



French know-how  
in the field of  
**energy efficiency in buildings**





The energy efficiency in buildings is generally the first sector to be targeted in order to achieve a massive reduction in energy consumption and emissions of greenhouse gases.

This sector is a priority in French energy and climate policy. An important programme to reduce energy consumption in buildings is currently being implemented within the framework of the "Grenelle Environnement" (Environmental Round Table). In a rapidly expanding sector, efforts at a national level have enabled France to offer a high quality and a dynamic range of products and services.

To showcase, this brochure presents a summary of French expertise in the field of energy efficiency in buildings: offers from private companies, the public policy framework, measures to support Research & Development, innovation and training etc.

This brochure is part of a published collection of themed brochures aimed at presenting French products and services in the Eco-Technologies sector, in particular the renewable energy.

*Philippe Van de Maele, President of the ADEME*



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## > Context

Since the beginning of the industrial Age, the emissions of greenhouse gases associated with the use of fossil fuels have increased considerably, leading to an increase in the average temperatures of the earth. This phenomenon could have significant consequences in terms of climate change, ecosystems and human society. In response to these challenges, the international community has set a target of halving emissions of greenhouse gases by 2050.

The energy consumption of buildings (apartment and office blocks, houses, factories, etc.) accounts for about 40% of CO<sub>2</sub> emissions and has a major impact on climate change. The general increase in the number of buildings, the average area occupied and the growth in the ways electricity is used have resulted in a worldwide surge in energy requirements.

The fight against climate change, the depletion of fossil fuel resources of fossil fuels and the substantial savings that can be achieved through the improved energy performance of buildings, are all factors that call for dynamic action to reduce the energy consumption of buildings.

### France is committed to an extensive programme to reduce energy consumption.

France pledged in 2003 to divide its emissions of greenhouse gases by four by 2050. A first stage was set at 2020 by which France must reduce its emissions by 20%.

In 2010, the energy consumption of buildings accounted for 43% of total energy consumption in France (corresponding to 70 million tonnes of oil equivalent - TOE) and nearly 25% of CO<sub>2</sub> emissions (about 33 million tons).

Heating is the main contributor, accounting for almost three quarters of energy consumption. Improving the energy efficiency of buildings is therefore one of the main challenges in the fight against climate change in France.

### Key issue: the renovation in terms of energy efficiency of old buildings

France has 31 million residential buildings covering an area of more than two billion square metres. Commercial buildings account for more than 900 million square metres. 20 million dwellings were built before the first thermal regulations were introduced in 1975. Highly demanding in energy, these dwellings represent 58% of the housing sector and account for more than 75% of its energy consumption. Their renovation has therefore become a priority.

As part of the Grenelle Environnement, a goal was set to reduce primary energy consumption in existing buildings by 38% by 2020 and to renovate 400,000 dwellings per year from 2013.

France is also gradually reinforcing its thermal regulations (TR) for new buildings.

The objective for metropolitan France is that:

- "Low Energy Consumption Buildings" will become widespread with TR 2012,
- "Positive Energy Buildings" will be the target of TR 2020.

The challenge: to make "low energy consumption buildings" consume 10 to 20 times less than buildings built before 1975.

### A varied cross-functional French offer

To accompany this change, numerous regulatory instruments and mechanisms, and several R&D programmes, have been set up by public authorities. For example, the Programme for Research and Experimentation on energy in Buildings (PREBAT), launched in 2004, enables experimentation and dissemination of new solutions for energy efficiency in new and old buildings.

On the private side, a large number of research laboratories, engineering and research departments, architects, services managers, construction companies and manufacturers, are also involved. Training in all aspects of construction has been adapted to new technical requirements and new professions have emerged.

**This coherent mobilisation of all the French players in the energy efficiency of buildings has enabled trends to be shifted and numerous model projects to be set up in France and internationally.**



To make buildings more efficient in terms of energy consumption, many technologies have been developed or improved, such as insulation, ventilation, heating, and the management of the supply of light and heat. New sectors related to building design and intelligent energy management are also emerging.

## > Technologies

The building sector, with 1.3 million jobs, is one of the engines of the French economy.

The ambitious goal of reducing energy consumption is bringing about fundamental changes within this market.

This transformation is reflected both on the supply side, with technical and professional developments, and on the demand side, from private individuals and the public sector.

### A dense network of SMEs and micro-businesses is present throughout France

Some 300,000 companies are active in France in the construction sector. In addition to the numerous self-employed workers and building and renovation companies, several other types of service providers play a key project management role in the design, renovation and construction of buildings with low environmental impact:

- **consulting and engineering firms** research, design and commission systems, structures, equipment and products, enabling overall

quality and sustainability requirements to be met. More than 7,000 French companies are specialised in technical studies and engineering in the construction sector, with a total of about 55,000 jobs;

- **French architects and town planners:** architects are primary partners in the design of energy efficient buildings. They play a cross-disciplinary role, in direct dialogue with the commissioner, seeking to establish a balance between the project's various aspects: architectural, energy, town planning, etc. There are nearly 30,000 architects in France. The profession is developing increasing expertise in the field of energy.

Over several decades, French engineers and architects have built up internationally recognised expertise, enabling them to be involved in numerous projects across all five continents.

### Numerous large French companies

Large French companies are present throughout the value chain of energy efficiency in buildings:

- Saint Gobain for insulation materials,
- Vicat and Lafarge for building materials,
- De Dietrich and CIAT for heating equipment; Giannoni for isothermal heat exchangers (an essential component of condensing boilers)
- Schneider and Legrand for electrical equipment,
- Vinci, Bouygues and Eiffage in the public works and civil engineering sector,
- Dalkia, Cofely and Idex for energy management services,
- SPIE for measurement engineering and smart metering,
- The Artelia group (merger of Coteba and Sogreah) for engineering in the construction, infrastructure and environmental sectors.

Through ambitious public policies and an awareness of the issues involved in the energy efficiency of buildings, these various players in the French industry have become increasingly committed to providing innovative solutions at a national and international level.

## Insulation: the primary target for high-level energy efficiency

High-performance insulation is essential for an energy efficient building. It enables major reductions in heating and air-conditioning costs.

Insulation is now divided into two categories: static insulation and dynamic insulation.

