PassREg

# Successful regulation processes:
# The examples of Brussels and Hannover

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# Content





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# Introduction

PassREg front runners are regions and municipalities which show real success models in place for the implementation of nearly zero energy buildings (nZEB) adopting the comprehensive passive house criteria and strategies. Thanks to these, in few years the front runner regions actually have reached important targets visible as hundreds of passive house buildings recently built. These are very high performance but common buildings of all shapes and types (residential, social housing, office, school, care centers, sport facilities, etc.). This regions show in practice successful results both for real buildings and building market developments both for the supporting strategies, solutions and measures in the political field. These shining examples can offer complete set of solutions to be adopted also partially in each other regions. These solutions and models were deeply described, analyzed and summarized in many documents and web-site of the PassREg project - www.passreg.eu. Sometimes these successes could produce astonishment but they are real and affordable for very different regions.

# Passive house targets in local policy decisions and market

It's **possible to insert now** the passive house requirements in local building codes, public tenders and policy decisions, as it is happening in regions and municipalities in Europe as Hannover (Germany), Brussels Capital Region (Belgium), Tyrol (Austria). But it's also possible to adopting passive house requirements in regulations by **intermediate steps** with intermediate quantitative requirements or initially involving only some building types following a coherent and effective medium and long term strategies to reach complete passive house solutions. Some municipalities in Italy already are doing these, for examples adopting the passive house targets in the local building codes (*Regolamento Edilizio*) as quantitative requirements needed to reach financial supports. For example is the case of Municipality of Muzzano (Biella) and Municipality of Botticino (Brescia).

Passive house strategies and **set of requirements** lead to high performance buildings with high environmental value and the best indoor comfort conditions, due to optimal thermal insulation level of building envelop, external movable solar shading devices, very good indoor air quality thanks to effective mechanical ventilation with heat recovery systems. For this reasons, passive house new buildings and refurbishments can represent very **attractive solutions for the construction market**, which can improve its quality and the level of product. The high quality and the profitable life cycle cost of passive houses can make increase the building market activities and related employment at local and national level.

Passive house solutions are suitable also for the **strategic sector of buildings renovations:** to reach energy savings and environmental targets at local and national level, it's crucial to adopt energy efficiency and



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renewable energy measures in the renovations of existing buildings. Passive house solutions are suitable and proved also in refurbishments projects, as it's demonstrated by many completed renovations. Refurbishment according passive house principles and adopting suitable components can be done also following a step by step approach with intermediate interventions at passive house level, as it's also demonstrated and analysed in the european research project EuroPHIT - www.europhit.eu.

Local climate and sustainable energy policies in general should have a **long term and coherent vision**. Important objectives and main strategic elements should be shared and committed by main persons and parties involved in the administrative and policy processes at local and national level. The successful process could start from a strong political will which can then generate policy measures, successes and consensus. Then the political process should develop in adequate intermediate steps, implemented with constancy. For example we could consider the successful case of **Hannover** where in early 1990es (and also before) the Municipality started the policy process leading to the actual results also in terms of nZEBs and passive houses wide spread and relevant energy savings in building sector. Or also the success experience of **Brussels**, where since 2004 the regional government started a very fast and effective process to implement passive house requirements in building regulations, in mandatory way since 2015 and supported by some policy measures before. We can recognise two different kind of successful process about time table, more constant and continuous in Hannover while faster during the last few years in Brussels, but in both cases the path moved from a strong and coherent political will.

Local policies should develop strategies to arise care about climate protection and sustainable energy actions in all citizens, implementing **effective information campaigns** and communication strategies on the planned solutions. We recognize as crucial those information and communication activities addressing **demand-side** players, building occupants, owners and tenants, who can increase and improve the quality of the demand in the building sector.

Policies measures can be driven and consensus can be increase by arising attention on successes and good experiences of **real exemplary buildings** completed in the regions. This is the approach used in Brussels region with the large programme implementing exemplary buildings and this is the strategy of passive house beacon projects in PassREg.

Sometimes local climate policies express too generic objectives and avoid quantitative requirements also in construction sector. This could not be effective to lead to real results. The Passive House standard represents a high quality and proved design strategy with a complete set of quantitative requirements on building components and performances. This quantitative indexes and related quality assurance procedures can be explicitly required in the local policy measures. This could allow to express **precise commitments and requirements as passive house solutions, avoiding too generic requirements**.



