EUROGYPSUM
THE VOICE OF THE EUROPEAN GYPSUM INDUSTRY

Increasing Energy Efficiency in Buildings with Internal Insulation: The European Gypsum Industry Solutions

with the support of EUMEPS

Foreword

The Gypsum Industry is an integrated industry operating world-wide but producing and consuming locally. The Gypsum Industry business activities start with extraction and ends by turning gypsum waste into a resource. Gypsum products are eternally and fully recyclable as they always keep their natural properties during use. Therefore, the gypsum companies strive to effectively recycle the products at the end of their life-cycle (demolition waste). So the Gypsum Industry is a good example for making things work in a holistic approach rather than by bits and pieces.

The gypsum products and solutions in the built environment look at the whole life cycle of materials and ecological properties giving birth to innovative solutions reconciling extraction (recycling of gypsum waste and use of by-product as a raw material) with other ecological requirements like increased energy efficiency (gypsum plasterboards contribute with the insulating material to the performance of external walls and linings), acoustic performances (gypsum walls, ceilings and floors with insulation materials create quiet zones in the house or business environment), fire protection (Gypsum is non-combustible and able to delay a fire's spread up to 4 hours) to name a few. The properties of Gypsum and the products' eternal recyclability improve the overall eco-efficiency and sustainability of buildings.

In the field of energy efficiency in buildings, the European Gypsum Industry has developed innovative, technological, energy-efficient solutions for building interiors, with a complete offering for walls, floors and ceilings. Internal insulation is very effective in case of renovation and refurbishment. However, we should not forget that substantial energy savings can also be achieved with new buildings.

The European Gypsum Industry is convinced that internal insulation techniques are an integrated part of the solutions package for reaching a low carbon economy and green growth. Therefore we produced this brochure to share and transfer our knowledge and achievements for an uptake of those techniques all over Europe with the objective of making internal insulation happen when and where it makes sense.

Bernard Lekien
President

Increasing Energy Efficiency in Buildings with Internal Insulation: **The European Gypsum Industry Solutions**

I. How Internal Insulation contributes to the EU Agenda

A. Overview

The European Union's 2020 Strategy aims to deliver smart, sustainable and inclusive growth. Increased energy efficiency is key to this growth strategy, and will require investment in technologies, incentives and solutions to generate substantial energy savings across major sectors including construction, transport & industry.

For the construction sector, this translates into the need for a sharp and effective increase in energy savings in the building stock. While in new constructions this may be addressed via building regulations, large scale refurbishment of existing European buildings will also be required, as demolition and reconstruction is very often not an option. In this context, due to adaptability, ease of implementation, performance and cost efficiency benefits, internal insulation is a highly adapted and competitive solution.

Current uptake of refurbishment is far too slow, mainly because solutions are perceived as costly, time-consuming and difficult to implement. Industry therefore needs the effective support of national and European Union authorities, NGOs and professional associations, in the form of financial incentives and robust, targeted, long-term information campaigns for end-users. Only then, can there be a shift in the perceptions and behaviours which can trigger large scale refurbishments. The private and public sectors must work together, investing time, effort and financial means to achieve this goal.

The aim of this brochure is to present these internal insulation techniques and credentials to stakeholders, national and European public authorities, highlighting the benefits of using these technologies via 10 case studies from different countries within the European region.

B. Benefits of the Gypsum Industry Internal Insulation Systems

The European Gypsum Industry has developed innovative, technological, energy-efficient solutions for building interiors, with a complete offering for walls, floors and ceilings.

In addition to the essential contribution to thermal insulation and energy efficiency, gypsum-based solutions provide other key benefits in terms of safety and comfort. It is worth noting that in the case of refurbishment, internal insulation often represents the sole option to increase the energy efficiency of the building.

1. Solutions for Sustainable Comfort and Safety

- **Thermal insulation properties:** improved thermal comfort in homes (warmer in winter, cooler in summer);
- **Sound insulation** properties, provide protection from exterior noise for a more comfortable interior acoustic environment;
- **Fire resistance** properties, contribute to delaying the spread of fire by up to 4 hours;
- **Intrinsic moisture and mould resistance properties** can contribute to a healthier interior environment;
- **Aesthetics**, proposed systems offer high aesthetic standards, adapted for any type of building interior, and without alteration to building exterior façades;
- **Positive Environmental impact** (reduced energy consumption and CO_2 emissions).

2. Adaptable

- Adapted for all building types (including historical, listed buildings where façades must be preserved intact);
- Allow single apartment retrofits in multi-storey apartment blocks (where owner consensus would be required to insulate from the exterior);
- Maintain a high standard for exterior and interior aesthetics;
- No planning permits required;
- Offer complete solution (walls, attics, floors and ceilings);
- Offer the option of carrying out this type of insulation on a room to room basis over time depending on the owner's budget.

3. Ease & Speed of Installation

- No scaffolding required;
- Installation not dependent on weather conditions;
- Intermediate skills and equipment required to install;
- Materials widely available, accessible;
- Systems are relatively fast and easy to install.

4. Sustainable and Cost-Effective

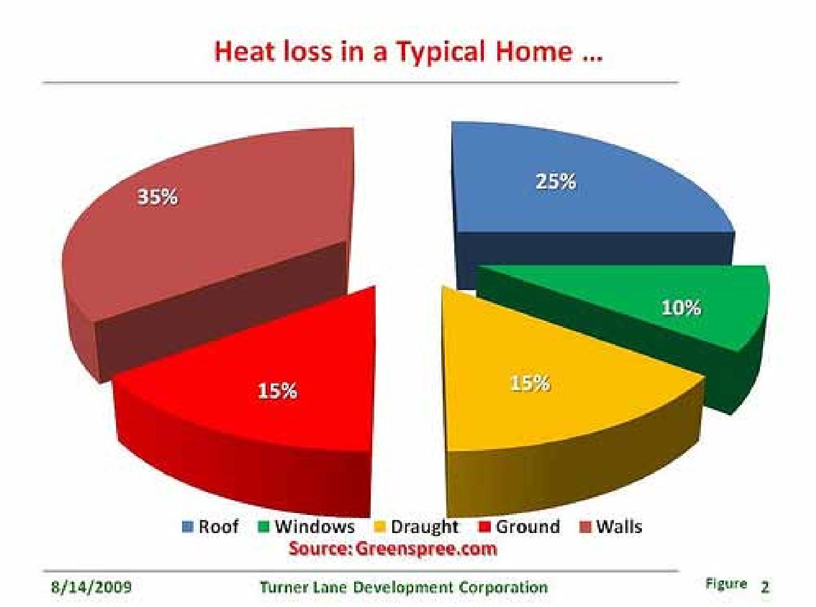
- Relatively low investment / installation costs;
- Tangible reduction in CO_2 emissions;
- Results quickly tangible (reduced energy bills);
- Comparatively quicker return on investment versus external insulation[1].

II. Internal Insulation Applications

A. Energy Costs Savings and CO_2 Reduction with Internal Insulation

a. Overview

The main sources of loss of energy in buildings are:



It is essential to analyse and prioritise before commencing a refurbishment project in order to understand the technical constraints of these solutions. The European Gypsum Industry has a complete offering for all internal insulation applications also covering acoustic, fire and impact (e.g. for vibrations caused by industrial applications) insulation.

b. Costs versus Payback[1]

It is important to understand that it is very difficult to give accurate costs, financial and carbon payback as the economic situation is different from country to country as well as the refurbishment needs and the methods of construction. The costs given below must be taken with care as an example for both external and internal insulation which are complementary tools for achieving energy-efficient buildings.

Financial Costs[2]

- **External solid wall insulation** –The cost of insulated render/cladding is around 50 Euro to 75 Euro per square metre, depending on the selected product, installer, the condition of the exterior surface and its complexity. Since the whole house needs to be insulated using this method, minimum costs start around 2.300 Euro. A typical semi-detached house with some 80 m^2 of walls is likely to cost between 4.000 Euro and 5.000 Euro.
- **Interior solid wall insulation** – to insulate a whole 3-bedroom semi-detached house would cost approximately 800 Euro if done by a professional or 500 Euro if done as a do-it-yourself job. Prices vary by product and installer.

1. Note: The cost of installing wall insulation will vary substantially depending on the technique employed, size of house, and nature of the project.
2. http://oxfordsolar.energyprojects.net/

Financial Payback

- **External solid wall insulation** - typical annual savings are between 100 Euro and 140 Euro on the fuel bills. Payback period is 12+ years with an installation life of 25-30 years.
- **Interior solid wall insulation** - typical annual savings are between 90 Euro and 120 Euro on the fuel bills. Payback period is 3 years for DIY (do-it-yourself) installations and 6-7 years for professional installations.

Carbon Saving[3]

- **External solid wall insulation** - a three bedroom semi-detached house could save around 2.5 tonnes of CO_2 a year.
- **Interior solid wall insulation** - a three bedroom semi-detached house could save around 2.4 tonnes of CO_2 a year.

B. Solid External Walls

Solid external walls are typically a major source of heat loss in individual homes (representing up to 35% of total heat loss). Solid walls can be insulated either with internal insulation (from the inside) or external insulation (from the building exterior) to increase energy efficiency.

Internal solid wall insulation solutions usually involve the installation of metal or timber studs (frames) with an insulation layer installed between the studs and then overlaid with a vapour control layer and plasterboard. Alternatively, a thermal laminate board or rigid insulation board plus plasterboard can be glued or mechanically fixed to the walls.

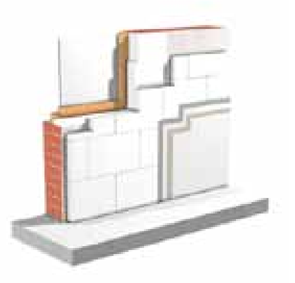
Internal wall insulation is particularly adapted:

- as part of a refurbishment involving the disruption of internal surfaces and fixtures;
- in multi-storey buildings where access for external insulation would be expensive;
- in buildings with an attractive external appearance and/or in conservation areas;
- in high thermal capacity structures with condensation and mould growth problems.

