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building
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Raising awareness for energy efficiency in the service sector: *learning from success stories to disseminate good practices*

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Abstract

Energy efficiency in the service sector is a key issue because of the important growth of its energy consumption. The energy performance of buildings and equipment can be improved through technical investments, but this has to be linked with an efficient management and good practices in order to reach better energy efficiency levels in a cost-effective way. Experience feedback concerning awareness activities in the service sector highlights the interesting opportunities of energy efficiency improvements they represent.

This paper first draws a synthesis of the available feedback in this area to detect factors of success for this kind of activities. More than twenty operations from Europe and North America were analyzed looking at items such as the stakeholders involved, the actions implemented, the communication means, and the evaluation performed.

Then a case study describes an EDF pilot operation in South East of France. An awareness campaign was led in four particular EDF buildings to inform the employees of the best practices and to involve them to apply these advice. Different action packages were used to compare their efficiency. The evaluation emphasizes the success of the operation, with around 10% of energy savings (i.e. more than 270 MWh/a). More than 80% of the employees said they changed their energy behavior and other indicators show their commitment and satisfaction towards the campaign.

Finally, suggestions are made to disseminate good practices at a broader scale, especially out of the "initiated" circle. Building up a know-how from the evaluation of past experiences makes easier the development of process such as networking, experience sharing, and including these activities in energy services offers and in white certificates systems.

Keywords:

Energy efficiency, raising awareness, experience feedback, evaluation, commitment theory, user behaviour, white certificates

Introduction

The amount of GHG emissions of the service sector in Europe[4] was 456 $MtCO_2$ in 1990. In the European Climate Change Program, the target of emission reduction by 2010 for this sector is 105

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MtCO2/a (in relation to 1990 emission level). Which represents around one fourth of the global target for this program (where transportation is not accounted) (EC – 2003).

In France, the final electricity consumption of the service sector has raised of 76% from 1986 to 2000, while its whole final energy consumption increased by 31% (CEREN – 2002). This is the second sectorial growth, below transportation, but above the residential sector. In the UK, the energy consumption growth of the service sector is assessed to be three time higher than for residential sector (SCRASE – 2001). Energy efficiency in the service sector is therefore a key issue.

The achievement of the emission reduction objectives has to be done through technical improvements of the buildings, as indicated in the European Directive on the Energy Performance of Buildings. The technical potential would already be significant if the available best technologies were used, as well in the existing as in the new commercial buildings (NEUMANN et al. – 2005). But actions on the energy consumption patterns are also needed. Raising awareness among the building users has to be included in the energy efficiency strategy, because total energy consumption in buildings is highly affected by occupants (JANSSEN – 2004, DUSCHA et al. – 2005). In fact energy efficiency is not only a matter of technology. Taking into account the energy issues in the choices of development models (LEBOT et al. – 2005) and changing behavior toward rational energy use (BOERAKKER et al. – 2005, EIJADI et al. – 2005) are also necessary.

In this paper, we focus on the raising awareness activities in the public and commercial buildings. First, we present an overview of researches and operations in this field. Second, we made a detailed case study of an EDF pilot operation done in the Provence-Alpes-Côte d'Azur region in France. Then the analysis of this case study and the experience feedback highlights key success factors in order to disseminate successful operations at broader scale. Finally, prospects are considered, especially the opportunity to include raising awareness operations in white certificates systems.

Potential of raising awareness operations in the service sector

Raising awareness actions can target building users, as well as building operators and/or decision-makers. The actions for operators and decision-makers are very important, both for optimizing the energy management of the buildings (AUNE et al. – 2005), and for encouraging the demand for more energy efficient buildings (LUTZENHISER et al. – 2001). We focus here on the actions targeting building users. But for better results, they have not to be considered separately. They should be embedded into global energy management systems (VAN GORP – 2005).