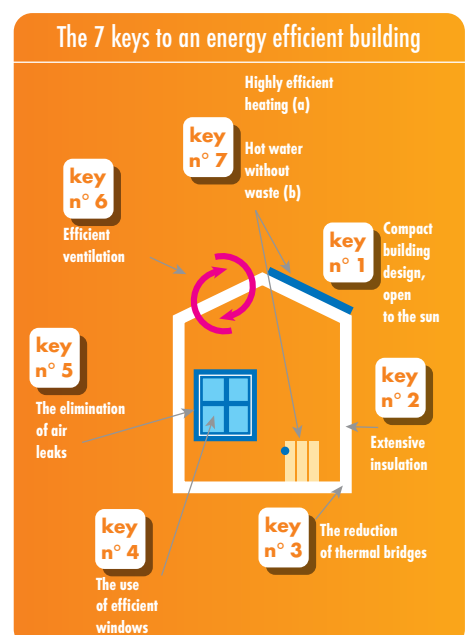
### Static insulation

Static insulation is used in the renovation or construction of buildings. It consists of several layers of insulating material and no air circulation.

There are various methods of static insulation, such as:

- wall insulation from the inside,
- wall insulation from the outside,
- wall insulation in the thickness of the wall or distributed insulation (monomur clay, aerated concrete blocks),
- insulation of attics and roofs,
- underfloor insulation,
- insulation of areas of windows.

Samples of building envelope and insulation materials, CAPEB stand at the Renewable Energy Show in Lyon.



(Source: Alsace region)



## Dynamic insulation

Given the impossibility of reducing conduction heat losses to zero through improvement of the insulation material, dynamic insulation aims to make a wall function as a heat exchanger.

Dynamic insulation is divided into two categories:

- permeodynamic insulation (which is the most effective solution in a "low consumption" context),
- parietodynamic insulation.

These systems are suitable for all types of buildings (residential, office buildings, hospitals, schools etc.).

## Insulating materials

The performance of insulation depends to a very large extent on the technical characteristics of the insulation used: thermal conductivity, mechanical strength, fire resistance, air tightness, resistance to water vapour diffusion, water absorption, dimensional stability, heat resistance and acoustic quality.

## Insulation of mineral origin

Mineral wool insulation is made from sand or volcanic rock, both abundant natural raw materials, or from recycled glass. This type of insulation includes glass wool, rock wool, expanded perlite and cellular glass.

## Insulation of plant or animal origin

The most common insulation materials of plant or animal origin are cellulose, hemp, flax, cotton, recycled fibres, wood fibres, wood wool, sheep wool, feathers, and expanded cork.

Some of these materials are considered to be "eco-materials" because they have environmental benefits (that other insulators do not have) such as the capacity of the resource to renew itself or the capacity to capture and store carbon.

## Insulation of organic origin

Expanded polystyrene, extruded polystyrene and polyurethane are the three types of polymers used in building insulation.

They have the particularity of being fire-retardant and do not release VOCs (volatile organic compounds).



### "La Clairière" a passive council housing complex (Reims, France)

Built at the initiative of a French social landlord, "La Clairière" council housing in Reims has French BBC Effinergie (Low Energy Building label) certification and German PassivHaus certification. Among other things, it has external thermal insulation provided by new generation expandable polystyrene, dual flow ventilation, underground heat exchangers and solar panels for hot water. Energy consumption for heating the building is less than 15 kWh/m<sup>2</sup> per year.

## Hygienic ventilation and energy consumption

Ventilation plays a vital role in all types of building design. Primarily concerned with the hygiene and health requirements of occupants, ventilation is used to:

- provide fresh air for occupants,
- regulate humidity levels,
- remove unwanted odours and gases associated with human presence and activities.

Ventilation requirements depend on the type of building (e.g. housing, school, hospital, etc.) and the function of a room in a building (e.g. individual office or meeting room).

Professionals recognize four types of ventilation:

1. the flow of air through natural ventilation (aeration)
2. controlled mechanical ventilation (CMV), with single and dual flow systems equipped with a fan,
3. hybrid ventilation, which combines natural ventilation and mechanical ventilation depending on weather conditions,
4. centralized ventilation controlled by air handling units. Such systems are used primarily in commercial buildings.

While vital to air quality, ventilation inevitably increases a building's energy consumption.

### Ventil'Action (ADEME)

ADEME has developed Ventil'Action, an online self-assessment tool for commercial ventilation systems.

Ventil'Action enables the optimization of the energy efficiency of ventilation systems, while respecting health regulations and product quality.







## Air-conditioning and comfort during the summer

Air-conditioning enables indoor cooling during hot weather; it can also help to regulate temperatures, that have risen due to heat generated internally (by lighting, electrical appliances, etc.), and the humidity in rooms, buildings or an entire office or residential block.

The energy consumption associated with air-conditioning is considerable. It is growing steadily worldwide.

Two techniques can help to avoid the use of air-conditioning:

- reduce heat inputs (from both internal and external sources),
- remove accumulated heat (e.g. by ventilation during cool periods).

In order to increase public awareness of how to make energy savings in relation to air conditioning, the ADEME (French Environment and Energy Management Agency) has created a good-practice guide.

## Efficient heating and domestic hot water (DHW) systems

Boiler performance has improved significantly over the past twenty years.

Advanced technologies (low temperature, condensation) offer excellent benefits in terms of performance, comfort and reducing pollution.



### Renewable energies

Renewable energy offers many advantages for heating and reduces buildings' consumption of fossil fuels: solar thermal collectors for hot water, photovoltaic panels for electricity, wood-burning or geothermal heating (heating networks or heat pumps). These technologies are well-integrated in France in the construction of new buildings and in renovation projects. France has thus acquired substantial expertise in this field.

*Note. The reader is invited to refer to the brochure on French know-how in the field of renewable energies.*

*Apartment blocks. Thermal solar heating system. Hot water production.*

### Condensing boilers

Heating by condensation returns the latent heat in the water vapour produced during the combustion of natural gas to the heating circuit. This operation enables a 15 to 20% energy saving. Such boilers can be supplemented by solar or wood-burning heating.

### Low temperature boilers

While traditional boilers operate constantly at around 80°C to avoid acid condensation, low temperature boilers operate between 10 and 75°C. The variable operation of the burners enables energy savings of up to 15%.