3. http://www.staffordarea.saveyourenergy.org.uk/how/insulation/solid_wall_insulation

Indoor Insulation

Systems overview with mineral wool and polystyrene

System:	MINERAL WOOL INSULATION SYSTEM	POLYSTURE INSULATION SYSTEM
Application area:	All kinds of masonry Rough or no adhesive existing walls	All kind of masonry Viable, especially flat inventory walls
System structure:	 ▸ Variable drywall assembly on steel framing ▸ Mineral wool insulation ▸ Sheating with gypsum boards	 ▸ Sandwich element compound of plasterboard and EPS insulation
Characteristics:	▸ Best sound insulation ▸ Fire protection upgrade ▸ Integration of installations, like electrical sockets, light switches, etc.	▸ Space-saving insulation system ▸ Best insulation value by thermal optimized EPS ▸ For special air-tight Z-fold edging joints
Thermal conductivity:	Depends on insulation material	0.032 [W/mK]
Insulation material:	Mineral wool	Polystyrene
Vapor retarder:	As needed	Can be equipped on demand (sd = 10 m)
Surfaces, renders:	Plasterboard for surface quality Q1 - Q4(1)	Plasterboard for surface quality Q1 - Q4(1)
System accessory:	Insulation key of polyurethane with λ = 0,030 W/mK for e.g. embedding ceilings Reveal insulation board of pur with λ = 0,025 W/mK for e.g. window embrasures	Insulation key of pur with λ = 0.030 W/mK for e.g. embedding ceilings Reveal insulation board of pur with λ = 0.025 W/mK for e.g. window embrasures
Building material classification:	A2 (plasterboard)	A2 (plasterboard), B2 (insulation)

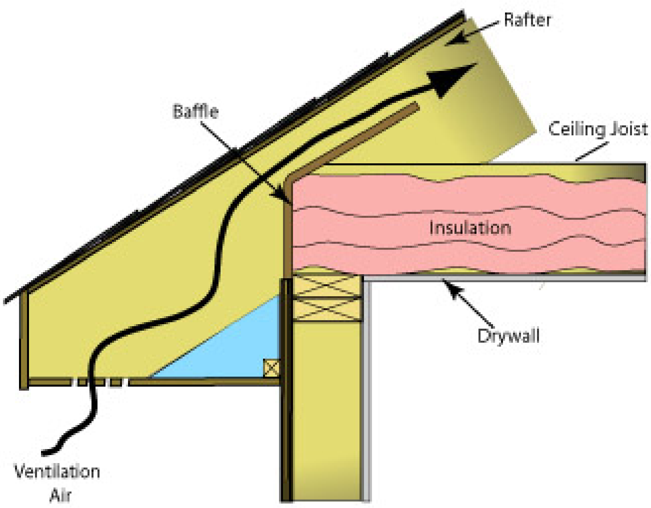
C. Attic Roofs

Roofs and attics account for a large percentage of total heat loss and gain for individual houses, making them a priority for insulation. In new constructions, insulation levels for attics are higher than for any other areas. In existing individual homes, the attic should be the first area where insulation retrofit should be undertaken.

Attics are comparatively easy to insulate since there are usually no space constraints. Good ventilation, with airflow circulating into and out of the attic is critical to help stabilize the attic temperature and remove moisture.

While attic ventilation is important, equally important is sealing air leaks from the rest of the house to the attic, especially in cold climates. In a typical home, recessed light fixtures, bathroom vents, plumbing stacks, chimneys and wall cavities present numerous potential air leakage paths to the attic. Air leakage from the house causes many problems including condensation, rot, mildew and in cold climates – ice dams. Ducting that runs through the attic should be well sealed and properly insulated.

Attic Roof Insulation



D. Suspended Ceiling Insulation

Insulation materials are used over suspended ceiling panels to economically improve both the noise control and thermal performance of new or existing ceiling systems.

This application requires that the building envelope prevents air flow from the outdoor environment to the conditioned space. Failure to provide an adequate air barrier could lead to loss of thermal control, discomfort of the building occupants and frozen pipes.

Maximum thermal performance is obtained by minimizing the number of penetrations in the ceiling.

When insulation is added to the inside perimeter of a structure, the area outside the insulation becomes exposed to greater temperature extremes. Building structures should be inspected to ensure they can withstand the additional expansion and contraction forces.

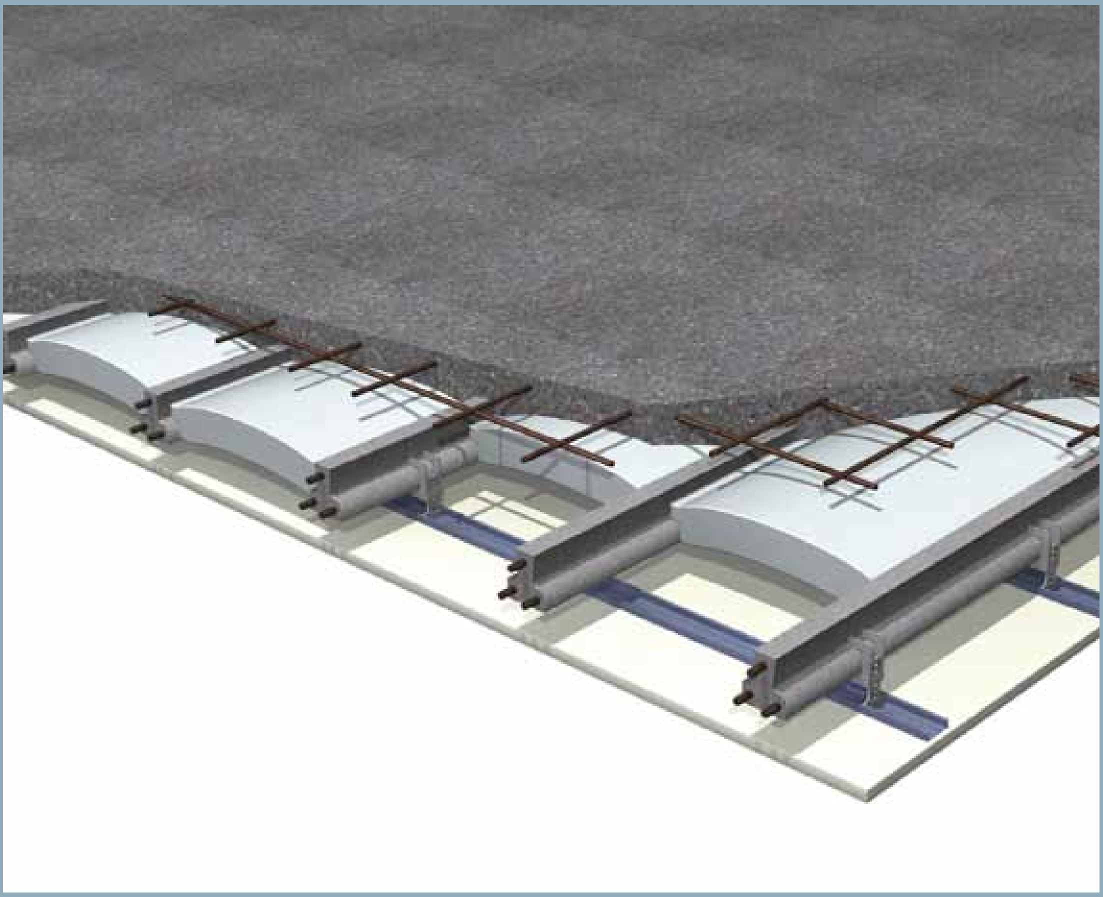
E.Internal Floor Insulation Systems

The overwhelming concern of the designer when considering the internal floors of a dwelling is to ensure that the floor has the ability to support the dead and live loads that will be applied to it in the context of the whole structure of the building. Building regulations determine the minimum standards for structure and fire resistance. Another important consideration is the spatial separation that the floors provide within a dwelling in both acoustic and thermal terms.

The thermal performance of internal elements is not regulated, but with the improvements in heating system efficiency and zoning controls that will be necessary to meet future building regulations. It therefore makes sense that floors that divide spaces with different functions within dwellings can help to maintain the optimum temperature required for the function of each space.

Insulated floors above and below rooms with high internal heat gains would help to avoid overheating in adjoining rooms in summer.

