AFFIRMATIVE INTEGRATED ENERGY DESIGN ACTION

AIDA

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D2.1 Best Practice Guide: Operational Success Stories

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1. INTRODUCTION

The objective of this document is to identify the main ingredients that are necessary for constructing or refurbishing exemplary buildings in terms of energy consumption known as "nearly Zero Energy Buildings" (nZEB) by analysing the similarities observed in a range of success stories from the different partner countries involved in AIDA (Austria, France, Greece, Italy, Hungary, Spain and UK/Scotland).

These success stories are displayed hereafter in the form of a series of case study cards, which will be complemented progressively by new cards related to those sites where study tours will be organised throughout the course of the AIDA project.

The diversity in location, use, design and construction techniques of the exemplary buildings presented here demonstrates that nZEB design can be put into practice anywhere and become common over Europe in the next coming years: this is expected to contribute to making this concept, which is not well developed yet, more popular and attractive.

This guide presents first a review of the national contexts in which nZEB concept takes place in the participating countries. Then there will be a description of the success story cards conception and how the data were collected. Finally, the data will be analysed and some recommendations will be made.

2. OVERVIEW AND CONTEXT

2.1. Utilities and interests

Efficient buildings are not very common today in most European countries and there is a lack of feedbacks to massively encourage owners to construct nZEB (nearly Zero Energy Buildings) or to refurbish existing ones in such a way. The complexity of the process and the cost involved in the construction or the renovation of a building pushes owners and building professionals to focus on proven techniques and design procedures rather than trying out innovations that they consider risky since they do not know much about it.

Moreover, the nZEB concept is not a technique that can simply be applied without changing our view and our practices of building development, construction and occupancy. It forces us to question our real energy needs, our operating mode and finally our way of living. It is more than creating a protective shell against the elements and installing technical systems to compensate climatic conditions.

Basically, the nZEB concept promotes both the highest reduction of energy needs and consumption of the building and the highest harnessing of energy on-site. Following the so-called bioclimatic concept, every element in the environment can be used either to catch as much radiation as possible or, quite the opposite, to provide the best protection against sun or wind: this approach clearly challenges traditional ways of doing in the building industry. In addition, nZEB forces to adapt, renew or even change usual construction techniques and practices, and to focus on the highest quality of implementation and of reception procedures, which is of a particular importance for the theoretical objectives to be actually reached.

Finally, the effective success of nZEB design in terms of energy performance will also depend on the behaviour of the buildings occupants and on the skills of systems operators. All these considerations imply that nZEB is more than a simple step in a continuous process, it involves a real change of viewpoint and of practices in all countries, whatever the level of awareness about energy issues as a whole and specifically of knowledge about energy management in building design and operation.

By comparing real-life nZEB success stories in different countries and by assessing their similarities and differences as well on technical items as on the decision process, this Guide is expected to help bringing out and highlighting those common features so as to accelerate and facilitate the dissemination and the implementation of this innovative concept all over Europe.

2.2. Status quo of nZEB regulations

The definition of *nearly Zero Energy Building* (nZEB) at European level is define from Directive 2010/31/EU as "*a building having a very high energy performance that requires little or no energy, which should be covered to a very significant extent by energy from renewable sources*".
At national level the nZEB definition it is implemented, partly implemented or not already implemented, see Table 1.

Table 1: Status of the national implementation of the EU directive 2010/31/EU

Country	Status yes/no	Comments on the state of implementation of 2010/31/EU in national legislation
Austria	Partly	Although building-related legislation falls under the competence of the nine regions (Bundesländer), the Austria Institute of Construction Engineering (OIB) published in April 2007 a guideline (OIB-Richtlinie 6), that defined four categories of limit values for heating/cooling demand of buildings, a first step in the right direction to nZEB. While *OIB-Richtlinie 6* may be considered as the building code currently in force, a new version published in 2011 includes stronger requirements that went into force in January 2013 in four regions (Carinthia, Styria, Vorarlberg and Vienna), and are likely to be implemented in all other regions in 2014. In addition, the nine regions have agreed on a draft national plan in accordance with the EPBD recast that includes the definition of nZEB and the implementation of interim targets. It considers, both for new buildings and for major renovations, targets for heating needs, delivered energy, total efficiency factor, primary energy demand and CO2-emissions for the years 2014 (start of implementation 1.1.2015), 2016 (1.1.2017), 2018 (1.1.2019) and 2020 (1.1.2021).
France	Partly	In October 2010, France published a new building energy regulation (Réglementation Thermique 2012, or RT2012) that made mandatory « Low energy consumption » building (BBC – Bâtiment Basse Consommation) for all new constructions that partly transposes the Directive 2010/31/EU (art. 3, 4 and 6) and became compulsory as of 1st January 2013. The absolute limit value for consumption in housing is 50 kWh/sqm.year covering five energy uses: space heating and cooling, domestic hot water, lighting and auxiliary equipment (pumps, fans). The official calculation model was published in September 2011. Although there is currently no official definition of nZEB, the national State plans to introduce BEPOS (Bâtiment à Energie Positive or "positive energy building") as the required energy performance level in the future regulation scheduled for 2020. The professional association Effinergie who is at the origin of RT2012 is currently developing the BBC+ and BEPOS standards, which, based on previous experiences, will probably

		be taken as a working basis for the official definition of nZEB.
Greece	No	In Greece, the Law 4122/2013, which is the transposition of Directive 2010/31 into national legislation, was voted on February 2013, but it does not provide with a more precise definition on nZEB than the one appearing in the Directive. Furthermore, no nZEB definition existed either in the previous Building Law and Building Code Regulation (Law 3661/2008 and D6/5825/2010). According to Art, 9, paragraph 2 of Law 4122/2013 a national action plan to support the penetration of nZEB is foreseen. This action plan, among other things, will also provide with a precise definition on nZEB, as far as technical aspects are considered. The working group for the preparation of this action plan has not been allocated yet by the Ministry of Environment, Energy & Climate Change, but is expected to be allocated in the forthcoming months.
Hungary	No	The former Directive (2002/91/EC) expired on 01.02.2012, which should be replaced by 2010/31/EU. Hungary's Renewable Energy Utilisation Action Plan plans that significant legislative amendments are required to implement the Directive 2010/31/EU. Preparation work has already begun.
Italy	Yes	Law of 3 August 2013, n. 90 is converted into law, with amendments, of Decree-Law 4 June 2013, n. 63, on urgent measures for the transposition of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings for the definition of infringement proceedings by the European Commission, as well as other provisions of social cohesion. (13G00133) (OJ 181 of 03.08.2013). The new law presents some clarifications, such as: - definition of nearly zero energy building - definition the Action Plan to increase the number of nearly zero energy buildings at national level, and deadline by 30 June 2014; - deadline for the Ministries for elaboration of the financial measures list to promote energy efficiency and nearly zero energy buildings by 31 December 2013; - energy performance certificate of building for sales contract, the acts of transfer of properties in free of charge or for new leases;

		- tax deduction (or 55%) for documented expenses related to energy upgrading of buildings apply to the extent of 65 percent of the costs incurred from June 6, 2013 (date of entry into force of the measure) until 31 December 2013.
Spain	No	Spain does not have any nZEB definition yet. However, in the Energy Savings and Efficiency Action Plan 2011-2020 and in the Second National Energy Efficiency Action Plan under the EU Energy services Directive106, Spanish authorities have set up a preliminary roadmap for implementing nZEB, whose definition is likely to be based on the "energy class A" of the existing performance certification methodology (EPC), which means that all buildings constructed from 2021 onwards will have a primary energy consumption 70% lower than the current building codes requirements (Technical Building Code-TBC2006) and 85% lower than reference buildings for 2006 building stock. Specific provisions both for new buildings or refurbishment of existing buildings are foreseen, such as: - a definition of nZEB based on primary energy needs (kWh/m^2.yr) adjusted for each of the 12 climatic zones - definition of intermediate goals by 2015 in order to improve the energy performance of new buildings - the establishment of a package of policies and financial tools for implementing nZEB IDAE (Institute for Energy Diversification and Savings) will support the implementation of nZEB in Spain by coordinating several support mechanisms such as projects subsidies allocated on annual call basis and communication campaigns for promoting selected nZEB
United Kingdom / Scotland	No	The Scottish Government consultation on transposition of EU Directive 2010/31/EU is due to close on January 20th, 2012. The results of this will dictate how the requirements of the directive will be implemented in Scotland. Similar procedures are in place throughout the rest of the UK. The primary vehicle for addressing provisions within this Directive will be the English/Welsh/Scottish building regulations. Delivery of nearly zero energy new buildings will be addressed by the on-going building regulations review process, with recognition of similar review and research ongoing within the UK. The definitive definition of nZEB is still to be finalised

		but will be based on the UK zero carbon buildings policy triangle.

Energy consumption in buildings is actually taken into account in the policies of all countries participating in the AIDA project, and the implementation as well as the transposition of the recommendations of the Directive is specific to each country. There is no common definition of nZEB, neither in terms of energy performance targets nor in terms of which indicators to use. Some countries base their definition on the primary energy consumption of the building while others take final energy or CO_2 emissions. This situation is expected to make the comparison of exemplary projects conducted in the AIDA project more complicated. However using the Net ZEB Evaluation Tool elaborated by IEA Task 40/Annex 52 project that allows comparing four definitions of energy balance of buildings finally allowed solving this problem by offering a simple-to-use and reliable tool (see http://task40.iea-shc.org/net-zeb).
Thanks to this it became possible to extract basic common features and recommendations that can be largely disseminated. More detailed information on the progress of policy transition towards nZEBs and the implementation on 2010/31/EU can be found in the "overview of buildings policy frameworks in the EU-27 countries", a report recently published by the IEE-project ENTRANZE (www.entranze.eu).

3. THE SUCCESS STORIES CARDS

3.1. Objective and design principle

Despite the many experimental programmes and the informed work of certain design teams over the past decades, efficient buildings are still relatively rare and suffer from a lack of popularity, often because of a lack of publicity.

The success story case studies related to high performance buildings within the AIDA project will increase the visibility of the results and make the data available to the greatest number of professionals and futures owners, facilitating reproduction and repeatability of the building experiments. As the number of case studies will increase, owners willing to engage in the construction or renovation of a nZEB will be able with increasing ease to view examples that demonstrate the feasibility of such a projects, and they will have more opportunities to find a success story that is close to their own projects.

These sheets highlight the lessons learned and the strengths of the different project processes and of the buildings themselves. Technical characteristics of the building and of systems used are not the only data to be collected and published: supplying a significant amount of information about the context of the project implementation and of decision-making process for designing and choosing technologies is also crucial for readers to understand the genesis and the day-to-day running of the project.

To ensure comparable data that will allow future building owners and design teams to conduct a meaningful analysis, the case studies are published according to a model that includes technical and economic indicators as well as clients and contractors motivation.

The model presents both technical data and a description of the progress of the project in a booklet of three pages. It contains technical information on the building as a whole and on systems as well as the origin and the roll-out of the project. Thus, decisive steps, goals that have been met, lessons learnt and success factors are presented in a chronological and easily viewable manner that reflects how the project has evolved over time.

3.2. AUSTRIAN SUCCESS STORIES

1. Plus Energy Residen/al Building -renovated building, Kapfenberg (3pgs)
2. School Centre Neumarkt renovated building, Neumarkt/Styria (2pgs)
3. PlusEnergieWohnen Weiz New building, Weiz (2pgs)
4. klima:ak'v Kindergarten Eggersdorf New building, Amstetten (3pgs)

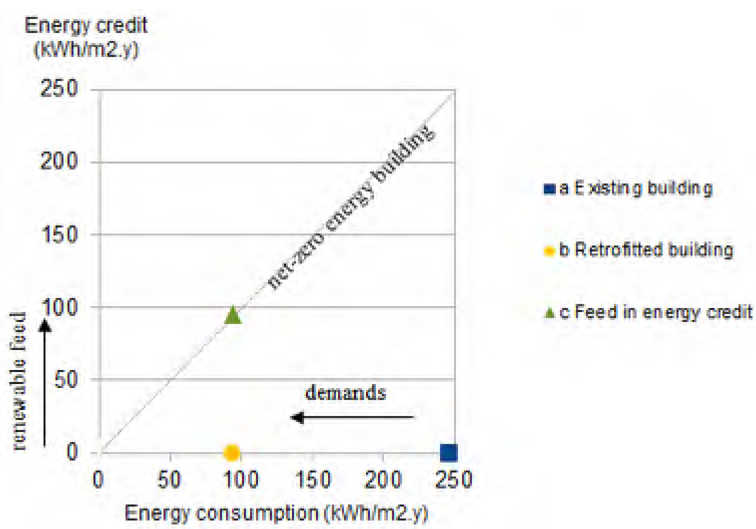
Plus Energy Residential Building
Renovated building, Kapfenberg (AT)

(source: AEE INTEC)

GENERAL INFORMATIONS	
Owner:	Gem. Wohn- u. Siedlungsgenossenschaft ennstal reg. Gen.m.b.H. Liezen
Architect:	Arch. DI Werner Nussmüller
Use :	Residential Building
Surface :	2.845 m² (GFA)
Volume :	8.538 m³
Built:	1960 - 1961
Renovated:	2012-2014
Building costs:	ca. 1.500 €/m^2_{GFA} (without pv-system)
Photovoltaic-system:	ca. 2.500 €/kWp
Nr. of apartments	32

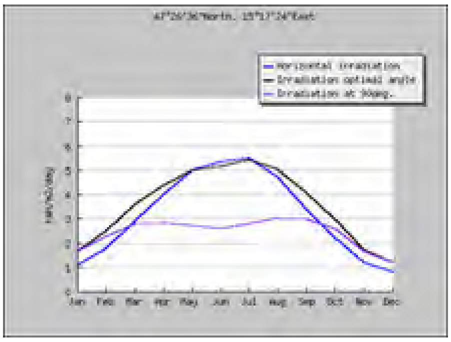
ENERGY PERFORMANCE

CO_2-Emissions:	12,6 kg/m^2_{GFA}y (incl. solar thermal +PV)
Primary energy demand:	94,10 kWh/m^2_{GFA}y (excl. solar thermal + PV)
Primary energy production on site:	85,70 kWh/m^2_{GFA}y (solar thermal + PV phase 1) 95,25 kWh/m^2_{GFA}y (solar thermal + PV phase 1+2)
Primary energy surplus:	1,15 kWh/m^2_{GFA}y -> positive annual energy balance can be achieved



Graphic 1: Plus Energy Balance (source: AEE INTEC)

DESCRIPTION OF THE CLIMATE



Address:	Johann-Böhmstraße 34/36, 8605 Kapfenberg
GPS:	Latitude = 47°26´43"N Longitude = 15°18´23"
Altitude:	503 m
Yearly solar radiation: (graphic)	1.150 kWh/m²y *(average sum of horizontal global irradiation per square meter)* *(http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*
HDD_{20} : *(http:// www.degreedays.net/)*	HDD_{20}= 3.794 (Kapfenberg)
CDD_{26}: *(http:// www.degreedays.net/)*	CDD_{26}= 65 (Deutschfeistritz)

SPECIFICATIONS OF THE BUILDING

1) Building

Orientation	East/West
The building envelope	
Compact:	S/V = 0,38 (1/m)
Heating demand	16,90 kWh/m²y (useful energy)
U-value of the opaque surface	
• Walls:	0,17 W/m²K
• Roof:	0,10 W/m²K
• Ceiling:	0,30 W/m²K
U-value of the window surface	0,90 W/m²K

2) Systems

Mechanical ventilation system with heat recovery

Centralized ventilation system
- 65% efficiency

Heating and cooling system

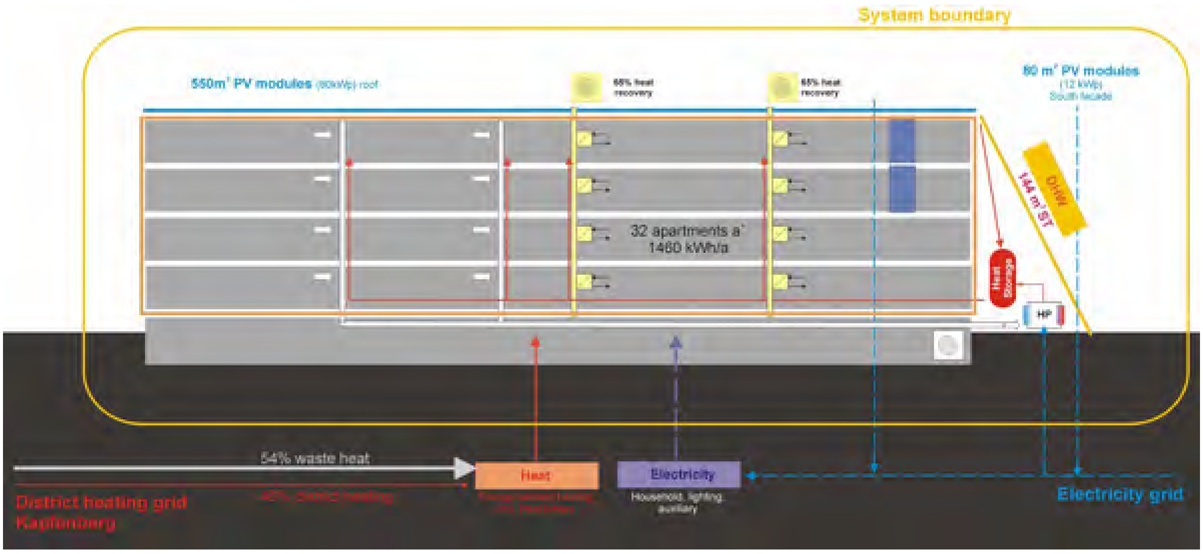
Solar thermal collectors
- 144 m²

Local district heating
- 115 kW

On site electric energy generation

The electricity production from PV allows to cover the electricity demand of the whole building and to sell the surplus to the net.

Photovoltaic panels
- 550 m² (ca. 80 kWp) photovoltaic power plant on the roof of the building
- 80 m² (ca. 12 kWp) photovoltaic power plant on the south façade of the building



Graphic 2: energy concept of the renovated building (source: AEE INTEC)

CONTEXT AND HISTORY OF THE BUILDING

1st step **"Project launch"**

Initial situation:

- high energy demand of the building
- poor thermal situation
- living area of apartments too small
- …

Conclusion: high-performance renovation of building is necessary

2nd step **Definition of the retrofit objectives**

The main goal of the renovation was the improvement and upgrade of the Indoor Environmental Quality, of the living area and of the heating system.

Additionally a "plus energy" building should be achieved after the renovation. → more energy generation on-site than energy consumption in the same period of time

Further goals to be achieved after the renovation of the residential building:

- 80% reduction of the heating demand of the existing building
- 80% renewable energies based on the final energy demand of the building
- 80% reduction of the CO_2-emissions of the existing building

but also

- raise the awareness of the residents and the property management for sustainable energy efficient usage of the apartments

3rd step **Analysis of the existing building**

- Inspection of the existing building on site
- Calculation of the energy performance of the existing building
- Inquiry of miscellaneous necessary parameters and information

Is renovation of the building generally possible and recommendable?
What is the best retrofit strategy?

4th step **Development of the retrofit strategy**

The retrofit concept is based on energy efficiency measures (well-insulated prefabricated façade modules with integrated building services), high ratio of renewable energy and an intelligent integration of the energy production on site into the heat and electricity grid.

5th step **Development of the prefabricated façade modules**

Based on the knowledge of the involved experts the first design of the prefabricated façade modules was developed. The following requirements had to be considered in the design phase:

- Requirements concerning the building physics and the building construction
- Economical and ecological sustainability
- Production and transport
- Assembling and joining technology
- Integration of active and passive elements (e.g. photovoltaic-modules)
- Opportunity to integrate external installation shafts

Different calculations (regarding the building physics, LCA, LCC,…) were carried out to prove the set requirements.

After the design and development first modules were built and tested to the set requirements. After completion of the tests the final design was determined.

6th step **Design/development of the energy production on site**

Because of the defined "plus energy"-goal an energy generation on site was necessary to fulfill this objective.

Therefore different varieties were evaluated, supported by different calculations and simulations.

7th step **Construction phase**

The renovation of the residential building was carried out in two construction phases in the period 2012 – 2014:

- 1. construction phase finished in May 2013
- 2. construction phase finished in May 2014

School Centre Neumarkt
renovated building, Neumarkt/Styria (AT)

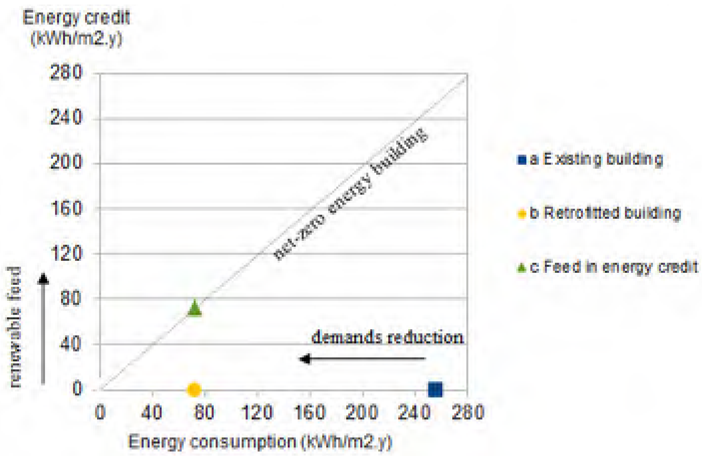
(source: ARCH+MORE ZT GmbH)

ENERGY PERFORMANCE

CO_2-Emissions:	6,97 kg/m²$_{NFA}$y (heating and ventilation)
Primary energy demand:	72,20 kWh/m²$_{NFA}$y (heating and ventilation)
Primary energy generation on site:	72,20 kWh/m²$_{NFA}$y (energy generation by biomass district heating plant close to the school centre – school centre is main energy consumer)
Primary energy surplus:	0 kWh/m²$_{NFA}$y -> annual zero energy balance can be achieved

GENERAL INFORMATIONS

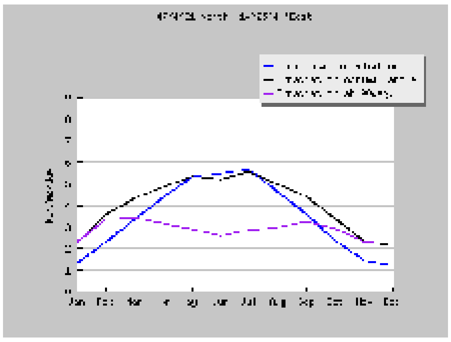
Owner:	Schulbauerrichtungs- und Sanierungskommandit-gesellschaft Stellvertreter KG Hauptmann Franz Karner
Architect:	Arch. DI Gerhard Kopeinig
Use :	school building
Surface :	3.252 m² (Net Floor Area)
Volume :	18.935 m³
Built:	2009 (phase 1) 2011 (phase 2)
Building costs:	ca. 950 – 1.450 €/m²$_{NFA}$ (without VAT)
Number of classrooms	11



Graphic 1: Plus Energy Balance (source: AEE INTEC)

DESCRIPTION OF THE CLIMATE

Address:	Meraner Weg 3, A-8820 Neumarkt/Styria
GPS:	Latitude = 47°4'31“N Longitude = 14°25'40“E
Altitude:	837 m
Yearly solar radiation: (graphic)	1.245 kWh/m²y *(average sum of horizontal global irradiation per square meter) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*
HDD_{20} : (*http:// www.degreedays.net/)*	HDD_{20}= 4.562 (Zeltweg)
CDD_{26}: (*http:// www.degreedays.net/*)	CDD_{26}= 25 (Zeltweg)



SPECIFICATIONS OF THE BUILDING

1) Building

Orientation	South
The building envelope	
U-value of the opaque surface	
• Walls:	0,13 W/m²K
• Roof:	0,11 W/m²K
• Floor	0,16 W/m²K
U-value of the window surface	0,79 W/m²K
Airtightness	0,42 1/h
Calculated heating demand	14 kWh/m²y (useful energy)

2) Systems

Mechanical ventilation system with heat recovery

Centralized ventilation system with heat recovery	• 83% efficiency • SFP = 0,43Wh/m³

Night ventilation (22:00 to 07:00) to reduce the overheating of the classrooms in summer (- active from mid-March to the end of September)

Heating system

Heat generation:	District heating based on wood chips from the farmers of the region
Heat dissipation	Low-temperature radiators in the classrooms

CONTEXT AND HISTORY OF THE BUILDING

The success story of the renovation started with an open project development that integrated the intended users right from the beginning and aimed to foster the incorporation of the school into the region. On one hand the school buildings host besides the secondary school the public music school, rooms for clubs and event rooms for the municipality. On the other hand a strong focus was set on wood as regional construction material. A major part of the building complex was renovated with prefabricated wooden modules that were cladded afterwards with a wood slat façade. The installation of a centralized ventilation system with about 80 % heat recovery, external venetian blinds and a very elaborate system for night ventilation were designed to guarantee a high indoor environmental quality.

