very low. This situation have a negative impact on the sustainability of the project and consequentially on the attractiveness for an ESCo. This kind of project could be realized directly by the Municipality;
- The amount of public grants is very relevant (76%). This kind of tender is not a market practice for Public Private Partnership logic. In addition the amount of grant should be found in the availability of funds by the public administration;
- The amount of Subsided Fund is not maximized because the cash flows are not sufficient to increase this value in substitution of part of the grant amount;
- The duration of the EPC contract is higher than the normal market condition (normally 15 years maximum). This duration is due to the fact that the project has a long payback period (32 years);
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;
- In addition, given the small dimension of the project, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.3.6. *Sustainability evaluation – Lekuona*

3.3.6.1 Renovation Scheme and Market Test

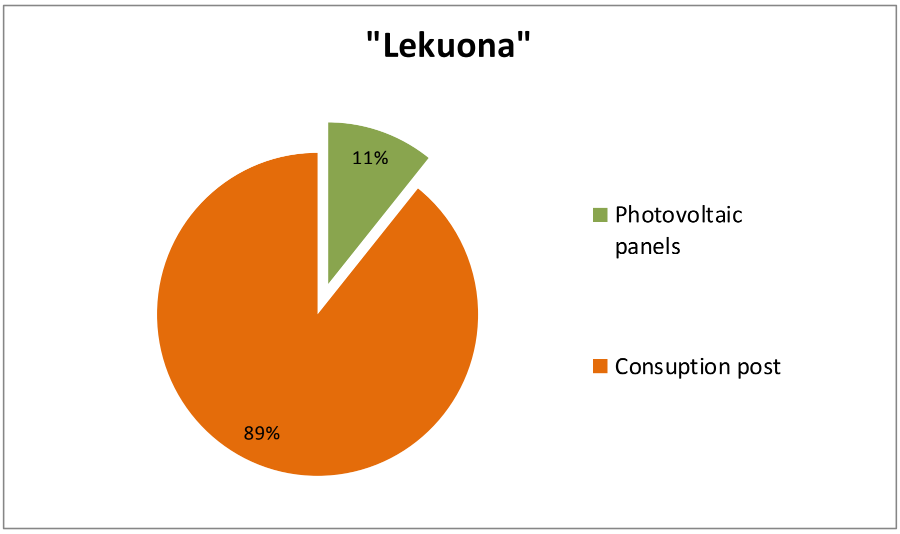
Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

Total investments estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
Renewable energy	126.587
Investment for renovation	**126.587**

The identified technological solution lead to an energy saving of 35.745 kWh, equal to 11%.

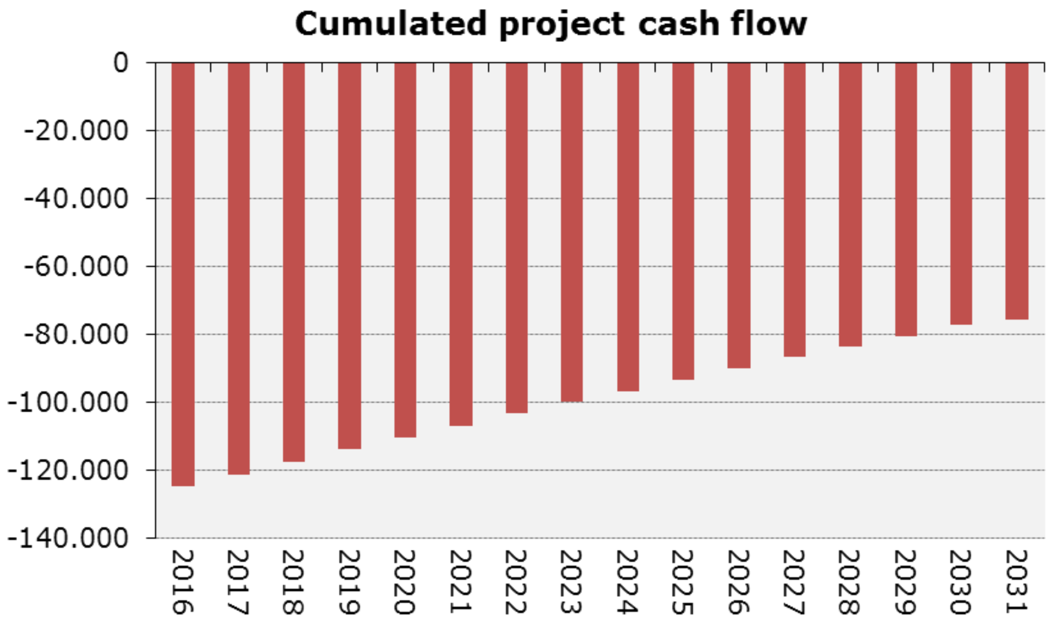
The following graph represents the marginal contribution of the intervention to Energy saving (kWh)



According to the proposed renovation scheme, expenditure post-intervention is higher than the baseline for 10.382 Euro/year, equal to 17%. The difference between energetic savings and economic saving is because the maintenance cost post renovation is much higher than the baseline. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year
Electric Energy	42.739
Thermal Energy	0
Maintenance	19.972
Total expenditure pre-intervention	**62.711**
Electric Energy	38.141
Thermal Energy	0
Maintenance	20.871
Total expenditure post-intervention	**59.012**
ANNUAL SAVINGS	**3.699**

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the pay-back of the project is longer than 15 years.

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
Renewable energy	126.587
Investment for renovation	**126.587**
Starting liquidity	100
Interests and Banking Fees	1.806
Total investment exc. VAT	**128.493**
VAT	26.583
TOTAL INVESTMENT	**155.076**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	38.548	25%	30%
Senior Debt	89.945	58%	70%
Total Financial Sources exc. VAT	**128.493**	**83%**	**100%**
VAT Facility	26.583	17%	
TOTAL FINANCIAL SOURCES	**155.076**	**100%**	

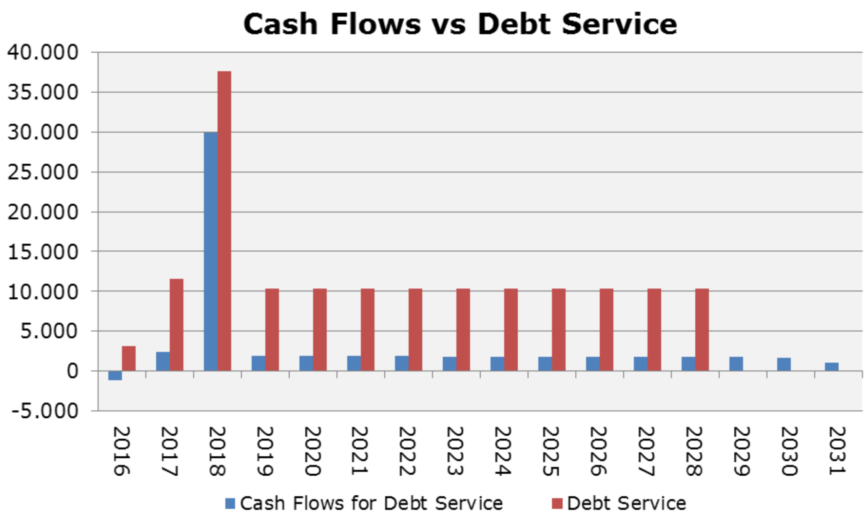
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 25.274 Euro, resulting from 4.374 Euro of energy savings fee and 20.900 Euro maintenance fee, and pays annual costs for 23.368 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 42.739 Euro less post-intervention expenditure of 38.141 Euro) less the 5% shared savings (224 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	4.374
Maintenance fee	20.900
Total Revenues	**25.274**
Maintenance	20.900
Administration costs	1.836
Insurance	633
Total Costs	**23.368**
EBITDA	**1.905**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 1.905 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's clear that an ESCo intervention is not possible at market conditions because cash needed to serve the debt service is much more than cash generated by the project.

Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions.

3.3.6.2 Single Renovation Option Convenience Test

In this case, since only one intervention options has been identified, It is not possible remove some expensive intervention in order to shorten the payback of the project.

3.3.6.3 Financial Structure Optimization

In order to make the project desirable for an ESCo, an important financial support should be given to the project and the duration of the EPC contract should be extended. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo of 13.729 Euro;
- Grant for 90.000 Euro (Incl. VAT);
- Subsided funds for 38.500 Euro (duration 15 years);
- Duration of the EPC contract: 25 years

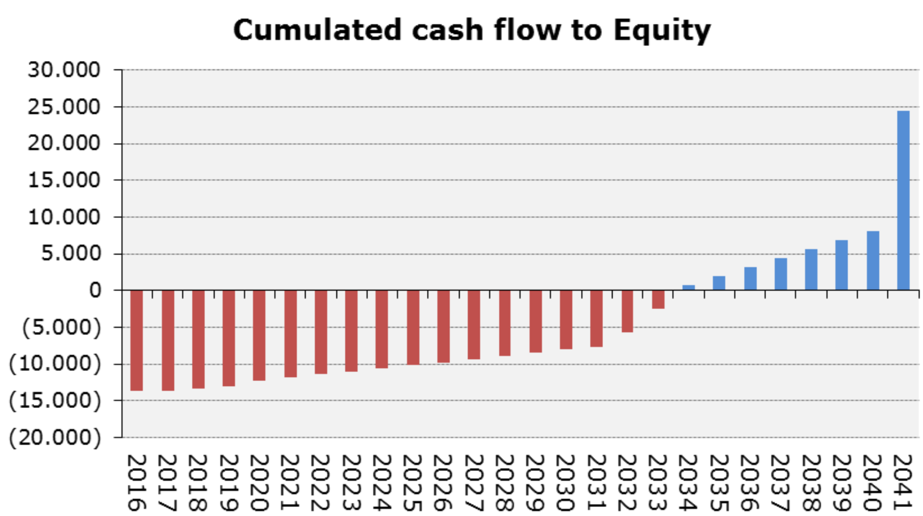
FINANCIAL SOURCES (ESCo)	€	%
Equity	13.729	9%
Senior Debt	0	0%
Grant	90.000	59%
Subsided Funds	38.500	25%
Total Financial Sources exc. VAT	**142.229**	
VAT Facility	10.963	7%
TOTALE FINANCIAL SOURCES	**153.192**	**100%**

As a consequence, the amount of total investment is slightly reduced because the elimination of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
Renewable energy	126.587
Investment for renovation	**126.587**
Starting liquidity	0
Interests and Banking Fees	22
Total investment exc. VAT	**126.609**
VAT	26.583
TOTAL INVESTMENT	**153.192**

With this financial structure an ESCo intervention is possible but the remuneration of the invested capital, in terms of IRR, is lower than the average expectation of the market.

The following graph shows the cumulated cash flows to equity.



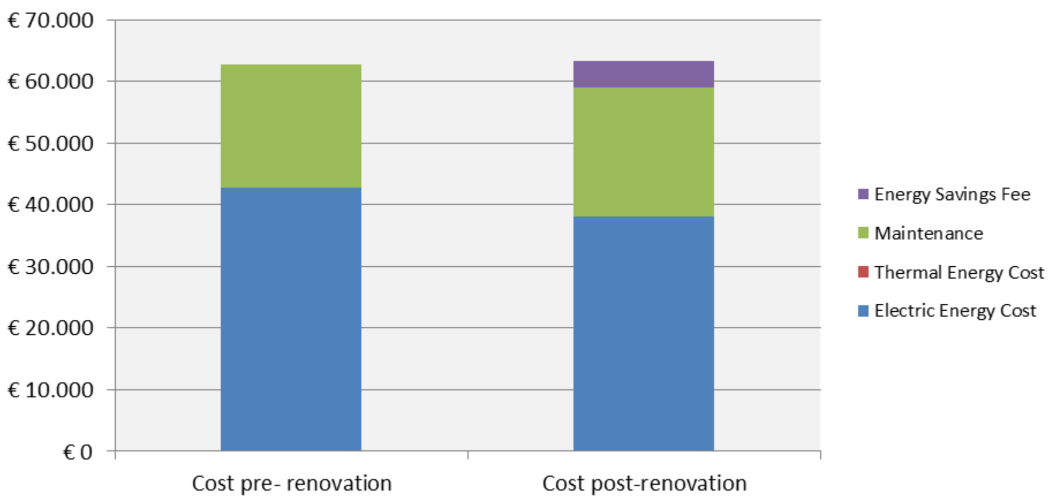
Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered lower than the average expectation of the market. The project presents a negative NPV. Main indicators for the ESCo investment are:

- Equity Pay-back period: 19 years
- ESCo IRR: 5.6%
- Equity NPV: -2.800 Euro

The hypothesis of a larger amount of Grant could ensure the ESCo the achievement of the target Equity IRR of around 8%. However, a larger amount of Grant should not be considered consistent with market practice.

3.3.6.4 IMPACT ON THE MUNICIPALITY

The implementation of this EPC contract leads to an increase of expenditure for the Municipality of around 669 Euro/year (around 1%), resulting from the 5% shared energy savings of 230 Euro less the increase in maintenance costs of about 900 Euro, mainly due to the photovoltaic system. In this case the increase of the maintenance costs overtakes the saving shared with ESCo (5%) and total costs post-interventions are higher than pre-intervention costs. As a consequence, the Municipality would face an increase of overall expenditures even after the end of the EPC contract.



3.3.6.5 PROJECT CONCLUSION

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors			
			a	b	b/a				
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 21% (€/kWh)	GaS energy price (incl. VAT21%)
Spain	Errenteria	Building "Lekuona"	4.406	126.587	28,7	2,00%	21%	0,160	0,058

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
42.798	332.279	75	38.194	296.534	67	4.604	35.745	27

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
20.000	20.900	-900	3.704	6%	34

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	7%	25%	59%	25	15	>D	<0%	19	6%

(*) Interest rate= 5,64%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, , given that it's not possible to implement a single renovation option convenience test, a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 4.406 m2;
- The total investment cost is equal to 126.587 Euro, that means an investment cost per square meter of 28,7 Euro/m2;
- The energy consumption before renovation is equal to 332.279 kWh/year and the energy consumption on square meter is equal to 75 kWh/m2
- The energy savings are equal to 35.745 kWh/year, that means an energy expenditure saving of 4.604 Euro/year;
- The maintenance expenditure post renovation is higher than before by 900 Euro/year, this affects negatively, at economic level, on the total savings achievable by the intervention and also on the payback period;
- The Project Pay Back period is too long, in fact considering the Maintenance cost post renovation the project shows low saving and cash flows are very low and not sufficient. This have a negative impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;

- The amount of public grants is very relevant (59%). This kind of tender is not a market practice for Public Private Partnership logic. In addition the amount of grant should be found in the availability of funds by the public administration;
- The amount of Subsided Fund is not maximized because the cash flows are not sufficient to increase this value in substitution of part of the grant amount;
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;
- In addition, given the small dimension of the project, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.4. MUNICIPALITY OF MESSINA

3.4.1. *PROJECT ASSUMPTIONS*

The first group of Actions which called Category of Layers 1M involves all actions related to the building skin and intends to reduce the energy losses. The second group of Actions, called Category of Layers 2M, involves all actions which are focus to improving the energy efficiency. The provided photovoltaic systems are included to the second group. The total cost of the projects is:

- Category of Layers 1M € 3,772,597.00
- Category of Layers 2M € 2,991,400.00

Even the size of the projects is different and the local climate conditions slightly different, the Messina projects have many similarities with those of municipality of Errenteria and Alimos.

Project, building \ Technical solutions		Building skin				HVAC			Lighting	Control	RES	Passive Elements
		Opaque elements, structural improvements			Transparent elements							
Messina	Palazzo Zanca				Fenestration replacement € 1,519,150	VRV system (offices, new circulation area) € 1,200,000			Relighting € 321,000	BEMS € 25,000	Photovoltaic system € 122,000	
	Palacultura "Palantonello"	External wall insulation € 1,014,929	New FV cover shelter € 360,000	Structural improvements € 316,308		VRV system (offices) € 500,000			Relighting € 101,200	BEMS € 20,000	Photovoltaic system € 310,000	
	Palazzo Satellite	Internal insulation € 354,210	Fenestration replacement € 208,000						Relighting € 336,200		Photovoltaic system € 56,000	

Project 1M
Project 2M

Table 13. Actions included in Category of Layers 1M and Category of Layers 2M

The following table represents the savings that each single layer/intervention can bring to the project. In this case each layer is considered to be developed alone without considering the others.