Underfloor illustration



III. Renovation of Buildings

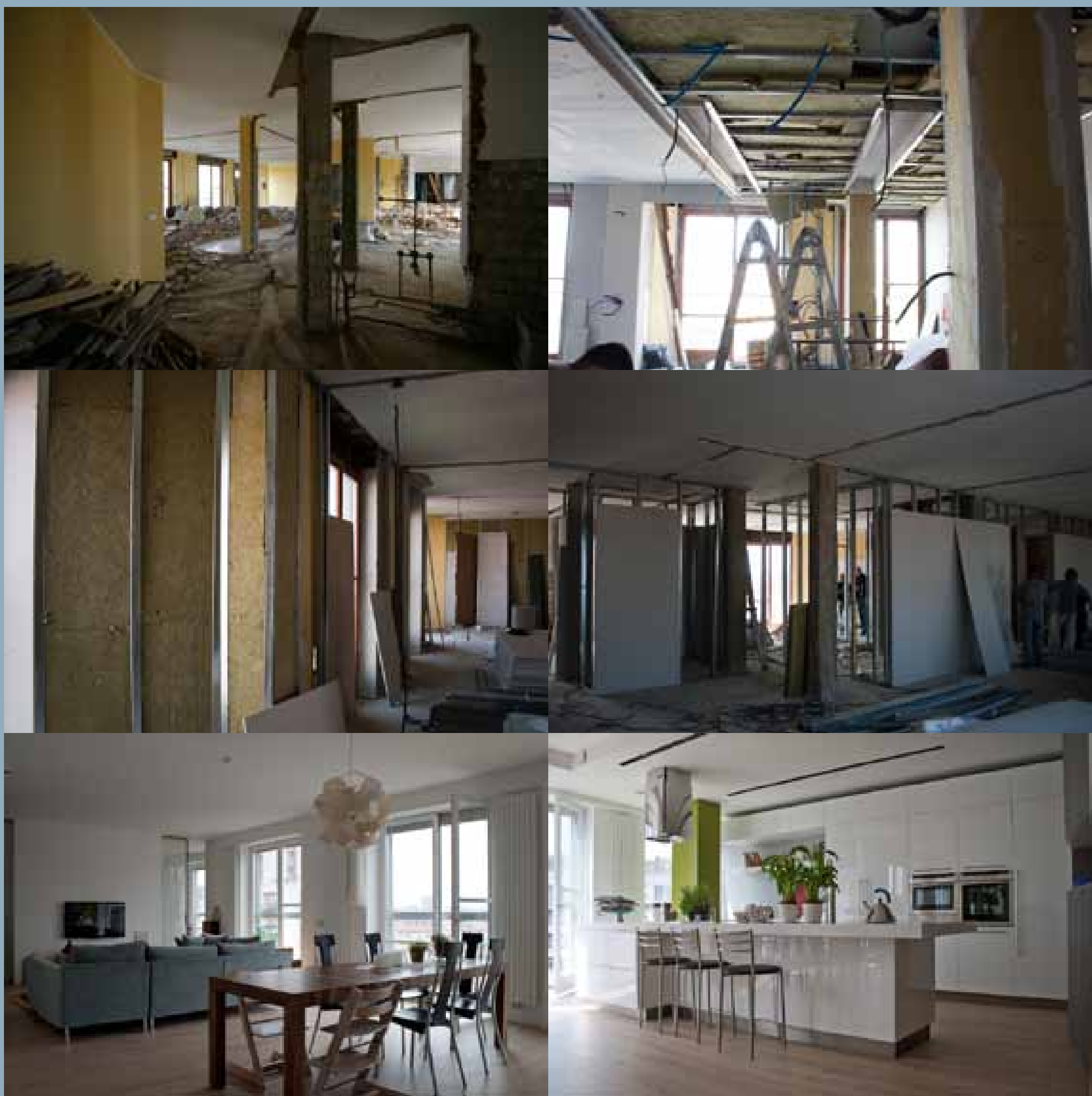
The following six cases have been segmented into two sections illustrating current and optimised practices in applying internal insulation solutions.

A. Standard Renovation Illustrations

CASE STUDY N°1

a. 1970's Apartment

Installation of a metal frame, insulating layer and plasterboard on walls & ceiling.



The renovation was carried out to insulate one apartment in a non insulated apartment block.

Energy Performance: 0.3247 W/m²K

Project description:	Restructuring of a 1970s apartment building with perimetric external wall infill masonry, without thermal insulation. The existing walls were removed to allow access to the entire exterior cladding. This work was realised in Italy (Milan).
Project Objective:	The goal was to obtain a new external wall that would guarantee excellent thermal-acoustic insulation of the façade to improve interior comfort, whilst reducing heating consumption.
Thermal insulation solution chosen:	Internal freestanding double wall that allows the creation of a new drywall set away from the perimetric drywall to prevent thermal and acoustic transmissions. Rock wool with a density of 70 kg/m3 and a conductivity of 0.035 W/mK has been inserted within the “C” profile. The external cladding consists of a 15mm fibreboard sheet and a plasterboard sheet coupled with a water barrier. The mass of the panels also increases the thermal insulation for summer.
Energy efficiency performance of the solution:	0.3247 W/m²K.
Benefits for the owner:	Better thermal comfort in both winter and summer and subsequent energy savings via a solution featuring high mechanical strength that allows the hanging or use of heavy furnishings against the double wall.
Innovative character of the solution:	1. System with excellent thermal performance; 2. Advantage of having a clean site with great flexibility to accommodate the plant; 3. Ability to hang or furnish the walls with heavy items or furnishings due to the high mechanical strength of the panels.

CASE STUDY N°2

b. Listed Historic Building

Installation of glued composite board
(plasterboard + insulating layer) on walls.

The internal insulation solution was adopted as the sole option for meeting legal insulation requirements and stakeholders' demands for listed historic buildings.

Energy savings: The primary energy consumption has been reduced from 146.81 kWh/(m^2a) to 68.93 kWh/(m^2a), which represents a 53% saving.

Project description:	Town Hall in the Franconian village of Schonungen near Schweinfurt (Germany). Rooms previously used as office space were remodelled into a municipal library.
Project Objective:	The use of exterior insulation was not permitted due to the monument protection status of the building and the need to retain its historic façade.
Thermal insulation solution chosen:	The composite board consists of a gypsum board and a grey polystyrene insulation, with thickness of 60 mm in a handling format 600 mm x 2500 mm, which can be installed easily. The polystyrene insulation achieves a thermal conductivity λ=0,032 W/(mK) because of a thermal optimisation. The excellent value has been achieved by addition of graphite. By means of it a larger proportion of the thermal radiation is reflected or absorbed.
Energy efficiency performance of the solution:	The primary energy consumption has been reduced from 146.81 kWh/(m^2a) to 68.93 kWh/(m^2a), which represents a 53% saving.
Benefits for the owner:	**Thermal Comfort:** ‣ the internal thermal insulation evokes a high surface temperature on the walls inside and results in an improvement in the living environment.
Innovative character of the solution:	**High quality heat protection with λ=0,032 W/(mK):** ‣ reduction of the insulation thickness with equivalent thermal insulation (living space was optimised); ‣ increased savings on heating costs for equivalent insulation thickness.

B. Optimised Design Renovation Cases

The following cases illustrate the optimisation of energy savings within high environmental standards at no additional cost and the optimisation of net surface area using interior insulation techniques.

CASE STUDY N°3

a. 90% energy savings (according to BBC standards[4])

Installation of a metal frame, semi-rigid insulation panel and plasterboard on walls.

4. See Glossary for more details

Renovation achieved BBC standards[5] at no additional cost versus a "traditional renovation".

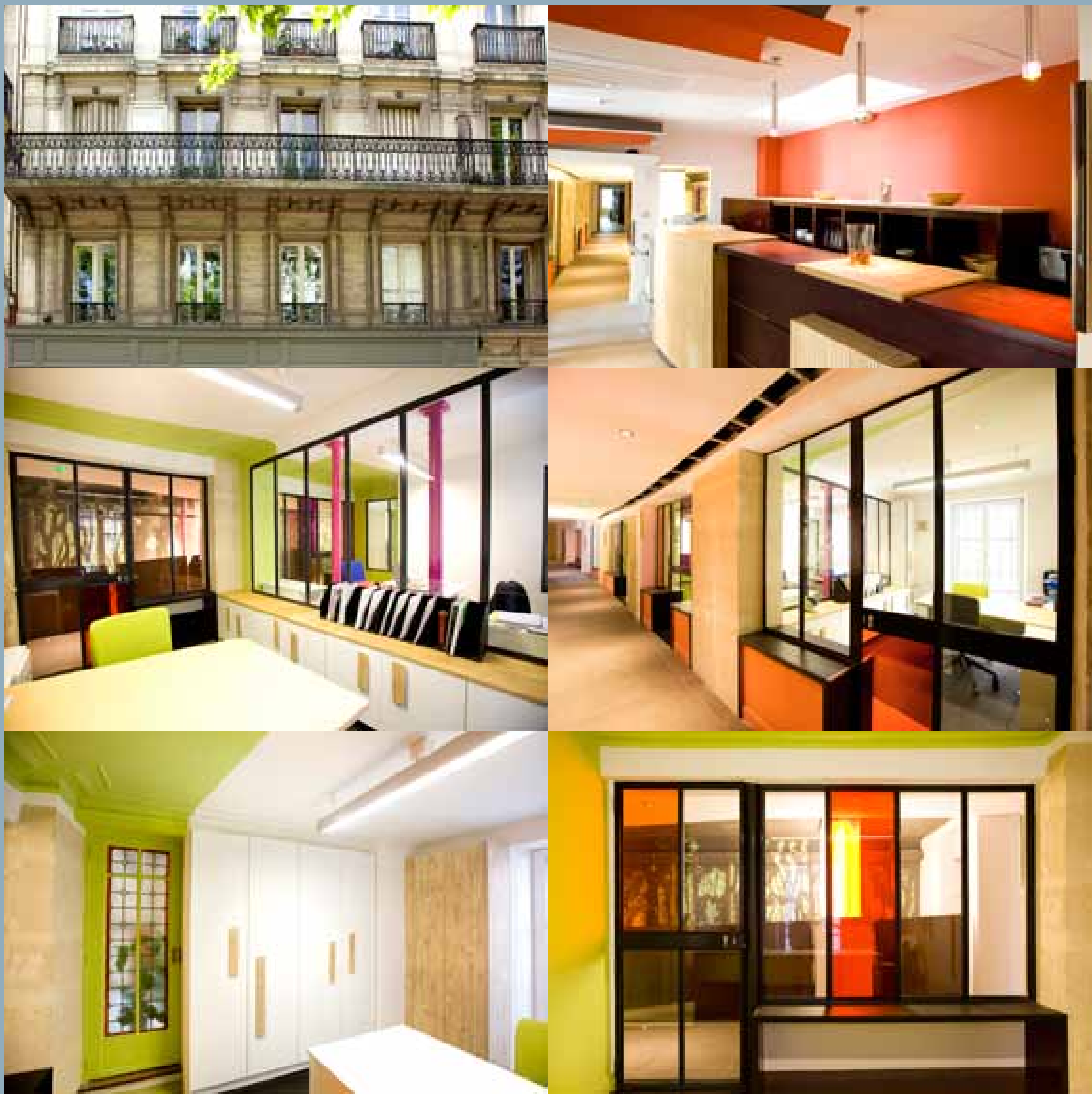
Energy savings: Energy consumption was divided by 10. Move from D.P.E. Class G (828 kWh/m² / year) to D.P.E. Class B (87 kWh/m² / year)