PlusEnergieWohnen Weiz

New building, Weiz (AT)

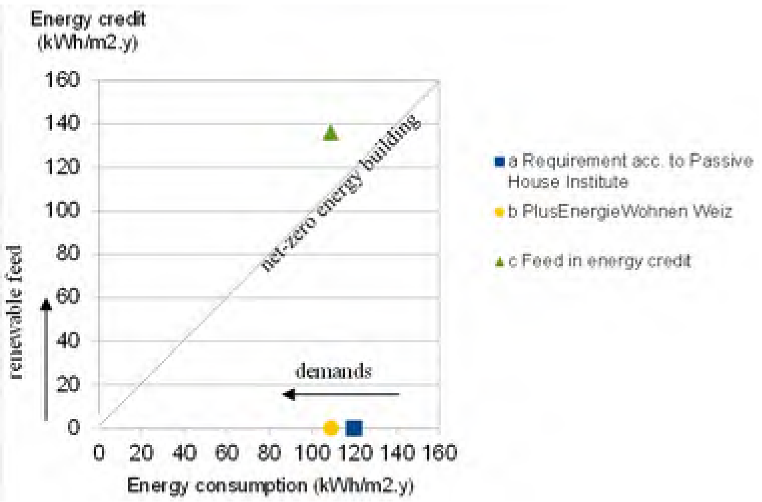
(source: Arch. Dipl.-Ing. Erwin Kaltenegger)

GENERAL INFORMATIONS

Owner:	Gemeinnützige Siedlungsgesellschaft ELIN GmbH
Architect:	Arch. DI Erwin Kaltenegger
Use :	Residential Building
Surface :	101,82 m^2_{NFA} (larger apartments) 89,32 m^2_{NFA} (smaller apartments)
Volume :	424 m³ per apartment
Built:	2004-2005
Building costs:	ca. 1.100 €/m^2_{NFA} (without VAT and pv-system)
Photovoltaic-system:	ca. 29.500 €/plant excl. VAT
Nr. of apartments	22

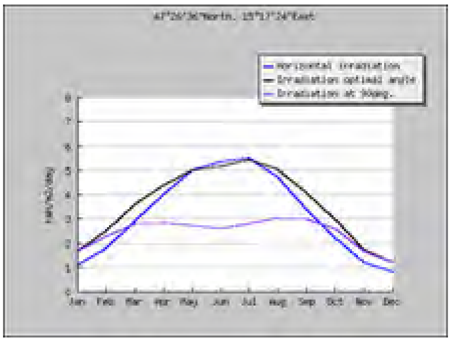
ENERGY PERFORMANCE

CO_2-Emissions:	28 kg/m^2_{NFA}y
Primary energy demand:	109 kWh/m^2_{NFA}y
Primary energy production on site:	136 kWh/m^2_{NFA}y
Primary energy surplus:	27 kWh/m^2_{NFA}y -> positive annual energy balance can be achieved



Graphic 1: Plus Energy Balance (source: AEE INTEC)

DESCRIPTION OF THE CLIMATE



Address:	Johannes Hymel Gasse, 8160 Weiz
GPS:	Latitude = 47°12´22”N Longitude = 15°17´31”
Altitude:	477 m
Yearly solar radiation: (graphic)	1.160 kWh/m²y *(average sum of horizontal global irradiation per square meter) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*
HDD_{20} : *(http:// www.degreedays.net/)*	HDD_{20}= 3.714 (Weiz)
CDD_{26}: *(http:// www.degreedays.net/)*	CDD_{26}= 42 (Graz)

SPECIFICATIONS OF THE BUILDING

1) Building

Orientation	South
The building envelope	
Compact:	S/V = 0,72 (1/m)
Heating consumption	15 kWh/m²y (useful energy)
U-value of the opaque surface	
• Walls:	0,09 W/m²K
• Roof:	0,08 W/m²K
U-value of the window surface	0,70 W/m²K
Airtightness	0,50 1/h

2) Systems

Mechanical ventilation system with heat recovery

Centralized ventilation system with geothermal heat exchanger	• 89% efficiency

Heating and cooling system

Air-to-air heat pump with a performance of … per apartment	• 1 kW_{th}

On site electric energy generation

The electricity production from PV allows to cover the electricity demand of the whole building and to sell the surplus to the net.

Photovoltaic panels	• ca. 40 m² (4,95 kWp) per apartment

CONTEXT AND HISTORY OF THE BUILDING

1st step **Appraisal**

The idea behind the building project was to create a passive house settlement which keeps up with the purchase price of conventional housing development and breaks herewith the cliché that energy-saving houses would have to be expensive.

2nd step **Planning phase**

During the planning phase, ecology has always been highest priority. Therefore regenerating raw materials, used instead of concrete and polystyrene plates, offer now a good living quality at customary prices.

For energetic and economic reasons the houses were built without cellars, so therefore the architect planned storage containers which are thermally separated from the building and placed next to the house entrance at the north side of the row houses.

AIDA AFFIRMATIVE INTEGRATED ENERGY DESIGN ACTION

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

TECHNISCHE UNIVERSITÄT WIEN Vienna University of Technology

Operational success story

klima:aktiv Kindergarten Eggersdorf

New building, Amstetten (AT)

klima:aktiv

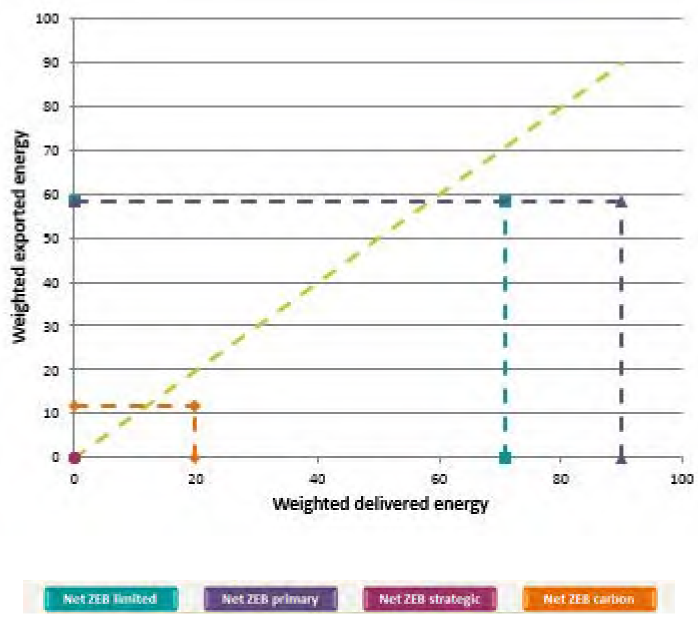
GENERAL INFORMATION

Owner:	GWSG Amstetten
Architect:	arch. DI Georg W. Reinberg
Use:	Half-day kindergarten
Surface:	2151 m²
Volume:	3554 m³
Gross floor area:	808 m²
Net floor area:	720 m²
Built:	2007 -2008

ENERGY PERFORMANCE

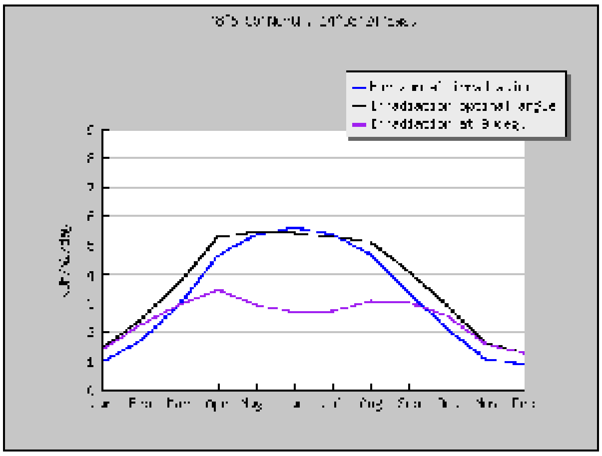
Type of certification: Klima:aktiv standard Silver

- heating demand 23,8 kWh/m²a
- total energy efficiency - 4 kg CO_2/m²a



Graphic 1: Estimated Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings“. Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE



Address:	Aluminiumstrasse 15, 3300 Amstetten, Lower Austria.
GPS:	Latitude = 48.116N, Longitude = 14.890E
Altitude:	270 m
Yearly solar radiation: (graphic)	3200 Wh/m²*day *(average sum of horizontal global irradiation per square meter) (* *http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*
HDD_{20} : *(www.degreedays.net)*	HDD_{20}= 3709 K Amstetten, Ybbs (15.07E,48.17N), 3580 K according to the energy performace certificate
CDD_{26}: *(www.degreedays.net)*	CDD_{26}= 77 K Amstetten, Ybbs (15.07E,48.17N)

SPECIFICATIONS OF THE BUILDING

1) Building Data

Orientation	East southeast – optimal for mornings operation
The building envelope	
Compact:	S/V = 0.61 (1/m)
Heating demand	23,8 kWh/m²a klima:aktiv Silver
U-value of the opaque surface	
• Walls:	0.16 W/m²K
• Roof:	0.09 W/m²K (grass-roofed)
• Basement	0.15 W/m²K
U-value of the window surface	1.00 W/m²K

2) Systems

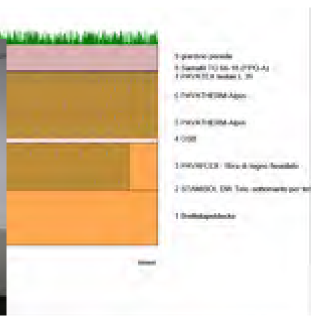
Mechanical ventilation system with heat recovery

Centralized ventilation system	• efficiency of the heat exchanger larger than 73 %
Heating and cooling system	
Heating	The building is optimised for passive solar gains; the remaining heating demand is covered by biomass district heating
Cooling	High quality thermal insulation and exterior sun-blinds block diffuse as well as direct radiation; passive night ventilation via controlled tilt fanlight windows

On site electric energy generation

The electricity production from PV allows to cover the electricity demand of the building equipment.

Photovoltaic panels	• 60 m² semi-transparent polycrystalline photovoltaic panels produced by Ertex Solar



CONTEXT AND HISTORY OF THE BUILDING

December 2005

Design contest

- The building was positioned and oriented with the aim of directing the group rooms towards the East (morning sun) and South (noon sun and view towards the pre-Alpine hills). This also allows for sufficient sun in the garden until afternoon.

- The building is shaped as a closed cube and therefore very compact. It is formed by two parts positioned opposite of each other (group rooms – functional rooms) and embracing a shared hall in the middle.

- The semi-transparent photovoltaics roof over the entrance represents the ecological concept of the kindergarten.

January 2006

Design development, technical design, feasibility study

- The energy concept mainly relies on retaining heat and using passive solar yields. The orientation of the transparent surfaces allows for solar yields during the main operational hours (morning). The building is compact and well insulated. Ventilation-induced heat losses are minimized by deploying a heat recovery mechanism in the central ventilation system as well as an air-tight building shell. This allows for a high solar fraction to be achieved. The building was shaped so as to allow for the group rooms to be oriented towards South-East. This way the children can benefit from the sun during the kindergarten hours and passive solar yields are achieved during the time when heat is needed. The rest of the heating demand is covered by district heating (biomass).

- The increased electricity demand caused by additional building services is supplied by a small PV system (60 m²). The PV roof over the entrance fulfills a dual function; on the one hand the efficiency of this technology is increased due to good ventilation, on the other hand it also helps to reduce investment costs.

May 2007

Construction start

- The building owner decided to use wood-cement-concrete bricks which have a low heat capacity. Ceiling surfaces out of concrete and clay plaster insulation are implemented in order to compensate for this.
- Overheating protection in the summer: the basic concept for passive cooling is a strong thermal insulation and avoiding solar yields in summer. Exterior sun-blinds are deployed for blocking diffuse as well as direct radiation. Furthermore, the building can be ventilated with cool air during the night. For this purpose, tilt fanlight windows and flaps (with lamellas) are installed as air inlets while the toplight strip serves as outlet (controlled by a rain detector). The coolness is temporarily stored in the building's mass and used by the heat recovery in the ventilation system.

Year 2008

Construction phase

- The group rooms are flooded with direct sunlight during all operation hours. In the summer the light can be filtered according to need by using the adjustable blinds installed. Natural lighting can reach every corner of the building which reduces the electricity demand.
- Rain water is retained on the property and the grass roof absorbs any roof water.

August 2009

Handover of the works – commissioning of building

- According to the kindergarten manager the heat protection in summer is not sufficient. It cannot be determined at this stage whether this is attributable to design mistakes or to wrong use of the exterior blinds. This example shows clearly how important it is to include all stakeholders (designers, building owner and users) into the design process.
- The building achieves 846 (out of 1000 max.) points and is therefore awarded the silver standard by "klima:aktiv".

3.3. FRENCH SUCCESS STORIES

1. 1. Le Clos des Visitadines Refurbished building, Vaugneray (3pgs)
2. CRIIRAD Headquarters New office and laboratory, Valence (2 pgs)
3. Residence Jules Ferry New building, Saint Dié les Vosges (3pgs)

AIDA AFFIRMATIVE INTEGRATED ENERGY DESIGN ACTION www.aidaproject.eu

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HESPUL

Operational success story

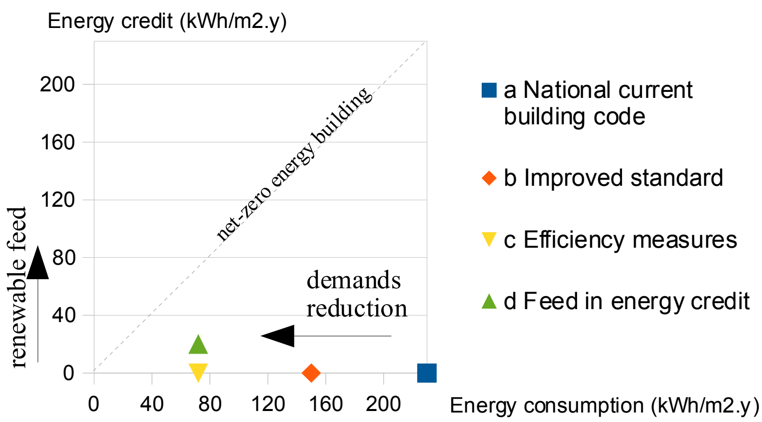
Le Clos des Visitandines
Refurbished building, Vaugneray (FR)

GENERAL INFORMATIONS

Owner:	Municipality of Vaugneray
Architect:	arch. Lucca Lotti, Paris
Design :	BETEREM Eco-service ENERTECH HESPUL
Use :	Housing
Surface :	1800 m^2
Built:	1960
Refurbished:	2008
Construction cost:	2,700,000 €
Design cost: *(architectonic, electronic, plans, structure and security..)*	-
Total cost:	1500,00€/m²
Method of financing:	Grants from : - ADEME - Rhône-Alpes Region - Rhône Departement

ENERGY PERFORMANCE

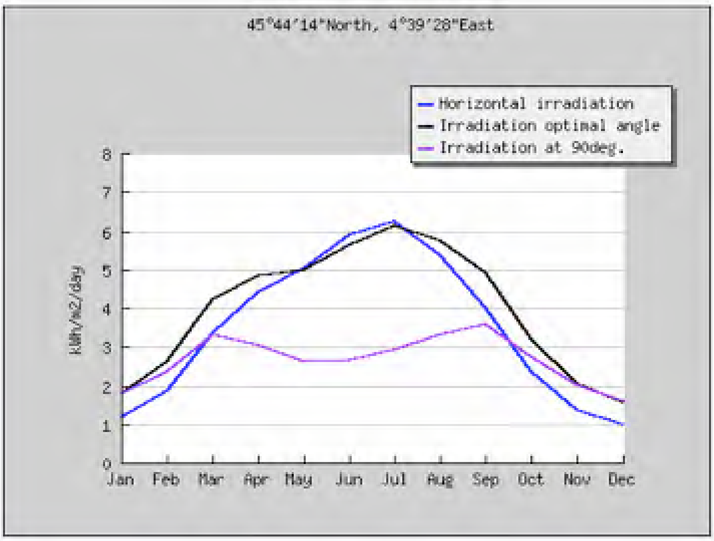
Primary energy demand :	52 kWh/m^2.y
Type of certification:	No official specific certification had been issued; Building Energy Rating „A" based on operational data
Emission of CO2:	0,11 t/y/hab



DESCRIPTION OF THE CLIMATE

Address (town, country...) : Vaugneray, France
GPS : 45.737, 4.657
Altitude : 400 m

HDD20 : 2924
CDD26 : 50
Yearly solar radiation : 1280 kWh/m2 (average sum of horizontal global irradiation per square meter received)



Monthly solar irradiation in Vaugneray – source PVGIS-classic

SPECIFICATIONS OF THE BUILDING

1) Demand reduction

Description of the form of the building :
The building has a complex shape with lot of levels. It is not very compact and presents many surfaces able to loose heating energy.

Ventilation hygro type B
Upper floor : U = 0,16
Low floor : U = 0,30 (earth full) and U = 0,15 (crawlspace)
Walls : U = 0,21 (external insulation)
Windows : Uw = 1,5 (double glazing 4.16.4)
Results of the airtighness test : I4 = 0,55 m3h/m^2

2) Renewable energy ressources in-site

Renewable energy production (description of solutions and quantity (kWh/m^2.y))
No electric production

Source of heat production (description of solutions and quantity (kWh/m^2.y))
1 Wood boiler : 80 kW
2 Gas boiler : 120 kW and 60 kW
Solar thermal : 28 m^2

CONTEXT AND HISTORY OF THE BUILDING

2007	**Appraisal** In order to preserve local heritage and to respond to a demand for housing for rent or purchase for low-income households, the municipality of Vaugneray bought the monastery of the visitation. Its goal is to turn it into housing. However, the programming phase doesn't provide energy performance element at this stage.
12 months	**Design development, technical design, feasibility study, fund raising** After participing in a tour of wood boiler, the mayor questioned the relevance of installing renewable energy for heating. Unfortunately the actors of renewable energy were not in the original draft. It would be difficult to negociate with the architect to integrated this concept. An other point is the big number of actors who work on the projet. Indeed, for publics grants, they had to work with independent consultants. Strengths and weaknesses : The relations between the professionals have been diffcult. They were to many actors. Tools, sofwares, various techniques : CLIMAWIN, SOLO, SIMSOL
18 months	• **Construction phase** Finally the construction stars at a time of great changes in regulations and techniques in France. Nobody had experience on the airtightness and learning is done on site. Strengths and weaknesses : The architect had no knowledge on renewable energies or the airtightness. The owner is heavily involved in the project.
	Handover of the works and practical completion Strengths and weaknesses : Pre delivery of technical equipments have been developed to overcome the shortcomings.
Since oct. 2011	**Use of the building**



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

Operational success story

CRIIRAD Headquarters

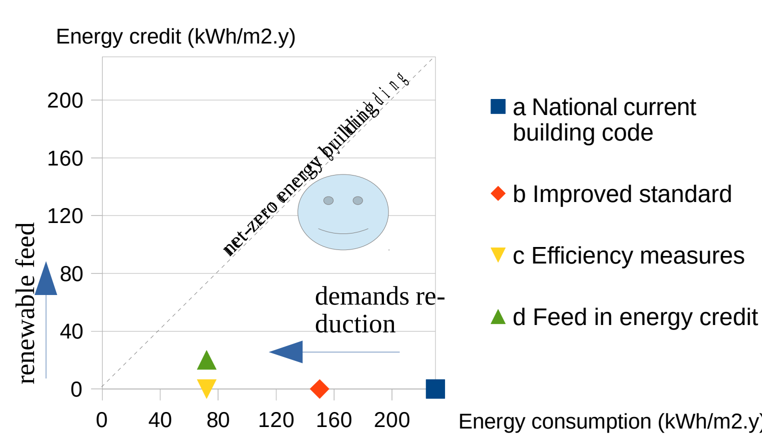
New office and laboratory, Valence (FR)

GENERAL INFORMATIONS

Owner:	Ville de Valence / CRIIRAD
Architect:	AGC Concept (26)
Design :	ENERTECH HESPUL
Use :	Office and Laboratory
Surface :	670 m²/ 570 m²useful
Built:	2013
Construction cost:	840 000 €
Design cost: *(architectonic, electronic, plans, structure and security..)*	-
Total cost:	1 1450,00€/m² / 1 340,00€/m²
Method of financing:	Grants from : - ADEME - Rhône-Alpes Region - Rhône Departement

ENERGY PERFORMANCE

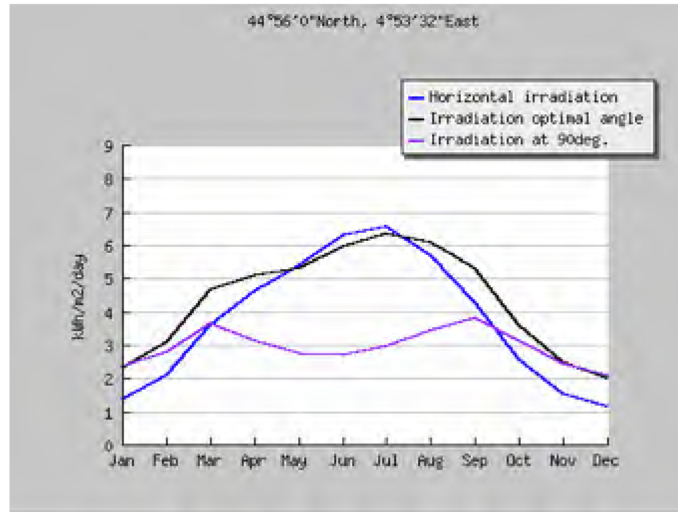
Primary energy demand :	52 kWh/m².y
Type of certification:	Goal → Passive building
Emission of CO_2:	0,11 t/y/hab



DESCRIPTION OF THE CLIMATE

Address : Valence, France
GPS : 44.93, 4.93
Altitude : <200 m

Yearly solar radiation : 1590 kWh/m2 (average sum of horizontal global irradiation per square meter received)



Monthly solar irradiation in Valence – source PVGIS-classic

SPECIFICATIONS OF THE BUILDING

1) Demand reduction

Initially, a passive building with no heating system was suggested, but staff were reluctant to try this out, so it was decided to aim for a Passive building.

Floor:	R = 5,30
Roof :	U = 0,13 (45cm cellulose)
Walls :	U = 0,15 (36cm thick pre-fabricated straw)
Windows :	Uw = 1,5 (double glazing 4.16.4)

Results of the airtightness test : n50 = 0,69 m3h/m2. The construction fault that lead to this high value has been identified : poor quality of the windows frames. The airtightness of the extraction fans for the laboratories was very closely followed.

2) Renewable energy resources in-site

Renewable energy production (description of solutions and quantity (kWh/m2.y)) - No electric production. Roof slope wrong orientation and limited budget. No solar thermal – minimal demand.
Source of heat production (description of solutions and quantity (kWh/m2.y)) - Gas boiler : 1,5 to 17kW (modular)
On demand electric hot water heaters next to taps

3) On-site electricity usage
Electricity for lighting was specifically studied with movement detectors installed, and task specific situational lighting. Overall 2 to 4W/m2.
Office equipment (plug loads) are cut automatically when the security alarm is turned on in the evening, reducing all phantoms loads

4) Ventilation
The heat recovery ventilation is commanded by movement detectors (some rooms) and air quality levels. Both extraction and injection vents, depending on location. Because of the continuous radon level monitoring, much information regarding the ventilation is available. This monitoring revealed a fault in the ventilation circuits (high permanent radon concentration in a particular room). Different ventilation regimes have been tested to investigate the impact on indoor radons levels. Results tend to indicate that the ventilation may ultimately be continuous to avoid background interference in sample specific measures.

5) Summer comfort
For insurance reasons, the planned night-time natural ventilation (open windows) was not integrated into the project.A high performance heat recovery ventilation unit, coupled to a liquid based buried pipes cooling system was chosen. A hydraulic network was chosen to reduce Radon risks. Building overhangs to be retrofitted after monitoring of building performance over the buildings first summer.