Property	Building name	Interventions/Layers	Savings						% risparmio	Cost of Planned Investments	Payback period
			Electric Energy		Thermal Energy		Total				
			kWh	€	kWh	€	kWh	€	kWh	€	year
Municipality of Messina	Palazzo Zanca	Compression heat pumps - VRV system - OFFICES AREAS	9.734	1.752	0	0	**9.734**	**1.752**	**0%**	393.361	**225**
		Compression heat pumps - VRV system - NEW CIRCULATION AREAS	n.a	n.a	n.a	n.a	**0**	**0**	**n.a.**	553.846	**n.a.**
		Compression heat pumps - VRV system - OFFICES AREAS	192.737	34.693	0	0	**192.737**	**34.693**	**7%**	252.793	**7**
		Horizontal structures on roofs - False Ceiling OFFICE AREAS	93.448	16.821	0	0	**93.448**	**16.821**	**3%**	244.352	**15**
		Horizontal structures on roofs - False Ceiling CIRCULATION AREAS	n.a	n.a	n.a	n.a	**0**	**0**	**n.a.**	75.633	**n.a.**
		Double glass	93.448	16.821	0	0	**93.448**	**16.821**	**3%**	1.519.150	**90**
		LED	986.397	177.552	0	0	**986.397**	**177.552**	**34%**	321.000	**2**
		Photovoltaic panels	n.a	n.a	n.a	n.a	**0**	**0**	**n.a.**	122.000	**n.a.**
		BACS	n.a	n.a	n.a	n.a	**0**	**0**	**n.a.**	25.000	**n.a.**
	Palazzo Satellite	Compression heat pumps - VRV system - OFFICES AREAS	106.844	19.232	0	0	**106.844**	**19.232**	**5,7%**	500.000	**26**
		New facades - External wall, windows, green wall	142.459	25.643	0	0	**142.459**	**25.643**	**7,6%**	1.014.929	**40**
		Horizontal structures on roofs - NEW FV COVER SHELTER	53.422	9.616	0	0	**53.422**	**9.616**	**2,9%**	316.308	**33**
		Horizontal structures on floors - WATERPROOFING FOUNDATIONS and FOUNDATIONS STRUCTURAL RENOVATION	17.807	3.205	0	0	**17.807**	**3.205**	**1,0%**	360.000	**112**
		LED	741.066	133.392	0	0	**741.066**	**133.392**	**39,6%**	101.200	**1**
		Photovoltaic panels	147.223	26.500	0	0	**147.223**	**26.500**	**7,9%**	310.000	**12**
		BACS	35.615	6.411	0	0	**35.615**	**6.411**	**1,9%**	20.000	**3**
	Palacultura	New facades - -INTERNAL INSULATION OF WALLS and COVER BLOCK ESCALATORS - GREEN ROOF	54.841	9.871	0	0	**54.841**	**9.871**	**6%**	354.210	**36**
		Double glass NEW WINDOWS + curtain film	54.841	9.871	0	0	**54.841**	**9.871**	**6%**	208.000	**21**
		LED	59.058	10.630	0	0	**59.058**	**10.630**	**7%**	336.200	**32**
		Photovoltaic panels	36.235	6.522	0	0	**36.235**	**6.522**	**4%**	56.000	**9**

Table 14 Messina_ Saving generate by each layer

3.4.2. COUNTRY SPECIFIC COST FACTORS

Electric energy price (excl. VAT 22%): 0,180 Euro/kWh

Electric energy price (incl. VAT 22%): 0,220 Euro/kWh

The following table which can be found in greater detail in shows the key financial assumptions which are taken into consideration in the financial modelling and their respective outcome (i.e. project IRR and payback period).

		General Assumptions		
Municipality	**Project**	**Inflation rate**	**VAT rate**	**Senior debt interest rate**
Messina	City Hall "Palazzo Zanca"	2,00%	22%	5,93%
Messina	Building "Palazzo Satellite"	2,00%	22%	5,93%
Messina	Building "Palacultura"	2,00%	22%	5,93%

3.4.3. SOME ELEMENTS OF RISK ANALYSIS

The challenges to reach nZEB energy consumption in Messina's municipal buildings is challenging from a technical perspective due to their "heritage" status and limitations that accompany the renovation proposals. The great size of the City Hall and the Palacultura building allows for large scale technical solutions to be implemented that support the project of bringing centuries old buildings to today's energy consumption levels but with significant budget required to do so.

A necessary parameter that adds additional restrains to this accomplishment is the Government / Ministry of Culture interventions and requirements that care to preserve the character of the Messina municipal buildings.

The Italian market provides an indifferent business environment ranked #56 in the world to the involvement of ESCO companies compared to the EU average but also the 3rd highest after tax cost of electricity (EU-28) that provides a strong market opportunity for ESCO companies to be involved.

3.4.4. SUSTAINABILITY EVALUATION – CITY HALL – PALAZZO ZANCA

3.4.4.1 RENOVATION SCHEME AND MARKET TEST

Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

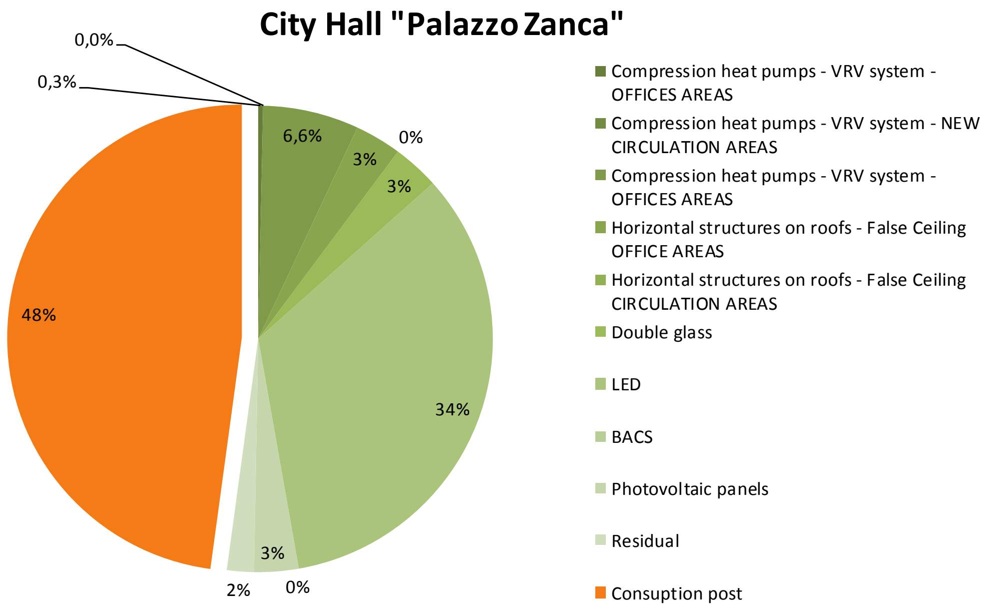
Total investments estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
HVAC	1.200.000
Lighting system (internal+external)	321.000
Renewable energy	122.000
Casing Building skin	319.985
Windows - Low e Thermo Break	1.519.150
Control system	25.000
Investment for renovation	**3.507.135**

The identified technological solutions lead to an energetic saving of 1.518.815 kWh, equal to 52%. The detail of the energetic savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
Compression heat pumps - VRV system - OFFICES AREAS	9.734	0,3%
Compression heat pumps - VRV system - NEW CIRCULATION AREAS	0	0,0%
Compression heat pumps - VRV system - OFFICES AREAS	192.737	7,0%
Horizontal structures on roofs - False Ceiling OFFICE AREAS	93.448	3%
Horizontal structures on roofs - False Ceiling CIRCULATION AREAS	0	0,0%
Double glass	93.448	3%
LED	986.397	34%
BACS	0	0%
Photovoltaic panels	88.944	3%
Interior Equipment	54.106	2%
Total	**1.518.815**	**52%**

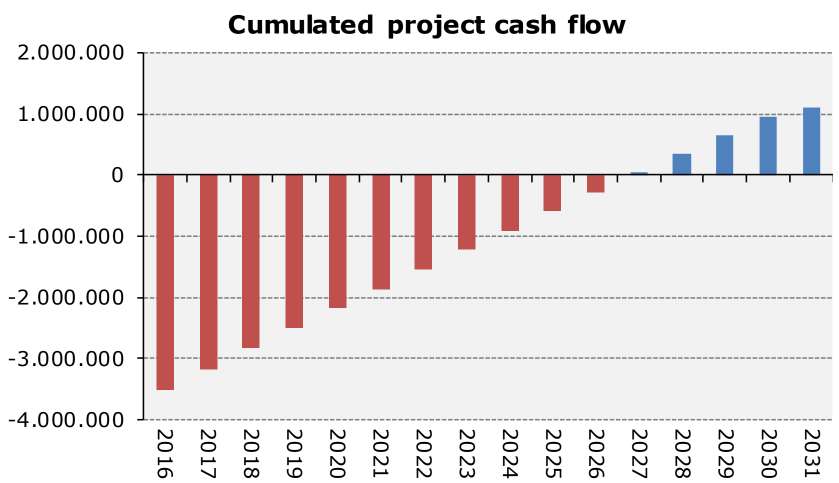
The following graph represents the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, total economic savings amount 332.311 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	523.606	
Thermal Energy	0	
Maintenance	134.814	
Total expenditure pre-intervention	**658.420**	
Electric Energy	250.596	-52%
Thermal Energy	0	0%
Maintenance	75.514	-44%
Total expenditure post-intervention	**326.109**	**-50%**
ANNUAL SAVINGS	**332.311**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project is able to pay-back the investment in 11,5 years.

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
HVAC	1.200.000
Lighting system (internal+external)	321.000
Renewable energy	122.000
Casing Building skin	319.985
Windows - Low e Thermo Break	1.519.150
Control system	25.000
Investment for renovation	**3.507.135**
Starting liquidity	0
Interests and Banking Fees	50.063
Total investment exc. VAT	**3.557.198**
VAT	771.570
TOTAL INVESTMENT	**4.328.767**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	1.067.159	25%	30%
Senior Debt	2.490.038	58%	70%
Total Financial Sources exc. VAT	**3.557.198**	**82%**	**100%**
VAT Facility	771.570	18%	
TOTAL FINANCIAL SOURCES	**4.328.767**	**100%**	

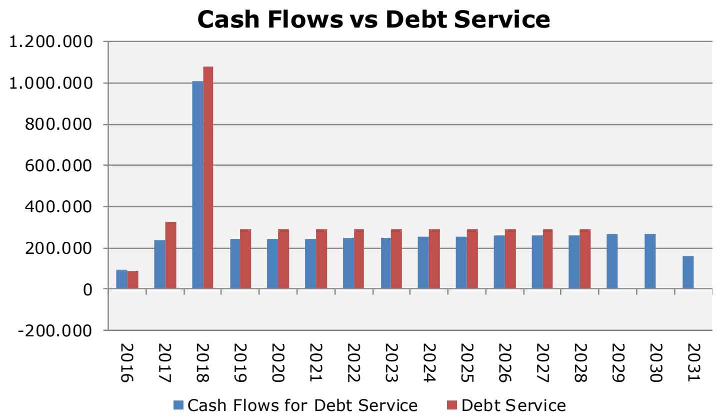
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 335.335 Euro, resulting from 259.717 Euro of energy savings fee and 75.618 Euro maintenance fee, and pays annual costs for 102.153 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 523.606 Euro less post-intervention expenditure of 250.596 Euro) less the 5% shared savings (13.293 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	259.717
Maintenance fee	75.618
Total Revenues	**335.335**
Maintenance	75.618
Administration costs	9.000
Insurance	17.536
Total Costs	**102.153**
EBITDA	**233.182**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 233.182 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

In this case the EBITDA of the project is not enough to achieve the pay-back of the investment in 15 years. In addition, as shown in the following graph, the cash flows generated by the project do not allow the ESCo to pay back the bank loan. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's clear that an ESCo intervention is not possible at market conditions.

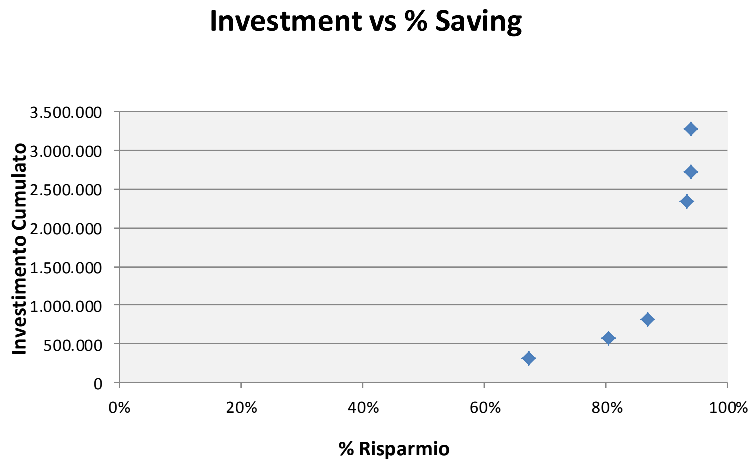
Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions. To do so, a convenience test was implemented to check which a single renovation option is sustainable at market conditions and which is not. For those renovation options that are considered non sustainable at market conditions, alternative financial solutions should be identified.

3.4.4.2 *SINGLE RENOVATION OPTION CONVENIENCE TEST*

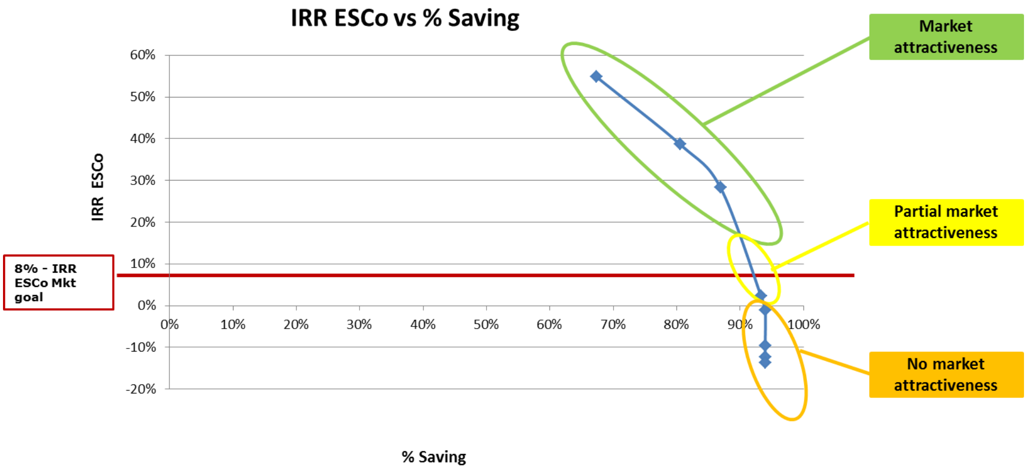
On the basis of the marginal contribution of each intervention to energy savings described in Delivery 2.1, Some further elaboration was made in order to represent the relationship between cumulated investment and cumulated savings.

In practice, each intervention was first sorted by economic convenience, expressed in terms of lower investment/savings ratio. Then, a XY scatter chart was plotted to express the relationship between the cost of each renovation option and its contribution to energy savings.

As a result, marginal contribution of each investment to energy savings is decreasing. In particular, the Euro amount invested to obtain a 1% savings starting from baseline is much lower than the Euro amount invested to obtain the same 1% savings with the last renovation option, starting, for example, from 70% savings.



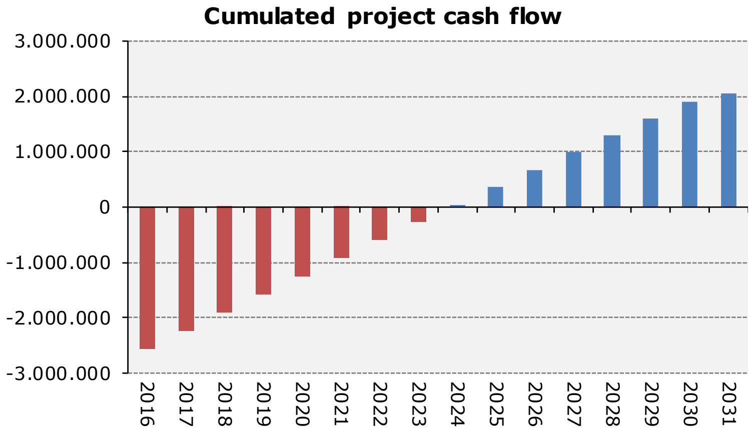
As a consequence of this evidence, another XY scatter chart was plotted to represent the relationship between project IRR and energy savings. From the graph we can observe that very high energy savings (>90%) lead to a significant reduction of the expected IRR of the intervention. In this case, in order to ensure the feasibility of an ESCo intervention, a specific facility or grant should be provided by the Municipality.