## Intelligent Building Design

### Bioclimatic houses

Bioclimatic houses are built with a view to maximizing external inputs and reducing energy consumption. They respect six basic principles (in temperate northern hemisphere climates):

1. optimal use of sunshine, in order to collect as much heat and light as possible in the winter. A bioclimatic house uses south facing windows, with openings being protected depending on latitude;
2. protection against the cold: living rooms are south-facing, garages and cellars are north-facing. Vegetation around the building provides wind protection;
3. highly efficient insulation enables reductions in the energy required for heating (winter) and protection against the heat (summer);
4. air tightness reduces leaks;

5. heat recovery, by increasing the building's inertia and the use of dual flow mechanical ventilation, enabling the recovery of heat losses due to ventilation;
6. the use of renewable energies such as geothermal, solar, wind and biomass.

### Phase change materials (PCMs)

These isothermal or quasi-isothermal materials have the capacity to store heat when there is an excess (during the day) and release it at the end of the day and during the night. Incorporated into the exterior of a building, these materials act as temperature regulators.

### Energy positive house in Antibes

This 150 m<sup>2</sup> house has no heating or air-conditioning system and incorporates various energy efficient technologies:

- reinforced insulation (blocks of 150 mm polystyrene graphite on the outside, 200 mm of rock wool on the roof terrace and a
- polystyrene base slab),
- intelligent use of sunshine (south-facing openings, protection from summer sun with metal shade screens),
- dual flow ventilation, coupled with a micro heat pump for heat in the winter,
- waterproof photovoltaic membrane on the roof enabling the generation of an estimated 3000 kWh/year of electricity.

Overall, there was an extra investment of 5% compared to a conventional new construction (return on investment assessed after ten 10 years).



## Energy management in buildings

### Low-energy lighting

Lighting represents a significant proportion of energy consumption in housing.

Compared to conventional incandescent lighting, a "low consumption" bulb consumes 4-5 times less energy and last 6-10 times longer.

### Home Automation

Based on the connection of a building's electrical equipment to a network, home automation involves several technologies including electronics, automation, computing and telecommunications.

Home automation enables the programming of openings and lighting, the adjustment and programming of heating, monitoring of energy consumption, the detection of open windows and the simultaneous turning off of all lights and standby modes. It provides greater comfort, better energy management and enhanced security (alarm system).

*EFFINERGIE certified low energy house (French low energy building label). Panel-based wooden frame using 245 mm thick casing material with exceptional carbon balance (maritime pine laminated, plywood maritime pine). Green roof, curved quartz-zinc roof, Douglas fir cladding.*



### Low energy house in the Rhône-Alpes region

With its bioclimatic design, the first low energy house in the Rhône-Alpes region consumes 23 kWh/m<sup>2</sup> per year.

A website describes the various stages in its construction: [www.construc-teur-maisonbbc.com](http://www.construc-teur-maisonbbc.com)

### Kyoto High School (Poitiers, France)

The "Kyoto high school" does not consume any fossil fuels. In particular, the establishment is supplied by a micro-cogeneration system fuelled with vegetable oil, producing both heat and electricity. This is topped up by 1,000 m<sup>2</sup> of photovoltaic panels. Combined with other energy-efficient equipment, the installation has reduced annual consumption from 90kWh/m<sup>2</sup> to 7 kWh/m<sup>2</sup>.

### Elithis Tower, positive energy office building (Dijon, France)

Designed by French engineers with support from ADEME, the Elithis tower combines aesthetics, urban integration, comfort, and energy and environmental performance. This building is considered to be one of the most efficient buildings in the world in terms of energy and the environment, and produces six times fewer greenhouse gases than conventional buildings.

At a technical level, the Elithis tower includes the following components:

#### 1. technical elements relating to walls and roofing:

- wooden casing to a height of 25m around the tower (75% glazed)
- compact design
- solar shield integrated into the overall design and taking into account the path of the sun

#### 2. technical elements relating to comfort:

- wood-fired boiler (10 m<sup>3</sup>/year)
- 560 m<sup>2</sup> photovoltaic cell integrated into the roof (82,000 kWh/year)
- patented triple flow natural ventilation system enabling the offices to be cooled at no cost
- adiabatic air handling system
- mobile lighting network for workstations
- recycled insulation (cellulose wadding)

With 1,600 photovoltaic panels spread over its exterior, the building is the first experimental laboratory dedicated to research into eco-behaviour.

[www.tour-elithis.fr](http://www.tour-elithis.fr)







**While existing technologies already enable the energy performance of buildings to be considerably improved, innovation and research are essential if French emissions of CO<sub>2</sub> are to be reduced to a quarter of their present level by 2050.**

## > Research, Development and Innovation

Measures to stimulate, maintain and coordinate public and private research have been developed in France for several years. These programmes encourage the construction and renovation of low energy consumption buildings and the development of breakthrough technologies; they also increase the use of renewable energy in buildings.

### PREBAT: "preparing the future of construction"

In 2004, France launched the PREBAT (Programme for Research into Energy in the Construction Industry), a huge R&D and experimentation programme aimed at helping to make energy positive buildings widespread by 2020 (new and existing buildings).

Structured around four themes (new buildings, existing buildings, technological and socio-economic aspects), PREBAT especially targets solutions to modernize existing buildings and stimulate innovation in the field of materials.

With more than 62 million euros of public funds mobilised in four years (2005-2009), PREBAT 1 has contributed to the implementation of the 2012 French thermal regulations, which are recognised as being very demanding.

**More than 1,100 demonstration buildings with low energy consumption have been developed as part of the programme.**

Having run its course, PREBAT 1 will soon be replaced by "PREBAT 2", which targets even higher performance objectives.

The way that the public research stakeholders operate and are organised has also been redefined in order to increase the programme's effectiveness.

Among the research activities undertaken, the PACTES formula (Programme of Concerted Action in Energy Technologies) is particularly innovative. Set up in 2008, PACTES aim to create multidisciplinary skills clusters, with a view to making finalised, operational solutions available to the market in the short term (three to four years).

Currently, five PACTES are in operation:

- the "LED" PACTE for the development of innovative lighting technologies using light emitting diodes (LEDs). It is estimated that the replacement by LEDs of the 59 million existing halogen spotlights in France would save 1.4 TWh of electricity annually, or the equivalent of 167,000 tons of CO<sub>2</sub>. The project is implemented by a private and public sector consortium (Philips France, ENTPE-CNRS, the CEA, the LNE and the CSTB);
- the "ECS" PACTE for reducing energy consumption associated with domestic hot water (DHW). Its objective is to reach a maximum level of consumption of primary energy for DHW of 15 kWh/m<sup>2</sup> per year;
- the "Super insulation at atmospheric pressure" PACTE for the development of innovative insulation technology solutions operating at atmospheric pressure using silica aerogels;

- the "Vacuum Insulation Products" PACTE for the development of insulation technology solutions consisting of panels with vacuum cells;
- the "Efficient ventilation" PACTE for the optimisation of the use of air as a carrier of heat and as a regulator of comfort in buildings, through modulating flows as a function of the quality of the internal air.

