

Energy saving buildings

How to reduce operating costs with high efficiency systems:
energy class A without building thermal envelope



Energy efficiency in buildings

Energy efficiency in air conditioning is of great interest, as highlighted by the latest regulations.

In fact, an innovation has been recently introduced to the real estate market: the Energy Certificate, a mandatory document establishing the energy efficiency of both new and existing buildings.

It is to be expected that the catch phrase "self contained heating", that in the last decade has been widely used in the real estate market, will be quickly replaced by the new one "Energy class A building".

If so far energy efficiency and certification of buildings has been recalling for many years the increase in costs, energy certification is now introducing a tool for increasing the value of buildings in the real estate market.

One issue that directly affects the energy certification is the development of a nation-wide approach. In Italy, the lack of implementation of Ministerial Decrees and energy certification standards is causing the spread of tools and methods, while leaving to the regions the implementation of energy certification systems.

Among several energy certification standards, the Province of Bolzano (Northern Italy) first introduced a its own standard, namely Klimahaus, intending to assume a nation-wide leadership position.

The building energy classes of Klimahaus include:

- Energy class Gold: less than 10 kWh/m² per year;
- Energy class A: less than 30 kWh/m² per year;
- Energy class B: less than 50 kWh/m² per year;
- Energy class C: less than 70 kWh/m² per year.

Therefore, two trends are to be expected in the real estate market: on one hand the improvement of energy efficiency in building, on the other hand the increase in building costs. Actually, a different approach could be expected: a strong reduction in construction costs (material, insulation, glass areas...), while investing in innovative technologies to meet the heating requirements of buildings, thus achieving the best energy performance certificate. Actually, this would be a valid alternative if there was a profitable technology, especially if its purchase cost was lower than the investment costs on construction.

This technology is already available on the market and provides efficiency by 40% higher when compared to the best condensing boilers.

The gas absorption heat pumps, manufactured by Robur SpA, an Italian company situated in Zingonia near Bergamo, in the North of Italy, are fired by natural gas or LPG. In Italy, ENEA, a renowned Authority for new Technologies, Energy and Environment, has already given a favourable opinion on the effectiveness of this technology. Recently, the European Commission has acknowledged this technology as one of most performant.

How to reach energy class A

To better understand the performance of Robur gas absorption heat pumps, a comparative test has been carried out with the cooperation of the engineering office Taddei - Dami Prato on a residential building in which the energy performance variation has been calculated according to the design solutions and the system choices as well. The building represents a good starting point, since:

- external walls with 25 cm wide Poroton blocks and thermal insulation with fiberglass, 8 cm wide vapor barrier and 8 cm wide hollow bricks;
 - roof and terrace insulation with 10 cm wide polystyrene panels and first floor insulation on all open areas with 5 cm wide polystyrene panels;
 - Wood windows with insulated glass and insulated box with shutter.
- The heating system has been designed with the best technologies available on the market:

- condensing boiler;
- radiant floor system.

The result of energy classification according to the structural design and the system above mentioned, is an energy performance rating of 31,44 kWh/m² per year thus achieving **energy class B Klimahaus**. As it was expected, a "well-done" building and a "well-done" installation may lead to a valuable energy class, but not to A energy class, that would catch the attention in the real estate market.

There are two ways to achieve the A energy class: the improvement of the construction **or the installation of innovative heating systems, such as gas absorption heat pumps**.

The only solution to improve the building, taking into account that the insulation complies with MD 311/06 for the year 2010, is the use of Gasbeton blocks against heat bridges or the adoption of building thermal envelopes.

Building data

Reference town	Florence
Day temperature	1740
Project external temperature	-1,0 °C
Gross volume	9.089 m ³
Dispersion surface	4.900 m ²
Form factor	0,54
Useful area	2.216 m ²
Internal walls area	674 m ²
External walls area	2.389 m ²
Floors	752 m ²
Ceiling	765 m ²
Glass area	320 m ²



Building thermal envelope

Since this solution is more widespread than Gasbeton blocks, taking into account the building above mentioned, external walls with building thermal envelope results in energy performance rating of 28.02 kWh/m² per year thus leading to energy class A.

The objective of energy class A is then met, but at cost of greater expenses that can be estimated as follows:

- external walls area = 2.389 m²;
- increase in cost for building thermal envelope = 40 Euro/ m²;
- cost for building thermal envelope = 95.000 Euro.

Solution with Robur gas absorption heat pumps (GAHP)

The use of Robur gas absorption heat pumps with radiant floor heating system, allows

to avoid the building thermal envelope and allows to achieve an energy performance rating of 20.84 kWh/m² per year and **the energy class A**.

The use of gas absorption heat pumps with low temperature radiators also allows to achieve the energy class A, with energy performance

rating of 22.76 kWh/m² per year.

The cost required is estimated as follows:

- Heating capacity required = 100 kW;
- Gas absorption heat pumps cost = 25.000 Euro;
- Savings compared to building thermal envelope = -70.000 Euro.

Renovation

The results above mentioned represent an interesting scenario as far as renovation in existing buildings is concerned.

The use of gas absorption heat pumps lead to significant advantages, improving the energy class of existing buildings.

In this case, the energy class A is achievable reducing the investment in the construction, with interventions on the heating system only.

Comparative table

Test	kWh/m ² year	kWh/m ² year field	EtaG %	EtaG % field	Class KlimaHaus	Notes
12	63,7	7,39	71,07	126,2	A gold	Gasbeton /Robur GAHP/radiant floor system/rec. cal 70% Mech.vent/glasshp
11	63,7	9,77	71,07	126,3	A gold	Gasbeton /Robur GAHP/radiant floor system/rec. cal 70% Mech. vent.
14	63,7	13,10	71,07	126,5	A	Thermal envelope / Robur GAHP / radiant floor system
10	63,7	15,15	71,07	126,6	A	Gasbeton insulation / Robur GAHP / radiant floor system
16	63,7	15,86	71,07	120,9	A	Gasbeton insulation / Robur GAHP / low temperature radiators
4	63,7	19,07	71,14	86,9	A	Thermal envelope / basic heating system
15	63,7	20,42	72,22	81,2	A	Thermal envelope / condensing unit / low temperature radiators
9	63,7	20,84	71,07	132,3	A	Basic envelope / Robur GAHP / radiant floor system
8	63,7	22,00	71,14	87,1	A	Gasbeton insulation / basic heating system
18	63,7	22,76	71,07	121,1	A	Basic envelope / Robur GAHP / low temperature radiators
17	63,7	23,53	72,22	81,5	A	Gasbeton insulation / condensing unit / low temperature radiators
3	63,7	28,02	71,14	87,5	A	Thermal envelope / basic heating system
1	63,7	31,44	71,14	87,7	B	Basic envelope / central heating system / radiant floor system
13	63,7	32,74	71,18	84,2	B	Basic envelope / central heating system / low temperature radiators
5	63,7	33,78	71,10	81,6	B	Basic env. / 3 stars centr. heating system / med. temp. radiators
2	63,7	34,12	71,14	87,8	B	Basic envelope / low-insulated Tab. 2006
6	63,7	34,55	72,22	79,8	B	Basic envelope / condensing unit / low temp. radiators
7	63,7	39,01	72,94	70,7	- -	Basic envelope / 3 stars heating boiler / med. temp. radiators

Conclusions

Actually, the objective of KlimaHaus energy class A for new buildings, or the improvement of energy class for existing buildings can be easily achieved with cost effective heating systems using renewable energy.

A further advantage of gas absorption heat pumps can be mentioned: with small increase in purchase costs, these devices can be supplied in reversible type to produce cold water even for summer cooling.