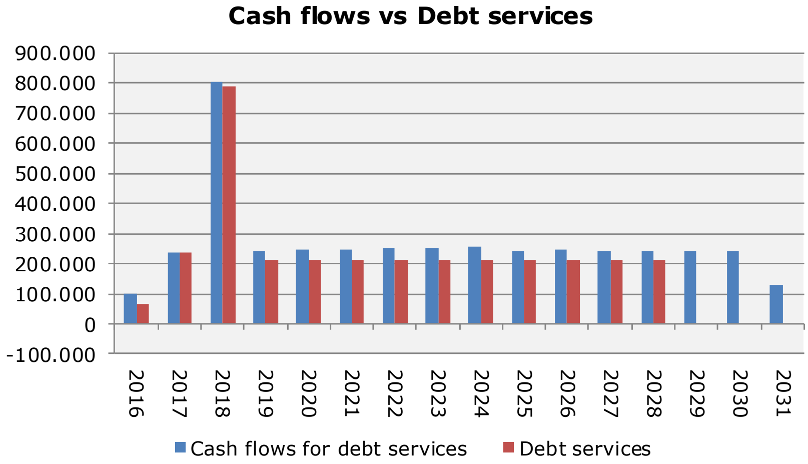
The following table shows the list of the interventions proposed for the building sorted by investment/savings ratio:

Intervention	Investment (€)	Savings (€)	Investment/ Savings ratio	Cumulated saving
LED	321.000	177.552	2	67%
Compression heat pumps - VRV system - OFFICES AREAS	252.793	34.693	7	81%
Horizontal structures on roofs - False Ceiling OFFICE AREAS	244.352	16.821	15	87%
Double glass	1.519.150	16.821	90	93%
Compression heat pumps - VRV system - OFFICES AREAS	393.361	1.752	225	94%
Compression heat pumps - VRV system - NEW CIRCULATION AREAS	553.846	0	n.a.	94%
Horizontal structures on roofs - False Ceiling CIRCULATION AREAS	75.633	0	n.a.	94%
BACS	25.000	0	n.a.	94%

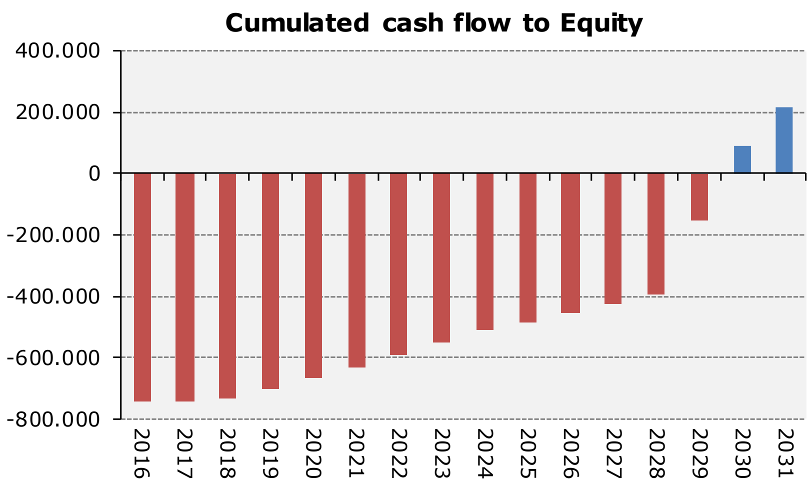
In order to improve the sustainability of the project, the impact of the removal of the VRV system, False ceiling (circulation areas) and BACS, thus the reduction of the investment costs by 30% while keeping savings at 93%, was analyzed. In this case, the project achieves payback after years, as shown in the following graph:



From the ESCo point of view, the project is sustainable at market conditions and under the assumption of implementation of the standard EPC contract. As shown in the following graph, the project generates enough cash flow to allow the ESCo to pay back the bank loan.



While the project should be considered sustainable, the profitability for the ESCo is below the minimum expected level of return with an IRR of 1,64%. Cumulated cash flows to equity are shown in the following table:



3.4.4.3 *Financial Structure Optimization*

In order to make the project desirable for an ESCo, an important financial support should be given to the project. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 513.459 Euro;
- Senior debt for 770.189 Euro;
- Subsided Funds for 1.420.000 Euro (duration 12 years);
- Grant for 1.000.000 (Incl. VAT);
- Duration of the contract: 20 years (5 more than base case)

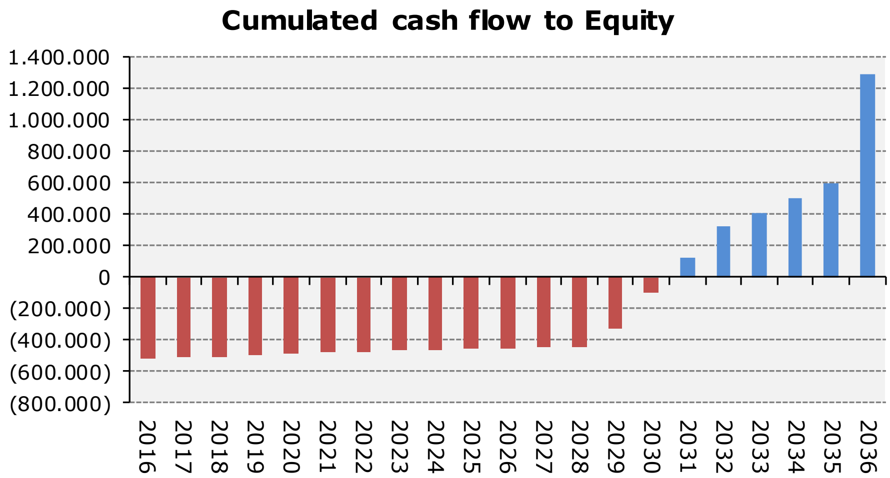
FINANCIAL SOURCES (ESCo)	€	%
Equity	513.459	12%
Senior Debt	770.189	18%
Grant	1.000.000	23%
Subsided Funds	1.420.000	33%
Total Financial Sources exc. VAT	**3.703.649**	
VAT Facility	591.242	14%
TOTALE FINANCIAL SOURCES	**4.294.890**	**100%**

As a consequence, the amount of total investment is slightly reduced because the decrease of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
HVAC	1.200.000
Lighting system (internal+ esternal)	321.000
Renewable energy	122.000
Casing Building skin	319.985
Windows - Low e Thermo Break	1.519.150
Control system	25.000
Investment for renovation	**3.507.135**
Starting liquidity	0
Interests and Banking Fees	16.186
Total investment exc. VAT	**3.523.321**
VAT	771.570
TOTAL INVESTMENT	**4.294.890**

With this financial structure an ESCo intervention is possible and the remuneration of the invested capital, in terms of IRR, should be considered adequate for this kind of projects.

The following graph shows the cumulated cash flows to equity.

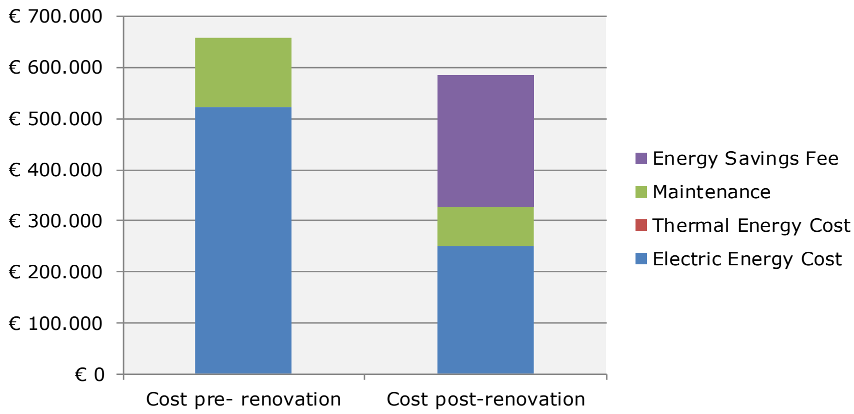


Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered sustainable and profitable. Main indicators for the ESCo investment are:

- Equity Pay-back period: 15,5 years
- ESCo IRR: 8,0%
- Equity NPV: 79.887 Euro

3.4.4.4 IMPACT ON THE MUNICIPALITY

The implementation of this EPC contract leads to a reduction of expenditure for the Municipality of around 72.951 Euro/year, resulting from the 5% shared energy savings of 13.651 Euro and the reduction of maintenance costs of 59.301 Euro. At the end of the contract, the Municipality will benefit from the whole energy savings generated by the renovation.



3.4.4.5 PROJECT CONCLUSION

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 22% (€/kWh)
Italy	Messina	City Hall "Palazzo Zanca"	13.500	3.507.135	259,8	2,00%	22%	0,220

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
524.328	2.912.933	216	250.941	1.394.118	103	273.387	1.518.815	13

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
135.000	75.618	59.382	332.769	50%	11

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
12%	18%	14%	33%	23%	20	12	15	4%	16	8%

(*) Interest rate= 5,93%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a single renovation option convenience test and a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 13.500 m2.
- The total investment cost is equal to 3.507.135 Euro, that means an investment cost per square meter of 259,8 Euro/m2.
- The energy consumption before renovation is equal to 2.912.933 kWh/year and the energy consumption on square meter is equal to 216 kWh/m2;
- The energy consumption savings are equal to 1.518.815 kWh/year, that means an energy expenditure saving of 273.387 Euro/year;
- The maintenance expenditure post renovation is lower than before of 59.382 Euro/year. This situation affects positively, at economic level, on the total savings achievable by the intervention, in fact the economic saving both energy and maintenance is about 332.769 Euro/year;
- The Project Pay Back period is 11 years considering the maintenance savings but the cash flows are not sufficient to implement a financial structure at market condition;
- The duration of the EPC contract is higher than the normal market condition (normally 15 years maximum).This duration is due to the fact that the project has a long payback period;

- The financial structure implemented is a mix of source of finance even though the amount of Subsided Funds is not maximized because the cash flows are not sufficient to increase this value in substitution of part of the grant amount;

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.4.5. *Sustainability Evaluation – Palazzo Satellite*

3.4.5.1 Renovation Scheme and Market Test

Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

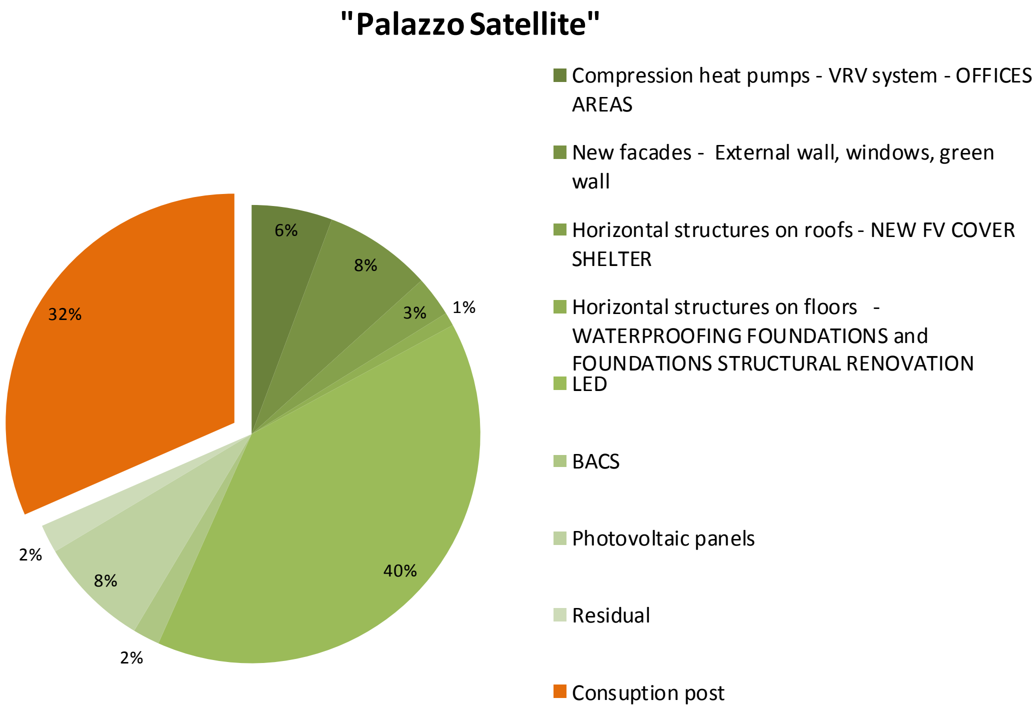
Total investments estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
HVAC	500.000
Lighting system (internal)	101.200
Renewable energy	310.000
Casing Building skin	1.691.237
Control system	20.000
Investment for renovation	**2.622.437**

The identified technological solutions lead to an energetic saving of 1.281.906 kWh, equal to 68%. The detail of the energetic savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
Compression heat pumps - VRV system - OFFICES AREAS	106.844	6%
New facades - External wall, windows, green wall	142.459	8%
Horizontal structures on roofs - NEW FV COVER SHELTER	53.422	8,6%
Horizontal structures on floors - WATERPROOFING FOUNDATIONS and FOUNDATIONS STRUCTURAL RENOVATION	17.807	-5%
LED	741.066	39,6%
BACS	35.615	2%
Photovoltaic panels	147.223	8%
Interior Equipment	37.469	2%
Total	**1.281.906**	**68%**

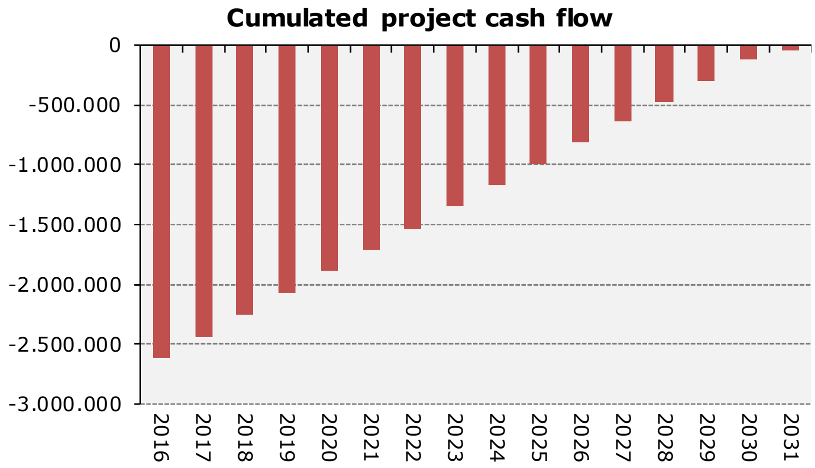
The following graph represents the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, total economic savings amount 184.899 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	337.153	
Thermal Energy	0	
Maintenance	42.441	
Total expenditure pre-intervention	**379.595**	
Electric Energy	106.240	-68%
Thermal Energy	0	0%
Maintenance	88.455	108%
Total expenditure post-intervention	**194.696**	**-49%**
ANNUAL SAVINGS	**184.899**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project is not able to pay-back the investment in 15 years.

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
HVAC	500.000
Lighting system (internal)	101.200
Renewable energy	310.000
Casing Building skin	1.691.237
Control system	20.000
Investment for renovation	**2.622.437**
Starting liquidity	100
Interests and Banking Fees	37.436
Total investment exc. VAT	**2.659.973**
VAT	576.936
TOTAL INVESTMENT	**3.236.909**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	797.992	25%	30%
Senior Debt	1.861.981	58%	70%
Total Financial Sources exc. VAT	**2.659.973**	**82%**	**100%**
VAT Facility	576.936	18%	
TOTAL FINANCIAL SOURCES	**3.236.909**	**100%**	

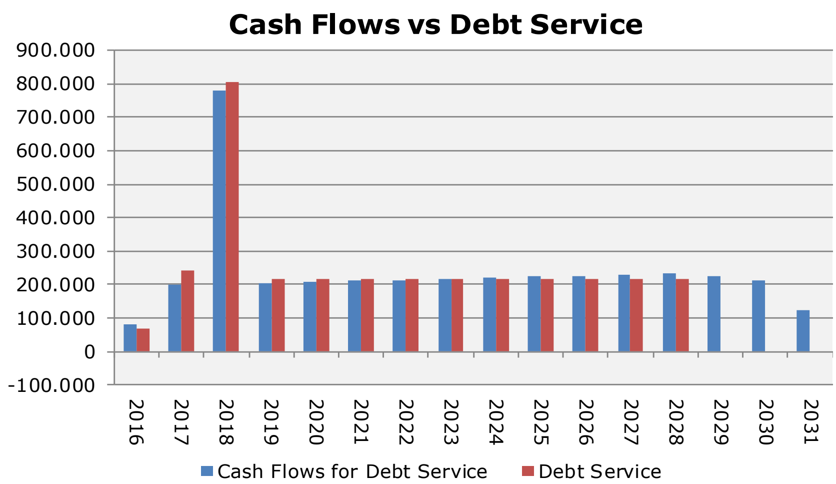
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 308.247 Euro, resulting from 219.670 Euro of energy savings fee and 88.577 Euro maintenance fee, and pays annual costs for 110.689 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 337.153 Euro less post-intervention expenditure of 106.240 Euro) less the 5% shared savings (11.243 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy savings fee	219.670
Maintenance fee	88.577
Total Revenues	**308.247**
Maintenance	88.577
Administration costs	9.000
Insurance	13.112
Total Costs	**110.689**
EBITDA	**197.558**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 197.558 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

The following graph shows a comparison between the cash flows available for debt service and the amount of debt service. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case cash flows generated by the project are not enough to pay the back the loan during the first years. Thus, an ESCo intervention is not possible at market conditions.

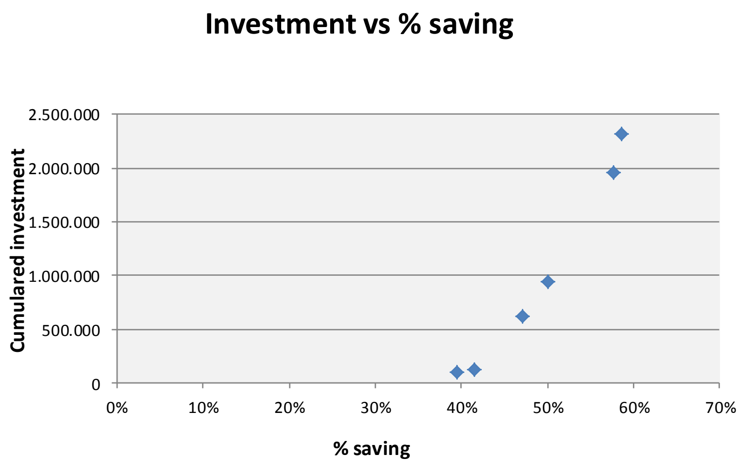
Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions. To do so, a convenience test was implemented to check which a single renovation option is sustainable at market conditions and which is not. For those renovation options that are considered non sustainable at market conditions, alternative financial solutions should be identified.

