

CASA CLIMA QUALITY SEALS – A KEY TO SUSTAINABLE BUILDINGS

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ABSTRACT: For CasaClima, sustainability in buildings is a holistic concept, which not only evaluates the energy efficiency but goes further by considering a broad spectrum of aspects. At the roots of the CasaClima sustainability seals lays the proven CasaClima energy efficiency certification extended by a set of criteria aimed at reducing the waste of natural resources, thereby limiting the environmental impact and assuring the wellbeing of the people who live or work in the building. The CasaClima Agency, a public and independent body, deals with all aspects related to the quality assurance of the entire construction process from the planning, to on-site audits and finally the issuing of the CasaClima certification.

Keywords: energy efficient buildings, sustainability certification, design and execution quality.

INTRODUCTION

More than a third of energy consumption and CO₂ emissions in Europe are due to construction related sectors. A CasaClima building requires less energy through a high performing building envelope and an optimized use of modern and energy efficient systems for heating, cooling, ventilation, lighting, etc. It covers further its energy needs to a high degree from renewable energy sources. Building according to the CasaClima standards means showing responsibility and respect for the environment in a long-term perspective. Buildings designed according to the CasaClima standards can save up to 90% of the energy compared to traditionally built residences - thereby resulting in both CO₂ reductions and financial savings.

The CasaClima standard and energy efficiency certification were developed in 2002 with the objective to implement the European 'Energy Performance of Buildings Directive' (EPBD 91/2002/EC) in the Autonomous Province of Bolzano – Alto Adige. With more than 13.000 buildings certified, CasaClima represents an absolute reference in Italy in the field of energy efficient and sustainable buildings. First and foremost, the CasaClima quality seals stand for improved comfort, healthy indoor conditions and environmentally sustainable buildings.

CERTIFIED DESIGN AND EXECUTION QUALITY

CasaClima is an energy and environmental standard and a construction quality seal. A CasaClima building can be realized using the most varied types of construction systems, technologies and materials and a maximum freedom of design. The certification process guarantees high planning quality of both building and installed HVAC-appliances.

In addition, it also guarantees a high standard of the construction process which has to reach a documented standard. Besides the controls of the project and calculus, on-site audits are the distinct proof of the compliance with the CasaClima quality requirements. Performed by an independent third party, the audits are carried out throughout the construction phase and upon completion of the building project (including e.g. visual inspections, blower-door tests, etc.).

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Figure 1: on-site audits are fundamental to ensure high execution quality

The inspection in the construction yard is crucial to certify the executive quality of the building: in fact, few and small mistakes are enough to vanish the efforts and the good intentions. These mistakes are frequent, especially in the situation where engineers and workers have not specific knowledge and the necessary skills in the field of low-energy construction and NZEB – nearly zero energy buildings.

CASA CLIMA SUSTAINABILITY CERTIFICATION

Over the years, the CasaClima Agency has adopted new tools aimed at evaluating the overall sustainability of the building works. The objective is to investigate not merely the energy efficiency aspects, but also the impact of the building works on the environment, on the resources and on the human beings. Hitherto, several protocols on sustainability have been developed regarding specific buildings' typologies. An important aspect is that CasaClima a priori doesn't favour specific materials or construction systems. The standard is rather agnostic in that respect and doesn't affect the architecture and design of the building. Instead, it defines specific targets to be met (shown in Table 1), which help to improve the overall environmental building performance.

CasaClima Nature

CasaClima Nature certifies a building not only out of an energetic point of view but also in regards to the impact on the environment, on the health and wellbeing of its residents. CasaClima Nature introduces an objective assessment of the eco-compatibility of the materials and of the systems used in construction as well as the water-footprint of the building. In order to guarantee comfort and health of the indoor environment, detailed requirements for indoor-air-quality, natural illumination, acoustic comfort and protection against radon gas, are required.

Based on the CasaClima Nature protocol, the Agency has developed an entire group of quality seals that take into account the specificities and needs of various areas of application.