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# Possible steps to reach the goals

In the local policy instruments, passive house requirements can be adopted directly as complete set of targets and limits for all building types, or they can be adopted in **intermediate steps**. A gradual adoption of passive house strategies could be implemented in the following kind of steps and elements:

- passive house requirements initially could be put only for **selected building types** as
  - public and/or private
  - according buildings use: residential, office, school, tertiary, etc.
  - only for buildings of selected new settlements
  - buildings with conditioned floor surfaces greater than certain thresholds
  - new buildings and/or renovations
  - deep and/or partial renovations.
- Passive house quantitative limits and performances could be requested by regulations through **intermediate values**, which will be improved and become more stringent progressively in time: the path towards limits suitable for passive houses could start from fixing values slightly better than the regulations now in force. Then sets of improved more stringent values could be fixed with an established timetable (e.g. every two years). In this way, local regulations could reach passive house limits and targets at the end of a reasonable process in which all actors involved can be follow the steps.
- Urban plans or related tenders for settlements with several buildings (more than one) should require a **mix of passive house buildings and lees energy efficient ones** (e.g. energy class A or according the basic regulation in force)**.** This could help investors, designers and construction companies to approach more gradually the passive house principles. In addition, this could open more opportunities and wider possibilities to choice in the building market.
- Implementation of passive house strategies directly in complete way or through intermediate steps could be **supported by proper policy measures** (incentives, tax deductions, preferential loans, etc.) which can follow in dynamic way the process timetable, varying in function of progresses.

# Policy instruments available to be implemented in Italy

Relevant **instruments are already available and diffuse** to implement local policy plans and regulations at regional, district or municipal levels. Many of these instruments are mandatory and requested by national and regional laws. In addition, their structures and typologies are already well known by policy makers and consultants. These instruments are different and covers strategic planning, regulations and codes for buildings construction, urban planning, guide lines for public tenders and procurements, etc.. Here below we list important available instruments, where the Passive House set of requirements can be well integrated.


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- Sustainable energy action plan (SAEP) and Covenant of Majors commitment (*Piano d'Azione per l'Energia Sostenibile - PAES*)
- Municipal energy plan (*Piano energetico comunale*)
- Regional energy plan (*Piano energetico regionale*)
- National energy plan (*Piano energetico nazionale*)
- Public tenders asking explicitly for new buildings and renovations according the quantitative passive house requirements
- Regional and national guidelines for public tenders asking explicitly for new buildings and renovations according the quantitative passive house requirements
- Municipal building codes (*Regolamento Edilizio*)
- Regional and national guidelines for municipal building codes and exemplary documents / annexes available to be integrated in this instrument at local levels
- Urban plans documents (*Piano Regolatore*, *Piano di Governo del Territorio*, etc.)
- Municipal development plans for settlements (*Piani di Intervento, Piani Attuativi, Documenti di Inquadramento*, etc.)

All these instruments are suitable to be easily integrated with overall passive house requirements, which can be expressed both as **energy performances** (energy need for heating and cooling, total primary energy demand, etc.) and **comfort requirements** both as limits on **building and systems components** (envelope thermal transmittances, glazed surfaces properties, airtightness level, efficiency ratio of heat recovery, etc.). Also the passive house **calculation method** and the **quality assurance procedures** can be easily required in the policy instruments.

In addition to the complete set of quantitative requirements of the passive house strategies, in the policy instrument should be also fixed some general but important requirements with the aim of

- **optimizing the solar gains** in the buildings energy balance to guarantee high indoor comfort conditions and low energy demand (reaching maximum solar gains in heating season and minimum in cooling season),
- **thermal mitigation of local microclimatic conditions**, reducing urban heat island effects and using trees and vegetation in the buildings surroundings to provide summer shading to buildings.
- For this objectives criteria and limits could be indicated about
- distances between buildings,
- main expositions of building and particularly of glazed surfaces of buildings,
- presence of vegetation, plants and trees also as *green infrastructure* in the city.



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# The successful example in Hannover

## Legal framework

The policy process in Hannover showed these following steps, since the year 1995 until now. Since the beginning, the Passive House standard was supported by the Municipalities offering different incentives and in the negations processes to allow constructions on municipal plots.

- Low Energy House (LEH) - with reduction of thermal energy consumption for space heating by 25% as compared to the related norms in force at that time;
- Low Energy House Plus (LEH-plus) - with further reduction of thermal energy consumption for space heating up to 40%;
- Passive House requirements and standard (PH).