3.4.5.2 *Single Renovation Option Convenience Test*

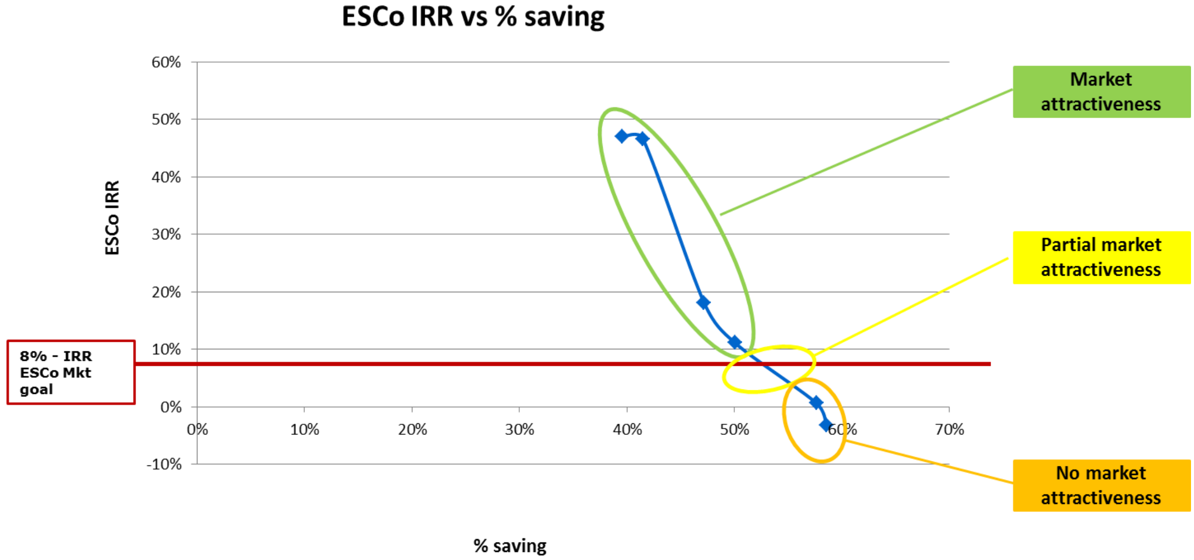
On the basis of the marginal contribution of each intervention to energy savings described in Delivery 2.1, some further elaboration was made in order to represent the relationship between cumulated investment and cumulated savings.

In practice, each intervention was first sorted by economic convenience, expressed in terms of lower investment/savings ratio. Then, a XY scatter chart was plotted to express the relationship between the cost of each renovation option and its contribution to energy savings.

As a result, the marginal contribution of each investment to energy savings is decreasing. In particular, the Euro amount invested to obtain a 1% savings starting from baseline is much lower than the Euro amount invested to obtain the same 1% savings with the last renovation option, starting, for example, from 70% savings.



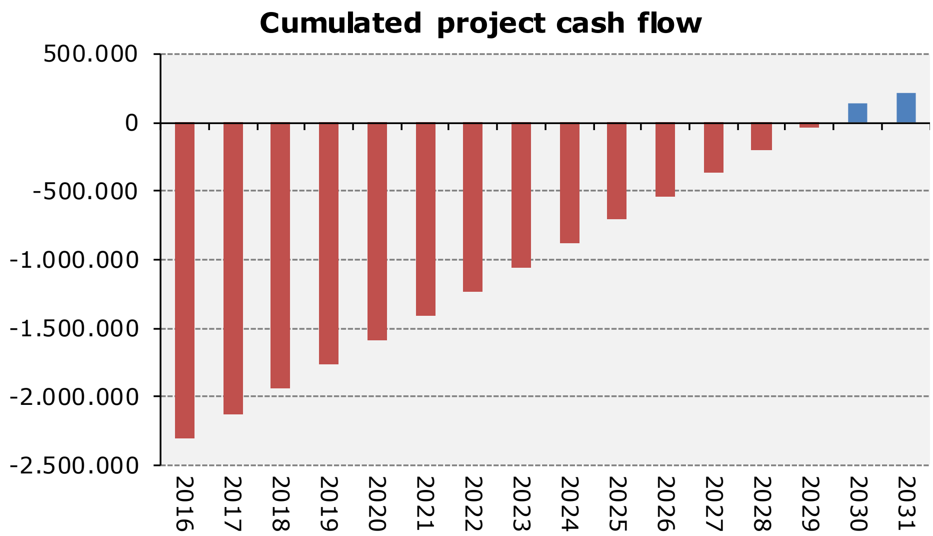
As a consequence of this evidence, another XY scatter chart was plotted to represent the relationship between project IRR and energy savings. From the graph we can observe that very high energy savings (>55%) lead to a significant reduction of the expected IRR of the intervention. In this case, in order to ensure the feasibility of an ESCo intervention, a specific facility or grant should be provided by the Municipality.



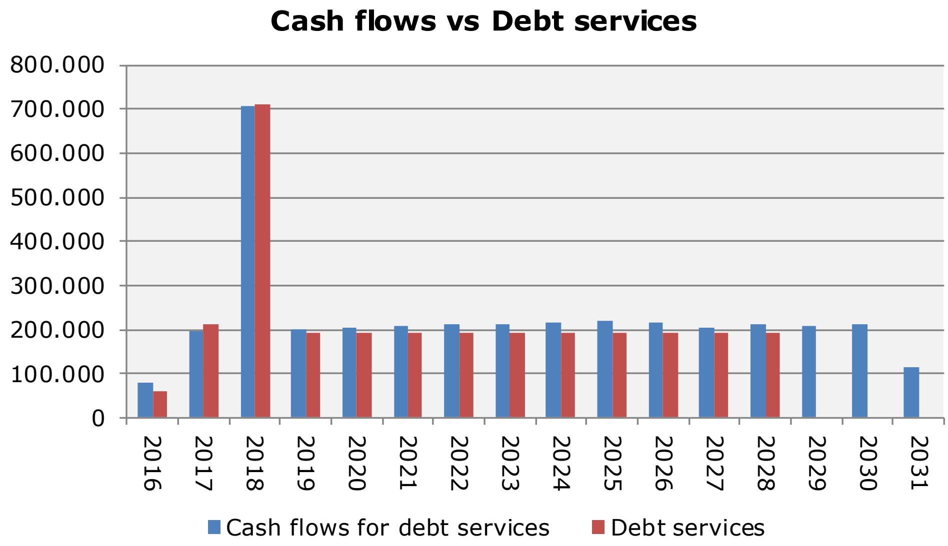
The following table shows the list of the interventions proposed for the building sorted by investment/savings ratio:

Intervention	Investment (€)	Savings (€)	Investment/Savings ratio	Cumulated saving
LED	101.200	133.392	1	40%
BACS	20.000	6.411	3	41%
Compression heat pumps - VRV system - OFFICES AREAS	500.000	19.232	26	47%
Horizontal structures on roofs - NEW FV COVER SHELTER	316.308	9.616	33	50%
New facades - External wall, windows, green wall	1.014.929	25.643	40	58%
Horizontal structures on floors - WATERPROOFING FOUNDATIONS and FOUNDATIONS STRUCTURAL RENOVATION	360.000	3.205	112	59%

In order to improve the sustainability of the project, analyzed the impact of the removal of the Waterproofing foundation, thus the reduction of the investment costs by 16% while keeping savings at 58%, was analyzed. In this case, the project achieves payback after 13,5 years, as shown in the following graph:



From the ESCo point of view, the project becomes hardly sustainable at market conditions and under the assumption of implementation of the standard EPC contract. As shown in the following graph, the project generate just enough cumulated cash flow to allow the ESCo to pay back the bank loan.



In any case, an ESCo intervention is not possible at market conditions because the project, besides its formal sustainability, is not able to remunerate sufficiently the capital invested by the ESCo. The IRR of the investment is 0,17%.

3.4.5.3 *Financial Structure Optimization*

In order to make the project desirable for an ESCo, an important financial support should be given to the project. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 267.612 Euro;
- Senior debt for 369.560 Euro;
- Subsided Funds for 1.600.000 Euro (duration 12 years);
- Grant for 480.000 Euro (Incl. VAT);

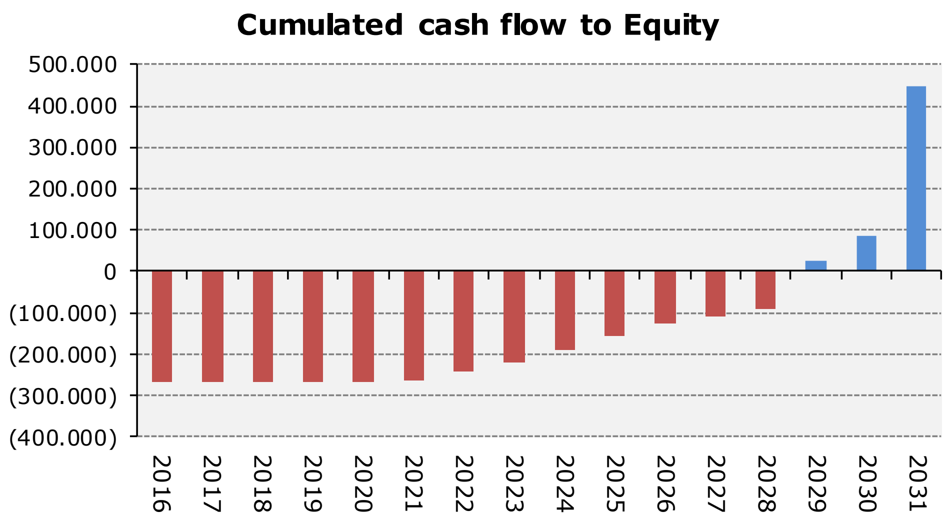
FINANCIAL SOURCES (ESCOs)	€	%
Equity	267.612	8%
Senior Debt	369.560	12%
Grant	480.000	15%
Subsided Funds	1.600.000	50%
Total Financial Sources exc. VAT	**2.717.172**	
VAT Facility	490.379	15%
TOTALE FINANCIAL SOURCES	**3.207.551**	**100%**

As a consequence, the amount of total investment is slightly reduced because the decrease of Senior Debt implies the reduction of interests and banking fees in the construction period. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
HVAC	500.000
Lighting system (internal)	101.200
Renewable energy	310.000
Casing Building skin	1.691.237
Control system	20.000
Investment for renovation	**2.622.437**
Starting liquidity	0
Interests and Banking Fees	8.178
Total investment exc. VAT	**2.630.615**
VAT	576.936
TOTAL INVESTMENT	**3.207.551**

With this financial structure, an ESCo intervention is possible and the remuneration of the invested capital, in terms of IRR, should be considered adequate for this kind of projects.

The following graph shows the cumulated cash flows to equity.

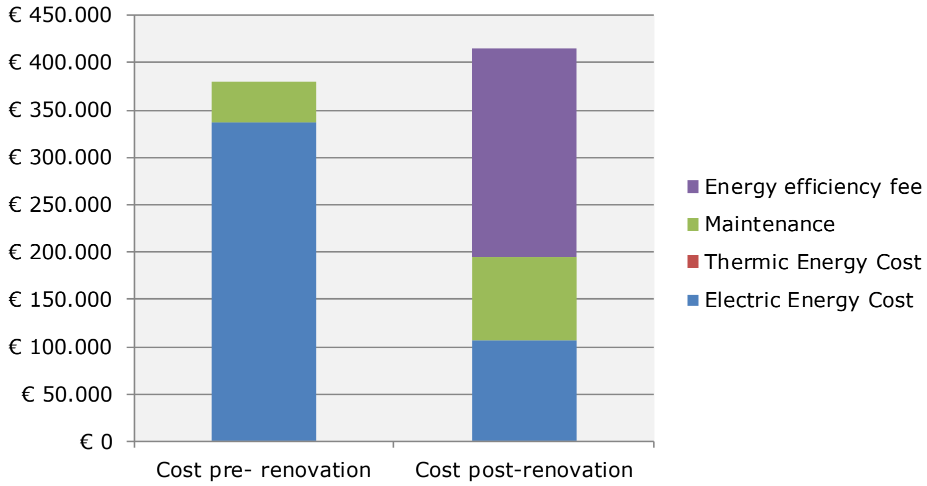


Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered sustainable and profitable. Main indicators for the ESCo investment are:

- Equity Pay-back period: 13,5 years
- ESCo IRR: 8,0%
- Equity NPV: 34.040 Euro

3.4.5.4 IMPACT ON THE MUNICIPALITY

The implementation of this EPC contract leads to an increase of expenditure for the Municipality of around 34.468 Euro/year, resulting from the 5% shared energy savings of 11.546 Euro less the increase in maintenance costs of 46.014 Euro. In this case, the increase in maintenance costs overtakes the benefits from shared savings and thus post-intervention expenditure is higher than pre-intervention expenditure. At the end of the EPC contract, the Municipality would anyway benefit from a reduction of overall expenditure.



3.4.5.5 PROJECT CONCLUSION

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 22% (€/kWh)
Italy	Messina	"Palazzo Satellite"	6.870	2.622.437	381,7	2,00%	22%	0,220

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
337.130	1.872.943	273	106.387	591.037	86	230.743	1.281.906	11

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
42.500	88.577	-46.077	184.666	49%	14

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
8%	12%	15%	50%	15%	15	12	13	3%	14	8%

(*) Interest rate= 5,93%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

In this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a single renovation option convenience test and a further financial structure optimization have been performed in order to give some indications to better structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 6.870 m2;
- The total investment cost is equal to 2.622.437 Euro, that means an investment cost per square meter of 381,7 Euro/m2;
- The energy consumption before renovation is equal to 1.872.943 kWh/year and the energy consumption on square meter is equal to 273 kWh/m2;
- The energy consumption savings are equal to 1.281.906 kWh/year, that means an energy expenditure saving of 230.743 Euro/year;
- The maintenance expenditure post renovation is higher than before of 46.077 Euro/year, this affects negatively, at economic level, on the total savings achievable by the intervention and also on the payback period. In fact the economic saving both for energy and maintenance is 184.666 Euro/year;
- The Project Pay Back period is 14 years considering the maintenance savings but the cash flows are not sufficient to implement a financial structure at market condition;
- The financial structure implemented is a mix of source of finance. The use of Subsided Funds is quite maximized, in fact the grant percentage is about 15%.

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions.

3.4.6. *Sustainability Evaluation – Palacultura*

3.4.6.1 Renovation Scheme and Market Test

Given the features and actual conditions of the building, designers identified come simple renovation options concerning heating and lighting system.

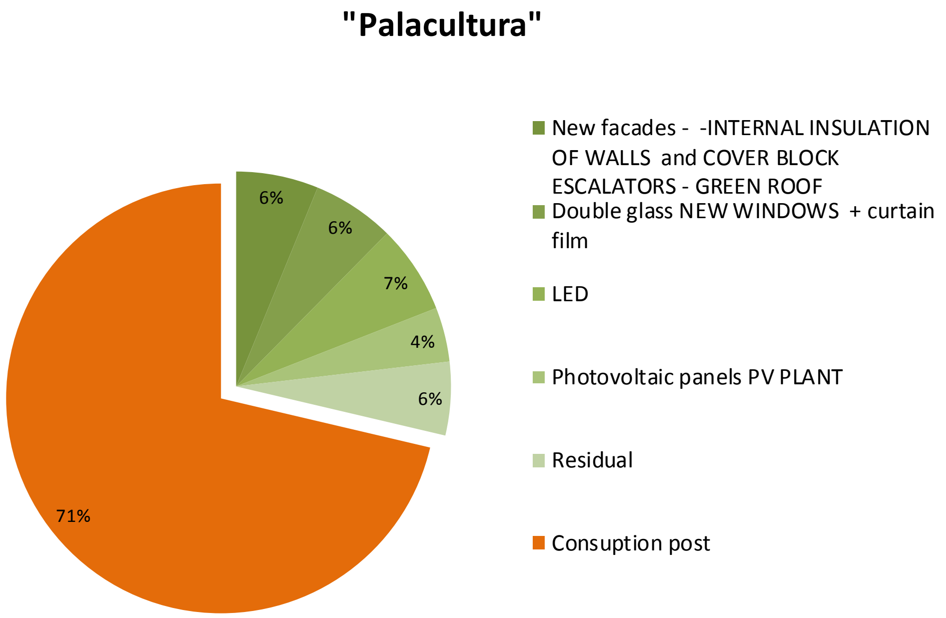
Total investments estimated to realize the interventions are shown in the following table:

INVESTMENTS	€
Lighting system (internal)	336.200
Renewable energy	56.000
Casing Building skin	354.210
Windows - Low e Thermo Break	208.000
Investment for renovation	**954.410**

The identified technological solutions lead to an energetic saving of 253.879 kWh, equal to 29%. The detail of the energetic savings is reported in the following table. The % saving represents a marginal saving. It means that each % savings related to an interventions/layers should be considered as the marginal contribution to energy savings that the single intervention/layer adds to the project after having done the previous interventions/layers in the specific order represented in the table.