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

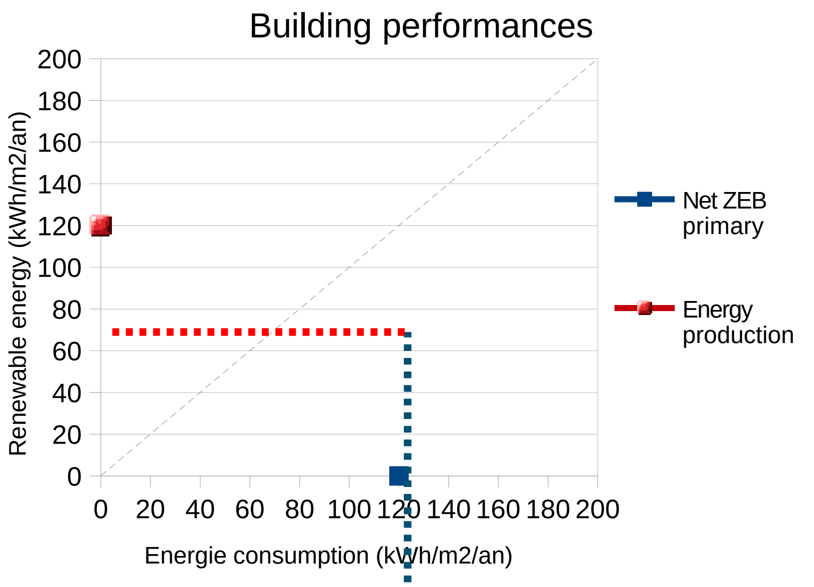
HESPUL

Operational success stor

Residence Jules Ferry
Residential building
New building, Saint Dié les Vosges (FR)

General informations
Owner : Le Toit Vosgien (88)
Architect : ASP Architecte
Design office :
Ingenieurie Bois (67) & Terranergie (88)

Use : residential
Surface : 1850 m2   Volume : 4625 m3
Built in 2014



Cost of construction and project management : 3,6 M€ HT (1800 €/m2)

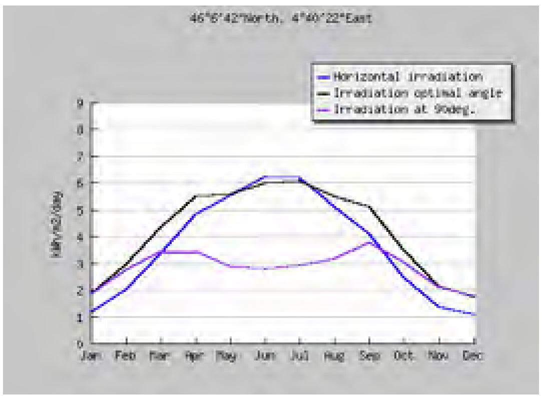
Method of financing : 35% payed thanks to grants and funds of the social landlord.

CO_2 : +1100 tonnes of CO_2 absorbed by the bio-sourced materials.

Primary energy demand : 120 kWh/m2.y
Heating energy demand : 14 kWh/m2.y

Description of the climate

Address : Saint-Dié-des-Vosges ; FRANCE
GPS : 48° 17′ 06″ North 6° 57′ 00″ Est
Altitude: 343 m



Context and history of the building

	Appraisal
	Description of the context The residence Jules Ferry is the highest bulding in France with a wooden shape and staw isolated (7 floors). This project was directyed by « Le Toit Vosgien » wich is a social landlord engaged for several years in the construction / renovation of social housing with very reduced charges and using eco-materials. The residence Jules Ferry is located within close proximity of downtown Saint-Die-des-Vosges, on a plot of about 2500 m ² partly composed by the courtyard of a former school.
	Concept, design development, technical design, feasibility study
	"Produce less but produce more quality, it is the policy of the Board of Directors" *Jean Luc Charrier*
	Use of the building
	Each apartment has an instant display system. This system provides information about consumption (heating / hot & cold water / electricity / lighting), temperature and humidity. All the information is provide by a complete monitoring of the energy system.

Specifications of the building

1) Demand reduction

Design & concept

The shape of the two buildings has been bioclimatic optimized relative to the sun . Sizing balconies and railings on the south side off a corner to let the sun go into the house in winter and prevent it from entering in mid-season. 30% of the heating requirements by direct sun radiation.

The buildings has been design in accord with the surounding and the existing buildings in order to be well adapted.

Envelope

The envelope and the building's floors are made of wood panels of laminated spruce which are fixed prefabricated boxes filled with straw bales for the insulation. The outer walls are 100% plant fiber (wood and straw) = free migration of water vapor and natural hydro-dynamic regulation of the building.

CO2 balance

Thanks to using bio-based materials, the carbon footprint of the construction is positive :

→ +1100 tonnes of CO_2 absorbed by the materials.

→ +1000T CO_2 stored in the wood used 1000m³

→ +200T CO_2 stored in the used straw 600m³

→ -100T CO_2 consumed during construction

2) Renewable energy resources

Renewable energy production - DHW (domestic hot water)

In this multi family housing, domestic hot water requirements represent twice the heating needs. 35% of these needs are provided by a heat recovery system on waste water. The remaining needs are met by the 50 m2 of solar panels and geothermal system.

Source of heat - Heating & Ventilating – 14 kWhep/m2.y

Ventilation is provided by a double flow CMV matching the requirements of the certification Passiv Haus (85% yield). A heater provides additional heat by drawing its energy from a pump at high temperatures associated with geothermal heat probes. The building has 12 geothermal wells 35m deep.

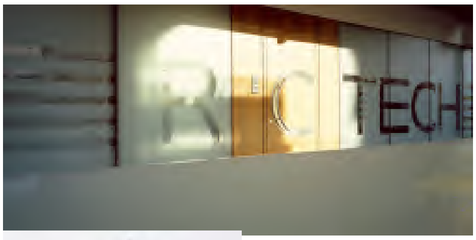
3.4. GREEK SUCCESS STORIES

1. R.C.TECH New building, Athens (3pgs)
2. Region of Central Macedonia - New building, Thessaloniki (3pgs)

Operational success s

R.C.TECH

New building, Athens (GR)



GENERAL INFORMATIONS

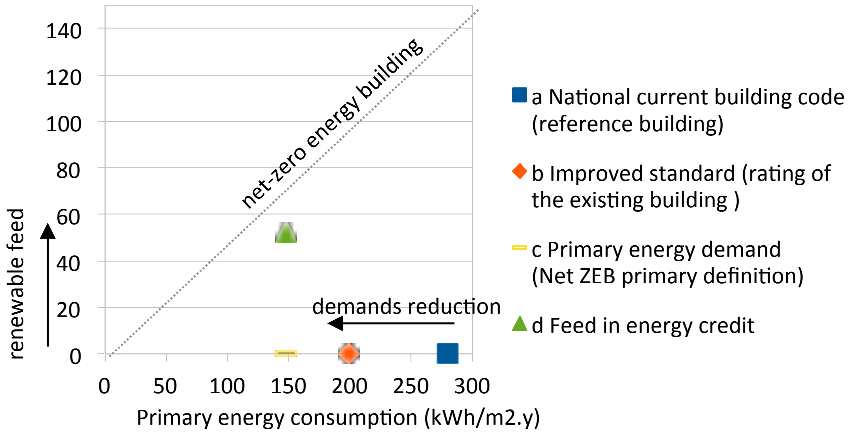
Owner:	R.C.TECH
Architect:	Design office: R.C. TECH
Use :	Office building
Surface :	609 m²
Volume :	N/A m³
Built:	2006
Construction cost:	The cost of this building exceeds by a factor of 1,15 the cost of a conventional building.
Methods of financing:	The construction was partly funded by the European Union, through a subsidies program for the design and construction of sustainable buildings.
Type of certification:	No certification, since the building was built in 2006, before the enforcement of the national building code “KENAK” in 2010.

ENERGY PERFORMANCE

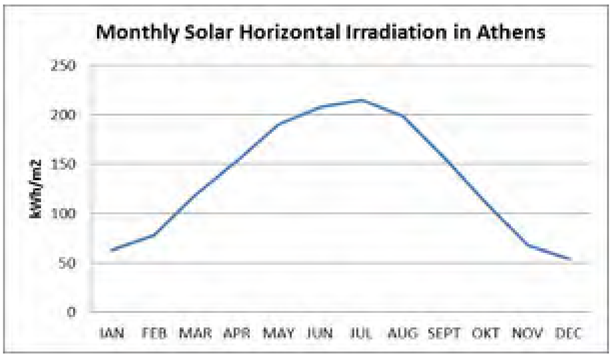
Certification (asset rating):	If the certification of KENAK was applied to the building, it would belong to B+ energy class, with a primary energy consumption of 198,8 kWh/(m²y). The reference building according to KENAK belongs to B energy class and has a primary energy consumption of 279,4kWh/(m²y).
Primary energy demand (according to real measurements and invoices):	149,5 kWh/(m²y) (definition of: Net ZEB primary)
Primary energy demand for heating:	32 kWh/(m²y)
Primary energy demand for electricity:	117,5 kWh/(m²y)
CO_2 emissions:	47,7 kg CO_2 /(m²y)

Energy credit (kWh/m2.y)

(The path to net zero-energy performance - source SOLAR XXI)



DESCRIPTION OF THE CLIMATE



Address:	Athens, Greece.
GPS:	+37° 59' 57.05", +23° 46' 1.93"
Altitude:	
Yearly solar horizontal irradiation: (graphic)	1,613 kWh/m²*year *(source: National Technical Specification TOTEE20701/3)*
HDD_{20} : (http:// www.degreedays.net/)	HDD_{20}= 1663 Athens, GR (HDD_{18}= 887 Athens, GR, source: TOTEE 20701/3)
CDD_{26}: (http:// www.degreedays.net/)	CDD_{26}= 220 Athens, GR (CDH_{26}= 5534 Athens, GR, source: TOTEE 20701/3)

SPECIFICATIONS OF THE BUILDING

1) Built Wh/m²/day

The building envelope

U-value of the opaque surface
- Walls: 0,36 W/m²K
- Basement 0,6 W/m²K

U-value of the window surface 1,70 W/m²K

2) Systems

Heating and cooling system

Low temperature oil boiler for heating:
- Heating capacity of the boiler: 149,1 $kW_{thermal}$ *COP=0,9*
- Use of ceiling capillary system for cooling and heating of the building

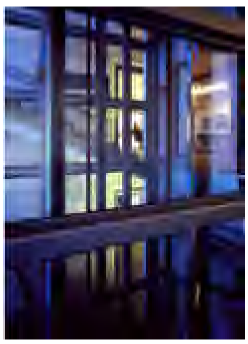
Air to air heat pumps for cooling:
- Cooling capacity: 102 $kW_{thermal}$ *EER=2,12*

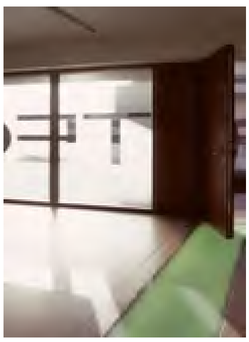
The distribution system uses low temperature water (32°C) for winter and relatively high temperature for cooling (18°C)

On site electric energy generation
The building does not yet support any RES, but a study has been conducted in order to investigate the installation of PVs on the roof.

Scenario for Photovoltaic panels installation:
- 7,5kW_p polycrystalline photovoltaic panels
- 30° angle

The expected electricity production from the PV panels is calculated to be: 18 kWh/(m²y) or in terms of primary energy production 52,2kWh//(m²y)





CONTEXT AND HISTORY OF THE BUILDING

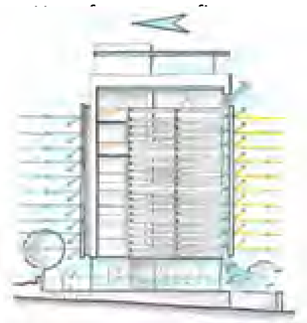
Appraisal

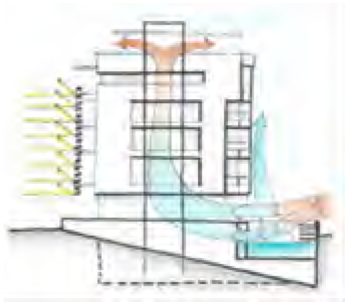
The building is located on a 350m2 plot near the center of Athens and houses the offices of R.C.TECH. The basic design principles were the consistency with the firm's architectural work and vision along with the sustainability of the building. The design is characterized by simple geometry, functionality in spaces and extensive use of modern and efficient materials and systems.

Concept, design development, technical design, feasibility study

The building is developed in five levels along the East-West axis allowing natural light to enter the building in a controlled manner, thus creating a feeling of comfort to its users. Technologies and design strategies regarding sustainability include:

- Optimal orientation for the building and its openings.
- Active and passive solar systems for cooling and heating of the building lowering energy consumption and increasing the feeling of comfort.
- Sun-light control unit with aluminum louvers along the building's west face.
- High-end aluminum window framing and low-e glass facades for minimum thermal losses.
- Use of ceiling capillary system for cooling and heating of the building.
- Full external thermal insulation reducing the number of thermal bridges.
- Aluminum sheet covering for the buildings north face for wind break effect.
- Regulation of building's condition through an electronic Building Management System (BMS).





Use of building

The building owners have mentioned that the total energy consumption in the building is less than the one estimated during the design phase. The natural lighting covers a big share of the building's lighting needs and there is pleasant temperature both in summer and in winter, thus it is usual that there is no need for the mechanical heating and cooling systems to operate under normal weather conditions or there is less need for the same systems to operate under freak weather conditions comparing to conventional buildings. Users are in general pleased by the internal conditions of the building.

Operational success story

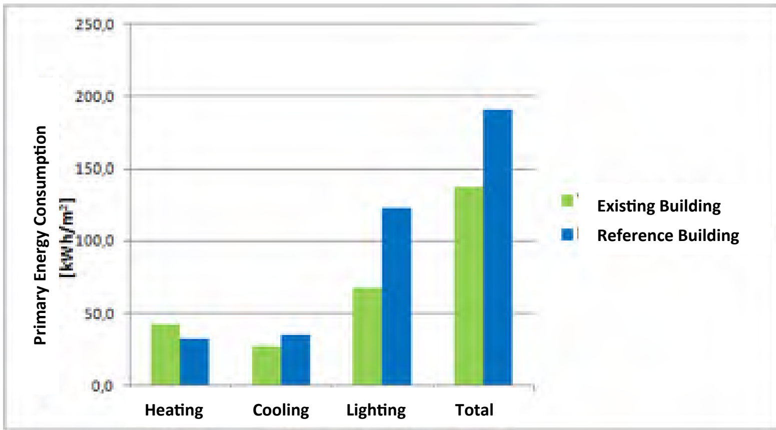
REGION OF CENTRAL MACEDONIA
New building, Thessaloniki (GR)

GENERAL INFORMATIONS

Owner:	REGION OF CENTRAL MACEDONIA
Architect:	METE. SYSM. S.A.
Mechanical Engineers:	MAKTE LTD
Associates:	EMDC ZM - elec – mech -e n g
Use:	Office building
Surface :	37.611 m²
Built:	2015
Construction cost:	43.804.896,00 €
Methods of financing:	The construction was funded from own financial resources.
Type of certification:	No certification. Expected classification B- B+.

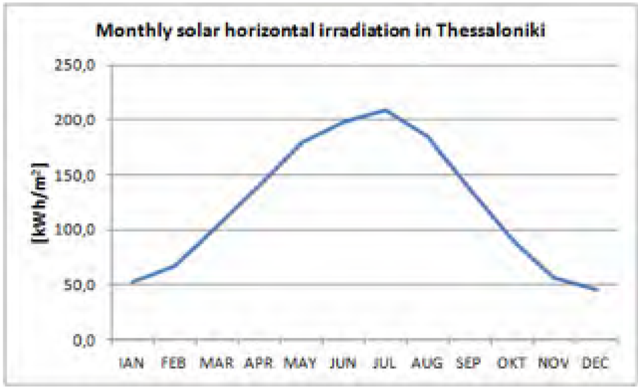
ENERGY PERFORMANCE

Certification (asset rating):	The certification of KENAK classified the building to B energy class, with a primary energy consumption of 155,5 kWh/(m²y). The reference building according to KENAK belongs to B energy class and has a primary energy consumption of 206,5 kWh/(m²y).
Primary energy demand :	155,5 kWh/(m²y)
Primary energy demand for heating :	42,5 kWh/(m²y)
Primary energy demand for lighting :	68,0 kWh/(m²y)
CO_2 emissions:	52,0 kg CO_2/(m²y)



DESCRIPTION OF THE CLIMATE

Address:	Thessaloniki , Greece
GPS	40° 38’’30.00" N, 22° 55’ 05.00" E
Altitude:	6m
Yearly solar horizontal irradiation: (graphic)	1.466,1 kWh/m²*year *(source: National Technical Specification TOTEE20701/3)*
HDD_{18}: (http:// www.degreedays.net/)	HDD_{18}= 1677 Thessaloniki, GR (source: TOTEE 20701/3)
CDH_{26}: (http:// www.degreedays.net/)	CDD_{26}= 2795 Thessaloniki, GR (source: TOTEE 20701/3)



SPECIFICATIONS OF THE BUILDING

1) Construction

The building envelope

U-value of opaque surface

• 1rst – 3rd Wall :	0,484 W/m²K
• 4th Wall :	0,383 W/m²K
• Horizontal roof:	0,321 W/m²K
Ug-value of the window surface	1,40 W/m²K

2) Systems

Heating and cooling system

3 Geothermal systems	Capacity Heating / Cooling
Horizontal (SLINKY)	237 / 253 kW
Vertical (coaxial)	86 / 78 kW
Vertical (open)	547 / 354 kW
Geothermal heat pumps (2)	869,6 / 685,2 kW COP 4,21 / EER 3,62
Air to air heat pumps for heating and cooling (3) :	1890 / 1800 kW COP 3,82 / EER 2,82
Low temperature gas boiler for heating:	800 kW

CONTEXT AND HISTORY OF THE BUILDING

Appraisal

The building is located on a 10 acres plot in FIX area near the center of Thessaloniki and intended to house the services of the Region of Central Macedonia.
The basic design principles during the tendering of the project were just the relocation of the services of the Region of Central Macedonia in new private spaces. During the implementation of the new laws and under the Ministers' Decision D6/B/14826 (Government Gazette 1122/17-6-2008) regarding the improvement of energy efficiency and the energy saving in the public and broader public sector in conjunction with the Law 3661/2008 and the Regulation of Energy Performance of Buildings (Government Gazette 407/9-4-2010), the energy upgrade of the building was required. This energy upgrade achieves 70% reduction in energy consumption compared to the initial building design.

Concept, design development, technical design, feasibility study

The L– shaped building is developed in five levels along the East-West and the North-South axis, allowing the controlled admission of daylight, creating a feeling of comfort to its users.
Technologies and design strategies regarding sustainability include:

- Triple Geothermal System
- Sunlight control with movable metal louvers on the West façade
- Low-e glazing for minimum thermal losses
- Internal building environment control through an electronic Building Management System (BMS)
- Management system KNX combined with presence sensors for controlling the lighting and the local air conditioning units, in order to reduce the energy consumption.
- Green Roof on a part of the building

Use of building

The building is not yet in use.



3.5. HUNGARIAN SUCCESS STORIES

1. Regional Environmental Center Refurbished building, Szentendre (3pgs)
2. ÉMI Knowledge Center New building, Szentendre (3pgs)

Operational success story

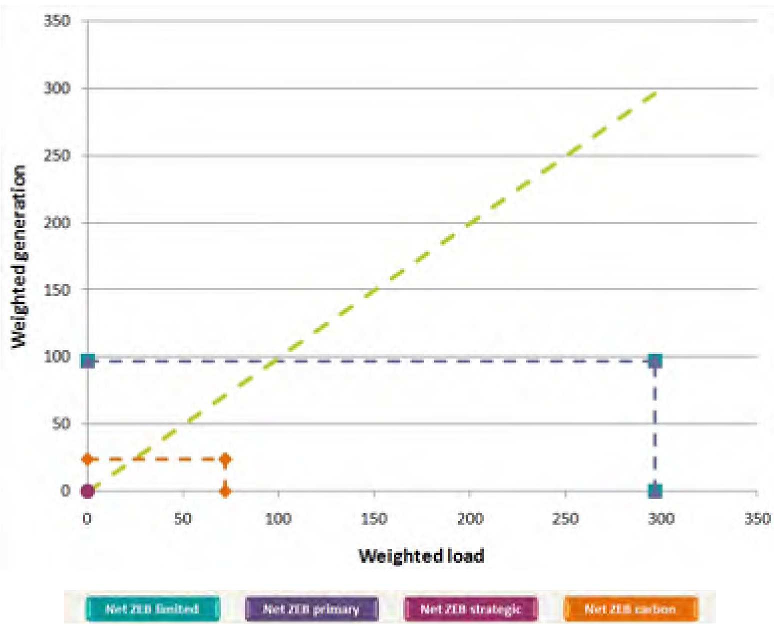
Regional Environmental Center
Refurbished building, Szentendre (HU)

GENERAL INFORMATIONS

Owner:	The Regional Environmental Center for Central and Eastern Europe
Architect:	arch. Federico M. Butera Architetture Sostenibili Kima Studio
Use :	Conference center, Information and demonstration center, library, offices
Surface :	700 m²
Volume :	2800 m³
Built:	1973
Refurbished:	2008
Construction cost:	1,960,000 €
Design cost: *(architectonic, electronic, plans, structure and security..)*	N/A it was part of the funding scheme the project received (indicative, net worth of non-construction related costs ~400,000 €)
Total cost:	2800,00€/m²
Cost distribution:	- 42,2 % new facade, insulation - 2,8 % lighting - 11,4 % PV panels - 23,3 % heating and cooling (ground source heat pumps + distribution) - 20,3 % design, tendering, authorisation, etc.

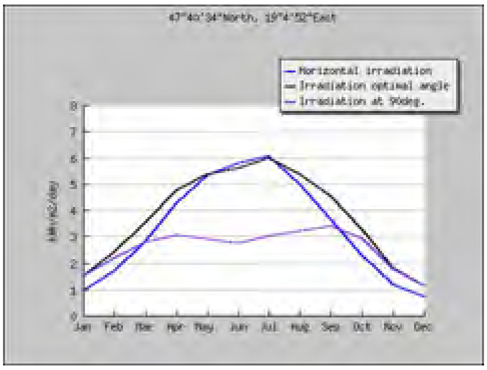
ENERGY PERFORMANCE

Type of certification:	No official specific certification had been issued; Building Energy Rating „A" based on operational data
Saving of CO2:	Zero emission building No conventional fossil-fuel based technology is installed



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings".

DESCRIPTION OF THE CLIMATE

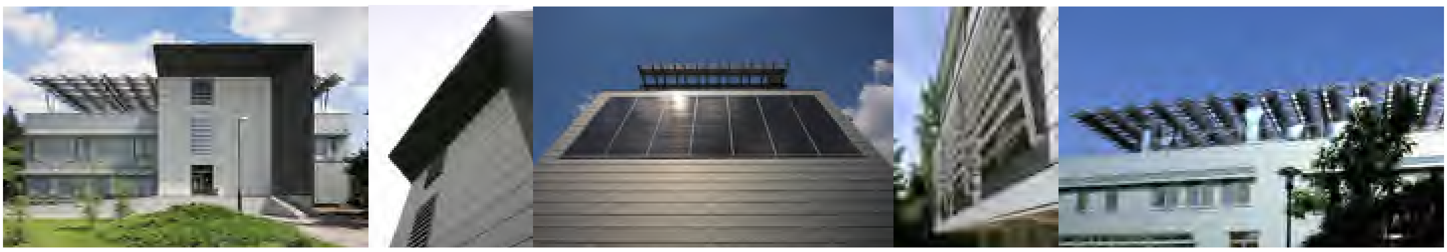


Address:	9-11 Ady Endre út, H-2000 Szentendre, Hungary
GPS:	Latitude = 47.676195 Longitude = 19.081203
Altitude:	104 m
Yearly solar radiation: (graphic)	3320 Wh/m2*day *(average sum of horizontal global irradiation per square meter) ()*
HDD20 : *()*	HDD20= 3335 Dunakeszi, HU (19,13E,47.65N)
CDD26: *()*	CDD26= 80 Dunakeszi, HU (19,13E,47.65N)

SPECIFICATIONS OF THE BUILDING

1) BuiltWh/m2/day		
	Orientation	East-West
	Conference area	
	U-value of the opaque surface	
	• Walls:	2,73 m2 * K /W
	Library/office area	
	U-value of the opaque surface	
	• Walls:	2,73 m2 * K /W
2) Systems		
	Mechanical ventilation system with heat recovery	
	Centralized ventilation system	• 90% efficiency
	Heating and cooling system	
	Electric heat pump	• 2 x 9,5 kW electric • 2 x 30 kW thermal *(COP_m 3,8 heat pump for heating- COP_m 4,2 heat pump for cooling)*
	Geothermal probes	• 12 ground probes, 102m deep
	Solar thermal collectors	• 3,24m² of flat plate collectors collocated on the roof
	On site electric energy generation	
	Produced energy is fed to the national grid during times of surplus production, such as sunny days or at the weekends. When the generated power proves insufficient, for example when the sky is overcast or at night the earlier „lent” energy is „borrowed” back from the grid.	
	Photovoltaic panels	• 168 m2 polycrystalline photovoltaic panels Total electric peak power installed: 27 kW

REGIONAL ENVIRONMENTAL CENTER



CONTEXT AND HISTORY OF THE BUILDING

June 2005

Planning phase – energy design concept

The first idea of the current REC zero emission conference center was to retrofit the previous 3-storey office building (built in 1973) to a very energy efficient office building. In the form of a brownfield investment, the existing conference centre was redesigned to reduce fossil-fuel-based energy consumption to zero, thereby eliminating carbon-dioxide emissions. One of the main functions of the REC Conference Center will be to serve as a training and demonstration facility for sustainability solutions.From the beginning of the design process on, the energy target was fixed to achieve a nearly Zero Energy Building.

The main orientation of the building with entrance and transparent surfaces was aligned to east-west, thus significant passive energy gains could be exploit.

Also by creating the available area for the installation of PV-panels on the rooftop reduced the impact of the construction on the surrounding park. From the beginning the building was specified to reach the highest available efficiency, with an energy efficient envelope, by employing high-end isolation materials, optimizing daylight and using efficient building systems.