Project description:	This project involved an extensive renovation of an 18th century house, to convert old agricultural buildings into rented housing.
Project Objective:	The aim was to achieve BBC (Batiment Basse Consommation)[6] performance standards for this renovation project.
BBC requirements are:	▸ 64 – 120 Wh/m2 / year for renovation projects; ▸ <50 kWh/m2/year for new residential buildings.
Thermal insulation solution chosen:	**Roof:** rock wool was applied between the chevrons. Monospace rock wool was applied under the chevrons + airtight membrane. **Walls:** Lining on frames with 160mm thickness semi-rigid glass wool panel for application on concrete blocks or brick walls and a pre-printed plasterboard. **Floor:** Underfloor insulation applied using 2 layers of panels (61mm).
Energy efficiency performance of the solution:	**Value** Energy consumption was divided by 10. Move from D.P.E. Class G (828 kWh/m² / year) to D.P.E. to Class B (87 kWh/m² / year)[7].
Costs of the solution:	**Monetary value** The renovation cost 92K€ including 32K€ for the building structure and equipment.
Costs savings of the solution for the owner:	For the same overall project cost, the cost/ performance ratio was greatly improved, compared to the level of insulation which existed prior to the renovation.
Benefits for the owner:	**Qualitative value** For the same overall cost, better thermal performance was achieved, as well as the building's luminosity (additional 13% of glazed surface).
Innovative character of the solution:	By approaching the renovation project from the building structure's thermal insulation performance angle, adapted heating equipment using renewable energy sources was introduced, and overall, superior thermal performance was obtained at no additional total cost.

5. See Glossary for more details
6. See Glossary for more details
7. See Glossary for more details

CASE STUDY N°4

b.90% energy savings (beyond BBC standards[8])



8. See Glossary for more details

Renovation of a historic building according to Adelie standards[9] (strict legal requirement for energy consumption reduction), using an innovative rigid insulation system.

Energy savings: The 360 m² of office space achieved factor 10 by changing their energy consumption from 413 to 37.1 kWh/m²/year.

Project description:	95 Boulevard Beaumarchais is in a central urban environment, acquired in November 2009 by the "Compagnie des Architecteurs" to make it into their head office. The premises extend over two levels within a building dating from the end of the 18th century. The "Architecteurs" have been working for more than 3 years within the "Adélie" Programme, financed by the "Bâtiment Energie" Foundation. The future head office of the "Architecteurs" is a symbol of this desire and has been renovated on the basis of these principles.
Project Objective:	The 360 m² of office space will achieve factor 10 by changing their energy consumption from 413 to 37.1 kWh/m²/year.
Thermal insulation solution chosen:	For the vertical walls: 160 mm polystyrene panels λ = 0.029 W/(m.K) with a reflective membrane in weldable polyethylene aluminium. The panels were fitted with a plasterboard system. The 1st inner partition with a plasterboard finish equipped with rigid insulation, needing no adhesive or screws. It enables cables and sheaths to be fed through on the warm side and optimum insulation control.
Energy efficiency performance of the solution:	Original U-value, 1.09 W/m²K ; U-value after renovation, 0.145 W/m²K. Before 413 kW/h/m²/year ; After 37.1 kW/h/m²/year. Heating, hot water and lighting
Costs of the solution:	The complete renovation costs for the building are estimated to be €1,500 / m².
Costs savings of the solution for the owner:	A very effective solution for reducing energy consumption costs.
Benefits for the owner:	A real major improvement in the building's energy performance.
Innovative character of the solution:	▸ A new concept in inner partitions with rigid insulation; ▸ Very easy to use; ▸ Continuous, consistent insulation thickness over the whole surface area; ▸ Checking that insulation is perfect before fitting plasterboards; ▸ Cable and sheath feed-through on the warm side, without breaching the thermal insulation; ▸ All processes are dry, which enables work to be carried out even in cold weather.

9. See Glossary for more details

CASE STUDY N°5

c. Preventing Thermal Bridging by combining Internal and External Insulation Techniques

Addressing thermal bridging via the installation of insulating cabinets for interior floors

The combined interior and exterior insulation system was chosen to address potential thermal bridging and condensation issues, while providing a 97% energy saving.

Energy Savings: The primary energy consumption was reduced from 421 kWh//m²a) to 13 kWh/(m²a), which represents a 97% saving.

Project description:	Block 300 is an existing building belonging to an urban housing association, built between 1920 & 1950 (Germany).
Project Objective:	An important condition of the NUWOG (public housing association) characterizes the thermo-technical renovation of the building, with the stipulation that no thermal insulation composite system should be installed. Relevant for this guideline is also the fact that all four buildings are property line structures and the application of exterior insulation would protrude onto public grounds. After the renovation, the KFW 40 standard[10] had to be achieved.
Thermal insulation solution chosen:	**Solid Walls** A furring consists of metal profiles and mineral wool cladding with gypsum board was installed. **Interior Floor** Metal profiles was installed on the ceiling. In the space between the profiles polystyrene insulation was installed. This serves for the avoidance of thermal bridging and consist of a 50 mm layer of mineral wool incorporated into an independent furring. **External insulation** A 60 mm thick layer of insulation plaster with Perlite-aggregate was applied on the exterior thermal conductivity λ = 0,07 W/mK and coated with a scratch plaster system corresponding to the colour concept of the architect
Energy efficiency performance of the solution:	Before: 421 kWh /(m² per year) After: 13 kWh /(m² per year) Energy saving of the building: 97%
Costs of the solution:	With renovation costs below 1000 €/m² (cost type 300- 400 according to DIN 276) the pilot project shows that a sustainable and value-preserving renovation with KfW 40 standard for municipal housing associations is financially feasible.
Benefits for the owner:	The internal thermal insulation evokes a high surface temperature on the walls inside and results in an improvement of the living climate.
Innovative character of the solution:	The evaluations took into consideration the probability that cabinets may be positioned against the inside of exterior walls. The examination of several wall constructions with respect to temperature progression indicated that the planned insulation measures (interior insulation and exterior insulation plaster) were not sufficient to prevent the formation of condensation behind cabinets. Therefore, it was not possible to reach the energy efficiency of 40 kWh per m² per year just with the exterior insulation plaster. To reach this target an additional interior insulation was installed. Economical and safety related building physics solutions have emerged in a dialogue between companies for the reliable insulation of the thermal bridges

10. See Glossary for more details

CASE STUDY N°6

d.Preventing Dampness

Installation of glued composite board (plasterboard + insulating layer) on walls. Ceilings treated with plasterboard and insulating layer to insulate the interior floor.

The internal insulation solution was the sole option for meeting the insulation requirements required by law and stakeholders for a listed historic building. Interior floors were insulated to prevent dampness in the construction.

Energy savings: 190 kWh /(m^2 per year).

Project description:	Renovation project in Papenburg, Germany involving comprehensive conversion of a Wilhelminian style mansion built in 1903, to meet current standards for aesthetics, safety, accessibility and energy savings.
Project Objective:	The aims of the project: ▸ redesign the interior, optimising net interior surface area; ▸ optimise energy efficiency in line with German regulations (EnEV)[11].
Thermal insulation solution chosen:	▸ Composite panel made of gypsum board and expanded polystyrene. ▸ A heat transfer coefficient of 0.35 W (m2·K) was achieved with a system thickness of only 60 mm. ▸ Lightweight board in optimised 625 mm width format facilitated handling, installation, including required cut-outs, final finishing.
Energy efficiency performance of the solution:	**Value** Final Energy Demand (before / after values) : 274 kWh /(m^2 per year) 85.44 kWh /(m^2 per year) **U-value of exterior walls (before / after values):** 0.88 W/(m^2.K) 0.35 W/(m^2.K)
Costs savings of the solution for the owner:	**Monetary value** Estimated savings of approximately 5.400 € per year (190 kWh /(m^2 per year) (estimated oil price: 0.6 €/ litre).
Benefits for the owner:	**Qualitative value** After refurbishment, the building has an overall energy demand equivalent to a modern construction, in line with the German energy efficiency regulations (EnEV)[12].
Innovative character of the solution:	**Benefits at all project stages** The solution responded fully to the requirements of all stakeholders: ▸ energy saving and building exterior conservation targets met ; ▸ interior design flexibility, high aesthetic standards achieved ; ▸ reduced installation and finishing time for contractor (ease and speed of handling) ; ▸ potential problems relating to condensation / mould growth resolved in design ; ▸ return on investment (significant annual energy savings).

11. See Glossary for more details
12. See Glossary for more details

IV. New construction with Internal Insulation Techniques

A. Introduction

For new constructions, the energy efficiency is optimised at the design stage according to the European and national regulation and certification systems.

Conforming to strict energy efficient legislation is however also affordable for family houses. This is what we wish to highlight in cases 7 and 8.

Alternative building techniques - wood frame construction (renewable and recyclable material) - are more typical in Nordic countries but the concept can be extended in Western and Eastern European countries as a sustainable alternative to traditional bricks and stone methods of construction (see case 10).

Case 7 and 8 show that internal insulation is a financially viable and technically convenient solution for southern European countries.

CASE STUDY N°7

B. Affordable Family Home

Treatment of ground floor using expanded polystyrene blocks

Low energy consumption according to BBC certification[13]. Optimised design based on the use of traditional thermal insulation products and techniques applied from the inside with a view to reducing building and operating costs, to make this home accessible to first time buyers.

Energy savings: Primary energy consumption: 36 kWh of primary energy consumption per sq. metre, per year based on an independant external thermal survey.

