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D3.4 -
Calculations on Reference Buildings and Identification of Optimal Integrated Packages of Solutions.

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PUBLISHABLE EXECUTIVE SUMMARY

The HAPPEN project is aimed at stimulating the market uptake of deep retrofitting of buildings, with special regard to the Mediterranean area and to the residential built stock, by tackling major bottlenecks such as the fragmentation of the supply chain, the lack of transparency and of the perceived reliability of the interventions, of adequate financial support mechanisms, of integration among the relevant aspects connected to retrofitting, the low return on investments, or the lack of a retrofit approach clearly tailored for the Med environments. To this extent, the project will be acting on the following complementary themes: engagement and empowerment of target groups such as owners, inhabitants, building professionals; technological insight for the development of optimized one-stop shop packages of solutions for deep and beyond retrofitting; financial solutions for supporting the market uptake of deep retrofitting, and proposal of suitable changes in the regulatory frameworks.

In the above described Project framework, the definition of different suitable retrofitting options for each reference building into a specific climate and "integrated sets of renovation measures" plays a pivotal role. This deliverable is related to the Work Package 3 entitled "Optimal Solutions", in particular to the Task T3.3, whose title is "Calculation on reference buildings and identification of optimal integrated packages of solutions".

The aim of this Deliverable is to provide the definition of an extensive set of cost-optimal packages of solutions to be applied to refurbish the existing building stock of buildings with reference to the different target building typologies and climates. A total of 16 packages of optimal solutions have been identified for 4 reference buildings and 4 reference climates in the Mediterranean Region. Each one of these solutions is composed of 12 combinations of renovation measures that minimize the Life Cicle Cost of the building in a 30 years of time period. The renovations measures and their respective costs have been selected from the abacus which was the main result of the task 3.2 and was reported in the deliverable D3.3. The set of 16 packages of optimal solution have been validated for the rest of reference buildings (42) and climates (13) combinations, providing a total of 546 cases where the POS have been proven to perform properly. Alternative packages of optimal solutions depending on the inhabitant's use of the building and the orientation of the windows and façades are provided as well. In order to make the process of renovation more affordable, a ste-by-step approach has been proposed. This consists in spliting the package of optimal solutions in two, proposing a set of measures to be implemented in a first step and another set of measures in a second step; the improvements in the HVAC and DHW are always taken into account in the third and last step. Finally, a methodology for including the Excel files that have been used for creating the POS is proposed in order to give to a potential advance user of the HAPPEN platform the possibility of modify some parameters like energy source, energy prices, conversion factors, cost of the renovation measures, and create a tailored POS.

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ACRONYMS AND ABBREVIATIONS

All acronyms and abbreviations (AAs) used in the report should be listed in alphabetical order in the table below (other than symbols for units of measurement) in the following way:

BAT(s)	Best available technology
COP	Coeficient of Performance
DHW	Domestic Hot Water
EER	Energy Efficiency Ratio
GCS	Global Climatic Severity
HVAC	Heating, Ventilation and Air Conditioning
MS	Member States
PBs	Pilot Buildings
POS	Packages of Optimal solutions
RBs	Reference Buildings
RCs	Reference Climates
SCS	Summer Climatic Severity
WCS	Winter Climatic Severity

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1 INTRODUCTION

1.1 Aims and objectives

About 35% of the EU buildings, at present, are over 50 years old, almost 75% of the building stock is energy inefficient. 75%-85% of those buildings will be still in use in 2050 [1,2]. At the same time, only 0.4-1.2% (depending on the country) of the building stock is renovated each year. Therefore, Europe is facing now more than pressing challenge to triple the current renovation rate, from 1.2% per annum to 2-3%, in order to meet its climate and energy goals, mitigate climate change and get on track to limit global temperature increase to 1,5°C as agreed in the Paris Agreement in December 2015.

Tackling this challenge would not only be beneficial for the climate, but first and foremost for the people living, working and using these buildings: inadequate and poor housing causes high energy bills, health issues and a lower quality of life.

For owners, inhabitant's and building managers, the renovation process can seem complicated, due to the ambiguity of the interventions to implement, a lack of knowledge on the existing solutions and their implementation and installation costs, as well as a lack of enterprises that provide services to coordinate all the required market actors involved in the renovation process and works. This often results in lengthy, time-consuming and expensive renovation processes.

Thus, in one hand, renovating the existing building stock represents an extraordinary opportunity, with the potential to boost the economy and generate local jobs. The energy renovation market plays an important role in the economy, amounting to a value of €109 billion and generating 882.900 jobs in Europe (2015) [1] and its potential is far greater [2].

On the other hand, renovation of existing buildings can lead to significant energy savings and is of a paramount importance when considering the clean energy transition, as it could reduce the EU's total energy consumption by 5-6% and lower CO_2 emissions by about 5%.
In addition to energy efficiency gains, a renovated building stock can also:
-create economic, social and environmental benefits;
-contribute to the improved health, comfort and wellbeing of their residents by reducing respiratory and other illnesses caused by a poor indoor climate;
-make homes more affordable and help households escape energy poverty.

In order to boost energy performance of buildings the EU has established a legislative framework that includes the Energy performance of buildings directive (EPBD) (2010/31/EU) and the Energy efficiency directive (2012/27/EU). Both directives were recently amended as part of the"Clean energy for all Europeans package" and both of them promote policies that will help achieving a highly energy efficient and decarbonised building stock by 2050, creating a stable environment for investment decisions to be taken and that will enable consumers and businesses to make more informed choices for saving energy and money.
In particular, the 2010 EPBD recast requests that Member States ensure that minimum energy performance requirements for buildings are set "with a view to achieving cost-optimal levels". The cost-optimal level shall be calculated in accordance with a comparative methodology established by the EU Commission. According to this methodology, each Member State has to:

- Define the reference buildings;
- Define energy efficiency measures to be assessed for the reference buildings: these can be measures for buildings as a whole, for building elements or for a combination of building elements;
- Assess the final primary energy need of these reference buildings;
- Calculate the costs of energy efficiency measures during the expected economic lifecycle of the reference buildings.

The term "cost optimal level "points out "the energy performance level, which leads to the lowest global cost during the economic lifecycle" as written in the EPBD recast 2010. As it can be read in this Directive, the Energy Efficiency Measures should be assessed as a single measure or as a package of measures, for selected reference buildings as a whole and /or for building elements. The measures defined should cover building envelope design alternatives and high-efficiency alternative solutions, also including renewable energy sources. The number of measures for each reference building has to be equal or higher than ten packages or variants.

However, when considering the building renovation process, the reality for many building owners is that it is not easy from a financial and logistic point of view to carry out a complete deep energy retrofit in one step. More common are step-by step retrofit which are partial retrofit steps completed over time.
In this context, the definition of integrated and holistic cost optimal packages of solutions plays a pivotal role into Happen to answer the EPBD Recast Request. In particular, beyond the definition of reference climate conditions, the reference building typologies evaluated through a deep analysis of the existing building stock in each country involved, the Work Package 3 activities are aimed at the identification of integrated renovation measures synthesized into an "Abacus/Matrix" of Renovation Measures. These renovation measures are assembled with a holistic approach by employing a multilevel, pyramidal structure.
At the top of the pyramid there is level zero, in which the building, the behavioural issues and urban environment at a district scale are set. The building is then divided in subparts: the envelope and the technical systems, which are both set on level one.

The components at level one are furtherly split up in another level, that is the final level two, in which the BATs for the renovation measures are extensively detailed.
When considering the level two of the building, renovation measures for the external walls, roof, heating and cooling systems are presented. In order to take into account the country specific peculiarities, each partner country provided its own contribution to the abacus construction. Non-technical aspects as the wellbeing of lived-in spaces and the quality of life at neighborhood/ district level have been evaluated.

The definition of the Packages of Optimal Solutions represents the main aim of this document and of the Task T3.3 of the Project. Starting from a literature survey, the HAPPEN multilevel approach is presented and extensively described in the deliverable. Different optimal solutions will be proposed considering the climate, the typology of the buildings, their orientation and the inhabitant`s behaviour.
Each POS is identified as a combination of renovation measures that minimize the Life cycle cost (LCC) of the building in 30 years' time. Thus, in this deliverable summarizes the cost-optimality evaluation of the combinations of the renovation measures identified in the D3.3 "Abacus of renovations measures" (about 142500 combinations per building and climate) according to the main European standards (EN 15459 and EN 15603).

1.2 Relations to other documents

1.2.1 Legal Framework

The Consortium and Project activities are regulated under the following legal framework:

- The Grant Agreement (GA) - contract between the Commission and the Consortium, especially relevant Annex 1 (also known as Description of Action - DoA);
- The Consortium Agreement (CA) - agreement among the Consortium members.

1.2.2 Other Project Documents

This deliverable is related to the following documents:

WP(3) Title: Optimal Solutions

- D(3).1 Report on representative climates and zoning;
- D(3).2 Catalogue of reference building classes in Mediterranean countries
- D(3).3 Abacus of renovation measures at building and district scale

1.3 Report structure

This report is divided into six main paragraphs. Starting from the introduction in which the main aim and objective of the document are described, a brief literature survey is provided. The benchmark European projects and the outcomes of selected papers referring to the cost optimal building renovation targeted for the Mediterranean Area are presented in the second subsection. On the basis of the available results, the HAPPEN approach employed to conceive the Abacus of Renovation Measures is depicted in the third paragraph. The identification of the Packages of Optimal Solutions to be applied for the first selection of reference builings and reference climates is carried out in the fourth paragraph. The way of splitting these packages in a step-by-step approach is described in the following subsection of this chapter. The valiadation of the preliminary set of POS in all the possible combinations of reference buildings and reference climates is then presented including a table which identifies the POS providing the best performance for each combination. The utilization of the POS in the HAPPEN platform is shown in chapter 5. Finally, in the sixth chapter, the main conclusions obtained throughout the process are explained.

2 PACKAGES OF OPTIMAL SOLUTIONS: BACKGROUND ANALYSIS

2.1 – Benchmark Projects

2.1.1 ExcEED Project

The "European Energy Efficient building district Database" project, established a robust and durable return of knowledge mechanism collecting actual buildings energy performance data and providing information to designers, energy managers and policy makers. http://www.exceedproject.eu/

2.1.2 EuCalc Project

The EUCalc project develops trade-offs and pathways towards a sustainable and low-carbon Europe. http://www.european-calculator.eu. Next figure summarizes the buildings WP timeline and highlights key milestones and expected outcomes.

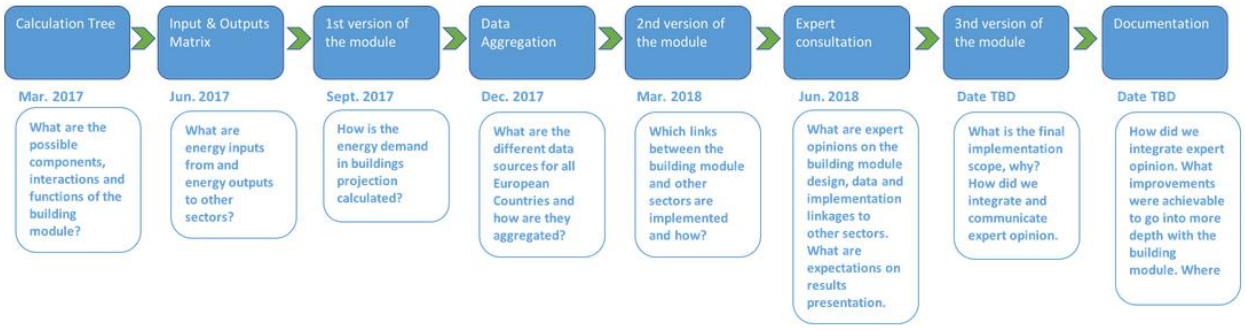

Figure 1- Buildings work-package timeline of the EuCalc project

The building calculation model includes the calculations of the energy demand of a country on the basis of its total floor area, the share of single- and multi-family buildings, and their respective energy need (useful energy demand). In order to obtain the delivered energy (final energy demand), the energy need for each building type is multiplied by the the share of the heating systems (energy mix), and their efficiency. The limitation of this project is that the reduction of the energy demand achievable by the renovation of the existing building stock is not taken into account.

2.1.3 Turnkey Retrofit Project

The Horizon2020-funded Turnkey Retrofit project, a service-oriented model, offers homeowners tailor-made solutions aiming to make the complex and fragmented renovation process simple, straightforward and attractive. This digital tool, targeting single-family and multi-family housing, considers energy efficiency improvements as well as other aspects such as accessibility and security, indoor comfort and more. https://www.turnkey-retrofit.eu/ . This project is very interesting and has a lot of common points with HAPPEN however the technical identification of building stock characteristics is limited and does not allow to define reference buildings in which the renovation measures could be analyzed in detail so as to obtain optimal packages of renovation solutions (POS).

2.1.4 EmBuild Project

EmBuild supported public authorities in Southeast European countries to prepare long-term strategies to mobilise investment in energy efficient renovation. http://embuild.eu/. The proposed renovation plans of this project are limited to some locations in Serbia, Croatia, Bulgary, Slovenia, Romania, and Germany. In this framework the regions mainly tackled in this project are complementary to the MED area which is the main focus of the HAPPEN project. The renovation plans are written in local languages and using different methooldogies, therefore they can not be extended and possibly adapted easily to other regions or case-study applications.

2.1.5 CommON Energy Project

CommONEnergy aims to convert EU shopping malls into energy efficiency lighthouses. http://www.commonenergyproject.eu/. The project focuses on transforming shopping centres into energy efficient and high-indoor-environmental-quality buildings, by developing smart renovation strategies and solutions supporting their implementation and assessing their environmental and social impact. The target of this project is represented by shopping malls instead of residential buildings, thus the technologies developed and installed in this typology of building is not applicable to residential buildings. Nevertheless, common goals to the HAPPEN project in terms of payback period (reduced to 7 years) and reduction of energy demand (75%) can be found. The methodology is completely different because in this project the packages of optimal measures are not assessed for pilot buildings in reference climates.

2.1.6 EPISCOPE Project

The overall strategic objective of the EPISCOPE project is to make the energy refurbishment processes in the European housing sector transparent and effective. This would help to ensure that the climate protection targets will actually be achieved and that corrective or enhancement actions can be taken in due time, if necessary.

The starting point was the TABULA concept of residential building typologies which was continued and expanded. As a further step, the objective was extended towards the elaboration of building stock models to assess refurbishment processes and project the future energy consumption. Case studies were conducted in 16 countries to track the implementation of energy saving measures and their effect on the consumption in practice.

A main outcome is a concerted set of energy performance indicators which shall enable key actors and stakeholders on different levels to ensure a high quality of energy refurbishments, the compliance with regulations, to track and steer the refurbishment processes in a cost-efficient way and to evaluate the actually achieved energy savings. A long-term objective was to install bottom up monitoring procedures in each European country in different fields: in energy certificate databases, representative surveys, regional or national census, heating or energy bills, strategic asset development, energy management. https://episcope.eu/welcome/. This is an extremely interesting project from the residential building typologies and the set of indicators proposed. In fact, the results of this project were used to define the reference buildings (RB) in deliverable 3.2. Nevertheless, a lack of a complete database or renovation measures and their prices as well as a lack of climatic characterization was identified in order to improved the HAPPEN project outputs.

2.1.7 EASEE Project

The EASEE project develops a new holistic approach to energy efficient envelope retrofitting of multi-storey and multi-owner buildings built before 1975.
The tool-kit developed to retrofit envelopes of existing multi-storey and multi-owner buildings combines novel design and assessment strategies, modular prefabricated elements, advanced insulating materials and new scaffolding-free installation approaches, to reduce energy demand, minimising the impact on occupants while preserving the façade original appearance.
In particular, the project targets residential buildings with cavity walls built before 70's. These buildings require façade retrofitting for technical reasons or improvements in the insulation and energy efficiency to reduce the energy demand, while the conservation of the building appearance is necessary.
This project was developed between 2012 and 2016 and its limitations were the focus on only 3 components of the envelope: the outer façade, the cavity walls and the interior envelope. Thus, the new range of specific solutions developed within the project was not successful as they have not been placedinto the market.
Some common goals with HAPPEN are found in this project with an overall retrofitting cost over the whole life cycle and considering a total cost of ownership up to 120 Euro/m^2 allowing a return on investment below 7 years.

2.1.8 Interset Project

This project was developed between 2002 and 2004, and was focused on the renovation of existing building considering them as part of a settlement. Thus, this is probably the older precursor of thew HAPPEN project that deals with buildings integrated in a neighbourhood and including improvement measures that include the built environment. Software tools and computers did not allow at that time the massive calculations which have been carried out in the HAPPEN project.

2.1.9 EnerPhit Project

A step-by-step certification process of the retrofitting plan was proposed and checked. Once the first step is completed, a preliminary certification can be issued. A schematic representation of the Enerphit certification Process is provided in Figure 2
The criteria, which a refurbished building has to achieve in order to be awarded of the certificate are based on energetic aspects.

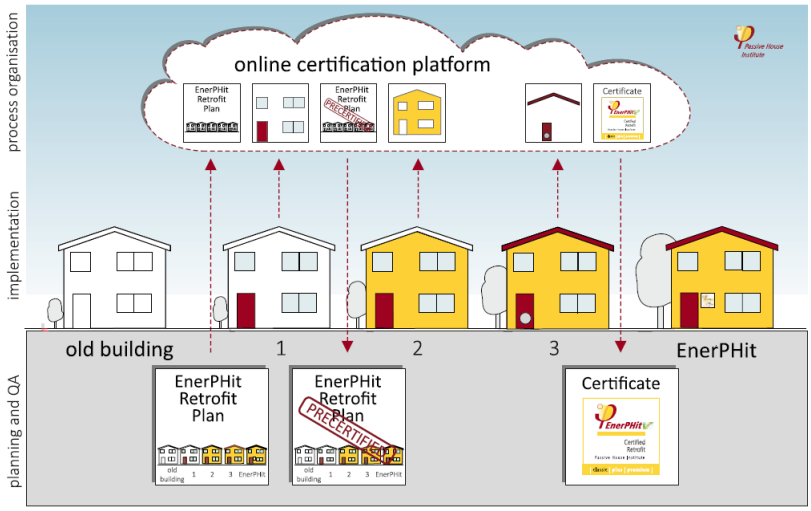

Figure 2- Schematic representation of the certification process

2.2 – Literature overview at a glance

In this section the main outcomes of the papers available in the literature are added. In particular, the papers targeted to the building renovation in Europe in general and those focused on the Mediterranean Area are reviewed. The analysis of the above mentioned papers is reported below.

2.2.1 Cost-optimality in building renovations

In 2010 the Building Performance Institute Europe[1] published this document which has been the major reference for the methodology followed in the drafting of this deliverable.
The metholodogy proposed is based on the requirements of the EPBD directive[2] in Annex III, the Commission Delegated Regulation 244/2012[3], and on the additional guidance document on how to implement the methodology at national level that was published by the EU Commission in April 2012[4].
Figure 3 represents the typology of graphics required to identify the optimal region. A variable related to the energy requirements of the building is used usually in the x-axis, as for example energy needs, the primary energy consumption or the final energy consumption. An economic variable is employed in the y-axis, as for example the life cycle cost or the global costs.

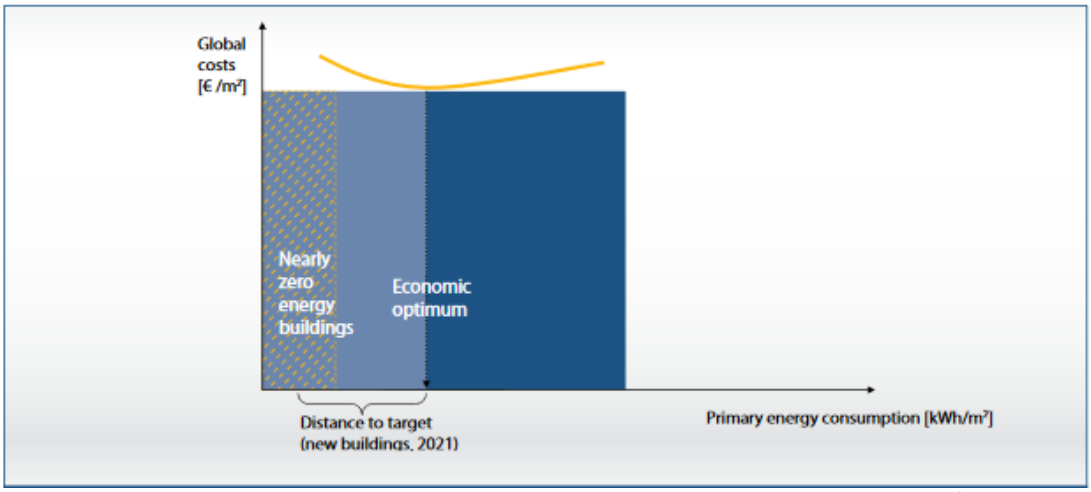

Figure 3- Schematic representation of the optimization process. Source: BPIE, 2010[1]

[1] BPIE (2010). Cost optimality. Discussing methodology and challenges within the recast Energy Performance of Building Directive. http://bpie.eu/wp-content/uploads/2015/10/BPIE_costoptimality_publication2010.pdf. Accessed Jan 2020.

[2] Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.156.01.0075.01.ENG. Accessed Jan 2020.

[3] Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1580302850455&uri=CELEX:32012R0244

[4] Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52012XC0419%2802%29

2.2.2 Implementing the cost-optimality methodology in EU countries

In 2010 the Building Performance Institute Europe[5] published this report which describes the degree of flexibility for Member States when the EPBD directive has to be applied, regarding the selection of input data for the calculation, the reference buildings selection, energy costs, etc. Through this report BPIE intended to provide practical examples on how to effectively implement the cost-optimal methodology at national level on the belief that Member States would benefit from additional guidance on the cost-optimality process and on how to use the methodology relating to nearly Zero-Energy Buildings (nZEB) requirements and long-term climate goals.

Three case studies were analyzed with the support of consultants from Austria (e-sieben), Germany (IWU) and Poland (BuildDesk), focusing on cost-optimal calculations for multi-family and / or single-family buildings. The report and case studies demonstrate how ambitious yet affordable cost-optimal energy performance requirements for buildings can be, and how to support the transition towards nearly Zero-Energy Buildings (nZEBs).

Only 1 SFH and 1 MFH were considered in the German case.
Six U-values were considered for roofs, upper ceiling, walls, cellar ceiling, windows, rooflight and front door. The way of obtaining these values is not reported, the price used to implement these measures is evaluated in € per m^2K/W or € per cm/m^2. Twelve different HVAC/DHW production systems were considered. They artificially rotated the SFH to allow for the installation of PV panels. They recommended to use models designed by architects with common and simple geometries.
Figure 4 shows the results for the MFH. It is important to observe the relative low number of points calculated, the dependence of the optimum on the HVAC/DHW system.
As we can read in the above mentoned document, the cost optimal level for SFH and MFH is represented by a package composed by thermal insulation standard with U-values at 85% of the EnEV 2009 for reference building, combined with a condensing boiler and with solar heating system (4th data point of the curve – BWK+Sol / primary demand approx. 53-54 kWh/m^2yr).
Packages based on combinations of thermal insulation measures with wood pellet boilers (curves with green colour) or electric heat pumps (curves with brown colour) have nearly comparable global costs for both SFH and MFH. The global costs are nevertheless higher than those of packages including condensing boilers (curves with blue colour), but the primary energy demand values are lower, especially for heat supply systems with wood pellet boilers. The global cost differences are more significant for the SFH than in the MFH (due to lower investment costs per sq. meter for wood pellet boilers and electric heat pumps in the MFH).
In Annex 1 the initial investment costs are provided.

[5] BPIE (2013). Implementing the cost-optimal methodology in EU countries. Lessons learned from three case studies. http://bpie.eu/wp-content/uploads/2015/10/Implementing_Cost_Optimality.pdf . Accessed Jan 2020.

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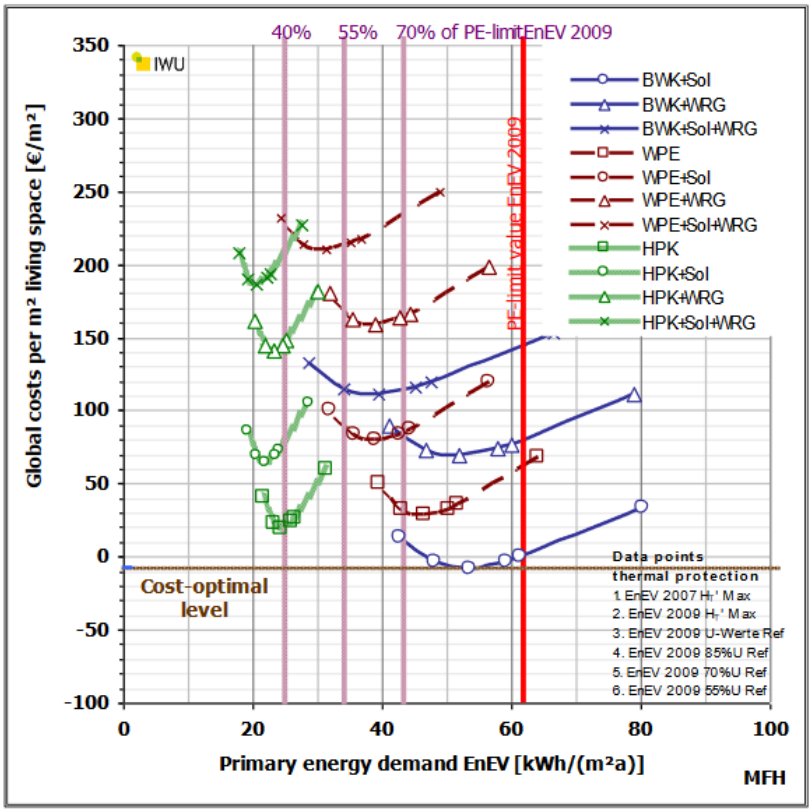

Figure 4 – Global costs MFH / all heat supply systems (one Pareto per system). Source: BPIE, 2013[6]

In the Austrian case five variants were analysed: the variant compliant with the current building regulation and four other configurations. The thermal insulation of the walls, the roofs, the basement was modified and also the windows were improved. Five different heat supply systems were considered.