These standards are applied for all new municipal buildings (both residential and public) and for all new residential buildings constructed on municipal plots. In the second case the application of these standards is ensured through the contract for purchase of municipal land or through the building permit. Taking due account of the good results achieved in the pilot projects (implemented in connection with EXPO 2000 in Hannover), a number of investors, including retail chains and banks, have decided voluntarily to apply the new standards. The municipal administration, on its part, approved its own Action Plan, which comprises 30 measures oriented towards renovation of all the public municipal buildings and of the street lighting in the city in accordance with the new standards, as well as mandatory application of the new standards in all public procurement orders of the municipality.

## Low Energy House (LEH)

In connection with EXPO 2000 at the end of the 1990'es started the construction of a new housing estate in the Kronsberg neighborhood (Hanover). It was there that the Low Energy House (LEH) Standard, known also as the "Kronsberg Standard", began to be applied for a first time. This new standard achieves reduction of thermal energy consumption for space heating by 25% as compared to the Heat Insulation Regulation (WsVO 1995 ) norms in force at that time. The Low Energy House Standard has established itself as the most massively applied low-energy standard for that part of Hanover. Simultaneously, in one of the quarters of the Kronsberg Housing Estate several buildings were built under the Passive House (PH) Standard. Investors, who apply that standard, are motivated by the municipal authority through different incentives, including with financial support from proKlima.

## Low Energy House Plus (LEH-plus)

As a logical follow-up of the initially applied in Kronsberg new Low Energy House (LEH) Standard, which ensures reduction of heat losses by hardly 25% as compared to the Heat Insulation Regulation (WsVO 1995) in force till that point of time, the Hanover Municipality introduced later the new Low Energy House-Plus (LEH-Plus) Standard. The latter provides for reduction of space heating costs by nearly 40%. Under the LEH-Plus Standard still remains the need of additional heating, which is provided most efficiently by the municipal district heating network. For this reason, wherever there are no objective barriers,


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connection to that network is mandatory. This standard defines the mandatory minimum of requirements for all new buildings in Hanover, which are constructed on municipal plots. The municipality, on its part, is obliged to provide the necessary consultations to entrepreneurs, who apply the new standard

## Passive House (PH)

For full renouncement of the need of external heat supply to the buildings Hanover Municipality has introduced the latest local standard - Passive House (PH)- which is also called ”Healthy Comfort House“. Under it heat losses are approx. 80% (on basis ENEV 2009) lower as compared to the standards in force in the country. In such buildings installation of a ventilation plant with heat recovery, which replaces entirely the additional heat supply, is mandatory. This is far less than what may be achieved under the Low Energy House Plus (LEH-Plus) Standard, but as yet it cannot be avoided, especially when the ventilation system is switched on. Because of the higher initial capital investments this standard is as yet not mandatory for application on the area of Hanover, but the municipality encourages entrepreneurs to apply it in the event of purchase of municipal land and assignment of public procurement orders. The application of this standard is also supported financially by proKlima.

## Ecological standards for building construction

Parallel with the application of the three low-energy standards for buildings of new construction (LEH, LEH-plus and PH), Hanover Municipality has introduced also a series of ecological requirements, applied in the event of construction of buildings municipal property or in the event of build-up of municipal plots sold to building contractors. These requirements comprise the urban development plans (build-up density, solar orientation, engineering infrastructure), as well as the application of the above listed standards in the construction of new buildings. The selection of any of these standards is subject to negotiations between the municipality and the contractors prior to signing of the respective contract for sale of municipal land or prior to the issue of the respective building permit. Parallel with it, connection of the new buildings to the environmentally most efficient district heating system is ensured. In the majority of cases that is the system of Stadtwerke Hannover AG, which uses a significant number of small co-generation plants and renewable energy sources. These ecological requirements are applied in the construction of residential buildings, as well as of commercial sites and facilities.

## Policy institutions

The application of the policies for climate protection and energy efficiency improvement and the updating of the regulatory framework impose the necessity of setting in place and development of adequate institutional structures. Specialized units are created within the municipal administration and efforts are made for building their capacity. Public-private partnerships are set up, in which a balance among the interests of the different participants is sought. Networks are built by stakeholders having different status and public positions, which ensure horizontal binding and coordination of actions. In this way all interested parties unite their efforts and resources and orient them jointly towards achievement of the desired goals



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# The successful example in Brussels

In less than 7 years, the Brussels-Capital Region has transformed from "the worst student in Europe" to a laudable front-runner in matters of energy policy and energy efficient building. Currently, there are 860 new passive projects that are being built in Brussels, to add to a large amount of passive houses in the social housing sector.