This kind of activities has been broadly studied for the residential sector (ABRAHAMSE et al. – 2005), but deep analysis of operations in the service sector are rare. Indeed, studies on energy efficiency improvements in commercial buildings often focus mainly on technical potential (TIAX LLC – 2004). But technical performance alone is not enough to reach better energy efficiency (SMITH et al. – 2005). Investments linked with ad-hoc advice reach better results (see (GREGORY et al. – 1997) cited by (HENRYSON et al. 2000)). And technical solutions can not always be applied for old buildings or equipments. The review by (NORDMAN et al. – 2000) showed that if the U.S. Energy Star program enabled important savings thanks to the use of low-power mode for PC and monitor, "additional savings could be gained if more equipment were turned off at night manually".

The lack of studies on raising awareness operations in service sector can be explained by the complexity of the analysis needed, which requires especially pluridisciplinary skills: technical, economical and sociological (PYRKO et al. – 1998). The scientific literature provides little information on the potential of these activities. For the residential sector, studies proved that an energy savings potential of around 10% seems reachable (HENRYSON et al. 2000). This order of magnitude is also commonly indicated in the available case studies for the service sector.

To characterize the potential of these operations, we looked for the available experience feedback on Internet and in scientific publications. More than twenty operations or operation groups were detailed

enough, i.e. with most of the following items: kind of targeted buildings, stakeholders involved, objectives, list of implemented actions, communication means used, energy impact and/or economical balance, barriers / problems encountered, success factors (see Table 1 for some examples of operations). Case studies were much easier to find for public buildings than for private ones.

The experience feedback mostly confirms an energy savings potential of around 5 to 10%. But the definition of this potential is unclear: for global building energy consumption or for only targeted end-uses, with or without technical interventions or investments. The part of energy savings really due to the implemented actions is hard to assess accurately. Moreover, the lasting of the supposed impacts is also an important issue, as these actions are reversible by nature.

The analysis of the experience feedback highlights the main barriers for raising awareness activities:
- lack of concrete knowledge on how to use energy efficiently and on the environmental impacts linked to energy consumption
- difficulties to quantify the actions impacts, and then to give a feedback and for benchmarking
- difficulties to change behavior
- difficulties to involve the building users because they don't directly benefit by the achieved savings
- technical problems preventing good practices to be applied (e.g. radiator without thermostat)

The main responses suggested to these barriers are:
- to provide concrete examples of good practices and successful operations
- to use the several available internal communication means of the company or public body
- to propose to the building users to use a part of the savings for something they choose (sharing of the savings, improvement of the building, donation to charitable organizations)
- to organize a monitoring and a regular communication of the operation achievements

In most of the cases, the operation theory can be summed up by the following approach:
1- to better inform the building users to make them aware of their possibilities of actions
2- to encourage / to induce the users to act out (from awareness to actions)
3- to perpetuate the changes by the monitoring and the communication on the results
But this model can not always give explanations for features linked to the specificity of the building or its use for a given case. However it remains the most common model (PYRKO et al. – 1998).

The analysis of the experience feedback shows that the most significant interest among the building users is often induced by the uncommon actions. And "successful conservation measures were mostly initiated, decided and realized by a single person fairly low down in the hierarchy" (WEBER – 1999). Our analysis highlights the main success factors for raising awareness activities. This last synthesis is presented in the conclusion part of this paper.

Building up a know-how and experience sharing

The analysis of experience feedback has been done for some specific sub-sectors to constitute methodologies and good practices guidebooks. For instance, for the health care centers in Canada (OEEC – 2003) or for schools in the European Union (NILSSON et al. – 1997). Organizing a contest is also a good way to stimulate the realization of operations and to encourage experience sharing. Such contests are organized in the United States for federal buildings (HARRIS et al. – 2005) or in Europe for all tertiary buildings [9]. Networking is another efficient tool for experience sharing. Good European examples are Energie-Cités or the "e-team" projects for schools [1]. A SAVE project on this issue was led in 2002-2004 (MØRK – 2003). Another solution is to develop resource centers, as www.energyoffice.org, a SAVE project to gather experience and best practices.

But advertising is still needed so that these tools can be used at a broader scale, especially out of the "initiated" circle. Moreover, the provided information has to be reliable, which depends on the quality of the evaluation performed.