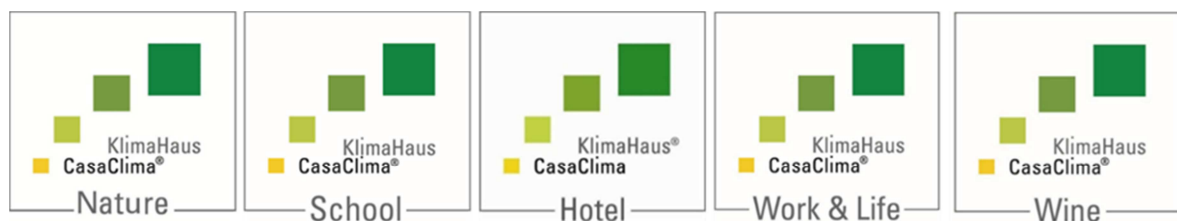


Figure 2: Family of CasaClima sustainability protocols and certifications

Envelope Energy efficiency	Energy demand for heating \leq CasaClima B
Total Energy efficiency	CO2 Emission index \leq CasaClima B
Environmental impact of the construction material	< 300 Points, the following environment indicators are considered: - Primary non-renewable energy (PEI n.r.) - Acidification potential (AP) - Greenhouse potential (GWP100)
Water impact	Water impact Index Wkw \geq 35%
Indoor Air Quality	Presence of controlled mechanical ventilation and/or Low emissions materials and products (VOC and formaldehyde)
Daylighting	Daylighting minimum factor FmLD \geq 2% In classrooms FmLD \geq 3%
Radon gas protection	Radon gas protection measurements Rn-222
Acoustic comfort	Performance of sound insulation by on-site acoustic testing

Table 1: Criteria for the evaluation of the CasaClima Nature certificate

ClimaHotel and CasaClima Welcome

Consumers increasingly give greater importance to sustainable and authentic products and services, even during their vacation. The sustainability seals CasaClima Hotel and Welcome are given to hotels and accommodations, which contribute successfully towards a sustainable development of the company, through the integration of innovative and sustainable technologies and through strategic management measures that enhance the eco-friendliness of their business.

CasaClima Work&Life

This quality seal is a sustainability certification developed for the specific needs of tertiary buildings. The certification verifies and assesses various criteria of sustainability both, in regards to energy efficiency, as well as an intelligent use of the resources. A central theme is the wellbeing of the employees at their workplace: internal comfort, acoustics, natural lighting and air quality, all play a fundamental role. CasaClima Work&Life sustains the efforts that the companies make in regards to energy efficiency, quality of the work-place and of eco-social responsibility.

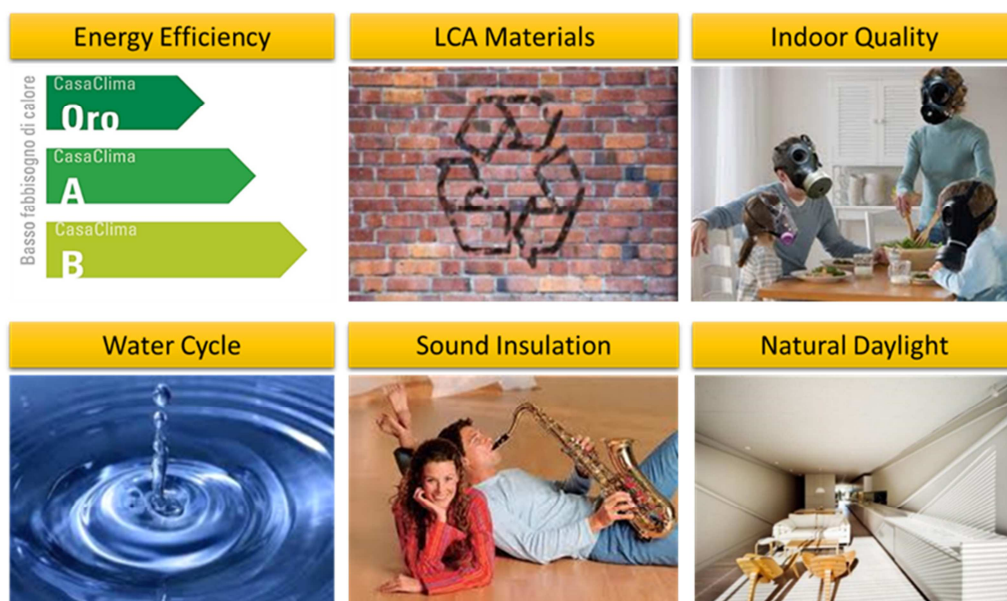


Figure 3: Assessment areas of the CasaClima Nature certification scheme

CasaClima Wine

CasaClima Wine is a quality certification developed to promote sustainable wineries. Besides the requirements for energy efficiency and sustainability of the building, particular attention is paid towards a production process with low environmental impact that limits the use of resources.

The certified wineries use, amongst other aspects, recyclable lightweight packaging and pay attention towards a sustainable waste management in the winery. They also inform and train their team on topics concerning sustainability. These wineries also guarantee high levels of comfort and health in the reception and work areas for their visitors and employees.