Interventions	Saved kWh	% saving
New facades - -INTERNAL INSULATION OF WALLS and COVER BLOCK ESCALATORS - GREEN ROOF	54.841	6%
Double glass NEW WINDOWS + curtain film	54.841	6%
LED	59.058	7%
Photovoltaic panels PV PLANT	36.235	4%
Interior Equipment	48.905	6%
Total	**253.879**	**29%**

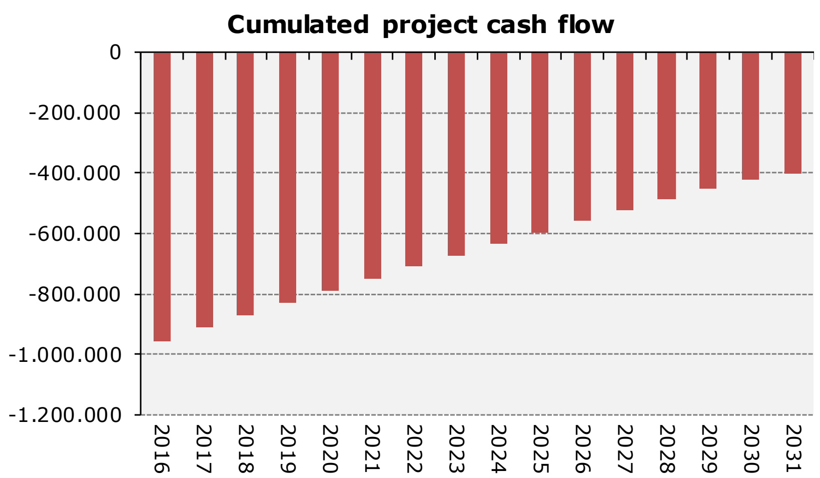
The following graph represents the marginal contribution of each intervention to the energy savings (kWh)



According to the proposed renovation scheme, total economic savings amount 42.263 Euro/year. The detail of expenditures and savings is shown in the following table:

EXPENDITURES & SAVINGS	€/year	% savings
Electric Energy	159.165	
Thermal Energy	0	
Maintenance	29.959	
Total expenditure pre-intervention	**189.124**	
Electric Energy	113.530	-29%
Thermal Energy	0	0%
Maintenance	33.331	11%
Total expenditure post-intervention	**146.861**	**-22%**
ANNUAL SAVINGS	**42.263**	

Project cash flows from the renovation scheme are shown in the following graph:



As shown in the graph, the project is not able to pay-back the investment in 15 years.

From an ESCo point of view, some extra investment is considered in order to pay interests, banking fees and commissions.

INVESTMENTS (ESCo)	€
Lighting system (internal)	336.200
Renewable energy	56.000
Casing Building skin	354.210
Windows - Low e Thermo Break	208.000
Investment for renovation	**954.410**
Starting liquidity	100
Interests and Banking Fees	13.625
Total investment exc. VAT	**968.135**
VAT	209.970
TOTAL INVESTMENT	**1.178.105**

Given the assumptions explained above, the financial structure of the ESCo is the following:

FINANCIAL SOURCES (ESCo)	€	% of total	% Excl. VAT
Equity	290.441	25%	30%
Senior Debt	677.695	58%	70%
Total Financial Sources exc. VAT	**968.135**	**82%**	**100%**
VAT Facility	209.970	18%	
TOTAL FINANCIAL SOURCES	**1.178.105**	**100%**	

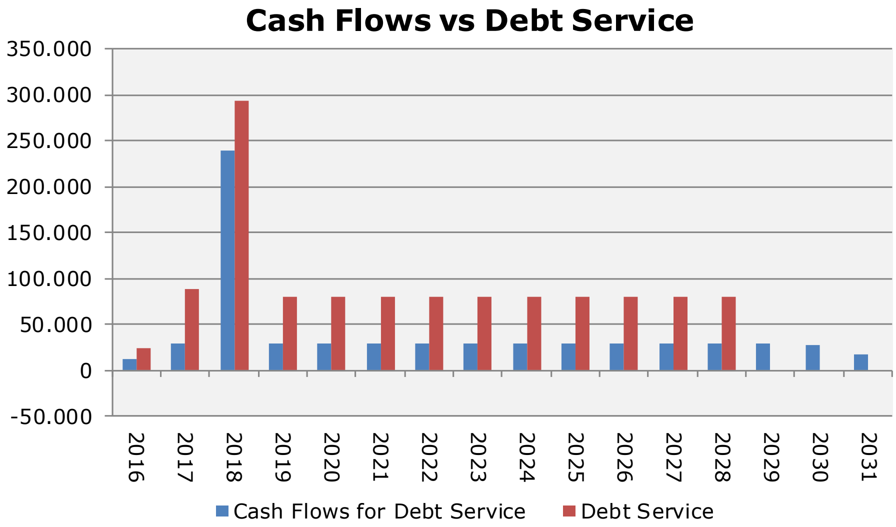
By implementing the EPC contract, the ESCo receives annual fees from the municipality for 76.790 Euro, resulting from 43.413 Euro of energy savings fee and 33.377 Euro maintenance fee, and pays annual costs for 47.149 Euro. Energy savings fee is equal to the economic savings (i.e. pre-intervention expenditure of 159.165 Euro less post-intervention expenditure of 113.530 Euro) less the 5% shared savings (2.222 Euro).

Maintenance costs were estimated on the basis of actual expenditure given by the Municipality while administration and insurance costs were calculated on the basis of the amount of the investment.

REVENUES & COSTS (ESCo)	€/year
Energy saving fee	43.413
Maintenance fee	33.377
Total Revenues	**76.790**
Maintenance	33.377
Administration costs	9.000
Insurance	4.772
Total Costs	**47.149**
EBITDA	**29.641**

The structure of revenues and costs of this project provides the ESCo with an operating margin of 29.641 Euro/year. This is the amount available for depreciation, amortization, interests and taxes.

In this case the EBITDA of the project is not enough to pay-back the investment in 15 years. In addition, as shown in the following graph, the cash flows generated by the project do not allow the ESCo to pay back the bank loan. Please note that the peak of cash flows in 2018 is due to the reimbursement of VAT on construction from the Government to the SPV and consequent reimbursement of VAT facility from the SPV to the bank:



In this case, it's clear that an ESCo intervention is not possible at market conditions.

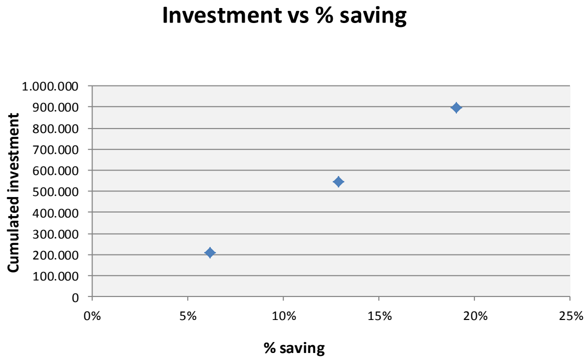
Therefore, it's necessary to carry on the economic and financial evaluations in order to find out alternative and complementary financial solutions to senior debt at market conditions. To do so, a convenience test was implemented to check which a single renovation option is sustainable at market conditions and which is not. For those renovation options that are considered non sustainable at market conditions, alternative financial solutions should be identified.

3.4.6.2 *Single Renovation Option Convenience Test*

On the basis of the marginal contribution of each intervention to energy savings described in Delivery 2.1, some further elaboration was made in order to represent the relationship between cumulated investment and cumulated savings.

In practice, each intervention was sorted by economic convenience, expressed in terms of lower investment/savings ratio. Then, a XY scatter chart was plotted to express the relationship between the cost of each renovation option and its contribution to energy savings.

As a result, the marginal contribution of each investment to energy savings is decreasing. In particular, the Euro amount invested to obtain a 1% savings starting from baseline is much lower than the Euro amount invested to obtain the same 1% savings with the last renovation option, starting, for example, from 70% savings.

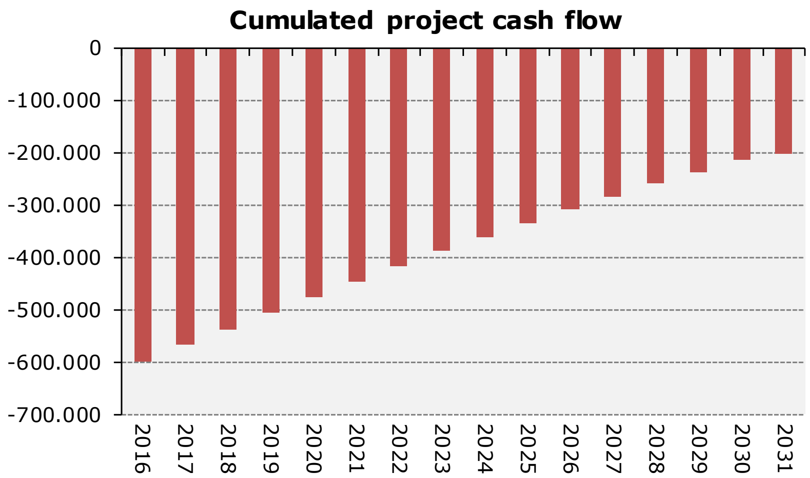


From previous graph it can be observed that very high energy savings lead to a significant increase of the investment.

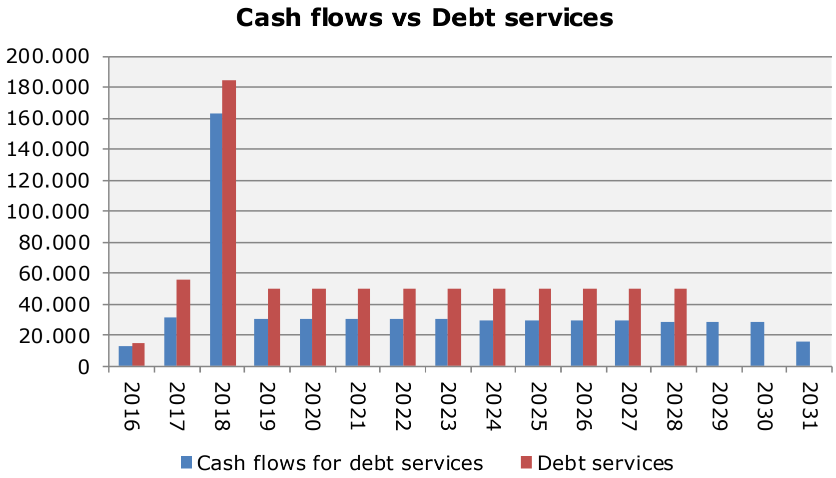
The following table shows the list of the interventions proposed for the building sorted by investment/savings ratio:

Intervention	Investment (€)	Savings (€)	Investment/Savings ratio	Cumulated saving
Double glass NEW WINDOWS + curtain film	208.000	9.871	21	6%
LED	336.200	10.630	32	13%
New facades - -INTERNAL INSULATION OF WALLS and COVER BLOCK	354.210	9.871	36	19%

In order to improve the sustainability of the project, the impact of the removal of the internal insulation, thus the reduction of the investment costs by 39% while keeping savings at 13%, was analyzed. In this case, the project is not able to achieves payback in 15 years, as shown in the following graph:



From the ESCo point of view, the project remains non sustainable at market conditions and under the assumption of implementation of the standard EPC contract. As shown in the following graph, the project does not generate enough cash flow to allow the ESCo to pay back the bank loan.



3.4.6.3 *Financial Structure Optimization*

In order to make the project desirable for an ESCo, an important financial support should be given to the project and the duration of the EPC contract should be extended. In this case, a specific financial structure was implemented assuming:

- Equity investment by the ESCo for 105.407 Euro;
- Subsided Funds for 300.000 Euro (duration 15 years);
- Grant for 670.000 Euro (Incl. VAT);
- Duration of the EPC contract: 25 years;

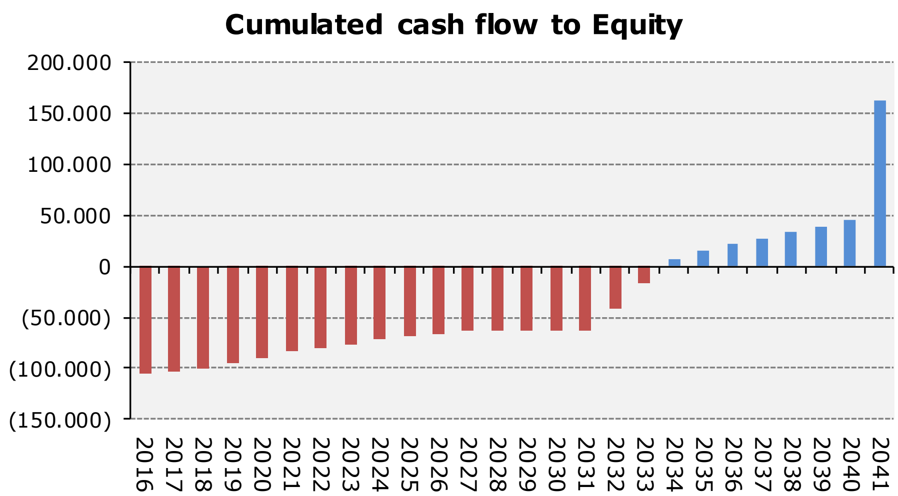
FINANCIAL SOURCES (ESCo)	€	%
Equity	105.407	9%
Senior Debt	0	0%
Grant	670.000	58%
Subsided Funds	300.000	26%
Total Financial Sources exc. VAT	**1.075.407**	
VAT Facility	89.151	8%
TOTALE FINANCIAL SOURCES	**1.164.558**	**100%**

As a consequence, the amount of total investment is slightly reduced because the decrease of Senior Debt implies the reduction of interests and banking fees. Please note that VAT Facility is lower than total VAT of investment because the amount of Grant includes a share of VAT.

INVESTMENTS (ESCOs)	€
Lighting system (internal)	336.200
Renewable energy	56.000
Casing Building skin	354.210
Windows - Low e Thermo Break	208.000
Investment for renovation	**954.410**
Starting liquidity	0
Interests and Banking Fees	177
Total investment exc. VAT	**954.587**
VAT	209.970
TOTAL INVESTMENT	**1.164.558**

With this financial structure an ESCo intervention is possible but the remuneration of the invested capital, in terms of IRR, is lower than the average expectation of the market.

The following graph shows the cumulated cash flows to equity.



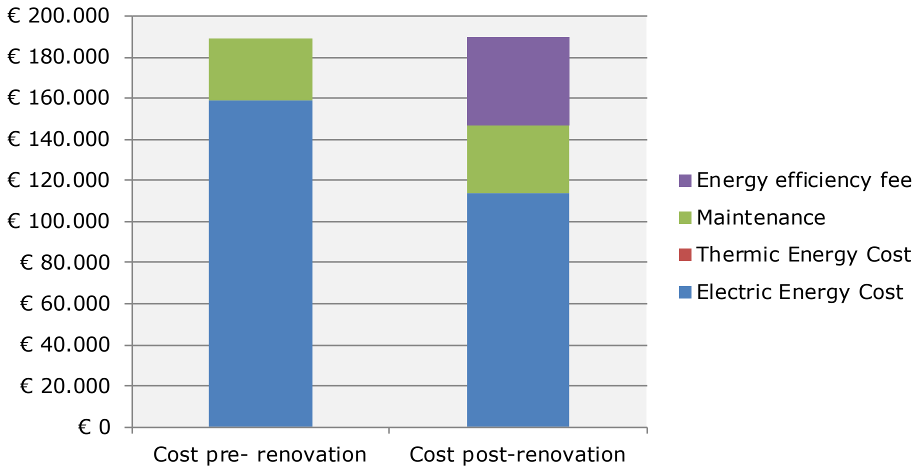
Given this financial structure and under the hypothesis of availability of a public grant of this amount, the investment made by the ESCo should be considered sustainable but not profitable enough. Indeed, equity IRR is lower than expected cost of capital and NPV is negative. Main indicators for the ESCo investment are:

- Equity Pay-back period: 18,5 years
- ESCo IRR: 5,33%
- Equity NPV: -23.460 Euro

Given these assumptions, the project should be considered not attractive for an ESCo.

3.4.6.4 *Impact on the Municipality*

The implementation of this EPC contract leads to an increase of expenditure for the Municipality of around 1.090 Euro/year, resulting from the 5% shared energy savings of 2.282 Euro less the increase in maintenance costs of 3.372 Euro. In this case, the increase in maintenance costs overtakes the benefits from shared savings and thus post-intervention expenditure is higher than pre-intervention expenditure. At the end of the EPC contract, the Municipality would anyway benefit from a reduction of overall expenditure.