Such progress is remarkable and worthy of attention, not least because Brussels took considerably less time to move ahead than other front-runner regions. As a matter of example, the energy efficiency success model of Hanover was initiated in the 1980s - it took the Hanover region more than 25 years to become a front-runner. In contrast, the Brussels model developed much more rapidly, starting in 2004. In view of the above, a question looms before aspiring regions.

## Actual steps reaching a nearly Zero Energy Building legislation

In 2007 Brussels was still nowhere close to the lead in energy-efficient construction. Not a single building in the region complied with the passive standard. Companies, industries, architects and end consumers perceived low energy housing as a luxury item. Nonetheless, Brussels is a front-runner in eco-construction today. The following paragraphs will trace the roots and evolution of Belgian federal and Brussels regional legislation, culminating in the adoption of passive construction standards.

In the **1990's**, Brussels authorities considered integrating sustainability into regional development. Consequently, the Region initiated a broad sustainability program. In 1998, Brussels-Capital joined **Energy Cities**, the European Association of local authorities for sustainable energy (http://www.energy-cities.eu/). Energy Cities is a European Union initiative aiming to connect local governments, to promote and support sustainable energy initiatives, to influence policymaking, and to serve as a forum for exchanging ideas in the area of sustainable energy. For Brussels-Capital, joining Energy Cities proved to be a milestone in the development of low energy building legislation. The idea for the Exemplary Buildings project, which is at the base of today's legislation, was a result of cross-regional exchange of best practices within Energy Cities.

In the **early 2000's**, Belgium's Federal government issued the *2nd Federal Plan for Sustainable Development 2004-2008.* This policy framework expressed a **commitment to the *2000 Millennium Development Goals***, and the decisions of the World Summit on Sustainable Development (2002), particularly in the areas of living environments, energy and climate change. The plan was extended to 2009, and contained provisions on energy and environmental protection. Such a policy shift towards **energy-efficiency** is noteworthy, especially in light of Belgium's very limited potential for renewable energy use. Belgium lacks large hydro resources and lands for biomass plantations, and its coastline is



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small, which constrains wind resources. Despite these challenges, Belgian policymaking since the early 2000s reflects a growing interest in renewable energy use.

In the early 2000's, building insulation in Brussels-Capital was still among the poorest in the European Union. In 2001, the energy loss through walls in the Brussels-Capital Region amounted to 250 MJ/$m^2$ per year. However, a concern about high consumption of energy, particularly its impact on the air quality in the urban areas of Brussels, was growing within policy circles. It was this preoccupation with air quality that lead to the adoption of the first **structural air quality improvement plan**, *Plan d'amélioration structurelle de la qualité de l'air et de lutte contre le réchauffement climatique 2002-2010* (or Plan Air-Climat) on November 13, 2002. Plan Air-Climat contained several provisions that dealt with energy efficiency and demand management, thus giving a push to policymaking in these areas.

Despite these slow developments, energy issues did not firmly make it onto the regional policy agenda until 2004, when a new Regional government took office. The political discussions at that time did not include energy issues, however there was a realization that climate change is real, and that energy prices were about to skyrocket. Thus, 2004 saw the adoption of a new regional policy that incorporated energy and environmental issues into the building sector.

As a result, the **2004 Brussels energy policy** aimed to develop an energy-saving culture, to stimulate demand for energy efficiency, to provide expert technical support, as well as financial aid to consumers, and above all, to lead by example in matters of energy efficiency, and the use of renewable energy resources. The 2004 framework included: the legal framework for Energy Performance of Buildings (EPB), the integration of eco-construction elements (such as green roofs) into the building sector, financial incentives, public inter-agency cooperation to instill norms of eco-construction, free technical support, and a reference centre for technical training and professional development. In order to implement the new policy, regional budgets were increased from € 3.6 billion in 2004 to € 16.7 billion in 2007, and the financial aid scheme from € 1 billion to € 11 billion between 2004 and 2007.

The Region officially committed to the passive standard only after having experimented with the first three calls for proposals for ***Exemplary Buildings***. The success of the Exemplary Buildings program showed that passive standards are affordable, and do not raise renovation and construction costs to unacceptable levels.

