

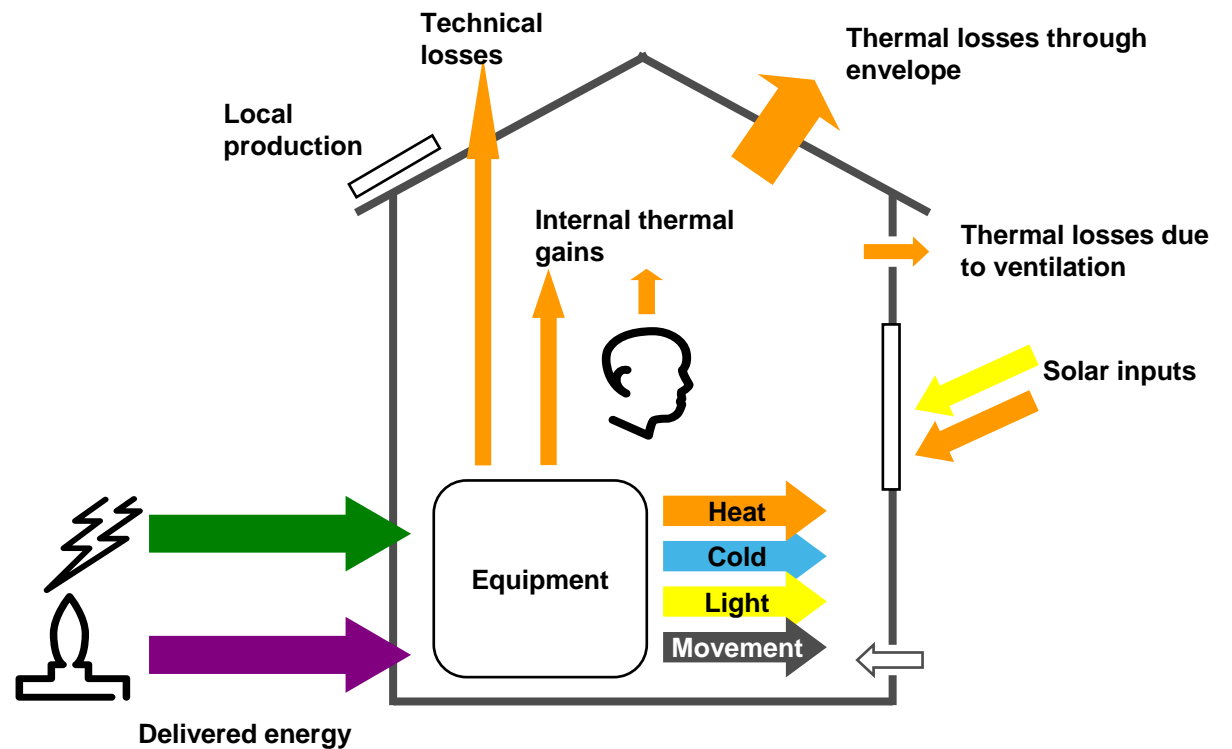


HABITAT OPTIMISÉ, MAÎTRISE DE L'ÉNERGIE & SERVICES

HOMES levers for **active energy efficiency**

Where does the energy in a building come from? Where does it go?