3.4.6.5 PROJECT CONCLUSION

In order to analyze the feasibility of achieving nZEB targets for each project, a common evaluation sustainability methodology, which takes into account several aspects, has been developed. Using the mentioned evaluation methodology, with the above explained project assumptions and country specific cost factors, through the assessment of the market test, of the single renovation option convenience test and of the financial structure optimization, the project under analysis evidences the following findings:

Project			Size			Country Specific Factors		
			a	b	b/a			
Country	Municipality	Building	Square meter (m2)	Cost of the investment (€)	Investment/m2 (€/m2)	Inflation rate	VAT rate	Electric energy price - incl. VAT 22% (€/kWh)
Italy	Messina	"Palacultura"	10.300	954.410	92,7	2,00%	22%	0,220

Energy Expenditure pre e post renovation						Results		
c	d	c/a	e	f	f/a	c-e	d-f	b/(c-e)
Energy expenditure - Before renovation (€/year)	Energy consumption - Before renovation (kWh/year)	Energy consumption before/ m2 (kWh/m2 yearly)	Energy expenditure - Post renovation (€/year)	Yearly Energy consumption - Post renovation (kWh/year)	Energy consumption post renovation/ m2 (kWh/m2 yearly)	Energy Savings (€/year)	Energy Savings (kWh/year)	Energy PayBack Period
159.384	885.469	86	113.686	631.590	61	45.698	253.879	21

Maintenance Expenditure pre e post renovation		Results			
g	h	g-h	(c-e)+(g-h)	[(c-e)+(g-h)] / (c+g)	b/[(c-e)+(g-h)]
Maintenance Expenditure - Before renovation (€/year)	Maintenance Expenditure - Post renovation (€/year)	Maintenance Saving (€/year)	Savings (Energy and Maintenance) (€/year)	Savings € (Energy and Maintenance) % yearly	PayBackPeriod (Energy and Maintenance)
30.000	33.377	-3.377	42.321	22%	23

Financial structure hypothesis							Results			
Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Duration EPC Contract	Duration Subsides Fund	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
9%	0%	8%	26%	58%	25	15	>D	<0%	19	5%

(*) Interest rate= 5,93%, the sources are available in the previous paragraph; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
"> D" the pay back is longer than analysed period

n this project ESCo involvement **is not possible at current market conditions** considered and, in order to make the project hypothetically feasible for an ESCo, a single renovation option convenience test and a further financial structure optimization have been performed in order to give some indications to structure the whole realization of the project.

A summary of the characteristics of the projects and resulting analysis is the following:

- The building has an area of 10.300 m2.
- The total investment cost is equal to 954.410 Euro, that means an investment cost per square meter of 92,7 Euro/m2.
- The energy consumption before renovation is equal to 885.469 kWh/year and the energy consumption on square meter is equal to 86 kWh/m2;
- The energy consumption savings are equal to 253.879 kWh/year, that means an energy expenditure saving of 45.698 Euro/year;
- The maintenance expenditure post renovation maintenance is higher than before of 3.377 Euro/year. This situation affects negatively, at the economic level, on the total savings achievable by the intervention. In fact the economic saving both for energy and maintenance is about 42.321 Euro/year;
- The Project Pay Back period is very long, 23 years considering the maintenance, and the project cash flows are very low. This situation have a very negative impact on the sustainability of the project and consequentially on the attractiveness for an ESCo;
- The amount of public grants is very relevant (58%). This kind of tender is not a market practice for Public Private Partnership logic. In addition, the amount of grant should be found in the availability of funds by the public administration;
- The amount of Subsided Fund is not maximized because the cash flows are not sufficient to increase this value in substitution of part of the grant amount;
- The duration of the EPC contract is higher than the normal market condition (normally 15 years maximum). This duration is due to the fact that the project has a long payback period;
- In order to make the investment more sustainable for the ESCo the project could consider alternative ways to the standard EPC contract, for example to implement other kind of contract or a global service or a direct procurement by the Municipality;
- In addition, it could be a good option to aggregate more than one initiative. This aggregation could be useful to obtain cost efficiency, incremental revenues and synergies;

Given the expectations and context framework of the Municipality, these results could be considered as useful indications for the individuation of the optimal solutions

3.5. ALTERNATIVE SCENARIOS

The following paragraphs show some possible alternative solutions to those found in the previous "Financial Structure Optimization" chapters. This analysis aims to find out whether some of the 12 projects (especially for those who need a high amount of grant) may be realized by an ESCo by reducing the amount of investment to be covered by the ESCO (Scenario 1) or by involving some subject with a lower expectation on return on capital invested (Scenario 2).

3.5.1. *SCENARIO 1: MUNICIPALITY PAYS SOME INTERVENTIONS*

This scenario analyzes a particular solution on which:

- The Municipality finances with own capital those single interventions having a long payback period;
- The ESCo signs an EPC contract with the Municipality and finances the rest of the interventions;
- The Municipality pays the ESCo an annual fee corresponding to total energy savings (including those coming from the interventions financed with own capital)

In this scenario, the investment to be made by the ESCo is much lower than the base case and this can increase its sustainability and profitability for the ESCo.

An example of this solution applied to the Municipal Library of Alimos is here shown.

The following table shows those investments that should be financed by the Municipality with own capital:

MUNICIPALITY	RENOVATION OPTION	INVESTMENT (€)	SOURCES
Alimos Municipal Library	Casing Building skin	30.900	Own capital
	Windows - Low e Thermo Break	40.650	
	Total	**71.550**	

The following table shows the other investments that should be financed by the ESCo with equity and debt at market conditions:

MUNICIPALITY	RENOVATION OPTION	INVESTMENT (€)	SOURCES	
Alimos Municipal Library	HVAC	15.350	Equity	24%
	Lighting systame (internal)	2.150		
	Renewable energy	8.000		
	Control system	3.010	Senior Debt	76%
	Ventilation systems	4.000		
	Total	**32.510**		

Given these assumptions, economic results for the ESCo are as follows:

- Equity IRR: 8%
- Payback Period: 13,5 years
- Equity NPV: 1.626

In this case, this solution leads to a fully sustainable intervention by an ESCo, with an attractive IRR and a relatively short payback period.

This scenario represents just a theoretical example because the share of investment that should be taken in charge by the Municipality is very high. Thus, a public-private partnership is not likely to be activated just for a residual part of total investments. A simple reason is that in this moment one of the main problems of the Municipalities is the lack of financial sources. In addition, this solution needs major efforts to organize the realization of each layer of the project, which may depend on different subjects, and to manage different construction timing.

3.5.2. *SCENARIO 2: INVOLVEMENT OF SOME DISTINCTIVE INVESTORS IN THE CAPITAL OF THE ESCO*

This scenario analyzes the case of some projects with the involvement in the capital of the ESCo of some distinctive Investors with lower return expectation (for example around 4% IRR). This could be the case of the intervention of some particular investment fund having low revenues expectations. This scenario is aimed at finding a way of reducing to zero the public grant needed by those project with low sustainability by reducing the returns on capital invested. This is because public grants are generally difficult to obtain and usually don't exceed a certain percentage of total investment and thus it's better to find a way to reduce or to zero its amount.

Here is shown an example of this solution applied to the "Palazzo Satellite" of Messina.

Let's assume a target Equity IRR of 4% and try to set the amount of Public Grant at zero.

The following table shows the possible financial structure of the intervention:

FINANCIAL SOURCES (ESCOs)	€	%
Equity	643.585	20%
Senior Debt	0	0%
Grant	0	0%
Subsided Funds	1.980.000	62%
Total Financial Sources exc. VAT	**2.623.585**	
VAT Facility	576.936	18%
TOTALE FINANCIAL SOURCES	**3.200.521**	**100%**

As a result, in order to achieve a 4% Equity IRR with no Grant, an increase in equity invested by 375.973 Euro (8 percentage points) and an increase in subsided funds by 360.000 Euro (13 percentage points) is needed. This way, equity invested by the ESCo should cover the 20% of total investment while subsided funds should cover 62%.

This example shows that the interventions of an investor with low return expectation and the increase in equity and subsided funds could avoid the recourse on public grant.

In facts, the use of subsided funds is generally preferable than grants because of the revolving mechanism that allows the lender to reinvest the proceeds from the loan in other projects.

3.6. PROJECT RESULTS

The results from the analysis developed for the 12 project is recapped in this paragraph.

According to the adopted structure of analysis, as previously explained, results are shown by steps.

The following tables report:

- the assumptions about inflation rates, VAT rates, interest rates, general terms of the EPC contract and the percentage shared savings;
- the financial structure (equity, senior debt, VAT facility, subsidized funds)
- the results of the analysis both from the project and from the ESCOs (SPV) point of view, in terms of payback and IRR.

Two summary table of starting assumption for the simulations and financial results are reported, “Simulation I – Market test” and “Simulation III – Financial Optimization”.

The Market Test analysis shows that only one project is fully market sustainable and one is partially market sustainable while the others are not sustainable. See the Table “Market test results”.

		General Assumptions			I Simulation - Market test											
Municipality	Project	Inflaction rate	VAT rate	Senior debt interest rate	Sharing Savings	Duration EPC Contract	Equity	Senior Debt € (*)	VAT Facility € (**)	Subsided Funds	Public Grant	Tot Funds	Project Payback period	Project IRR	Equity payback perod	ESCo IRR (SPV)
					%	Year	%	%	%	%	%	€	Year	%	year	%
Alimos	*Municipal City Hall*	2,00%	23%	7,16%	5%	15	24%	57%	18%	0%	0%	314.556	> D	<0%	> D	< 0%
Alimos	*Municipal Library*	2,00%	23%	7,16%	5%	15	24%	57%	18%	0%	0%	129.481	> D	<0%	> D	< 0%
Alimos	*Municipal Offices*	2,00%	23%	7,16%	5%	15	24%	57%	18%	0%	0%	125.842	> D	<0%	> D	< 0%
Coimbra	*Town Hall*	2,00%	23%	6,22%	5%	15	26%	61%	13%	0%	0%	732.876	> D	<0%	> D	< 0%
Coimbra	*Municipal House of Culture*	2,00%	23%	6,22%	5%	15	26%	60%	15%	0%	0%	401.959	9	10,4%	13	9,1%
Coimbra	*Elementary school of Solum*	2,00%	23%	6,22%	5%	15	26%	61%	14%	0%	0%	31.853	9	9,0%	15	6,8%
Errenteria	*City Hall*	2,00%	21%	5,64%	5%	15	25%	58%	17%	0%	0%	207.735	> D	<0%	> D	< 0%
Errenteria	*Building "Kapitain Etxea"*	2,00%	21%	5,64%	5%	15	25%	58%	17%	0%	0%	136.671	> D	<0%	> D	< 0%
Errenteria	*Building "Lekuona"*	2,00%	21%	5,64%	5%	15	25%	58%	17%	0%	0%	155.076	> D	<0%	> D	< 0%
Messina	*City Hall "Palazzo Zanca"*	2,00%	22%	5,93%	5%	15	25%	58%	18%	0%	0%	4.328.767	15	0,9%	> D	< 0%
Messina	*Building "Palazzo Satellite"*	2,00%	22%	5,93%	5%	15	25%	58%	18%	0%	0%	3.236.909	13	2,9%	> D	< 0%
Messina	*Building "Palacultura"*	2,00%	22%	5,93%	5%	15	25%	58%	18%	0%	0%	1.178.105	> D	<0%	> D	< 0%

(*) Interest rate= column "Senior Debt interest rate", the souces are available in the previous paragraph ; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
"> D" the pay back is longer than analysed period

Table 15. Market test results

The Simulation “Financial Structure Optimization” shows that almost every project needs a financial aid from specific Financial instruments.

		General Assumptions			III Simulation - Finacial structure Optimisation													
Municipality	Project	Inflaction rate	VAT rate	Senior debt interest rate	Duration EPC Contract	Duration Subsides Fund	Sharing Savings	Equity	Senior Debt (*)	VAT Facility (**)	Subsided Funds (***)	Public Grant	Tot Funds	Project Payback period	Project IRR	Equity payback perod	NPV Equity	ESCo IRR (SPV)
					Years	Years	%	%	%	%	%	%	€	Year	%	year	€	%
Alimos	*Municipal City Hall*	2,00%	23%	7,16%	25	14	5%	9%	0%	11%	38%	43%	311.009	23	1,0%	18	5.201	8%
Alimos	*Municipal Library*	2,00%	23%	7,16%	25	15	5%	9%	0%	8%	24%	59%	128.013	>D	<0%	19	<0	6%
Alimos	*Municipal Offices*	2,00%	23%	7,16%	25	15	5%	8%	0%	16%	23%	53%	168.812	>D	<0%	19	<0	6%
Coimbra	*Town Hall*	2,00%	23%	6,22%	25	15	5%	10%	0%	3%	37%	49%	724.999	25	0,4%	18	5.806	7%
Coimbra	*Municipal House of Culture*	2,00%	23%	6,22%														
Coimbra	*Elementary school of Solum*	2,00%	23%	6,22%	15	12	5%	33%	22%	14%	31%	0%	31.613	9	9,0%	14	1.054	8%
Errenteria	*City Hall*	2,00%	21%	5,64%	20	15	0%	9%	0%	16%	38%	37%	219.573	>D	<0%	15	2.584	8%
Errenteria	*Building "Kapitain Etxea"*	2,00%	21%	5,64%	25	12	0%	9%	0%	15%	0%	76%	155.738	>D	<0%	26	<0	1%
Errenteria	*Building "Lekuona"*	2,00%	21%	5,64%	25	15	5%	9%	0%	7%	25%	59%	153.192	>D	<0%	19	<0	6%
Messina	*City Hall "Palazzo Zanca"*	2,00%	22%	5,93%	20	12	5%	12%	18%	14%	33%	23%	4.294.890	15	3,8%	16	79.887	8%
Messina	*Building "Palazzo*	2,00%	22%	5,93%	15	12	5%	8%	12%	15%	50%	15%	3.207.551	13	2,9%	14	34.040	8%
Messina	*Building "Palacultura"*	2,00%	22%	5,93%	25	15	5%	9%	0%	8%	26%	58%	1.164.558	>D	<0%	19	<0	5%

(*) Interest rate= column "Senior Debt interest rate", the souces are available in the previous paragraph ; Duration= 12 y
(**) Interest rate= 4,70%; Duration= 2 y
(***) interest rate = 1,5%
">D" the pay back is longer than analysed period

Table 16. Financial structure optimization results

In addition, for each project, the summary tables containing the data provided by the designers are reported in **Annex A** .

In the tables “Baseline Expenditure and Post-Intervention Expenditure” the detail of ex-ante and ex-post consumption is provided, both in energetic (kWh) and economic (Euro) terms. Maintenance costs are also provided.

In the tables “Savings Evidence” an abstract of the data contained in the first table is reported and an evidence of the energy savings gained thanks to the realization of the interventions is then shown. In this table an indicator of energetic consumption for square meter is introduced, this also both in electric and thermal terms.

3.7. KEY FINDINGS AND RECOMMENDATION

The goal of this work was to analyze, through a sample of twelve projects, the feasibility of achieving nZEB targets. These interventions were contextualized on the basis of the current situation of the market, in which the ESCo operation is still in an initial development phase, and of the Municipalities, which face strong needs of renovation of public buildings but lack the necessary financial resources because of strict budget constraints. In this context, analyses were carried out trying to maximize the activation of the market by favoring, where possible, the intervention of an ESCo for the realization of the sustainable interventions/layers. Then, for the residual part of the project, the activation of subsidized funds and public grants was assumed in order to complete the realization of the proposed energy efficiency renovation options.

In order to reach this goal, a common evaluation sustainability methodology, which takes into account several aspects, was developed as described in the previous paragraphs. The identified methodology processed discussion between subjects bearing complementary skills and belonging to different fields (technical, administrative, economic and risk management, contractual). This way of approaching the evaluation of each project creates an important value added because it simulates the market practice, it can be understood by the market operators since it's based on analysis/communication standards commonly used in the market and, if used in a widespread way, it may facilitate the comparison between the interested subjects such as municipalities, construction and management companies (including ESCos) and financial institutions.

As said before, in order to carry out an evaluation of the projects, the possibility of financing them at market condition by implementing the most widespread EPC contract among the four Countries (see Paragraph 3 "Project Evaluation") was first evaluated.

Then, when the above process is not implementable[24], a specific ad-hoc financial structure was implemented in order to make the project attractive for the market and for the ESCos..

This financial structure is structured trying, were possible, in order to favour subsidized funds while public grants were only used in a residual way only where necessary. A minimum percentage of equity invested by the ESCo was also assumed as a warranty of the effective contribution of the private subject for the development of the project. As far as subsidized funds are concerned, a standard instrument with a very competitive interest rate[25] is assumed just for example purpose[26]. In addition, ESCo were also supposed to have a good credit rating or a warranty system that should allow them to obtain these financing conditions.

This process was applied to the CerTus twelve-project sample, representing some of the possible solutions that can be applicable on public buildings and having its own characteristics.

In summary, it was possible to ascertain that it's very difficult to reach the nZEB threshold by developing projects in public-private partnership at market conditions involving an ESCo. As a matter of fact, as verified in previous experience of the project Partners, the typical energy savings threshold typically obtainable at market conditions is around 30%-40%. Further energy savings are therefore achievable only by realizing

[24] Such a situation is the case for the majority of the projects

[25] As shown in Paragraph 3, a 1,5% interest rate was assumed.

[26] The analysis of the different financial instruments will be carried out in WP3.

more investments that are not always feasible at market conditions and that usually need to be financed with specific ad-hoc financial instruments or public grant.

Given the analyzed sample, in the majority of the cases it emerged that, in order to make the projects attractive for the market, there was the need of structuring a very strong financial support with important percentages of public grant and subsidized funds while reducing the percentage of equity invested (this never lower than 8%/10%).