The average budget for a PACTE is €1 m per year. The French government contributes up to 50% of the programme's funding.

### Support for demonstration projects and technology platforms

Since 2008, ADEME has been supporting projects enabling pre-industrial experimentation with "breakthrough" technologies. These "demonstration" projects allow companies to take a technological and financial risk between the research phase and the industrialisation of new eco-technologies.

After writing "strategic roadmaps" for each priority issue, Calls for Declaration of Interest (CDI) are made regularly in order to identify and select projects to be undertaken. CDI's on the subject of "energy-positive buildings and urban blocks" was launched in late 2010. It will enable, among other things, experiments at a urban block scale regarding exchanges and the sharing of energy produced. Several CDI's relate to the renewable energy sector.

As part of a large national loan to revive French industry, nearly 1.35 billion euros will be invested in the coming years by the government and managed by the ADEME in the implementation of renewable, carbon-free energy demonstration projects.

The development of international demonstration projects will allow technologies to be tested in the most appropriate environment.



Solaris HEQ® Residence  
Rennes (Bretagne region).





## The Building-Energy Research Foundation

Created in 2005 by several French industrial companies (Arcelor, Gaz de France, EDF, Lafarge) with the support of the ADEME and the CSTB (French Scientific and Technical Centre for Construction), the Building-Energy Foundation (Fondation de recherche Bâtiment-énergie) provides financial support for research carried out by public and private laboratories, and for the evaluation and development of this work.

11 research projects have already been supported (with total funding of €8 m), in the following areas, among others:

- the development of "packages" of technical solutions for the rehabilitation of private houses and the integration of renewable energy,
- the minimization of the grey energy used in new and renovated offices,
- the development of methodologies for "Factor 4 audits" targeting managers of social housing,
- the carrying out of studies targeting commercial accommodation buildings (typological analysis, development of audits and appropriate work schedules).

## Competitiveness clusters: French clusters for growth and employment

Pillars of French public policy for innovation and R&D, competitiveness clusters bring together companies, research laboratories and higher education establishments on the same site. This concentration of knowledge helps to unite the innovation capacity of the private and public sector in projects with high R&D potential.

To stimulate the emergence of projects, tenders are launched by public authorities. For the period 2009-2011, the French government allocated 1.5 billion euros to the funding of these centres, which also benefit from the support of French local authorities and a special tax regime. Several of the 70 French competitiveness clusters are working on energy efficiency in buildings.



Completed in early 2009, the new headquarters of the Agency for Environment and Energy Management in Angers was the first office building to receive official certification as a Low Energy Consumption Building. The building energy consumption is 30.24 kWh/m<sup>2</sup>/year.



HEQ® building (Ile de France region)

External HEQ® targets: façade frames, chilled beams and prefabricated facing/insulation façade panels.

### TENERRDIS Competitiveness cluster

The primary objective of this cluster is to optimize the use of new energies in the construction and transport sectors. Based in the Rhône-Alpes region, Tenerdis manages many innovative projects, such as:

- **Eco-Obs:** development of an observatory for eco-neighbourhoods in France and Switzerland in the form of a web portal bringing together the methodologies adopted in the two countries and promoting "co-learning" among the entities involved. The project is based on five eco-neighbourhood pilot sites (two in France, two in Switzerland and one cross-border). [www.eco-obs.org](http://www.eco-obs.org)
- **Inertrans:** this project focuses on innovation in building envelopes: glass bricks combining inertia and translucent insulation using phase change materials (PCMs) and granular aerogels.

### DERBI Competitiveness cluster

Located in the Languedoc-Roussillon region, the DERBI competitiveness cluster focuses on the development of the renewable energy sector as applied to construction and the building industry.

The DERBI cluster's "Rider" project aims to develop an innovative information system, enabling the optimization of the energy efficiency of a building or groups of buildings. The system enables exchanges of energies between different buildings by integrating different types of energy: conventional energy, renewable energy and "intermittent" sources of energy, such as the heat generated by industrial processes.

### Alsace Energivie Competitiveness cluster

Based in Alsace, the Energivie cluster is dedicated to positive energy solutions in construction. The result of a long collaboration between the Alsace region and ADEME, the cluster has built its strategy on the basis of three themes: the transition to positive energy, making this approach competitive and taking a position in the development of future standards. Its activities focus on four key stages in the development of a project: design, construction, power generation equipment and instrumentation and control systems, and the marketing of these new solutions.

### Capenergies Competitiveness cluster

The Capenergies cluster brings together 400 players from industry and research and training establishments in the regions of Provence-Alpes-Côte d'Azur, Corsica, Guadeloupe, Réunion and the Principality of Monaco. It focuses on the development and deployment of energy systems enabling the concrete solutions necessary for the replacement of fossil fuels to be provided, particularly in the construction sector.



**The French public policy framework to promote energy efficiency in buildings has been greatly enhanced in recent years following an extensive public process called the Grenelle Environnement (Environmental Round Table). These regulations and incentive mechanisms improve the convergence between public policies, research and training programmes, the technology supply and project funding.**

## > Public Policies

### The Grenelle Environnement (Environmental Round Table)

The Grenelle Environnement is a vast consultation process. Its objective is the preparation in a participatory manner of long-term decisions on the environment and sustainable development in France.

Initiated in 2007, the Grenelle Environnement consisted of six themed work groups including one that specifically focused on the fight against climate change and managing energy demand. These groups were made up of representatives from five panels (government, local authorities, employers, employees and environmental NGOs) representing different stakeholders in sustainable development in France. After an intense phase of public consultation (19 regional meetings, 8 Internet forums with 11,000 contributions, 2 debates in Parliament, referral to 31 advisory bodies), the five panels agreed on 268 specific commitments.

These commitments were then discussed in the French Parliament. The Grenelle 1 law, which set the objectives and main approaches was passed almost unanimously in August 2009. The Grenelle 2 law, passed July 12, 2010, defined concrete measures and their implementation.

*Poster of the French awareness raising campaign "Hurry up, it's warning up!" from ADEME and the Ministry for ecology and sustainable development.*



### The Grenelle Environnement plan for the energy performance of buildings

The Grenelle Environnement includes a major program to reduce energy consumption in all sectors of the construction industry. Ambitious goals in terms of thermal regulations set a maximum limit on the energy consumption of buildings depending on their use (commercial, residential, etc.) and their nature (new or existing).