[6] http://bpie.eu/wp-content/uploads/2015/10/BPIE_Cost_Optimality_Germany_Case_Study.pdf

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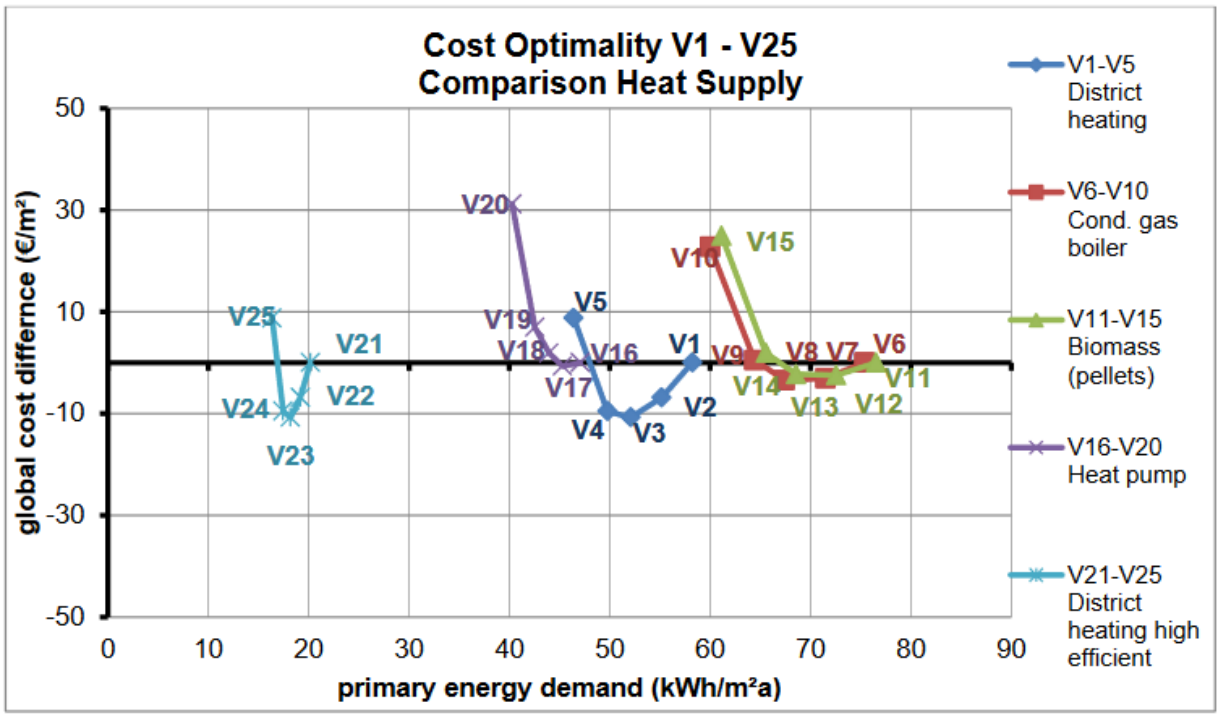

Figure 5 – Results of cost-optimality calculation for different materials – Global cost difference compared to actual minimum requirements. Source: BPIE, 2013[7]

In the Austrian case can be seen that points 3 and 4 regarding the envelope improvement are always in the optimal region (minimizing consequently the global costs) regardless of the system used for the heat supply as noted above in the German case.

All the lessons learned from these studies have been considered in the framework of the HAPPEN Project and in particular to develop this deliverable. The selection of buildings has been wide: 3 SFH and 3 MFH per country have been considered. The models have been taken from existing buildings and they have common and simple geometries. Finally, we decided to optimize the building envelope and to add the system as a variable only for the software tool, due to the fact that the combinations of measures that optimize the consumption is the same regardless ofthe system. We calculated the buildings in different orientations and considering different inhabitant's behaviours in order to have a more general perspective of the improvement measure and how the optimal solutions are influenced by these parameters.

2.2.3 Papers published in scientific journals

When searching by keywords "cost optimal renovation of buildings" in the Scopus database from Elsevier a total of 136 documents in scientific publications can be found, 86 of them are article, 39 conference papers and the rest are conference reviews, book chapters or reviews. The number of

[7] http://bpie.eu/wp-content/uploads/2015/10/BPIE_Cost_Optimality_Austria_Case_Study.pdf

scientific articles is very constant at around 20 publications per year in the last 5 years which means that this topic keeps the interest but the number of researchers that are publishing about it is moderate. Amongthese papers there are a relative high number that are focused in the social science (18), environmental science (34) and earth and planetary science (13); the main concern in these papers is not represented by the thecnical solutions that leads to the optimal renovation under the energy consumption and LCC point of view, thus we deal with 87 publications in the "energy" area and 47 in the "energy" area.

Ashort description of the most representative of them is presented below

- EPBD cost-optimal methodology: Application to the thermal rehabilitation of the building envelope or a Portuguese residential building. Energy and Buildings. Vol 111. Pp 12-25. 2016
  https://www.sciencedirect.com/science/article/pii/S0378778815303704

This paper defines the parameters needed for the EPBD phasing methodology. The results obtained by the thermal rehabilitation of the building envelope of a multifamily Portuguese residential reference building are conditioned by the reference building characteristics and by Lisbon's climatic conditions. These resultsmake it possible to identify the best cost-efficient thermal rehabilitation measures. Conclusions on cost-efficient thermal rehabilitation are as follows: (i) the thermal rehabilitation of the roof provides the greatest variation in the primary energy building consumption (and the floor measures the smallest), (ii) the combination of thermal envelope rehabilitation measures creates synergy effects that lead to better results than single measures (regarding global costs and primary energy consumption), and (iii) it is more advantageous to proceed with a thermal rehabilitation package of measures rather than doing nothing.

- Energy Cost-Efficient rehabilitation measures for the Portuguese residential builidngs constructed in the 1960-1990 Period. Sustainable construction pp 23-42. 2016
  https://link.springer.com/chapter/10.1007/978-981-10-0651-7_2

The same authors published this article in a congress and although an interpretation of the title could make us think that a whole period is considered, actually the reference building considered is representative of the whole period.

- A comparison between cost optimality and return of investment for energy retrofit in buildings- A real options perspective. Sustainable cities and society. Vol 21. Pp 12-25. 2016
  https://www.sciencedirect.com/science/article/pii/S2210670715300482

This study considers a multi-objective optimization approach to identify the minimum global cost and primary energy needs of 154,000 combinations of energy efficiency measures. The proposed model is solved by the NSGA-II multi-objective evolutionary algorithm. As a result, the cost-optimal levels and a return on investment approach are compared for a set of suitable solutions applied to

a reference building. Eighteen combinations of retrofit measures are selected and an analysis of the influence of real options on investments is proposed. The authors show that a sound methodological approach to determine the advantages of this type of investment should be offered so that Member States can provide valuable information and ensure that the minimum requirements are profitable to the majority of investors. The authors apply the methodology to a a two-bedroom single-family dwelling built before 1960. The calculations use climate data from the city of Amarante, located in central region of Portugal. A reference building representative of detached houses built before 1960 was defined.

- Cost optimality assessment of a single family house: building and technical systems solutions for the nZEB target. Energy and buildings. Vol 90. Pp 173-187. 2015 https://www.sciencedirect.com/science/article/pii/S0378778814011232

Three net zero energy balance solutions, based on all electric systems, were presented in the paper. Net ZEB solutions allowed also the building carbon footprint to be reduced by 40% compared to the reference case study. Without proper financial subsides, net ZEB solutions are still far from being economic feasible, having a global cost 212–313 €/m^2 higher than cost optimal solutions. In conclusion, this paper aims to present guidelines for designing reference building envelope and technical systems solution for residential nZEB.

- Assessment of cost-optimality and technical solutions in high performance multi-residential buildings in the Mediterranean area. Energy and buildings. Vol 102. Pp 250-265. 2015 https://www.sciencedirect.com/science/article/pii/S0378778815003370

A methodology is developed to assess energy and cost effectiveness in new buildings located in the Mediterranean area. Several energy efficiency technical variants are applied to a multi residential reference building selected as a representative model of the national building stock. Primary energy consumption and global costs are evaluated in a number of configurations to derive the cost-optimal solution.
The paper shows how to obtain economical highly efficient buildings at a design stage in case of warm climate. The selected configuration shows a decrease in primary energy consumption by 90% and CO_2 emissions by 88% with respect to the baseline building.
Results appear useful for comparison with other climates and building types. The paper also points out that the methodology is suitable to guide and support the choice of cost-effective energy efficiency measures in compliance with EU requirements.

- Comparing cost-optimal and net-zero energy targets in buildings retrofit. Building research and Information. Vol 44. Pp 188-201. Online 2014. Printed 2016. https://www.tandfonline.com/doi/abs/10.1080/09613218.2014.975412

The assessment of the most cost-effective solutions to achieve the net-zero standard was analysed by considering a multifamily building representative of the 20% of the MFH stock in Portugal, Not only the most cost-effective retrofit solutions were determined but also these net-zero solutions were compared with those resulting from the cost-optimal calculation. Both approaches lead to similar results, indicating that the transition between 'cost optimality' to 'nearly zero-energy buildings' could occur in Portugal.

- Data of cost-optimality and technical solutions for high energy performance builidngs in warm climate. Data in brief. Vol 4. Pp 222-225. 2015. https://www.sciencedirect.com/science/article/pii/S2352340915000839

The data reported in this article refers to input and output information related to the research articles entitled "Assessment of cost-optimality and technical solutions in high performance multi-residential buildings in the Mediterranean area" by Zacà et al. (Assessment of cost-optimality and technical solutions in high performance multi-residential buildings in the Mediterranean area, in press.) and related to the research article "Cost-optimal analysis and technical comparison between standard and high efficient mono residential buildings in a warm climate" by Baglivo et al. (Energy, 2015, 10.1016/j.energy.2015.02.062, in press).
A combination of technical variants has been then applied to the reference case in order to obtain several configurations to be compared in terms of primary energy consumption and global costs. The cost-optimal solution is identified by assessing technical features and energy performance. Standard and high efficiency buildings are analyzed to show how the selected configuration allows for a decrease in primary energy consumption and CO_2 emissions at the lowest cost. Results are useful for comparison with other climates and building types. They also show the feasibility of the methodology to comply with EU requirements and to support the choice of economically efficient nZEBs solutions at the design stage.

- Cost optimal building performance requirements: calculation methodology for reporting on national energy performance requirements on the basis of cost optimality. US Department of Energy Office of Scientific and Technical Information. 2011. https://www.osti.gov/etdeweb/biblio/22022553

The methodology described in this report is consistent with the description of the process as presented in the study 'Cost Optimality - Discussing methodology and challenges within the recast Energy Performance of Buildings Directive' published in September 2010 by the Buildings Performance Institute Europe (BPIE). The present document provides additional insights and details.

- Cost optimal analysis of heat pump technology adoption in residential reference buildings. Renewable Energy. Vol 60. Pp 615-624. 2013 https://www.sciencedirect.com/science/article/pii/S0960148113003066

Heat pump (HP) systems have proven to be an efficient and economically viable alternative to conventional systems to provide heating and cooling services in buildings. An effective penetration of this technology in the built environment plays a key role in achievement of the ambitious goals set by the recent EU Directives on energy efficiency and energy performance of buildings. Although this technology is very versatile, its optimal design and management are related to specific climate, operational and economic conditions. The research presented aims to evaluate the performance of technical solutions for heating and cooling in multifamily residential buildings, using a "reference building" methodology in three locations of Italy: Milan, Rome and Palermo. The comparison involves performance indicators such as primary energy consumption, CO_2 emission and net present cost.

As we can see, there are two types of publications: on one hand those regarding the cost optimal renovation of a building and on the other hand, we have those regarding a whole set of building typology in a specific region. The former are the most common, thus the work carried out in the HAPPEN project in this sense contributes to a sector that needs more general information. Our conclusion is that we have filled the gap regarding the cost optimal renovation solution for a whole set of buildings, in a wider region, considering the classic geometrical and thermal parameters but also the orientation, the inhabitant's behaviour and level of energy awareness.

3 PACKAGES OF OPTIMAL SOLUTIONS: THE HAPPEN APPROACH

3.1 – Multilevel Approach

In deliverable 3.3 a comprehensive description of the building renovation measures to be applied in each field was depicted. However, and as it was mentioned in the same deliverable, the single measures have to be grouped in packages of measures or packages of solutions in order to be more effective. A solution should be a combination of a certain number of renovation measures, one for each field considered. Also, this combination should be optimized in terms of the Life Cicle Cost (LCC), initial investment or payback period.
The methodology for the determination of a defined number of pakages of renovation measures will be explained in this chapter. This methodology is introduced with the approach employed to build the Abacus of the Packages of solutions in three steps.

3.1.1 Step 1: construction of a solution

Starting from the renovation measures individuated, -see Paragraph 5 of D3.3-, each solution is built by taking into account 12 compatible renovation measures, one for each field, as depicted, for example, in Figure 6. One renovation measure in each field is assembled, together with the others, to build a solution.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

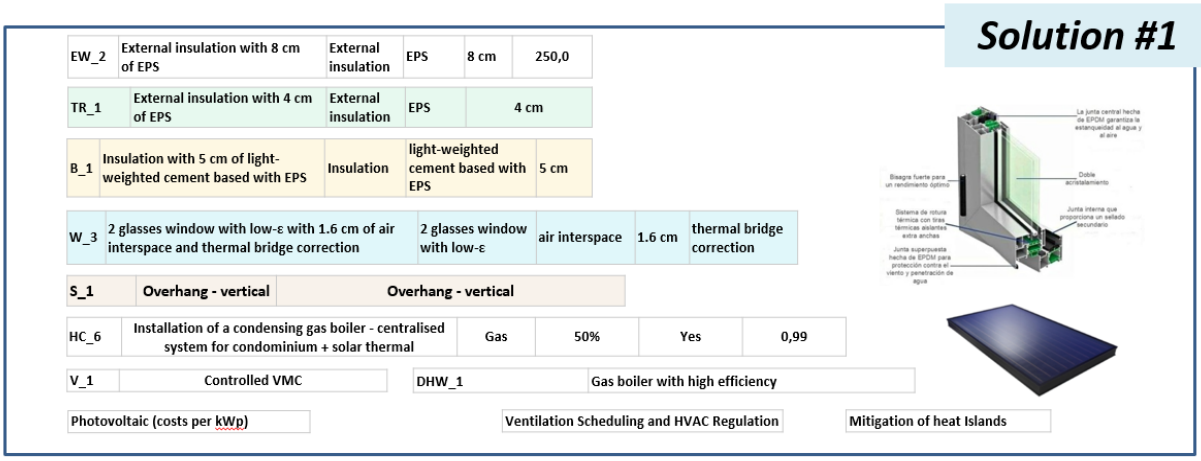

Figure 6- Example of the construction procedure for the solution, starting from the sigle renovation measures in each field

3.1.2 Step 2: Contrustion of a package of solutions

After the construction of the solutions, a comprehensive set of 12 solutions (S) will provide a «Package of solutions». Each Package is specific for each reference building and for each climate.

Figure 7- Example of the construction procedure for the one package of solutions

3.1.3 Step 3: Abacus of the renovation measres where renovation measures stand for packages of solutions

Then as a final stage, a comprehensive set of Packages of solutions (P), one per climate, will provide the Abacus of Renovation Measures, assembled with a holistic approach, considering also the non-technical aspects as behavioural issues and measures to be applied in the urban environment at district scale.

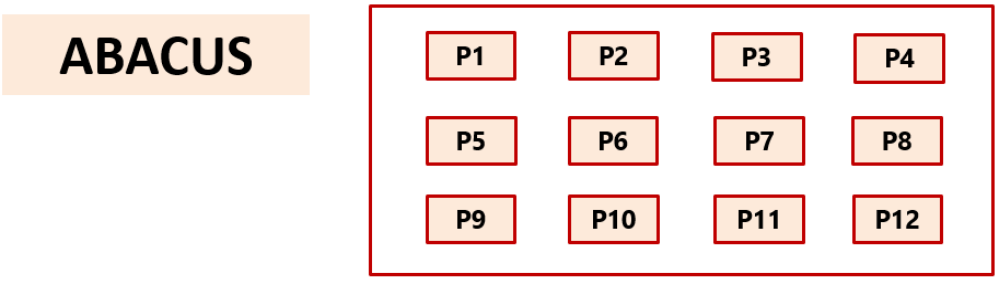

Figure 8--Cconstruction procedure for the final abacus conttitued by the Packages of solutions

In the Grant Agreement the foreseen dimesion of the Abacus were going to be 12 x 12, because 12 different climates were envisaged. After the development of the Task 3.1, a total of 15 reference climates were identified in Europe, thus the final abacus will be compossed of 15 different packages of 12 solutions.

3.2 – Methodology

3.2.1 Calculation Methodology

The methodology used is described in the amending EPBD 2018/844/EU[8] in order to obtain the global renovation costs and the primary energy consumption for different packages of renovation measures. The global costs have been based on the calculation on the life cycle costs for set of packages and the primary energy consumption required the calculation of energy performance for the same set of packages. This methodology has been used in other references like in BPIE, 2010[9]. The sets of measures considered are very extensive and related to façades, roofs, slabs, windows, airtightness, thermal bridges, HVAC and ventilation systems.

The software tool employed for the simulation of the building is a dynamic tool developed by the Group of Termotecnia of the University of Seville for the assessment of energy needs and the verification of the Spanish building technical code. This tool evaluates, on an hourly basis, energy needs of heating and cooling of all the spaces of the building, taking into account the transient effect in walls, roofs, floors, windows, the heat losses and gains through thermal bridges, the effect of

[8] Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.156.01.0075.01.ENG. Accessed Jan 2020.

[9] BPIE (2010). Cost optimality. Discussing methodology and challenges within the recast Energy Performance of Building Directive. http://bpie.eu/wp-content/uploads/2015/10/BPIE_costoptimality_publication2010.pdf. Accessed Jan 2020.

airtightness and ventilation, and shadings over the windows or other elements of the building envelope.

3.2.2 Optimization Methodology

An optimization process requires a variable to maximize or minimize, in this case this variable is going to be the Life Cycle Cost (LCC) in 30 years of each solution for the renovation of a existing building in a given location; and this variable is going to be minimized in order to reach the low zones of the curves shown in the figures 4 and 5. Thus the **Package of Optimal Solution** (POS) is defined as a set of 12 solutions that leads to a package that minimice the LCC of the buildings after the renovation process. It is important to clarify that the LCC includes the investment costs, and the energy costs during a certain period of time, in our case 30 years. All the BATs described in the Abacus (see D3.3) were taken into account assuming for the determination of the **Packages of Optimal Solutions** the average costs reported in D3.3. This is obviously a limitation, as in the deliverable D3.3 it is possible to observe the variability in the costs of the renovation measures from one country to another. Nevertheless, in the HAPPEN platform the calculations performed are going to be available in an excel format, in which the users of the platform will be able to change the costs of the measures and internally, with an automated procedure, the excel sheet will perform the calculation to update the results. In this way, the calculations are flexible enough to provide the POS, when the cost of the renovation measures or the energy costs are modified. The number of 12 depends on the definition of "package" made in the proposal and in the previous section, it is important to notice that there are other solutions near this package that can work as well too. The selection of 12 points is aimed at offering a number of euristic solutions high enough that, although they are not the optimum, are very near to it.
The combinations of all the renovation measures yields a total number of 641,520 combinations, which are provided when multiplying the following renovation measures:

- 12 different renovation measures for the façades
- 9 different types of glazing
- 11 measures for the renovation of the roofs
- 10 measures for the renovation of the floors
- 3 measures for the renovation of the thermal bridges
- 3 measures for the renovation of the ventilation system
- 2 measures for the renovation of the shading elements

In the D3.3 more different renovation measures were evaluated but we reduced them due to a compromise between the variations and the computational time required for assessing all the cases. Nevertheless, the renovations can be modified in the HAPPEN platform, so the previous does not limit the flexibility of the solutions that a potential user of the results of the project could obtain.
Previous measures lead to 213,840 cases that have been calculated 3 times each for the next assumption:

- Building with the main façades N-S oriented, standard user
- Building spinned 90º (main façades E-W), standard user

- Building with the main façades N-S oriented, user with adequate behaviour under the energy point of view as explained in Annex C.

The HVAC or DHW production systems are not considered in the previous list, because the software will calculate energy needs. Later, in a postprocess phase, energy needs will be converted into energy consumption by using the seasonal performance (seasonal COP or Seasonal EER eventually) of the previously mentioned systems.

The total computation cost for the calculation of the POS applied to one building in one climate using Monte Carlo's method is of 155 hours in a computer with the following characteristics: 8 GB RAM, 2.4 GHz i7 Processor.

Figure 9 shows the results obtained by applying the previous methodology to one building in one climate. Each dot in the figure represents one possible renovation intervention on the building that could include from one to several of the previous renovation measures considered together.

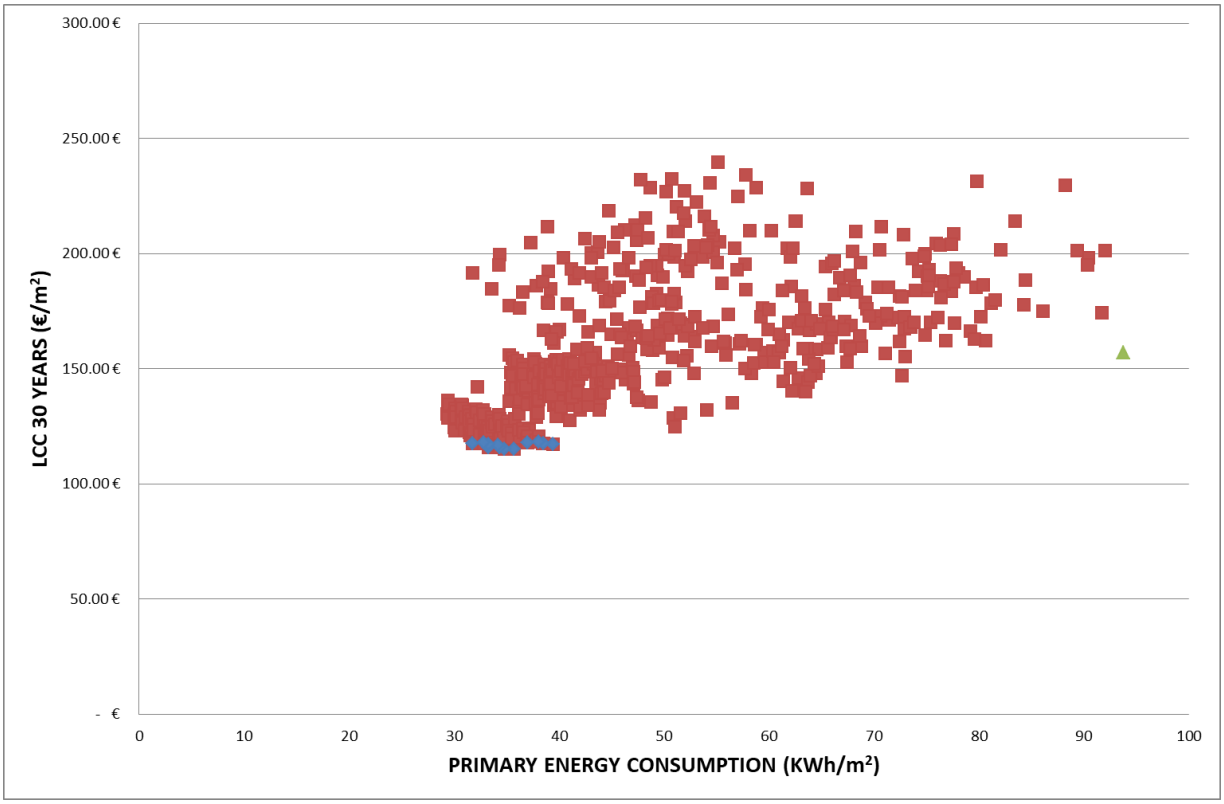

Figure 9—Results of applying the calculation methodology, in the x-axis the prmary energy consumption of each case is represented, while in the y-axis the corresponmging Life Cycle Cost is shown.

The optimization consists in identifying in this graph a region of 12 points, 12 combinations of renovation measures, which minimize the Life Cycle Cost. This is a criterion that could be discussed because there are other variables to optimize as the energy consumption, emissions or direct

investment cost. However, it has been decided to choose the LCC as the optimization variable because, as shownin the state of the art section, it has been commonly accepted that this is the most more interesting variable for the inhabitants while the others are more interesting for the estates or for the environment.