These results underline some limits:

- the amount of public grant needed for the realization of nZEB projects is too high, also considering the current situation of Municipality's lack of financial resources
- the activation of a public-private partnership with an equity invested by the ESCo at 10% of total investment is not feasible at market conditions but should only be possible if subsidized lending is available

In order to investigate some alternative scenarios and understand which could the financial solutions be, an analysis was made to verify if there are some projects:

c) whose investment could be realized in two complementary ways: investments that are not sustainable at market conditions to be covered by the Municipality with own capital while the others to be covered by the ESCo (Scenario 1)

d) that, given the involvement in the capital of the ESCo of some distinctive investors with lower return expectation (around 4% IRR), should be developed with a financial structure more feasible on the market (Scenario 2)

Case a) represents uniquely a theoretical example because the share of investment that should be taken in charge by the Municipality is very high. Thus, a public-private partnership is not likely to be activated just for a residual part of total investments. A simple reason is that in this moment one of the main problems of the Municipalities is the lack of financial resources. In addition, this solution needs major efforts to organize the realization of each layer of the project, which may depend on different subjects, and to manage different construction timing.

Case b) shows that the involvement of an investor with low return expectation, the increase in equity and subsidized funds could avoid the recourse on public grant. In facts, the use of subsided funds is generally preferable with respect to grants because of the revolving mechanism that allows the lender to reinvest the proceeds from the loan in other projects.

In summary, the results of the analysis of the twelve projects are the following:

- Only one project is market sustainable and attractiveness with a market financial structure
- One project is feasible/sustainable on the market only if some subsidized funds have been added up
- Subsidized Funds and Grant are needed for the other ten projects:
  - Percentage range for Subsidizes Fund: 24% to 50%
  - Percentage range for Grant: 15% to 88%
  - Five projects are feasible/sustainable on the market using both Subsides Funds and Grant
  - Three projects are partially feasible/sustainable using both Subsides Funds and Grant
  - Two project still remain not market sustainable even using Subsides Funds and Grant

Financial unsustainability, subject to market conditions, is mainly due to several factors:

- in the four countries, while using the same technologies, buildings' initial characteristic (e.g. construction year, size, use, climatic conditions, …) have led to different results;
- technological solutions, currently available in the market, are quite expensive if compared to savings (e.g. thermal insulation coating or windows replacing, etc.) with a negative impact on project's economic and financial sustainability;
- the cost of interventions with medium and long term payback time, for example interventions concerning the improvement of the building skin, passive or hybrid systems;
- the additional cost of special constructions or systems, compared with conventional, which are required for listed buildings;
- Energy efficiency interventions may improve the ability of Municipalities to identify appropriate maintenance frequency compared with the initial situation with an increase of maintenance annual costs entirely sustained by the ESCO. This aspect, although it initially increases public expenditure, is fundamental for the proper maintenance of the new plants.

The sample, although differentiated, is still too small, to obtain statistically robust results. However the proposed financing structure and economic results are valid and should be confirmed by all project stakeholders.

Our evaluation highlights that **financial sustainable projects** must have the following characteristics:

- A **well-defined baseline of energy consumption and maintenance costs are clearly-defined**. It is crucial to carry out a careful audit action on buildings where it's possible to intervene with nZEB solutions establishing a close cooperation between the public administration and the engineering companies in charge of technical and economic evaluation. This is the starting point to identify a solid project pipeline both in energy and economic terms, in order to set clear targets and the best technological solutions. Furthermore, Municipalities, to improve energy efficiency, should pay attention both to energy savings (e. g. fuel consumption) but also to financial savings. In particular it must be carried out a detailed assessment of energy carrier costs, in order to identify whether these are aligned (or not) with current market conditions, indeed matching market conditions may generate immediate savings for the local authorities. Usually it is recommended to separate the supply of carriers from energy efficiency contracts;

- **Layers/project must have a short pay back period.** In the CERtuS project some layers (such as building skin, passive or hybrid systems) have a long pay back period. It must be said that this kind of solutions cannot be remove. Indeed Municipalities which implement nZEB interventions often sustain additional expensive refurbishment costs (such as windows substitutions if these are obsolete) to guarantee better public services, focus the entire refurbishment in a single period and ensure best results combined with other interventions. Therefore, in order to match public needs and economic/financial sustainability of nZEB interventions, from our point of view, it is fundamental to identify additional financial tools to support the entire building refurbishment;

- **Energy savings (compared to layers costs or full projects costs) should ensure a payback period less than ten years**. In fact, as seen in these twelve projects ESCos, which achieve nZEB interventions, often get savings that do not allow the repayment of the investment in less than 20 years. This is mainly due to the fact that municipality's fees are calculated on the basis of achievable savings in order to get lower energy costs than initial consumption;

- The municipality should **aggregate projects** in order to reach a critical mass especially when their size is small. This way the Municipality could reduce the structure costs and benefit from economies of scale during construction and management period. Therefore ESCo maybe better attracted by bigger project that could provide sufficient revenues to repay the investment.

In order to encourage nZEB interventions some observations should be done. Such observations were not directly implemented within the analysis because of their characteristics but represent some further food for thought for the recovering of sustainability and for the realization of the interventions. In this sense, a list of observations follows :

- interventions to activate public - private project governance between Public Authorities, financial institutions and private entities in order to achieve clear common targets;
- increase public buildings use (subject to nZEB interventions) during different times of the day with complementary activities (e.g. sport and social activities during the evening/night, office activities during the day). Consequently the government may pay more fees to the ESCOs, fostering projects' appeal on the market;
- increase ESCo services, which, in addition to hard facility management, could offer them the possibility to carry out ancillary services such as soft facility management, (e.g. cleaning services, green care ..). This would provide additional revenues to the ESCOs, enhancing the sustainability of the initiative;
- if the initial situation of public buildings makes it difficult to implement nZEB interventions (even with a grant), a possible solution could be the sale of part of the assets and the use proceeds to intervene on the remaining buildings, using them in a more efficient and rational way (e.g. fostering their use from morning until evening);
- either when the project reaches its maturity or after a few years since the beginning of the EPC contract, a further opportunity to increase energy efficiency interventions could be the entry of financial institutions (e.g. institutional investors, funds, etc.) injecting liquidity into the ESCO. Consequently the ESCo could recover additional resources to carry out extra projects. This scheme may solve ESCO's undercapitalization or decrease their need of financial resources.

ANNEX A

In the tables "Baseline Expenditure and Post-Intervention Expenditure" the detail of ex-ante and ex-post consumption is provided, both in energetic (kWh) and economic (Euro) terms. Maintenance costs are also provided.

In the tables "Savings Evidence" an abstract of the data contained in the first table is reported and an evidence of the energy savings gained thanks to the realization of the interventions is then shown. In this table an indicator of energetic consumption for square meter is introduced, this also both in electric and thermal terms.

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Coimbra	Town Hall	**5.880**		**350.206**	**46.568**	**0**	**0**	**869**	**350.206**	**47.437**	**243.917**	**143.311**	**100.606**	**11.688**	**0**	**0**	**1.479**	**100.606**	**13.167**
			HVAC								292.834	0	292.834	34.021	0	0	869	292.834	34.890
			Lighting systems (internal)								243.917	0	243.917	28.338	0	0	869	243.917	29.207
			Renewable energy								243.917	143.311	100.606	11.688	0	0	1.479	100.606	13.167

Table 17. Coimbra _ Town Hall - Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Coimbra	Town Hall	5.880		350.206	47.437	0	60	100.606	13.167	0	17	249.600	34.880	0	0	-610	249.600	34.270	-42	71%	72%	632.068	18
			HVAC			0	0	292.834	34.890	0	50	57.372	8.017	0	0	0	57.372	8.017		16%	17%	80.209	10
			Lighting systems (internal)			0	0	243.917	29.207	0	41	106.289	14.853	0	0	0	106.289	14.853		30%	31%	97.126	7
			Renewable energy			0	0	100.606	13.167	0	17	249.600	34.880	0	0	-610	249.600	34.270		71%	72%	632.068	18

Table 18. Coimbra _ Town Hall – Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Coimbra	Municipal House of Culture	13.225		565.980	63.492	0	0	591	565.980	64.082	346.430	254.200	92.230	10.411	0	0	991	92.230	11.402
			HVAC								447.587	0	447.587	50.525	0	0	591	447.587	51.116
			Lighting systems (internal)								346.430	0	346.430	39.106	0	0	591	346.430	39.697
			Renewable energy								346.430	254.200	92.230	10.411	0	0	991	92.230	11.402

Table 19. Coimbra _ Municipal House of Culture - Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures Total kWh	Base line Expenditures Total €	Thermal kWh/m2	Elettric kWh/m2	Expenditures post-intervention Total kWh	Expenditures post-intervention Total €	Thermal kWh/m2	Elettric kWh/m2	Savings Electric Energy kWh	Savings Electric Energy €	Savings Thermal Energy kWh	Savings Thermal Energy €	Savings Maintenance €	Savings Total kWh	Savings Total €	Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments €	Energy Payback period (net maintenance) year
Municipality of Coimbra	Municipal House of Culture	13.225		565.980	64.082	0	43	92.230	11.402	0	7	473.750	53.081	0	0	-400	473.750	52.681	-36	84%	82%	338.274	6
			HVAC			0	0	447.587	51.116	0	34	118.393	13.265	0	0	0	118.393	13.265		21%	21%	126.945	10
			Lighting systems (internal)			0	0	346.430	39.697	0	26	219.550	24.599	0	0	0	219.550	24.599		39%	38%	144.066	6
			Renewable energy			0	0	92.230	11.402	0	7	473.750	53.081	0	0	-400	473.750	52.681		84%	82%	338.274	6

Table 20. Coimbra _ Municipal House of Culture – Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures Electric Energy kWh	Base line Expenditures Electric Energy €	Base line Expenditures Thermal Energy kWh	Base line Expenditures Thermal Energy €	Base line Expenditures Maintenance €	Base line Expenditures Total kWh	Base line Expenditures Total €	Expenditures post- intervention Electric Energy kWh	Expenditures post- intervention Electric Energy kWh from PV	Expenditures post- intervention Electric Energy kWh tot	Expenditures post- intervention Electric Energy €	Expenditures post- intervention Thermal Energy kWh	Expenditures post- intervention Thermal Energy €	Expenditures post- intervention Maintenance €	Expenditures post- intervention Total kWh	Expenditures post- intervention Total €
Municipality of Coimbra	Elementary school of Solum	1.655		30.749	5.561	16.775	1.446	0	47.524	7.006	32.552	17.216	15.336	2.981	0	0	200	15.336	3.181
			HVAC								35.651	0	35.651	6.929	0	0	0	35.651	6.929
			Lighting systems (internal)								32.552	0	32.552	6.327	0	0	0	32.552	6.327
			Renewable energy								32.552	17.216	15.336	2.981	0	0	200	15.336	3.181

Table 21. Coimbra _ Elementary school of Solum - Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Coimbra	Elementary school of Solum	**1.655**		**47.524**	**7.006**	**10**	**19**	**15.336**	**3.181**	**0**	**9**	**15.413**	**2.580**	**16.775**	**1.446**	**-200**	**32.188**	**3.826**	**-9**	**68%**	**55%**	**27.167**	**7**
			HVAC			**0**	**0**	35.651	6.929	0	**22**	-4.902	-821	16.775	1.446	0	11.873	625		25%	9%	5.330	9
			Lighting systems (internal)			**0**	**0**	32.552	6.327	0	**20**	3.099	519	16.775	1.446	0	19.874	1.964		42%	28%	7.704	4
			Renewable energy			**0**	**0**	15.336	3.181	0	**9**	15.413	2.580	16.775	1.446	-200	32.188	3.826		68%	55%	27.167	7

Table 22. Coimbra_ Elementary school of Solum – Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Alimos	Municipal City Hall	**1.302**		**111.965**	**16.347**	**0**	**0**	**6.500**	**111.965**	**22.847**	**28.328**	**20.900**	**7.428**	**1.084**	**0**	**0**	**3.064**	**7.428**	**4.149**
			External insulation								108.490	0	108.490	15.840	0	0	0	108.490	15.840
			Windows								107.858	0	107.858	15.747	0	0	100	107.858	15.847
			Solar gains circulation								107.607	0	107.607	15.711	0	0	100	107.607	15.811
			Shading elements								96.219	0	96.219	14.048	0	0	171	96.219	14.219
			Night Ventilation								88.195	0	88.195	12.876	0	0	421	88.195	13.298
			Replacement of heating/cooling plants								58.761	0	58.761	8.579	0	0	1.850	58.761	10.429
			Replacement of lamps (and luminaries, ballast)								39.527	0	39.527	5.771	0	0	2.050	39.527	7.821
			BMS								28.328	0	28.328	4.136	0	0	2.650	28.328	6.786
			Renewable energy								28.328	20.900	7.428	1.084	0	0	3.064	7.428	4.149

Table 23. Alimos _ Municipal City Hall - Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Alimos	Municipal City Hall	**1.302**		**111.965**	**22.847**	**0**	**86**	**7.428**	**4.149**	**0**	**6**	**104.537**	**15.263**	**0**	**0**	**3.436**	**104.537**	**18.698**	**-80**	**93%**	**82%**	**252.799**	**17**
			External insulation			**0**	**0**	108.490	15.840	0	83	3.475	507	0	0	0	3.475	507		3%	2%	67.890	134
			Windows			**0**	**0**	107.858	15.847	0	83	4.107	600	0	0	-100	4.107	500		4%	2%	112.890	188
			Solar gains circulation			**0**	**0**	107.607	15.811	0	83	4.358	636	0	0	-100	4.358	536		4%	2%	113.890	179
			Shading elements			**0**	**0**	96.219	14.219	0	74	15.746	2.299	0	0	-171	15.746	2.128		14%	9%	134.215	58
			Night Ventilation			**0**	**0**	88.195	13.298	0	68	23.770	3.471	0	0	-421	23.770	3.049		21%	13%	138.715	40
			Replacement of heating/cooling plants			**0**	**0**	58.761	10.429	0	45	53.204	7.768	0	0	-1.850	53.204	5.918		48%	26%	199.529	26
			Replacement of lamps (and luminaries, ballast)			**0**	**0**	39.527	7.821	0	30	72.438	10.576	0	0	-2.050	72.438	8.526		65%	37%	214.899	20
			BMS			**0**	**0**	28.328	6.786	0	22	83.637	12.211	0	0	-2.650	83.637	9.561		75%	42%	231.899	19
			Renewable energy			**0**	**0**	7.428	4.149	0	6	104.537	15.263	0	0	3.436	104.537	18.698		93%	82%	252.799	17

Table 24. Alimos _ Municipal City Hall – Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Alimos	Municipal Offices	**446**		**30.160**	**4.403**	**0**	**0**	**600**	**30.160**	**5.003**	**7.918**	**7.918**	**0**	**0**	**0**	**0**	**1.570**	**0**	**1.570**
			External insulation								29.146	0	29.146	4.255	0	0	0	29.146	4.255
			Windows								26.400	0	26.400	3.854	0	0	20	26.400	3.874
			Night Ventilation								25.618	0	25.618	3.740	0	0	170	25.618	3.910
			Replacement of heating/cooling plants								15.258	0	15.258	2.228	0	0	613	15.258	2.841
			Replacement of lamps (and luminaries, ballast)								11.178	0	11.178	1.632	0	0	713	11.178	2.345
			BMS								7.917	0	7.917	1.156	0	0	1.063	7.917	2.219
			Renewable energy								7.917	7.917	0	0	0	0	1.570	0	1.570

Table 25. Alimos_ Municipal offices - Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Alimos	Municipal Offices	**446**		**30.160**	**5.003**	**0**	**68**	**0**	**1.570**	**0**	**0**	**30.160**	**4.403**	**0**	**0**	**-970**	**30.160**	**3.433**	**-68**	**100%**	**69%**	**101.135**	**23**
			External insulation			**0**	**0**	29.146	4.255	0	65	1.014	148	0	0	0	1.014	148		3%	3%	21.000	142
			Windows			**0**	**0**	26.400	3.874	0	59	3.760	549	0	0	-20	3.760	529		12%	11%	31.000	56
			Night Ventilation			**0**	**0**	25.618	3.910	0	57	4.542	663	0	0	-170	4.542	493		15%	10%	34.150	51
			Replacement of heating/cooling plants			**0**	**0**	15.258	2.841	0	34	14.902	2.176	0	0	-613	14.902	1.563		49%	31%	51.670	24
			Replacement of lamps (and luminaries, ballast)			**0**	**0**	11.178	2.345	0	25	18.982	2.771	0	0	-713	18.982	2.059		63%	41%	54.955	20
			BMS			**0**	**0**	7.917	2.219	0	18	22.243	3.247	0	0	-1.063	22.243	2.185		74%	44%	63.755	20
			Renewable energy			**0**	**0**	0	1.570	0	0	30.160	4.403	0	0	-970	30.160	3.433		100%	69%	101.135	23

Table 26. Alimos_Municipal offices – Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Alimos	Municipal Library	**611**		**42.136**	**6.152**	**0**	**0**	**0**	**42.136**	**6.152**	**9.995**	**8.041**	**1.954**	**285**	**9.589**	**1.098**	**1.500**	**11.543**	**2.883**
			External insulation								42.076	0	42.076	6.143	0	0	0	42.076	6.143
			Windows								41.428	0	41.428	6.048	0	0	50	41.428	6.098
			Night Ventilation								35.389	0	35.389	5.167	0	0	200	35.389	5.367
			Replacement of cooling/heating system								18.010	0	18.010	2.629	12.307	1.409	900	30.317	4.939
			Power meter/Thermostats/Lux sensors								15.346	0	15.346	2.241	9.589	1.098	1.000	24.935	4.338
			Replacement of lamps (and luminaries, ballast)								9.417	0	9.417	1.375	9.589	1.098	1.200	19.006	3.673
			Renewable energy								9.417	8.041	1.376	201	9.589	1.098	1.500	10.965	2.799
			residual								9.995	0	1.954	285	9.590	1.098	1.500	11.544	2.883