#### New Buildings

For new constructions, the Grenelle Environnement has set a target of **low-energy buildings (BBC - "Bâtiments Basse Consommation") becoming widespread by 2012 and positive energy buildings by 2020.**

All new buildings should have a primary energy consumption below a threshold of an average of 50 kWh/m<sup>2</sup> per year (equivalent to the French low energy buildings label):

- by the end of 2011 for public and commercial buildings and for residential construction carried out within the framework of the national urban renovation programme;
- by 1 January 2013 for all residential buildings.

#### Existing buildings

The Grenelle Environnement has set an overall goal of reducing primary energy consumption in existing buildings by 38% by 2020.

Specific targets have been adopted for:

- 1. the renovation of public buildings**, with a reduction target of at least 40% of energy consumption and at least 50% of greenhouse gas emissions for government buildings (50 million m<sup>2</sup>) and its main public institutions (70 million m<sup>2</sup>) within eight years. To meet this challenge, a major plan to renovate public buildings began in 2008 with a budget of €200 M;
- 2. the renovation of council housing, private commercial buildings and private housing.** 800,000 of the most energy inefficient council houses are to be renovated by 2020;
- 3. the renovation of dwellings in tropical climates:** from 1 May 2010, the first thermal regulations for hot and humid climates apply in Guadeloupe, Martinique, Guyana and Réunion (the French overseas regions) for all new individual houses and apartment blocks.

**Numerous financial incentive schemes and awareness campaigns have been launched to achieve these goals.**

### Financial incentive schemes

#### Interest free eco-loan

To promote energy efficiency in existing buildings, France introduced the interest free eco-loan. Since April 2009, this measure has already enabled the renovation of 100,000 buildings. Aimed at helping the private market to finance the most profitable renovation works, the loan offer three possibilities:

- the carrying out of a "package of works",
- the reaching of the minimum level of "overall energy performance" for housing,
- the replacement of an individual sewerage system by one that does not consume energy.

#### Council housing eco-loan

Financial incentives have also been introduced for council housing. The government and the "Caisse des Dépôts" (the French deposit and Consignment Office) mobilised 1.2 billion euros over 2009-2010 to fund the thermal renovation of dwellings in the form of subsidised loans.

#### Certificates for energy savings (CEEs)

The CEE system is based on the obligation to carry out energy saving measures imposed by public authorities on energy vendors (electricity, gas, heat, cold, domestic heating oil and motor fuels).

A three-year target is set and then shared among operators according to their sales volumes. This objective is backed up with a financial penalty of two euro Cents/kWh for energy vendors not meeting their obligations within the time limit. Certificates for energy savings are allocated, under certain conditions, to those carrying out energy saving measures.

Energy vendors can meet their obligations by holding certificates for an equivalent amount, these certificates being obtained as a result of measures undertaken by the operators on their own account or by buying them from other operators who have carried out such measures. In the initial period, the construction sector has accounted for nearly 90% of CEEs issued.

### Tax credits for sustainable development

This tax measure allows households to deduct from their income tax some of the cost incurred in carrying out energy improvement works on main residences (house or apartment).

The tax credit applies to the purchase of certain energy efficient equipment (heating, renewable energies, insulation etc.).

The tax credit rate ranges from 15 to 50% depending on the equipment or materials.

### The European Regional Development Fund (ERDF)

The ERDF is the EU's main financial instrument to reduce gaps between the levels of development in European regions and to help disadvantaged regions to catch up. Its field of operation covers expenses related to energy efficiency and renewable energy in the homes of low-income families. Social landlords can thus apply to the ERDF for funding for the rehabilitation of housing.

## Energy Performance Assessment (EPA)

Since 2006, EPAs have provided information on the energy performance of a dwelling or building, assessing its energy consumption and its impact in terms of greenhouse gas emissions. An EPA certificate is required for the sale of a building or residential and commercial premises as well as for rental housing. It must be carried out by an assessor that has been certified by an authorized body.

Understanding an EPA is facilitated by two labels (energy and CO<sub>2</sub>) showing **7 classes from A to G** (A corresponding to the best performance).

## Energy Labels

Energy labelling for energy-consuming products was introduced in the 1990s at European Union level. The energy efficiency of new equipment for sale is assessed in terms of energy efficiency classes ranging from A + + + to G. Following the revision of the Directive in May 2010, new products such as televisions, water heaters and boilers will soon be covered.

## Labels, certification, environmental quality approaches: drivers of change

The French High Energy Performance label ("Label haute performance énergétique") targets new housing and consists of five levels:

Performance level	Requirements for New Housing
HEP (High Energy Performance)	Maximum power consumption reduced by 10%
HEP EnR (HEP - Renewable Energy) 2005	Maximum power consumption reduced by 10% with use of renewable energy
VHEP (Very High Energy Performance) 2005	Maximum power consumption reduced by 20%
VHEP EnR 2005	Maximum power consumption reduced by 30% with use of renewable energy
BBC / Effinergie (low energy buildings)	Primary energy consumption up to an average of 50 kWh/m <sup>2</sup> /year (depending on the climate and altitude of the construction zone)

### 1. High energy performance labels for the construction of new buildings

The French BBC/Effinergie label (low energy buildings label) sets an average threshold for maximum primary energy consumption of 50 kWh/m<sup>2</sup> per year for new housing. This limit may vary slightly depending on the type of climate and altitude of the construction zone.

Buildings other than housing are also concerned by the label with a goal of reducing consumption to 50% of standard conventional consumption.

**Requests for "BBC-Effinergie" certification have seen strong growth in 2009 and 2010, reaching a total of 45,000 dwellings in mid-2010.**

This strong growth is well beyond the forecasts made during the Grenelle Environnement's preparatory work.

### 2. High energy performance labels for renovation

To stimulate energy efficiency in existing buildings, France created the "High Energy Performance Renovation" label. The label is divided into 2 levels:

- HEP renovation (high energy performance renovation): maximum energy consumption of 150 kWh/m<sup>2</sup> per year (adjusted according to altitude and climate);
- BBC renovation (low energy consumption building renovation): maximum energy consumption of 80 kWh/m<sup>2</sup> per year (adjusted according to altitude and climate).