In 2007, the Passive Buildings idea started to take shape in Brussels, but not on such a high technical level as in Germany, which was good, because had Brussels applied the German model literally, it would not have worked. That is how BatEx emerged.

Based on three rounds of successful trials with Exemplary Buildings (in 2007, 2008 and 2009), on July 12, **2009** the Brussels government passed an order imposing the passive standard on all regional new public buildings by 2010, and on May 3, 2011 adopted new energy target regulation for all new construction (housing, offices and schools) by 2015. The EPB recast directive imposed the zero energy standard, and the "passive" standard became an important first step towards achieving the zero energy standards in insulation. The legislation requests:

- A net heating requirement (energy need for heating) of less than 15/kWh/m2/y
- A net cooling requirement (energy need for cooling) less than 15/kWh/m2/y (only for offices and schools)
- An air tightness of 0,6 volume $.h^{-1}$
- An overheating over 26*C time limited to 5%
- A primary energy consumption limited to:
  - 45 kWh/m2/yr for housing (for heating, hot water, ventilation, pumps and fans);
  - 90 – (2,5 x compacity) for offices and schools.

For newer buildings with a better exposition (i.e. with easier access to natural light), it is easier to apply the passive standard. But this is not the case for older buildings with insufficient solar gains, too much solar shadow, bad compacity, etc. Thus, the rules for construction in the Brussels-Capital region have been adapted to reflect the situation of these disadvantaged buildings. The passive standard, adapted to reflect the particular situation of buildings with bad compacity or a bad orientation is under review at the time of writing, and should be approved by the Brussels government by the end of 2012.

The calculation takes account of renewable energy devices installed in buildings (thermal and photovoltaic panel, heat pump, geothermal system, and biomass).
This new piece of legislation is the last piece of the strategy. Boosting the demand for passive building from the top down, and improving the supply was a top priority. The second step was to move to a more horizontal model, encouraging grassroots solutions first with public buildings and secondly with regulation. Finally, the legislation served as a timely warning for all developers, architects, and design firms who were preparing their applications for planning permission after December 31, 2014.

At first, the market did not embrace the idea of going passive in 2015 – professionals thought the policy was moving too fast. There was insecurity and fear about certain aspects. For instance, real estate companies were very worried about airtightness tests. But in the end, all buildings submitted and successfully passed the airtightness tests.



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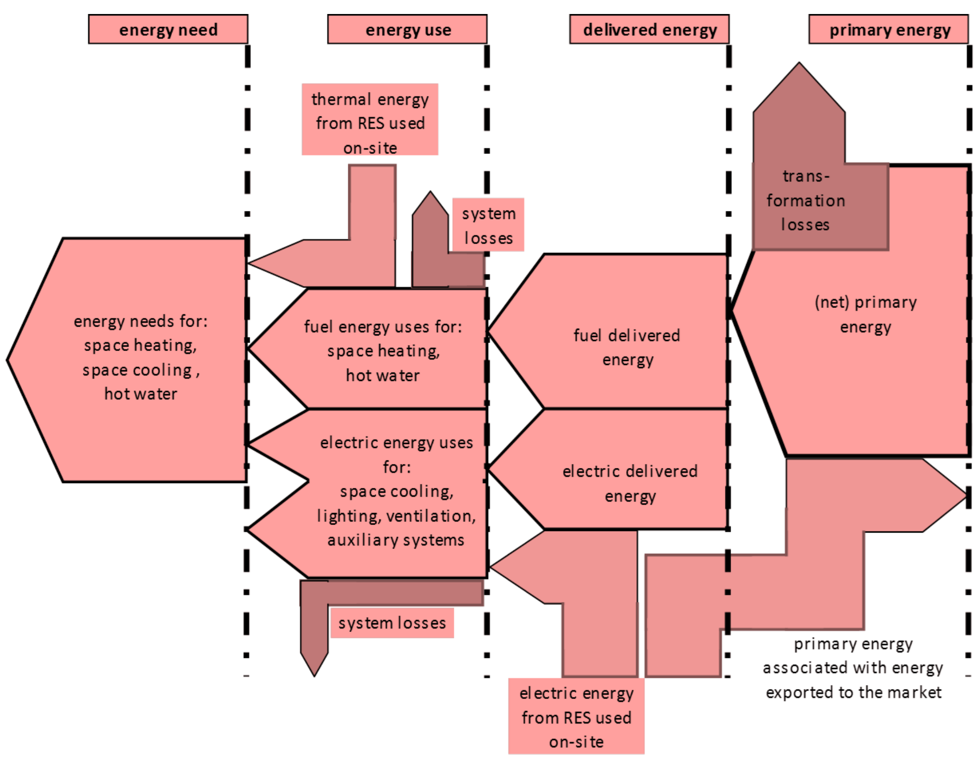
# Technical requirements for Passive House targets

Passive house strategy is based on the following quantitative requirements on the energy and comfort performances of building. These are also closely linked to the technical features of building components and systems described below.