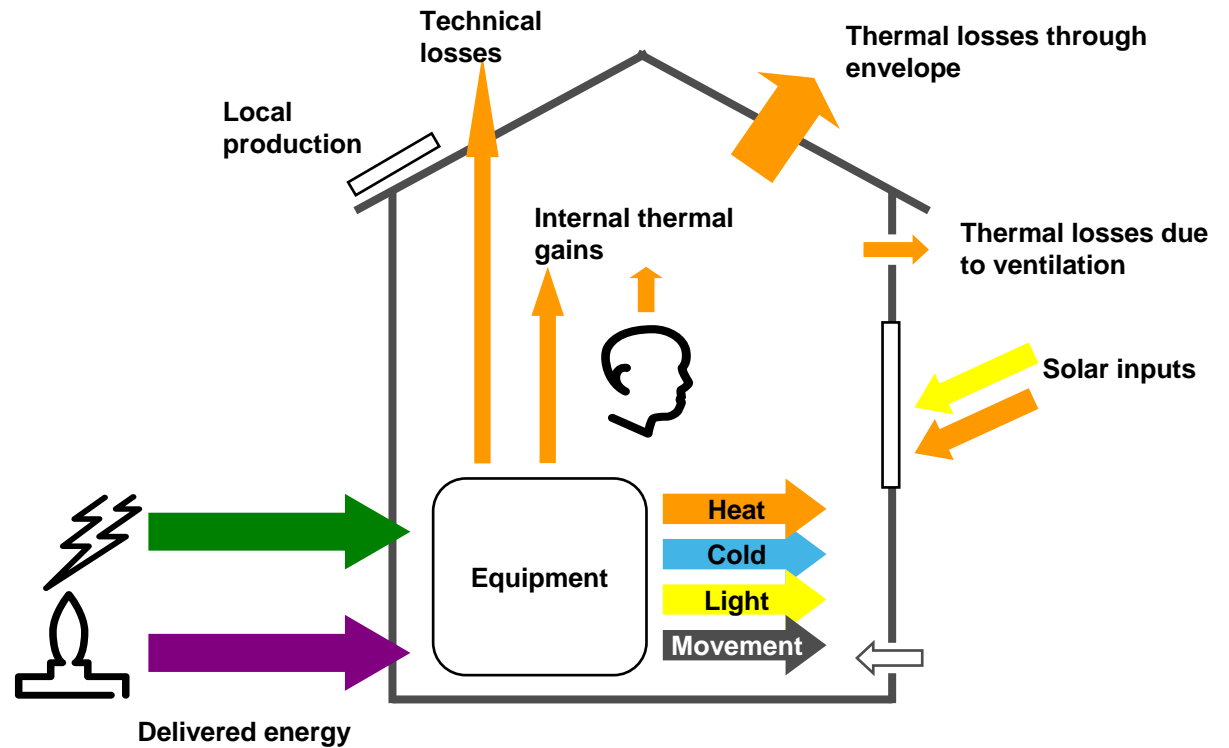
In a building, energy continuously comes and goes via a number of inputs, conversions and outputs. The quantities of incoming and outgoing energy vary greatly for different buildings.



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How to reduce energy needs and CO₂ emissions?

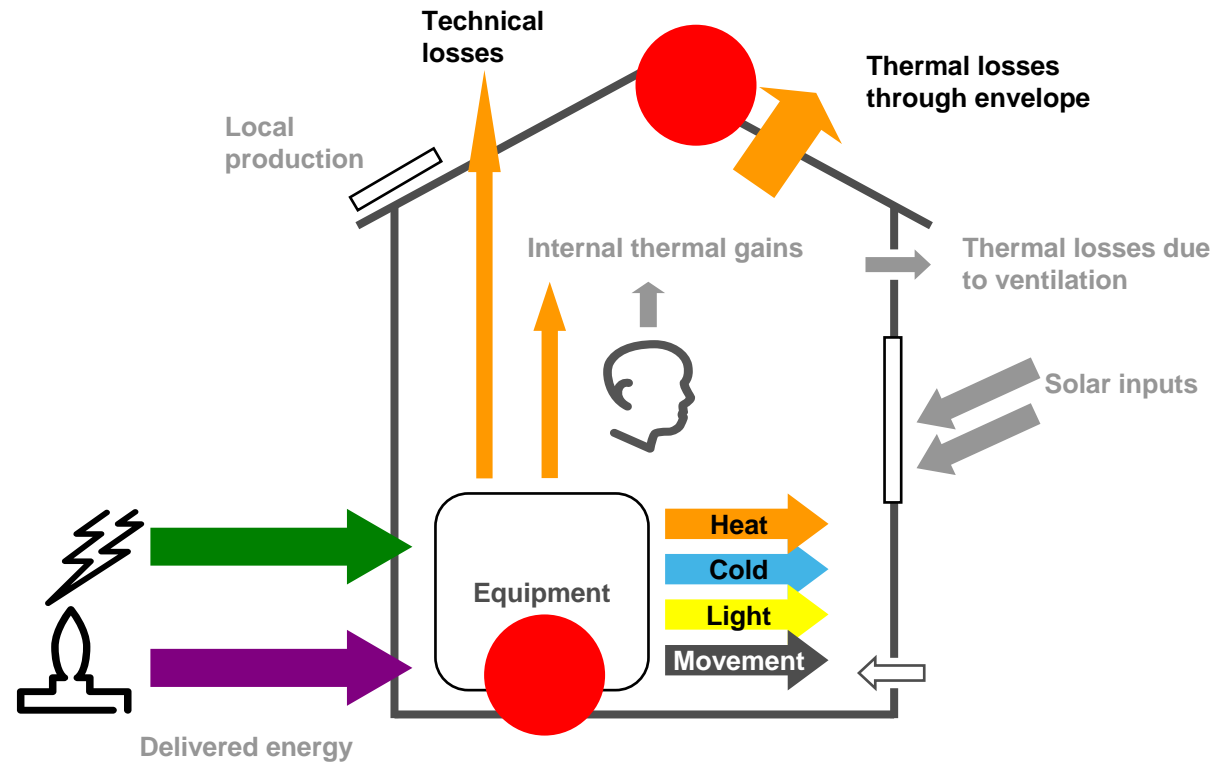
Energy efficiency in buildings and local green energy production are the solution. In Europe, buildings account for almost 40% of total energy consumption and 25% of CO₂ emissions!