2006-2007

Design development, technical design, feasibility study, fund raising

- An integrated approach has been followed in the design of the building's architecture and energy systems: optimal energy conversion technologies are presented using modern architectural language
- Innovative design process was adopted, in which the formal and functional architectural requirements were tested against their impact on energy consumption and aesthetics by means of the most advanced simulation models
- installation of a continuous glass ribbon along the upper part of the walls to increase the use on natural light. The ribbon sits on a horizontal overhang that extends towards the inside of the room, creating a "light shelf" that diffuses natural light throughout the interior.
- High-efficiency lighting, controlled by illumination sensors connected to a control system, ensures appropriate dimming according to the available natural light
- interior air temperature is regulated by a dual system, comprising an air-circulating unit and radiant ceiling heating/cooling
- new insulation and a new building envelope were added to the building, minimizing heat loss in winter, preventing heat absorption in summer, and maximizing the use of natural light
- Building system: heat pump with geothermal probes
- Ventilation System with a constant flow rate
- PV system on the roof

February 2008

Construction phase

- Construction of the basement and geothermal plant.

April 2008

Construction phase

- Building of the new facade
- Installation of the PV panels.
- Many architectural details and material choices were taken during the construction phase to increase flexibility and efficient technical solutions.

– *Good coordination and time management is necessary, in order to reduce the construction time and to guarantee the synchronized presence of different trade workers it the same period, side by side.*

27 June 2008

Handover of the works – commissioning of building

- Positive energy balance since Day 1.
- Start of a monitoring campaign of the building

Operational success

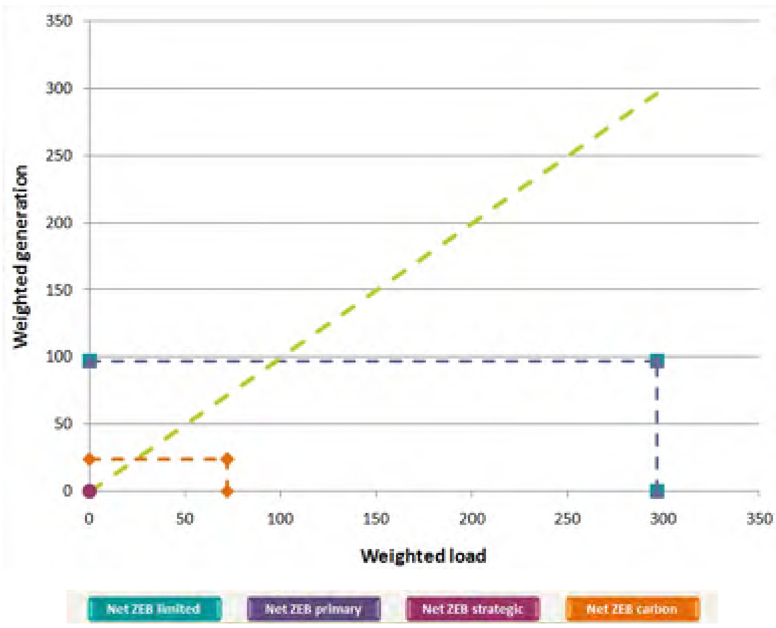
ÉMI Knowledge Center
New building, Szentendre(HU)

GENERAL INFORMATIONS

Owner:	ÉMI Non-profit Limited Liability Company for Quality Control and Innovation in Building
Architect:	Puhl and Dajka Architects Ltd.
Use :	Conference center, Information and demonstration center, library, offices
Surface :	5680 m²
Volume :	16048 m³
Built:	2013
Refurbished:	-
Construction cost:	5,926,666 €
Design cost: *(architectonic, electronic, plans, structure and security..)*	166,127 €
Total cost:	1073 €/m²
Cost distribution:	- 19,6 % heating and cooling system (heat pumps + distribution) - 3 % design, tendering, authorisation, etc.

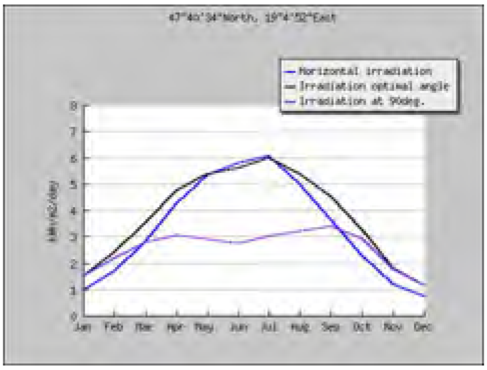
ENERGY PERFORMANCE

Type of certification:	No official specific certification had been issued; Building Energy Rating „A" based on operational data
Saving of CO_2:	Zero emission building No conventional fossil-fuel based technology is installed



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE



Address:	26 Dózsa György út, H-2000 Szentendre, Hungary
GPS:	Latitude = 47.646301 Longitude =19.071707
Altitude:	116 m
Yearly solar radiation: (graphic)	3320 Wh/m²*day *(average sum of horizontal global irradiation per square meter) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*
HDD_{20} : (*http://www.degreedays.net/*)	HDD_{20}= 3335 Dunakeszi, HU (19,13E,47.65N)
CDD_{26}: (*http://www.degreedays.net/*)	CDD_{26}= 80 Dunakeszi, HU (19,13E,47.65N)

SPECIFICATIONS OF THE BUILDING

1) Built Wh/m²/day

Orientation: East-West

Conference area

U-value of the opaque surface

- Walls: 6,67 m² * K /W

Office area

U-value of the opaque surface

- Walls: 6,67 m² * K /W

2) Systems

Mechanical ventilation system with heat recovery

Centralized ventilation system
- min. 70% efficiency

Heating and cooling system

Electric heat pump

2 piece heat pump are installed:

- HS1:100kW thermal for heating before 23 kW power consumption (COP 4,3)
  94 kW thermal for cooling before 27 kW power consumption (COP 3,5)
- HS2:370kW thermal for heating before 85 kW power consumption (COP 4,3)
  344 kW thermal for cooling before 100 kW power consumption (COP 3,4)

On site electric energy generation

All of produced energy is fed to the ÉMI Industrial Park locally.

Photovoltaic panels

- 253 m² thin film photovoltaic panels

Total electric peak power installed: 15,7 kW



CONTEXT AND HISTORY OF THE BUILDING

2007

Planning phase – energy design concept

The ÉMI Knowledge Center was designed and constructed to incorporate the latest features and technologies of energy-conscious architecture and building engineering solutions. While compiling the detailed design for the building the team of architects were aiming at to keep its future energy consumption to the bear minimum, similar to the standards set by the German passivhaus regulation. Due to the size of the industrial park, in which the building is located, one of the key issues of the design work was to harmonize the construction with the municipality's rational use of energy plans. In addition to that the local sewage treatment facility was also considered to be integrated into the energy concept of the area.

One of the prime targets was to promote the principles of green-architecture, the utilization of renewable energy sources and innovative building solutions:

- advanced thermal insulation, increased heat capacity
- energy efficient doors and windows, with various types of glazing (orientation dependent)
- recycled thermal insulation materials
- geometric shading for the windows on the south facade to reduce solar gain during the summer months.
- increased ratio of opaque surfaces to the total facade area
- green roof: heat mitigation, precipitation and dust buffer
- green facade for heat mitigation
- open water surfaces for heat mitigation
- seasonal canopy system to provide shading for the windows facing the inner courtyard
- mobile shading mechanisms during the summer time on the western facade
- dual-layered climate-facade at the south-west corner
- low-temperature surface heating-cooling system
- biogas fed CHP engines
- heat pump heating system for heating and cooling purposes utilizing the waste heat of the sewage treatment plant

2007-2011

Design development, technical design, feasibility study, fund raising

To deliver the first stages of the development project ÉMI used different sources of funding (structural funds and FP7-Concerto funding by participating in the PIME'S project. These funding were allocated to renew the utility system of the hosting industrial park and to erect the current building.

There was a long way for the detailed plans to become final, and it took a lot of preparatory measures. During the planning phase between 2007 and 2011 first the concept design was delivered which yielded the preliminary technical building design. Once the CONCERTO funding were secured the proposed innovative materials and structures were implemented into the existing documentation. This action obviously required the update of the already existing plans.

In March 2010 the demolition works has started and the first steps of the utility development, too.

After acquiring all the necessary and mandatory permits and authorizations the tendering and public procurements were to be conducted. By the Fall of 2011 all the paperwork related to the complete infrastructural development of the industry park, to the energy center and to the new office building had been compiled and the detailed plans for all these features were readily available.

2012

Construction phase

The construction of the building has commenced early in 2012, and as a result of the timely delivery on the contractor's side the building was inaugurated in May 2013.

The three floor (ground floor, 1st and 2nd) new office building's net floor area is 5680 m2 and is divided into three different wings by stair cases. Apart from the regular office building functions the building hosts a restaurant and a reception hall. The second floor contains a lecture hall fit for up to 150 people and a smaller council room for up to 40 people.

2013

Handover of the works – commissioning of building

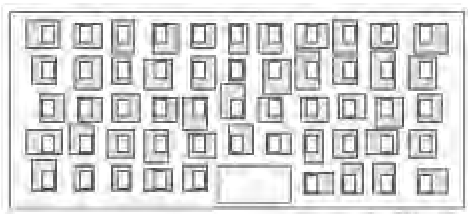
The building is in the process of having certified against the BREEAM (BRE Environmental Assessment Method) criteria. Since their installation there is a continuous monitoring of the constructed innovative architectural features and installed engineering components. The intelligent system, currently under construction, will be in charge of monitoring the building and the energy systems in order to be able to select those sources which yield an optimum solution in order to provide the premises with the required amount of energy. This system will ensure the most efficient utilization of the heating and cooling energy not only in the current building but later on all those additional facilities which will be connected to it.

3.6. ITALIAN SUCCESS STORIES

1. Ex-Post Refurbishing 2005, Bolzano (3pgs)
2. Kererhof Year of construction (2012), Bolzano (3pgs)
3. Primary School Laion / Novale New building 2006, Laion (3pgs)
4. Naturaliabau New building, Merano (3pgs)
5. Salewa New building 2011, Bolzano (2pgs)

Ex-Post
Refurbishing 2005, Bolzano (IT)


The building in the previous state

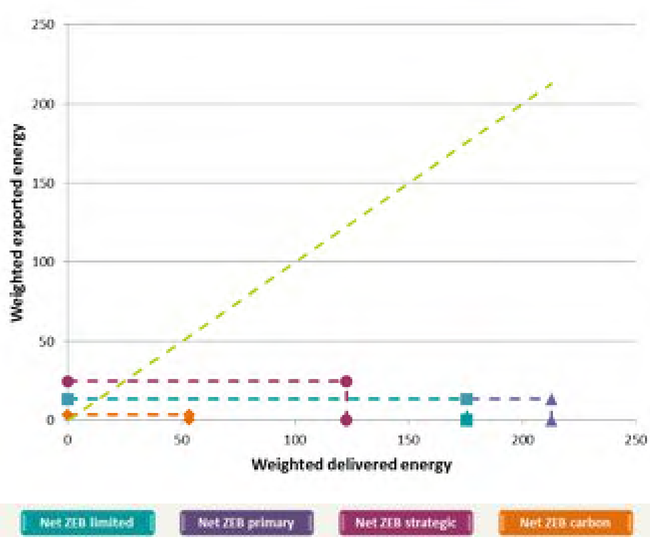


GENERAL INFORMATIONS

Owner:	Province of Bolzano
Architect:	Michael Tribus
Design office:	Michael Tribus
Use:	office building
Heated surface:	4940 m2
Gross volume:	23208 m3
Built in:	1950s
Renovated in:	2005
Cost:	
Method of financing:	-

ENERGY PERFORMANCE

Primary energy demand:	
Type of certification:	*CasaClima certification (mandatory certification for Heating Energy Demand):* 7 kWh/m²y standard 'Casa Clima Gold'.
Saving of CO2:	



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE:

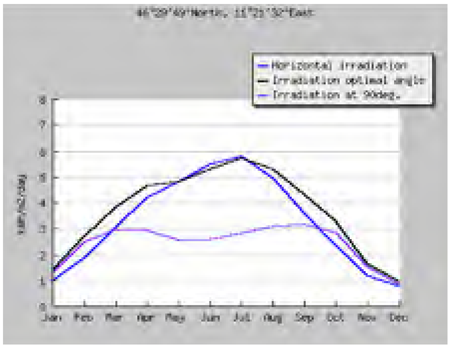
Address: Renon street n.4, Bolzano, South Tyrol, North Italy.

GPS: Latitude = 46. 4971, Longitude = 11. 3591

Altitude: 262m

Yearly solar radiation: 3260 Wh/m²*day (Average sum of horizontal global irradiation per square meter received)

(graphic) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)



HDD20 (http://www.degreedays.net/): HDD_{20}= 3131 Bolzano, IT (11.33E,46.46N)

CDD26 (http://www.degreedays.net/): CDD_{26}= 106 Bolzano, IT (11.33E,46.46N)

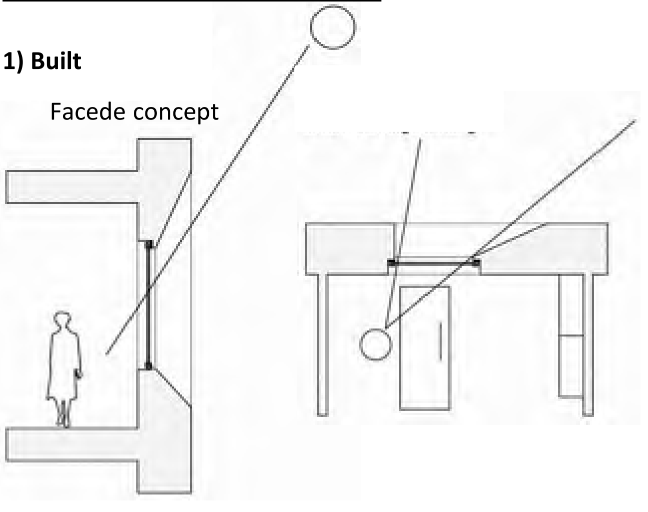
HDD20, Italian Classification: HDD20= 2791 Bolzano, IT (11.33E,46.46N)

(italian law: n. 412 26/august/1993)

SPECIFICATIONS OF THE BUILDING

1) Built

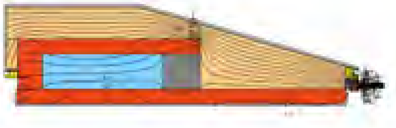
Facede concept



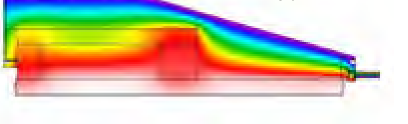
- Green Roof
- The main characteristic of building is in the facades theme. This is been obtained by a particular used of the external insulation layer. In order to maximize the solar gains in the office s part different values of the thickness of external EPS layer (λ=0,035 W/mK) is been used all around the windows. To reduce the artificial lighting each desk is placed under the window. U-Wert 0.08 W/m²K
- Passive-House windows U-Wert 0.79 W/m²K
- Analisys of thermal bridge near the windows and in others architectural elements
- Bloower Door Test: n_{50}=0.60

Thermal bridge:

Façade: Technical solution for the windows.

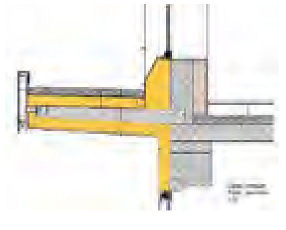


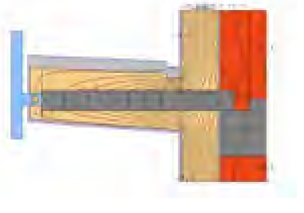
Isothermal curves.

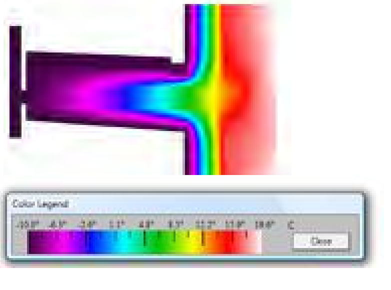


ψ_{ext}= 0,10 W/mK

Temperatures







2) Systems

Ventilation system: Menerga (capacity 10000 m³/h)

Heat Recovery Ventilation (HRV) nominal efficiency of 90 %

Heating energy system: heat air supplemented with reheat coils in each office

Cooling system:
- air dehumidification primary fan premises
- compression cooling machine (12 kW) with a direct evaporator (47 kW)

PV: Polycrystalline silicon (26.73 kWp)
PV orientation South-West/South-east, and PV inclination 90°

CONTEXT AND HISTORY OF THE BUILDING

1950s **Building for the Postal Service offices**.
The original envelope consisted of three storeys building, with a structure of bearing walls and reinforced concrete.

2004 **Dismissed building.**
Buoght by Department of Planning and Environment of the local government (Provincia Autonoma di Bolzano/Autonome Provinz Bozen).

2004-06 **Refurbishment of the building**
The building was enlarged to five storeys and the facade was modified with the aim to having both good illumination and shading, even thought the architectural concept was not modified: a very simple shape broken by the diagonally windows reveals. On the underground floor there are the archives, the server room, and the heating and cooling system. On the ground floor there are three offices, two meeting rooms and the big 285,71 m2 exhibition hall. On the other four storeys there are situated offices for two or three people and two lounge halls. The entry of the building is situated on the ground floor at the north long side on the street.

- Windows: The particular reveals of the windows have different inclinations to optimize the access of the sun in winter and prevent from it in summer. It is important to underline that the access of the sun on the southern side is a good heat gain during the winter period but a problem during the summer, because there is no shading system.
- Isolation: a continuous layer of a 35cm EPS with a λ=0,035 W/mK in the main part of the facade that contributes with the massive structure to have a very low U= 0,08 W/m2K with a geometrically regular wall with no different materials.
- Minimization of the thermal bridges. Used tool: THERM.
- Green roof.
- Central heating system of a gas-condensing furnace (60 kW power).
- Central ventilation system and Heating Recovery Ventilation (nominal efficiency of 90 %).
- Cooling air conditioning system, chilled water is produced by a 85 kW battery of gas-driven absorption chillers.
- monitoring system to assess the energy performance of the building in order to gain the necessary data for an energy optimization.

Construction phase

- description of the context
- feedback from stakeholders
- strengths and weaknesses
- tools, sofwares, various techniques
- Features.

Handover of the works and practical completion

- description of the context
- feedback from stakeholders
- strengths and weaknesses
- tools, sofwares, various techniques
- Features

2006 **Use of the building**

- description of the context
- feedback from stakeholders
- strengths and weaknesses
- tools, sofwares, various techniques
- features

Operational success story

Kererhof

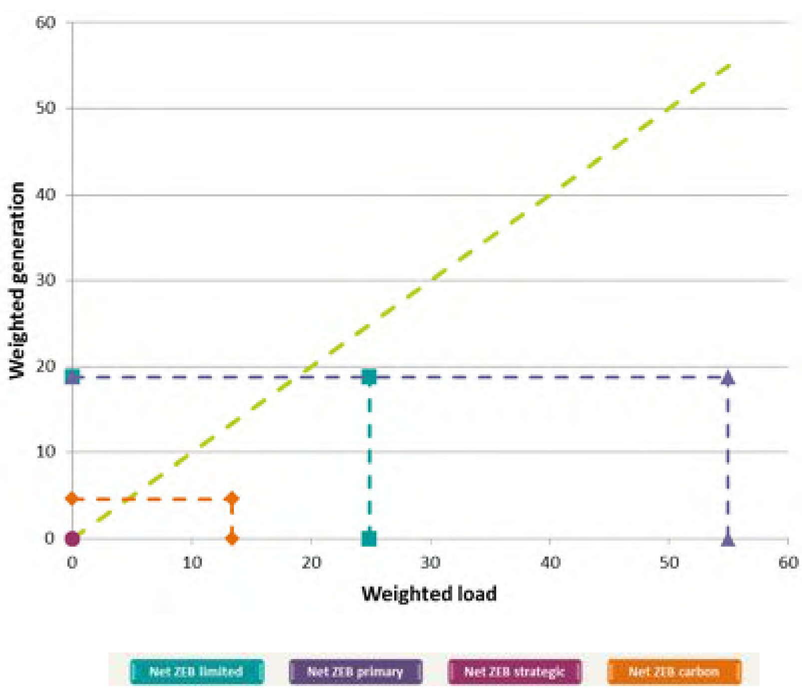
Year of construction (2012), Bolzano (IT)

GENERAL INFORMATIONS

Owner:	Province of Bolzano
Architect:	Michael Tribus
Design office:	Michael Tribus
Use:	Residential building
Heated surface:	472,51 m^2
Gross volume:	1796,89 m^3
Built in:	2012
Total cost	2.120 €

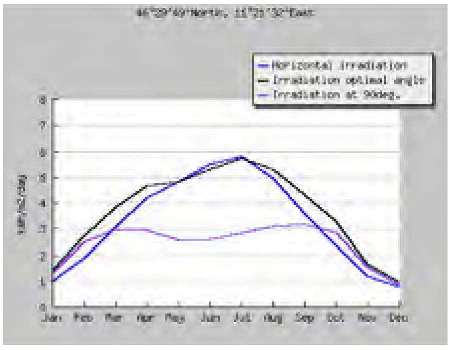
ENERGY PERFORMANCE

Primary energy demand:	68 kWh/m²a
Type of certification:	*CasaClima certification (mandatory certification for Heating Energy Demand)* 8 kWh/m²y standard 'Casa Clima Gold'.
Total CO2 Emissions:	17,1 kg CO2/m²a
Total saving :	17,2 kWh/m²a (due to the PV system)
Total CO2 saving :	3,7 kg CO2/m²a



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE:



Address:	Renon street n.4, Bolzano, South Tyrol, North Italy.
GPS:	Latitude = 46.503034 Longitude = 11.277047
Altitude:	237 m
Yearly solar radiation: (graphic)	3270 Wh/m²*day (Average sum of horizontal global irradiation per square meter received) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)
HDD20 (http://www.degreedays.net/):	HDD_{20}= 2501 Bolzano, IT (11.33E,46.46N)
CDD26 (http://www.degreedays.net/):	CDD_{26}= 34 Bolzano, IT (11.33E,46.46N)
HDD20, Italian Classification: (italian law: n. 412 26/august/1993)	HDD20= 2791 Bolzano, IT (11.33E,46.46N)

SPECIFICATIONS OF THE BUILDING

1) Built

CONCEPT

The building achieves the Passive House energy requirements and it is certified 'CasaClima gold' . The energy demand and air tightness are two important characteristics controlled during all stages, from the early design to the construction phase, with on-site testing (e.g. the blower door test). Moreover, in order to achieve an internal comfort, a ventilation system with the heat recovery efficiency of 90% has been planned.

The structure consists of two buildings connected by a common entrance. The two V-shaped residential buildings form a closed courtyard where the farm, a private parking and the boiler room are located.

The two different dwellings are designed for couples and families. In the upper floor there is also an apartment, which can be rented out.

The building envelope

Compactness : S/V=

U-value of the opaque surface

- Walls: 0.142 W/m²K
  0.15 W/m²K
- Roof: 0.109 W/m²K
- Basement: 0.13 W/m²K

Windows

- G-value 0.62-0.58
- Ug 0.64-0.69 W/(m²K)
- Uf 1.09-1.31 W/(m²K)

Blower Door 0.40 [h-1] air tightness demonstrated

2) Systems

Renewable energy production

Photovoltaic systems
- 96 solar cells, Pnom 236 W

Solar plant
- SST large collector 12,14m²

Source of heat production

Heat pumps
- LZW270 Stebel Eltron
- η 85.1%

CONTEXT AND HISTORY OF THE BUILDING

2010.10

Phase of the project assignment.

In October 2010 the building process of the Kererhof private house has started.

The energy requirement desired by the owner was the value fixed by law - CasaClima B, with the heating demand for winter season lower than 50 kWh/m²year.
In the other hand the architect wanted to built a Passive house since the very beginning.

2010.11 – 2011.12

Preliminary project.

The most important work done by the architect was to inform the owner about the significant difference between two solutions (CasaClimaB and Passive House standards), in particular for the quality of the internal comfort, the reduced operating costs and a higher initial investment.

It was decided to benefit from a local law that allowed to increase the volume of 10% if the new building would achieve the CasaClima A standard (heating demand lower than 30kWh/m² year).

The building volume increased from 1250m³ to 1375m³.

2011.01 – 2011.02

Definitive project.

During this phase the project achieved the CasaClima Gold requirement (heating demand lower than 10 kWh/m² year).

Other technical solutions:
- thermal bridge free construction
- high energy efficiency of the building
- low thermal transmittance for opaque and transparent elements
- wood pellets boiler.

2011.03 – 2011.04

Detailed project

Finally the building achieved the Passive House energy requirement with:
- thermal bridge free construction
- high energy efficiency of the building
- low thermal transmittance for opaque and transparent elements
- geothermal plants
- heat pump of 10kW for heating and cooling.