CasaClima School

CasaClima School rewards those school buildings and kindergartens, which comply with the idea of sustainability in which ecological as well as sociological and economical aspects are considered. The seal of quality includes numerous criteria besides those regarding energy efficiency: an ecological choice of building materials, comfortable indoor spaces, high standards of hygiene and a careful waste-management plan.

In this way, CasaClima realizes a comfortable and healthy environment for teaching staff, students and children, thereby creating a learning atmosphere. At the same time, the CasaClima schools are places, which sensitize children for sustainability issues by living it in a concrete way.



Figure 4: CasaClima School, a certified kindergarten in Cascina near Pisa, Italy

TOOLS AND INSTRUMENTS

The tools provided by CasaClima to support the planning phase and certification process are: the catalogue of criteria, the evaluation sheets, calculation tools, the technical directives and guidelines. In the catalogue criteria, the evaluation criteria and their purpose are listed, as the quality requirements for each criterion and the documentation to be made available during the different phases of the certification process.

The criteria and related requirements can be both quantitative and qualitative, considering respectively the energy and environmental impacts, the comfort aspects, the indoor environment quality and the economic and the management aspects.

The evaluation sheets and checklist are tools used for the collection of data necessary for the verification of the different criteria, firstly in the planning stage and then tested on the construction yard. For the verification of certain criteria, as for instance the energy efficiency and the water impact, it is used a computing tools available via the CasaClima Agency.

Finally, the guidelines give the pieces of information related to the verification procedures and methods for the all criteria in order to standardize the calculation and controlling methods.

ProCasaClima Software

The central tool in both the design and certification phase is the ProCasaClima Software. It is a Microsoft Excel® based calculation tool, downloadable for free from the CasaClima Agency website, for the evaluation of the energy requirements of heating and sanitary hot water, but also for cooling, dehumidification, lighting and auxiliary energy. It allows the evaluation of the primary energy demand, CO2 emissions and the percentage of renewable energy used. The calculation of the environmental assessment for the sustainability certification (Nature) is also integrated.

The software further allows to perform dynamic simulations that are essential for an effective evaluation of indoor comfort during the heating and cooling season. ProCasaClima is a particularly flexible instrument, which can be used for the certification, for the design, as well as for the evaluation of the different system choices also from the point of view of cost-benefit optimization.