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How to reduce energy needs and CO₂ emissions?

Reducing thermal losses through the building envelope and increasing the intrinsic performance of equipment are **PASSIVE ENERGY EFFICIENCY** actions. For example, replacing incandescent light bulbs by CFLs increases the potential performance of lighting from 14 to 60 lumens per Watt.



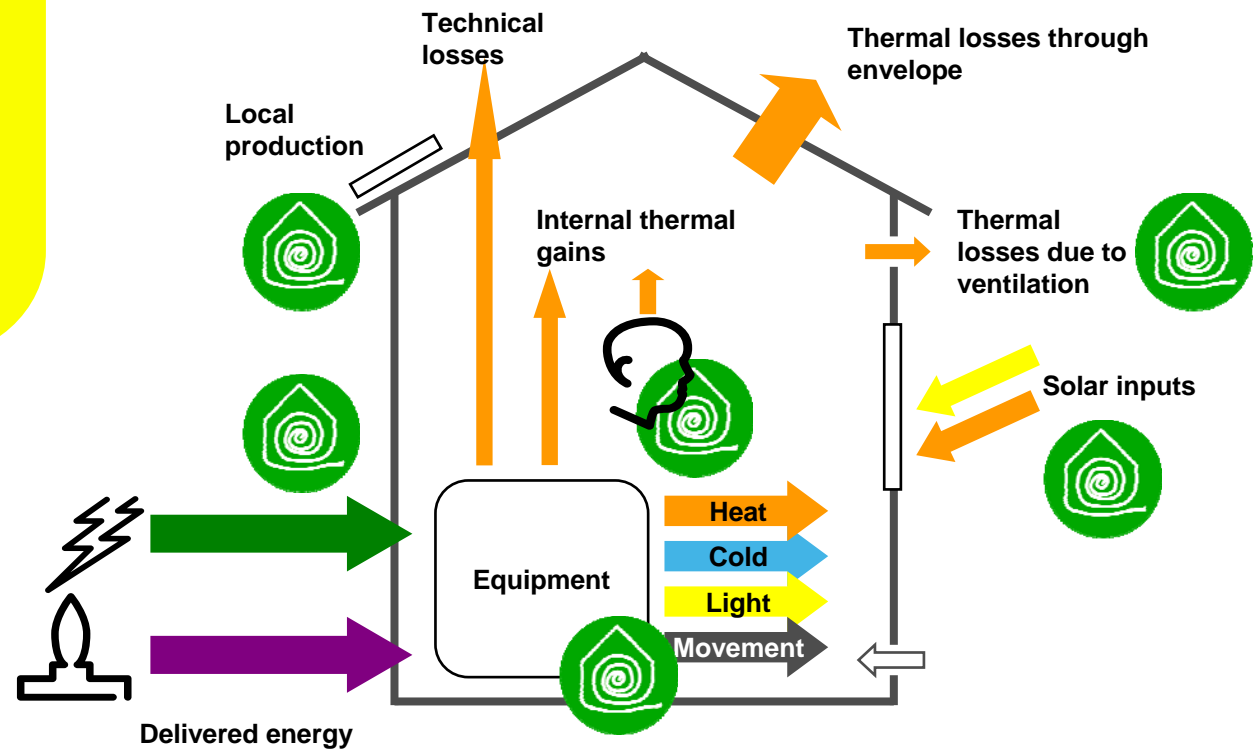
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How to reduce energy needs and CO₂ emissions? Active energy efficiency