Primary School Laion / Novale

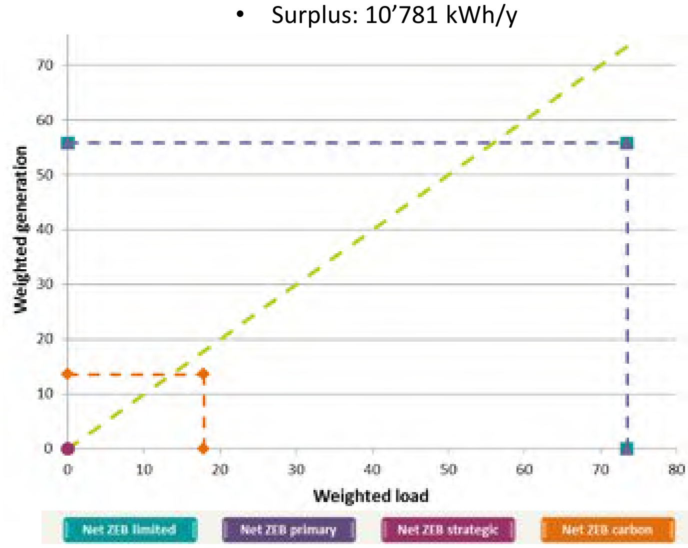
New building 2006, Laion (IT)

GENERAL INFORMATIONS

Owner:	Municipality of Laion
Architect:	Arch. Johann Vonmetz, (Dir. Lav.) Arch. Stefan Trojer
Engineer:	Ing. Paolo Rosa (statica) Malleier Walter (impianti tecnologici) Brugger Manfred (imp. Elettrici) Günther Gantioler (casa passiva)
Design office:	arch.tv, Arch, Johann Vonmetz, Arch. Thomas Ebner Www.archtv.net
Use:	Primary school for 40 students divided in: · 4 classrooms · a workroom · a multipurpose room · a teachers room
Heated surface:	Usable area of 625 m2
Gross volume:	3115 m3 (from PHPP calculation)
Built in:	2004 - 2006
Cost:	Total budget 1.207.000 € (costi di costruzione senza onorari e IVA) , 1.930 €/m²
Method of financing:	Financial support by Provincia Autonoma di Bolzano e , Municipality of Laion

ENERGY PERFORMANCE

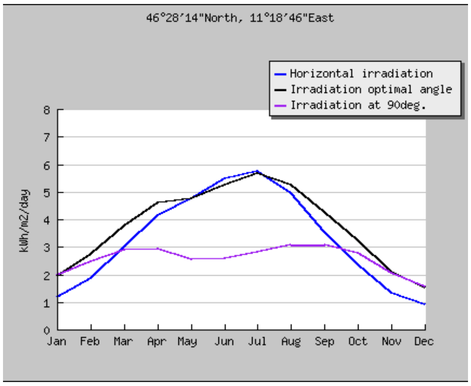
Primary energy demand:	89 kWh/m2*y
Type of certification:	CasaClima Gold + (heating demand <10kWh/m²*year)
Saving of CO2:	88,90 kWh/(m²*y)
Total energy balance	Energy balance is positive (no solar thermal collectors considered and PV production doesn´t cover the energy demand from November to February): • Demand: 5’690 kWh/y • Production: 16’471 kWh/y • Surplus: 10’781 kWh/y



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings“. Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE:

Address:	Grundschule Lajen Ried 39040 Lajen
GPS:	Location: 46°36'32" North, 11°33'50"
Altitude:	1099 m
Yearly solar radiation: (graphic)	3570 Wh/m² *day (Average sum of horizontal global irradiation per square meter received) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)
HDD20 (http://www.degreedays.net/):	HDD20= 3131 Bolzano, IT (11.33E,46.46N)
CDD26 (http://www.degreedays.net/):	CDD26= 106 Bolzano, IT (11.33E,46.46N)
HDD20, Italian Classification: (italian law: n. 412 26/august/1993)	HDD20= 4186 Lajon



SPECIFICATIONS OF THE BUILDING

1) Built

The building envelope

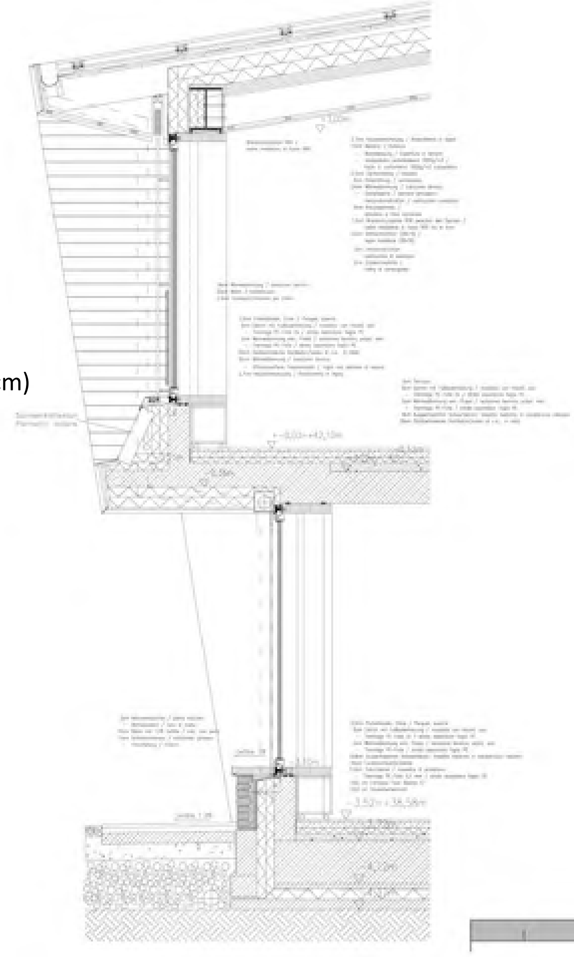
Compact: S/V = 0.53 m-1

U-value of the opaque surface 0.23W/m²K

- Walls: 20cm mineral foam
- Roof: 24cm fibers of wood

U-value of the window surface 0.78W/m²K

- Argon triple coated panes Oak windows frames(Raicotherm8 cm)
- Large glazed surface facing south with venetian blinds (128 m² out of 150m²) :
  - Maximize solar gains
  - Natural daylightning



Overall building envelope energy performance:

- 9kWh/m²a Klimahaus Gold
- 7.6kWh/m²a PHPP
- Blower Door: 0.49 [h-1] air tightness demonstrated

2) Systems

Mechanical ventilation system with heat recovery.

The heating energy system

- Radiant floors
- Electric heat pump: 1.8kW electric, 8.3kW thermal
- Geothermal plant: 3 ground probes of 50m
- Solar thermal collectors: 18m² of flat plate collectors integrated in the 1stfloor facade

The electric energy system

- The PV electricity production allows to cover the electricity demand of the whole building and to feed into the grid a high amount of energy.

Polycrystalline photovoltaic panels

- 140m² of silicon polycrystalline photovoltaic panels
- electric peak power of 17.7kWp

CONTEXT AND HISTORY OF THE BUILDING

1938	The elementary school building was built in Lajen Ried (heating system with boiler wood).
1980	School expansion (heating system with electric radiators).
April 2002	Assignment of the feasibility study to analyze a possibility for a building renovation or expansion of the existing building.
August 2002	Positive result of the feasibility study to build a new school.
April 2003	Assignment of the design project to Arch. Vonmetz. Energy requirements fixed by the owner, the Municipality of Lajon: • ClimaHouse A + • Architectural concept for maximizing the energy saving • Passive House certification was a requirement no necessary to reach such as the ventilation system. The architect team wants to reach a Passive House building. Architectonical choice: - landscape integration and urban architectural language - interior distribution - passive solutions.
July 2004	Construction phase Demolition of the existent school and beginning of construction.
August 2004	The Municipality validated the air ventilation system in the classrooms and air distribution channels were integrated in the cement building structure and between the wood beans in the roof.
September 2005	Municipal election. The new administration confirmed the Passive House standard . Verification of the passive requirements through a PHPP tool calculation. Modification of the heating system with a geothermal pumps and sensors.
June 2006	The municipality wanted to achieve an active house and realized a PV pannels.
July 2006	End of works.
September 2006	Inauguration of the new building.
December 2006	Start-up of the PV panels. Opening of the school to the students and professional training about the use of the school to the teachers and students. The heating system has a remote control and the Municipality can be control the correct work of the technology plans. There is monitoring system too.

Operational success story

Naturaliabau

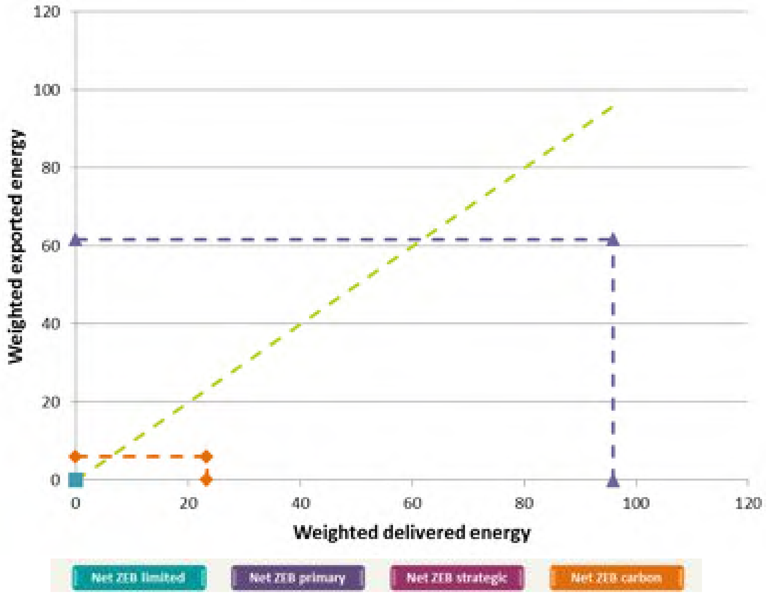
New building, Merano (IT)

GENERAL INFORMATIONS

Owner:	Naturaliabau
Architect:	arch. Dietmar Dejori
Use :	Office and storage area for building materials
Surface :	975 m²
Volume :	3516 m³
Built:	2007 -2008
Construction cost:	1.230.000 €
Design cost (architectonic, electronic, plans, structure and security..):	183.000 €
Total cost:	1450,00€/m²
Cost distribution:	- 2,4 % insulation (ecological materials) - 9,7 % windows - 4,2 % geothermal heating plant - 2 % ventilation system - 12,8 % total building system (heat pump + distribution) - 7,4 % PV panels - 11,8 % design

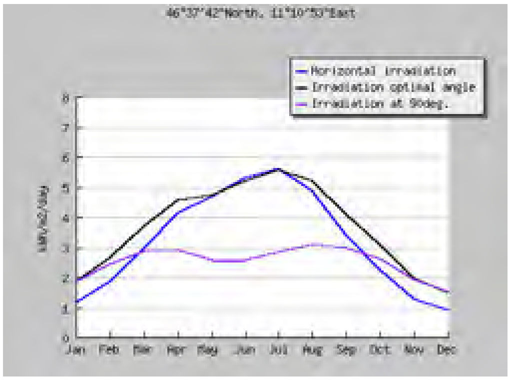
ENERGY PERFORMANCE

Type of certification:	CasaClima certification ´Casa Clima Gold´: • heating demand 7,44 kWh/m²y • total energy efficiency - 4 kg Co2/m²y
Saving of CO2:	-4,00 kWh/(m²y) Positive Energy balance (no solar thermal collectors considered; PV production doesn´t cover the energy demand from November to February): • Demand: 5’690 kWh/y • Production: 16’471 kWh/y • Surplus: 10’781 kWh/y



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings“. Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE:



Address: Via Carlo Abarth 20 39012 Merano, Bolzano.

GPS: Latitude = 46,62835 Longitude = 11,18135

Altitude: 262m

Yearly solar radiation: (graphic) 3220 Wh/m²*day (average sum of horizontal global irradiation per square meter) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)

HDD20 (http://www.degreedays.net/): HDD_{20}= 3131 Bolzano, IT (11.33E,46.46N)

CDD26 (http://www.degreedays.net/): CDD_{26}= 106 Bolzano, IT (11.33E,46.46N)

SPECIFICATIONS OF THE BUILDING

1) Built Wh/m²/day

Orientation: North

The building envelope

Compact: S/V = 0.43 (1/m)

Heating demand: 7,44 kWh/m²a Klimahaus Gold

Office part

U-value of the opaque surface
- Walls: 0.20 W/m²K
- Roof: 0.16 W/m²K (green roof)
- Basement: 0.27 W/m²K

U-value of the window surface: 1.10 W/m²K

Store area

U-value of the opaque surface
- Walls: 0.20 W/m²K
- Roof: 0.17 W/m²K (green roof)
- Basement: 0.30 W/m²K

U-value of the window surface: 1.40 W/m²K

2) Systems

Mechanical ventilation system with heat recovery

Centralized ventilation system
- 90% efficiency

Heating and cooling system

Electric heat pump
- 3,1 kW $_{electric}$
- 15,6 kW $_{thermal}$

(COP$_m$ 3,8 heat pump for hesting- COP$_m$ 4,2 heat pump for cooling)

Geothermal probes
- 5 ground probes, 100m deep

Solar thermal collectors
- 180m² of flat plate collectors collocated on the roof
- 45 m² integrated in the south-west façade

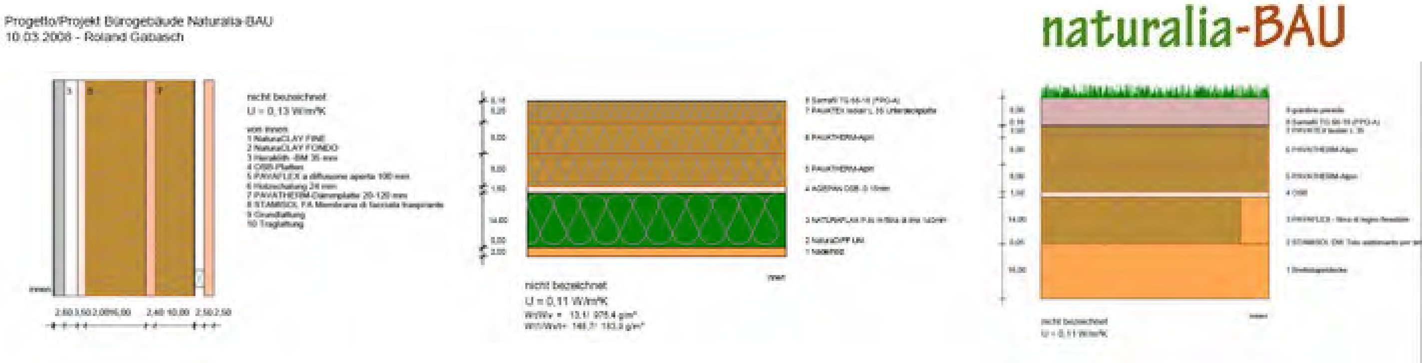
On site electric energy generation

The electricity production from PV allows to cover the electricity demand of the whole building and to sell the surplus to neighbouring buildings.

Photovoltaic panels
- 530 m² polycrystalline photovoltaic panels
- 30 m² amorphous silicon panels

Total electric peak power installed: 44 kWp + 15 kWp collocated on the Naturalias' roof and on the close buildings´ roof.

Cogeneration system
- 100 kWp of electric energy
- 166 kWp of thermal energy



CONTEXT AND HISTORY OF THE BUILDING

March 2007

Planning phase – energy design concept

The first idea of the Naturalia-Bau was to built a very energy efficient office building with a storehouse. From the beginning of the design process on, the energy target was fixed to achieve a nearly Zero Energy Building. The available area for the installation of PV-panels as well as the not advantageous position and the orientation of the building were in contradiction to this objective.

The main orientation of the building with entrance and transparent surfaces was aligned to north and northwest: no passive energy gains could be exploit.

From the beginning was specified, that the building should reach the standard CasaClima Gold, with an energy efficient envelope, by employing natural isolation materials, optimizing daylight and using efficient building systems.

July 2007

Design development, technical design, feasibility study

- The distribution concept is based on a big hall in the entrance and all rooms are connected with this area. The Hall, a double height room, has big vertical windows for maximizing the entry of daylight. The meeting room was located on the third floor, where the windows could be orientated to south façade.
- To reduce the construction time, the building was designed as a prefabricated structure.
- To limit the environmental impact the building was built by using mostly ecological materials (where it was possible).
- To maximize passive energy strategies, walls were finished with a thick clay plaster of 4,5 cm in order to guarantee a thermal mass.
- Building system: heat pump with geothermal probes
- Floor heating and wall heating system
- Ventilation System with a constant flow rate
- PV system on the roof

November 2007

Construction phase

- Construction of the basement and geothermal plant.

April 2008

Construction phase

- Building structure in prefabricated wood construction.
- Many architectural details and material choices were taken during the construction phase to increase flexibility and efficient technical solutions.

➢ *Good coordination and time management is necessary, in order to reduce the construction time and to guarantee the synchronized presence of different trade workers it the same period, side by side.*

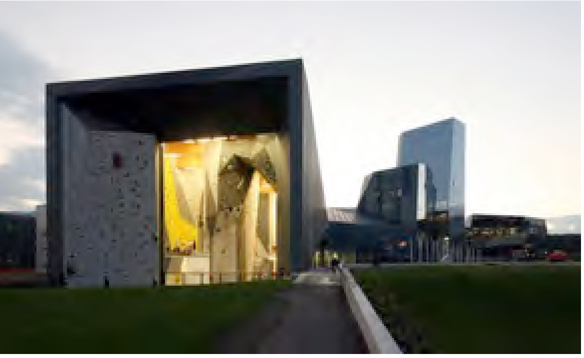
15 July 2008

Handover of the works – commissioning of building

- Even if at the beginning the ventilation system didn´t work, the building had a positive energy balance.
- Start of a monitoring campaign of the building

Salewa

New building 2011, Bolzano (IT)

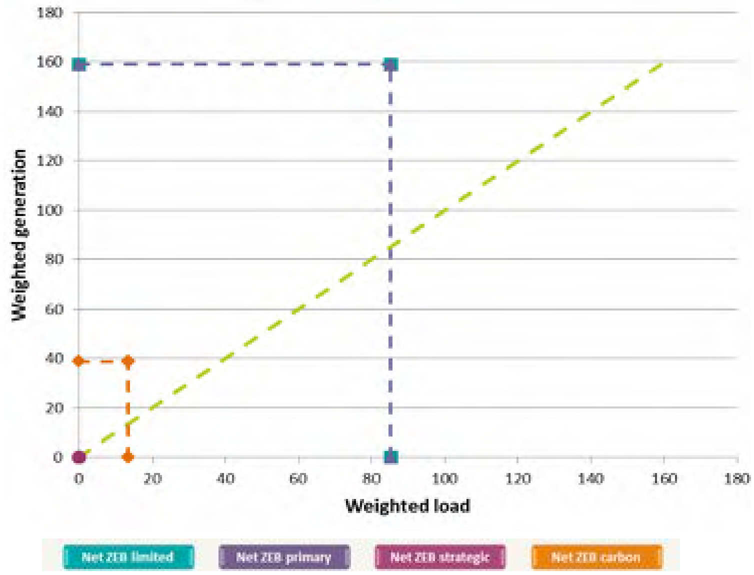


GENERAL INFORMATIONS

Owner:	Salewa SpA, Oberrauch group, Bolzano
Architect:	Cino Zucchi Architetti e Park Associati (Filippo Pagliani,Michele Rossi)
Design office:	Cino Zucchi Architetti e Park Associati (Filippo Pagliani,Michele Rossi)
Engineer:	Georg Felderer di Energytech
Use:	Office building, climbing gym, automatic warehouse.
Heated surface:	4940 m^2
Gross volume:	160.000 m^3
Built in:	July 2009 - October 2011
Cost:	40 millions euro
Method of financing:	-

ENERGY PERFORMANCE

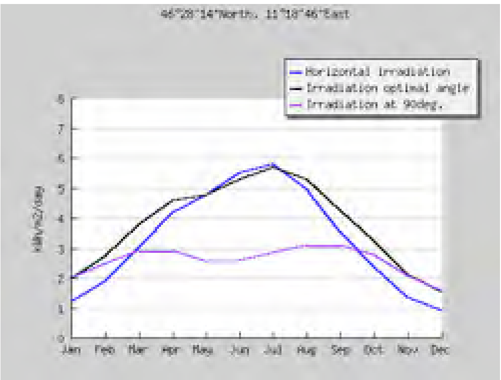
Primary energy demand:	85,20 kWh/m^{2}years for heating, cooling, DHW and electric demand (lighting, auxiliaries, plug loads).
Type of certification:	CasaClima certification: • ´Work&Life´certification • ´Casa Clima B´< 50 kWh/m^{2}y for Heating Energy Demand
Saving of CO2:	335 t/y (by the PV generation)



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3.
Results calculated without energy demand of electricity of automatic warehouse.

DESCRIPTION OF THE CLIMATE:

Address:	Via Waltraud Gebert Deeg, Bolzano, Italy.
GPS:	Latitude = 46.4699, Longitude = 11.3147
Altitude:	262m
Yearly solar radiation: (graphic)	3290 Wh/m²*day (Average sum of horizontal global irradiation per square meter received) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)
HDD20 (http://www.degreedays.net/):	HDD_{20}= 3131 Bolzano, IT (11.33E,46.46N)
CDD26 (http://www.degreedays.net/):	CDD_{26}= 106 Bolzano, IT (11.33E,46.46N)
HDD20, Italian Classification: (italian law: n. 412 26/august/1993)	HDD20= 2791 Bolzano, IT (11.33E,46.46N)



SPECIFICATIONS OF THE BUILDING

1) Built

S/V 0,29 (1/m)

- Double facade: a great transparency on the north, obtained with the use of a continuous transparent facade without interruptions, is in contrast with an obsessive protection of the east, south and west facades which entirely clad with a bright aluminium skin
- Exterior cladding cancels the free winter solar gains but allows to protect the internal environmental comfort from the summer solar radiation (providing shading and ventilation) leading towards the direction of a maximum natural control.

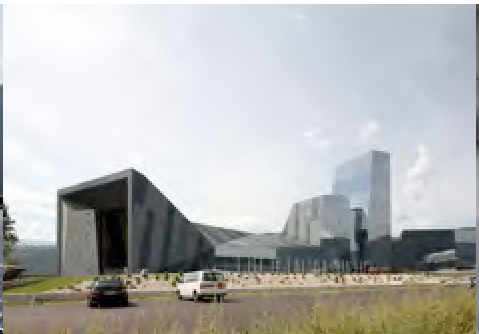
2) Systems

The heating energy system

- District heating
- Cooling tower
- Higher value of thermal mass
- Thermal mass activation (automatic regulation)
- Ventilation system

Electric energy system, PV

- Total installed 450 kWpel
- The PV Panels generate 520‘000kWh/year


3.7. SPANISH SUCCESS STORIES

1. Blood and Tissue Bank of Catalonia (BTBC) New building, Barcelona (4pgs)
2. CIRCE: Research Centre - Centre of Research for Energy Resources and Consumption New building, Zaragoza (3pgs)
3. CIEM Office building Municipal Building Incubator Digital Mile - New building, Zaragoza (3pgs)
4. La Llantà, social housing building New building, Mataró (3pgs)
5. Melendez Valdéz social housing building New building, Mataró (3pgs)

Operational success story

Blood and Tissue Bank of Catalonia (BTBC)

New building, Barcelona (ES)

GENERAL INFORMATIONS

Owner:	Consorci de la Zona Franca
Architect:	Architect Joan Sabaté, Horacio Espeche, Àlex Cazurra Design office SaAS
Use :	Laboratories and offices.
Surface :	10.300 m²(heated-cooled area) 16.600 m²(constructed area).
Volume :	49.800 m³
Built:	2010
Construction cost:	30.000.000 €
Design cost: *(architectonic, electronic, plans, structure and security..)*	
Total cost:	1807,23€/m²
Cost distribution:	Improvement cost: According to a study carried out in the framework of the b_EFIEN programme, the additional investment required to achieve a high performance level, is 1 Million Euros (M€) in a total budget of 29M€, is expected to result in an annual saving of 0.25M €. Accounting for financing costs this corresponds to a rate of return of almost 20%. (*)b_EFIEN programme led by b_TEC and developed by a series of companies grouped together in the Energy Efficiency Cluster of Catalonia – CEEC)

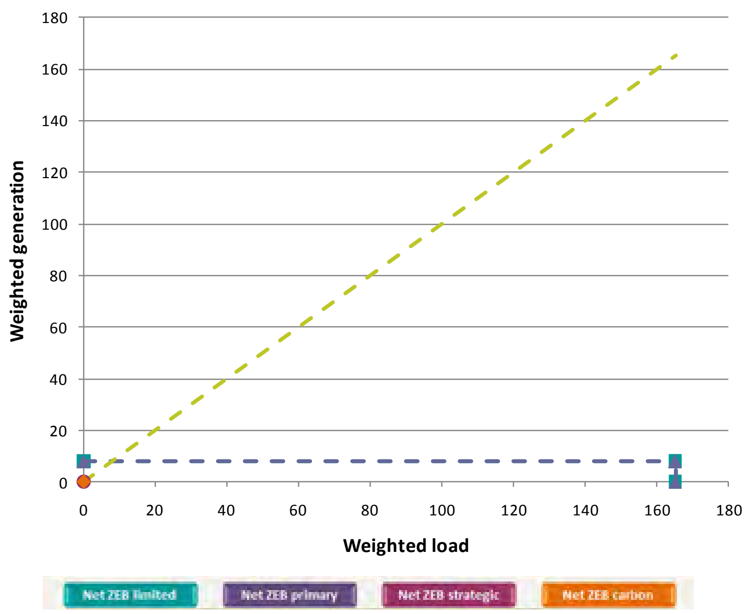
ENERGY PERFORMANCE

Type of certification: Energy Efficiency Certification: A “grade“.