Project description:	The Ars Vivendi "Puissance 4" single family home intended for first time buyers.It won the Gold Medal in the "First Home, no Pass Foncier" category handed out by Union des Maisons Françaises (UMF) in December 2009 in Copenhagen.
Project Objective:	▸ Build a single family home at low cost that qualifies for the BBC-Effinergie, French energy efficiency label[14]. ▸ Prove the feasibility of sustainable building with a cost effective, energy efficient and environmentally friendly approach using technically certified quality materials regularly used in traditional construction projects.
Thermal insulation solution chosen:	The chosen solution uses thermal insulation applied from the inside with: **External walls:** Gypsum plasterboard thermal insulation composite panels (Grey EPS 10 + 80, R = 2,55 m2.K/W) sticked on the internal face of hollow concrete blocks. **Attic:** blown-in rock wool (36 cm, R = 9 m2.K/W) over plasterboard ceiling **Ground floor:** concrete floor with prefabricated concrete beams and EPS blocs of 120mm (Up = 0,36 W/ m2.K). To complete the isolation and weatherproofing of the building, the PVC window frames and aluminium sliding doors are all fitted with 4/16/4 argon gas double glazing for low heat emissions. The roller shutters provided for the sliding doors are included in insulated casings.
Energy efficiency performance of the solution:	Primary energy consumption: 36 kWh of primary energy consumption per sq. metre, per year (below the low energy consumption building threshold of 40 kWh per sq. metre in the climate area where the construction project is located) based on an independent thermal survey. Achieving BBC-Effinergie certification[15].
Costs of the solution:	A "Puissance 4" home is offered at a price of €99,000 for a usable floor area of 83 sq. metres with a living room and two bedrooms (i.e. a cost of less than €1,200 per sq. metre excluding land) with the provision of a terrace, a car port and a technical facility to be assembled by the customer. The concrete foundations for these ancillaries are poured.
Benefits for the owner:	**Controlled costs** with the provision of the terrace, the car port and the technical facility to be assembled by the customer. The concrete foundations for these ancillaries are poured. **A modular home:** Its compact dimensions are compatible with small land areas (352 sq. metres) and the building takes on a contemporary appearance thanks to a ready to assemble kit of wooden extras (technical facility, terrace and car port) that bring the covered area up to 133 sq. metres. **Limited operating costs:** 36 kWh of primary energy consumption per sq. metre of floor area (SHON) as set out in the building permit. The chosen technical equipment (single flow hygro-adjustable ventilation, a condensation boiler, a solar heating and hot water system with 2 sq. metres of solar panels and 300 litre hot water tank) all play a part in the energy efficiency of the whole. **A durable home:** building applies conventional construction approaches, well known to the majority of building professionals.
Innovative character of the solution:	Optimised design based on the use of traditional thermal insulation products and techniques applied from the inside with a view to reducing building and operating costs so as to make this home accessible to first time buyers.

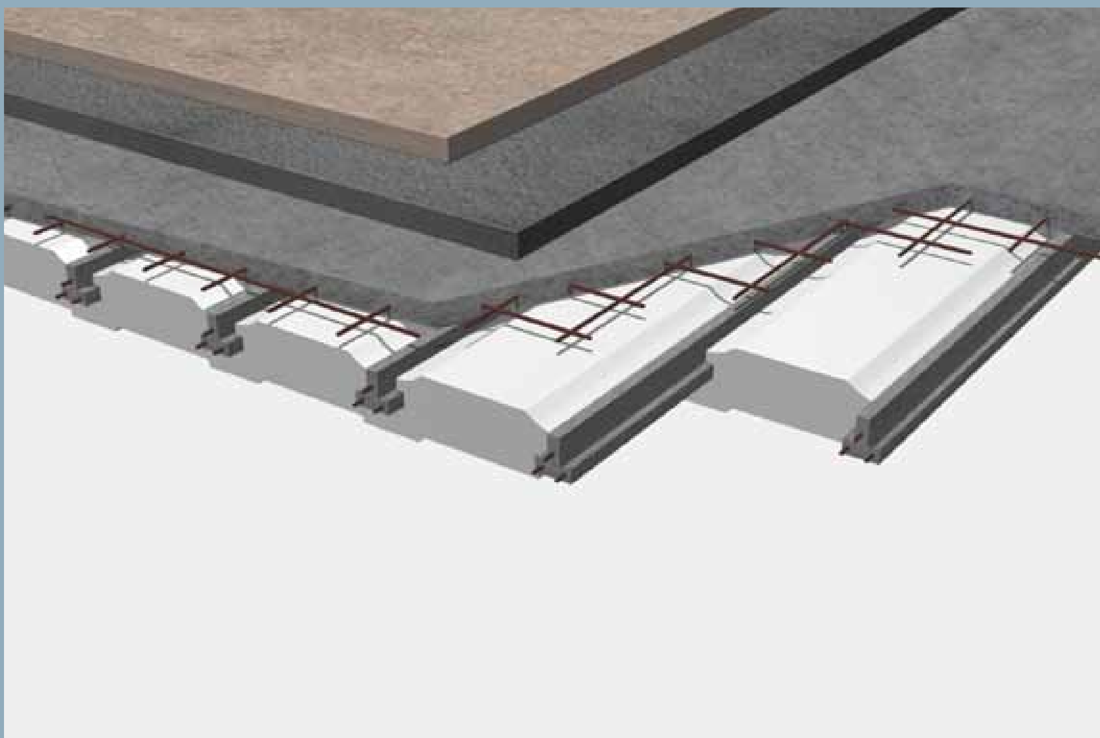
13. See Glossary for more details
14. See Glossary for more details
15. See Glossary for more details

CASE STUDY N°8

C.Bioclimatic Design

Installation of a laminate system (plasterboard = insulation panel)

Groundfloor



The single family house was designed and built according to the BBC certification[16] using bioclimatic design to achieve higher environmental and energy efficiency performance.

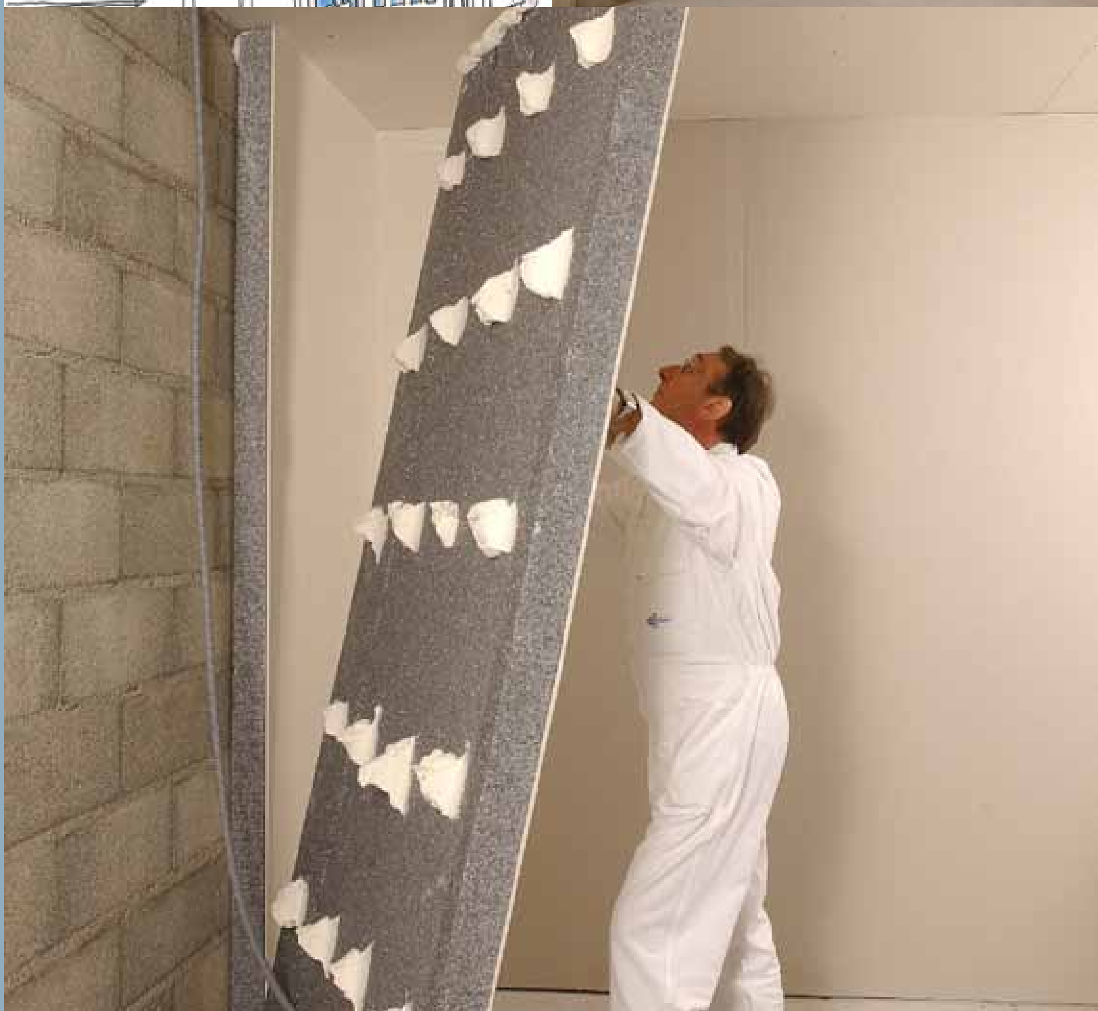
Energy savings: Overall energy consumption is less than 48 KWh of primary energy consumption per sq. metre per year according to the thermal survey work performed by an external independent consultant.