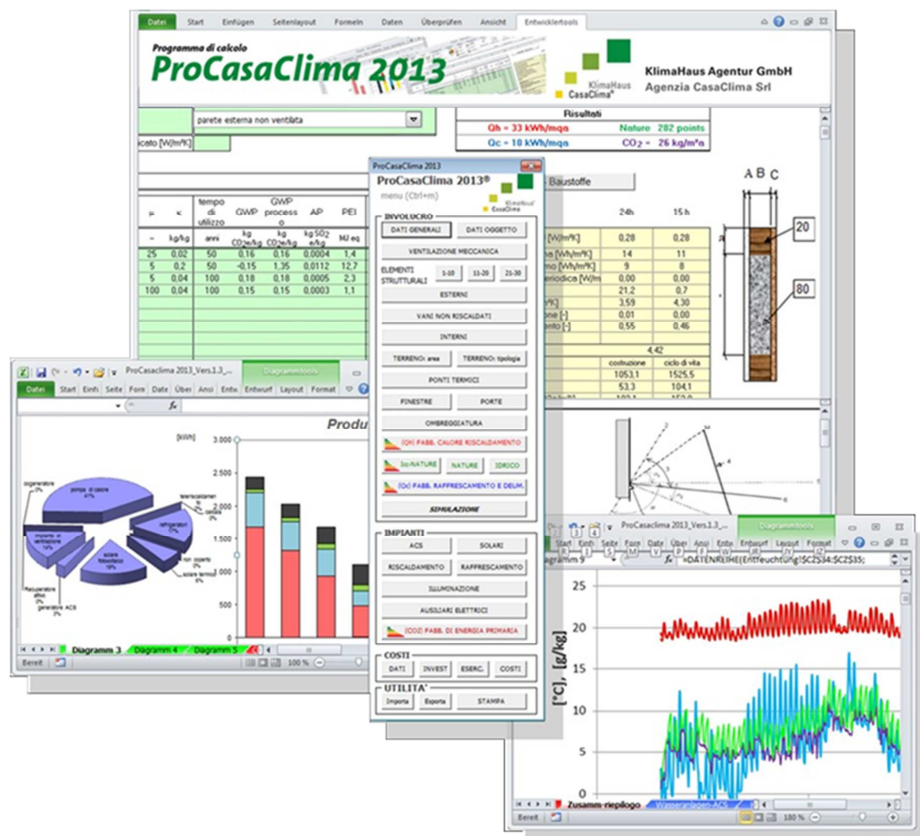


Figure 5: Free ProCasaClima Software Tool, a design and certification tool

ENERGY EFFICIENCY

The reduction in energy use is a fundamental point for any sustainable development: that's why the CasaClima's sustainability certificates have as their basis the CasaClima energy certificate. The efficiency of the building envelope is used as an indicator for assessing the thermal energy demand of the building (kWh/m²a), which is related to the properties of building components that enclose the heated area.

This depends primarily on a good thermal insulation and factors as: the absence of thermal bridges, the reduction of ventilation losses (via the installation of a controlled mechanical ventilation system with a

heat recovery unit), a good air-tightness, the use of passive solar energy through the optimization and contribution of the building transparent surfaces. Therefore, the total efficiency is a parameter for describing the envelope-HVAC system in relation to the energy sources used. The overall efficiency is expressed in terms of total primary energy demand and CO₂ emissions.

	CasaClima Gold	CasaClima A	CasaClima B	CasaClima C
Efficiency Building Envelope	≤ 10 kWh/m ² a	≤ 30 kWh/m ² a	≤ 50 kWh/m ² a	≤ 70 kWh/m ² a
Overall Efficiency	≤ 15 kg CO _{2eqv} /m ² a	≤ 30 CO _{2eqv} /m ² a	≤ 50 CO _{2eqv} /m ² a	≤ 70 CO _{2eqv} /m ² a

Table 2 – CasaClima energy efficiency classification scheme

Each CasaClima sustainability protocol requires for new buildings the achievement of CasaClima B efficiency standards for the envelope, the obligation of the absence of thermal bridges, the verification of summer shading systems and of the summer performance of the opaque exterior elements to guarantee an adequate indoor comfort environment during very warm seasons.

The Protocol CasaClima Wine requires precise performance limits for the efficiency of the envelope, set for the ripening and aging wine areas, in order to ensure optimal environmental conditions for storing wine, by using as less energy as possible.

For the sensible cooling demand is needed a limit equal to 30 kWh/m²a. Moreover, the Protocol CasaClima Wine necessitates an evaluation of the overall productive processes, for establishing the total efficiency.



Figure 6: CasaClima plaque and energy efficiency certificate

Due to the high energy demand of non-residential buildings, specific requisites are required as lighting efficiency obligations and building’s management and control systems. The smart management of artificial light in function of the daylighting and of the hours of the day allows further optimising the energy consumption of lighting. To reduce the lighting disturbance, it is necessary to limit the lighting beam scattered upwards.

Thus, the CasaClima Hotel Protocol also provides precise energy efficiency requirements for installed appliances and for the installations of pools and wellness areas.

ENVIRONMENTAL IMPACT OF CONSTRUCTION MATERIALS

The environmental impacts assessment and LCA – Life Cycle Analysis of the materials, and consequently of the entire building, takes place in CasaClima sustainability protocols via the ProCasaClima software, which allows a quantitative analysis, according to the type and the quantity of the materials utilised. The result of the evaluation is an eco-index of the building (I_{eco}), expressed by a score which is calculated on the basis of three indicators related to the materials used for the construction. The specific values are taken from the materials database of the ProCasaClima software:

- (1) non-renewable primary energy demand (PEI), expressed in MJ,
- (2) acidification potential (AP) expressed in kg of SO₂ equivalent, and
- (3) the potential for greenhouse (GWP100) expressed as kg of CO₂ equivalent, describing the greenhouse effect as well as the global warming.