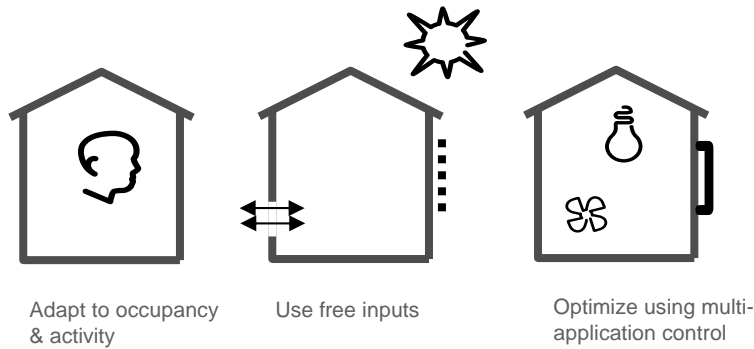
ACTIVE ENERGY EFFICIENCY focuses on **PEOPLE** and their **USAGE** of equipment and energy.

- > **Reduce energy demand** while maintaining comfort by taking in account real time occupancy and free inputs such as solar gains through windows.
- > **Reduce delivered energy** through optimized control strategies and use of local renewable energies and smart grid connections.
- > **Reduce energy consumption** by developing energy awareness.

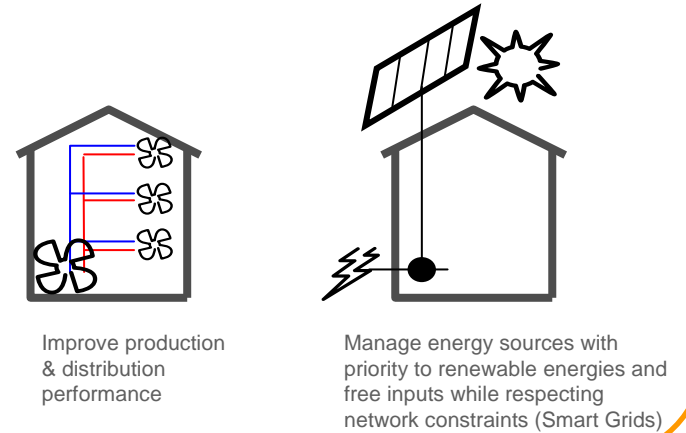
That's what the HOMES program is all about.



Reduce energy demand in each room by optimizing comfort & activity conditions



Optimize energy supply & distribution to serve user needs



Let's have a closer look at our HOMES levers!



Involve people: awareness, improvement, maintenance



Occupants



Owners



Maintenance technicians



Energy Managers

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Take into account the real occupancy of each zone in the building

Observation

In many cases, unoccupied areas of a building are provided with the same level of comfort as occupied areas.

Action

Provide optimal comfort where & when it is needed and save energy in all other cases:

- . Install occupancy detection systems (presence/absence or number of people)
- . Anticipate inoccupancy periods and adjust heating, cooling and ventilation strategies accordingly

Example

Adapt ventilation to the real occupancy using the measured CO₂ level to control ventilation flowrates.

Possible savings: approximately **25%** on the air flowrate (assuming an office context and EN15232 occupancy profiles)

On the average,
only 30% of
offices are
occupied during
office hours



Adapt the level of comfort to the occupants, their activity and their preferences

Observation

Required temperature or lighting levels vary greatly according to the type of activity and the metabolism, age and clothing of each occupant.

Action

Manual and/or automatic adjustment of the levels to the real need, either room by room or for each workstation, makes it possible to increase occupant satisfaction and reduce misadjustments made by unsatisfied occupants.