- Primary energy demand (kWh/m².y) 165,55.
- Primary energy reference building: (kWh/m².y) 593,94.

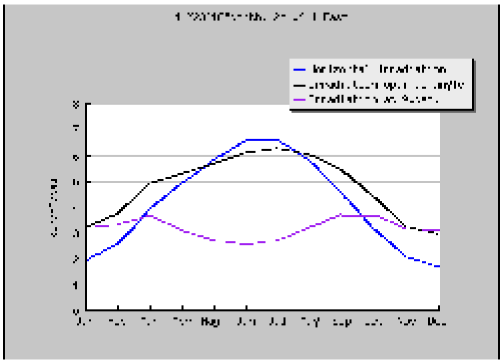
Saving of CO_2: -963 (tonnes per year)

- Total demand: 75.40 kWh/m².y
- Production PV: 3.10 kWh/m².y
- Production ST: 1.76 kWh/m².y



Graphic1: Net ZEB Primary graphic by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings“. Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE



Address: Passeig Taulat, 106-116, Barcelona

GPS: Latitude = 41,400 Longitude = 2,207

Altitude: 5 m

Yearly solar radiation: (graphic) 1740 kWh/m²*day *(average sum of horizontal global irradiation per square meter) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*

HDD_{20} : (http://www.degreedays.net/) HDD_{20}= 1756 Barcelona, ES (2.20E,41.40N)

CDD_{26}: (http://www.degreedays.net/) CDD_{26}= 21 Barcelona, ES (2.20E,41.40N)

SPECIFICATIONS OF THE BUILDING

1) Built Wh/m²/day

Orientation	45º South-West (main façade)
The building envelope	
Compact:	S/V = 0.33 (1/m)
Heating demand	12,10 kWh/m².y
Cooling demand	12,6k kWh/m².y
Office and laboratories areas	
U-value of the opaque surface	
• Walls:	0.41 W/m²K
• Roof:	0.28 W/m²K
• Basement	0.30 W/m²K
U-value of the window surface	1.59 W/m²K; Solar Factor: g: 0.27; Luminic Trasnmitance: T:0,5

2) Systems

Mechanical ventilation system with heat recovery

Centralized ventilation system
- 100% heat recovery /free cooling

Heating and cooling system

Electric components
- 3 chillers (high efficiency with ratio of 4,96) 651 kW.
- 3 adiabatic chillers 723 kW.
- 12 fans 2,1 kW.
- Centrifugal compressors with floating turbines.

Others
- Occupancy and C02 sensors in key areas to regulate the building's variable flow heating, and HVAC system.

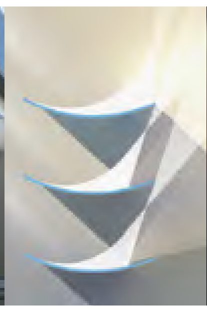
Solar thermal collectors
- The solar thermal system cover a 61% of DHW demand

Daylighting systems
- Selective glazing: allow of 50% daylight penetration and only 27% solar heat gains.
- Interior blinds: mirrored blades re-direct daylight into the building, reducing the electric demand in 30%.
- Automatic regulations of blinds: related to inclination of the sun and cloudiness, to avoid daylight glare and solar gains

On site electric energy generation

The electricity production from PV allows to cover the 5.44% of electricity demand.

Photovoltaic panels
- Total electric installed: 32 MWh/year, collocated on the roof.


CONTEXT AND HISTORY OF THE BUILDING

2002-2004 **Contest and planning phase – energy design concept**

•The City Council convened in 2002 a competition for the creation of a building containing economic activities in 22 @ district. This contest, won by SaAS architects, was the basis of the BST project. Initial conditions not envisaged a special relevance to environmental issues, which were a contribution of equipment SaaS.

•The change program involved a rethinking of the concept of the building, in order to give it maximum flexibility, security and efficiency.

•The building consists of a structural concrete facade, which ensures both the zoning fire as a significant thermal mass on the outside and four inside that house all the core systems installation circular and vertical installations, and which enable full registration and maintenance.

2004-2006 **Design development**, **technical design**, **feasibility study**

•In the Mediterranean region, the primary problem concerning energy demand in office buildings is excess heat.

•In the Blood and Tissue Center, the thick façade (30cm concrete), altogether with high levels of thermal insulation (8cm mineral wool, on the interior of the façade and upon and below the slabs to minimize thermal bridges), act as an exterior shield against overheating. The size of windows has been limited and their solar protection has been assured by design. Less than 50% of the façade is glazed and selective glazing has been used allowing 50% daylight penetration but only 30% solar heat energy penetration.

•To determine the best solar protection elements for the transparent part of the façade, Bartenbach Lichtlabor GmbH from Austria has been contracted in the design phase. Their studies led to install interior blinds with mirrored horizontal laminas to transport the daylight further into the building reducing the demand for electrical lighting by 30%. Automatic regulation of these blinds in relation to the inclination of the sun and cloudiness of the sky avoids any unwanted solar energy penetrating the building.

• Different energy simulation tools have been used, among them the CARRIER Hourly Analysis Program v 4.12b to determine the energy saving potential of different demand reduction and energy distribution systems. The results of these simulations led to install air conditioning equipment that allows free cooling, natural cooling with cooler air from outside the building when available, and also heat exchangers that allow 100% heat recovery during renovation of air in the building. Occupancy and CO2 sensors in key areas regulate the building's variable flow heating, ventilation and air conditioning (HVAC) system.

• The use of the existing ground water aquifer for condensing the cooling system, was studied to cooling the building, Therefore, a forty meters deep well was installed assuring the needed ground water flow rate. Dynamic simulations developed by the consultancy ENVIROS (actually AMPHOS XXI) installed a virtual grid of more than 15.000 nodes to calculate the heat dissipation of the warmed up ground water. Unfortunately, due to the aquifer behaving like a well insulated bubble without any flow direction, and the maximum distance between extraction and absorption well of 100m, the ground water is found to heat up in a couple of years up to a temperature that makes its use as cooling source unfeasible.
Therefore, a conventional cooling system but with innovative technology was installed. It is based on the use of centrifugal compressors with floating turbines, condensed by highly energy efficient adiabatic chillers. Finally, solar thermal and photovoltaic systems integrated in the pergola over the roof of the building exploit the solar radiation incident on the roof to help meet the domestic hot water demand and to generate 32MWh/year of electricity respectively.

•The sum of these strategies has enabled the BTBC building to obtain an "A" grade Energy Efficiency Certification according to the Energy Performance of Buildings Directive (EPBD), with an overall HVAC saving of 72.12% (84% in cooling) compared to a conventional building designed for the same use. In other words, this is a pioneering building in terms of the use of innovative technology and strategy to combat climate change in the Mediterranean region.

CONTEXT AND HISTORY OF THE BUILDING

2006-2010

Construction phase

•To assure the quality of the building's execution, especially the on-site white concrete, and the combination of different materials (interior façade cladding, windows, blinds, etc.), a mock-up was built at the beginning of the execution works.
To ensure control of the execution of the work was to have a permanent team with daily monitoring of all actions.

• Another key issue was that to ensure the durability of the building, facing the harsh marine environment. The materials used are limited to the white concrete in situ (with special protection for the marine environment and waterproofing treatment to facilitate cleaning and maintenance), laminated chestnut wood treated with natural oil (the only European species with oak which has a natural durability, due to the presence of tannins), glass and stainless steel.

• The BTBC is expected to save almost one and a half million kWh of energy per year (1,445,600kWh) equivalent to the annual energy consumption of 429 homes (1).

(1) The average domestic energy consumption in Catalonia (a house with 2.7 occupants) is 3,370 kWh/year with corresponding CO_2 emissions of 1.44 tonnes/year (Source: Advisory Council for Sustainable development - CADS)

• The reduction of CO_2 emissions is expected to be 963 Tonnes/year, equivalent to the emissions of 669 homes. Perhaps, the most surprising result for many is that achievement of this high level of performance is also very cost effective. For these reasons, the BTBC received the 2009 BCM Meeting Point ENDESA prize for the most sustainable real-estate development.

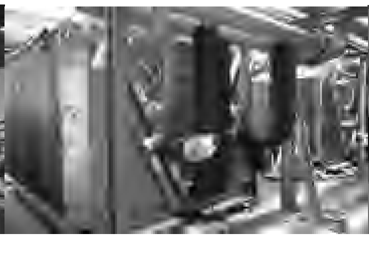
July 2010-2013

Use of the building

•The BTBC was nominated in Living category to “Sustainable Energy Europe Awards 2011”. Also, was a Spanish representative building in the Architect’s Council of Europe (Brussels 2010) and The Green Building Challenge (Helsinki, 2011)

• Financing problems have prevented the installation of monitoring systems to establish energy consumption by type of loads (pumps, air conditioning systems, lighting, blood and tissue preservation, etc.)

• The users of the building, employees of the Blood and Tissue Center of Catalonia, are very satisfied with the thermal and particularly the visual comfort within the building.
The first is mainly due to the well insulated exterior skin and the highly reflective solar blinds, which avoid warm surfaces in summer and cold ones in winter, so that the heat exchange of the user’s skin with the surrounding surfaces is homogeneous into all directions, avoiding thermal discomfort. The visual comfort is high due to the visual contact to the exterior and high natural lighting fraction, even in workplaces close to the center of the building.

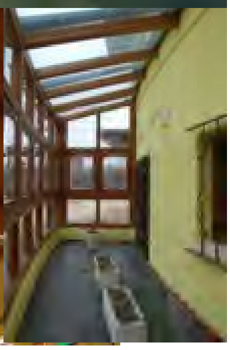



Co-funded by the Intelligent Energy Europe Programme of the European Union

Operational success story

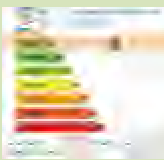
CIRCE: Research Centre

Centro de Investigación de Recursos y Consumos Energéticos
Centre of Research for Energy Resources and Consumption
New building, Zaragoza (ES)



GENERAL INFORMATIONS

Owner:	**Instituto Universitario de Investigación Mixto CIRCE de la Universidad de Zaragoza** CIRCE- Centre of Research for Energy Resources and Consomption)
Architect:	Petra Jebens Zirkel
Use :	Tertiary: Research centre, office and laboratories.
Surface :	1.381 m² (ground floor area) 1.743 m² (useful area). 1.990 m² (total constructed area) 1.327,83 m² (conditioned area).
Volume :	9.550 m³
Built:	2010
Construction cost:	€ 1.358/m²
Design cost: *(architectonic, electronic, plans, structure and security..)*	
Total cost:	€ 2.700.000 € 2.900.000
Cost distribution:	
Financing:	Funded by the EU using FEDER funds, within the framework of the University of Zaragoza's 2006-2012 Infrastructure Plan, and co-financed by the Aragon Regional Government.



ENERGY PERFORMANCE

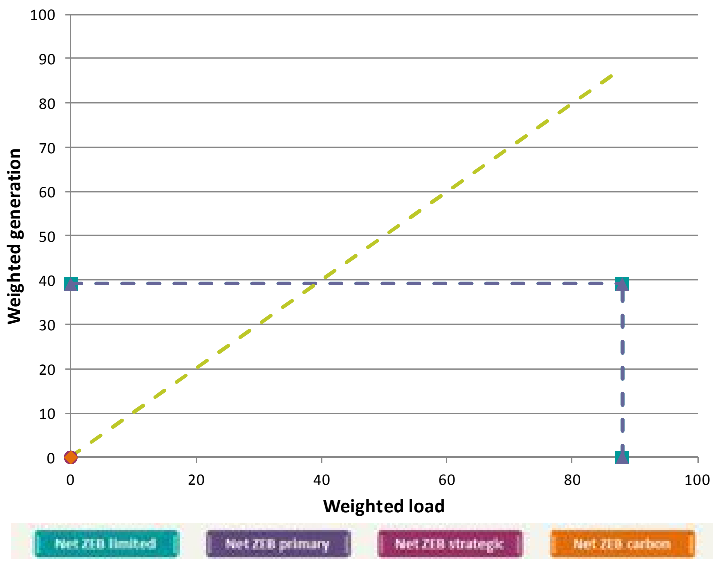
Type of certification: Energy Efficiency Certification**: "A" degree**
Royal Decree 47/2007

- Primary energy demand (kWh/m².y): 88,00 (1) (67 -Electricity and 21 - Natural Gas)
- Primary energy reference building (kWh/m².y): 194,10 (1)
- (1) based on CALENER calculations.

Saving of CO_2: -54,95 (1) ton CO2. year (tonnes per year)
-45 Kg. CO2/m2.year (related reference building)

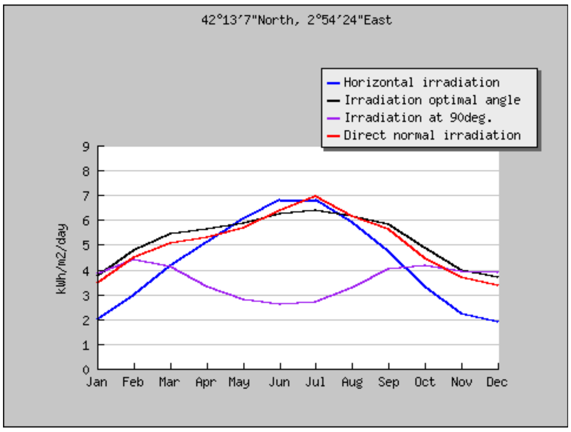
- Production Micro-WT (2): 4,80 kWh/m².y
- Production WT (2): 7,72 kWh/m².y
- Production PV (2): 4,18 kWh/m².y
- Production ST (2): 2,12 kWh/m².y

(2) Based in simulation results (source: IREC: NZEB Overview, Task 40/ECBCS Annex 52)



Graphic1: Net ZEB Primary graphic by Net ZEB Evaluation Tool (Source: IREC: NZEEB Overview, in the framework of Task 40, IEA)
*Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE



Address: C/ Mariano Esquillor Gomez 15, 50018 Zaragoza , Spain.

GPS: Latitude = 41° 40' 21.1620'' N
Longitude = 0° 53' 28.8672'' W

Altitude: 263 m

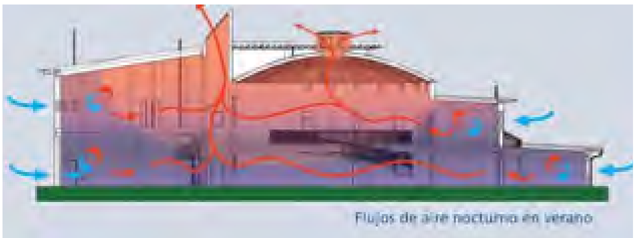
Yearly solar radiation: (graphic) 4,65 kWh/m²*day *(Yearly horizontal irradiation per square meter) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php) (41.670604 N; -0.897939 W)*

HDD_{20} : *(http://www.degreedays.net/)* HDD_{20}= 2440, Zaragoza / Aeropuerto, ES (1.01O,41.66N)

CDD_{26}: *(http://www.degreedays.net/)* CDD_{26}= 137, Zaragoza / Aeropuerto, ES (1.01O,41.66N)

SPECIFICATIONS OF THE BUILDING

Night ventilation scheme (Summer). Source: Petra Jebens Zirkel



1) Built

Orientation: South

The building envelope

Compact: S/V = 0.69 (1/m)

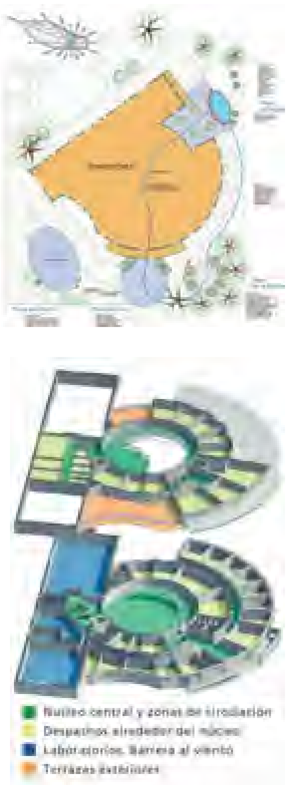
Heating demand: 38,50 kWh/m².y (1)

Cooling demand: 11,08 kWh/m².y (1)

U-value of the opaque surface
- Walls: 0,66 W/m²K
- Roof: 0,25 W/m²K
- Basement: 0,48 W/m²K

U-value of the window surface: 1,10 W/m²K; (Double glazing: 4/16/4, Low-e) Solar Factor: g: 0,40 (Frames: wood certified)

2) Systems



Location and floor plans.
Source: Petra Jebens Zirkel

Ventilation system

Natural ventilation
- Cross and selective ventilation (night ventilation)
- Lantern: passive cooling duct of 13 m height (chimney effect) and solar chimney.

Heating and cooling system

Components
- Ground source electric heat pump (water-water): 160kWh (66 kW heating, 55 kW cooling)
- Condensing boiler (biomass boiler)
- Absorption machine (solar thermal and biomass): feasibility studies.

Others:
- Low temperature distribution system: radiant floor (cooling and heating)

Solar thermal system (ST)
- DHW: 12 m2 vacuum tube collector, complemented with natural gas condenser boiler (in feasibility studies)

Passive and bioclimatic features
- Greenhouse corridor around the core.
- Green roof and landscaping in surroundings.
- Wind protection (Cierzo winds): 36º degrees deviation in axis East-West .

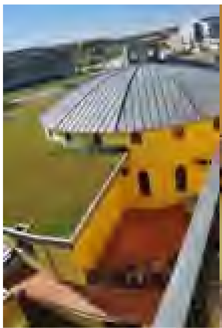
Daylighting
- Skylight over interior corridor: daylight access to interior corridor (east wing) 37m² .
- Solar protection: overhangs (avoid direct solar radiation in summer).

Thermal Inertia
- Thermal mass: attenuate high daily temperature range by means of thermal storage in light clay bricks.

Others
- Thermal insulation, avoiding thermal bridges.

On site electric energy generation

(2) Based in simulation results (source: IREC: NZEB Overview, Task 40/ECBCS Annex 52)
- Production Micro -WT (2): 4,00 kWp (8.370 kWh/y)
- Production WT (2) : 6,00 kWp (13.464 kWh/y)
- Production PV (2): 5,44 kWp (7.302 kWh/y) 55 modules of 6 different PV technologies.




CONTEXT AND HISTORY OF THE BUILDING

2002-2004 **Contest and planning phase – energy design concept**

The basic ideas in the conception of the CIRE building were- 1) Health, 2) Comfort, 3) Savings and 4) Environmental preservation. Also, as a Life cycle zero emissions building .

The CIRCE buildings wants to be a single and unique building, as a model of bio-construction and sustainability, and a monument to state of the art technology and progress in the field of eco-efficiency and energy saving.

2004-2006 **Design development, technical design, feasibility study**

Advanced simulations are realized with EnergyPlus, Design Builder; and SimaPro V7.18 and Ecoinvent V2.0 (database) for LCA (life cycle analysis).

Architectonic, energetic and materials features of the building:

•Zero Emissions Lab. Zero emissions into the atmosphere throughout the building's life cycle: construction, use and maintenance g

•Maximum energy rating

•Integration of renewable energy

•Adapted to the surrounding weather conditions and its operational needs

•Heating and cooling needs substantially below those of conventional or reference buildings

•Clear result of its "creators and users' thoughts, where the building mirrors the content within

•Use of low environmental impact materials: natural stone, cork, certified wood, natural paint, etc.

•Health, comfort, saving, environment: 1990$m^2$of healthy, sustainable surroundings

•An example in Europe of the concepts of bio-efficiency and eco-efficiency

•Centre for demonstration, research and diffusion of energy, for practical and modern learning and teaching.

The passive solutions integrated on the building are: improve the envelope performance (wind protection), thermal mass, sun shading, thermal chimney, natural and night ventilation, green roof, greenhouse and daylighting. Also, the building systems are: GSHP-ground source heat pump.

2006-2009 **Construction phase**

It was constructed using materials of low ecological impact and as a Zero Emissions buildings trough the Life Cycle and maximum level in energy certification (A level). The building itself is a R+D+I laboratory, aiming to lay out the most advanced scientific-technological foundations worldwide in the development of Zero Emissions Constructions. It integrates techniques involving bio-construction, energy saving, water, renewable energy and materials, thus obtaining the greatest possible efficiency with the resources available, without compromising thermal comfort.

+ Low construction cost has resulted, compared to other "nNZEBs" (even to the Spanish average of office buildings)

July of 2010 **Use of the building**

After the first years in functioning, the building's occupation have increased in 30% (from 50 to 80 occupants), relating the initial considerations, so the electricity and cooling demands are increase too.

+ Good performance of the greenhouse space (both in summer and winter), solar protection and daylighting solutions.

+ The users of the building appreciate the "home-like" interior design and materials

- "Green roofs" in dry places require maintenance (as a Zaragoza city)

- Due to not realist calculation and reduction of total budget for GSHP (geothermal system), are resulting in a poor efficiency (summer discomfort, because the little interchange with the ground) and generate feasibility studies to find solutions.

- The generation of renewable energy (Hybrid system: wind turbine- photovoltaic) is currently not available. Also, the integration of the absorption machine to DHW (solar thermal and biomass system) is in feasibility studies.

-Due bureaucratic issues with the university, the installation of PV and micro-wing generation are delayed, so they are not yet in functioning.

+ Awards received: "**Mención de honor"-** Honourable mention in Facilities Category. **"Construcción sostenible, Castilla y León- IV Edición 2011-2012"** (Castilla y León Government, Institute of Building of Castilla y León).