- **Energy need for heating**: the space heating energy demand is not to exceed 15 kWh per square meter of net living space (treated floor area) per year or 10 W per square meter for thermal power peak demand for space heating.
- **Energy need for cooling**: in climates where active cooling is needed, the space cooling energy demand requirement roughly matches the heat demand requirements above: ≤ 15 kWh/($m^2$y), (with a slight additional allowance for dehumidification).
- The total **primary energy demand**, for all energy uses (heating, hot water and domestic electricity - all uses) must not exceed 120 kWh per square meter of treated floor area per year.
- A**irtightness** performance of the building envelope, a maximum of 0,6 air changes per hour at 50 Pascals pressure ($n_{50}$), as verified with an onsite pressure test (in both pressurized and depressurized states).
- **Thermal comfort** must be met for all living areas during winter as well as in summer, with not more than 10 % of the hours in a given year over a reference indoor temperature of 25 °C.

For these requirements, the following scheme on energy levels have to be kept in mind.




*F. 1. Scheme on energy levels: energy needs, delivered energy and primary energy demand (according standard EN 15603).*



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All of the above criteria are achieved through intelligent design and implementation of the **5 Passive House principles**, which ask to have care in the design and construction phases to have

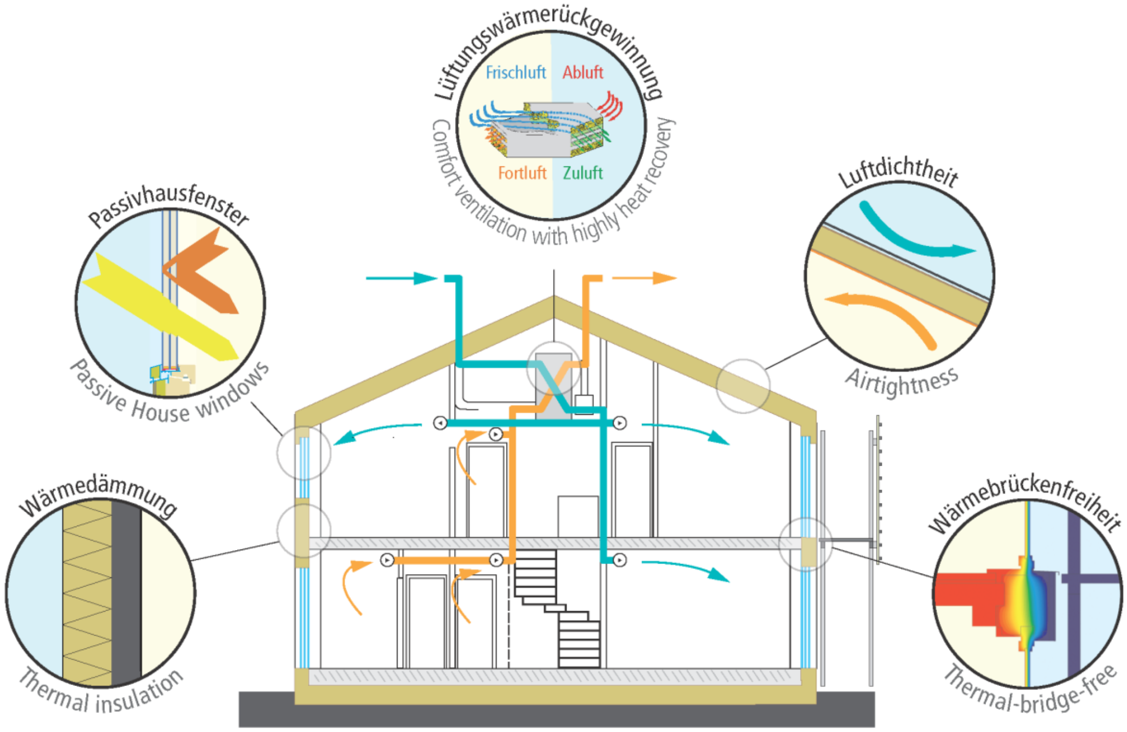
- thermal bridge free design
- windows with adequate thermal
- visual and airtightness feature
- ventilation with heat recovery
- quality insulation and airtight construction

In climates like italian and in general Mediterranean ones, the following aspects are also important

- installation of external movable solar shading devices for the control of solar gains in warm seasons,
- adoption of nigh-time ventilation natural and/or mechanical to have benefits from free-cooling when outdoor temperatures allow it.