### HEQ® approach

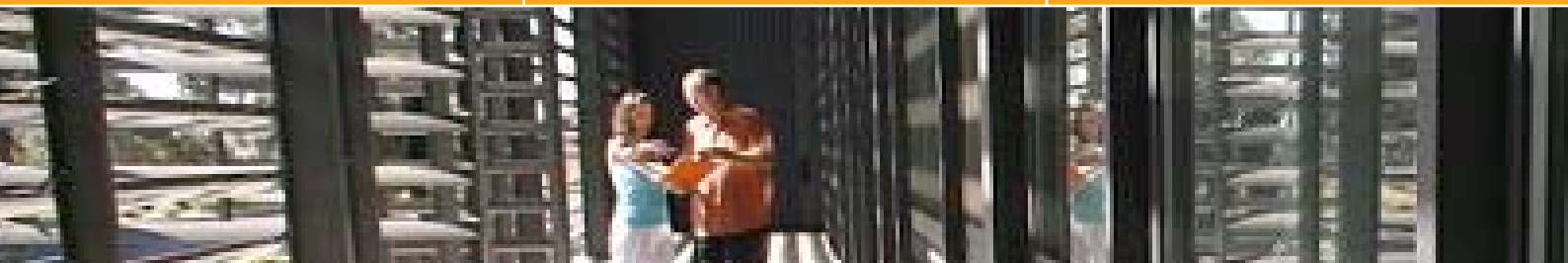
HEQ® (High Environmental Quality) labelling aims to limit the environmental impact of buildings (new and renovated).

This method has 14 targets covering green building, eco-management, comfort and health. The approach addresses the entire lifecycle of a building and its components.

The new HEQ® Performance (High Quality Environmental Performance) standard will integrate energy requirements into a set of environmental requirements covering water, emissions of CO<sub>2</sub> and pollutants, indoor air quality and waste generation.







## French expertise worldwide

Various instruments and funding tools support development projects and technology transfers in the field of energy efficiency in buildings.

### FASEP - Green Studies & Innovation (for emerging countries)

The FASEP is an instrument for donations to local recipients (central government, provincial government, municipalities, technical agencies, etc.), of an average of around 400,000 euros. It provides funding for services that respond to requests from local recipients, which are upstream of development projects, for which funding has been identified (public or private, bilateral or multilateral), and which are likely to require the expertise of French companies (engineers, components manufacturers, operators). The budget allocated to the FASEP process is approximately €20 million per year.

The following sectors, among others, include: drinking water, sanitation, solid waste, management of water resources, protection of the environment (renewable energy, project mechanisms) and energy efficiency.

The following types of intervention can be supported: preparatory studies for construction projects and/or operating infrastructures; feasibility studies, preliminary pilot studies, detailed pilot studies, etc.; technical assistance in preparing or carrying out projects, institutional cooperation for economic purposes.

FASEP "Green Innovation" enables funding for pilot projects to demonstrate innovative French green technology in emerging countries.

### French Development Agency (AFD) projects

With offices in over 50 countries, the AFD funds projects for economic and social development in many countries as the key operator of the French public aid mechanism for development. With a wide range of financial instruments (loans, grants, guarantees etc.) the AFD supports public authorities, the private sector and local community networks in the implementation of a wide variety of social and economic projects.

The AFD is also active in the fields of environmental protection and energy management.

In 2009, nearly €2.5 billion was allocated to projects and programmes contributing to the fight against global warming. AFD funding in 2009 in developing countries enabled the saving of 4.9 million tons of CO<sub>2</sub> (the equivalent of emissions from 1.8 million vehicles).

## Energy Efficiency in China: a programme based on cooperation and consultation

The building sector accounts for 28% of energy consumption in China, which needs to build about 10 million housing units per year. Such growth requires the implementation of sustainable urban planning and building design. The Chinese authorities, service providers and population share this desire for improvement and are aware of its importance for the country.

Between 1999 and 2010, ADEME has piloted the "Energy Efficiency Programme for Construction in China" funded by the FGEF. This programme focused on both new construction and the rehabilitation of existing housing (with energy saving targets of 50-65% with acceptable additional costs for markets), while supporting China's energy management policy in the building sector. This included promoting the application and development of local standards and regulations and facilitating knowledge transfers enabling energy savings in construction to be maintained.

### Interventions on nearly one million m<sup>2</sup> in three climate zones.

The programme enabled:

- the construction of 3000 new housing units (300,000 m<sup>2</sup>) and thirty rural houses; 335 existing housing units rehabilitated in the Heilongjiang Province;
- large-scale social programmes in Beijing: 5,000 new dwellings constructed (500,000 m<sup>2</sup>);
- 1,145 new housing units (150,000 m<sup>2</sup>) in Shanghai: a pilot operation for green certification.

These projects enabled a reduction in greenhouse gas emissions of about 50,000 tons/year with additional construction costs of less than 7%.

500,000 m<sup>2</sup> of new homes built in Beijing.



## Energy efficiency in buildings in new towns in Morocco (Tangier)

In the Chrafat region in Morocco, the FASEP is providing a €520,000 funding for a preparatory study to develop a new town with low energy consumption.

The city would be an industrial centre dedicated to the automotive industry and would include a Renault plant. Three French companies are involved in this project: Automatique et Industrie, H3C and Sogreah.



## HEQ® guide in China

As part of a FASEP project, the French Scientific and Technical Centre for Construction (CSTB) has published a guide on HEQ® in China: *The Sustainable Design Handbook, China. A reference work on environmental quality in China*, available in French and English. This guide is distributed to the various entities involved in construction in China: central authorities, local government, developers, Chinese architecture and design agencies, and universities.



## Energy efficiency in buildings in Morocco

The building sector accounts for 35% of energy consumption in Morocco, with an increase of 41% in 8 years.

With over 200,000 houses built every year and more than 5 million existing houses, construction and renovation issues are very important.

The French Global Environment Facility (FGEF) has appointed ADEME to implement a project concerning the improvement of energy efficiency in the construction industry in Morocco (2010-2012).

ADEME is carrying out this project in conjunction with its Moroccan counterpart, the ADEREE (Agency for the development of renewable energies and energy efficiency) and with financial support from several international sponsors (FFEM, UNDP, European Commission).

The project includes the finalisation and implementation of an Energy Efficiency code in Morocco, the consolidation of expertise, management and funding capacities of local partners, the training of Moroccan professionals, the construction of demonstration projects and the promotion of good practices.

## French Global Environment Facility (FGEF)

A French policy instrument for cooperation and development, the FGEF is a bilateral public fund that was created in 1994 by the French government following the Rio Summit.