The score is calculated considering the building envelop of the building:

$$I_{eco} = \frac{1}{3} \cdot \left[\frac{1}{10} \cdot (PEI_{buildingenvelop} - 500) + \frac{1}{2} \cdot (GWP_{buildingenvelop} + 50) + \frac{100}{(0,46 - 0,21)} \cdot (AP_{buildingenvelop} - 0,2) \right] \cdot \frac{Area_{buildingenvelop}}{NGF}$$

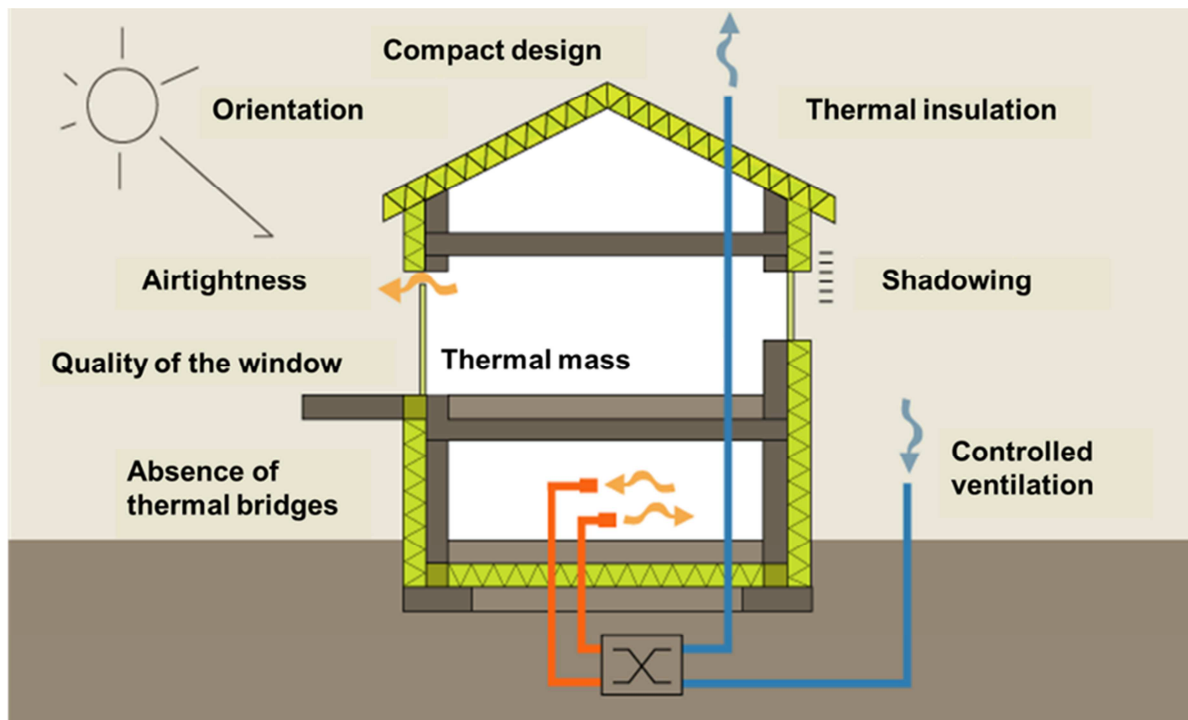


Figure 7: A CasaClima has a high performing building envelope and efficient HVAC-appliances

EFFICIENT USE OF WATER RESOURCES

The growing of the soil sealing due to the increasing urbanisation has negatively affected the natural water cycle by altering the equilibrium amongst the precipitation, the evaporation, the fuelling of aquifer and surface outflows

To help maintain the natural water cycle is, therefore, necessary to build a sustainable management of the outflows, which goes beyond the traditional methods of channelling and favour systems that permit the infiltration of rainwater on site and, where possible, the recovery and reuse of it. Moreover, it is necessary to take concrete actions to reduce water consumption. Each component of the hydraulic system needs to be performed with the purpose of water cycle optimisation, in order to reduce the consumption and maximise the resources reuse.

All these evaluations can be described by the water impact index (WKW), which is a parameter that allows evaluating simultaneously the contribution of the intervention to the maintenance of the natural water cycle and the efficient use of water resource.

It is based on the following indicators:

- water demand due to the use of the building
- the water disposal due to the use of the building
- the amount of rainwater to be disposed into sewer

The indicator evaluates the degree of the water impact improvement of a building, with respect to a reference standard building, in which all existing hydraulic installations are standard, all the built surfaces are waterproofed, and without any recovery systems for the on-site rainwater.

In order to comply with the criterion, the index for the improvement of the water impact must be above 35% for the Wine and Work & Life protocols and 30% for the Nature, School and Hotel certification.

VISUAL COMFORT AND USE OF NATURAL LIGHT

The design and the integration of natural and artificial light influence the energy consumption, the perceived comfort and the implementation and management costs of a construction. Natural light, compared to artificial light, provides greater variability over time of luminous flux and colours that allows achieving higher light levels and better quality in colours reproduction. The light radiated from the sun is free and non-polluting and increases indoor comfort as it creates a visual connection with the outside environment.