These principles can be also expressed as quantitative requirements with the values presented below and in the next page.

The following basic principles apply for the construction of Passive Houses:




*F. 2. Schematic view of the 5 Passive House principles.*

## Thermal insulation

All opaque building components of the exterior envelope of the house must be very well-insulated. For most cool-temperate climates, this means a thermal transmittance (U-value) of 0,15 W/(m²K) or lower.

### Windows

The window frames must be well insulated and fitted with low-e glazings filled with argon or krypton to prevent heat transfer. For most cool-temperate climates, this means a U-value for the whole window (frames + glazings) of 0,80 W/(m²K) or less, with g-values around 50% (where g-value is the total solar transmittance, proportion of the solar energy available for the room).

### Ventilation heat recovery

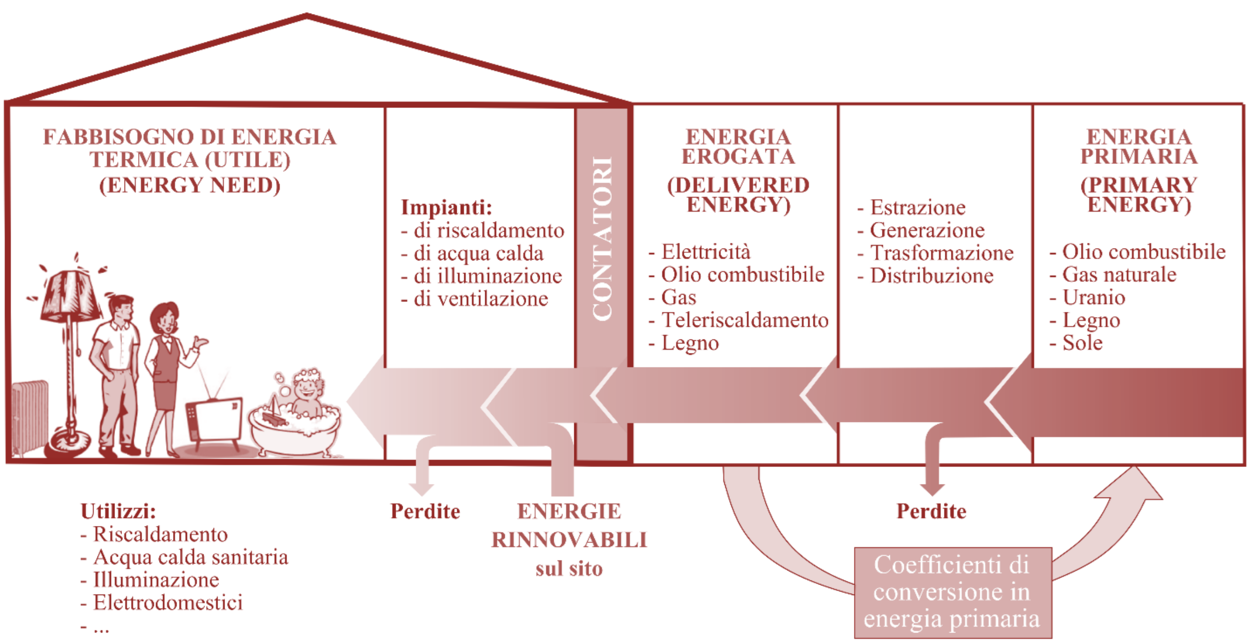
Efficient heat recovery ventilation is key, allowing for a good indoor air quality and saving energy. In Passive House, at least 75% of the heat from the exhaust air is transferred to the fresh air again by means of a heat exchanger.

### Airtightness of the building

Uncontrolled leakage through gaps must be smaller than 0,6 of the total house volume per hour during a pressure test at 50 Pascal (both pressurised and depressurised).

### Absence of thermal bridges

All edges, corners, connections and penetrations must be planned and executed with great care, so that thermal bridges can be avoided. Thermal bridges which cannot be avoided must be minimised as far as possible.