FGEF cofinancing, limited to a maximum of 50% of the total project, aims to support multi-stakeholder partnerships, and are part of the strategic priorities of French aid.

The fund objective is to link global environmental protection and local development through sustainable development projects in the following areas: biodiversity, the fight against climate change, the management of international waters, the fight against land erosion and the treatment of persistent organic pollutants. The AFD carries out secretarial functions for the FGEF.

## Clean Development Mechanism (CDM)

Established in the Kyoto Protocol, the CDM allows companies from industrialized countries to carry out and/or co-finance projects that reduce emissions of greenhouse gases in developing countries. In return, the investor obtains "carbon credits", the amount of which corresponds to the emissions avoided through the implementation of the project.

The aim is to encourage investment in developing countries and promote the transfer of environmentally friendly technologies.

So far, two thirds of projects registered with the United Nations are located in Asia, with the remaining third being located in Latin America. Similarly, nearly two thirds of projects concern energy efficiency and the substitution of renewable energy for fossil fuels. French companies have also participated in a large number of CDM projects concerning the energy efficiency of buildings.

*The International fair "Pollutec Maroc" (October 2010, Casablanca), during which energy efficiency in buildings was highlighted.*

## Passive solar design in India

In 2009, as part of a strategy based on energy efficiency and renewable energy in developing countries undergoing crisis or earthquake recovery, the GERES (Renewable Energy, Environment and Solidarity Group) helped to build 275 houses and two community buildings using passive solar design.

To accomplish this, GERES, supported by CO<sub>2</sub>Solidaire, trained 128 local professionals in energy efficiency techniques.







**The training of construction professionals is a major challenge for the implementation of energy efficiency policies.**

## > Consultancy and Training

The quantitative and qualitative leap to be made in the performance level of buildings being built or renovated necessitates a change in practices and a significant increase in the skills of all those involved in the construction industry.

To meet these needs, state agencies offer high quality consultancy and training services. Hundreds of consulting firms and design offices also offer their services in France and worldwide.

### FEE Bat

Initiated by the main public entities in construction training, FEE Bat training (Training in Energy Savings for Businesses and Workers in the Building Industry) aims to train 120,000 professionals in energy renovation by 2012. FEE Bat addresses energy savings in technical and environmental terms, and addresses selling points, quality of work, etc.

### CSTB Training

The CSTB (French Scientific and Technical Centre for Construction) assists professionals in acquiring new skills and expertise. More than 80 courses and 180 sessions enable the training of professionals and trainers in construction and planning, particularly in the following fields: Planning and Sustainable towns, Sustainable Buildings and HEQ® approach, energy performance of buildings, energy audits etc. Tailored training can also be developed to meet specific requirements.

### ADEME

The Agency for Environment and Energy Management offers a series of trainings on energy efficiency in buildings and renewable energy. These trainings are intended primarily for the private sector:

- **PRAXIS Ecobat**

The PRAXIS Ecobat project aims to make technical and educational platforms available to bodies offering initial and ongoing training for seven technologies: ventilation, wood energy, lighting, opaque walls, photovoltaic solar energy, thermal solar energy and heat pumps.

- **Regional resources centres**

ADEME financially supports the establishment of "Bâti Environnement Espace Pro" regional resource centres, or "BEEPs". These centres are intended to stimulate interest in the professional sector regarding energy and environmental performance.

- **Low Energy Buildings**

The objectives of this training are to understand the issues involved in the process of designing a low-energy building and to identify its components.

- **Daily control and management of energy in private commercial property**

This training focuses on stages, methods and tools in energy efficiency. It enables participants to set up tools to monitor energy consumption.

- **Training on energy performance contracts for buildings**

These two training courses are suited to private and public assets respectively, and provide a methodology for the implementation of an energy performance contract in buildings with feedback on such contracts in France and in other countries.

- **Carrying out good quality energy audits for buildings**

This training shows participants how to perform an energy audit for a building. It enables better use and implementation of energy audit tools. Participants learn to write good quality energy audit reports.

- **Technical Guides**

The ADEME provides a range of technical guides on renewable energy and energy efficiency in buildings. In collaboration with the FFB (French Building Federation), the ADEME also publishes a guide to improving the energy efficiency of existing buildings.

### Energy Information spaces: raising public awareness and encouraging action

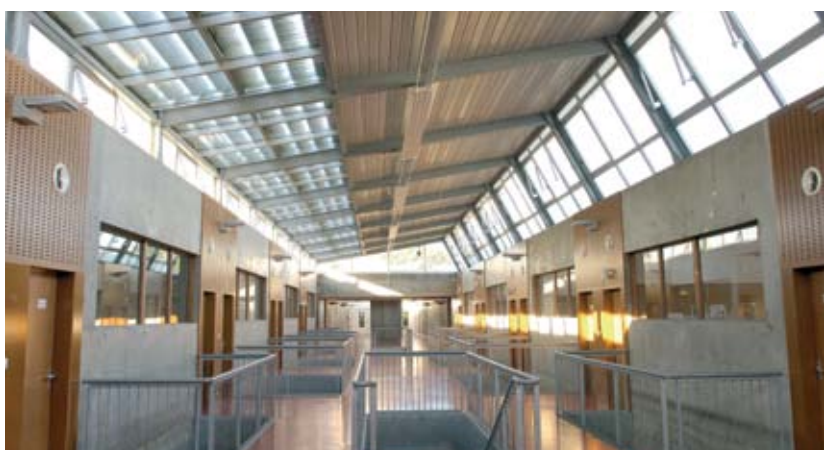
To provide information on support programmes and opportunities for improving energy efficiency in homes, a network of Energy Information Spaces ("Espaces info energie") was set up in 2001 with the ADEME. More than 400 advisers in more than 230 structures covering all of France provide individuals, professionals and SMEs with advice and practical solutions to improve the energy performance or the use of renewable energy in construction and renovation projects. In 2009, more than 1.6 million people were informed by the Energy Information Spaces, 80% of whom declared themselves satisfied with the service.

### ACAD (French Association of Consultants in Urban Planning and Land Development)

This professional association brings together more than 100 French consultancy companies operating in all areas of urban and land development.

### AFEX: French Architects Overseas Association

Published in 2009 in partnership with the ADEME and the Ministry of Ecology, the AFEX guide "Building for Sustainable Development" presents the French approach to sustainability issues and provides a summary of the main challenges to be met by professionals in the industry.



HEQ® architecture at Pope Clement High School in Pessac (Aquitaine region).