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

Operational success story

CIEM Office building

Centro de Incubación Empresarial Milla Digital

(Municipal Building Incubator Digital Mile)

New building, Zaragoza (ES)

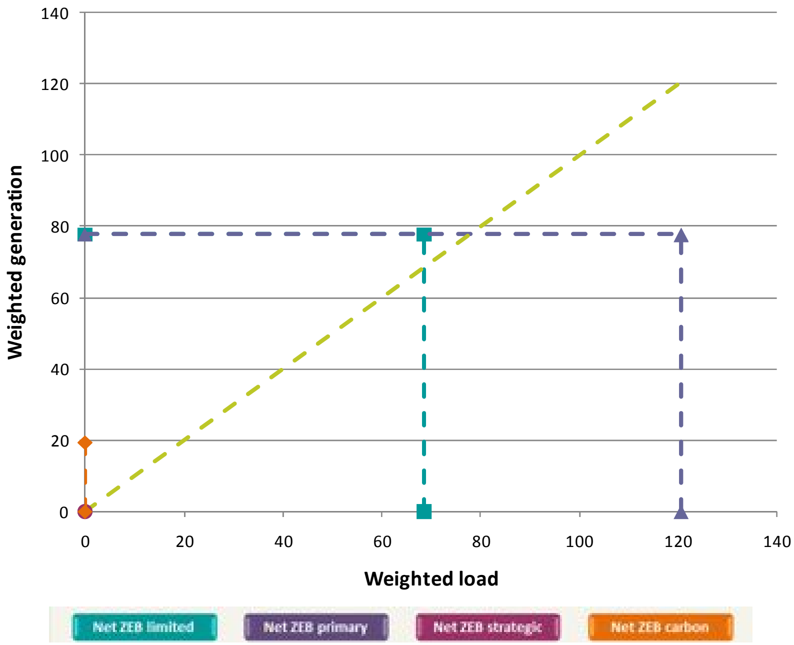
GENERAL INFORMATIONS

Owner:	Zaragoza Municipality
Architects:	Javier Gracia Aurora Sánchez
Engineers:	Manuel Sánchez (Interven Energy) Octavio Cabello (Zeroaplus)
Use :	Office, tertiary.
Surface :	1.392,73 m² (heated area) 2.309 m² ((usable area) 2.727 m² (total built area)
Volume :	11.700 m³
Built:	2011
Construction cost:	1932 €/m²
Design cost: *(architectonic, electronic, plans, structure and security..)*	120.000 €
Total cost:	5.270.651 €
Cost distribution:	HVAC: 12,86% RES: 5,26% Electricity: 6,25% Structure: 9,14% Façades and envelope:18,90% Excavation and founding works : 5,24% Roof: 4,72% Partition walls: 4,72% Insulation and waterproofing: 0,91%. Windows and doors: 6,81% Glazing: 3,56% Floors and ceilings: 5,94% Paint: 1,43% Landscaping: 4,60% Others: 5,47%

ENERGY PERFORMANCE

Primary energy demand:	22,4 (kWh/m².y) Reference building: 85,5 (kWh/m².y) (Royal Decree 47/2007)
Type of certification:	Energy Efficiency Certification in Spain: "A" degree. (Royal Decree 47/2007)
Total CO_2 saving:	(tonnes per year) - 76,1 (Taking in account the reference building)

- Total demand: 24,76 kWh/m².y
- Production PV: 29,89 kWh/m².y
- Wind production: 4,95 kWh/m².y



Graphic 1: Net ZEB Primary graphic by Net ZEB Evaluation Tool *. Beased on simulated data (Source: Eng. Manuel Sanchez Iturbe)

* Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

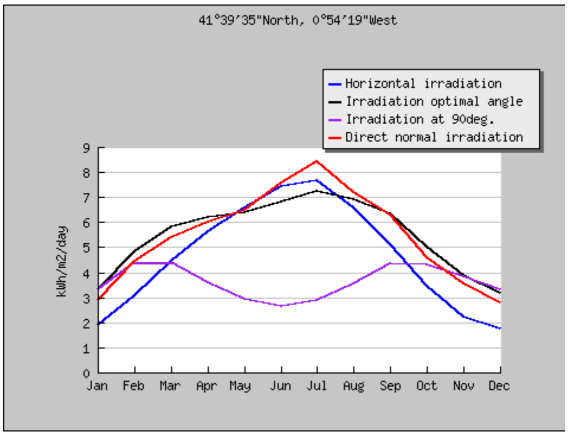
DESCRIPTION OF THE CLIMATE

Address: Av.de la Autonomía nº 7, 50003, Zaragoza

GPS: Latitude = 41° 39' 35.8848'' N Longitude = 0° 54' 19.1160'' W

Altitude: 198 m

Yearly solar radiation: (graphic) *4,68* kWh/m²*day *(average sum of horizontal global irradiation per square meter)* *(http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*



HDD_{20} : *(http://www.degreedays.net/)* HDD_{20}= 2440, Zaragoza / Aeropuerto, ES (1.01O,41.66N)

CDD_{26}: *(http://www.degreedays.net/)* CDD_{26}= 137, Zaragoza / Aeropuerto, ES (1.01O,41.66N)

SPECIFICATIONS OF THE BUILDING

1) Built

Orientation: SouthEst-SouthWest

The building envelope

Compact: S/V = 0,23 (1/m)

Heating demand: 17,6 kWh/m².y

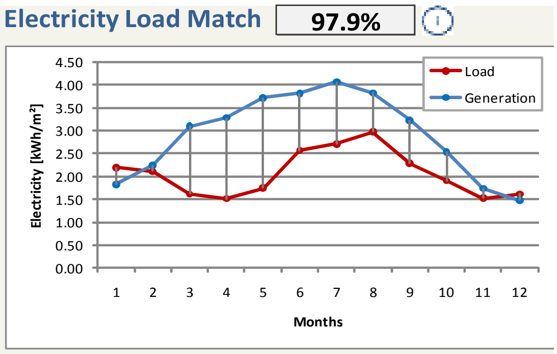
Cooling demand: 23,6 kWh/m².y

Office and laboratories areas

U-value of the opaque surface

- Walls: 0,295 W/m².K
- Roof: 0,37 W/m².K
- Basement: 0,333 W/m².K

U-value of the window surface: Exterior glazing : 5,8 W/m².K; Interior glazing: 2,8 W/m².K;
Curtain wall with air camera- double façade: 1,36 W/m².K
Solar Factor: 35 % (interior glazing);
Visual light Transmittance: 33 % (interior glazing)



Graphic Electricity Load Macht NZEB Tool, based on simulated data (Source: Manuel Sanchez Iturbe)

2) Systems

Ventilation

- Natural and mechanical with heat recovery ventilation.

Heating and cooling system

- GSHP (Ground Source Heat Pump) for HVAC (CoP 5,01 and CoP max 6,2) + biodiesel boiler.
- Air handling unit (100% exterior air)
- Direct cooling by ground water (water to air)
- Earth tubes (18 tubes, 50 m) earth to-air heat exchanger, pre-treatment of air for ground-source heat pump.
- Displacement ventilation system (cool and heat)
- Radiant floor.
- Heat gain by greenhouse effect in the double façade.
- Adiabatic cooling of façades.

Others

- Thermal inertia (reinforced concrete and thermal clay bricks)
- Building Management system.

Daylighting

- Daylight optimization (glazing façade and skylight and atrium).
- Skylight and central courtyard with light diffuser and thermal buffer.
- Sensors (wind, rain, solar radiation) and actuators (solar devices, open and close windows)
- Occupancy sensors on/off artificial light (LED), dimming and glare protection.

On site electric energy generation

Photovoltaic panels
- PV installed on the roof and south façades: 81.409 kwh.year.

Wind turbines
- 3 Vertical-axis wind turbines: 13.503 kwh.year (no connected yet)

Photos by Manuel Sanchez Iturbe

November 2009

Contest and planning phase – energy design concept

A Zero Emission Building goes beyond a bioclimatic building, since it has to be designed so that all the energy necessary for its use must be generated by RES. Starting from this premise, it began designing the building with criteria used in the traditional architecture but with current systems (construction and facilities). The initial approach was a zero emission building with 4 principle lines of action, these set of actions works as a partnership between the bioclimatic architecture and new technologies.

1. Bioclimatic architecture → reduce energy demand
2. Use of RES → balance emissions.
3. Energy efficient → reduce consumption
4. Effective energy management → rationalise consumption

February 2010

Design development, technical design, feasibility study

The group of energy efficiency -GEE of University of Zaragoza University performed the simulations for the use of geothermal energy (DesignBuilder), the double facade, atrium and the thermal inertia of materials (CFD).

In February 2010 the executive design is completed. In it, apart from the energy conditions of a building "zero emissions", two key aspects were considered:

-Limiting the cost of the works

-The maximum execution time must be not exceeding 7 months.

Scheme of functioning in a sunny winter day. Source: Manuel Sanchez Iturbe.

June 2010 – December 2010

Construction phase

In June 2010 began the foundation work and 7 months later the works were completed. Two months were required for the development of all systems and testing operation.

Different tests are performed during the execution of the work, such thermography and Blower Door Test (detection of thermal bridges and airtightness test). Test system were also performed for the displacement air system (air diffusers).

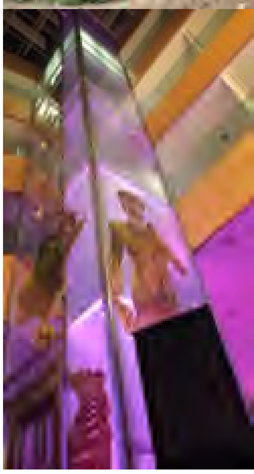
May 2011 until today

Use of the building

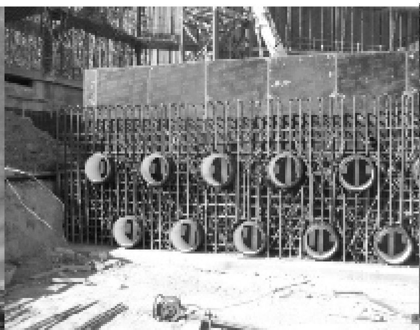
The CIEM building has been open in May 2011 and the INIT Services Company has started his services, as a company's incubator.

Currently, the ratio of occupancy of the building has increased 50 % (80 persons and 45 companies), regarding the initial values.

Several bureaucratic problems have prevented the complete implementation of the RES installation, but the Municipality of Zaragoza is working on to solve it as soon as possible. (Source: FutureEnergy, Enero-febrero 2014, pag.53-56)



Photos by Manuel Sanchez Iturbe



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

Operational success story

La Llantià, social housing building

New building, Mataró (ES)

GENERAL INFORMATIONS

Owner:	PUMSA - Promocions Urbanístiques de Mataró S.A (Ajuntament de Mataró)
Architect:	Lluis Grau i Molist yand Jerónimo Durán Pérez. DURAN and GRAU Arquitectes i Associats S.L
Use :	Social Housing Building and facilities for youth people (23 dwellings)
Surface :	50 m² (net area per unit) 1.412 m² (net total area) 2.520 m² (constructed area).
Volume :	3.841 m³
Built:	2002
Construction cost:	616€/m²
Design cost: *(architectonic, electronic, plans, structure and security..)*	
Total cost:	1,789.942,68 € (included VAT 7%)

Cost distribution:

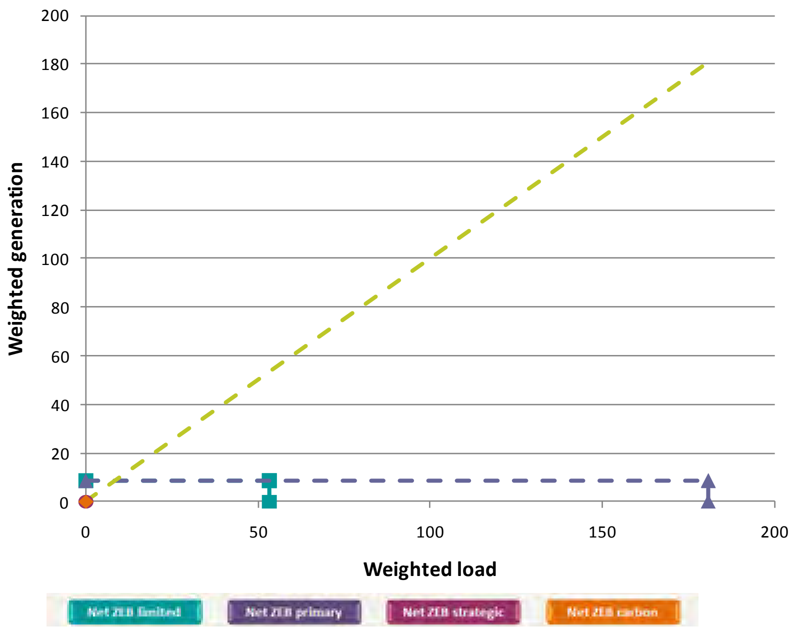
ENERGY PERFORMANCE

Type of certification: Previous to the mandatory Energy Efficiency Certification in Spain.

- Primary energy demand: 172.30 kWh/m².y
- Primary energy reference building: 315 kWh/m².y

Saving of CO_2:

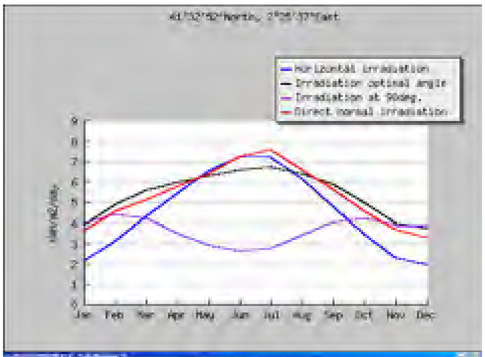
- Production PV: 3,30 kWh/m².y
- Production ST: 32,64 kWh/m².y



Graphic1: Net ZEB Primary graphic by Net ZEB Evaluation Tool*. Based on simulated data (Source: Arch. Lluis Grau i Molist)

*Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE



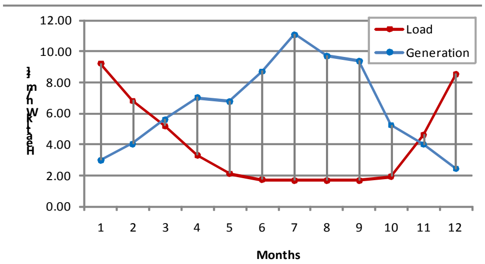
Address:	C/ Teia, 5-9 Mataró, Barcelona, Spain.
GPS:	Latitude = 41° 32' 52.1304'' N; Longitude = 2° 25' 37.4772'' E
Altitude:	124 m
Yearly solar radiation: (graphic)	4,55 kWh/m²*day *(average sum of horizontal global irradiation per square meter) (*41.547814, 2.427077) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)
HDD_{20} : (http://www.degreedays.net/)	HDD_{20}= 1814, Vista Alegre, Mataró, Barcelona, ES (2.45E,41.55N)
CDD_{26}: (http://www.degreedays.net/)	CDD_{26}= 26, Vista Alegre, Mataró, Barcelona, ES (2.45E,41.55N)

DHW and HVAC centralized system scheme.

SPECIFICATIONS OF THE BUILDING

1) Built Wh/m²/day

Orientation	Southeast
The building envelope	
Compact:	S/V = 0,37 (1/m)
Heating demand	25,60 kWh/m².y
Cooling demand	
Office and laboratories areas	
U-value of the opaque surface	
• Walls:	0,54 W/m2K
• Roof:	0,54 W/m²K
• Basement	0,49 W/m²K
U-value of the window surface	3,21 - 3,10 W/m²K;



Thermal Load Match graphic= **83,90%** (NZEB Tool*). Source: Arch. Lluis Grau i Molist

2) Systems

Detail of dwelling unit. Source: Arch. Lluis Grau i Molist

Ventilation

Ventilation system
- Natural ventilation (cross ventilation in all dwelling places)

Heating and cooling and DHW system

Solar thermal collectors panels (unglassed) Energie Solaire SA
- Solar thermal collectors panels on the roof. Inverse function in summer time.
- Centralized controller of DHW, HVAC and solar production.
- Radiant slab for HVAC (cooling and heating) and DWH (storage tank= 6.000 l) with radiant – self-regulation for HVAC.
- Summer (14/04 to 1st/09), Winter (1st/09 to 15/04). Day and night regime for summer.
- Gas boiler (auxiliary system) and accumulation tank = 300 l.
- Monitoring of slab temperature (15 thermocouples), temperature and humidity.
- Automated lecture of total and partial loads of DWH.
- 3 way valvules.

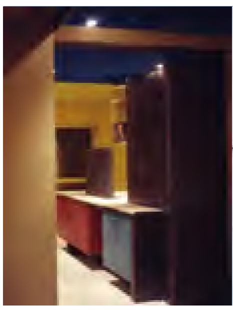
Thermal inertia (walls)
- Mass: 530 kg/m³

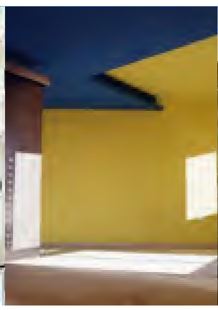
Others systems

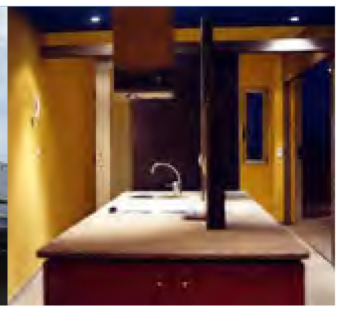
Daylighting optimization.
Communal areas and facilities are regulated by presence sensors and photo-cells to save electric energy.

On site electric energy generation

Solar thermal collectors panels (roof)	178 m², solar fraction= 75 %, (100% during 9 months)= 37.530,90 kWh.y (Based on simulated data. Source: Arch. Lluis Grau i Molist)
Photovoltaic panels (roof)	34 m², electricity generation= 3796 kWh.y. (Monitored data year: 2004, Source: Arch. Lluis Grau i Molist)







CONTEXT AND HISTORY OF THE BUILDING

1999

Contest and planning phase – energy design concept

The program definition was started with the need of housing and facilities to the youth population (derived from the Study: "Estudio de la Juventud de Mataró de 1997"- Study of Youth of Mataró, 1997)

Features:

• low cost building, one vertical communication core and exterior walkways on the back, for 23 homes, allowing into the main spaces the availability of views and daylighting, using radial arrangement and stepped position in section that adapt to the street alignments.

• type of apartment: 50 m2 per unit. It is organized in two longitudinal rows , corresponding to areas of day and night.

• the double orientation ensures minimal sun exposure and a variety of uses (natural light and direct sunlight, diffuse light).

• full integration of the solar system in the overall composition of the building (collector roof: forming a thermal sloping roof, photovoltaic´s pergola: as umbracle or flat shading roof) suitable for any urban setting, using thermal collectors unglazed with a minimum of solar geometry requirements.

• maximizing community services (air conditioning, domestic hot water and laundry) and rationalization without loss of performance or comfort, allowing minimum installed power (at level of the community and private)

1999-2001

Design development, **technical design**, **feasibility study**

Optimizing solar system installed for heat the building, using temperatures closer to the comfort operation temperatures and, its allows to consume less energy because all over the floor is a radiant surface and the existence of the large thermal inertia inside the building
Calculations made by Lesosai v.5.0.

April 2001-December 2002

Construction phase

The construction was carried out with an industrialized building system (for structure, walls and distributions). This allows the breakdowns of all the work on solid concrete panels, that were manufactured on site and then mounted. Also, the concrete performance have been improved (as a sound insulation, etc.) also enabling higher thermal inertia and structural rigidity. The concrete, as a finishing material, as its product systematized in manufacture and assembly, has been more economic, consumed less energy (than traditional systems) and produced less construction waste. This system allows complete isolation of the interior elements with total absence of thermal bridges (including overhanging balconies). Built with industrial concrete ceiling system BSCP (Building Concrete Panel System with SL)

1st of June of 2003

Use of the building

Awards won:

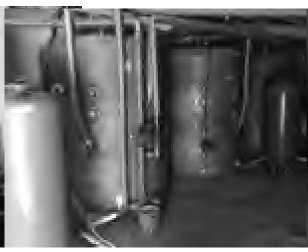
-Building choose for representing Spain at the International Conference of Sustainable Building 2005" and prized with the "**Best contribution per country".** Tokyo, Japan, September of 2005.

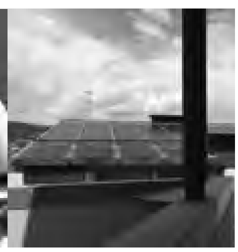
- 1st Prize Puig i Cadafalch of Architecture, 10º Edition, organized by The Mataró Municipality. Mataró, Spain, November of 2004.

- Ex-aequo Prize for New Buildings of Public Use at the 1st Triennial of Architecture of the Mareseme, organized by The COAC (Architects) Demarcation of Barcelona, Spain, November of 2004.

- **Mention of "The best idea for building in competition",** organized by the INCASOL, Government of Catalunya, Spain, December of 2002.







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

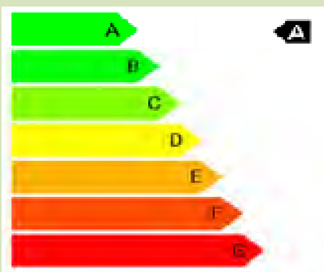
Operational success story

Melendez Valdéz social housing building

New building, Mataró (ES)

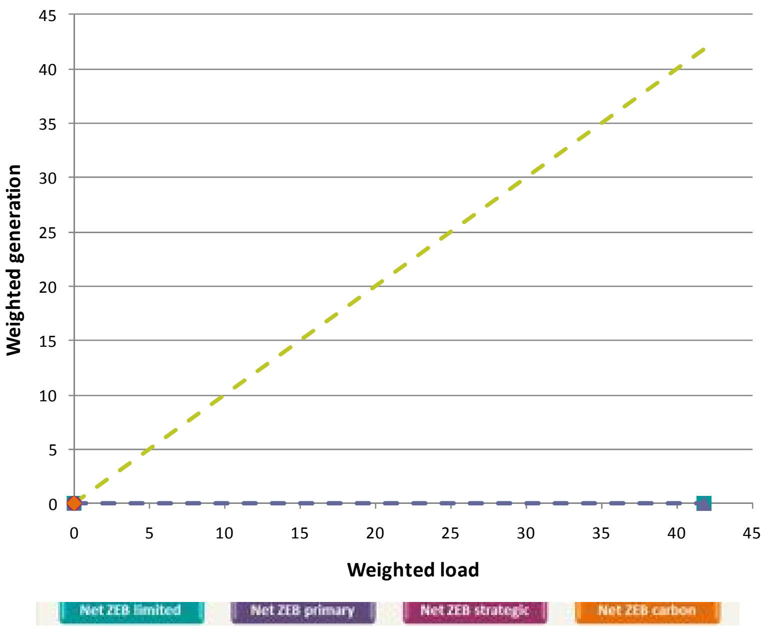
GENERAL INFORMATIONS

Owner:	PUMSA - Promocions Urbanístiques de Mataró S.A (Ajuntament de Mataró)
Architect:	Lluis Grau i Molist
Use :	Social Housing Building (dwellings)
Surface :	1.119 m² (total usable area). 30,80 m² (1 unit) 61,50 m² (6 units)
Volume :	3750 m³
Built:	2010
Construction cost:	1083€/m² 173 143 €/unit
Design cost: *(architectonic, electronic, plans, structure and security..)*	
Total cost:	1.212.000 € (included VAT %)
Cost distribution:	Renewable Energy System: 104.313€



ENERGY PERFORMANCE

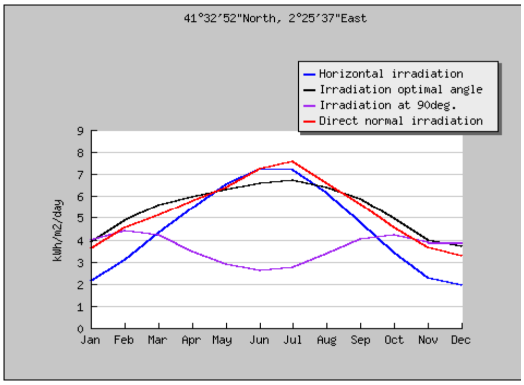
Primary energy demand:	41,80 kWh/m².y Reference building: 94,58 kWh/m².y (Royal Decree 47/2007)
Type of certification:	"A" level Energy Efficiency Certification in Spain. Royal Decree 47/2007
Saving of CO_2:	CO_2 emissions. 1, 715 (CO_2 tonnes per year)



Graphic1: Net ZEB Primary graphic by Net ZEB Evaluation Tool*. Based on simulated data (Source: Arch. Lluis Grau i Molist)

*Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE

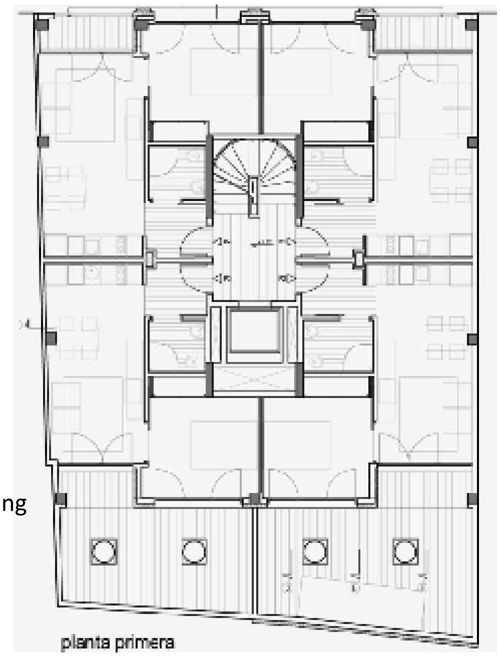


Address:	C/ Meléndez Valdés 15-17, Mataró, Barcelona, Spain.
GPS:	Latitud = 41° 32' 36.3552'' N Longitud = 2° 26' 30.8976'' E
Altitude:	44 m
Yearly solar radiation: (graphic)	4,55 kWh/m^2*day *(average sum of horizontal global irradiation per square meter)* (41.547814, 2.427077) *(http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*
HDD_{20} : *(http://www.degreedays.net/)*	HDD_{20}= 1814, Vista Alegre, Mataró, Barcelona, ES (2.45E,41.55N)
CDD_{26}: *(http://www.degreedays.net/)*	CDD_{26}= 26, Vista Alegre, Mataró, Barcelona, ES (2.45E,41.55N)

SPECIFICATIONS OF THE BUILDING

1) Built

Orientation	Norwest/Southwest
The building envelope	
Compact:	S/V = 0,30 (1/m)
Heating demand and Cooling demand	13,7 kWh/m².y
Office and laboratories areas	
U-value of the opaque surface	
• Walls:	0,37 W/m^{2}K . Ventilated Façade. Recycled glazing panel (Product STOventec)
• Roof:	0,16 W/m^{2}K
• Basement	0,46 W/m^{2}K
U-value of the window surface	2,92 W/m^{2}K



Detail of 1st floor (4 units). Source: Arq. Lluis Grau i Molist

2) Systems

Ventilation

Ventilation system
- Natural ventilation (cross ventilation in all dwelling places)

Heating and cooling and DHW system
- GSHP (Ground Source Heat Pump) for HVAC (500 l) and DHW (450 l), CoP higher than 4,5 kW.
- Heat pump 40W (Fighter 1330-40) with geothermal probes.
- Humidity treatment Unit (Product: Hygro A)
- High efficiency radiant panels (water) on the ceiling and walls (heat and cooling; Product: Energie Solaire SA)

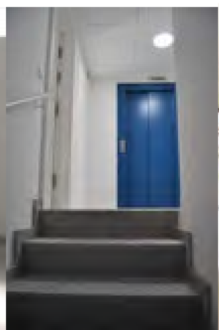
Other systems

Daylight
- Daylighting optimization.
- Lateral and top lit system (skylights on the roof).
- Solar tubes for daylighting in communal spaces with artificial light control systems. (Product: Solatube)
- Communal areas and facilities artificial light are regulated by presence sensors and photo-cells to save electric energy.