Table 27. Alimos_ Municipal Library - Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Alimos	Municipal Library	**611**		**42.136**	**6.152**	**0**	**69**	**11.543**	**2.883**	**16**	**3**	**40.182**	**5.867**	**-9.589**	**-1.098**	**-1.500**	**30.593**	**3.269**	**-66**	**73%**	**53%**	**104.060**	**22**
			External insulation			**0**	**0**	42.076	6.143	0	69	60	9	0	0	0	60	9		0%	0%	30.900	3.470
			Windows			**0**	**0**	41.428	6.098	0	68	708	104	0	0	-50	708	54		2%	1%	71.550	691
			Night Ventilation			**0**	**0**	35.389	5.367	0	58	6.747	985	0	0	-200	6.747	785		16%	13%	75.550	77
			Replacement of cooling/heating system			**0**	**0**	30.317	4.939	20	29	24.126	3.523	-12.307	-1.409	-900	11.819	1.213		28%	20%	90.900	43
			Power meter/Thermostats/Lux sensors			**0**	**0**	24.935	4.338	16	25	26.790	3.911	-9.589	-1.098	-1.000	17.201	1.814		41%	29%	93.910	33
			Replacement of lamps (and luminaries, ballast)			**0**	**0**	19.006	3.673	16	15	32.719	4.777	-9.589	-1.098	-1.200	23.130	2.479		55%	40%	96.060	26
			Renewable energy			**0**	**0**	10.965	2.799	16	2	40.760	5.951	-9.589	-1.098	-1.500	31.171	3.353		74%	55%	104.060	21
			residual			**0**	**0**	11.544	2.883	16	3	40.182	5.867	-9.590	-1.098	-1.500	30.592	3.269		73%	53%	104.060	22

Table 28. Alimos_ Municipal Library – Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Thermal	Elettric	Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		kWh/m2	kWh/m2	Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€			kWh	Wh from P	kWh tot	€	kWh	€	€	kWh	€
Municipality of Errenteria	City Hall	**2.961**		**147.530**	**19.547**	**131.630**	**6.318**	**13.294**	**279.160**	**39.160**	**44**	**50**	**99.540**	**38.757**	**60.783**	**8.054**	**127.040**	**6.098**	**3.500**	**187.823**	**17.651**
			Condensing gas boiler								**0**	**0**	143.993	0	143.993	19.079	105.310	5.055	1.500	249.303	25.634
			LED								**0**	**0**	99.540	0	99.540	13.189	127.040	6.098	1.500	226.580	20.787
			Photovoltaic panels								**0**	**0**	99.540	38.757	60.783	8.054	127.040	6.098	3.500	187.823	17.651

Table 29. Errenteria _ City Hall – Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Expenditures post-intervention			Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintena
				Total		Maintenance	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		aintenanc	Total						
				kWh	€	€	kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Errenteria	City Hall	**2.961**		**279.160**	**39.160**	**3.500**	**187.823**	**17.651**	**43**	**21**	**86.747**	**11.494**	**4.590**	**220**	**9.794**	**91.337**	**21.508**	**-29**	**33%**	**-55%**	**169.683**	**14**
			Condensing gas boiler			1.500	249.303	25.634	36	49	3.537	468	26.320	1.263	11.794	29.857	13.526		11%	1%	9.760	6
			LED			1.500	226.580	20.787	43	34	47.990	6.358	4.590	220	11.794	52.580	18.373		19%	13%	20.253	3
			Photovoltaic panels			3.500	187.823	17.651	43	21	86.747	11.494	4.590	220	9.794	91.337	21.508		33%	-55%	169.683	14

Table 30. Errenteria _ City Hall – Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Thermal	Elettric	Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		kWh/m2	kWh/m2	Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€			kWh	Wh from P	kWh tot	€	kWh	€	€	kWh	€
Municipality of Errenteria	"Kapitain Etxea"	**395**		**14.602**	**2.258**	**54.383**	**2.991**	**3.800**	**68.985**	**9.049**	**138**	**37**	**27.455**	**3.389**	**24.067**	**3.721**	**0**	**0**	**350**	**24.067**	**4.071**
			Glazing-walls-roof								**0**	**0**	15.263	0	15.263	2.360	17.182	945	0	32.444	3.305
			HVAC								**0**	**0**	31.182	0	31.182	4.821	0	0	250	31.182	5.071
			LED								**0**	**0**	27.455	0	27.455	4.245	0	0	250	27.455	4.495
			Photovoltaic panels								**0**	**0**	27.455	3.389	24.067	3.721	0	0	350	24.067	4.071

Table 31. Errenteria - "Kapitain Extea"- Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Expenditures post-intervention			Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintena
				Total		Maintenance	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		aintenanc	Total						
				kWh	€	€	kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Errenteria	"Kapitain Etxea"	**395**		**68.985**	**9.049**	**350**	**24.067**	**4.071**	**0**	**61**	**-9.464**	**-1.463**	**54.383**	**2.991**	**3.450**	**44.919**	**4.978**	**24**	**65%**	**6%**	**111.636**	**73**
			Glazing-walls-roof			0	32.444	3.305	44	39	-660	-102	37.201	2.046	3.800	36.541	5.744		53%	21%	50.870	26
			HVAC			250	31.182	5.071	0	79	-16.580	-2.563	54.383	2.991	3.550	37.803	3.978		55%	2%	72.410	169
			LED			250	27.455	4.495	0	70	-12.853	-1.987	54.383	2.991	3.550	41.530	4.554		60%	8%	99.034	99
			Photovoltaic panels			350	24.067	4.071	0	61	-9.464	-1.463	54.383	2.991	3.450	44.919	4.978		65%	6%	111.636	73

Table 32. Errenteria - "Kapitain Extea"- Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Thermal	Elettric	Expenditures post- intervention									
				Electric Energy		Thermal Energy		Maintenance	Total		kWh/m2	kWh/m2	Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€			kWh	Wh from P	kWh tot	€	kWh	€	€	kWh	€
Municipality of Errenteria	"Lekuona"	**4.406**		**332.279**	**42.798**	**0**	**0**	**20.000**	**332.279**	**62.798**	**0**	**75**	**332.279**	**35.745**	**296.534**	**38.194**	**0**	**0**	**20.900**	**296.534**	**59.094**
			PV								**0**	**0**	332.279	35.745	296.534	38.194	0	0	20.900	296.534	59.094

Table 33. Errenteria - Lekuona"- Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Expenditures post-intervention			Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintena
				Total		Maintenance	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€	€	kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Errenteria	"Lekuona"	**4.406**		**332.279**	**62.798**	**20.900**	**296.534**	**59.094**	**0**	**67**	**35.745**	**4.604**	**0**	**0**	**-900**	**35.745**	**3.704**	**-8**	**11%**	**-17%**	**126.587**	**27**
			PV			20.900	296.534	59.094	0	67	35.745	**4.604**	0	0	-900	35.745	3.704		11%	-17%	126.587	27

Table 34. Errenteria - Lekuona"- Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Messina	City Hall "Palazzo Zanca"	**13.500**		**2.912.933**	**524.328**	**0**	**0**	**135.000**	**2.912.933**	**659.328**	**1.483.062**	**88.944**	**1.394.118**	**250.941**	**0**	**0**	**75.618**	**1.483.062**	**326.559**
			Compression heat pumps - VRV system - OFFICES AREAS								2.903.199	0	2.903.199	522.576	0	0	11.790	2.903.199	534.366
			Compression heat pumps - VRV system - NEW CIRCULATION AREAS								2.903.199	0	2.903.199	522.576	0	0	29.362	2.903.199	551.937
			Compression heat pumps - VRV system - OFFICES AREAS								2.710.461	0	2.710.461	487.883	0	0	38.341	2.710.461	526.224
			Horizontal structures on roofs - False Ceiling OFFICE AREAS								2.617.013	0	2.617.013	471.062	0	0	44.784	2.617.013	515.847
			Horizontal structures on roofs - False Ceiling CIRCULATION AREAS								2.617.013	0	2.617.013	471.062	0	0	47.241	2.617.013	518.303
			Double glass								2.523.565	0	2.523.565	454.242	0	0	58.836	2.523.565	513.078
			LED								1.537.167	0	1.537.167	276.690	0	0	63.618	1.537.167	340.308
			BACS								1.537.167	0	1.537.167	276.690	0	0	65.118	1.537.167	341.808
			Photovoltaic panels								1.537.167	88.944	1.448.223	260.680	0	0	75.618	1.448.223	336.298
			Residual								1.483.062	0	1.394.118	250.941	0	0	75.618	1.483.062	326.559

Table 35. Messina - "Palazzo Zanca" - Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Messina	City Hall "Palazzo Zanca"	**13.500**		**2.912.933**	**659.328**	**0**	**216**	**1.483.062**	**326.559**	**0**	**103**	**1.518.815**	**273.387**	**0**	**0**	**59.382**	**1.518.815**	**332.769**	**-113**	**52%**	**50%**	**3.507.135**	**13**
			Compression heat pumps - VRV system - OFFICES AREAS			**0**	**0**	2.903.199	534.366	0	215	9.734	1.752	0	0	-11.790	9.734	-10.038		0%	-2%	393.361	225
			Compression heat pumps - VRV system - NEW CIRCULATION AREAS			**0**	**0**	2.903.199	551.937	0	215	9.734	1.752	0	0	-29.362	9.734	-27.610		0%	-4%	947.207	541
			Compression heat pumps - VRV system - OFFICES AREAS			**0**	**0**	2.710.461	526.224	0	201	202.471	36.445	0	0	-38.341	202.471	-1.896		7%	0%	1.200.000	33
			Horizontal structures on roofs - False Ceiling OFFICE AREAS			**0**	**0**	2.617.013	515.847	0	194	295.920	53.266	0	0	-44.784	295.920	8.481		10%	1%	1.444.352	27
			Horizontal structures on roofs - False Ceiling CIRCULATION AREAS			**0**	**0**	2.617.013	518.303	0	194	295.920	53.266	0	0	-47.241	295.920	6.025		10%	1%	1.519.985	29
			Double glass			**0**	**0**	2.523.565	513.078	0	187	389.368	70.086	0	0	-58.836	389.368	11.250		13%	2%	3.039.135	43
			LED			**0**	**0**	1.537.167	340.308	0	114	1.375.766	247.638	0	0	-63.618	1.375.766	184.020		47%	28%	3.360.135	14
			BACS			**0**	**0**	1.537.167	341.808	0	114	1.375.766	247.638	0	0	-65.118	1.375.766	182.520		47%	28%	3.385.135	14
			Photovoltaic panels			**0**	**0**	1.448.223	336.298	0	107	1.464.710	263.648	0	0	-75.618	1.464.710	188.030		50%	29%	3.507.135	13
			Residual			**0**	**0**	1.483.062	326.559	0	103	1.518.815	273.387	0	0	59.382	1.518.815	332.769		52%	50%	0	13

Table 36. Messina - “Palazzo Zanca” - Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Messina	"Palazzo Satellite"	**6.870**		**1.872.943**	**337.130**	**0**	**0**	**42.500**	**1.872.943**	**379.630**	**738.260**	**147.223**	**591.037**	**106.387**	**0**	**0**	**88.577**	**591.037**	**194.964**
			Compression heat pumps - VRV system - OFFICES AREAS								1.766.099	0	1.766.099	317.898	0	0	13.643	1.766.099	331.541
			New facades - External wall, windows, green wall								1.623.639	0	1.623.639	292.255	0	0	39.441	1.623.639	331.697
			Horizontal structures on roofs - NEW FV COVER SHELTER								1.570.217	0	1.570.217	282.639	0	0	54.041	1.570.217	336.681
			Horizontal structures on floors - WATERPROOFING FOUNDATIONS and FOUNDATIONS STRUCTURAL RENOVATION								1.552.410	0	1.552.410	279.434	0	0	62.034	1.552.410	341.468
			LED								811.344	0	811.344	146.042	0	0	64.844	811.344	210.886
			BACS								775.729	0	775.729	139.631	0	0	66.077	775.729	205.708
			Photovoltaic panels								775.729	147.223	628.506	113.131	0	0	88.577	628.506	201.708
			Residual								738.260	0	591.037	106.387	0	0	88.577	591.037	194.964

Table 37. Messina - "Palazzo Satellite"- Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Messina	"Palazzo Satellite"	6.870		1.872.943	379.630	0	273	591.037	194.964	0	86	1.281.906	230.743	0	0	-46.077	1.281.906	184.666	-187	68%	49%	2.622.437	11
			Compression heat pumps - VRV system - OFFICES AREAS			0	0	1.766.099	331.541	0	257	106.844	19.232	0	0	-13.643	106.844	5.589		6%	1%	500.000	26
			New facades - External wall, windows, green wall			0	0	1.623.639	331.697	0	236	249.304	44.875	0	0	-39.441	249.304	5.433		13%	1%	1.514.929	34
			Horizontal structures on roofs - NEW FV COVER SHELTER			0	0	1.570.217	336.681	0	229	302.726	54.491	0	0	-54.041	302.726	449		16%	0%	1.831.237	34
			Horizontal structures on floors - WATERPROOFING FOUNDATIONS and FOUNDATIONS STRUCTURAL RENOVATION			0	0	1.552.410	341.468	0	226	320.533	57.696	0	0	-62.034	320.533	-4.338		17%	-1%	2.191.237	38
			LED			0	0	811.344	210.886	0	118	1.061.599	191.088	0	0	-64.844	1.061.599	126.244		57%	33%	2.292.437	12
			BACS			0	0	775.729	205.708	0	113	1.097.214	197.499	0	0	-66.077	1.097.214	131.421		59%	35%	2.312.437	12
			Photovoltaic panels			0	0	628.506	201.708	0	91	1.244.437	223.999	0	0	-88.577	1.244.437	135.421		66%	36%	2.622.437	12
			Residual			0	0	591.037	194.964	0	86	1.281.906	230.743	0	0	-46.077	1.281.906	184.666		68%	49%	0	11

Table 38. Messina - "Palazzo Satellite"- Savings Evidence

Property	Building name	M2	Interventions/Layers	Base line Expenditures							Expenditures post- intervention								
				Electric Energy		Thermal Energy		Maintenance	Total		Electric Energy				Thermal Energy		Maintenance	Total	
				kWh	€	kWh	€	€	kWh	€	kWh	kWh from PV	kWh tot	€	kWh	€	€	kWh	€
Municipality of Messina	"Palacultura"	**10.300**		**885.469**	**159.384**	**0**	**0**	**30.000**	**885.469**	**189.384**	**667.825**	**36.235**	**631.590**	**113.686**	**0**	**0**	**33.377**	**631.590**	**147.063**
			INTERNAL INSULATION OF WALLS and COVER BLOCK ESCALATORS - GREEN ROOF								830.629	0	830.629	149.513	0	0	13.876	830.629	163.389
			Double glass NEW WINDOWS + curtain film								775.788	0	775.788	139.642	0	0	21.286	775.788	160.928
			LED								716.730	0	716.730	129.011	0	0	26.177	716.730	155.188
			Photovoltaic panels PV PLANT								716.730	36.235	680.495	122.489	0	0	33.377	680.495	155.866
			Residual								667.825	0	631.590	113.686	0	0	0	631.590	147.063

Table 39. Messina - “Palacultura”– Baseline Expenditure and Expenditure Post – Intervention

Property	Building name	M2	Interventions/Layers	Base line Expenditures		Thermal	Elettric	Expenditures post-intervention		Thermal	Elettric	Savings							Differenza post -pre kWh/m2	% Saving kWh	% Saving €	Cost of Planned Investments	Energy Payback period (net maintenance)
				Total		kWh/m2	kWh/m2	Total		kWh/m2	kWh/m2	Electric Energy		Thermal Energy		Maintenance	Total						
				kWh	€			kWh	€			kWh	€	kWh	€	€	kWh	€				€	year
Municipality of Messina	"Palacultura"	**10.300**		**885.469**	**189.384**	**0**	**86**	**631.590**	**147.063**	**0**	**61**	**253.879**	**45.698**	**0**	**0**	**-3.377**	**253.879**	**42.321**	**-25**	**29%**	**22%**	**954.410**	**21**
			INTERNAL INSULATION OF WALLS and COVER BLOCK ESCALATORS - GREEN ROOF			**0**	**0**	830.629	163.389	0	81	54.841	9.871	0	0	-13.876	54.841	-4.005		6%	-2%	354.210	36
			Double glass NEW WINDOWS + curtain film			**0**	**0**	775.788	160.928	0	75	109.681	19.743	0	0	-21.286	109.681	-1.544		12%	-1%	562.210	28
			LED			**0**	**0**	716.730	155.188	0	70	168.739	30.373	0	0	-26.177	168.739	4.196		19%	2%	898.410	30
			Photovoltaic panels PV PLANT			**0**	**0**	680.495	155.866	0	66	204.974	36.895	0	0	-33.377	204.974	3.519		23%	2%	954.410	26
			Residual			**0**	**0**	631.590	147.063	0	61	253.879	45.698	0	0	-3.377	253.879	42.321		29%	22%	0	21

Table 40. Messina _ “Palacultura”– Savings Evidence

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