*F. 3. Synthetic scheme on energy levels: energy needs, delivered energy and primary energy demand.*



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Achieving the Passive House Standard in refurbishments of existing buildings is not always a realistic goal, one of the reasons being that basement walls remain as barely avoidable thermal bridges even after refurbishment.

For such buildings, the Passive House Institute has developed EnerPHit for certified energy retrofits with Passive House Components. This requires either a maximum energy need for heating of 25 kWh/(m²a) or alternatively the consistent use of Passive House components in accordance with the requirements for PHI certification of components and in general with quantitative performances we presented above.

More detailed references are available here at these links

- http://www.passiv.de/en/02_informations/02_passive-house-requirements/02_passive-house-requirements.htm
- http://passiv.de/en/03_certification/02_certification_buildings/02_certification_buildings.htm

## Optimized opportunities for Renewable Energy Sources

Passive House principles can be the base for an **optimal integration** of renewables energy sources systems in buildings. Passive Houses have **very low energy demand** which can be cover completely and in easier way with the on-site integration of RES systems.

So dimensions and components of RES systems can be optimized with an easier integration to reach the **nZEB targets**.

Passive House strategies allow to adopt the way indicated by the EPBD recast, which asks for "*energy efficiency first*" and then to cover the remain small energy demand of the buildings thank to on-site RES.

This allows also RES systems which are easier to manage and with better relationships with grids. Thanks to lower energy needs for all uses, the match between the RES energy production and the energy demand can be manage in easier and better way.

In Italy the requirements for RES systems to produce electricity and thermal energy in buildings are expressed by the ***Legislative Decree n. 28 of 3rd March 2011*** (also called *Decree Romani*). This national regulation requires a certain amount of electricity produce by photovoltaic and percentages of thermal energy demand cover by RES systems both for new and renovated buildings. The Decree is quite interesting and require the installation of an amount of RES systems quite ambitious, which increases following steps in the next years.

Often local authorities, designers and experts recognized that the limits requested by the Decree are quite high and difficult to be reached in practice if we consider common buildings.

Adopting the Passive House approach and performances allows to reach in easier way the RES percentages of coverage requested by the Decree, making it really feasible and improving the projects compliance with it.



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## Suitable tools

According the Passive House Standard, results and values of energy and comfort performances have to be calculated using the comprehensive energy balance calculation tool *PHPP* - Passive House Planning Package (http://passiv.de/en/04_phpp/04_phpp.htm), which is based on recognized calculation method and standards, mainly on the EN 13790 and other relevant ones. In general to have a direct comparison is crucial to consider the energy levels represented in figures F. 1 and F. 3 (like energy need for heating and cooling, primary energy demand, etc.).
Further quality assurance procedures and tests can be seen in the checklist available here at this link: http://www.passipedia.org/basics/passive_house_checklist .

## Adaptation to the Mediterranean and other climate contexts

**Consolidated studies** and **successful examples** show that Passive House Standard can be successfully adopted also in Mediterranean climates, reaching high energy performance and indoor comfort conditions. High solar radiation and moderate average air temperatures help also **effective performances of renewables** energies systems as solar thermal and photovoltaic ones and heat pumps, to reach real passive house building with integrated renewable energy towards nearly/Net Zero Energy Buildings.
**Passive-On** project is about the adaptation of the Passivhaus concept to **warm climates** (with the inclusion of explicit specification of summer comfort targets and cooling energy need limits, inclusion of shading, night ventilation and other summer comfort technologies) has been undertaken in the passive-on project coordinated by  the end-use Efficiency Research Group of the Politecnico di Milano.
Passive-On aimed to build on the success of the Passivhaus concept by spreading the good word –and appropriate practice- towards southern and more moderate climates of Europe. Further information and links to the results are available at this link:
http://passregsos.passiv.de/wiki/Adaptation_to_mediterranean_climate .
Other comprehensive and valuable studies have been developed by the Passive House Institute ad "**Passive Houses in South West Europe**":
http://www.passiv.de/en/02_informations/05_ph-mediterranean/05_ph-mediterranean.htm .
The passive house principles are suitable worldwide. However, some adaptation in the suitable technological solutions can be considered also according the guidelines available at the following link where using an interactive map suggestion for solution for suitable regional Passivhaus components can be find, particularly on

- Building envelope elements
- Mechanical systems
- Renewable energy

(http://www.passipedia.org/passipedia_en/planning/component_guidelines_for_cost-optimal_passive_houses_and_enerphit_retrofits).