Project description:	BBC[17] single family home awarded by Union des Maisons Françaises (UMF) with a Gold Medal in the "City Dwellings" category.
Project Objective:	Show that it is possible to design and build an energy efficient building using existing materials and the most commonly used and best understood construction techniques.
Thermal insulation solution chosen:	The chosen solution uses thermal insulation applied from the inside with: **A ground floor** (insulation rating of R = 4.8 m2°K/W) with underfloor insulation and a layer of insulation over the slab under the floating surface layer. **Intermediate floor level:** Prefabricated concrete beams with a concrete compression slab and insulating interjoints sections of flooring. **Walls:** Concrete blocks using thin joints and high performance thermo-acoustic lining complexes affixed to a graphite grey expanded polystyrene panel. **Attic:** 29 cm of blown-in rock wool over a 13mm plasterboard ceiling.
Energy efficiency performance of the solution:	Overall energy consumption is less than 48 KWh of primary energy consumption per sq. metre per year according to the thermal survey work performed by an external independent consultant. This level is therefore within the limits set for the BBC label at 50 kWh per sq. metre per year. Related equipment: Gas fired condensation boiler coupled to an individual solar powered water heater and a heated floor, single flow hygro-adjustable ventilation and solar panels.
Costs of the solution:	Building cost : €142.000. Rent value : €850/ month.
Costs savings of the solution for the owner:	The annual cost of energy consumption is estimated to be €1,021.06 including VAT which breaks down as follows: ▸ Heating: 6,627 kWh or €330.53 incl. VAT, ▸ Domestic hot water: 746 kWh or €37.22 incl. VAT, ▸ Ventilation: 317 kWh or €34.06 incl. VAT, ▸ Miscellaneous (estimated power consumption of domestic appliances + ancillaries): 4,415 kWh or €406.04 incl. VAT, ▸ Utility contracts (single rate 6 KVA supply + B1/3 Gb price scale): €213.80 incl. VAT.
Benefits for the owner:	**The environmental and energy efficiency of the construction with:** > Bio-climatic design for greater comfort, > Excellent thermal insulation and good draught proofing for improved energy efficiency and lower operating costs. **A level A energy label** based on Energy Performance Diagnostics (DPE)[18].
Innovative character of the solution:	Designing and building an energy efficient home (achieving BBC level goals and a DPE level A label[19]) using existing materials and the most often used and best understood modes of construction.

16. See Glossary for more details
17. See Glossary for more details
18. See Glossary for more details
19. See Glossary for more details

CASE STUDY N°9

D.Combining Internal and External Insulation



In many cases (especially mid terraced houses), the optimum solution may be to install a combination of external and internal wall insulation.

An external insulation system may suit the back of a house, where appearance is less important, or already compromised by single storey extensions, outriggers, soil stacks, rainwater downpipes and boiler flues. The front of the house can be insulated with an internal insulation system which maintains aesthetic quality, while also delivering high levels of thermal performance and a flexible installation solution.

In this specific case, the project constraints led to the full rethinking of the building's structural design, using a mix of internal and external insulation technologies, and choosing a different solution for each façade.

Energy savings: Primary energy consumption of 81 kWh/m²/ year which represents a saving of 35% in relation to thermal regulation RT 2005[20].

Project description:	This project involved the construction of a new 6 floors apartment block built on a cramped parcel of land, between other buildings in a city with a high cost per square metre for accommodation. This project was based in France.
Project Objective:	To justify a selling price of 10K€ / m², it was important to optimise the quality of the insulation technology (thermal and acoustic performance) as well as net surface area for this small apartment block.
Thermal insulation solution chosen:	**Roofing:** 20 panels (thickness of 180mm). **Building Façade:** external thermal insulation 150mm + an exterior mineral finishing coating and internal thermo-acoustic composite lining. **Floor:** Insulation with underfloor 50mm panels. Rock wool was projected in the parking area.
Energy efficiency performance of the solution:	Primary energy consumption of 81 kWh/m²/ year which represents a saving of 35% in relation to French thermal regulation RT 2005[21].
Costs savings of the solution for the owner:	**Monetary value** Approximately 13.3m² of net surface area was gained due to the chosen solution, representing a saving of around 130K€ for the property developer.
Benefits for the owner:	**Qualitative value** This solution provided a high level of thermal and acoustic comfort, while also optimising the net interior surface area, allowing the property developer to maximise the return on investment.
Innovative character of the solution:	Project constraints led to a full rethinking of the building's structural design, using a mix of interior and exterior insulation, and choosing a different solution for each façade.

20. See Glossary for more details
21. See Glossary for more details

CASE STUDY N°10

E. Wood Frame Construction according to High Environmental Quality Standards

The case study covers roofs, walls and floors in new built construction.

The wood frame construction was built according to rigorous HQE standards[22] and achieved BBC (Bâtiment Basse Consommation) certification[23]. This office served as a showcase for the architect's "Natural Positive Building" concept.

Energy savings: Energy consumption of 45 kWh per year (of which only 15 kWh / m² per year for heating) => D.P.E. Class A. (low energy consumption bracket)[24].

Project description:	This project involved the construction of a wood frame office building, combining energy efficiency and high environmental quality standards, to serve as a showcase for the architect's "Natural Positive Building" concept. The project is located in France.
Project Objective:	The aim of this project was to meet rigorous HQE (Haute Qualité Environnementale)[25] and BBC (Bâtiment Basse Consommation)[26] certification requirements for a wood frame office building. For the HQE certification, the architect wanted to cover all 14 criteria.
Thermal insulation solution chosen:	**Roof:** glass wool + climatic membrane + 18mm plasterboard. **Walls:** glass wool, membrane + plasterboard. **Floors:** 2 coats of 70mm underfloor insulation. **Windows:** glass double glazing (Uw = 1.3) and triple glazing (Uw = 1.1).
Energy efficiency performance of the solution:	Energy consumption of 45 kWh per year (of which only 15 kWh / m² per year for heating) => D.P.E. Class A= low energy consumption bracket.
Costs of the solution:	**Monetary value** The project cost 800K€.
Costs savings of the solution for the owner:	**Monetary value** Operating costs were divided by 3, thanks to high focus on optimising the integration of the building with its environment.
Benefits for the owner:	**Qualitative value** ‣ Thermal comfort thanks to inertia and controlled ventilation. ‣ Acoustic comfort. ‣ The complex met all the energy efficiency requirements in the project specifications.
Innovative character of the solution:	In this case insulation provided high performance thermal insulation solutions, in line with HQE methods and BBC certification.

22. See Glossary for more details
23. See Glossary for more details
24. See Glossary for more details
25. See Glossary for more details
26. See Glossary for more details

V. Applying Sustainable Technical Design to maximise Effective Internal Insulation Systems

A. The Basics

The energy performance of a home reaches its highest potential when the home is thought of as a combination of separate but integrated systems that include insulation, moisture control, ventilation and air sealing. Combined, these make up the full thermal performance of the home. All materials used in building construction combine to deliver the overall performance.

B. Preventing Thermal Bridging

We refer to case study n°5 for a practical example of the way to prevent thermal bridging.

A thermal bridge is a component, or assembly of components, in a building envelope through which heat is transferred at a substantially higher rate than through the surrounding envelope area. Thermal bridges increase the building energy demand for heating and cooling. R-value is the measure of how well insulation resists the flow of heat or cold. Higher R-values mean greater insulating power. Whole wall R-value is a concept that takes into account the gaps in insulation (at windows, doors, studs, voids, etc.).

The basic approach to minimising thermal bridging is to design a wall system with a thermal envelope (insulation layer) that is continuous at all interfaces. This insulation layer must therefore completely cover either the inside or outside of concrete or steel building membranes.

Thermal bridges can be avoided through an adequate structural composition and through insulation of the existing thermal bridges. These issues are important not only for energy saving and costs reduction, but also for the increase of the building's lifetime.

When a wall is insulated internally, there are unavoidable thermal bridges at the junctions with internal partitions, separating walls and floors. At window and door openings, the insulation should always be returned into the reveal and the soffit, otherwise there is a high risk of condensation occurring on un-insulated reveals. Where an independent steel framework is used as the lining, there should always be a continuous layer of insulation on one side of the steel frame to avoid severe thermal bridging through the steel members.

C. Minimising Air Infiltration throughout the Building Envelope

Each building is a combination of systems. Optimal thermal protection for a building comes with proper air sealing and insulation. And, in fact, the only way to stop air infiltration is to properly seal the building envelope.

Air infiltration behind an insulated lining, and through gaps and cracks in the wall behind, reduce the thermal performance of the wall.

The design should incorporate an air barrier to reduce air leakage. This can be:

- A parging coat on the inside of the external wall;
- Continuous ribbons of adhesive behind a rigid insulation backed plasterboard along the top and bottom of the wall, at internal and external corners and around all openings and service penetrations;
- A layer of plasterboard sealed at all junctions, with a flexible sealant used at the floor junction and around openings and service penetrations;
- A separate vapour control layer.

D. Anticipating Condensation in the Construction

All air contains a certain amount of 'invisible' water vapour. The higher the temperature of the air the more water vapour it can hold. Condensation frequently occurs when air carrying vapour comes into contact with a cool surface. At this reduced temperature less water can be held and it is deposited.

In order to minimise the risk of condensation forming on the cold internal surface of the external wall, it is essential to have a vapour control layer on the warm side of the insulation.

Furthermore, the following will help limit the amount of warm room air getting behind the insulation:

- Seal the joints at the junctions between the dry lining and surrounding walls and floors ;
- Keep the number of service penetrations to a minimum ;
- Seal around penetrations, such as waste pipes, with an expanding foam.

E. Dealing with Dampness in Existing Walls

We refer to case study n°6 for a practical example of the way to prevent dampness.

Dry lining should not be used to treat a dampness problem. Any dampness in an existing wall should be cured before internal insulation is installed. Existing solid walls may be temporarily suffering from damp following treatment for rising damp or after curing rain penetration problems or rectifying leaking gutters or downpipes.

Polyfoam extruded polystyrene has high moisture resistance and its thermal performance is unaffected by moisture, making it an ideal insulant for use on solid walls which may not be completely dry.

Where doubts remain about the resistance of the wall to rain penetration (despite repointing or rendering), an insulated independent lining should be used. The independent lining should be placed at least 25mm clear of the existing masonry. A collection and draining device for possible water infiltration must be laid at the foot of the insulating material. The resulting cavity is in fact ventilated to the outside. The air blade is thus ventilated to the outside. Particular care is needed to seal the insulated lining at the perimeter, at all service penetrations and around openings.