Considering the previous figures regarding the computational time, the calculations were carried out simultaneously thorough an array of sevencomputers. Therefore, it has been possible to reduce the calculation time to 1528 hours and a total of 3 months taking into account stops for the verification of the results, corrections, validation and programming the new cases.

3.2.3 Sensitivity analysis

There are several parameters that affect to the POS. For first, we could mention the building typology (geometric and thermal characteristics) and the climate.. However, apart from these, there are also other relavant parameters, which can affect significantly the POS. .Therefore, in the HAPPEN framework a sensitivity analysis has been carried out for the first time in order to show the influence of some parameters which have usually been considered as secondary but actually have been proven to be very important becausethey can completely change the POS for a given building in a given location (climate). They are **the orientation** and **the user behaviour** towards energy use.
The orientation of the main façade of the building is crucialin terms of its impact on the POS. several measures can be modified or taken at different levels (for example different level of insulation, use of different windows, etc.) on the basis of the building's orientation. The choice of the orientation can also cause that the POS are composed by different combinations of more or less similar measures. In any case, this is a very important parameter that mainly depends on the town planning and the actual direction of the streets and existing parcels that is necessary to be taken into account at the same level oft other parameters as for example the building typology, its year of construction or its thermal characteristics.
The user behaviour is another important variable reported in several studies and projects. However, it has been impossible to find previous studies that analyse the influence on the optimal renovation solution due to the modification of the user behaviour. Standard user behaviour has been considered to obtain the preliminar results. Then, we repeated some cases to show the influence on the POS due to the inhabitants' behaviour. These cases represent the preliminary POS for the 4 reference buildings and climates. The extension of the use of the preliminary results that is described in this document in sections 4.1 and 4.2 is extensible to the "spinned" cases and to the "good inhabitant's behaviour" towards energy use in residential buildings.

Can you discuss here a bit more the results of the sensitivity analysis, by anticipating thre results described in the Annex B and C?

Further points emerged in Bolzano:

— the glazing renovation should be considered as a "must" in most Italian climates, due to severe winter conditions, and therefore, to high potential discomfort.

— we have seen that the RB used for Italian climates was calculated on a milder Marseille climate, probably not suitable for most of the Italian territory; we had discussed that it should be possible to generate manually "intermediate climates" in order to cope with a finer climatic zoning, and that this should be also part of the customization (automated?) potential of the platform tool, together with the cost data and other options. I would anticipate this here, and then discuss it more in depth in the paragraph related to the platform, if possible

4 PACKAGES OF OPTIMAL SOLUTIONS: THE HAPPEN RESULTS

In this section the description of the selection of the packages of optimal solutions will be carried out, starting from the choiceof 4 reference climates and 4 reference buildings that have lead to the definition of the preliminary POS and their validation, when they are applied to for their other climates, buildings' geometries and typologies.

4.1 – Preliminary Packages of Optimal Solutions

4.1.1 Selection of reference buildings

In the Grant Agreement it was stated that "…*It's obviously difficult to identify aprioristically the number of "optimized packages" due to the huge varieties of technical/no-technical packages of measures, the reference buildings and climate conditions, but it's expected the evaluation of about 5 optimal PoS…"* This set of pre-evaluated POS is what we call the preliminary POS. Nevertheless, instead of beginning with 5, it has been decided to define 16 preliminary POS. This is due to the fact that 4 Reference Buildings (RBs) have been evaluated in 4 different climates, providing a total 16 different POS, one per combination building-climate.
The criterion employed for the selection of the 4 different reference building is based on the choiceof those building whose geometry, tipology, use, compactness and thermal characteristics appear more frequently in all the countries. Therefore, 2 multifamily houses and 2 single family houses have been selected. Their codes are SP, FR, HR, CY and in Figure 10, their geometry can be appreciated. Their main geometrical and thermal characteristics are shown in the next tables. One of the main criterion that has been taken into account for the selection of these building is that they are similar to the frontrunner pilots, in order to use the calculations for suggesting the optimal intervention to the corresponding pilot. In fact, the four buildings are representative also of the pilots from Spain, France, Croatia and Cyprus, and the first two are frontrunner pilots.

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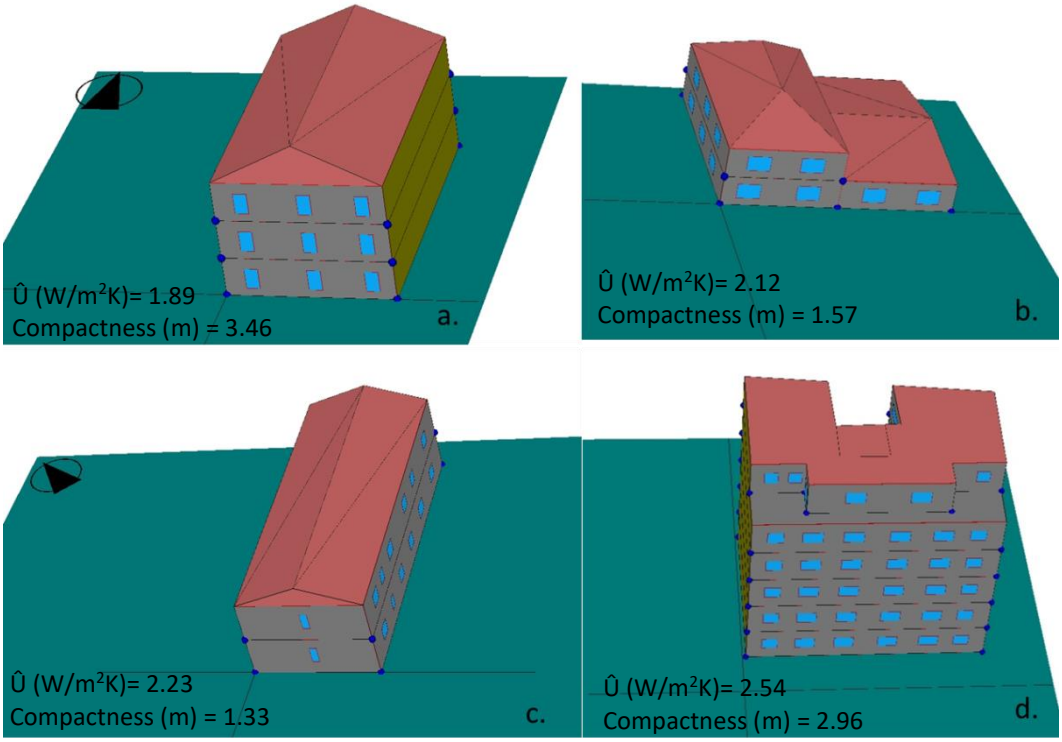

Figure 10—Captions of the geometry of the four pilot buildings taken from the thermal simulation tool. a. FR - Marseille pilot, b. CY - Cyprus Pilot, c. HR - Labin Pilot and d. SP - Castellón Pilot

4.1.2 Selection of reference climates

The criterion employed to select the 4 climatesis based on the choice of have been those climates more frequent in the Med area. Therefore, the climates W1S2, W2S2, W2S3 and W3S2 have been selected. In Figure 11 it is possible to check that these four climates **cover the majority** of the regions around or near to the Mediterranean which is one of the main objectives of the project.

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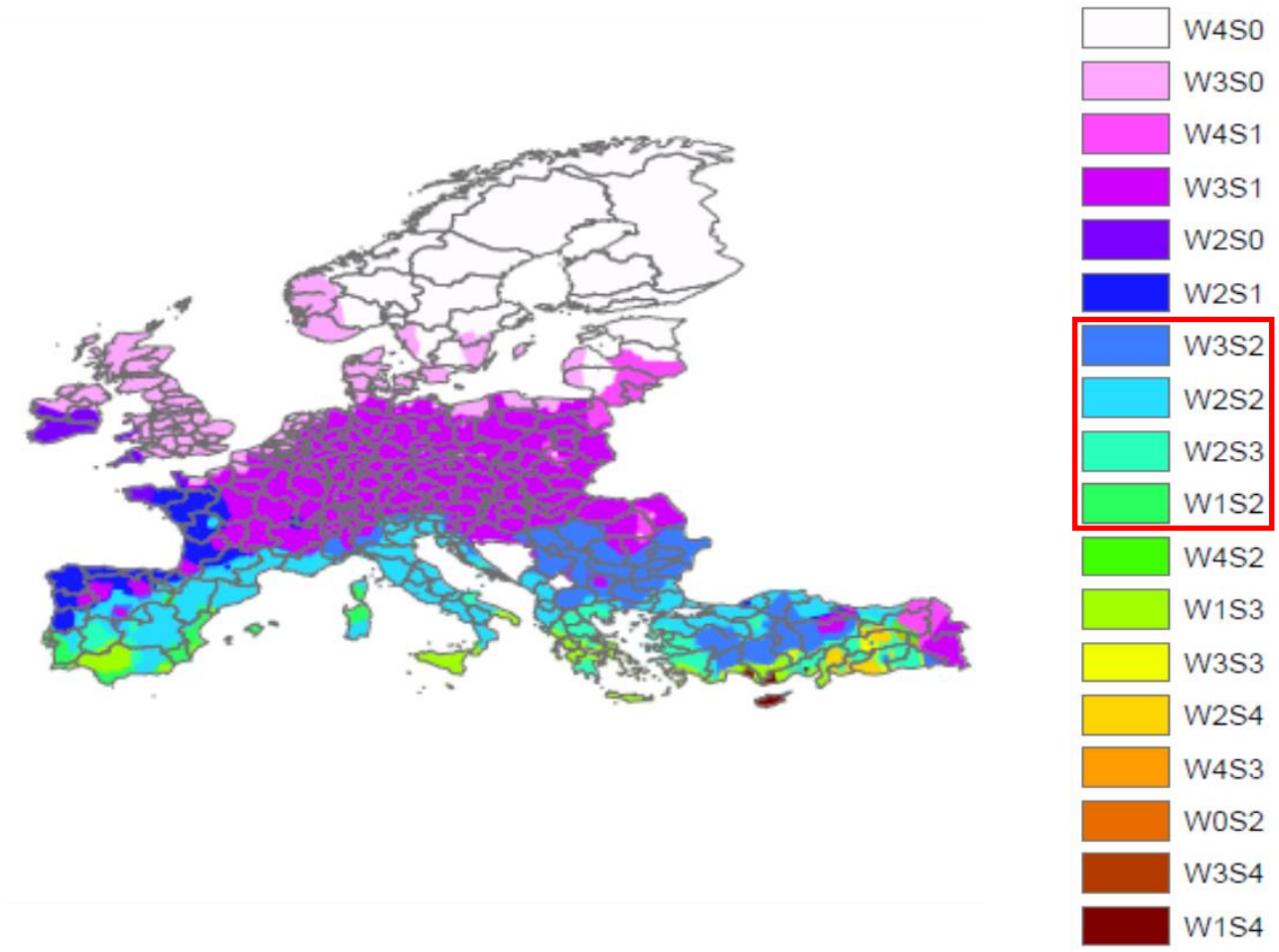

Figure 11—Map of climate zoning as a result of the D3.1. Climates inside the red square have been selected for defining the preliminary POS.

4.1.3 Results of the calculations

The following tables, from Table 1b POS1 of the CY building in the W1S2 climate to Table 16 b fully describe the POS applied to r the 4 pilot buildings in the 4 climates, providing a total of 16 preliminar POS. In order to identify them clearly they have been numbered in the table captions from POS 1 to POS 16.

The measures in the tables and the colour code for each measure are corresponding to the one described and used in the D3.3 "Abacus of renovation measures". Moreover, the measures have been described identically as they were described in the mentioned deliverable, thus all the elements are described using a thermal parameter and the relative cost to the surface of that element. For instance, the external walls are described by the increment in the thermal resistance due to the renovation and the cost in € per sq. meter of wall. More complex cases are the windows were the U-value of the glazing and the frame are provided in addition to the g-value (solar factor) and the cost in € per sq. meter of window. A more detailed explanation of each renovation measure,

for example the kind of insulation in the walls or the position of the insulation in the wall, or the number of pans and the thickness of the air gap in the windows, can be found in the deliverable 3.3. The tables which describe the POS have been divided in two, as the BATs cover not only the building envelope but also the air-tightness, the ventilation and the thermal bridges between other,

The tables have 12 lines, one per combination of renovation measures that configure one optimal renovation. Thus the tables should be read horizontally, and the potentital user should select one line to renovate the existing building. Therefore, each line in the next POS defines a combination of renovation measures that, once implemented in the building, will optimize the refurbishment in terms of the LCC. It is important to observethat combinations of measures of different lines do not lead to an optimal solution.

Finally, for each line, or optimal solution of the POS, we have added the next information:

- Primary energy consumption (kWh/m^2). This is the value of the primary energy consumption after the implementation of the optimal solution proposed in the corresponding line.
- Initial investment (€/m^2). This is the cost of implementing the optimal solution in € per sq.m. of useful/conditioned surface of the building.
- Life Cycle Cost (€/m^2). This is the initial investment plus the operational costs in 30 years after implementing the optimal solutions. This is the variable that has been optimized.
- Primary energy savings (%). This is the reduction of primary energy consumption in relation to the existing building. This is a global goal of the project and this is the reason why it is important to show the value whichcan be reached optimizing the variable that is more interesting from the inhabitant's/owner point of view. The higher values have a green background colour while the lower values have a red background colour. In the proposal the goal was fixed in a 60% of primary energy savings
- CO_2 emmissions (kg/m2). This is the value of the CO_2 emmissions after the implementation of the optimal solution proposed in the corresponding line.
- CO_2 savings in relation to the existing building (%). This is the reduction of the CO_2 emmissions in relation to the existing building.
- Total final energy savings per year (MWh). This is the plannedabsolute value of the final energy savings per year.
- Total primary energy savings per year (MWh). This is the planned absolute value of the primary energy savings per year.
- Total CO_2 savings per year (kg). This is the plannedabsolute value of the CO_2 emmissions savings per year.
- Total cost (€). This is the total cost of implementing the corresponding optimal solution.

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SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 1a POS1 of the CY building in the W1S2 climate

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Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
44.95	43.58 €	123.31 €	55%	8.47	57%	9.01	12.89	2.59	10,240.62 €
43.00	48.79 €	125.07 €	57%	8.10	58%	9.35	13.34	2.68	11,466.74 €
40.04	53.54 €	125.49 €	60%	7.65	61%	9.99	14.04	2.78	12,582.98 €
41.47	51.68 €	126.11 €	58%	7.91	59%	9.73	13.70	2.72	12,144.43 €
39.41	55.77 €	126.63 €	61%	7.53	61%	10.11	14.19	2.81	13,106.95 €
38.09	58.76 €	127.20 €	62%	7.27	63%	10.33	14.50	2.87	13,809.10 €
47.18	43.57 €	127.26 €	53%	8.89	54%	8.61	12.36	2.49	10,239.53 €
39.53	56.90 €	127.84 €	60%	7.54	61%	10.07	14.16	2.81	13,370.55 €
37.47	60.99 €	128.34 €	62%	7.16	63%	10.45	14.64	2.90	14,333.07 €
45.22	48.79 €	128.98 €	55%	8.52	56%	8.96	12.82	2.58	11,465.66 €
42.21	53.54 €	129.36 €	58%	8.06	59%	9.61	13.53	2.69	12,581.90 €
43.67	51.67 €	130.03 €	56%	8.33	57%	9.34	13.19	2.62	12,143.35 €

Table 1b POS1 of the CY building in the W1S2 climate

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 2 a- POS2 of the CY building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
56.64	60.99 €	156.18 €	62%	10.09	62%	16.36	21.27	3.95	14,333.07 €
59.89	55.77 €	156.45 €	59%	10.67	60%	15.74	20.51	3.81	13,106.95 €
60.23	56.90 €	158.02 €	59%	10.71	60%	15.67	20.43	3.80	13,370.55 €
63.43	51.68 €	158.22 €	57%	11.29	58%	15.07	19.67	3.67	12,144.43 €
50.58	73.61 €	160.87 €	66%	9.26	66%	17.77	22.69	4.14	17,297.72 €
47.51	78.82 €	160.89 €	68%	8.71	68%	18.34	23.42	4.27	18,523.84 €
53.83	69.51 €	162.08 €	63%	9.82	63%	17.14	21.93	4.01	16,335.20 €
50.75	74.73 €	162.11 €	66%	9.27	66%	17.71	22.65	4.14	17,561.32 €
60.30	60.99 €	162.31 €	59%	10.74	60%	15.66	20.41	3.80	14,331.99 €
63.56	55.77 €	162.60 €	57%	11.32	58%	15.05	19.64	3.66	13,105.87 €
63.89	56.89 €	164.18 €	57%	11.37	58%	14.97	19.57	3.65	13,369.47 €
67.11	51.67 €	164.39 €	54%	11.94	56%	14.37	18.81	3.51	12,143.35 €

Table 2 b - POS2 of the CY building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 3 a POS3 of the CY building in the W2S3 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
69.75	76.60 €	200.82 €	62%	13.20	62%	20.91	26.99	4.97	17,999.87 €
68.45	78.82 €	200.85 €	63%	12.97	62%	21.15	27.29	5.03	18,523.84 €
80.26	60.99 €	201.00 €	57%	14.86	57%	18.70	24.52	4.58	14,333.07 €
81.63	58.76 €	201.11 €	56%	15.11	56%	18.45	24.19	4.53	13,809.10 €
73.58	71.38 €	202.16 €	60%	13.90	60%	20.20	26.09	4.81	16,773.75 €
72.29	73.61 €	202.21 €	61%	13.66	60%	20.44	26.39	4.87	17,297.72 €
84.21	55.77 €	202.56 €	54%	15.58	55%	17.97	23.59	4.42	13,106.95 €
85.56	53.54 €	202.63 €	54%	15.82	54%	17.72	23.27	4.36	12,582.98 €
72.72	74.73 €	203.97 €	61%	13.73	60%	20.35	26.29	4.85	17,561.32 €
84.74	56.90 €	204.54 €	54%	15.67	54%	17.87	23.46	4.39	13,370.55 €
76.50	69.51 €	205.23 €	59%	14.42	58%	19.65	25.40	4.69	16,335.20 €
88.62	51.68 €	205.97 €	52%	16.38	52%	17.15	22.55	4.23	12,144.43 €

Table 3 b POS3 of the CY building in the W2S3 climate

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
9	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_3	3.33	48.94 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 4 a POS4 of the CY building in the W3S2 climate

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
80.80	78.82 €	211.03 €	65%	13.99	65%	28.61	35.10	6.16	18,523.84 €
89.20	65.16 €	218.30 €	61%	16.24	60%	27.84	33.13	5.63	15,312.52 €
86.69	78.82 €	220.60 €	62%	15.00	63%	27.46	33.72	5.92	18,522.76 €
81.07	89.41 €	222.06 €	65%	14.04	65%	28.56	35.04	6.15	21,010.32 €
85.44	82.54 €	222.33 €	63%	14.79	63%	27.71	34.01	5.97	19,396.86 €
94.95	65.16 €	227.49 €	59%	17.22	57%	26.70	31.78	5.40	15,311.44 €
89.47	75.74 €	229.32 €	61%	16.29	59%	27.78	33.06	5.62	17,799.00 €
93.76	68.87 €	229.39 €	59%	17.02	58%	26.94	32.06	5.45	16,185.55 €
78.05	102.70 €	230.46 €	66%	13.52	66%	29.15	35.75	6.27	24,133.37 €
75.79	106.74 €	230.87 €	67%	13.14	67%	29.60	36.28	6.36	25,083.99 €
86.97	89.40 €	231.64 €	62%	15.05	63%	27.41	33.65	5.91	21,009.24 €
91.34	82.54 €	231.91 €	60%	15.80	61%	26.56	32.63	5.73	19,395.78 €

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Table 4b POS4 of the CY building in the W3S2 climate

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
2	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
9	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_16	0.71	16.71 €	FR_8	0.93	10.73 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €

SOLUTIONS	Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
1	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
2	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
3	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
4	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
5	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
6	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
7	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
8	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
9	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
10	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
11	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
12	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Table 5 a - POS5 of the HR building in the W1S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
57.05	48.86 €	150.60 €	47%	10.81	46%	16.53	20.57	3.66	19,544.90 €
54.22	55.74 €	152.50 €	50%	10.28	49%	17.39	21.70	3.87	22,296.90 €
56.13	52.20 €	153.92 €	48%	10.82	46%	17.13	20.94	3.66	20,881.58 €
54.26	56.20 €	154.74 €	50%	10.48	48%	17.73	21.69	3.79	22,478.60 €
53.18	59.08 €	155.61 €	51%	10.27	49%	18.03	22.12	3.88	23,633.58 €
51.27	63.08 €	156.37 €	53%	9.92	50%	18.64	22.88	4.02	25,230.60 €
57.05	60.01 €	161.75 €	47%	10.81	46%	16.53	20.57	3.66	24,005.02 €
54.22	66.89 €	163.65 €	50%	10.28	49%	17.39	21.70	3.87	26,757.02 €
51.92	70.78 €	164.04 €	52%	9.91	50%	18.20	22.62	4.02	28,310.89 €
59.79	57.22 €	164.70 €	45%	11.43	43%	15.88	19.48	3.42	22,886.40 €
56.13	63.35 €	165.07 €	48%	10.82	46%	17.13	20.94	3.66	25,341.70 €
54.26	67.35 €	165.89 €	50%	10.48	48%	17.73	21.69	3.79	26,938.72 €

Table 5-b - POS5 of the HR building in the W1S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
12	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €

Table 6 a - POS6 of the HR building in the W2S3 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
80.06	59.68 €	194.44 €	50%	14.28	49%	26.23	31.84	5.53	23,870.93 €
66.12	80.63 €	194.70 €	59%	12.10	57%	31.26	37.41	6.40	32,252.47 €
69.15	76.64 €	195.69 €	57%	12.63	55%	30.27	36.20	6.19	30,655.45 €
83.26	55.68 €	195.78 €	48%	14.84	47%	25.19	30.56	5.30	22,273.91 €
89.54	46.40 €	196.39 €	44%	15.89	43%	23.04	28.05	4.88	18,558.38 €
85.09	53.97 €	196.46 €	47%	15.09	46%	24.47	29.83	5.20	21,586.95 €
75.49	67.35 €	196.46 €	53%	13.69	51%	28.11	33.67	5.76	26,939.92 €
71.14	74.92 €	196.72 €	55%	12.92	54%	29.51	35.41	6.07	29,968.49 €
81.46	59.67 €	196.81 €	49%	14.53	48%	25.78	31.28	5.43	23,869.72 €
67.46	80.63 €	196.94 €	58%	12.34	56%	30.83	36.88	6.30	32,251.26 €
78.32	63.36 €	197.13 €	51%	14.19	50%	27.18	32.53	5.56	25,342.90 €
92.52	42.40 €	197.35 €	42%	16.41	42%	22.07	26.85	4.67	16,961.36 €

Table 6-b POS6 of the HR building in the W2S3 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
2	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
12	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €

SOLUTIONS	Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
1	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
2	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
3	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
4	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
5	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
6	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
7	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
8	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
9	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
10	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
11	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
12	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Table 7 a -- POS7 of the HR building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
88.89	74.23 €	231.29 €	54%	16.68	52%	33.59	41.29	7.26	29,691.92 €
92.34	70.24 €	233.13 €	52%	17.30	50%	32.49	39.91	7.01	28,094.90 €
94.30	67.35 €	233.62 €	51%	17.66	49%	31.87	39.13	6.87	26,939.92 €
90.46	74.23 €	233.97 €	53%	16.97	51%	33.09	40.67	7.15	29,690.72 €
97.68	63.36 €	235.34 €	49%	18.26	48%	30.79	37.78	6.63	25,342.90 €
93.90	70.23 €	235.80 €	51%	17.58	50%	32.00	39.29	6.90	28,093.70 €
97.00	66.90 €	236.26 €	50%	17.98	48%	30.72	38.05	6.74	26,758.23 €
95.86	67.35 €	236.27 €	50%	17.94	49%	31.38	38.51	6.76	26,938.72 €
86.22	83.66 €	236.92 €	55%	16.28	53%	34.58	42.36	7.42	33,465.00 €
102.04	60.02 €	237.97 €	47%	18.89	46%	29.12	36.03	6.38	24,006.23 €
99.23	63.35 €	237.98 €	48%	18.54	47%	30.31	37.16	6.52	25,341.70 €
98.45	66.89 €	238.74 €	49%	18.24	48%	30.26	37.47	6.64	26,757.02 €

Table 7 b POS7 of the HR building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
10	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Table 8 a POS8 of the HR building in the W3S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
104.60	65.22 €	237.47 €	58%	18.23	57%	47.81	56.99	9.70	26,089.40 €
108.41	63.08 €	240.79 €	56%	18.81	56%	46.40	55.47	9.47	25,231.80 €
106.72	65.22 €	240.94 €	57%	18.60	56%	47.11	56.15	9.56	26,088.20 €
109.30	61.23 €	241.11 €	56%	19.04	55%	46.25	55.12	9.38	24,492.38 €
108.81	63.77 €	242.14 €	56%	18.88	56%	46.26	55.31	9.45	25,508.37 €
110.47	63.08 €	244.16 €	55%	19.16	55%	45.71	54.65	9.33	25,230.60 €
112.96	59.09 €	244.19 €	54%	19.59	54%	44.88	53.65	9.16	23,634.78 €
111.40	61.23 €	244.56 €	55%	19.40	54%	45.55	54.27	9.24	24,491.18 €
110.88	63.77 €	245.51 €	55%	19.23	55%	45.58	54.48	9.30	25,507.16 €
113.36	59.78 €	245.53 €	54%	19.66	54%	44.75	53.49	9.13	23,911.35 €
115.01	59.08 €	247.53 €	53%	19.94	53%	44.20	52.83	9.02	23,633.58 €
104.60	76.37 €	248.62 €	58%	18.23	57%	47.81	56.99	9.70	30,549.52 €