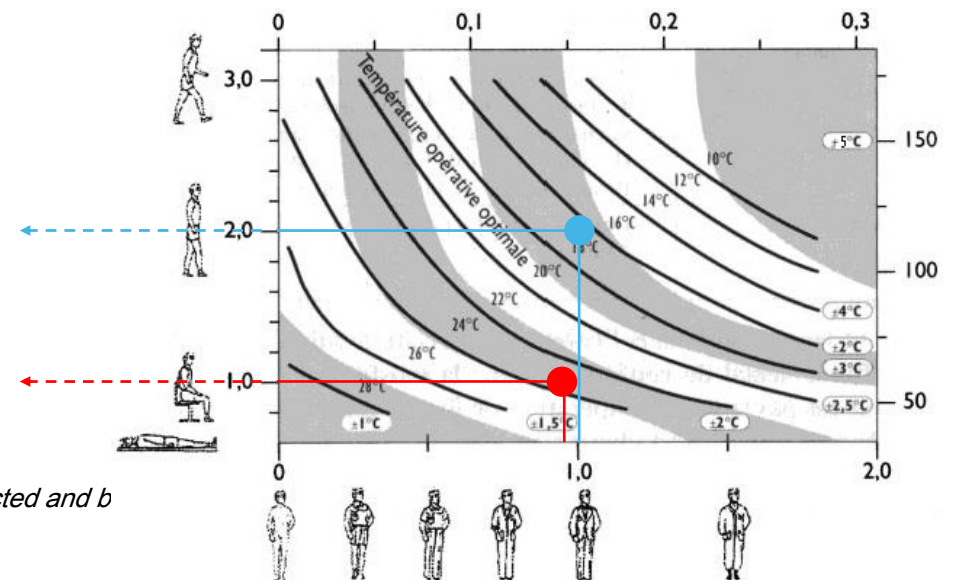
In this way, comfort levels no longer need to be set to meet the highest needs present on the site.

Example

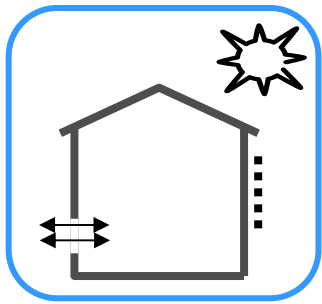
18°C is a comfortable winter operative temperature setpoint for corridors

24°C is a comfortable winter operative temperature setpoint for office working areas

The optimum operative comfort temperature can vary by as much as 5°C depending on activity and clothing



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Use free inputs

Observation

A great deal of free heat and light can be obtained through windows. The air outside a building can be used for heating or cooling.

Action

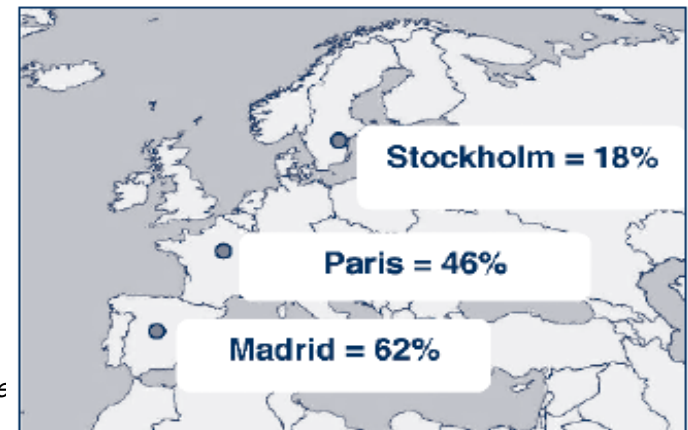
- . Control blinds and shutters to let solar radiation enter in winter and keep it out in summer.
- . Use illumination level detectors and anti-glare systems to allow maximum use of natural lighting.
- . Use free cooling whenever possible.

Example

Percentage of lighting needs (>500 lux) that can be covered by natural lighting.

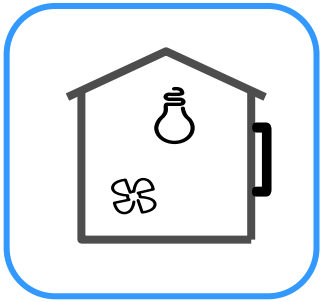
Assumptions: Between 7 a.m. and 7 p.m. at different latitudes on December 21 (the shortest day of the year), for a building with 20% window area (European average) and no shutters.

10 kWh/m²/yr of cooling energy can be saved by closing shutters or blinds for 2 hours a day in summer (for a building in Marseille, France with 30% window area).



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Figure 9. Source : simulation HOMES.



Optimize using multi-application control

Observation

A building is a complex system in which energies and applications interact. To achieve optimum energy performance, the overall system must be taken into account.

Action

- . Use sensors and advanced algorithms to choose the best options taking into account the performance of the building envelope, the equipment, energy costs and comfort and activity needs.
- . Use solutions based on application interactions and coordination.

Example

In summer, is it better to close blinds and shutters to keep solar gains out or open them to let natural light in?

> Different control strategies may be used depending on the relative technical performance of cooling and lighting equipment as well as the orientation of the building and the climate. The chosen solutions must also be acceptable to the occupants.