## > Institutions and contacts

### Private institutions

#### French architects Overseas (AFEX)

The association brings together over two hundred members - architects, urban planners, landscape architects, engineers and industrialists - focused on export issues. The AFEX, with many partners, promotes this French expertise throughout the world.

**[www.afex.fr](http://www.afex.fr)**

#### Association of Construction Product Industries (AIMCC)

Brings together producers of construction materials, products, components and equipment.

**[www.aimcc.org](http://www.aimcc.org)**

#### Confederation of Construction Trades and Small Businesses (CAPEB)

French employers' organisation representing the building trades.

**[www.capeb.fr](http://www.capeb.fr)**

#### Effinergie

The objective of the Effinergie association is to promote low energy consumption in new construction and renovation projects in France and to develop a repository of the energy performance of new and existing buildings (in particular through the Effinergie LEB and Effinergie LEB Renovation approval labels). The website has a catalogue of over 150 BBC (the French low energy buildings label) projects carried out in France.

**[www.effinergie.org](http://www.effinergie.org)**

#### French Building Federation (FFB)

Professional organisation that represents and supports more than 57,000 construction companies.

**[www.ffbatiment.fr](http://www.ffbatiment.fr)**

#### GIMELEC

French industry association for electrical equipment, automation and related services. Brings together 230 companies that provide electrical and automation solutions for the energy, construction, industry and infrastructure markets.

**[www.gimelec.fr](http://www.gimelec.fr)**

#### PEXE: France Eco-tech

This association brings together networks of French eco-companies, representing more than 3,500 eco-companies. It aims to strengthen the individual and collective competitiveness of eco-businesses and to create a network of excellence in the field of eco-activities.

**[www.pexe.fr](http://www.pexe.fr)**

#### Syntec Engineering

Brings together companies that provide assistance or technical studies, engineering, technology consulting, monitoring and inspection. Represents the profession in France with over 215,000 members, nearly 50% of which are managers and engineers.

**[www.syntec-ingenierie.fr](http://www.syntec-ingenierie.fr)**

#### National Union of French Architect Associations (UNSFA)

Brings together departmental and regional architect associations.

**[www.syndicat-architectes.com](http://www.syndicat-architectes.com)**

### Public institutions

#### Ministry of Ecology, Sustainable Development, Transport and Housing (MEDDTL)

Prepares and implements government policy in the areas of sustainable development and the environment, climate and industrial safety. Its responsibilities include, in conjunction with the Ministry of Economy, Finance and Industry, the preparation and implementation of government policy on renewable energy, the development and promotion of green technologies and the reduction of energy consumption.

**[www.developpement-durable.gouv.fr](http://www.developpement-durable.gouv.fr)**

#### Ministry of Economy, Finance and Industry (MINEFI)

Responsible for French economic policy, the ministry is specifically responsible for government policy on foreign trade, industry, energy and support for businesses.

**[www.economie.gouv.fr](http://www.economie.gouv.fr)**

#### Ministry of Higher Education and Research (MESR)

Designs, prepares and implements national policy on research and innovation.

**[www.enseignementsup-recherche.gouv.fr](http://www.enseignementsup-recherche.gouv.fr)**

#### ADEME (French Agency for Environment and Energy Management)

French public institution active in the implementation of public policy in the field of environment and energy management.

The agency stimulates, animates, coordinates, facilitates and implements operations in the following fields: waste management, soil protection, energy efficiency and renewable energies, air quality and noise reduction. ADEME provides expertise and advisory services to companies, local authorities, government bodies and the public at large.

**[www.ademe.fr](http://www.ademe.fr)**

#### Club ADEME International

Network composed of some hundred French eco-companies active on the global sustainable development market, supporting its members in the development of innovative projects and partnerships internationally.

**[www.clubinternational.ademe.fr](http://www.clubinternational.ademe.fr)**

#### AFD (French Development Agency)

Key operator for the French public development aid, the AFD is a public institution responsible for financing economic and social development projects in many developing countries.

**[www.afd.fr](http://www.afd.fr)**

#### Ubifrance and the French Trade Commissions

UBIFRANCE, the French Agency for international business development, has its own network dedicated solely to assisting SMEs in foreign markets.

The agency's 6 regional offices work (22 delegates) in partnership with Chambers of Commerce and Industry, to help mobilise businesses with export potential.

64 trade commissions in 44 countries support French businesses abroad.

**[www.ubifrance.fr](http://www.ubifrance.fr)**

#### French Scientific and Technical Centre for Construction (CSTB)

The CSTB has four key activities: research, consultancy, evaluation, dissemination of knowledge. The CSTB has 850 employees at national, European and international levels.

**[www.cstb.fr](http://www.cstb.fr)**

#### French National Housing Agency (ANAH)

The ANAH's mission is to implement national policy for the development, rehabilitation and improvement of existing private housing.

**[www.anah.fr](http://www.anah.fr)**

#### Environmental Construction - Professional Spaces (BEEPs)

Support and advice for construction professionals. Identifies model projects and practices for better sharing of information at a national level.

**[www.reseaubeeep.fr](http://www.reseaubeeep.fr)**

#### French Social Housing Union

**[www.union-habitat.org](http://www.union-habitat.org)**

### Other organisations

#### Energy Efficiency Services Club (CS2E)

**[www.clubs2e.org](http://www.clubs2e.org)**

#### French Chamber of Engineering and Consultancy, construction branch (CICF - Construction)

**[www.cicf.fr/cicf-syndicats/cicf-construction](http://www.cicf.fr/cicf-syndicats/cicf-construction)**

#### Housing improvement Club

**[www.cah.fr](http://www.cah.fr)**

#### Federation of Developers and Builders

**[www.fnpc.fr](http://www.fnpc.fr)**

#### Union of French Houses

**[www.uniondesmaisonsfrancaises.org](http://www.uniondesmaisonsfrancaises.org)**

#### Union of Builders of the French Building Federation

**[www.uci-ffb.fr](http://www.uci-ffb.fr)**

### Certification bodies

#### Qualibat

**[www.qualibat.com](http://www.qualibat.com)**

#### Promotelec

**[www.promotelec.com](http://www.promotelec.com)**

#### Cerqual

**[www.cerqual.fr](http://www.cerqual.fr)**

#### Cequami

**[www.mamaisoncertifiee.com](http://www.mamaisoncertifiee.com)**

#### Certivéa

**[www.certivea.fr](http://www.certivea.fr)**