Table 8 b POS8 of the HR building in the W3S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €
3	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €
6	EW_26	1.47	14.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_27	0.70	9.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	FR_3	2.35	28.78 €
10	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €
11	EW_26	1.47	14.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_26	1.47	14.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 9 a POS9 of the FR building in the W1S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
37.94	22.13 €	88.24 €	39%	7.02	40%	9.81	13.16	2.51	11,948.65 €
41.40	16.11 €	88.55 €	34%	7.69	34%	8.46	11.30	2.15	8,700.01 €
36.75	24.97 €	88.90 €	41%	6.79	42%	10.28	13.81	2.64	13,481.31 €
40.59	19.06 €	89.81 €	35%	7.51	36%	8.72	11.73	2.24	10,293.40 €
44.06	13.05 €	90.15 €	29%	8.19	30%	7.36	9.86	1.88	7,044.76 €
38.09	23.29 €	90.25 €	39%	7.11	39%	9.92	13.08	2.46	12,578.25 €
39.39	21.90 €	90.45 €	37%	7.28	38%	9.19	12.38	2.37	11,826.05 €
36.78	26.42 €	90.49 €	41%	6.80	42%	10.30	13.79	2.63	14,265.73 €
37.64	25.18 €	90.56 €	40%	6.94	41%	9.89	13.33	2.55	13,596.42 €
40.22	20.40 €	90.78 €	35%	7.47	36%	8.94	11.93	2.27	11,017.09 €
36.84	26.13 €	90.81 €	41%	6.87	41%	10.41	13.76	2.59	14,110.90 €
41.70	17.28 €	90.88 €	33%	7.82	33%	8.51	11.13	2.08	9,329.61 €

Table 9 b POS9 of the FR building in the W1S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_27	0.70	9.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_27	0.70	9.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_26	1.47	14.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_27	0.70	9.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_2	1.47	24.49 €
8	EW_26	1.47	14.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_2	1.47	24.49 €
9	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_2	1.47	24.49 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €

Table 10 a POS10 of the FR building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
35.72	54.03 €	115.21 €	62%	6.49	61%	25.64	31.35	5.48	29,178.46 €
34.76	55.20 €	115.30 €	63%	6.38	62%	26.21	31.87	5.54	29,808.05 €
33.26	58.20 €	115.82 €	65%	6.11	63%	26.87	32.67	5.68	31,427.15 €
34.35	57.03 €	115.93 €	63%	6.25	62%	26.25	32.09	5.61	30,797.56 €
34.22	58.33 €	117.03 €	64%	6.23	63%	26.31	32.16	5.62	31,495.54 €
33.26	59.49 €	117.12 €	65%	6.12	63%	26.87	32.67	5.68	32,125.13 €
39.40	49.77 €	117.30 €	58%	7.16	57%	24.10	29.36	5.12	26,873.97 €
38.47	50.93 €	117.48 €	59%	7.06	58%	24.66	29.86	5.17	27,503.56 €
31.78	62.49 €	117.66 €	66%	5.86	65%	27.53	33.48	5.82	33,744.23 €
32.84	61.32 €	117.74 €	65%	5.98	64%	26.92	32.90	5.75	33,114.64 €
37.02	53.93 €	118.07 €	61%	6.81	59%	25.30	30.65	5.31	29,122.66 €
38.09	52.76 €	118.13 €	59%	6.93	58%	24.67	30.07	5.24	28,493.07 €

Table 10 b POS10 of the FR building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_16	2.42	43.36 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 11 a POS11 of the FR building in the W2S3 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
47.89	48.84 €	134.84 €	60%	9.14	59%	31.23	39.13	7.01	26,375.18 €
49.84	46.00 €	135.40 €	59%	9.50	57%	30.41	38.08	6.82	24,842.53 €
45.76	53.13 €	135.52 €	62%	8.76	60%	32.14	40.28	7.22	28,692.26 €
47.71	50.30 €	136.08 €	60%	9.12	59%	31.32	39.22	7.03	27,159.60 €
43.17	59.73 €	138.16 €	64%	8.34	62%	33.37	41.68	7.45	32,254.32 €
44.24	58.56 €	138.79 €	63%	8.53	61%	32.91	41.10	7.34	31,620.11 €
41.03	64.02 €	138.80 €	66%	7.95	64%	34.29	42.83	7.65	34,571.40 €
45.18	56.89 €	138.84 €	62%	8.71	61%	32.54	40.59	7.24	30,721.66 €
42.08	62.85 €	139.40 €	65%	8.14	63%	33.83	42.26	7.55	33,937.19 €
43.03	61.18 €	139.46 €	64%	8.33	62%	33.45	41.75	7.45	33,038.74 €
46.25	55.72 €	139.46 €	62%	8.91	60%	32.08	40.02	7.14	30,087.46 €
49.70	50.86 €	140.02 €	59%	9.48	57%	30.47	38.15	6.83	27,466.46 €

Table 11 b - POS11 of the FR building in the W2S3 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_3	3.33	48.94 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_3	3.33	48.94 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_26	1.47	14.88 €	W_11	1.1	1.3	0.59	269.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 12 a POS12 of the FR building in the W3S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
47.90	54.30 €	133.17 €	68%	8.35	68%	46.33	55.51	9.50	29,321.85 €
50.77	50.01 €	133.51 €	66%	8.84	66%	45.04	53.96	9.24	27,004.77 €
50.49	51.46 €	134.61 €	66%	8.80	66%	45.19	54.11	9.26	27,789.20 €
53.36	47.17 €	134.98 €	65%	9.29	64%	43.90	52.56	8.99	25,472.12 €
47.90	56.76 €	135.62 €	68%	8.35	68%	46.33	55.51	9.50	30,648.05 €
44.52	62.25 €	135.66 €	70%	7.77	70%	47.87	57.33	9.81	33,612.90 €
50.77	52.46 €	135.97 €	66%	8.84	66%	45.04	53.96	9.24	28,330.97 €
47.36	57.96 €	135.98 €	69%	8.26	68%	46.58	55.80	9.55	31,295.82 €
49.96	52.30 €	136.32 €	67%	8.90	66%	45.91	54.40	9.20	28,241.85 €
52.80	48.01 €	136.61 €	65%	9.39	64%	44.62	52.86	8.94	25,924.77 €
46.35	60.52 €	136.96 €	69%	8.09	69%	47.05	56.34	9.64	32,681.94 €
50.49	53.92 €	137.06 €	66%	8.80	66%	45.19	54.11	9.26	29,115.40 €

Table 12 b - POS12 of the FR building in the W3S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
4	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_28	1.16	12.16 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	0.5	40.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €

Table 13 a POS13 of the SP building in the W1S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
53.59	25.72 €	126.69 €	51%	10.76	46%	55.99	65.86	11.05	30,858.68 €
49.47	38.18 €	128.30 €	54%	9.59	52%	57.56	70.81	12.46	45,817.20 €
48.95	41.71 €	129.78 €	55%	9.36	53%	57.37	71.44	12.73	50,051.68 €
50.52	42.31 €	133.05 €	53%	9.65	52%	55.86	69.55	12.39	50,775.23 €
48.57	47.77 €	136.38 €	55%	9.43	53%	58.44	71.89	12.65	57,320.99 €
51.59	49.63 €	143.27 €	52%	9.96	50%	55.51	68.27	12.01	59,555.02 €
51.52	52.76 €	145.19 €	53%	9.82	51%	54.90	68.35	12.17	63,312.60 €
47.16	59.13 €	145.40 €	57%	9.18	54%	59.82	73.58	12.95	70,961.83 €
55.90	45.74 €	148.95 €	48%	10.98	45%	52.76	63.09	10.78	54,888.60 €
53.45	52.11 €	151.27 €	51%	10.56	47%	55.16	66.04	11.29	62,537.83 €
64.95	36.76 €	152.93 €	40%	12.35	38%	42.67	52.24	9.15	44,115.79 €
64.95	38.18 €	154.34 €	40%	12.35	38%	42.67	52.24	9.15	45,814.48 €

Table 13 b POS13 of the SP building in the W1S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
3	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_28	1.16	12.16 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
9	EW_28	1.16	12.16 €	W_15	2.6	3.5	0.77	229.77 €	B_0	BASE	- €	FR_3	2.35	28.78 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_26	1.47	14.88 €	W_10	1.1	1.43	0.59	279.86 €	B_0	BASE	- €	TR_0	BASE	- €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	0.5	40.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Table 14 a POS14 of the SP building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
98.97	12.39 €	179.60 €	22%	17.72	22%	27.19	33.36	5.86	14,871.88 €
73.47	56.36 €	180.76 €	42%	13.19	42%	51.79	63.96	11.30	67,633.50 €
75.50	55.16 €	186.37 €	40%	13.93	38%	51.91	61.53	10.41	66,195.36 €
78.60	59.67 €	192.47 €	38%	14.07	38%	46.73	57.81	10.23	71,602.14 €
94.14	38.18 €	194.81 €	26%	16.59	27%	30.35	39.16	7.22	45,814.48 €
71.29	74.31 €	195.15 €	44%	12.81	43%	53.97	66.58	11.75	89,176.96 €
95.20	37.53 €	195.91 €	25%	16.77	26%	29.31	37.89	6.99	45,033.75 €
69.59	76.71 €	195.93 €	45%	12.64	44%	56.35	68.62	11.95	92,051.41 €
79.04	63.22 €	200.07 €	38%	14.52	36%	48.31	57.28	9.70	75,865.84 €
102.70	28.55 €	201.91 €	19%	18.37	19%	23.51	28.88	5.08	34,265.01 €
75.37	75.14 €	202.68 €	41%	13.52	40%	49.93	61.68	10.90	90,169.87 €
93.92	52.32 €	208.58 €	26%	16.55	27%	30.57	39.43	7.26	62,778.45 €

Table 14 b POS14 of the SP building in the W2S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
5	EW_2	2.22	44.00 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_0	BASE	- €
7	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
8	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
10	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_28	1.16	12.16 €	W_15	2.6	3.5	0.77	229.77 €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €

Table 15 a POS15 of the SP building in the W2S3 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
98.92	56.36 €	230.05 €	36%	18.44	35%	53.65	67.18	12.03	67,633.50 €
94.67	66.87 €	233.93 €	39%	17.74	38%	58.06	72.28	12.87	80,241.73 €
100.29	55.16 €	234.32 €	35%	19.04	33%	54.25	65.54	11.32	66,195.36 €
127.89	12.39 €	235.62 €	17%	23.70	17%	26.23	32.42	5.73	14,871.88 €
95.80	67.04 €	236.52 €	38%	18.00	37%	57.30	70.93	12.56	80,446.26 €
97.33	68.49 €	239.44 €	37%	18.15	36%	55.14	69.09	12.38	82,187.51 €
104.86	59.67 €	243.34 €	32%	19.50	32%	47.93	60.06	10.76	71,602.14 €
96.23	74.31 €	243.47 €	38%	17.96	37%	56.24	70.42	12.61	89,176.96 €
94.68	76.71 €	244.54 €	39%	17.83	37%	58.51	72.27	12.77	92,051.41 €
104.67	59.36 €	245.77 €	32%	19.81	30%	49.97	60.29	10.40	71,227.57 €
104.50	63.22 €	249.33 €	33%	19.77	31%	50.12	60.49	10.44	75,865.84 €
122.54	38.18 €	249.70 €	21%	22.44	21%	29.74	38.84	7.24	45,814.48 €

Table 15 b POS15 of the SP building in the W2S3 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m2K/W]	Cost (€/m2 wall)	Glazings	Uw [W/m2K]	Uf [W/m2K]	g (Solar Factor)	Cost (€/m2 window)	Slabs on the ground/ external	ΔThermal Resistance [m2K/W]	Cost (€/m2 slab)	Roof	ΔThermal Resistance [m2K/W]	Cost (€/m2 roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_2	2.22	44.00 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
6	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_0	BASE	- €
8	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
10	EW_28	1.16	12.16 €	W_15	2.6	3.5	0.77	229.77 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
12	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_2	1.47	24.49 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Table 16 a POS16 of the SP building in the W3S2 climate

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

Primary Energy Consumption (kWh/m2)	Initial Investment (€/m2)	Life Cycle Cost (€/m2)	Primary Energy Savings %	CO2 Emissions (kg/m2)	CO2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO2 Savings per Year (Tn)	Total Cost
118.51	56.36 €	250.20 €	39%	20.51	39%	75.04	90.46	15.59	67,633.50 €
118.01	55.16 €	250.72 €	39%	20.71	38%	77.09	91.07	15.35	66,195.36 €
117.20	66.87 €	260.84 €	40%	20.54	39%	77.73	92.03	15.56	80,241.73 €
117.16	67.04 €	261.04 €	40%	20.54	39%	77.82	92.08	15.55	80,446.26 €
112.24	76.71 €	261.71 €	42%	19.58	42%	82.12	97.99	16.70	92,051.41 €
115.12	74.31 €	262.66 €	41%	19.93	41%	78.43	94.53	16.28	89,176.96 €
120.00	68.49 €	264.77 €	38%	20.77	38%	73.57	88.67	15.28	82,187.51 €
124.40	59.36 €	265.16 €	36%	21.79	35%	70.62	83.39	14.05	71,227.57 €
126.56	59.67 €	266.57 €	35%	21.89	35%	67.00	80.80	13.93	71,602.14 €
123.67	63.22 €	267.87 €	36%	21.67	35%	71.37	84.27	14.20	75,865.84 €
157.03	12.39 €	269.14 €	19%	27.17	19%	36.80	44.24	7.60	14,871.88 €
117.22	79.59 €	273.84 €	40%	20.57	39%	77.86	92.01	15.52	95,508.79 €

Table 16 b - POS16 of the SP building in the W3S2 climate

As we highlighted in the state of the art section, this work has not been carried out previously taking into consideration such an extensive and representative database of buildings, climates and abacus of solutions.Moreover, , it is very important to underline that a novelty of the results of this project is that we have recalculated the POS in order to take into account two important parameters that affect to the optimal renovation solutions: the orientation of the RBs and the behaviour of the inhabitants of the building in relation to its energy consumption.
Thus, the original 16 POS have been multiplied by 3, providing a total of 48 POS depending not only on the geometry and the thermal characteristics of the building, but also on the orientation of their façades and the habits of the inhabitants of the building regarding the energy.
Thus as we stated in section 3.2.2 we have calculated the 16POS for the next scenarios:

- Building with the main façades N-S oriented, and standard user
- Building spinned 90º (main façades E-W), and standard user
- Building with the main façades N-S oriented, and user with adequate behaviour under the energy point of view as explained in Annex C.

The 16 POS for the scenario described by the first bullet are described by the tables 1 to 16. The second and the third sets of POS have been listed in the annexes B and C, respectively, in form of tables following the same criteria and colour/graphic codes we followed in the previous cases. Regarding the POS, the energy savings for the optimum case achieved in some solutions are lower than the target set at 60% in the project proposal. It is important to comment that this aspect does not represent a problem, because:
1. as all these POS only take into account the improvements regarding the envelope, it is always possible to modify/improve the systems in order to get the previous target;
2. as the solution proposed is the one that optimise the renovation minimising the LCC, it is possible to reach lower energy consumptions but the LCC increases and this is not always a convenient situation.

Figure 10 shows the situation for a building renovated without modifying the systems (line 1) and the situation for the same building renovation but improving the systemS (using e.g. a high performance system based in geothermal energy source).

SOLUTIONS	External Wall	Glazings	External Slab	Roof	Thermal Bridge Reduction	Ventilation (Ren/h)	Air Tighness (n50)	Shading Elements on Windows (Solar Factor)
1	EW_27	W_19	B_0	FR_8	NO REDUCTION	NO IMPROVEMENT	NO IMPROVEMENT	SHADING ELEMENTS COVER 50%
2	EW_27	W_19	B_0	FR_8	NO REDUCTION	NO IMPROVEMENT	NO IMPROVEMENT	SHADING ELEMENTS COVER 50%

Heating System	Cooling System	DHW System
Present System	Present System	Present System
GSHP - Ground Source Heat Pump - 200to250kW MFH	GSHP - Ground Source Heat Pump - 200to250kW MFH	DHW with 50% of Solar Contribution

Primary Energy Consumption	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per	Total Primary Energy Savings per Year	Total CO_2 Savings per Year (Tn)	Total Cost
44.06	13.05 €	90.15 €	29%	8.19	30%	7.36	9.86	1.88	7,044.76 €
22.50	123.25 €	169.09 €	64%	4.90	58%	18.07	21.50	3.65	66,557.64 €

Figure 10—Solution 5 of POS9 where it is shown how the energy savings are affected when the HVAC and DHW systems are modified together to the building envelope (line 2) or not (line 1).

We propose to use the POS as an initial solution and then, fine-tune it using the excel tool that is going to be available in the HAPPEN platform webpage.

4.1.4 Preliminary POS under a step-by-step approach

In this section one solution of each preliminary POS have been split in order to define a so called "step-by-step approach".
In order to define these steps some assumptions have been considered so as to avoid also the lock-in effects:

- Façades and thermal bridges related to façades must be changed together
- Air-Tightness and Façades must be improved together
- For the implementation of a ventilation system with heat recovery, the airtightness will have to be improved simultaneously
- Windows and Outside Glass-doors are changed together
- When the windows are changed then the Thermal Bridges related to windows contour must be improved simultaneously
- Limited Investment per Step: 120 €/m2

The following tables, from **¡Error! No se encuentra el origen de la referencia.** to **¡Error! No se encuentra el origen de la referencia.**,summarize the suggested way to split the global intervention described in the POS in steps so as to make the global renovation of the building more affordable for the owner and/or the inhabitant's. At the same time, we can see in each step the final Energy Savings per Year (Mwh) in relation to the previous situation. For the sake of readiness and keeping a reasonable length of this deliverable, only one solution has been shown in the next tables. The proposal is to split in the same way the other solutions of each POS. For instance, as we can see in the next tables, the solution 9 of the POS10 is splitby following the procedure described below:

- Step 1: renovation of the Façade + Glazings + Airtightness + Thermal Bridges
- Step 2: renovation of the Roof + Ventilation + Shading

Then, all the other solutions of the POS should be split in the same way, by , improving in the first step the façades, the windows, the airtightness and the thermal bridges and leaving the rest of measures regarding the envelope for the second step and the systems for the third one.

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	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS1	EW_26	BASE	CONTOURS + WINDOWS	BASE	TR_4	BASE	BASE	50% COVER
	Initial Investment				Initial Investment			
	5,751.60 €		24.47 €/m^2		8,581.47 €		36.52 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	1.02				4.72			

Table 17- POS1 of the CY building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS2	EW_26	BASE	CONTOURS + WINDOWS	BASE	TR_4	BASE	0.42	50% COVER
	Initial Investment				Initial Investment			
	5,751.60 €		24.47 €/m^2		12,772.24 €		54.35 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	2.16				9.4			

Table 18- POS2 of the CY building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS3	EW_26	BASE	CONTOURS + WINDOWS	BASE	TR_4	BASE	0.42	50% COVER
	Initial Investment				Initial Investment			
	5,751.60 €		24.47 €/m^2		12,772.24 €		54.35 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	2.74				11.64			

Table 19- POS3 of the CY building split in two steps.

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	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS4	EW_3	BASE	CONTOURS + WINDOWS	BASE	TR_4	BASE	0.42	50% COVER
	Initial Investment				Initial Investment			
	12,311.75 €		52.39 €/m^2		12,772.24 €		54.35 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	4.4				15.85			

Table 20- POS4 of the CY building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS5	EW_26	BASE	CONTOURS	BASE	FR_2	BASE	0.42	NO
	Initial Investment				Initial Investment			
	11,951.06 €		29.88 €/m^2		13,279.54 €		33.2 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	4.12				5.99			

Table 21- POS5 of the HR building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS6	EW_26	BASE	CONTOURS + WINDOWS	3	TR_4	BASE	0.42	NO
	Initial Investment				Initial Investment			
	16,412.38 €		41.03 €/m^2		15,840.09 €		39.6 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	7.58				12.16			

Table 22POS6 of the HR building split in two steps.

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	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS7	EW_26	BASE	CONTOURS + WINDOWS	3	TR_16	BASE	0.42	NO
	Initial Investment				Initial Investment			
	16,412.38 €		41.03 €/m^2		17,052.62 €		42.63 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	8.87				13.97			

Table 23- POS7 of the HR building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS8	EW_26	BASE	CONTOURS + WINDOWS	BASE	FR_3	BASE	0.42	NO
	Initial Investment				Initial Investment			
	11,952.26 €		29.88 €/m^2		14,137.14 €		35.34 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	12.78				20.07			

Table 24- POS8 of the HR building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS9	EW_27	W_19	CONTOURS	BASE	TR_4	BASE	BASE	50% COVER
	Initial Investment				Initial Investment			
	5,688.61 €		10.53 €/m^2		7,792.69 €		14.43 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	2.48				3.34			

Table 25POS9 of the FR building split in two steps.

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	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS10	EW_26	W_14	CONTOURS + WINDOWS	3	TR_4	BASE	0.42	50% COVER
	Initial Investment				Initial Investment			
	14,459.22 €		26.78 €/m^2		19,285.00 €		35.71 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	6.73				11.53			

Table 26- POS10 of the FR building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS11	EW_9	W_14	CONTOURS + WINDOWS	BASE	TR_4	BASE	0.42	50% COVER
	Initial Investment				Initial Investment			
	15,286.39 €		28.31 €/m^2		19,285.00 €		35.71 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	9.48				15.15			

Table 27 POS11 of the FR building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS12	EW_3	W_14	CONTOURS + WINDOWS	BASE	TR_4	BASE	0.42	50% COVER
	Initial Investment				Initial Investment			
	14,327.90 €		26.53 €/m^2		19,285.00 €		35.71 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	13.28				22.1			

Table 28 - POS12 of the FR building split in two steps.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS13	EW_26	BASE	CONTOURS + WINDOWS	3	FR_3	BASE	0.42	50% COVER
	Initial Investment				Initial Investment			
	32,562.82 €		27.14 €/m^2		38,399.01 €		32 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	14.15				18.87			

Table 29 POS13 of the SP building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS14	EW_26	BASE	CONTOURS	3	FR_2	BASE	0.24	50% COVER
	Initial Investment				Initial Investment			
	24,997.29 €		20.83 €/m^2		67,054.11 €		55.88 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	22.42				37.84			

Table 30 POS14 of the SP building split in two steps.

	STEP1				STEP2			
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS15	EW_2	W_18	CONTOURS + WINDOWS	BASE	FR_3	BASE	0.42	NO
	Initial Investment				Initial Investment			
	50,266.72 €		41.89 €/m^2		29,795.01 €		24.98 €/m^2	
	Total Final Energy Savings per Year (Mwh)				Total Final Energy Savings per Year (Mwh)			
	28.47				39.01			

Table 31- POS15 of the SP building split in two steps.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

	STEP1					STEP2		
	External Wall	Glazings	Thermal Bridge Reduction	Air Tighness (n50)	Roof	External Slab	Ventilation (Ren/h)	Shading Elements on Windows
POS16	EW_26	BASE	CONTOURS	BASE	FR_2	BASE	0.24	50% COVER
	Initial Investment					Initial Investment		
	20,683.94 €		17.24 €/m^2			71,367.47 €	59.47 €/m^2	
	Total Final Energy Savings per Year (Mwh)					Total Final Energy Savings per Year (Mwh)		
	34.33					45.13		

Table 32 - POS16 of the SP building split in two steps.

4.2 – Full set of Packages of Optimal Solutions

In the Grant Agreement it is stated that "*... it's expected the evaluation of about 5 optimal PoS to be evaluated on 15 different climates and 6 different reference buildings (≈360 evaluations)...*". In subsection 4.1 it was explained that instead of 5 optimal optimal POS our preliminary set of POS is composed of 16 cases. Now it is important to focus on the fact that these 16 cases have been evaluated in 13 different climates and 42 different reference buildings, which means that the final number of climates is slighty lower than the envisaged, while the number of RBs is much higher, providing a total number of combinations of 546 that is a 51.6% higher than the initial figure foreseen in the GA.

The methodology for validating and assigning a POS to a new combination has been the next:

1. To calculate, for each one of the 42 RBs, their average thermal transmittance and compactness, as a representative parameter of the thermal and geometrical characteristics respectively.
2. To compare the previous parameters with those parameters of the 4 pilots, in order to match each RB with the most similar pilot building
3. To extend the POS to the 4 main Med climates to the rest until reach the total 13 climates, in order to do this the next criteria has been used:
    a. The POS for W1S2 have been considered in principle also optimal for W0S3, W0S4 and W1S3.
    b. The POS for W2S2 have been preassigned to the W1S4 climate.
    c. The POS for W2S3 have been considered also optimal for W2S0 and W2S1.
    d. The POS for W3S2 have been preassigned to the W3S0, W3S1 and W4S0 climates.

    Previous selection has been done using the Global Climate Severity Index that result summing up the winter and the summer severity indexes.