Water consumption and re-use of gray water.
- Water consumption per day= 75 l.
- Re-utilization of 80 % of rainwater (collected on the roof) and gray – water. Mechanical filtered and water softening from community water.
- CO_2 and RH % sensors (indoor spaces).
- Radon gas and electromagnetic radiation protection; acoustic insulation (lead laminated on walls).

On site electric energy generation





2007-2008 — **Contest and planning phase – energy design concept**

The floors are resolved with a central "dark core" comprised by communal elements (access, services and lobbies of housing) so that allowed locate the rooms (kitchen and bedrooms) in the perimeter with natural lighting. This arrangement facilitates a rationalization of facilities (centralized) in their development, access to the units and provides monitoring and control of housing consumption.

The design prioritizes the passive systems above the active systems for controlling energy balance, water consumption and surveillance of the health of users.

2008- 2009 — **Design development**, **technical design**, **feasibility study**

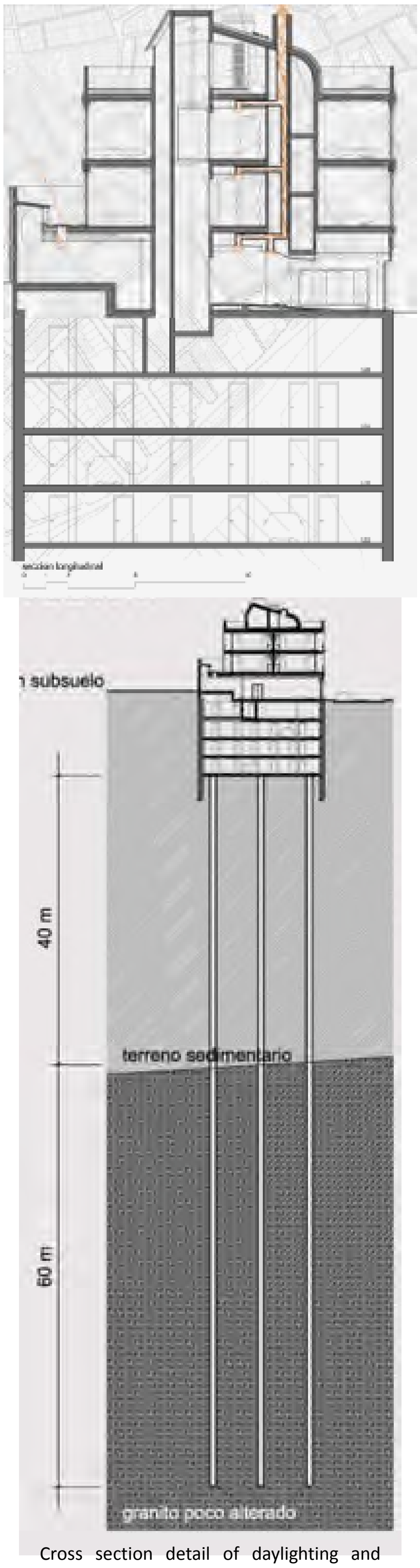
The building is the result of make compatible the architecture with the sustainability understood in its broad sense. The small size program, that consisting in social housing for rent (7 houses), contains commercial space on ground floor, parking and storage rooms in the basement. In a compact urban environment, in a reduced surface plot, and between dividing-walls the design propose a central core access and services, allowing to have the main spaces of dwellings on its perimeter and, therefore, in facade. The units are arranged, four on the first floor and three in the second floor (two units= one-bedroom and one units= two-bedroom).
The space-saving and sustainability (water and energy saving) indicated a community laundry, with other communal facilities on the under-roof floor plan, where are also the clotheslines. This arrangement allows great rationalization of facilities and in homes with two bedrooms, natural cross-ventilation and double orientation of the main space.

August 2009 - May 2010 — **Construction phase**

2011 until today — **Use of the building**

The building is currently operational with the total number of dwellings occupied.

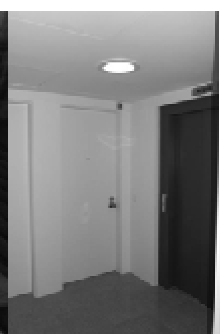
Awards received:
"*Premio de Eficiencia Energética Isover 2011*" (Award of Energy Efficiency Isover 2011), where the jury valued great consistency in the design proposed of the thermal envelope, its high performance insulation and maximum rigor in the execution of the planned solutions.



Cross section detail of daylighting and geothermal systems. Source: Arch. Lluis Grau i Molist







3.8. UK SUCCESS STORIES

1. Oak Meadow Primary School New Passivhaus building (3pgs)

Operational success s

Oak Meadow Primary School
New Passivhaus building

GENERAL INFORMATION

Owner:	Wolverhampton City Council
Architect:	Architype
Use :	Primary School
Surface :	2400 m²
Volume :	9000 m³
Built:	2011
Construction cost:	5.200.000 €
Design cost: *(architectonic, electronic, plans, structure and security..)*	800.000 €
Total cost:	2500,00€/m²

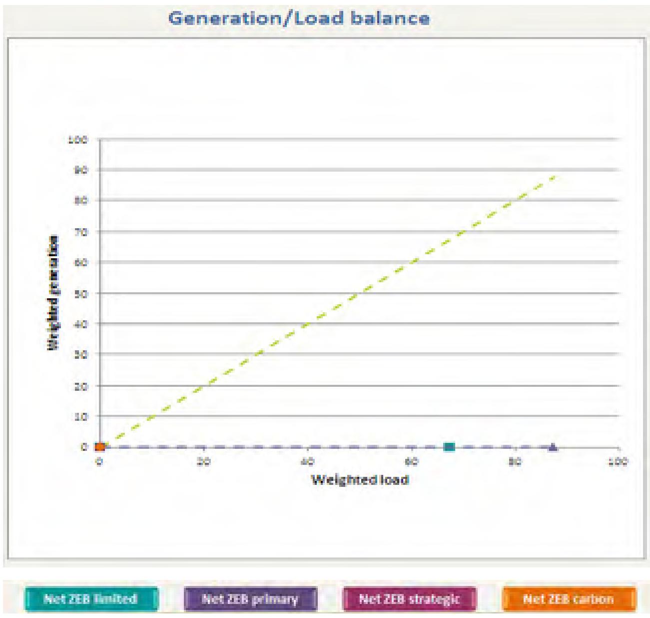
ENERGY PERFORMANCE

Type of certification: Passivhaus Certified:

- heating demand 14 kWh/m²y
- Hot water demand 11 kWh/m²y

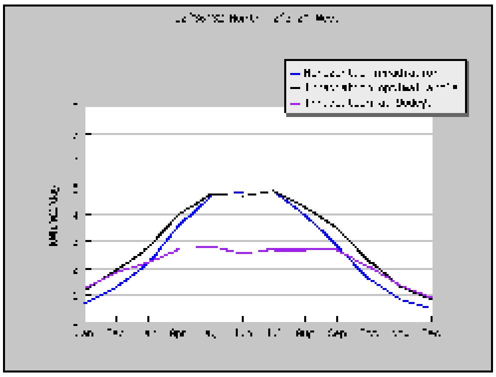
Saving of CO_2: The building has been designed to minimise CO_2 by:

- Very high levels of insulation
- Very low air leakage
- Minimisation of artificial lighting requirements



Graphic1: Monitored Import/Export calculated by Net ZEB Evaluation Tool
Developed within the IEA - SHC Task 40/ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings". Created by: Eurac Research within STA. Draft: V4.3

DESCRIPTION OF THE CLIMATE



Address:	Wolverhampton, UK
GPS:	Latitude = 52,60889 N Longitude = 2,05556 W
Altitude:	150 m
Yearly solar radiation: (graphic)	2650 Wh/m²*day *(average sum of horizontal global irradiation per square meter) (http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php)*
HDD_{20} : (*http:// www.degreedays.net/)*	HDD_{20}= 3656
CDD_{26}: (*http:// www.degreedays.net/*)	CDD_{26}= 0

SPECIFICATIONS OF THE BUILDING

1) Built Wh/m²/day

Orientation	South
The building envelope	
Compact:	S/V = 0.43 (1/m)
Heating demand	14 kWh/m²a
U-value of the opaque surface	
• Walls:	0.13W/m²K
• Roof:	0.10 W/m²K (green roof)
• Floors	0.064 W/m²K
U-value of the window surface	0.90 W/m²K

2)Construction

Ground Floor

- 250mm high density Jablite insulation
- 300mm Power floated slab
- Floor Finish

External Walls

- 12.5mm Fermacell
- 38mm Service void
- 18mm OSB (air tightness Pro Clima)
- 140mm Structural zone
- 200mm Duvet layer
- Both above fully filled with Warmcell blown recycled insulation
- 18mm Bitroc (wind tightness Pro Clima)
- 50mm Cavity
- Douglas Fir / Brick

Internal Walls

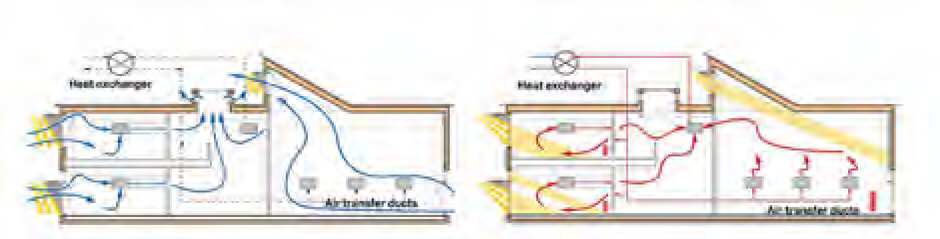
- 140mm stud(partially or fully filled with insulation dependent on acoustic requirements

Roof

- Ceiling
- Ceiling void
- 15mm Fermcell (fire lining)
- 18mm OSB (air tightness Pro Clima)
- 400mm I joist fully filled with Warmcell
- 9.2 Panel vent
- Breather membrane
- Ventilation zone
- 18mm Plywood
- Membrane / Aluminium

CONTEXT AND HISTORY OF THE BUILDING

Planning phase – energy design concept
Overheated and stuffy classrooms are often cited as key contributors to children's drowsiness and lack of focus. But in Oak Meadow Primary School on the outskirts of Wolverhampton, the provision of a heat-recovery ventilation system will hopefully lead to happier and more alert children.



The system will pump in fresh air during winter, while high-level vents allow for night and day ventilation during summer, ensuring improved indoor air quality all year round.

Design development, technical design, feasibility study
Most of its 16 classrooms on both floors are located on the south elevation where solar shading can be provided, while the hall, kitchen and administrative areas, together with the main entrance, are on the north. Space hungry corridors have been avoided and instead, classrooms lead off multi-use areas where children can do group activities.

By rationalising building form and simplifying detailing and systems, Passivhaus certification has been achieved within the standard available budget.

September 2010

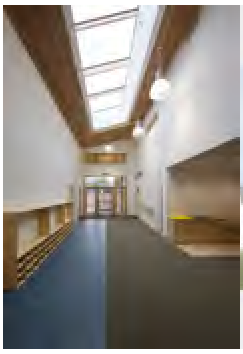
Construction phase
Oak Meadow is a two-storey timber-framed building with a 2,300sq m floor area. It incorporates high levels of insulation, timber-framed triple-glazed windows, and is clad with British-grown Douglas fir boards.

Rigorous attention to air tightness at every junction had to be achieved on site. Oriented strand board with taped joints was used to provide a robust air tightness layer. This layer is protected once the building is in use by the inclusion of a service zone inside the walls. Architype worked hard to eliminate penetrations of this – post, beams and portal frames all stand within this line. Careful attention has been given to all junctions with floors, roofs, windows, doors and internal partitions.

September 2011

Handover of the works – commissioning of building
Completed in September 2011, on time and within budget, this was the UK's first Passivhaus certified primary school.

A full-time research associate is employed to monitor the energy and water consumption, temperature, humidity and CO2 levels of 10 of Architype's recently completed buildings, alongside in-depth user feedback. Even before the research is complete, feedback is proving invaluable and being actively used to improve practice, and improve the design and performance of Architype's future projects.




4. DATA ANALYSIS

Five among the seven participating countries have provided data about some existing highly efficient buildings so far: Austria (2), Greece, France, Italy and Spain. The table below compiles all the data collected from front runner buildings identified for possible study tours.

Table 2: Comparison of some AIDA success story buildings

		Austria PlusEnergieWohnen Weiz	Austria Plus Energy Residential Building Kapfenberg	France Le Clos des	Greece R.C.TECH New building,	Italy Primary School Laion / Novale	Spain Blood and Tissue Bank of Catalonia Barcelona
Climatic data	Yearly solar irradiation (kWh/m^2)	1160	1150	1280	1613	1340	1740
	HDD20	3714	3794	2924	887	3131	1756
	CDD26	42	65	50	5544	106	21
Energy data	Primary energy demand (kWh/m^2.an)	109	85,68	72	149.5	9	146.55
	Production (kWh/m^2.an)	47	42	20	18[1]	26	20
	Balance sheet (kWh/m^2.an)	62	43.68	52	131.5	- 17	126.55
	CO2 Emission (kg/m^2.an)	28	12.9	4.4	47.7	88.9	NC
Technical data	TWalls U-value	NC	NC	0.21	0.36	0.23	0.41
	Windows U value	NC	NC	1.5	1.70	0.78	1.59
	Roof U-value	NC	NC	0.16	NC	0.23	0.28
	Airtightness test (m^{3}h/m^2)	NC	NC	0.55	NC	0.49	NC

It appears that most of the projects do not reach a balance between energy demand and on-site production but do reach nZEB standard. The best performing buildings within the sample are those whose energy demand is the most reduced, while the production of renewable energy on site nearly meets residual demand.

In the case studies, access to solar radiation is not directly related to the amount of solar energy produced, as countries with relatively low solar radiation have exploited solar energies whilst countries with high solar radiation have not at all, or very little.

Design and adaptation of the building to its environment are essential to achieve the performance targets of energy-neutral buildings. Each country has different climatic characteristics and yet despite this has the capacity to design and construct successful

1 The building does not support any RES yet, but a study has been conducted in order to investigate the installation of 7,5kWp of PV on the roof with a production of electricity expected at 18 kWh/m².y

projects. In some cases, contradictory goals must be achieved – for example, in Mediterranean zones summer heat management and the reduction of energy consumption associated with artificial lighting require different, often opposing, strategies. In contrast, in continental or mountain areas, the global challenge is to maximize the use of passive contributions to reduce heating requirements and lighting needs. In the two cases, we observe that technical solutions exist and are implemented to reach the goal.

In general, special efforts have been made on building insulation and glazing performance. Techniques of heat recovery, preheating and cooling of the incoming air are also used. Low temperature heating is preferred as well as smoothly refreshing air when necessary, rather than actively cooling it.

Only the Italian project (the Laion school) went beyond nZEB level, as production systems provide more energy than the building consumes, so that it could be called an “Energy-Plus” or a “Positive energy” building, according to the names in use in different countries. This result could be achieved thanks to a very low primary energy demand of the building. A special effort has been made to maximize solar gain and promote natural lighting. Efficient heating systems were then implemented (geothermal heat pump, solar heating). The insulation has been reinforced, particularly in glazing and careful implementation as shown by the results of air tightness test.

Technically, the project analysis indicates that the building sector is able to meet the expectations of owners with regards to design, construction and implementation of appropriate systems. The major difference between the case studies and "classic" projects lies in the targets set by building owners and their motivations.

Experience suggests that when stakeholders’ (building owner, project management teams) interest in a high performance building converges, exemplary projects may emerge. When this is not the case, as in France, success is more difficult to achieve. It seems that the most successful projects are those whose energy performance targets and / or environmental targets have been fixed in advance. Then, the client and the project management team can focus in a cooperative way on implementing the best technical solutions to reach their goal.

Sometimes, "classic" projects have evolved towards an exemplary project thanks to the intervention of a "facilitator" who alerted the owner at the design phase in order to integrate energy considerations into the consultation process for selecting the project management team. The role of these "facilitators" is important at this time to ensure the widest possible dissemination of the nZEB concept among both builders and contractors.

5. RECOMMENDATIONS AND CONCLUSION

The keys to a successful nZEB project are:

People :
- a convinced and motivated building owner
- an “energy” skilled project management team
- or an nZEB-aware energy “facilitator”

Planning :
- an integration of the nZEB concept as early as possible in the project, at the architect consultation stage if possible

Targets:
- setting clear energy objectives and targets, for consumption in absolute values of needs for the different uses (in kWh per m^2 constructed or renovated per year) and of maximum CO_2 emissions (in kg/m^2.year), and for production in percentage of energy needs to be covered by on-site renewable sources
- integrating performance targets to achieve into all consultation procedures and deciding on responsibilities and penalties in case of failure

Tests
- performing thermal simulations to assess assumptions and validate the solutions chosen
- performing tests for measuring the quality of works before the final approval (airtightness, systems fine-tuning, …)
- ensuring that building operators and users are fully aware and if needed trained about the specificity of an nZEB
- implementing energy consumption and technical systems monitoring facilities to check the proper operation of the building

As the concept of nZEB is still not widespread, the intervention of a facilitator specialized in energy and buildings can be key to the success of a project. The facilitator’s role would be to help achieve the definition of objectives, integrating energy selection criteria into the specifications and to make sure that stakeholders and contractors are appropriately implementing the chosen approaches and technical solutions to achieve the desired targets. They can ensure that the original intent of the project is maintained despite any difficulties that may be encountered. They are also available to ensure that ”easy” conventional or traditional technical solutions are not privileged at the expense of performance. A facilitator will also encourage and smooth exchanges between professionals and contractors.

Achieving efficient buildings is possible today with the technical skills existing in the industry and solutions already available on the market. Reaching goals can be through a mix of adapting the implementation of traditional building techniques (for example, adding extra insulation in cold climated or natural ventilation in warm climates), ensuring exemplary quality of both design and work (perfect airtightness for example) and allowing the use of innovative solutions when relevant.

Whatever the techniques and solutions chosen today, it is clear that high performance and energy efficient buildings require a change in building design, construction and user behavior, with a systematic consideration of energy efficiency and economy, and of highest quality in implementation and operation.

This cultural change highlights the importance of the nZEB knowledge dissemination work, especially towards those involved in the early phases of project design, to ensure the adoption of energy performance criteria that are properly relating to the immediate environment of the building. The target audience for the dissemination work in the early phases are not only building owners, who should integrate nZEB specifications in their calls for tender, but also consultants, who can either choose to propose performance objectives to their clients, or simply integrate sound energy design principles into their work as “standard”.

It is essential today to move from experiments to mass diffusion and uptake of this mode of design and of building construction or renovation. The multiplication of exemplary sites promotes the development of this type of construction whilst increasing professionals’ skills through concrete examples. Building requires considerable capital, it is important that buildings owners be comfortable with the feasibility, sustainability and accessibility of high performance projects. Free access to case studies is important for these reasons. The building / energy education of decision makers will enable them to make relevant decisions based on real-life examples and their own project simulations and tests.

Thus, the specifications and design objectives of energy performance criteria in buildings will be more accurate and less likely to suffer from budget or attention cuts, and will remain a priority throughout the building design and construction. This will support the European building sector in tackling 21st century challenges and a successful transition towards nearly zero-energy buildings.

APPENDIX

Data collection

In order to standardise the technical data and facilitate comparisons between projects, a number of indicators have been selected by the consortium members. Technical indicators to be collected are:

- the net useful area in m^2.
- the expected or measured energy performance expressed in primary demand per square meter per year (kWh_{pe}/m^2.year).
- the expected or measured on-site production of renewable heat or power expressed in kWh/m^2.year.
- the passive energy intakes calculated through project design (orientation, choice of materials, number, size and place of window walls).

To view the gap between the initial conventional design and the final energy performance of the project, a graphic pattern from the Net ZEB Evaluation Tool (http://task40.iea-shc.org/net-zeb) developed in IEA SHC Task 40/ ECBCS Annex 52 - "Towards Net Zero Energy solar Buildings" is used.

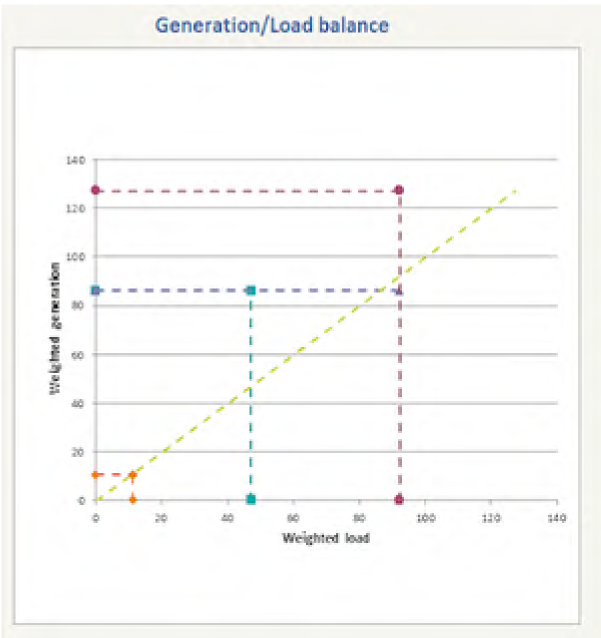


Figure 1: Net ZEB Evaluation Tool

This graph is particularly educational because it allows visualizing the gains from efforts through design, choice of materials in the initial situation and the effort still required from renewable energy for covering needs and getting closer to the diagonal representing the "zero energy state". It illustrates very simply the fact that the more the consumption of the building decrease, the easier it is to cover remaining needs with renewable energy.

With a view to consistency and easy use, climate data were all collected from the following sites:

- PVgis (http://re.jrc.ec.europa.eu/pvgis) for solar radiation data.
- Bizee Degree Days (www.degreedays.net) for Degree Days data (HDD 20 et CDD 26).

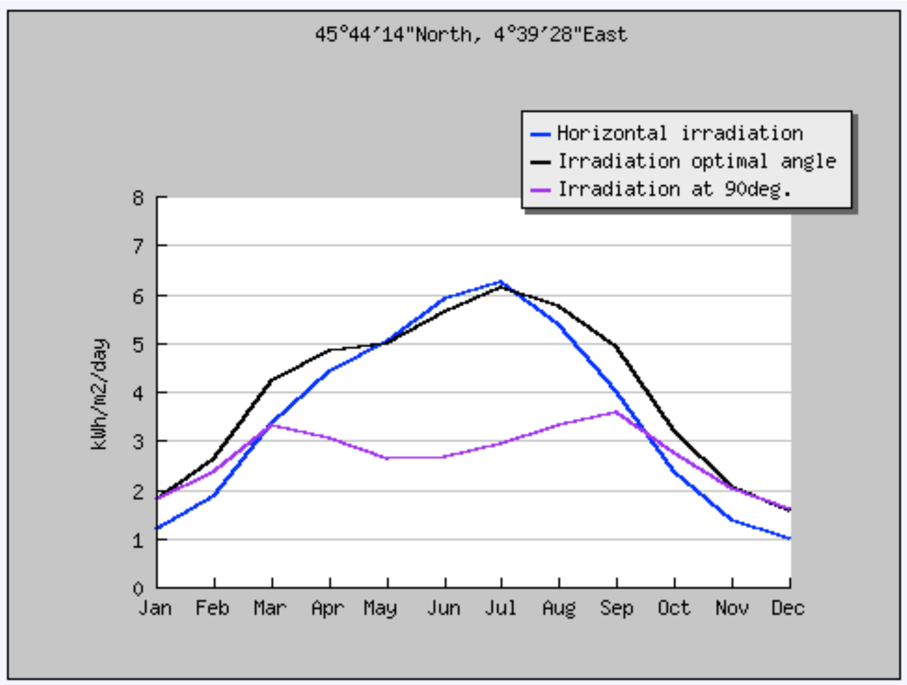


Figure 2: Monthly solar irradiation in Vaugneray - source PVGIS-classic

These climate data illustrate climatic differences between partner countries and allow to better understand the subsequent building design issues related both to the reduction of energy consumption and to the renewable energy potential on site. Indeed, the climatic conditions largely determine the production potential of electricity and passive and active heat with solar energy. They can also help breaking away from a priori since AIDA compares projects in countries as diverse as Greece and the UK-Scotland: these data are important in this context so as to be as objective as possible.

These case studies also contain technical data related to construction techniques. They provide performance data of materials and of technical systems in place required to achieve the targeted performance as defined during the preliminary studies. The data are, among others, the following:

- contribution liabilities related to the orientation and design of the building,
- the type and characteristics of the ventilation system,
- the insulation performance of opaque walls and windows,
- the results of any tests performed
- the production of renewable energy on site (electricity and heat).

Informations about the project implementation, operation and evolution overtime are collected from owners and / or contractors in the way local partners consider the most appropriate, especially for older projects for which data may be less easy to collect. The main difficulty is how to identify and get in touch with the most relevant person(s) to interview, since those that use or manage a building are not necessarily the owners, and successive personnel changes can result in a loss of anecdotal information about the building genesis, history and critical decision paths.