The indicator used in CasaClima sustainability protocols for the evaluation of natural light is the daylight factor. In function on the destination use of the building and for the type of the rooms, a minimum average daylight factor is required, between 2% and 3%.

In the pre-certification step it is required an evaluation using computational tools, and then during the certification step the observation of the criterion is verified through on-site measurements.



Figure 8: Acoustic and visual comfort are fundamental for quality of life and wellbeing

ACOUSTIC COMFORT

The acoustic comfort is one of the fundamental parameters in assessing the quality of a building, especially for residential edifices, schools, hotels and offices. CasaClima protocols provide verification of acoustic performance by following the construction process in order to support the planning and the construction of the building.

In the planning phase it is required provisional assessment of the fundamental acoustic parameters that characterise the sound insulation and sound absorption. The final phase of the certification provides an acoustic measurement. During this measurement campaign 20% of the building units need to be verified, with at least one room per floor.

In the case of offices buildings, in addition to the wall elements, the outside floor and the building units, it is required to verify the internal walls of potential noisy environments within the same building unit.

In the case of hotels, it is necessary to verify the internal walls between rooms and apartments, the external facades and all the division walls and elements between rooms and areas such as restaurant and pools.

INDOOR AIR QUALITY

The exposition to toxic and radioactive airborne pollutants is generally higher in indoor environment than in the atmosphere. The problem can be further highlighted in environments not properly ventilated and with high crowding index.

In CasaClima sustainability protocols the "Indoor Air Quality" criterion provides requirements both for the radon gas protection and for the protection of other pollutants that may be present inside the environment, such as VOC and formaldehyde.

In CasaClima Wine Protocol it is also required precise obligations for controlling the CO2 level in the wine fermentation rooms.

The indoor environment quality can be improved by working on the ventilation, e.g. by ensuring a sufficient air change rate and by limiting pollution sources inside the building. In CasaClima sustainability protocols, the achievement of this criterion can be met either by using a controlled mechanical ventilation or by using for the internal surfaces materials and products at low VOC and formaldehyde emissions.

In case none of the two options is possible, then, it is required a measurement of the air quality when the building is completed. Nevertheless, a controlled mechanical ventilation system becomes a mandatory requirement when there is a constant presence of persons within the same environment for many hours per day.



Figure 9: Monitoring helps to maintain efficiency and sustainability during the use of the building

ENVIRONMENTAL MANAGEMENT SYSTEM

For non-residential structures it is crucial the way in which the building is managed, regarding an effective and an efficient reduction of energy consumption and for the environmental impact. The smart management of the facility with an eye on the environmental aspects requires a regular monitoring of the energy consumption (both thermal and electric), the water consumption, the waste production and the chemicals used.

Concerning the waste management within a non-residential building it is important to provide all the facilities, as recycling bins as well as all the information that would enable users to perform correctly the waste and the recycling procedure.

The verification of the correct functioning of the installed systems allows optimising the performance and reducing the risks of malfunctioning. To verify that the control is performed regularly and by skilled workers it is required a maintenance plan in which it is clearly described the object of maintenance, the frequency, the person in charge of and the due date.

In the CasaClima Hotel certification, in addition of the requirements listed above there are specific requisites as the low environment impact management of linen, either in case the structure use an internal or external laundry service. To promote sustainable mobility, the Hotel protocol requires an adequate number of bicycles in function of number of beds; similarly, the CasaClima Work & Life protocol provides showers and dressing rooms for staff, an adequate safe areas and a shelter for the bicycles from the weather.

The attention on environmental issues and on the territory in which the property is located is a fundamental matter even for food products that it is offered to the guests. In this light, the CasaClima Hotel and CasaClima Wine protocol ensure that a portion of the food, it is produced locally (within 100 km form the site). This is a virtuous choice that allows a better understanding, for guests and visitors, of the area where the property is located, by reducing the impacts related to the transport and by providing a positive stimulus to local producers that can benefit economically through the short chain.



Figure 10: A CasaClima Nature certified building won the prestigious Solar Decathlon Europe 2014

CONCLUSIONS

For CasaClima, sustainability in buildings is a holistic concept, which not only evaluates the energy efficiency but goes further by considering a broad spectrum of aspects. At the roots of the CasaClima sustainability seals lays the tested and proven CasaClima standard certification extended by a set of criteria aimed at reducing the waste of natural resources, thereby limiting the environmental impact and assuring the wellbeing of the people who live or work in the building. In this paper the Authors gave an overview of the various certification schemes for residential and non-residential buildings.

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