4. To validate the previous assignment of POS and if the result is not satisfactory, to change the assignation. This has required the 546 evaluations of the pre-asigned POS.

-Table 33 shows the compactness and the average U-value of the 42 RBs and the 4 PBs. As a consequence of the step 2, each RBs has been assigned to a PB.

Building	Similar Building	Û (W/Km^2)	Compactness (m)	Building	Similar Building	Û (W/Km^2)	Compactness (m)
MFH1	PB4	2.54	2.96	SFH1	PB2	2.13	1.32
MFH2	PB2	1.21	2.27	SFH2	PB2	1.10	1.27
MFH3	PB3	0.73	4.72	SFH3	PB1	0.67	2.09
MFH4	PB4	3.03	3.32	SFH4	PB2	2.13	0.93
MFH5	PB3	0.66	3.28	SFH5	PB2	0.36	0.83
MFH6	PB3	0.46	2.79	SFH6	PB2	0.34	1.09
MFH7	PB3	1.64	2.19	SFH7	PB1	1.52	2.06
MFH8	PB3	1.55	3.26	SFH8	PB1	0.84	1.54
MFH9	PB3	0.40	4.03	SFH9	PB1	0.48	1.78
MFH10	PB4	2.15	2.87	SFH10	PB1	1.55	0.84
MFH11	PB2	1.60	1.06	SFH11	PB2	1.62	0.91
MFH12	PB1	0.62	1.05	SFH12	PB2	1.15	0.91
MFH13	PB1	1.76	2.20	SFH13	PB2	1.77	1.06
MFH14	PB3	1.10	2.96	SFH14	PB2	0.84	1.26
MFH15	PB3	0.42	1.24	SFH15	PB2	0.46	1.23
MFH16	PB1	2.53	1.54	SFH16	PB3	2.34	1.23
MFH17	PB1	2.41	2.22	SFH17	PB3	2.44	1.42
MFH18	PB3	0.95	2.42	SFH18	PB2	1.05	2.43
MFH19	PB3	3.53	4.78	SFH19	PB4	3.33	0.91
MFH20	PB1	1.80	2.69	SFH20	PB2	2.46	0.88
MFH21	PB3	0.99	1.83	SFH21	PB1	1.05	1.14

-Table 33 Average compactness and U-value of each RBs and PBs. Identification of each RB to a PB.

Table 34 shows the preassignation of the POS for a given PB and a MED climate to any RB and any climate. This has been obtained after carrying out the step 3 of the previous methodology.
In this matrix each colour of the background of the cell corresponds to a preliminary POS.

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Building	W0S3	W0S4	W1S2	W1S3	W1S4	W2S0	W2S1	W2S2	W2S3	W3S0	W3S1	W3S2	W4S0
PB1/CY			POS1					POS2	POS3			POS4	
PB2/KZ			POS5					POS6	POS7			POS8	
PB3/FR			POS9					POS10	POS11			POS12	
PB4/MFH1			POS13					POS14	POS15			POS16	
MFH2													
MFH3													
MFH4													
MFH5													
MFH6													
MFH7													
MFH8													
MFH9													
MFH10													
MFH11													
MFH12													
MFH13													
MFH14													
MFH15													
MFH16													
MFH17													
MFH18													
MFH19													
MFH20													
MFH21													
SFH1													
SFH2													
SFH3													
SFH4													
SFH5													
SFH6													
SFH7													
SFH8													
SFH9													
SFH10													
SFH11													
SFH12													
SFH13													
SFH14													
SFH15													
SFH16													
SFH17													
SFH18													
SFH19													
SFH20													
SFH21													

Table 34- Preasignation of each RB and climate to a POS.

The validation of the previous assignment required a very high calculation effort as this is a very time consuming process. In order to do this, the same arrangement of computer that was used for the calculation of the POS was used again. A total of 102 days of calculations, verification and analysis of results was required in order to obtain the next matrix, in which each combination of RB and climates is assigned with the POS that provides the better performance for them. The performance of the POS has been evaluated in terms of the energy savings provided by the POS, when it is applied . If it is lower than 60%, then other POSs are tested for the same combination of RB and climate; if the energy savings are higher than the goal of 60% then the POS is validated as optimal for the RB-climate combination.

Building\Climates	W0S3	W0S4	W1S2	W1S3	W1S4	W2S0	W2S1	W2S2	W2S3	W3S0	W3S1	W3S2	W4S0
MFH1	POS13	POS14	POS13	POS14	POS14	POS14	POS14	POS14	POS15	POS15	POS15	POS16	POS15
MFH2	POS12	POS9	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS6	POS5	POS6
MFH3	POS9	POS11	POS9	POS11	POS10	POS10	POS10	POS10	POS10	POS10	POS12	POS10	POS10
MFH4	POS14	POS14	POS14	POS14	POS14	POS14	POS14	POS14	POS14	POS14	POS14	POS14	POS14
MFH5	POS9	POS11	POS10	POS11	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10
MFH6	POS9	POS11	POS10	POS10	POS11	POS11	POS10	POS11	POS11	POS10	POS10	POS10	POS10
MFH7	POS9	POS10	POS10	POS11	POS12	POS12	POS12	POS12	POS12	POS12	POS10	POS12	POS11
MFH8	POS9	POS9	POS9	POS9	POS12	POS10	POS10	POS9	POS10	POS12	POS10	POS12	POS10
MFH9	POS9	POS11	POS9	POS9	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10
MFH10	POS14	POS14	POS15	POS15	POS15	POS15	POS15	POS15	POS14	POS15	POS15	POS15	POS15
MFH11	POS12	POS12	POS12	POS12	POS6	POS5	POS6	POS6	POS6	POS5	POS5	POS5	POS5
MFH12	POS3	POS1	POS1	POS2	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
MFH13	POS1	POS2	POS2	POS2	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
MFH14	POS9	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10	POS10
MFH15	POS9	POS11	POS9	POS9	POS12	POS12	POS12	POS9	POS12	POS12	POS12	POS12	POS12
MFH16	POS1	POS2	POS3	POS3	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
MFH17	POS1	POS1	POS1	POS1	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
MFH18	POS9	POS9	POS9	POS9	POS12	POS12	POS12	POS12	POS12	POS12	POS12	POS12	POS12
MFH19	POS9	POS12	POS12	POS12	POS11	POS11	POS11	POS11	POS11	POS11	POS10	POS10	POS10
MFH20	POS1	POS2	POS1	POS3	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
MFH21	POS9	POS12	POS9	POS9	POS12	POS12	POS12	POS12	POS12	POS12	POS12	POS12	POS11
SFH1	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH2	POS12	POS12	POS12	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH3	POS1	POS1	POS1	POS1	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
SFH4	POS12	POS12	POS7	POS7	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH5	POS12	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH6	POS12	POS12	POS12	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH7	POS1	POS1	POS1	POS1	POS2	POS4	POS4	POS2	POS4	POS4	POS4	POS4	POS4
SFH8	POS1	POS2	POS2	POS2	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
SFH9	POS1	POS1	POS1	POS1	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
SFH10	POS1	POS2	POS2	POS2	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4
SFH11	POS12	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH12	POS12	POS12	POS12	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH13	POS5	POS5	POS6	POS6	POS6	POS6	POS6	POS6	POS5	POS5	POS6	POS5	POS5
SFH14	POS12	POS12	POS12	POS12	POS5	POS6	POS6	POS5	POS6	POS6	POS6	POS6	POS6
SFH15	POS12	POS12	POS12	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH16	POS9	POS9	POS9	POS9	POS12	POS12	POS12	POS12	POS12	POS11	POS11	POS12	POS11
SFH17	POS9	POS12	POS9	POS12	POS12	POS12	POS12	POS12	POS12	POS11	POS11	POS12	POS11
SFH18	POS12	POS12	POS12	POS12	POS5	POS5	POS5	POS5	POS5	POS5	POS6	POS5	POS6
SFH19	POS13	POS14	POS14	POS14	POS14	POS15	POS15	POS14	POS15	POS15	POS14	POS14	POS15
SFH20	POS7	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5	POS5
SFH21	POS1	POS1	POS1	POS1	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4	POS4

Table 35- Validated POS for each RB and climate combination.

In the annex D a total of 530 tables can be found were the 12 solutions that provide the better performance or each combination of RB and climate is shown.

Table 36 shows the percentage of the energy savings of each POS validated previously. As commented in the chapter 4.1.3, this percentage is without improving the heating and cooling system, thus it can be noticed that some combinations do not reach a 60% of savings, which is not an obstacle to reach that value after the heating and cooling system renovation.

Building\Climates	W0S3	W0S4	W1S2	W1S3	W1S4	W2S0	W2S1	W2S2	W2S3	W3S0	W3S1	W3S2	W4S0
MFH1	26%	35%	41%	42%	43%	54%	54%	45%	43%	54%	52%	49%	53%
MFH2	34%	16%	48%	22%	26%	46%	40%	34%	35%	48%	44%	42%	48%
MFH3	31%	36%	31%	43%	44%	56%	56%	53%	51%	58%	56%	55%	55%
MFH4	44%	44%	61%	57%	55%	68%	66%	66%	70%	64%	65%	65%	65%
MFH5	26%	34%	42%	43%	44%	61%	60%	55%	55%	63%	60%	60%	60%
MFH6	22%	29%	33%	32%	36%	48%	49%	44%	43%	53%	51%	50%	52%
MFH7	40%	41%	45%	50%	50%	64%	64%	59%	59%	65%	62%	62%	62%
MFH8	37%	34%	43%	41%	47%	61%	59%	40%	55%	65%	63%	62%	63%
MFH9	14%	24%	30%	29%	34%	59%	57%	48%	49%	62%	59%	57%	60%
MFH10	41%	46%	63%	57%	55%	66%	66%	66%	62%	67%	64%	65%	64%
MFH11	39%	43%	58%	55%	31%	50%	45%	41%	40%	52%	46%	46%	49%
MFH12	11%	20%	30%	30%	41%	57%	56%	52%	50%	59%	56%	55%	58%
MFH13	29%	40%	54%	49%	51%	61%	59%	60%	55%	62%	59%	59%	60%
MFH14	22%	33%	45%	43%	43%	57%	55%	54%	50%	58%	58%	55%	58%
MFH15	22%	31%	32%	30%	38%	43%	43%	41%	41%	43%	43%	43%	42%
MFH16	38%	43%	57%	53%	53%	69%	66%	63%	62%	70%	66%	66%	68%
MFH17	31%	28%	39%	37%	50%	72%	68%	62%	62%	72%	69%	68%	71%
MFH18	28%	25%	31%	31%	44%	58%	57%	54%	52%	59%	60%	57%	59%
MFH19	47%	51%	70%	66%	65%	76%	76%	76%	72%	77%	75%	76%	75%
MFH20	32%	38%	39%	50%	53%	71%	69%	64%	62%	73%	68%	68%	68%
MFH21	34%	41%	32%	34%	47%	51%	52%	52%	49%	52%	55%	51%	53%
SFH1	24%	26%	35%	32%	32%	39%	37%	37%	35%	39%	37%	37%	38%
SFH2	46%	46%	59%	55%	27%	39%	36%	33%	33%	41%	37%	37%	39%
SFH3	26%	22%	29%	29%	36%	47%	45%	42%	40%	49%	47%	44%	48%
SFH4	45%	47%	41%	36%	38%	48%	46%	45%	42%	49%	46%	46%	47%
SFH5	28%	32%	24%	22%	25%	39%	36%	33%	32%	40%	37%	37%	39%
SFH6	29%	32%	37%	36%	24%	36%	33%	28%	30%	37%	35%	34%	37%
SFH7	34%	31%	39%	38%	45%	55%	55%	54%	51%	57%	55%	54%	55%
SFH8	44%	44%	55%	50%	50%	53%	54%	58%	50%	54%	50%	51%	49%
SFH9	34%	30%	40%	37%	42%	50%	50%	50%	45%	52%	48%	48%	47%
SFH10	40%	43%	52%	47%	56%	57%	57%	59%	56%	57%	56%	57%	56%
SFH11	52%	54%	49%	48%	55%	54%	53%	52%	56%	56%	54%	54%	54%
SFH12	43%	45%	54%	53%	40%	48%	46%	45%	44%	49%	47%	46%	47%
SFH13	42%	45%	57%	56%	56%	61%	61%	61%	49%	47%	46%	46%	47%
SFH14	42%	43%	53%	51%	37%	49%	47%	43%	44%	49%	47%	47%	48%
SFH15	34%	37%	46%	44%	30%	43%	40%	36%	37%	46%	43%	42%	45%
SFH16	48%	45%	57%	54%	60%	68%	65%	67%	62%	69%	67%	68%	67%
SFH17	49%	53%	56%	63%	61%	70%	67%	68%	65%	70%	69%	70%	68%
SFH18	36%	40%	51%	48%	28%	42%	39%	34%	35%	44%	41%	39%	44%
SFH19	61%	63%	71%	67%	66%	67%	67%	68%	65%	67%	66%	66%	65%
SFH20	40%	46%	58%	54%	53%	58%	58%	58%	68%	75%	72%	72%	74%
SFH21	40%	36%	44%	41%	50%	53%	53%	55%	50%	54%	50%	52%	50%

Table 36- Percentage of Energy Savings regarding the validated POS for each RB and climate combination.

As described previously, in the annexes B and C the POS for the spinned cases and for the nonstandard users can be found. We propose to extrapolate these POS to different climates and RBs combination following the same criteria that the one followed for non spinned buildings ans stadard user behaviour. This means that the criteria for the extrapolation of the POS given in the Table 20 can be used regardless from the the orientation of the building and the inhabitant's behaviour.

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5 USE OF THE POS SOFTWARE TOOL IN THE HAPPEN PLATFORM

In this section, the employment of the excel tool which has been used for obtaining the results of the deliverable is described. This is due to the fact that the POS that have been reported in this document are based on certain hypothesis or assumptions. For instance, assumptions regarding the prices as we have already mention in this deliverable have been done taking the average values for producing the POS. The use of assumptions for the preliminary POS is reasonable because otherwise we should generate a set of POS for every possible combination of prices which is possible but extremely unuseful due to the higher number of tables of precalculated cases to be managed. Instead of proceeding in this way, we have decided to provide a set of POS taking into account average prices, and then to provide a software tool that allows to post-process the results in order to reevaluate them with different assumptions. For instance, using the costs of the renovation measures for a specific country, defining a set of HVAC/DHW systems to be considered, or maybe selecting only those solutions that consider the renovation of all the glazings.

Figure 12 shows the main screenshot of the excel tool that have been developed.

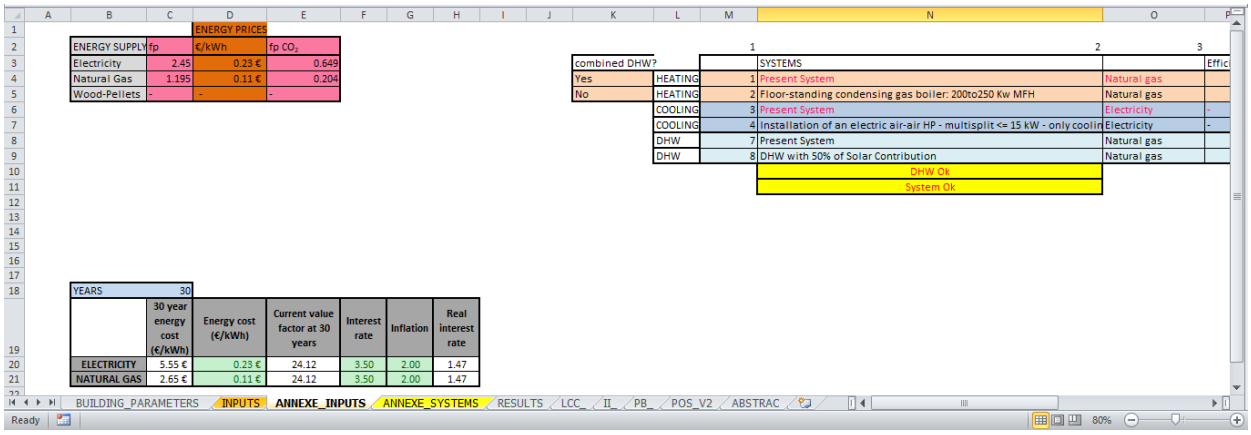

Figure 12—Sheet ANNEX E_INPUTS is where you can change systems and energy prices

The energy prices can be modified through the values of the cells D3 and D4
The prices of the renovation measures and systems can be modified through the values of the cells contained in the sheet INPUTS and in the sheet ANNEXE_SYSTEM.
The present systems COP, EER and performance can be modified in the cells M4 to Y9.

Automatically the software calculates the optimum region and shows the results in the same way that we have shown previously.
Figure 13 shows the results for a case and the same one when the prices are modififed to fit the values which are shown in D3.3 for SP.

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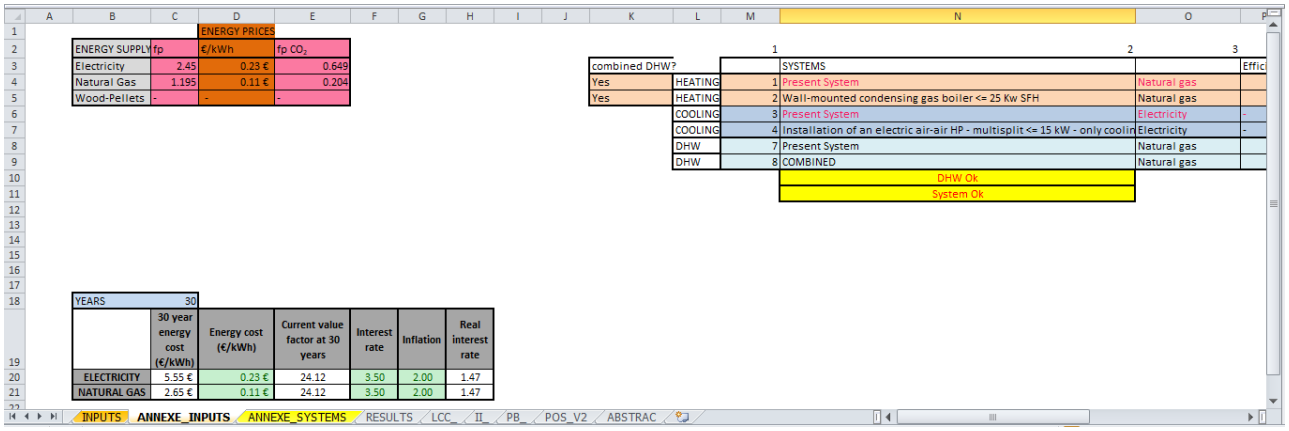


ENERGY SUPPLY	fp	ENERGY PRICES €/kWh	fp CO_2
Electricity	2.45	0.23 €	0.649
Natural Gas	1.195	0.11 €	0.204
Wood-Pellets	-	-	-

combined DHW?			SYSTEMS	Effic
Yes	HEATING	1	Present System	Natural gas
Yes	HEATING	2	Wall-mounted condensing gas boiler <= 25 Kw SFH	Natural gas
	COOLING	3	Present System	Electricity
	COOLING	4	Installation of an electric air-air HP - multisplit <= 15 kW - only coolin	Electricity
	DHW	7	Present System	Natural gas
	DHW	8	COMBINED	Natural gas

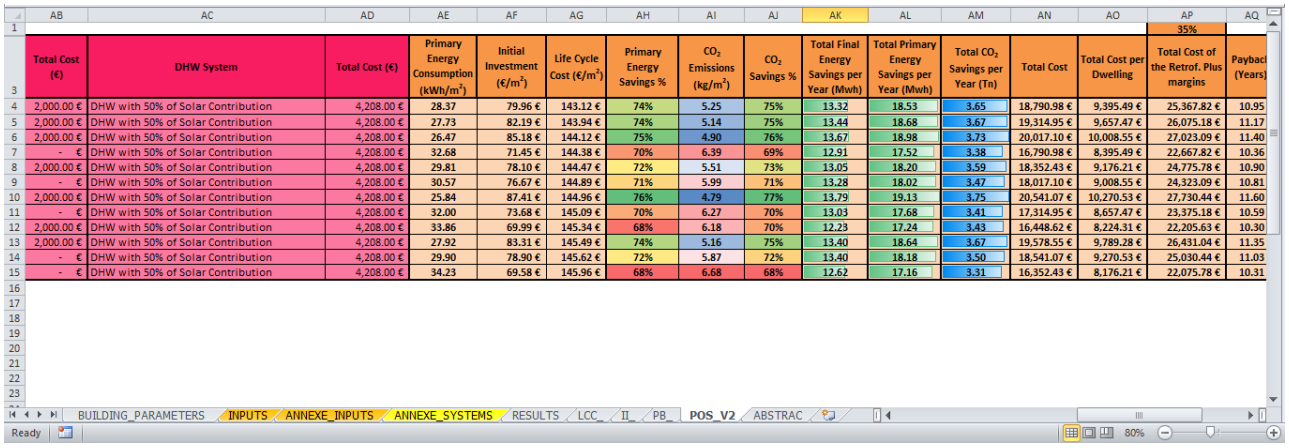
DHW Ok
System Ok

YEARS	30					
	30 year energy cost (€/kWh)	Energy cost (€/kWh)	Current value factor at 30 years	Interest rate	Inflation	Real interest rate
ELECTRICITY	5.55 €	0.23 €	24.12	3.50	2.00	1.47
NATURAL GAS	2.65 €	0.11 €	24.12	3.50	2.00	1.47

INPUTS | ANNEXE_INPUTS | ANNEXE_SYSTEMS | RESULTS | LCC_ | II_ | PB_ | POS_V2 | ABSTRAC

Figure 13—Example when the user chose the systems without problems

If the user chooses correctly the systems and the values in the cells N10 and N11, then it will appear an "ok" message.



Total Cost (€)	DHW System	Total Cost (€)	Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost	Total Cost per Dwelling	35% Total Cost of the Retrof. Plus margins	Payback (Years)
2,000.00 €	DHW with 50% of Solar Contribution	4,208.00 €	28.37	79.96 €	143.12 €	74%	5.25	75%	13.32	18.53	3.65	18,790.98 €	9,395.49 €	25,367.82 €	10.95
2,000.00 €	DHW with 50% of Solar Contribution	4,208.00 €	27.73	82.19 €	143.94 €	74%	5.14	75%	13.44	18.68	3.67	19,314.95 €	9,657.47 €	26,075.18 €	11.17
2,000.00 €	DHW with 50% of Solar Contribution	4,208.00 €	26.47	85.18 €	144.12 €	75%	4.90	76%	13.67	18.98	3.73	20,017.10 €	10,008.55 €	27,023.09 €	11.40
- €	DHW with 50% of Solar Contribution	4,208.00 €	32.68	71.45 €	144.38 €	70%	6.39	69%	12.91	17.52	3.38	16,790.98 €	8,395.49 €	22,667.82 €	10.36
2,000.00 €	DHW with 50% of Solar Contribution	4,208.00 €	29.81	78.10 €	144.47 €	72%	5.51	73%	13.05	18.20	3.59	18,352.43 €	9,176.21 €	24,775.78 €	10.90
- €	DHW with 50% of Solar Contribution	4,208.00 €	30.57	76.67 €	144.89 €	71%	5.99	71%	13.28	18.02	3.47	18,017.10 €	9,008.55 €	24,323.09 €	10.81
2,000.00 €	DHW with 50% of Solar Contribution	4,208.00 €	25.84	87.41 €	144.96 €	76%	4.79	77%	13.79	19.13	3.75	20,541.07 €	10,270.53 €	27,730.44 €	11.60
- €	DHW with 50% of Solar Contribution	4,208.00 €	32.00	73.68 €	145.09 €	70%	6.27	70%	13.03	17.68	3.41	17,314.95 €	8,657.47 €	23,375.18 €	10.59
2,000.00 €	DHW with 50% of Solar Contribution	4,208.00 €	33.86	69.99 €	145.34 €	68%	6.18	70%	12.23	17.24	3.43	16,448.62 €	8,224.31 €	22,205.63 €	10.30
2,000.00 €	DHW with 50% of Solar Contribution	4,208.00 €	27.92	83.31 €	145.49 €	74%	5.16	75%	13.40	18.64	3.67	19,578.55 €	9,789.28 €	26,431.04 €	11.35
- €	DHW with 50% of Solar Contribution	4,208.00 €	29.90	78.90 €	145.62 €	72%	5.87	72%	13.40	18.18	3.50	18,541.07 €	9,270.53 €	25,030.44 €	11.03
- €	DHW with 50% of Solar Contribution	4,208.00 €	34.23	69.58 €	145.96 €	68%	6.68	68%	12.62	17.16	3.31	16,352.43 €	8,176.21 €	22,075.78 €	10.31

BUILDING_PARAMETERS | INPUTS | ANNEXE_INPUTS | ANNEXE_SYSTEMS | RESULTS | LCC_ | II_ | PB_ | POS_V2 | ABSTRAC

Ready 80%

Figure 14—POS with the new energy prices and adding new systems

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6 CONCLUSIONS

This deliverable is aimed at providing a comprehensive set of packages of optimal solutions (POS) for the renovation of the typical buildings (RBs) and climates that can be found in Europe and more specifically in the Medierranean Region.
A set ot 16 POS has been assessed, each one of them composed of 12 combination of measures for the sake of the flexibility of the proposed solution. This is, to propose a high enough number of solutions and to allow the building designer, the constructor, the inhabnitants and/or the owner of the building, to choose the more adequate for their specific case.
The performance of these set of 16 POS has been evaluated and checked using a common methodology in 42 different buildings and 13 climates obtaining satisfying results. This is very important because as far as we know this is the first time this has been carried out. Some futher remarks are reported below:

- POS should be chosen taking into account the building characteristics and climate. As we have shown in table 36 and Annex D the best POS strongly depends on these.
- More fine tuned POS can be defined using the excel tool ad hoc developed for this deliverable and it is planned to be accessible via the HAPPEN platform. Thanks to this tool, the user canmodify the prices for the renovation measures, the energy prices and the HVAC/DHW systems.
- The POS depends on the orientation of the façades; thus, analogous 16 POS have been defined for cases spinned 90º (see Annex B).
- The POS depends on the inhabitant's behaivour; thus, similar 16 POS have been defined for users with a high energy awareness leading to higher energy savings (see Annex C). Another interpretation of this consists in the fact that the inhabitant's awareness can be considered as another renovation measure.
- POS are mainly focused on the optimization of the building envelope, ventilation systems, airtightness and shading devices, nevertheless the HVAC and DHW are also considered by the tool and we recommend to analyse the influence of modifying these.
- POS have been split in steps in order to ease the process of renovation for the owners and increase the renovation rate.

