EXECUTIVE SUMMARY

1. The protocol of the French Research Programme on Energy Efficiency in Buildings (PREBAT) sets out that one of the first actions to achieve is a *"state-of-the-art, on a national and international scale, in research, good professional practices and the most advanced buildings;* this state-of-the-art will serve as the foundation for continuous surveillance throughout the duration of PREBAT and will provide a basis for dissemination and valorisation actions".

2. This report is the intermediate report on the *International Buildings and Energy Comparison*, corresponding to the state-of-the-art priority set out by the protocol. This research, overseen by the CSTB – French Scientific and Technical Centre for Building, is co-funded 50% by ADEME - French Environment and Energy Management Agency, 25% by PUCA – Urban Development Building and Architecture Plan and 25% by research funds allocated by the CSTB and its expert partners.

3. The international comparison project provides an analysis of the *high-performing programmes operating in a number of foreign countries, including their components and equipment as well as research and development programmes.* The project is divided into two phases with an intermediate report in 2006 and a final report in 2007. This report provides an account of the first phase.

4. A *socio-eco-technical method of analysis* has been developed. It consists of 6 stages: Background, content of the innovation or initiative, implementation, evaluation, critical reflection (strengths, weaknesses, opportunities and threats), transposition conditions in France.

5. The *key figures* are summarised as follows. In 2000, buildings represented 47% of energy consumption in France, with industry and agriculture at 28% and transport at 25%. Two thirds of this is consumed in residential homes and a third in the tertiary, public and private sector. In 2004, the final energy consumed in the home can be distributed as follows: 44% in private houses built before 1974 and 24% in houses following 1974, 23% in collective buildings before 1974 and 9% in collective buildings following 1974.

6. Research has shown that via a survey of the regional initiatives *a movement was launched for promoting low consumption buildings in France.* The initiatives involve both the public and private sector. Some regions are currently launching tenders for projects with objectives fixed by PREBAT for 2010. This is good news for PREBAT. The objective is not to launch and manage such movements but to support and facilitate them.

7. The international Comparison project analysed the German programmes "Passivhaus", "3-litre houses" "EnSan" and "Low energy houses in existing buildings", the American programmes "Building America", "Zero Energy Homes", "Leadership in Energy and Environmental Design (LEED)" and the Japanese programme "low consumption houses". *Passivhaus is transposable* in France, with a problem associated with guaranteeing air permeability quality. The LEED experiments can be harnessed for developing the French HQE (High Environmental Quality) certification for tertiary buildings with a label allocating more importance to energy and adapted to the renovation of the current office buildings. The American and Japanese low consumption house experiments are more difficult to transpose given the differences in building methods.

8. The components and equipment studied include high thermal performance opaque inside walls, particularly those designed in Austria and Denmark, high thermal performance windows designed in Northern Europe, double flow heat recovery ventilation in Germany, Switzerland, the Netherlands, Belgium, compact heating-ventilation-hot water systems in Germany, Austria and Switzerland and photovoltaic systems in Japan. *The high-performance opaque outside walls are transposable* in France, subject to the setting up of conditions for correct implementation. The "Northern European" market of the three other components and equipment is *associated with the development of extremely low consumption operations.* Photovoltaic systems require continuous *policy and tax support*.

9. The research and development programmes that were analysed include the Austrian programme "Haus der Zukunft" and the Dutch programmes "Compass" and "Energy Onderzoek Subsidie" (EOS). The Austrian programme is interesting in terms of its practicality and the *connection between the technical research and the socio-economic research.* The Dutch programmes were interesting due to the dialogue between the economic players and their focus on the "*system" approach of the building*.

10. The studied foreign experiments have allowed for three designs for the control of building energy to be put forward.

a) Within the *"high energy saving" design*, the primary objective is to lower the building energy consumption significantly. The *"German low consumption variation"* such as the "Passivhaus" programme, is aimed at going as far as removing the heating system. The *"Swiss low consumption variation"* such as "Minergie" is less demanding.

b) In the *"consumption and energy production" design*, the primary objective is not the significant reduction of consumption but the production of electricity by means of a photovoltaic system. The *"American variation"* that combines reinforced insulation with photovoltaic, is associated with a context called into question by a high-energy consuming lifestyle and distinguished by a concern for the attenuation of electric energy consumption resulting from overloaded networks. The *"Japanese variation"* is not focused on insulation but puts forward the use of photovoltaic panels integrated into the casing of pre-fabricated houses. This design favours the modernism of the technical solutions implemented as well as the low consumption of electric energy.

c) In the *"energy and environment" design*, the energy is an important objective but hinged upon other environmental goals (on-site integration, water, materials, comfort etc.) deemed to be of importance by the buyer of the building. An example of this design is that of the American label LEED for office buildings. The investors decided in this case to prioritise a healthy and comfortable working environment over energy saving concerns.

11. On the basis of the lessons learned from the studied foreign experiments, eight suggestions have been highlighted for PREBAT:

- *Establish a partnership with the local governments;*
- *Establish a partnership with the private sector;*
- *Promote labels on the buildings and on the components;*
- *Place particular emphasis on economic, financial and fiscal instruments;*
- *Monitor the quality assurance elements of setting up a building site, skills and training;*
- *Incorporate the usage dimension and user behaviour;*
- *Ensure R&D and developments comply with technical regulations;*
- *Associate energy with the environment, building and transport.*

12. Five development areas were recommended for PREBAT:

- *Promote the setting up a national repository and a device for the evaluation of the operations and ecological districts;*
- *Put forward a comprehensive design of buildings, specifically by means of simulation devices;*
- *Develop examples of solutions and good practice guides;*
- *Define an R&D strategy for the existing stock;*
- *Establish a permanent inter-regional and international comparison project and an observatory of the operations and ecological districts.*

13. These five areas for development can be centred on two outlooks:

- A short-term outlook, centred on the distribution of the *existing techniques* with *incremental innovations* and focussed on *economic feasibility*;
- A mid- and long-term outlook, enabling changes to be anticipated that won't come to light until over the next few years, which have the potential to generate *radical innovations*.