Table 1 – examples of available experience feedback

Place, kind and number of buildings	Date	Stakeholders initiators	Posters / booklet	Meetings / training	Internal communication	Raising awareness only	Sharing of the savings	Special actions	Energy and/or environmental impacts	Web-reference
Heidelberg (Germany) - 16 schools	1995-1999	Local energy agency, City of Heidelberg	X	X	X	no	yes	constitution of an energy team	from 3 to 9%/a savings (around 600 tCO2 avoided in 4 years)	[1]
Hanover (Germany) - 98 schools	1995-1997	City of Hanover	X	X		no	yes	educational activities in a global frame (local 21 agenda)	5.000 tCO2 avoided in 2 years	[1]
Glasgow (UK) - the 300 buildings of the University	from 1996	University of Glasgow	X	X	X	no	no	award for the best energy savings suggestions	assessed potential of 10% reduction	[2]
Michigan (US) – all the buildings of the University	from 2001	Michigan University	X		X	no	no	interactive campaign through Internet, included in a global eco-footprint program	Detailed study of the energy consumption but no clear impacts detected	[3]
Winnipeg (Canada) - 25 buildings of the Health Sciences Centre		Health Sciences Centre	X		X	no	no	a central contact person ; post-it put on the switch and PC let off during the night	No quantification of the impacts	[4]
Clarenville (Canada) - 15 buildings of the Peninsulas Health Care Corporation	1991-2000	the Peninsulas Health Care Corporation and its energy supplier	X	X	X	no	no	preliminary study ; operation included in a global energy management program	around 10% reduction between 1997 and 2000	[4]
Pamplona (Spain) - municipal buildings	2001-2002	Local energy agency, City of Pamplona	X		X	yes	no	follow-up by the housekeeping personnel of the equipment let off during the night	a model to quantify the savings is under development	[1]
Chalon-sur-Saône (France) - city hall	1997-98 then 2004	City of Chalon, EDF, ADEME	X		X	yes	no	quarterly balance of the energy consumption by department	Punctual reductions from 4 to 7%	[5]
UK – 9.000 office buildings of BT plc	1993	British Telecommunication	X	X	X	no	no	one energy awareness manager in every buildings	Reductions from 3 to 6%	[6]

Case study: EDF pilot operation in the PACA region (France)

Operation context

Eco Energy Plan [7]

The Eco Energy Plan is a pluri-annual energy efficiency program (started in 2002) aiming at securing the electricity supply in the East of the PACA region[5]. This program is under the responsibility of the Alpes-Maritimes Prefecture[6] and the PACA Regional Council. EDF, ADEME[7] and the Regional Council implement it. The EDF pilot operation takes part in the action theme "the Eco Energy Plan partners show the example".

The environmental involvement of EDF

This operation lies within the scope of the environmental approach of EDF (with a link for instance with the ISO14001 certification and environmental management), and within the setting of the French white certificates system. This pilot operation aims at being a reference in order to reproduce it easily.

The European Energy Trophy [9]

The European Energy Trophy is a project co-funded by the European Commission. The objective of this contest is to stimulate the implementation of raising awareness activities in the public and commercial buildings. One of the buildings involved in this operation took part in this contest, and EDF received the award of the best French operation.

Operation principles

A campaign both reproducible and custom-made

The developed methodology is reproducible to serve as reference. It defines the steps to follow and includes the existing experience to provide advice in order to insure the success of the future operations. But it let enough freedom for the operation manager to do a custom-made operation.

Indeed, the objective is also the operation to fit with any particular building. A preliminary survey among the building users enables to better know the initial energy behavior and patterns, and then both, to better target the actions and to involve the users in the operation design.

The commitment theory

The operation is based on a voluntary approach. Meetings were proposed to the employees to present them the operation. At the meeting end, these who wanted it, could sign a commitment charter. Through this, they publicly committed themselves to apply the good practices of their choice.