In this process the relevant difficulties found have been:

- The classification of climates, that has been overtaken thanks to the results of the D3.1
- The definition of RBs, that has been overtaken thanks to the results of the D3.2
- The definition of abacus of renovations, that has been passed due to the results of the D3.3
- The variability in the prices (energy and renovation measures), that can be passed using the tool in the HAPPEN plataform.

The methodology used in this project was used in the Bolzano Congress to explain the potential of our tool to assess the best possible intervention in the Pilot of Castellón if it were located in another region of Europe, in this case in Bolzano. Therefore the prices of the improvements to average prices in Italy were changed and the climatic zone where the POS would be sought was modified. Obtaining an own package for that specific situation. Giving more value, therefore, to the tool created in this project so that the user can choose their prices and their climatic zone after choosing the type of building that is more similar to their own. Also in this congress we study the possibility of carrying out the intervention in several steps, in the same way as shown in this document. Figure 15 shows the step by step situation regarding the previous situation to compare energy, CO_2 and recalculate LCC.

STEPS	Primary Energy Consumption (kWh/m^2)	Initial Investment ($€/m^2$)	Life Cycle Cost ($€/m^2$)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
1	146.20	110.83 €	737.58 €	22%	27.38	22%	47.05	49.78	9.33	132,996.37 €
2	82.36	70.62 €	411.46 €	44%	15.39	44%	74.49	76.61	14.39	84,741.49 €
3	64.38	41.75 €	304.14 €	22%	12.02	22%	20.16	21.57	4.05	50,097.60 €

Figure 15—SbS with the new energy and improvements prices and adding new systems (the third step)

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7 ANNEX A: POS PRELIMINARY RESULTS

The preliminary results of the POS are represented in the first part of the four tables regarding each calculated climates for the Pilot Buildings. The relation between the glazing direction, the U-values, compactness and the Primary Energy Consumption will be determined. It is necessary remind the geometry of the building established in Table 1.

BASE					
Building	**Û (W/m^2K)**	**Compactness (m)**	**U_w (W/m^2K)**	**Windows % per wall orientation**	**Primary Energy Consumption (kWh/m^2)**
LABIN	**2.23**	**1.33**	**3.60**	**NW: 8% SE: 8%**	**108.48**
STROVOLOS	**2.12**	**1.57**	**2.70**	**N: 30% W: 22.7% S: 26%**	**99.78**
CASTELLÓN	**2.54**	**2.96**	**5.70**	**N: 6% S: 12%**	**77.59**
MARSEILLE	**1.89**	**3.46**	**5.65**	**N: 16% S:16%**	**62.32**

Table 37 - Data regarding the PBs in W1S2.

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BASE					
Building	Û (W/m^2K)	Compactness (m)	U_w (W/m^2K)	Windows % per wall orientation	Primary Energy Consumption (kWh/m^2)
LABIN	2.23	1.33	3.60	NW: 8% SE: 8%	159.65
STROVOLOS	2.12	1.57	2.70	N: 30% W: 22.7% S: 26%	147.15
CASTELLÓN	2.54	2.96	5.70	N: 6% S: 12%	126.67
MARSEILLE	1.89	3.46	5.65	N: 16% S:16%	93.77

Table 38 Data regarding the PBs in W2S2.

BASE					
Building	Û (W/m^2K)	Compactness (m)	U_w (W/m^2K)	Windows % per wall orientation	Primary Energy Consumption (kWh/m^2)
LABIN	2.23	1.33	3.60	NW: 8% SE: 8%	192.12
STROVOLOS	2.12	1.57	2.70	N: 30% W: 22.7% S: 26%	184.58
CASTELLÓN	2.54	2.96	5.70	N: 6% S: 12%	154.91
MARSEILLE	1.89	3.46	5.65	N: 16% S:16%	120.35

Table 39 - Data regarding the PBs in W2S3.

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BASE					
Building	Û (W/m^2K)	Compactness (m)	U_w (W/m^2K)	Windows % per wall orientation	Primary Energy Consumption (kWh/m^2)
LABIN	2.23	1.33	3.60	NW: 8% SE: 8%	247.09
STROVOLOS	2.12	1.57	2.70	N: 30% W: 22.7% S: 26%	230.17
CASTELLÓN	2.54	2.96	5.70	N: 6% S: 12%	193.90
MARSEILLE	1.89	3.46	5.65	N: 16% S:16%	150.69

Table 40- Data regarding the PBs in W3S2.

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8 ANNEX B: POS PRELIMINARY RESULTS FOR THE SPINNED PBS

This annex is aimed at establishing the necessity of new tables of Package of Solutions for the same Reference Buildings with other orientation. It means that, for example, the north face of the building now it would be the east face. After an overview of the results of the spinned buildings it could be possible to say that the windows previously oriented to north that could be improved in order to reduce energy consumption, when these windows have another orientations, maybe it is not necessary to retrofit the glazings. Below we can see some differences between spinned or normal Pilot Building.

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SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
5	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
11	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
50.20	43.58 €	131.78 €	52%	9.37	54%	8.93	12.74	2.56	10,240.62 €
48.24	48.79 €	133.51 €	54%	9.00	56%	9.28	13.20	2.64	11,466.74 €
45.01	53.54 €	133.59 €	57%	8.51	58%	9.98	13.96	2.76	12,582.98 €
53.01	40.95 €	134.14 €	49%	9.90	51%	8.43	12.08	2.43	9,623.14 €
46.47	51.68 €	134.23 €	55%	8.77	57%	9.71	13.62	2.70	12,144.43 €
43.01	58.76 €	135.23 €	59%	8.12	60%	10.33	14.43	2.85	13,809.10 €
44.47	56.90 €	135.88 €	57%	8.39	59%	10.06	14.09	2.78	13,370.55 €
52.65	43.57 €	136.06 €	50%	9.82	51%	8.49	12.17	2.45	10,239.53 €
47.89	50.92 €	136.11 €	54%	9.05	55%	9.47	13.28	2.63	11,965.51 €
49.34	49.05 €	136.74 €	53%	9.32	54%	9.20	12.94	2.57	11,526.96 €
50.67	48.79 €	137.76 €	51%	9.45	53%	8.84	12.63	2.54	11,465.66 €
47.43	53.54 €	137.84 €	55%	8.96	56%	9.55	13.39	2.65	12,581.90 €

Table 41- POS Spinned of the CY building in the W1S2 climate- POS1S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Base solution instead EW_26
- Glazings: No differences
- Slabs: No differences
- Roof: Changed an TR_4 and FR_3 by two FR_2
- Thermal Bridges: Contours + Windows instead only Contours
- Ventilation and Air-Tightness: No differences
- Shading elements: No differences
- Energy Savings: almost the same (3% lower)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
11	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
65.09	53.54 €	162.02 €	57%	11.49	58%	15.62	20.38	3.80	12,582.98 €
64.00	55.77 €	162.46 €	58%	11.30	59%	15.84	20.64	3.84	13,106.95 €
67.57	51.68 €	164.23 €	55%	11.92	57%	15.14	19.80	3.69	12,144.43 €
55.68	71.38 €	166.46 €	63%	10.08	64%	17.69	22.60	4.13	16,773.75 €
54.67	73.61 €	167.05 €	64%	9.91	64%	17.89	22.83	4.17	17,297.72 €
68.83	53.54 €	168.27 €	55%	12.15	56%	14.91	19.51	3.64	12,581.90 €
57.99	69.51 €	168.33 €	62%	10.48	62%	17.23	22.05	4.03	16,335.20 €
69.95	51.76 €	168.45 €	54%	12.36	55%	14.71	19.24	3.59	12,164.64 €
67.74	55.77 €	168.70 €	55%	11.96	57%	15.12	19.76	3.68	13,105.87 €
68.88	53.99 €	168.91 €	55%	12.17	56%	14.92	19.49	3.63	12,688.60 €
71.32	51.67 €	170.49 €	53%	12.58	54%	14.43	18.92	3.54	12,143.35 €
77.46	41.27 €	170.50 €	49%	13.69	50%	13.28	17.48	3.28	9,697.71 €

Table 42 - POS Spinned of the CY building in the W2S2 climate- POS2S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: W_28 appears and become the most chosen wall
- Glazings: No differences
- Slabs: No differences
- Roof: TR_4 disappears and TR_13 appears
- Thermal Bridges: There is one solution that doesn't require a Reduction
- Ventilation and Air-Tightness: One improvement dissapears
- Shading elements: No differences
- Energy Savings: almost the same (4% lower)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
72.07	76.60 €	204.61 €	62%	13.60	62%	21.32	27.93	5.22	17,999.87 €
70.78	78.82 €	204.66 €	63%	13.37	63%	21.56	28.24	5.27	18,523.84 €
82.65	60.99 €	204.89 €	57%	15.27	57%	19.10	25.45	4.83	14,333.07 €
84.01	58.76 €	204.97 €	56%	15.52	57%	18.84	25.13	4.77	13,809.10 €
75.89	71.38 €	205.93 €	60%	14.29	60%	20.61	27.03	5.06	16,773.75 €
74.62	73.61 €	206.01 €	61%	14.07	61%	20.85	27.33	5.11	17,297.72 €
86.59	55.77 €	206.42 €	55%	15.99	55%	18.37	24.52	4.66	13,106.95 €
87.93	53.54 €	206.47 €	54%	16.23	55%	18.12	24.20	4.60	12,582.98 €
76.61	76.59 €	212.35 €	60%	14.42	60%	20.47	26.86	5.03	17,998.79 €
75.32	78.82 €	212.40 €	61%	14.19	60%	20.72	27.17	5.08	18,522.76 €
81.30	68.75 €	212.55 €	57%	15.27	57%	19.61	25.76	4.83	16,156.28 €
80.05	70.98 €	212.67 €	58%	15.05	58%	19.84	26.06	4.88	16,680.25 €

Table 43- POS Spinned of the CY building in the W2S3 climate- POS3S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: EW_27 disappears
- Glazings: No differences
- Slabs: No differences
- Roof: FR_2 appears
- Thermal Bridges: Two solutions with only Contours became a solution
- Ventilation and Air-Tightness: Ventilation has two improvements more
- Shading elements: No differences
- Energy Savings: No differences

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
2	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_16	0.714285714	16.71 €	FR_3	2.35	28.78 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_16	0.714285714	16.71 €	FR_3	2.35	28.78 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_16	0.71	16.71 €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
81.74	60.61 €	203.64 €	65%	15.18	63%	30.17	35.60	5.99	14,243.57 €
76.42	74.72 €	207.41 €	67%	14.08	65%	31.01	36.85	6.25	17,560.24 €
88.88	46.95 €	207.56 €	62%	17.08	58%	29.49	33.92	5.55	11,032.26 €
74.13	78.82 €	207.61 €	68%	13.67	66%	31.44	37.38	6.35	18,522.76 €
89.88	51.68 €	208.65 €	61%	16.66	59%	28.66	33.68	5.64	12,144.43 €
81.35	68.39 €	209.53 €	65%	14.98	63%	30.10	35.69	6.04	16,070.69 €
82.84	61.06 €	209.56 €	64%	15.78	61%	30.39	35.34	5.85	14,348.92 €
84.16	62.48 €	209.66 €	64%	15.62	62%	29.72	35.03	5.89	14,682.13 €
79.07	72.48 €	209.76 €	66%	14.57	64%	30.52	36.22	6.14	17,033.21 €
80.61	65.16 €	209.91 €	65%	15.39	62%	30.81	35.86	5.95	15,311.44 €
88.40	55.77 €	210.20 €	62%	16.39	60%	28.94	34.03	5.71	13,106.95 €
87.73	54.72 €	211.58 €	62%	16.67	59%	29.49	34.19	5.64	12,859.37 €

Table 44- POS Spinned of the CY building in the W3S2 climate- POS4S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: EW_2 and EW_3 disappear and EW_27 and EW_28 become a solution
- Glazings: No differences
- Slabs: No differences
- Roof: TR_17 disappears and FR_3 become a majority solution
- Thermal Bridges: No differences
- Ventilation and Air-Tightness: No improvements become a majority solution
- Shading elements: No differences
- Energy Savings: No differences

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	FR_8	0.93	10.73 €
2	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	FR_8	0.93	10.73 €
3	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	FR_2	1.47	24.49 €
4	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	FR_8	0.93	10.73 €
5	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	FR_8	0.93	10.73 €
6	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	FR_2	1.47	24.49 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	TR_13	1.43	25.87 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	FR_8	0.93	10.73 €
9	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	TR_13	1.43	25.87 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_17	1.43	19.85 €	FR_2	1.47	24.49 €
11	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	FR_2	1.47	24.49 €
12	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	FR_8	0.93	10.73 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
68.92	37.84 €	159.14 €	37%	12.88	36%	12.77	16.00	2.87	15,134.56 €
73.79	29.80 €	159.80 €	32%	13.81	31%	11.32	14.05	2.50	11,918.70 €
65.98	44.72 €	160.82 €	39%	12.33	38%	13.67	17.18	3.09	17,886.56 €
69.89	37.83 €	160.85 €	36%	13.06	35%	12.48	15.61	2.79	15,133.36 €
69.09	39.80 €	161.45 €	37%	12.92	36%	12.74	15.93	2.85	15,921.56 €
70.88	36.68 €	161.56 €	35%	13.26	34%	12.20	15.22	2.71	14,670.70 €
66.14	45.41 €	161.81 €	39%	12.36	38%	13.62	17.11	3.07	18,163.13 €
73.98	31.76 €	162.18 €	32%	13.85	31%	11.27	13.97	2.48	12,705.70 €
71.05	37.37 €	162.54 €	35%	13.29	34%	12.15	15.15	2.70	14,947.27 €
66.94	44.71 €	162.54 €	39%	12.51	38%	13.38	16.79	3.01	17,885.36 €
66.14	46.68 €	163.14 €	39%	12.37	38%	13.63	17.11	3.07	18,673.56 €
70.06	39.80 €	163.18 €	36%	13.10	35%	12.44	15.55	2.78	15,920.36 €

Table 45- POS Spinned of the HR building in the W1S2 climate- POS5S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: All become EW_27
- Glazings: No differences
- Slabs: Improvements must carried out
- Roof: Tr_17 disappears and TR_13 appears
- Thermal Bridges: Only three solutions remain the same
- Ventilation and Air-Tightness: Ventilation has changed completely and Air-tightness has no improvement
- Shading elements: No differences
- Energy Savings:13% lower

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
10	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
12	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
85.09	42.13 €	184.66 €	47%	15.10	46%	24.57	29.95	5.22	16,850.26 €
83.33	44.27 €	184.72 €	48%	14.88	47%	25.31	30.65	5.31	17,707.86 €
69.27	65.22 €	184.75 €	57%	12.68	55%	30.38	36.28	6.19	26,089.40 €
71.11	63.08 €	184.87 €	56%	12.92	54%	29.62	35.54	6.09	25,231.80 €
74.01	59.09 €	185.64 €	54%	13.42	52%	28.67	34.38	5.89	23,634.78 €
72.27	61.23 €	185.70 €	55%	13.20	53%	29.39	35.08	5.98	24,492.38 €
89.81	35.25 €	185.73 €	44%	15.94	43%	23.06	28.06	4.88	14,098.26 €
88.14	38.13 €	185.74 €	45%	15.64	44%	23.58	28.73	5.01	15,253.24 €
75.72	56.20 €	185.75 €	53%	13.74	51%	28.14	33.70	5.77	22,479.80 €
86.50	40.28 €	186.01 €	46%	15.44	45%	24.29	29.39	5.08	16,110.84 €
78.57	52.21 €	186.43 €	51%	14.23	49%	27.20	32.56	5.57	20,882.78 €
92.79	31.25 €	186.71 €	42%	16.47	42%	22.09	26.87	4.67	12,501.24 €

Table 46- POS Spinned of the HR building in the W2S2 climate- POS6S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: No differences
- Glazings: No differences
- Slabs: No differences
- Roof: TR_13 and TR_4 disappear and FR_3 appears
- Thermal Bridges: All improvements with Countours of windows
- Ventilation and Air-Tightness: Air-tightness changes completely
- Shading elements: No differences
- Energy Savings: No differences

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
9	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
90.88	63.77 €	224.30 €	53%	17.05	51%	32.99	40.53	7.12	25,507.16 €
95.97	56.20 €	225.39 €	50%	17.97	48%	31.37	38.49	6.75	22,478.60 €
94.32	59.78 €	226.13 €	51%	17.67	49%	31.89	39.15	6.88	23,910.14 €
99.34	52.20 €	227.11 €	48%	18.57	47%	30.30	37.14	6.51	20,881.58 €
97.25	55.73 €	227.20 €	49%	18.21	48%	30.98	37.98	6.66	22,292.51 €
102.29	48.16 €	228.20 €	47%	19.12	45%	29.39	35.96	6.29	19,263.94 €
107.22	42.81 €	228.88 €	44%	19.75	43%	27.34	33.99	6.04	17,125.62 €
98.80	56.43 €	228.93 €	49%	18.31	47%	30.17	37.36	6.62	22,573.47 €
100.66	51.74 €	228.96 €	48%	18.82	46%	29.90	36.62	6.41	20,695.49 €
103.55	48.86 €	229.45 €	46%	19.17	45%	28.67	35.46	6.27	19,544.90 €
105.63	44.17 €	229.85 €	45%	19.72	43%	28.32	34.63	6.06	17,666.92 €
112.39	35.24 €	230.13 €	42%	20.68	41%	25.71	31.92	5.67	14,097.06 €

Table 47- POS Spinned of the HR building in the W2S3 climate- POS7S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: No differences
- Glazings: No differences
- Slabs: No differences
- Roof: Only appears FR_8 and TR_13
- Thermal Bridges: No reductions appears and Countours + Windows disappears
- Ventilation and Air-Tightness: Air-tightness changes entirelyand Ventilation has two solutions without improvement
- Shading elements: No differences
- Energy Savings: 3% lower

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
9	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
12	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
100.37	69.48 €	234.79 €	59%	17.50	59%	49.19	58.68	10.00	27,792.35 €
102.51	69.48 €	238.28 €	59%	17.87	58%	48.48	57.82	9.85	27,791.14 €
105.14	65.49 €	238.55 €	57%	18.32	57%	47.60	56.77	9.67	26,195.33 €
108.45	63.08 €	240.93 €	56%	18.82	56%	46.38	55.45	9.47	25,231.80 €
107.26	65.49 €	242.02 €	57%	18.69	56%	46.90	55.92	9.52	26,194.12 €
108.86	63.77 €	242.29 €	56%	18.89	56%	46.25	55.28	9.44	25,508.37 €
100.61	78.11 €	243.82 €	59%	17.54	59%	49.11	58.58	9.98	31,245.79 €
110.52	63.08 €	244.31 €	55%	19.18	55%	45.70	54.62	9.33	25,230.60 €
113.01	59.09 €	244.34 €	54%	19.60	54%	44.87	53.63	9.16	23,634.78 €
104.34	72.51 €	244.40 €	58%	18.19	57%	47.89	57.09	9.72	29,004.88 €
110.93	63.77 €	245.67 €	55%	19.25	55%	45.56	54.46	9.30	25,507.16 €
113.41	59.78 €	245.69 €	54%	19.67	54%	44.74	53.47	9.13	23,911.35 €

Table 48- POS Spinned of the HR building in the W3S2 climate- POS8S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: No differences
- Glazings: No differences
- Slabs: No differences
- Roof: FR_3 disappears and TR_4, TR_16 and TR_17 appear
- Thermal Bridges: Mostly the same
- Ventilation and Air-Tightness: In air-tightness all the solutions are without improvements
- Shading elements: No differences
- Energy Savings: No differences

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_26	1.47	14.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_13	1.43	25.87 €
3	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €
7	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_13	1.43	25.87 €
10	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_26	1.47	14.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
36.84	26.13 €	90.81 €	47%	6.87	49%	13.02	17.95	3.50	14,110.90 €
41.50	19.75 €	93.56 €	41%	7.84	41%	11.35	15.43	2.98	10,667.28 €
40.41	25.15 €	95.30 €	42%	7.44	44%	11.33	16.02	3.19	13,583.60 €
45.25	17.50 €	95.48 €	35%	8.27	38%	9.15	13.41	2.75	9,447.95 €
42.23	22.13 €	96.16 €	40%	7.86	41%	10.77	15.04	2.97	11,948.65 €
45.66	16.11 €	96.43 €	35%	8.53	36%	9.42	13.19	2.61	8,700.01 €
36.65	32.44 €	96.72 €	48%	6.83	49%	13.09	18.05	3.53	17,515.15 €
41.06	24.97 €	96.85 €	41%	7.63	43%	11.22	15.67	3.09	13,481.31 €
45.10	16.09 €	96.91 €	36%	8.59	36%	10.05	13.49	2.57	8,690.47 €
45.07	19.06 €	98.16 €	36%	8.40	37%	9.62	13.51	2.68	10,293.40 €
40.98	26.42 €	98.22 €	42%	7.62	43%	11.27	15.71	3.10	14,265.73 €
45.66	17.28 €	98.25 €	35%	8.60	36%	9.60	13.19	2.57	9,329.61 €

Table 49- POS Spinned of the FR building in the W1S2 climate- POS9S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Base is included
- Glazings: Base and W_14 are included, and W_13 disappears
- Slabs: No differences
- Roof: TR_13 are included
- Thermal Bridges: Very similar
- Ventilation and Air-Tightness: An air-tightness improved solution is included
- Shading elements: Two cases among those listed donot include shading elements
- Energy Savings: 6% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_16	0.71	16.71 €	FR_8	0.93	10.73 €
2	EW_0	BASE	- €	W_18	2.7	3.5	0.77	62.11 €	B_18	2.14	23.79 €	FR_2	1.47	24.49 €
3	EW_0	BASE	- €	W_11	1.1	1.3	0.59	269.57 €	B_0	BASE	- €	TR_0	BASE	- €
4	EW_0	BASE	- €	W_18	2.7	3.5	0.77	62.11 €	B_14	1.67	58.15 €	FR_8	0.93	10.73 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	TR_16	2.42	43.36 €
6	EW_0	BASE	- €	W_15	2.6	3.5	0.77	229.77 €	B_16	0.71	16.71 €	TR_13	1.43	25.87 €
7	EW_0	BASE	- €	W_19	2.7	1.43	0.77	116.17 €	B_6	1.00	37.47 €	FR_3	2.35	28.78 €
8	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	TR_13	1.43	25.87 €
9	EW_26	1.47	14.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_8	2.35	51.51 €	W_19	2.7	1.43	0.77	116.17 €	B_18	2.14	23.79 €	TR_16	2.42	43.36 €
11	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_19	4.29	18.00 €	TR_0	BASE	- €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_8	1.25	46.70 €	TR_15	1.52	38.58 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	0.5	40.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
30.95	24.71 €	81.94 €	69%	6.09	66%	31.04	37.40	6.44	13,341.69 €
36.21	21.92 €	88.21 €	64%	7.05	61%	28.82	34.56	5.92	11,835.28 €
37.44	27.53 €	99.65 €	63%	7.69	57%	29.31	33.89	5.58	14,864.43 €
40.84	27.72 €	99.82 €	59%	7.66	57%	26.26	32.05	5.59	14,968.92 €
33.94	37.11 €	99.85 €	66%	6.68	63%	29.87	35.78	6.12	20,037.80 €
32.06	43.68 €	102.57 €	68%	6.27	65%	30.50	36.80	6.35	23,584.54 €
33.43	40.50 €	102.59 €	67%	6.61	63%	30.15	36.06	6.16	21,869.88 €
42.44	28.82 €	103.73 €	58%	7.96	56%	25.60	31.19	5.43	15,562.54 €
30.86	47.01 €	105.72 €	69%	6.26	65%	31.52	37.44	6.35	25,385.67 €
32.06	46.92 €	105.81 €	68%	6.27	65%	30.50	36.80	6.35	25,335.90 €
45.05	26.95 €	106.05 €	55%	8.40	53%	24.42	29.78	5.19	14,554.05 €
36.14	40.09 €	106.32 €	64%	7.05	61%	28.86	34.59	5.92	21,647.20 €

