eSESH
Saving Energy in Social Housing with ICT

March 2010 – February 2013

Tested Methodologies

Throughout projects, various methodologies have already been tested in order to evaluate Energy performance of buildings.

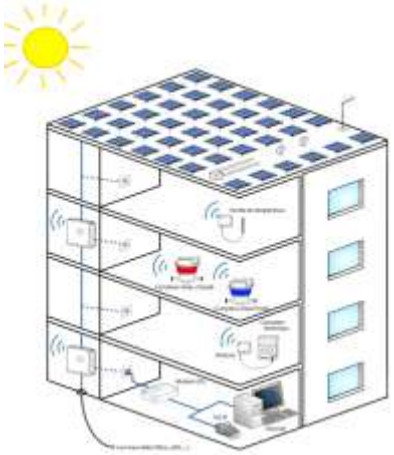
Each of the methodologies need:

- adapted instrumentation systems (which may be more or less expensive: for example, implementing temperature measurements or meters in the dwellings)
- together with social enquiries with regards to tenant behaviour.

2 methodologies could be implemented:

1. **To compare the implemented building with that of an equivalent building.**
2. **To compare consumption of tenants before and after implementation.**

Comparison of buildings



First case: to compare the implemented building with that of an equivalent building without any instrumentation and tenants information campaign.

point to pay particular attention to:

1. We have to establish an equivalent building to that of the implemented building (in terms of similar typology, orientation, heating system, inhabitants…)
2. We have to ensure that the tenants have not been influenced by any of the information campaigns towards the focus group.
3. We have to monitor any changes in the population (inflow, outflow)
4. We have to take into account energy price fluctuations.

Comparison of consumption

Second case: to compare consumptions of tenants before and after implementation.

This method is more reliable and also more challenging:

1. Sufficient consumption measurement data required before implementation for a long enough period (at least, by one heating season).
2. Monitoring temperature patterns (corrected from degree.days data).
3. Obtaining authorization from the energy suppliers to reach tenant personal data consumption.
4. Obtaining authorization from tenants to utilise their consumption data.
5. Review the population of each dwelling pre and post measurement campaigns

Key steps

In any cases, we have to:

1. Monitor any changes in the population (inflow, outflow).
2. Take into account energy price fluctuation.

Moreover, we have to face that information campaigns regarding energy saving are efficient initially, but thereafter seem to have less impact over time.

This is due to:

- Constant information necessity
- Collective heating causing invoice equalization and tenants are not able to notice direct effects of their saving.
- Elderly folks, for example, are not satisfied with the central heating system temperature set on about 19°C.
- Lack of real-time consumption data available for tenants willing to save energy.