This approach is based on the commitment theory. This theory, coming from the experimental social psychology, enables to understand how people led to do some preliminary actions *a priori* insignificant then come to do more difficult actions, if these preliminary actions are achieved in some conditions (so-called commitment conditions: freedom feeling, public actions, etc.) (JOULE et al. – 1998).

A study made in 2000 showed the interest of such a commitment approach to induce households to save energy (BEAUVOIS et al. – 2000, FLAHAUT et al. – 2001). The commitment charter uses this

[5] this area is at one end of the national electricity transportation network (see [8] for more details)
[6] State representation in this area
[7] French Agency for Environment and Energy Management

approach for the professional context. It enables for instance to make the committed users real actors of the operation, and so to strengthen their involvement.

Strengthening everyone's involvement

The operation success relies on the mobilization of all building users. In this respect, the most important items of the methodology are:
- to propose, on a voluntary basis, an individual commitment charter
- to show the involvement of the Direction
- to insure a contact with all building users, thanks to meetings and contact person in each department making easier the dissemination of information
- to keep the campaign dynamic thanks to various actions, consistently planned, and with messages evolving with time (especially adapted to the seasons)
- to make the actions visible by providing feedback on their results
- to increase the standing of the committed users

Evaluating the operation

This operation is a field experimentation. It was designed in order to highlight the success factors. Four different campaigns were launched at the same time in four distinct buildings (see Table 2 for the details on the different action packages). One more building without any action done was monitored as control site. The energy consumption of each building were monitored on a monthly basis.

Moreover, three surveys of the employees in each building were done:
- a preliminary one, to make an initial diagnosis (December 2004)
- an intermediate one, to get a first feedback and to adapt the end of the campaign (June 2005)
- a final one, to complete the evaluation (end of 2005)

These surveys were based on forms given directly to the employees, and mainly constituted of multiple-choice questions, so that quantitative analysis of the results could be done.

Operation implementation

Table 2 - implemented action package for each site

Actions[8] ↓ Site →	Site 1 (Energy Trophy)	Site 2	Site 3	Site 4
Posters	X	X	X	X
Eco-advice booklet	X	X	+ reminder stickers	
Information meetings[9]	X	X		
Involvement of the Direction	+++	++	+	
E-mails	X			
Message when PC on	X			
Commitment charter[9]	X			
Educational exhibition	X			

(Source: EDF)

Action details:
- the posters focused on the four main targeted end-uses (lighting, HVAC, PC monitor, elevators) and were renewed every two weeks
- and so was the message configured to be automatically displayed when PC are switched on
- the booklets presented a list of 21 good-housekeeping actions customized for office buildings
- the e-mails were personally sent by the Director of the building at the beginning, half-course and at the end of the operation
- the educational exhibition lasted one week in a room where the employees could visualize the

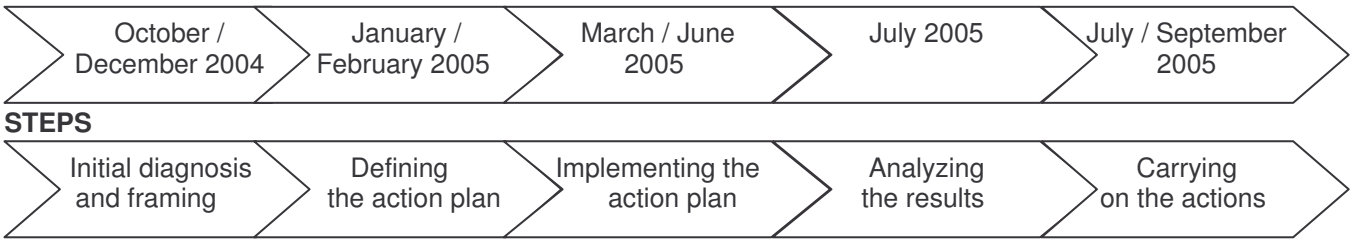
[8] for the details of the actions, contact Bertrand Combes at bertrand.combes@edfgdf.fr
[9] actions within the commitment theory approach (see also the "operation principles" section)

energy consumption of office equipment thanks to individual meters. They could see as well what are the good practices to reduce these consumption while keeping the same comfort level

The operation theory was:
1 – to inform the employees of both, the operation launching and concrete good practices which can be applied in office buildings
2 – to induce them to adopt and apply these good practices, especially by the commitment theory approach
3 – to inform them of the operation results to strengthen their involvement and motivation

The different steps of the operation are summed up in the Figure 1 below.