Table 50- POS Spinned of the FR building in the W2S2 climate- POS10S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Base is the majority solution and EW_8 and EW_9 appear
- Glazings: Completely different
- Slabs: Now it has improvements, B_14, B_16, B_18 and B_19
- Roof: Completely different. Base appears in solutions
- Thermal Bridges: No reduction and Only Contours has the same weight
- Ventilation and Air-Tightness: Only one improvement in ventilation and air-tightness has now a case with a great improvement and the half of the cases are without improvements
- Shading elements: Half of cases has no shading elements
- Energy Savings: Mostly the same but more spread out

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_2	2.22	44.00 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_2	2.22	44.00 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_2	2.22	44.00 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_2	2.22	44.00 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
10	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
49.63	48.84 €	138.31 €	60%	9.51	58%	31.58	39.87	7.20	26,375.18 €
51.57	46.00 €	138.84 €	58%	9.87	57%	30.77	38.82	7.00	24,842.53 €
47.45	53.13 €	138.85 €	62%	9.11	60%	32.51	41.05	7.41	28,692.26 €
49.39	50.30 €	139.39 €	60%	9.47	59%	31.70	40.00	7.22	27,159.60 €
45.97	56.80 €	140.40 €	63%	8.89	61%	33.25	41.84	7.53	30,674.01 €
43.74	61.09 €	140.87 €	65%	8.49	63%	34.19	43.04	7.75	32,991.08 €
47.97	53.97 €	141.06 €	61%	9.26	59%	32.42	40.76	7.33	29,141.35 €
44.69	59.73 €	141.16 €	64%	8.66	62%	33.80	42.53	7.66	32,254.32 €
45.74	58.26 €	141.51 €	63%	8.86	61%	33.36	41.97	7.55	31,458.43 €
42.48	64.02 €	141.65 €	66%	8.26	64%	34.74	43.73	7.87	34,571.40 €
46.69	56.89 €	141.81 €	62%	9.03	60%	32.96	41.45	7.46	30,721.66 €
45.79	58.56 €	141.85 €	63%	8.86	61%	33.33	41.94	7.55	31,620.11 €

Table 51- POS Spinned of the FR building in the W2S3 climate- POS11S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: EW_2 appears
- Glazings: No differences
- Slabs: No differences
- Roof: TR_16 disappears
- Thermal Bridges: No differences
- Ventilation and Air-Tightness: No differences
- Shading elements: No differences
- Energy Savings: No differences

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SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	TR_0	BASE	- €
2	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_17	1.43	19.85 €	FR_3	2.35	28.78 €
3	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	TR_13	1.43	25.87 €
4	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	TR_15	1.52	38.58 €
5	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_6	1.00	37.47 €	FR_2	1.47	24.49 €
6	EW_0	BASE	- €	W_18	2.7	3.5	0.77	62.11 €	B_18	2.14	23.79 €	FR_2	1.47	24.49 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_0	BASE	- €	W_11	1.1	1.3	0.59	269.57 €	B_0	BASE	- €	TR_0	BASE	- €
9	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_19	4.29	18.00 €	TR_0	BASE	- €
10	EW_3	3.33	48.94 €	W_13	1.4	1.43	0.58	184.83 €	B_16	0.71	16.71 €	FR_2	1.47	24.49 €
11	EW_0	BASE	- €	W_18	2.7	3.5	0.77	62.11 €	B_6	1.00	37.47 €	FR_2	1.47	24.49 €
12	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_18	2.14	23.79 €	FR_2	1.47	24.49 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
44.69	19.18 €	100.61 €	71%	8.66	67%	50.91	58.84	9.68	10,359.56 €
42.59	31.24 €	109.06 €	72%	8.28	69%	51.80	59.97	9.88	16,867.69 €
45.42	28.82 €	111.52 €	70%	8.80	67%	50.61	58.45	9.60	15,562.54 €
47.81	28.16 €	114.58 €	69%	9.19	65%	49.49	57.15	9.39	15,206.41 €
44.64	31.91 €	114.85 €	71%	8.83	67%	51.37	58.87	9.58	17,229.99 €
49.63	21.92 €	114.87 €	68%	9.90	63%	49.65	56.17	9.01	11,835.28 €
42.12	39.41 €	115.63 €	73%	8.11	70%	51.78	60.23	9.98	21,282.50 €
48.93	27.53 €	116.35 €	68%	9.45	64%	49.14	56.55	9.25	14,864.43 €
48.96	26.95 €	116.96 €	68%	9.58	64%	49.45	56.53	9.18	14,554.05 €
44.07	36.43 €	117.38 €	71%	8.61	68%	51.33	59.17	9.70	19,672.57 €
47.27	31.60 €	117.59 €	69%	9.15	66%	49.85	57.44	9.41	17,065.25 €
51.81	26.36 €	120.07 €	66%	9.96	63%	47.91	54.99	8.97	14,233.63 €

Table 52- POS Spinned of the FR building in the W3S2 climate- POS12S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Entirely changed. Base appears
- Glazings: Entirely changed. Base appears.
- Slabs: Only two solutions stand with Base
- Roof: Entirely changed. Base appears
- Thermal Bridges: No reduction and Only contours appear with the same weight
- Ventilation and Air-Tightness: Only one ventilation solution has improved and air-tightness has four solutions with improves
- Shading elements: Only four cases of shading elements
- Energy Savings: 3% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
3	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	FR_2	1.47	24.49 €
6	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_0	BASE	- €
7	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
8	EW_2	2.22	44.00 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_2	1.47	24.49 €
10	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_2	1.47	24.49 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	0.5	40.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	0.5	40.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	0.5	40.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	0.5	40.00 €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
48.95	41.71 €	129.78 €	45%	9.36	44%	37.07	47.46	8.69	50,051.68 €
50.52	42.31 €	133.05 €	43%	9.65	42%	35.56	45.57	8.35	50,775.23 €
51.52	52.76 €	145.19 €	42%	9.82	41%	34.60	44.37	8.13	63,312.60 €
47.16	59.13 €	145.40 €	47%	9.18	45%	39.52	49.61	8.91	70,961.83 €
53.45	55.85 €	155.00 €	40%	10.56	36%	34.87	42.06	7.25	67,014.92 €
54.95	53.53 €	155.16 €	38%	10.82	35%	33.39	40.26	6.94	64,234.16 €
54.60	54.64 €	155.55 €	38%	10.74	35%	33.64	40.68	7.03	65,569.79 €
50.96	67.13 €	163.14 €	42%	10.23	38%	37.89	45.05	7.65	80,557.10 €
53.83	69.07 €	165.42 €	39%	10.24	38%	32.39	41.60	7.63	82,885.64 €
54.44	63.16 €	165.50 €	38%	10.90	34%	34.83	40.87	6.84	75,791.53 €
50.52	75.14 €	165.88 €	43%	9.65	42%	35.56	45.57	8.35	90,167.15 €
52.28	67.36 €	166.23 €	41%	10.54	37%	37.02	43.46	7.28	80,828.43 €

Table 53- POS Spinned of the SP building in the W1S2 climate- POS13S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Mostly the same
- Glazings: W_13 appears and W_14 has included in more solutions
- Slabs: No differences
- Roof: Mostly the same, Base appears in five solutions
- Thermal Bridges: Only contours has been included in more solutions
- Ventilation and Air-Tightness: A better improvement of air-tightness appears four times
- Shading elements: One solution more with shading elements
- Energy Savings:10% Lower

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
4	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_0	BASE	- €
5	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_2	2.22	44.00 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
9	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
11	EW_28	1.16	12.16 €	W_15	2.6	3.5	0.77	229.77 €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_26	1.47	14.88 €	W_8	0.6	1.3	0.26	346.16 €	B_0	BASE	- €	TR_4	3.75	37.29 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	0.5	40.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
79.84	56.36 €	191.79 €	37%	14.36	36%	45.85	56.32	9.89	67,633.50 €
82.76	55.16 €	199.85 €	35%	15.36	32%	45.68	52.81	8.69	66,195.36 €
85.11	59.67 €	203.85 €	33%	15.28	32%	40.71	49.99	8.78	71,602.14 €
80.04	68.49 €	204.33 €	37%	14.40	36%	45.71	56.08	9.84	82,187.51 €
77.26	74.31 €	205.46 €	39%	13.90	38%	48.38	59.42	10.44	89,176.96 €
80.13	67.04 €	206.20 €	37%	14.77	35%	47.55	55.97	9.40	80,446.26 €
80.27	66.87 €	206.40 €	37%	14.81	34%	47.49	55.80	9.35	80,241.73 €
75.73	76.71 €	206.68 €	40%	13.79	39%	50.70	61.25	10.58	92,051.41 €
87.08	59.36 €	211.23 €	31%	16.12	29%	41.47	47.63	7.78	71,227.57 €
81.46	75.14 €	213.25 €	36%	14.64	35%	44.27	54.38	9.55	90,169.87 €
86.84	63.22 €	214.57 €	32%	16.07	29%	41.64	47.92	7.84	75,865.84 €
79.84	85.94 €	221.37 €	37%	14.36	36%	45.85	56.32	9.89	103,133.71 €

Table 54- POS Spinned of the SP building in the W2S2 climate- POS14S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Mostly the same
- Glazings: W_13 and W_19 appear
- Slabs: No differences
- Roof: Mostly the same
- Thermal Bridges: One improve more of Contours + Windows
- Ventilation and Air-Tightness: Ventilation is improved always and two improved solution disappear
- Shading elements: One case more without shading elements
- Energy Savings: 5% lower in the higher case (more closer between them)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_2	2.22	44.00 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_0	BASE	- €
5	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
8	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_28	1.16	12.16 €	W_15	2.6	3.5	0.77	229.77 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_2	1.47	24.49 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	0.5	40.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
101.73	56.36 €	235.08 €	34%	18.98	33%	51.13	63.81	11.39	67,633.50 €
103.34	55.16 €	240.18 €	33%	19.66	31%	51.76	61.88	10.57	66,195.36 €
100.91	67.04 €	247.15 €	35%	19.14	33%	53.60	64.80	11.20	80,446.26 €
101.96	68.49 €	247.66 €	34%	19.03	33%	50.95	63.54	11.33	82,187.51 €
98.68	74.31 €	247.84 €	36%	18.43	35%	54.04	67.48	12.05	89,176.96 €
96.91	76.71 €	248.70 €	37%	18.27	36%	56.61	69.60	12.24	92,051.41 €
107.93	59.67 €	248.92 €	30%	20.09	29%	45.22	56.37	10.05	71,602.14 €
103.34	66.87 €	251.88 €	33%	19.66	31%	51.76	61.88	10.57	80,241.73 €
108.21	59.36 €	252.57 €	30%	20.53	28%	47.07	56.04	9.53	71,227.57 €
108.21	63.22 €	256.43 €	30%	20.53	28%	47.07	56.04	9.53	75,865.84 €
103.63	75.14 €	257.09 €	33%	19.32	32%	49.31	61.53	10.98	90,169.87 €
101.57	79.59 €	261.18 €	34%	19.30	32%	53.19	64.00	11.01	95,508.79 €

Table 55- POS Spinned of the SP building in the W2S3 climate- POS15S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Mostly the same
- Glazings: Similar
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: Two more cases with Contours + Windows improved
- Ventilation and Air-Tightness: All ventilation must be improved and air-tightness has a better improvement in one case
- Shading elements: No differences
- Energy Savings: The lower case is 13% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_2	2.22	44.00 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_0	BASE	- €
8	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
10	EW_28	1.16	12.16 €	W_15	2.6	3.5	0.77	229.77 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_2	1.47	24.49 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	0.5	40.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
122.49	56.36 €	256.96 €	37%	21.23	37%	71.26	85.69	14.73	67,633.50 €
122.12	55.16 €	258.29 €	37%	21.51	36%	73.52	86.13	14.39	66,195.36 €
120.36	67.04 €	266.75 €	38%	21.15	37%	74.94	88.24	14.82	80,446.26 €
120.50	66.87 €	266.81 €	38%	21.17	37%	74.81	88.08	14.79	80,241.73 €
118.48	74.31 €	268.38 €	39%	20.54	39%	75.24	90.50	15.56	89,176.96 €
116.46	76.71 €	269.15 €	40%	20.37	39%	78.26	92.92	15.75	92,051.41 €
123.17	68.49 €	270.57 €	36%	21.39	36%	70.80	84.87	14.54	82,187.51 €
128.54	59.36 €	272.89 €	34%	22.61	33%	67.10	78.42	13.07	71,227.57 €
130.62	59.67 €	273.54 €	33%	22.63	32%	63.17	75.93	13.04	71,602.14 €
128.54	63.22 €	276.75 €	34%	22.61	33%	67.10	78.42	13.07	75,865.84 €
124.98	75.14 €	279.81 €	36%	21.66	35%	68.78	82.69	14.21	90,169.87 €
120.66	79.59 €	279.84 €	38%	21.20	37%	74.66	87.88	14.75	95,508.79 €

Table 56- POS Spinned of the SP building in the W3S2 climate- POS16S

The differences that appear between the Spinned POS and the normal POS are:

- Walls: Similar
- Glazings: Similar
- Slab: No differences
- Roof: One Base solution disappears
- Thermal Bridges: One case of only contours change to Contours + Windows
- Ventilation and Air-Tightness: Ventilation must be improved and air-tightness has a case with a better improve
- Shading elements: One case more with shading elements
- Energy Savings: The lower case is 14% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

9 ANNEX C: POS PRELIMINARY RESULTS FOR NON STANDARD USERS

In this annex will be shown some graphs regarding the diferences in consumption between a standard/normal behaviour and a good behaviour.
The good behaviour can be resume in the next points:

- Increase in temperature in case of Cooling: The system will start to work only if the temperature is above 26ºC indoor.
- Decrease in temperature f in case of Heating: The system will start to work only if the temperature is above 16ºC indoor.
- Reduce the hours of system needed: The system works at maximun only 8 hours at day.

The solutions in case of normal and good behavior are shown in the following graph:

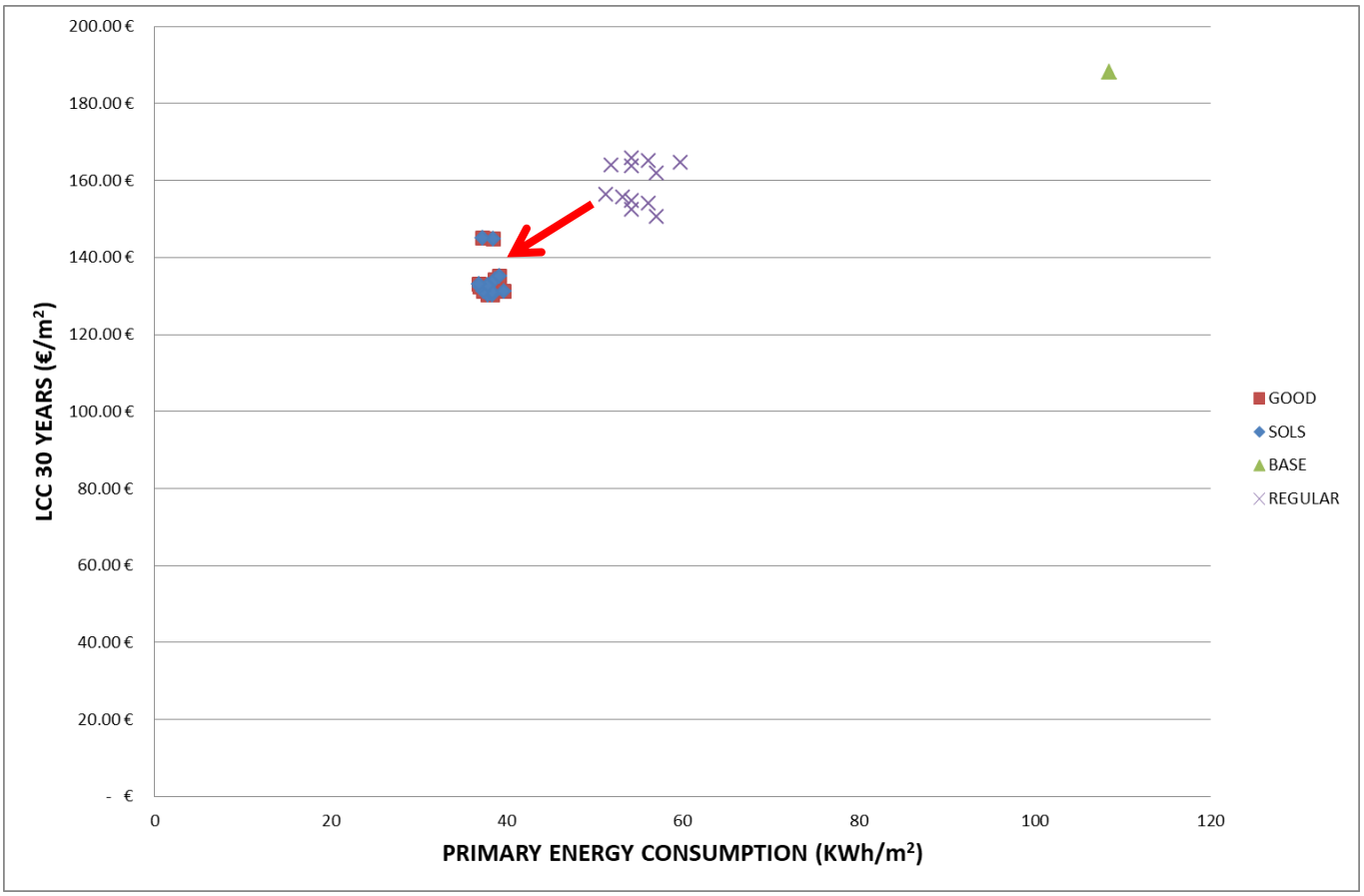

Figure 16—Solutions (SOLS) of the normal behaviour (REGULAR) and the good behaviour (GOOD)

It is clearly shown the advantage of a good behaviour in terms of energy savings. It can be concluded that the behaviour must be considered in order to obtain a low consumption and it will be necessary some feedback between the users and the enterprises that work in the retrofit of the buildings. The Package of Solutions with good behaviour is shown below compared the regular behaviour for the 16 POS.

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SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €

SOLUTIONS	Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
1	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
2	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
3	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
4	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
5	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
6	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
7	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
8	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
9	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
10	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
11	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
12	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

SOLUTIONS	Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
1	31.96	43.58 €	99.80 €	69%	5.97	70%	12.22	17.03	3.35	10,240.62 €
2	30.83	48.79 €	102.93 €	70%	5.75	72%	12.41	17.29	3.41	11,466.74 €
3	30.14	51.68 €	105.28 €	71%	5.69	72%	12.61	17.46	3.42	12,144.43 €
4	29.42	53.54 €	105.83 €	72%	5.56	73%	12.74	17.63	3.45	12,582.98 €
5	29.10	55.77 €	107.49 €	72%	5.49	73%	12.79	17.70	3.47	13,106.95 €
6	30.52	53.54 €	107.92 €	71%	5.78	71%	12.56	17.37	3.40	12,581.90 €
7	29.05	56.90 €	108.44 €	72%	5.48	73%	12.79	17.71	3.47	13,370.55 €
8	28.34	58.76 €	109.01 €	73%	5.34	74%	12.92	17.88	3.50	13,809.10 €
9	30.19	55.77 €	109.55 €	71%	5.71	72%	12.62	17.44	3.41	13,105.87 €
10	28.04	60.99 €	110.70 €	73%	5.28	74%	12.97	17.95	3.52	14,333.07 €
11	29.40	58.76 €	111.03 €	72%	5.55	73%	12.74	17.63	3.45	13,808.02 €
12	29.08	60.99 €	112.68 €	72%	5.49	73%	12.80	17.71	3.47	14,331.99 €

Table 57- POS1 of the CY building in the W1S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Base appears only twice
- Glazings: No differences
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: Similar
- Ventilation and Air-Tightness: No differences
- Shading elements: No differences
- Energy Savings: 11% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €

SOLUTIONS	Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
1	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
2	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
3	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
4	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
5	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
6	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
7	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
8	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
9	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
10	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
11	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
12	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

SOLUTIONS	Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
1	45.85	51.68 €	127.74 €	69%	8.05	70%	18.27	23.81	4.43	12,144.43 €
2	43.58	55.77 €	128.07 €	70%	7.66	72%	18.71	24.34	4.52	13,106.95 €
3	43.71	56.90 €	129.35 €	70%	7.67	71%	18.68	24.31	4.52	13,370.55 €
4	41.41	60.99 €	129.64 €	72%	7.27	73%	19.12	24.85	4.61	14,333.07 €
5	43.69	60.99 €	133.47 €	70%	7.68	71%	18.69	24.31	4.51	14,331.99 €
6	39.50	69.51 €	136.29 €	73%	7.08	74%	19.64	25.30	4.66	16,335.20 €
7	37.43	73.61 €	137.00 €	75%	6.72	75%	20.04	25.78	4.74	17,297.72 €
8	37.43	74.73 €	138.02 €	75%	6.71	75%	20.03	25.78	4.74	17,561.32 €
9	35.37	78.82 €	138.74 €	76%	6.35	76%	20.43	26.27	4.83	18,523.84 €
10	39.54	73.60 €	140.52 €	73%	7.09	74%	19.64	25.29	4.65	17,296.64 €
11	39.57	74.72 €	141.58 €	73%	7.09	74%	19.62	25.28	4.65	17,560.24 €
12	37.45	78.82 €	142.20 €	75%	6.72	75%	20.03	25.78	4.74	18,522.76 €

Table 58- POS2 of the CY building in the W2S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Similar
- Glazings: No differences
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: Similar
- Ventilation and Air-Tightness: Five cases without improvements in ventilation
- Shading elements: No differences
- Energy Savings: 8% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €

SOLUTIONS	Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
1	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
2	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
3	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
4	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
5	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
6	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
7	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
8	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
9	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
10	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
11	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
12	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

SOLUTIONS	Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
1	63.77	58.76 €	169.11 €	65%	11.71	66%	21.58	28.39	5.33	13,809.10 €
2	65.68	55.77 €	169.43 €	64%	12.06	65%	21.23	27.94	5.24	13,106.95 €
3	62.76	60.99 €	169.61 €	66%	11.53	66%	21.77	28.63	5.37	14,333.07 €
4	57.81	71.38 €	173.26 €	69%	10.82	69%	22.89	29.79	5.53	16,773.75 €
5	54.95	76.60 €	173.55 €	70%	10.30	70%	23.42	30.46	5.66	17,999.87 €
6	56.86	73.61 €	173.87 €	69%	10.65	69%	23.07	30.02	5.57	17,297.72 €
7	53.98	78.82 €	174.13 €	71%	10.12	71%	23.60	30.69	5.70	18,523.84 €
8	59.97	69.51 €	175.06 €	68%	11.21	67%	22.49	29.29	5.44	16,335.20 €
9	57.16	74.73 €	175.43 €	69%	10.69	69%	23.00	29.95	5.56	17,561.32 €
10	58.23	76.59 €	179.18 €	68%	10.90	68%	22.81	29.69	5.52	17,998.79 €
11	60.12	73.60 €	179.48 €	67%	11.24	67%	22.47	29.25	5.43	17,296.64 €
12	57.26	78.82 €	179.77 €	69%	10.72	69%	22.99	29.92	5.56	18,522.76 €

Table 59- POS3 of the CY building in the W2S3 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Similar
- Glazings: No differences
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: Only contours appears three times
- Ventilation and Air-Tightness: Only three cases without improvements in ventilation
- Shading elements: No differences
- Energy Savings: 8% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
9	EW_3	3.33	48.94 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_3	3.33	48.94 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
64.64	78.82 €	183.62 €	72%	11.08	72%	31.63	38.90	6.84	18,523.84 €
70.83	65.16 €	185.22 €	69%	12.73	68%	31.04	37.44	6.46	15,312.52 €
68.90	78.82 €	190.52 €	70%	11.81	71%	30.80	37.90	6.67	18,522.76 €
74.99	65.16 €	191.90 €	67%	13.43	67%	30.22	36.47	6.29	15,311.44 €
68.07	82.54 €	192.90 €	70%	11.67	71%	30.96	38.09	6.70	19,396.86 €
74.23	68.87 €	194.43 €	68%	13.31	67%	30.38	36.65	6.32	16,185.55 €
64.85	89.41 €	194.53 €	72%	11.12	72%	31.59	38.85	6.83	21,010.32 €
71.03	75.74 €	196.14 €	69%	12.76	68%	31.00	37.40	6.45	17,799.00 €
60.95	106.74 €	205.59 €	74%	10.45	74%	32.36	39.77	6.99	25,083.99 €
61.49	105.63 €	205.66 €	73%	10.58	74%	32.29	39.64	6.96	24,823.65 €
67.34	93.08 €	207.69 €	71%	12.15	70%	31.75	38.26	6.59	21,872.68 €
64.12	102.80 €	209.94 €	72%	11.35	72%	32.12	39.02	6.78	24,157.99 €