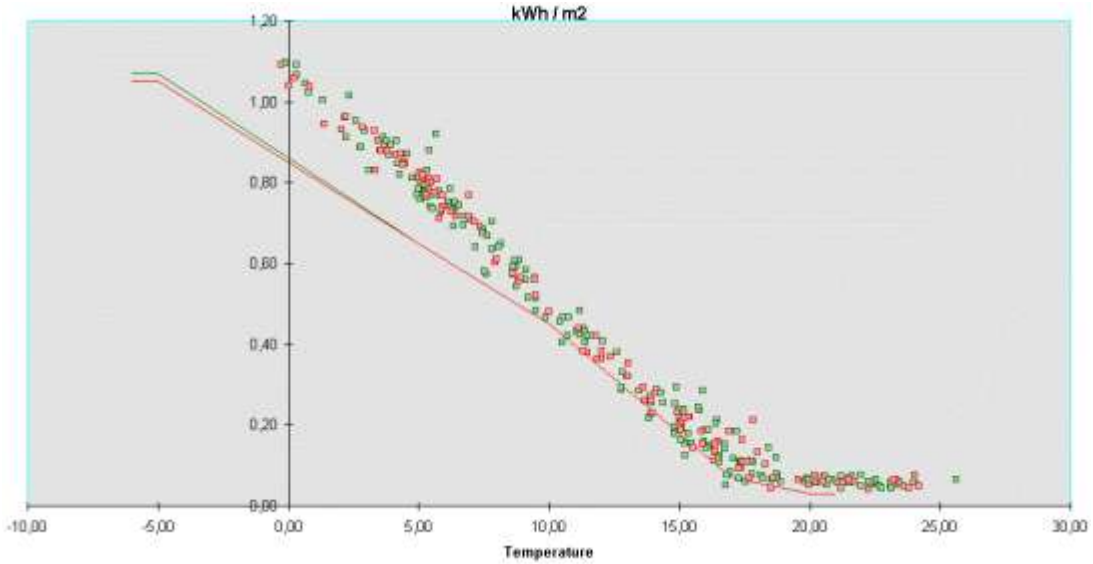
Conclusion

The evaluation of behaviour enhancement against consumption has to be statistical.

This evaluation has to be based on objective measurements as the energy signature, whereby mobilizing a significant number of tenants over a long period of time.

Most of it, we have to “measure” whether tenants have taken in account the recommendations of their landlords in relation to the saving of energy or if ICT tools have sufficiently been used.

What is an energy signature ?



By regularly monitoring the relation between energy consumption data and outdoor temperature fluctuations, it is possible to compile data which can be graphically presented. This graph represents the buildings energy signature and illustrates the logical dependency between the energy consumption and varying outdoor temperatures. The energy signature is used to analyze the energy requirements and operating costs of the building.

How is energy consumption measured ?

Energy consumption is usually measured in dm^3, m^3 fuel or the number of kWh or MWh.
When the energy consumption is divided by the area in the building to be warmed or cooled, it is possible to calculate the kWh/m^2 required.

This will yield a predefined level of energy consumption which can be used to analyze the energy values for different types of rooms and buildings.

To establish building energy consumption, it is necessary to determine what uses the energy. If meters are installed on the different types of system in a building, for example the ventilation and radiator systems, it is possible to analyze which system is responsible for any increase in operating costs.

Correcting measured values

The energy consumption in a building is affected by a number of factors which have to be considered.
In addition to the outdoor temperature, the wind velocity, the solar gain, machines or equipment that radiate heat and the number of persons present in the building have to be considered.

However, the most dominant factor of those above mentioned affecting the energy consumption is the outdoor temperature.
Other factors affecting the energy signature of the days of the week are the ventilation times, night reductions and holiday optimisations.

The degree day correction method

The average outdoor temperature is used to calculate the degree day correction or number of degree days.
To calculate the number of degree days, the assumption has to be made that the heating system in a building contributes to heating the room temperature to + 17 C. The energy required to heat the room to normal temperatures may be generated by solar gain, human beings, or machines and other equipment in the building.
Degree days are calculated by determining the difference between the indoor temperature (+17 C) and the average recorded outdoor temperature.

Example When the average outdoor temperature is +2 C, the number of degree days is (17-2) = 15 degree days. By recording the number of degree days in a month, the total number of degree days of that month can be established. The average degree days of the region may be obtained from past weather reports; after that, the correction factor of the month may be calculated. This will form a basis for correcting the energy consumption.

The degree day correction method

However, this method does have a few disadvantages:

If a specific month contains only a few degree days, the degree day correction method may result in an abnormal increase in energy consumption if the values are not adjusted.

The degree day correction method assumes that the room temperature has to drop to +17 °C before room heating is required. In newer, more well insulated buildings, this is rarely the case; the heating demand is usually lower than that of older buildings.

If one energy meter only is used for the whole of the building, then all of the energy consumption which does not contribute to the heating of the building must be deducted, such as the domestic hot water system, heat loss in pipes, etc.

The energy signature

The energy signature does not have the disadvantages of the degree day correction method, which is described above. There is no need to correct the energy consumption, as it is directly linked to the outdoor temperature.

There is no need to couple the measurement to the point in time when the room is initially heated, as this information can be extracted from the illustrated graph.

It is also possible to calculate the energy consumption of the domestic hot water system and the heat loss in pipes from the graph. The difference between the zero line and the deviation point closest to the zero line, when the outdoor temperature is at its highest, represents the energy consumption of the domestic hot water system and the pipe heat loss.