Figure 1 – operation schedule



ACTIONS

Constituting the operation team and defining the objectives Choice of the pilot sites and control building Survey of the energy behavior and habits of the building users (at the office)	Analyzing the preliminary survey Proposition of actions Action plan validation by the operation team Creating the communication tools	Implementing the first communication flight Intermediate survey (end of June) Communicating on the first quantitative results (for the details of the action packages, see Table 2)	Checking the efficiency of the communication campaign Fitting the messages to the results of the intermediate survey and to summertime	Implementing the second communication flight Communicating on the quantitative and qualitative results Updating the operation methodology with the experience feedback

(Source : EDF)

Operation results

Only site 1 (full action package) results are presented here. When possible, they are compared to the other sites results. Quantitative analysis of sites 2 and 3 results could not be performed, because of their too small sample size. Their results are however taken into account for the qualitative analysis.

Initial situation

The answers to the preliminary survey highlighted a global energy awareness level already high, with no significant differences between the sites. This high energy awareness level is linked with the EDF company culture. Most of the respondents said being enough (69%) and even too much (3%) informed by EDF about energy savings issues. As answering was voluntary, energy aware employees can be over-represented in the samples. The results of the surveys presented here are "gross", i.e. not corrected for this potential bias. But the analyses deduced from these results took this into account by testing if the results could be due to this bias, fully, partly or not.

The respondents said they have a "reasonable" (70%) or "very sparing" (6%) behavior toward energy. But particular potential still remains on targeted actions. Thus, 61% of the respondents said they open their window while heating or cooling is on. And only 15% said they switch off the PC monitor when leaving the office during the day (while they are 75% to do so while leaving at the end of the day).

It is interesting to notice that these potentials are not the same from one site to another. This confirms the usefulness of a preliminary study to better target the actions.

Participation

Two direct indicators enable to evaluate the employees' participation to the operation[10]:
- 67% of the employees have taken part in one of the proposed information meetings
- 75% of the employees who attended a meeting have signed an individual commitment charter

Most of the employees were therefore interested in the operation, and then voluntary committed themselves.

The rate of the employees who signed the charter is a bit higher within the sample of the intermediate survey (70%) than among all building users (50%). This was taken into account in the analysis.

Evaluation of the communication plan

The intermediate survey show that, according to the respondents, the most involving communication means were the ones linked to the commitment theory approach (meetings and charter).

Otherwise, according to the respondents, the most visible communication means are not necessarily the most reminded by the respondents, neither the most efficient. Posters are the most visible communication mean. But the respondents first remind being informed about the operation by the meetings (24% vs. 9% for the posters). They also find the meetings more efficient (36%, vs. 17%).

The intermediate results also highlight that the campaign has been mostly perceived in a positive way: efficient, involving and original are the most mentioned adjectives. This is confirmed by the global appreciation of the operation assessed as enough (66%) or very (16%) satisfactory.

The comparison with the other sites strengthens the analysis about the efficiency of the different communication means.

Table 3 – appreciation of the communication plan by site (from the intermediate survey)

Site	Site 1	Site 4
Kind of action package	full	posters only
Number of building users	340	230
Number of distributed forms	250	165
Number of respondents	94	66
Were the communication means involving?	yes (79%)	yes (47%)
You find the communication plan :		
- excessive	10%	1,5%
- appropriate	75%	30,5%
- too discreet	15%	68%

From a qualitative point of view, sites 2 and 3 results confirm the comparison between sites 1 and 4: posters and booklets enable to inform the building users, but a more direct contact (for instance meetings) is needed to involve them in the operation.