Air conditioning and fans can be combined to reduce cooling energy demand.

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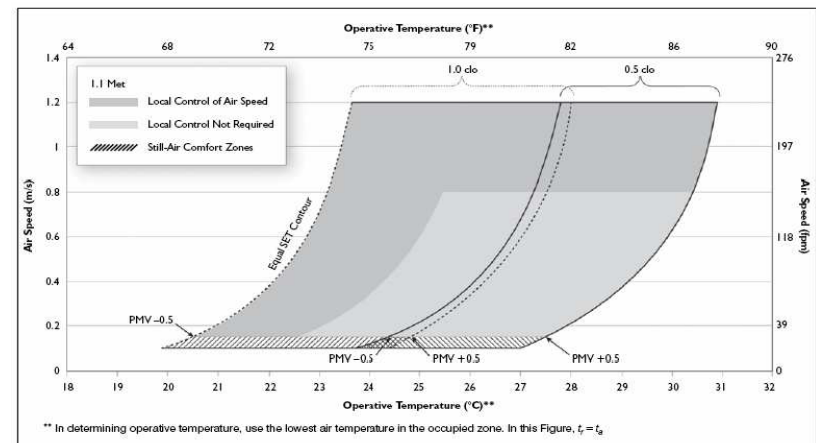
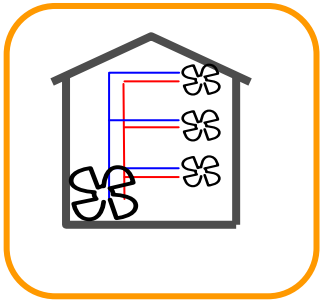


Figure 5: Elevated air speed for warm air temperatures.

source : [2] HOMES, "Comfort and Air quality definition for indoors", F. Alessi, CEA-INES



Improve the performance of heating, cooling and ventilation equipment at production, distribution and emission levels

Observation

Even quality equipment will lose performance if it is not used correctly.
Equipment is often not properly adjusted.

Action

- . The temperature of the heating or cooling liquid can be adjusted according to a relationship that takes the outdoor temperature into account to reduce distribution losses and the energy demand of the heat or cold production equipment.
- . The coordinated use of several different types of production equipment offers greater flexibility to meet variable needs.
- . Control systems can be used to maximize continuous operation or ensure the best compromise with respect to start/stop requirements.
- . Advanced control techniques (e.g. predictive control) can be used to make thermodynamic systems operate more efficiently.
- . Thermal energy can be stored and used when required.
- ...

> Save up to 15% in heating by taking the outdoor temperature into account .
> Save up to 10% savings in cooling or heat pumps using advanced control.

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Manage energy sources with priority to on-site renewable energy while satisfying network constraints (Smart Grids)

Observation: Energy procurement is rapidly changing

- . Emergence of **Smart Grids**
- . Increase in **local production** of green energy
- . Development of **sustainable neighborhoods** where energy can be shared

Action

To achieve this, it must be possible to:

- . connect to different energy sources and storage systems
- . communicate with energy providers
- . determine the best strategy for energy input (buy, store or sell)
- . determine the best strategy for loads (anticipate or delay starting, shed, etc.)



Create energy awareness

Observations

- . Our everyday behavior is often energy hungry
- . The decision to invest in energy-performance improvements is hard to take (lack of motivation, lack of knowledge)
- . Energy aspects are not sufficiently taken into account in the design, building, maintenance and management of buildings

Actions

- . Use inexpensive measurement equipment that is easy to install to obtain sufficiently detailed energy consumption information
- . Use indicators that are easy to understand and motivating, adapted to each profile

- . Use tools to convince building owners
- . Provide simulation tools to building professionals



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The HOMES goal: Higher energy efficiency for all buildings while maintaining or improving comfort

> Control solutions adapted to each context

- . sensors to measure contextual parameters related to occupancy and comfort
- . sophisticated algorithms to calculate the best equipment control strategies

> Fast, easy and economical solutions

- . no major or intrusive work
- . optimized control and monitoring architectures to reduce component and installation costs

> Solutions suitable for existing buildings

- . wireless technologies (radio or carrier current) and batteryless devices

> Solutions to predict, measure and monitor energy consumption

- . measure energy consumption per zone and per application
- . produce simple and motivating indicators
- . use easy energy simulations in the design phase

Remember...

information and control are the keys!