Table 60- POS4 of the CY building in the W3S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_2 disappears
- Glazings: One case with W_14
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: Only two cases with only contours
- Ventilation and Air-Tightness: No differences
- Shading elements: Two more cases without shading elements
- Energy Savings: 7% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_t [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
37.91	61.23 €	130.16 €	65%	7.33	63%	22.55	28.23	5.05	24,492.38 €
38.34	59.78 €	130.30 €	65%	7.51	62%	22.59	28.06	4.98	23,911.35 €
38.37	61.23 €	130.98 €	65%	7.42	63%	22.41	28.05	5.02	24,491.18 €
37.37	63.08 €	131.10 €	66%	7.24	64%	22.72	28.44	5.09	25,231.80 €
39.71	59.09 €	131.29 €	63%	7.68	62%	22.02	27.51	4.92	23,634.78 €
36.91	65.22 €	132.43 €	66%	7.15	64%	22.86	28.63	5.13	26,089.40 €
37.86	63.08 €	132.72 €	65%	7.41	63%	22.73	28.25	5.02	25,230.60 €
36.82	65.22 €	133.05 €	66%	7.22	64%	23.05	28.66	5.10	26,088.20 €
38.72	63.77 €	134.25 €	64%	7.50	62%	22.33	27.90	4.99	25,508.37 €
39.18	63.77 €	135.08 €	64%	7.58	62%	22.19	27.72	4.95	25,507.16 €
38.44	76.37 €	144.83 €	65%	7.27	64%	22.10	28.02	5.08	30,548.32 €
37.30	76.37 €	145.08 €	66%	7.31	63%	22.91	28.47	5.06	30,549.52 €

Table 61- POS5 of the HR building in the W1S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_27 disappears
- Glazings: No differences
- Slabs: No differences
- Roof: FR_8 and TR_17 disappear and FR_3 and TR_13 appear now
- Thermal Bridges: Contours + Windows appears seven times
- Ventilation and Air-Tightness: Two more cases of air-tightness improvements
- Shading elements: No differences
- Energy Savings: 15% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
6	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_13	1.43	25.87 €
9	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
51.29	63.36 €	151.43 €	68%	9.34	67%	35.81	43.35	7.50	25,342.90 €
53.31	67.35 €	158.72 €	67%	9.69	66%	35.14	42.54	7.36	26,939.92 €
50.42	72.59 €	159.20 €	68%	9.19	67%	36.09	43.69	7.56	29,036.61 €
53.94	68.60 €	160.24 €	66%	9.72	65%	34.78	42.29	7.35	27,439.59 €
52.69	70.93 €	160.55 €	67%	9.50	66%	35.19	42.78	7.44	28,371.47 €
53.76	73.30 €	164.64 €	66%	9.68	66%	34.84	42.36	7.36	29,318.77 €
52.44	74.92 €	164.83 €	67%	9.54	66%	35.42	42.88	7.42	29,968.49 €
52.87	74.92 €	164.84 €	67%	9.53	66%	35.14	42.71	7.42	29,967.28 €
51.85	76.64 €	164.85 €	68%	9.35	67%	35.47	43.12	7.50	30,655.45 €
52.03	76.64 €	165.15 €	67%	9.38	67%	35.41	43.05	7.48	30,654.24 €
50.47	80.63 €	167.30 €	68%	9.19	67%	36.07	43.67	7.56	32,252.47 €
51.34	80.63 €	168.76 €	68%	9.35	67%	35.79	43.32	7.50	32,251.26 €

Table 62- POS6 of the HR building in the W2S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_27 appears
- Glazings: No differences
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: No improvements appears in two cases
- Ventilation and Air-Tightness: All cases have improvements in ventilation
- Shading elements: No differences
- Energy Savings: 9% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
2	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
8	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
9	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_17	3.64	54.56 €

SOLUTIONS	Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
1	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
2	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
3	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
4	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
5	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
6	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
7	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
8	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
9	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
10	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
11	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
12	50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

SOLUTIONS	Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
1	67.12	48.86 €	168.11 €	65%	12.67	64%	40.34	50.00	8.87	19,544.90 €
2	64.46	55.74 €	170.47 €	66%	12.19	65%	41.18	51.07	9.06	22,296.90 €
3	70.48	52.20 €	177.39 €	63%	13.30	62%	39.31	48.66	8.61	20,881.58 €
4	68.79	56.20 €	177.71 €	64%	12.91	63%	39.69	49.33	8.77	22,478.60 €
5	65.64	63.08 €	179.85 €	66%	12.41	64%	40.81	50.59	8.97	25,230.60 €
6	68.29	59.08 €	180.36 €	64%	12.88	63%	39.97	49.53	8.78	23,633.58 €
7	69.92	66.89 €	190.35 €	64%	13.11	62%	39.34	48.88	8.69	26,757.02 €
8	74.96	60.01 €	192.06 €	61%	14.02	60%	37.74	46.86	8.33	24,005.02 €
9	71.30	70.78 €	196.56 €	63%	13.36	62%	38.89	48.33	8.59	28,310.89 €
10	70.37	74.23 €	197.49 €	63%	13.09	62%	39.00	48.70	8.70	29,690.72 €
11	73.08	74.12 €	203.73 €	62%	13.77	60%	38.49	47.62	8.43	29,647.57 €
12	72.51	78.11 €	205.99 €	62%	13.58	61%	38.52	47.85	8.50	31,244.59 €

Table 63- POS7 of the HR building in the W2S3 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Similar
- Glazings: No differences
- Slabs: No differences
- Roof: TR_17 appears
- Thermal Bridges: All cases are with only contours
- Ventilation and Air-Tightness: No differences in ventilation. Air-tightness has only three cases with improvements
- Shading elements: No differences
- Energy Savings: 11% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
2	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
4	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_8	0.93	10.73 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
10	EW_27	0.70	9.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_16	2.42	43.36 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
78.99	70.23 €	199.36 €	68%	13.66	68%	56.02	67.24	11.53	28,093.70 €
84.62	63.36 €	201.05 €	66%	14.56	66%	54.03	64.99	11.17	25,342.90 €
88.10	67.35 €	210.66 €	64%	15.16	64%	52.87	63.59	10.93	26,939.92 €
82.50	79.67 €	214.48 €	67%	14.26	66%	54.85	65.83	11.29	31,866.78 €
89.98	70.24 €	216.66 €	64%	15.49	64%	52.25	62.84	10.80	28,094.90 €
93.83	67.35 €	219.29 €	62%	16.07	62%	50.82	61.30	10.57	26,938.72 €
84.76	83.66 €	221.56 €	66%	14.59	66%	53.98	64.93	11.16	33,465.00 €
88.55	79.67 €	223.31 €	64%	15.19	64%	52.64	63.42	10.92	31,867.98 €
93.98	74.23 €	226.40 €	62%	16.09	62%	50.77	61.24	10.56	29,691.92 €
98.62	66.90 €	226.65 €	60%	16.89	60%	49.23	59.39	10.24	26,758.23 €
98.77	74.23 €	234.20 €	60%	16.92	60%	49.18	59.33	10.23	29,690.72 €
93.22	83.66 €	235.34 €	62%	16.05	62%	51.17	61.54	10.58	33,463.80 €

Table 64- POS8 of the HR building in the W3S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_27 appears
- Glazings: No differences
- Slabs: No differences
- Roof: FR_3 and TR_13 disappear and FR_8 and TR_16 appear
- Thermal Bridges: No differences
- Ventilation and Air-Tightness: No differences in ventilation. Air-tightness must be improved always
- Shading elements: No differences
- Energy Savings: 10% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €
2	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_26	1.47	14.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_27	0.70	9.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_27	0.70	9.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €
12	EW_27	0.70	9.88 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_8	0.93	10.73 €

SOLUTIONS	Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
1	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
2	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
3	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
4	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
5	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
6	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
7	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
8	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
9	50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
10	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
11	50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
12	50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

SOLUTIONS	Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
1	29.34	20.40 €	71.32 €	53%	5.40	54%	13.34	17.81	3.38	11,017.09 €
2	27.30	24.97 €	71.88 €	56%	4.98	57%	14.07	18.91	3.61	13,481.31 €
3	27.41	26.42 €	73.60 €	56%	5.00	57%	14.05	18.85	3.60	14,265.73 €
4	26.75	29.26 €	75.16 €	57%	4.87	58%	14.29	19.20	3.67	15,798.39 €
5	27.74	27.58 €	75.85 €	55%	5.12	56%	14.05	18.67	3.53	14,895.33 €
6	27.44	29.47 €	76.53 €	56%	4.99	57%	13.99	18.83	3.61	15,913.50 €
7	27.08	30.42 €	77.39 €	57%	4.98	57%	14.28	19.03	3.61	16,427.98 €
8	26.76	32.31 €	78.05 €	57%	4.85	58%	14.24	19.20	3.68	17,446.15 €
9	28.95	27.26 €	78.57 €	54%	5.45	53%	13.80	18.02	3.36	14,718.39 €
10	37.94	22.13 €	88.24 €	39%	7.02	40%	9.81	13.16	2.51	11,948.65 €
11	41.40	16.11 €	88.55 €	34%	7.69	34%	8.46	11.30	2.15	8,700.01 €
12	25.33	43.68 €	88.71 €	59%	4.78	59%	15.32	19.97	3.72	23,589.41 €

Table 65- POS9 of the FR building in the W1S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Similar
- Glazings: Similar
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: All cases are with improves
- Ventilation and Air-Tightness: One case with an improved ventilation
- Shading elements: One case without shading elements
- Energy Savings: 17% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_26	1.47	14.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_27	0.70	9.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_26	1.47	14.88 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_2	1.47	24.49 €
7	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_27	0.70	9.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_3	3.33	48.94 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_26	1.47	14.88 €	W_10	1.1	1.43	0.59	279.86 €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_3	3.33	48.94 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
27.56	55.20 €	102.00 €	71%	4.96	70%	29.01	35.76	6.30	29,808.05 €
26.84	58.20 €	103.81 €	71%	4.84	71%	29.32	36.14	6.37	31,427.15 €
27.13	58.33 €	103.96 €	71%	4.84	71%	29.07	35.99	6.37	31,495.54 €
26.70	59.49 €	104.88 €	72%	4.81	71%	29.39	36.22	6.39	32,125.13 €
26.45	61.32 €	105.83 €	72%	4.72	72%	29.37	36.36	6.44	33,114.64 €
28.27	58.22 €	106.48 €	70%	5.12	69%	28.77	35.37	6.22	31,439.74 €
25.98	62.49 €	106.68 €	72%	4.69	72%	29.71	36.61	6.45	33,744.23 €
26.45	63.78 €	108.28 €	72%	4.72	72%	29.37	36.36	6.44	34,440.84 €
25.98	64.95 €	109.14 €	72%	4.69	72%	29.71	36.61	6.45	35,070.43 €
25.73	67.44 €	111.27 €	73%	4.65	72%	29.83	36.74	6.47	36,416.18 €
25.53	69.17 €	112.73 €	73%	4.62	72%	29.93	36.85	6.49	37,351.26 €
25.01	70.44 €	113.07 €	73%	4.52	73%	30.15	37.13	6.54	38,035.28 €

Table 66- POS10 of the FR building in the W2S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_3 appears
- Glazings: W_10 appears
- Slabs: No differences
- Roof: Similar
- Thermal Bridges: Two cases with only countours
- Ventilation and Air-Tightness: No differences
- Shading elements: No differences
- Energy Savings: 7% higher

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SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_27	0.70	9.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
6	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_8	2.35	51.51 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
39.28	50.30 €	119.85 €	67%	7.39	67%	34.42	43.78	7.96	27,159.60 €
37.82	53.13 €	120.13 €	69%	7.12	68%	35.02	44.56	8.11	28,692.26 €
41.88	48.30 €	124.25 €	65%	8.08	63%	33.85	42.38	7.59	26,079.60 €
36.26	59.73 €	124.53 €	70%	6.89	69%	35.82	45.41	8.23	32,254.32 €
40.44	51.13 €	124.58 €	66%	7.81	65%	34.45	43.15	7.73	27,612.26 €
36.21	61.18 €	125.97 €	70%	6.89	69%	35.86	45.43	8.23	33,038.74 €
36.97	60.01 €	126.08 €	69%	7.02	68%	35.53	45.03	8.16	32,404.54 €
34.76	64.02 €	126.23 €	71%	6.61	70%	36.45	46.22	8.38	34,571.40 €
35.50	62.85 €	126.32 €	71%	6.75	70%	36.13	45.82	8.31	33,937.19 €
39.02	59.18 €	130.87 €	68%	7.63	66%	35.24	43.92	7.83	31,958.74 €
37.59	62.02 €	131.19 €	69%	7.36	67%	35.83	44.69	7.97	33,491.40 €
38.31	60.85 €	131.23 €	68%	7.49	66%	35.51	44.30	7.91	32,857.19 €

Table 67 - POS11 of the FR building in the W2S3 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Similar
- Glazings: No differences
- Slabs: No differences
- Roof: TR_16 disappears
- Thermal Bridges: One case with only countours
- Ventilation and Air-Tightness: No differences
- Shading elements: Five cases without shading elements
- Energy Savings: 5% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m²K/W]	Cost (€/m² wall)	Glazings	U_w [W/m²K]	U_f [W/m²K]	g (Solar Factor)	Cost (€/m² window)	Slabs on the ground/ external	ΔThermal Resistance [m²K/W]	Cost (€/m² slab)	Roof	ΔThermal Resistance [m²K/W]	Cost (€/m² roof)
1	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
4	EW_3	3.33	48.94 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_3	3.33	48.94 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_26	1.47	14.88 €	W_11	1.1	1.3	0.59	269.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_3	3.33	48.94 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
8	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
9	EW_9	3.53	56.54 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_3	3.33	48.94 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_3	3.33	48.94 €	W_11	1.1	1.3	0.59	269.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €
12	EW_9	3.53	56.54 €	W_11	1.1	1.3	0.59	269.57 €	B_0	BASE	- €	TR_4	3.75	37.29 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m² windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m²)	Initial Investment (€/m²)	Life Cycle Cost (€/m²)	Primary Energy Savings %	CO_2 Emissions (kg/m²)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
40.42	54.30 €	119.98 €	73%	6.95	73%	49.41	59.55	10.26	29,321.85 €
41.77	52.30 €	121.30 €	72%	7.30	72%	49.11	58.82	10.06	28,241.85 €
40.42	56.76 €	122.44 €	73%	6.95	73%	49.41	59.55	10.26	30,648.05 €
37.88	62.25 €	123.82 €	75%	6.51	75%	50.56	60.92	10.49	33,612.90 €
39.81	59.41 €	124.16 €	74%	6.85	74%	49.70	59.88	10.31	32,080.25 €
39.21	60.52 €	124.28 €	74%	6.74	74%	49.96	60.20	10.37	32,681.94 €
39.28	60.25 €	125.28 €	74%	6.88	73%	50.25	60.16	10.29	32,532.90 €
37.75	64.02 €	125.39 €	75%	6.49	75%	50.61	60.99	10.50	34,571.40 €
39.16	62.02 €	126.85 €	74%	6.86	74%	50.31	60.23	10.30	33,491.40 €
39.28	62.70 €	127.73 €	74%	6.88	73%	50.25	60.16	10.29	33,859.10 €
36.71	68.47 €	128.19 €	76%	6.32	76%	51.09	61.55	10.60	36,973.00 €
36.57	70.24 €	129.74 €	76%	6.29	76%	51.16	61.62	10.61	37,931.49 €

Table 68- POS12 of the FR building in the W3S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_9 appears
- Glazings: W_11 and W_13 appear
- Slabs: No differences
- Roof: Changed and TR_4 and FR_3 by two FR_2
- Thermal Bridges: Contours + Windows is the solution for all the cases
- Ventilation and Air-Tightness: No differences
- Shading elements: Two more cases without shading elements
- Energy Savings: 6% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
3	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
4	EW_28	1.16	12.16 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
6	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
9	EW_28	1.16	12.16 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
10	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
43.76	12.39 €	91.66 €	60%	8.43	58%	62.31	77.66	13.85	14,871.88 €
45.70	12.39 €	94.80 €	58%	8.76	56%	60.38	75.34	13.45	14,871.88 €
43.50	25.72 €	104.57 €	60%	8.39	58%	62.57	77.97	13.90	30,858.68 €
37.89	37.53 €	106.71 €	65%	7.36	63%	67.83	84.70	15.13	45,033.75 €
51.42	12.39 €	106.96 €	53%	10.06	50%	56.41	68.47	11.88	14,871.88 €
37.70	38.18 €	107.11 €	65%	7.33	63%	68.07	84.94	15.16	45,814.48 €
37.70	38.18 €	107.11 €	65%	7.33	63%	68.07	84.94	15.16	45,817.20 €
45.37	25.72 €	107.61 €	58%	8.71	56%	60.70	75.72	13.51	30,858.68 €
40.76	37.53 €	111.35 €	62%	7.85	61%	64.96	81.26	14.54	45,033.75 €
40.47	38.18 €	111.60 €	63%	7.81	61%	65.29	81.61	14.59	45,814.48 €
40.47	38.18 €	111.61 €	63%	7.81	61%	65.29	81.61	14.59	45,817.20 €
42.21	42.31 €	118.87 €	61%	8.14	59%	63.75	79.52	14.19	50,775.23 €

Table 69- POS13 of the SP building in the W1S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Similar
- Glazings: W_18 instead W_14
- Slabs: No differences
- Roof: FR_2 disappears and Base has three more cases
- Thermal Bridges: Contours + Windows has four cases and Contours eight cases
- Ventilation and Air-Tightness: Ventilation has no improvements. Air-tightness has five cases without improvements
- Shading elements: One case more with shading elements
- Energy Savings: 8% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_28	1.16	12.16 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
6	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
7	EW_0	BASE	- €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
8	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
10	EW_28	1.16	12.16 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_0	BASE	- €
12	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
NO REDUCTION	- €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
62.93	12.39 €	118.74 €	50%	11.27	50%	61.76	76.61	13.60	14,871.88 €
50.35	38.18 €	123.87 €	60%	9.09	60%	74.19	91.71	16.22	45,814.48 €
50.35	38.18 €	123.88 €	60%	9.09	60%	74.19	91.71	16.22	45,817.20 €
50.81	37.53 €	123.90 €	60%	9.16	59%	73.68	91.16	16.13	45,033.75 €
54.39	33.43 €	126.00 €	57%	9.81	57%	70.33	86.86	15.34	40,119.88 €
69.47	12.39 €	129.30 €	45%	12.39	45%	55.19	68.77	12.26	14,871.88 €
65.12	21.04 €	130.44 €	49%	11.59	49%	59.25	73.98	13.21	25,248.00 €
41.81	59.22 €	131.13 €	67%	7.63	66%	82.76	101.96	17.97	71,062.48 €
41.81	59.22 €	131.13 €	67%	7.63	66%	82.76	101.96	17.97	71,065.20 €
42.27	58.57 €	131.16 €	67%	7.70	66%	82.25	101.40	17.88	70,281.75 €
62.49	25.72 €	131.39 €	51%	11.20	50%	62.21	77.14	13.68	30,858.68 €
41.89	59.13 €	132.08 €	67%	7.74	66%	83.22	101.86	17.83	70,961.83 €

Table 70- POS14 of the SP building in the W2S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: Base appears and EW_2 and EW_27 disappear
- Glazings: Only two cases with improvements, W_18
- Slabs: No differences
- Roof: Changed an TR_4 and FR_3 by two FR_2
- Thermal Bridges: No reduction appear in one case instead Contours
- Ventilation and Air-Tightness: Only one case with improvements in Ventilation. Air-tightness has six cases of good improvements
- Shading elements: One case more without shading elements
- Energy Savings: 22% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
2	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
5	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_28	1.16	12.16 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	TR_4	3.75	37.29 €
7	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
10	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
11	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_3	2.35	28.78 €
12	EW_2	2.22	44.00 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	NO IMPROVEMENT	- €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
66.34	59.13 €	178.46 €	48%	12.68	44%	62.88	72.52	11.90	70,961.83 €
67.25	55.16 €	179.33 €	47%	13.22	42%	64.01	71.43	11.26	66,195.36 €
70.97	52.11 €	182.84 €	44%	13.91	38%	60.61	66.96	10.43	62,537.83 €
82.97	38.18 €	184.38 €	35%	15.53	31%	46.18	52.56	8.49	45,814.48 €
82.97	38.18 €	184.38 €	35%	15.53	31%	46.18	52.56	8.49	45,817.20 €
83.91	37.53 €	185.25 €	34%	15.69	31%	45.25	51.44	8.30	45,033.75 €
63.71	74.31 €	189.10 €	50%	12.20	46%	65.33	75.67	12.48	89,176.96 €
63.71	74.31 €	189.10 €	50%	12.20	46%	65.33	75.67	12.48	89,176.96 €
76.38	56.36 €	190.33 €	40%	14.22	37%	51.84	60.48	10.05	67,633.50 €
71.44	59.36 €	190.69 €	44%	13.98	38%	60.05	66.40	10.35	71,227.57 €
68.79	66.87 €	193.74 €	46%	13.50	40%	62.59	69.57	10.92	80,241.73 €
68.79	67.04 €	193.91 €	46%	13.50	40%	62.59	69.57	10.92	80,446.26 €

Table 71- POS15 of the SP building in the W2S3 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_27 disappears
- Glazings: W_15 disappears and Base appears two times more
- Slabs: No differences
- Roof: Only one case with Base and FR_2 disappears
- Thermal Bridges: Contours + Windows instead only Contours in three more cases
- Ventilation and Air-Tightness: Ventilation has two more cases without improves. Air-tightness has six cases without improvements
- Shading elements: One more case with shading elements
- Energy Savings: 11% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

SOLUTIONS	External Wall	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 wall)	Glazings	U_w [W/m^2K]	U_f [W/m^2K]	g (Solar Factor)	Cost (€/m^2 window)	Slabs on the ground/ external	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 slab)	Roof	ΔThermal Resistance [m^2K/W]	Cost (€/m^2 roof)
1	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	TR_4	3.75	37.29 €
2	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
3	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
4	EW_28	1.16	12.16 €	W_13	1.4	1.43	0.58	184.83 €	B_0	BASE	- €	TR_4	3.75	37.29 €
5	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
6	EW_2	2.22	44.00 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_3	2.35	28.78 €
7	EW_2	2.22	44.00 €	W_18	2.7	3.5	0.77	62.11 €	B_0	BASE	- €	FR_3	2.35	28.78 €
8	EW_2	2.22	44.00 €	W_19	2.7	1.43	0.77	116.17 €	B_0	BASE	- €	FR_3	2.35	28.78 €
9	EW_26	1.47	14.88 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €
10	EW_28	1.16	12.16 €	W_15	2.6	3.5	0.77	229.77 €	B_0	BASE	- €	FR_3	2.35	28.78 €
11	EW_26	1.47	14.88 €	W_14	1.4	1.3	0.58	129.57 €	B_0	BASE	- €	TR_0	BASE	- €
12	EW_28	1.16	12.16 €	W_21	BASE	BASE	BASE	- €	B_0	BASE	- €	FR_2	1.47	24.49 €

Thermal Bridge Reduction	Cost (€/m contours)	Ventilation (Ren/h)	Cost (€/Dwelling)	Air Tighness (n50)	Cost (€/m contours)	Shading Elements on Windows (Solar Factor)	Cost (€/m^2 windows)
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	3	17.00 €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.24	5,245.29 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	NO SHADING ELEMENTS	- €
50% REDUCTION CONTOURS	15.26 €	0.42	2,095.39 €	NO IMPROVEMENT	- €	SHADING ELEMENTS COVER 50%	90.00 €
50% REDUCTIONS + WINDOWS	15.27 €	0.42	2,095.39 €	0.5	40.00 €	SHADING ELEMENTS COVER 50%	90.00 €

Primary Energy Consumption (kWh/m^2)	Initial Investment (€/m^2)	Life Cycle Cost (€/m^2)	Primary Energy Savings %	CO_2 Emissions (kg/m^2)	CO_2 Savings %	Total Final Energy Savings per Year (Mwh)	Total Primary Energy Savings per Year (Mwh)	Total CO_2 Savings per Year (Tn)	Total Cost
73.46	55.16 €	179.11 €	48%	13.14	46%	71.70	82.65	13.55	66,195.36 €
74.87	59.13 €	182.81 €	47%	13.09	46%	68.74	80.95	13.60	70,961.83 €
78.10	52.11 €	183.75 €	45%	13.95	43%	67.16	77.08	12.57	62,537.83 €
78.86	59.36 €	192.04 €	45%	14.06	42%	66.29	76.16	12.44	71,227.57 €
71.51	74.31 €	192.52 €	50%	12.51	49%	72.07	84.98	14.30	89,176.96 €
71.51	74.31 €	192.52 €	50%	12.51	49%	72.07	84.98	14.30	89,176.96 €
75.41	66.87 €	194.04 €	47%	13.48	45%	69.79	80.30	13.14	80,241.73 €
75.41	67.04 €	194.21 €	47%	13.48	45%	69.79	80.30	13.14	80,446.26 €
72.55	76.71 €	197.40 €	49%	12.78	48%	71.53	83.74	13.98	92,051.41 €
80.77	63.22 €	199.07 €	43%	14.39	41%	64.42	73.87	12.04	75,865.84 €
91.72	56.36 €	205.50 €	36%	15.78	35%	50.75	60.73	10.38	67,633.50 €
79.24	75.14 €	206.04 €	44%	13.86	43%	64.45	75.71	12.68	90,169.87 €

Table 72- POS16 of the SP building in the W3S2 climate

The differences that appear between the good behaviour POS and the normal POS are:

- Walls: EW_27 disappears
- Glazings: Base is the majority solution
- Slabs: No differences
- Roof: Base only appears once
- Thermal Bridges: Contours + Windows appears one more time
- Ventilation and Air-Tightness: Ventilation must be improved and air-tightness has more cases with improvements
- Shading elements: One case more with shading elements
- Energy Savings: 8% higher

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement n. 785072

10 ANNEX D: POS RESULTS