VI. Overview of the Case Studies

Building	Energy savings	Cost savings	Innovation
Renovation of Building			
Standard Renovation			
Case study n°1			
Refurbishment of 1970's Apartment	0.3247 W/m²K.	Not available.	System with excellent thermal performance: the advantage of having a clean site with great flexibility to accommodate the plant and the ability to hang or furnish the walls with heavy items or furnishings due to the high mechanical strength of the panels.
Case study n°2			
Listed Historic Building	Primary energy consumption reduced from 146.81 kWh/(m²a) to 68.93 kWh/(m²a), which is 53% saving.	Not available.	High quality heat protection with λ=0,032 W/(mK) : ▸ reduction of the insulation thickness with equal thermal insulation (living space was optimised).
Optimised design for renovation cases			
Case study n°3			
90% energy savings (to BBC standards)	Energy consumption was divided by 10. Move from D.P.E. Class G (828 kWh/m² / year) to D.P.E. Class B (87 kWh/m² / year)	The renovation cost 92K€ including 32K€ for the building structure and equipment. For the same overall project cost, the cost/ performance ratio was greatly improved, compared to the level of insulation which existed prior to the renovation.	By approaching the renovation project from the building structure's thermal insulation performance angle, adapted heating equipment using renewable energy sources was introduced, and overall, superior thermal performance was obtained at no additional total cost.
Case study n°4			
90% energy savings (beyond BBC standards) Adélie programme	Original U-value, 1.09 W/m²K U-value after renovation, 0.145 W/m²K Before 413 kW/h/m²/year After 37.1 kW/h/m²/year.	The complete renovation costs for the building are estimated to be €1,500 / m².	A new concept in inner partitions with rigid insulation has been used.
Case Study n°5			
Preventing thermal bridging by combining internal and external insulation	Primary energy consumption reduced from 421 kWh//m²a) to 13 kWh/(m²a), which is 97% saving..	By using internal insulation, you save costs. With renovation costs below 1000 €/m² the pilot project shows that a sustainable renovation is financially viable.	Ability to reduce thermal bridges and condensation. Economical and safety related building physics solutions have emerged in a dialogue between companies for the reliable insulation of the thermal bridges.

Building	Energy savings	Cost savings	Innovation
Case study n°6			
Preventing dampness	Estimated savings of approximately 190 kWh /(m² per year)	Estimated savings of approximately 5400 € per year (190 kWh /(m² per year x estimated oil price: 0.6 €/ litre).	The solution fully met the requirements of stakeholders: energy saving and building exterior conservation targets were met; interior design flexibility and high aesthetic standards were achieved; reduced installation and finishing time for the contractor due to ease and speed of handling; potential problems relating to condensation and mould growth resolved in design.
Build new with internal insulation techniques			
Case study n°7			
Affordable Family Home	Primary energy consumption: 36 kWh of primary energy consumption per sq. metre, per year (below the low energy consumption building threshold of 40 kWh per sq. metre in the climate area where the construction project is located) based on the thermal survey work performed by external consultants.	A "Puissance 4" home is offered at a price of €99,000 for a usable floor area of 83 sq. metres with a living room and two bedrooms (i.e. a cost of less than €1,200 per sq. metre excluding land) with the provision of a terrace, a car port and a technical facility to be assembled by the customer.	Designing and building an energy efficient home (achieving BBC level goals and a DPE level A label) using existing materials and the most often used and best understood modes of construction.
Case study n°8			
Bioclimatic design	Overall energy consumption is less than 48 kWh of primary energy consumption per sq. metre per year according to the thermal survey work performed by external consultant. This level is therefore within the limits set for the BBC label at 50 kWh per sq. metre per year. Related equipment: Gas fired condensation boiler coupled to an individual solar powered water heater and a heated floor, single flow hygro-adjustable ventilation and solar panels.	Building cost : €142.000 Rent value : €850 each month The annual cost of energy consumption is estimated to be €1,021.06.	Designing and building an energy efficient home (achieving BBC level goals and a DPE level A label) using existing materials and the most often used and best understood modes of construction. The environmental and energy efficiency of the construction with: ▸ Bio-climatic design for greater comfort, ▸ Excellent thermal insulation and good draught proofing for improved energy efficiency and lower operating costs.
Case study n°9			
Combining Internal and External Insulation	Primary energy consumption of 81 kWh/m²/ year which represents a saving of 35% in relation to thermal regulation RT 2005.	Approximately 13.3m² of net surface area gained due to the chosen solution, representing a saving of around 130K€ for the property developer.	Project constraints led to fully rethinking the building's structural design, using a mix of interior and exterior insulation, and choosing a different solution for each façade.
Case study n°10			
New Build Wood Frame Construction	Energy consumption of 45 kWh per year (of which only 15 kWh / m² per year for heating) => D.P.E. Class A.	The project cost 800K€ Operating costs were divided by 3, thanks to high focus on optimising the integration the building with its environment.	Wood frame construction was built according to rigorous HQE standards (see annex I) which led to longer term operating cost savings. The building of this office served as a showcase for the architect's "Natural Positive Building" concept.

VII. Conclusion

As the 10 case studies illustrate, internal insulation techniques:

- **provide high performance insulation systems for both refurbishment and new-buildings:** high energy savings are obtained, at reasonable cost, using conventional building techniques, which are well-known. We have reduced investment and operating costs;
- **Greatly improve comfort of home owners:** solutions can provide increased luminosity, a more even temperature in winter and summer, providing a general improvement in living environments;
- **Are adapted for all kind of situation (renovation and new buildings);**
- **Are technically fit for state of the art thermal insulation;**
- **Require a collaborative approach** with stakeholders and public authorities;
- **Preserve the façade** while optimising the building's energy consumption, interior surface space, design, aesthetics and comfort.

The European Gypsum Industry is conscious that these technologies and the required know-how still need to be properly transferred across Europe. Internal insulation systems are widely used in France and Nordic countries, are starting to be implemented in Germany, and are only occasionally used in Southern and Eastern Europe.

With the recently adopted recast of the Energy Performance Buildings Directive (scope widened to include renovation) and the Commission proposal for an Energy Efficiency Directive with a mandatory target for refurbishment of public buildings, the Gypsum Industry will promote those technologies and know-how in the respective Member States to foster win-win cooperations in terms of cost-effectiveness and energy efficiency performance.

Glossary

KFW 40 standard - Germany

KfW banking group is a German government-owned development bank, based in Frankfurt. KfW Förderbank (KfW Promotional Bank), the largest business unit of the group, committed EUR 33.8 billion in 2008, mostly for housing and environmental protection in Germany. It is especially active in promoting energy-efficient housing for owner-occupied houses as well as for landlords, both for new houses and refurbishments. Its energy efficiency standards for houses (KfW-60 and KfW-40) have become accepted standards in Germany

KFW 40 standard= final energy demand less than 40 kWh per m² per year.

Germany Energy Conservation Regulations for Buildings (EnEV 2009)

http://www.zukunft-haus.info/index.php?id=11883

The Energieeinsparverordnung (EnEV), or Energy Conservation Regulations, is Germany's energy efficiency building code. One of the most stringent codes in the world, the EnEV sets standards for insulation, fenestration, envelope, and HVAC. The code was passed originally in 2002, and,meets requirements for the EU EPBD.

The German Energy Conservation Act 2009 contains a number of major changes compared to EnEV 2007. The primary energy consumption for heating, hot water and air conditioning of new residential buildings has to be at least 30 percent below the maximum values prescribed by EnEV 2007. The energetic requirements to be met by the building shell will also increase: as of next year, transmission heat losses have to be cut by at least 15 percent compared to the current regulations.

RT 2005 –France

The principle of the RT 2005 is to compare the building studied in a reference building, geometrically similar, but the technical pre-defined in the regulations.

OBJECTIVE

The building should be considered better than the reference case, in other words, to be more isolated and consume less energy.

INSULATION

Insulation is characterised by the amount of thermal energy loss through the walls (walls, floor and ceiling below) when the temperature difference between inside and outside the building is 1°C per unit time and reported on the surface of the building envelope. (Ubat in W / m² K)

ENERGY

Consumption is expressed in primary energy, that is to say, energy consumed in nature to produce the energy actually consumed in the building.

RT 2012 - France

In accordance with Article 4 of the Act Grenelle 1, RT 2012 aims to reduce the primary energy consumption of new buildings to a maximum of 50 kWhEP / (m^2. Year) on average, whilst creating:

- a significant industrial and technological development in all sectors of the building and equipment,
- a high level of energy quality of buildings, regardless of the choice of energy system technical and economic balance between the energy used for heating and producing hot water.

The Thermal Regulations 2012 will apply to all building permit applications submitted:

from October 28, 2011 for new buildings in the tertiary sector, and public buildings for residential use area built ANRU, from 1 st January 2013 for all other types of new buildings

Bâtiment Basse Consommation (Building Low Power) - France

A low energy building in accordance with regulations RT2005 is a building with a conventional primary energy consumption for heating, cooling, ventilation, hot water production, lighting and technical aids (pompes. ..) is 80% less consumption regulations.

The main principles to achieve this goal are:

1. A bioclimatic design of the building or house (compactness, orientation, treatment of façades orientation, natural light) can approach this goal at a lower cost.
2. High thermal insulation of 30 cm significantly reduces heating requirements. This insulation is preferably outside in case of masonry or concrete walls to protect the inertia or distributed in case of construction cranes in timber frame, with the aim to limit thermal bridging.
3. A perfect airtightness of the exterior and networks. In addition to limiting heat loss through air leakage directly, this ensures the best term sustainability of the building (insulation, structure, etc.)..
4. Good performance of technical equipment (lighting, boilers, pumps ...) and designed to get the best performance (no oversize).
5. Only then the question of how heating arises. Gas, wood, geothermal (electric) heat pump (electric), etc.. regulations require, beyond a certain area, a comparative study on 20 years of various heating means provided by considering the predicted increases in the cost of energy. It also requires a possibility of reversal of the heating mode.
6. Renewable energy, although very virtuous, provide only small savings in comparison points listed above. It should be noted that the installation of solar cells does not reduce the consumption of a building and that the sensors for the hot water must be properly sized to avoid overheating and thus worsen performance in summer.

Label Building Low Energy (BBC 2005) - France

In parallel with the generic "Building Low-Power", a label was created with the name of Building Low Energy (BBC 2005). This is an official standard, which was created by the decree of 3 May 2007 on the content and conditions of award of the "Eenergy Efficiency Label". It gets its inspiration from the Swiss label Minergie .

The promotion of this standard and guidance on its implementation are made by the ADEME , the CSTB and EDF.

The standard sets (for new dwellings) an energy requirement of 50 kWhep / (m^2 SHON . year) (kWhep: kWh of primary energy, as defined by the RT 2005). For commercial buildings, the baseline must be calculated individually.

Compared with new construction, renovation, which represents the greatest potential for energy savings, sets the consumption target in the same frame - 80 kWhep / (m^2 SHON.an) (kWhep: kWh of primary energy). This energy requirement is corrected by the same coefficient of rigorous climate, as the BBC in 2005.

The label **Low Consumption - Renovation** (Renovation BBC or BBC 2009) certifies:

- compliance of renovated buildings to a specification that incorporates the requirements of the thermal regulation of existing buildings provided for in the Code of Construction and Housing;
- compliance with a minimum level of overall energy performance and comfort in summer and the control procedures, the decree of September 29, 2009. For this label, the homes will see a renewed energy use between 64 and 120 kWh / m^2 / year.

BBC Effinergie - France

It is a label that sets the primary energy consumption in the home 9 to 50 kWh / m^2 and 80 kWh / m^2 / year in the existing housing (to be modulated according to climatic zones by a factor of 0.9 to 1.3). The organisation is Effinergie, a reference in France for setting standards **Building Low-Power** or BBC.

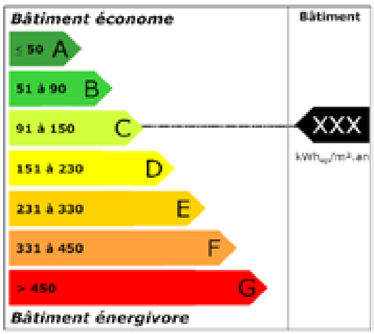
http://www.effinergie.org/site/Effinergie/

Adélie Programme – France

http://www.architecteurs.fr/adelie.html

Adélie program, supported by the Foundation Building Energy is the division 4 by emissions of greenhouse gases emissions in existing housing. The cheapest energy is energy saved. Adélie method gives priority to the increased insulation of the envelope, the solar heat, renewable energy and air quality.

DPE – France



The **energy performance** or **ECD** is a diagnosis made in France in real estate. It is a material part of the record of diagnostic techniques (DDT).

ECD must be presented at the sale or rental of housing and commercial buildings (offices, hotel, etc..) since 1 st July 2007.

It aims to inform the owner and tenant of the energy consumption of domestic housing commercial building on its heating, the air, its production of hot water (DHW), but not on the specific electricity lighting, appliances , etc.)..

We go from the annual consumption in final energy to primary energy consumption in kWh-ep / m 2 / year.

- 0-50 Class A - the most efficient new homes; difficult to achieve under renovation but achievable for new construction housing in accordance with the regulatory label "low energy buildings"
- From 51 to 90 Class B- achievable in new construction subject to the availability of a system of efficient heating and hot water (heat pump, condensing boiler system, solar ...), reached by renovation, and certain new buildings conforming to the regulatory label "low energy buildings"
- 91-150 Class C. - standard in new construction of gas-heated homes in France (RT 2005, for example, imposes up to Paris-ep 130 kWh / m 2 / year).
- 151-230 Class D - standard in new construction of homes heated by electricity in France (RT 2005, for example, imposes up to Paris-ep 250 kWh / m 2 / year) Standard 80 and 90 years for fuel heaters. Substantial improvements are easily achievable by including the replacement of the boiler and loft insulation and windows, or switching to a heat pump for electrical systems.
- 231-330 Class E - housing before the first oil shock or existing homes heated with electricity.
- 331-450 Class F - existing homes generally built between 1948 and 1975. The cost savings are very important, the economic return (ROI) is evident.
- 451 - ... G

HQE –Sustainable Building Rating Tools – France

http://assohqe.org/hqe/

14 key targets must be reached to obtain HQE certification:

Ecoconstruction Targets

C1. Harmonious link between the building & its immediate environment

C2. Integrated choice of products, systems, construction methods

C3. Building site which creates low levels of nuisance

Eco-management Targets

C4. Energy management

C5. Water management

C6. Waste activity management

C7. Maintenance and repair management

Comfort Targets

C8. Hygrothermal comfort

C9. Acoustic Comfort

C10. Visual Comfort

C11. Olfactory Comfort

Health Targets

C12. Sanitary quality of the environment

C13. Air quality

C14. Sanitary quality of the water

To comply with the HQE approach a building must fulfil as a minimum:

3 targets at a high performance level

4 targets at a performance level

7 targets at a basic level

MEMBERS' LIST

AUSTRIA

WKO – Fachverband Steine-Keramik
Wiedner Hauptstrasse 63
A-1045 Wien
Tel: +43 (0) 5 90 900 3531
Fax: +43 (0) 1 505 62 40
steine@wko.at
www.baustoffindustrie.at

BELGIUM AND LUXEMBURG

ABLG – Association Belgo-Luxembourgeoise de Gypse / BLVG – Belgisch Luxemburgse Gips Vereniging
Sint Jansweg 9, BE-91930 Kallo (Belgium)
Tel: (32-3) 360 25 52
Fax: (32-3) 360 25 53
blgv.ablg@gyproc.be

FRANCE

SNIP – Syndicat National des Industries du Plâtre
3, Rue Alfred Roll, F-75017 Paris
Tel: (33-1) 44 01 47 75
Fax: (33-1) 40 54 03 28
jmguihaume@lesindustriesduplatre.org
www.lesindustriesduplatre.org

GERMANY

Bundesverband der Gipsindustrie e.V.
Kochstrasse 6-7
D-10969 Berlin
Tel: (49- 30)-311 69 822-
Fax: (49-30)--311 69 822-9
info@gips.de
www.gips.de

ITALY

Assogesso (Member of CAGEMA)
Piazza G. Marconi 25,
I-00144 Roma
Tel: (39-06) 5421 0198
Fax: (39-06) 5921 533
info@assogesso.it
www.assogesso.it

NORDIC COUNTRIES (SWEDEN, NORWAY, DENMARK, FINLAND)

NGF – Nordisk Gipspladeforening
Confederation of Danish Industries
H.C. Andersens Boulevard 18,
DK-1787 Copenhagen V
Tel: (45-33) 77 33 77 -
Fax: (45-33) 77 39 80
jn@di.dk

POLAND

PSG – Polskie Stowarzyszenie Gipsu
Mokotowska 4/6,
PL-00-641 Warsaw
Tel: (48-22) 825 28 23
Fax: (48-22) 606 259 460
sekretarz@polskigips.pl
www.polskigips.pl

SPAIN

Atedy – Asociación Técnica y Empresarial del Yeso
C/ San Bernardo 22, 1°,
E-28015 Madrid
Tel: (34-91) 532 63 54
Fax: (34-91) 532 94 78
gerencia@atedy.es
www.atedy.es

THE NETHERLANDS

NBVG – Nederlandse Branche-Vereniging Gips
P.O. Box 45, NL 9930 AA Delfzijl – Holland
Oosterhorn 32-34, NL 9936 HD Farmsum
Tel: (31) 596 649 319
Fax: (31) 596 617 188
karin.roelfsema@lafarge.com
www.lafargegips.nl

TURKEY

Türkiye alçi üreticileri dernegi / Association of Turkish Gypsum Producers
Cinnah Caddesi 71/15
T-Cankaya Ankara
Tel: (90-312) 441 40 97
Fax: (90-312) 442 07 32
alcider@superonline.com

UNITED KINGDOM & IRELAND

GPDA – The Gyspum Products Development Association
PO Box 35084, UK-London
NW14XE
Tel: (44-20) 7935 85 32
Fax: (44-700) 606 59 50
admin@gpda.com
www.gpda.com

EXTRAORDINARY MEMBERS

Eteria « 5E » A. E.
Kolokostroni 42, GR-Patras, Greece
Tel: (30-2610) 277 361
Fax: (30-2610) 224 725

Orbond Gypsum Industries Ltd
1C, Yony Netanyahu St.,
Il-Yehuda 60250, Israel
Tel: (972-3) 634 28 53
Fax: (972-3) 634 28 94
jacob@orbond.co.il
www.orbond.co.il

Peletico Ltd
P.O. Box 1326
CY-1506 Nicosia, Cyprus
Tel: (357) 248 22 65
Fax: (357) 248 17 47
peletico@peletico.com
www.peletico.com

Sival
Rua Rodrigues Cordeiro 34,
P-2400 Leira, Portugal
Tel: (351-244) 815 054
Fax: (351-244) 815 063
www.guianet.pt/profile/sival.gessos

Gyptec Iberica
Gessos Técnicos,SA
Parque Industrial e Empresarial da Figueira da Foz, Lote 3 S. Pedro
P-3090-380 Figueira da Foz - Portugal
Tel.: (351) 233 403 050
Tel. (351) 965 669 059
Fax:(351) 233 430 126
geral@gyptec.eu
www.gyptec.eu

Korean Fire Rating Building Association
Ace-techno tower 10th - room 801
470-5 Kasang-dong Gumchun-Gu
Seoul
Korea
hjahn@kfbma.org
Tel:: 82 (2) 2052 3327
Fax: +82 (10) 8897 1659

www.eurogypsum.org