[10] both monitored actions were voluntary (taking part in the meetings and signing the charter)

Behavior changes

The possible behavior changes were evaluated through the intermediate survey, taking into account the preliminary survey analysis. The final survey (end of 2005) could not be analyzed yet. The questionnaires were not given directly to the persons as for the other surveys, and the answer rate was too low. A new survey is being made following the same process than for the preliminary and intermediate survey to get a better answer rate.

82% of the site 1 respondents say they have changed their behavior. The changes are mainly on switching off PC monitors (73%) and lights (55%) while leaving the office during the day, and in a smaller extent on heating and cooling (16%) and not taking the elevator (14%).

The advice on lighting and PC monitors are well perceived. They are easy to apply, and do not change the user comfort. Moreover an energy savings potential was detected for these end uses from the preliminary survey. At the opposite, advice on heating / cooling[11] and elevators get little approval. Indeed, these advice require more efforts and the users may feel as it changes their comfort. The corresponding habits are then harder to change.

The results for the other sites confirm this difference between PC monitor and lighting on one side, and heating / cooling and elevator on the other.

The comparison between sites 1 and 4 show clearly a better impact for the full action package (cf. Table 4). For the global behavior evolution, the difference between both sites is the same as for the appreciation on how involving the campaign is. The consistency between these results strengthens the analysis of the efficiency of a campaign with direct contacts.

Table 4 – behavior changes (from the intermediate survey)

	Site1	Site 4[12]
Have you changed your behavior concerning energy consumption?	82% (yes)	45% (yes)
Have you changed your behavior concerning : - lighting	55%	33%
- PC monitor	73%	23%
- heating / cooling	16%	8%
- not taking the elevator	14%	

These results may be partly explained by the high rate of committed employees in the site 1 sample. Even so, the rate of global behavior change (82%) is higher than the rate of charter signature (70%). Therefore, the global impact of the full action package can be considered as very good. Moreover for both sites, the respondents represent about 30% of all building users. This high answer rate reinforce the positive appreciation of the operation.

Energy consumption evolutions and links with the implemented actions

A first direct comparison between the annual consumption for 2005 and the average annual consumption for the previous period where data were available (2002-2004) gives a -9% decrease. After a simple Heating Degree-Days (HDD) correction for heating consumption, the result is -11,5%.

This evolution for site 1 is to be compared with the other sites evolution. Two indicators were used.

The first indicator is the average variability, defined as the ratio of the standard deviation of annual

[11] the advice for heating / cooling were to better use the thermostat and to limit the opening of windows as the ventilation system is already sufficient for the air change

[12] there were no messages about elevators in site 4 campaign

consumption for 2002, 2003 and 2004, to the average annual consumption for 2002-2004:

$$\text{average variability} = \frac{\text{standard deviation of annual consumption for 2002 - 2004}}{\text{average annual consumption for 2002 - 2004}}$$

The second indicator is the relative consumption change between 2005 and the average on 2002-2004:

$$\text{relative consumption change} = \frac{\text{2005 annual consumption - average annual consumption for 2002 - 2004}}{\text{average annual consumption for 2002 - 2004}}$$

These indicators were used first to study the total annual electricity consumption. As for two sites, the heating system is with gas and not electric, we also used the indicators for annual electricity consumption without heating, and then also for heating annual consumption apart. All these data were HDD corrected when necessary.

Even if they were build at different time, all sites can be considered with an initial efficient consumption level, because investments were made in the past to improve their energy efficiency and they all have operation contracting for their heating system.

Table 5 – energy consumption evolution by site

Site[13]	Site1	Site 2	Site 4	Site 5
Construction period	late 70's	late 80's	late 80's	early 80's
Heating system	electric	electric	gas	gas
Action package	full	partial	posters only	control site
Average annual electricity consumption (without heating) (in GWh/a)	1,5	0,5	1	0,2
Average variability for 2002-2004 HDD corrected total electricity consumption	+/- 6%	+/- 9,5%	+/- 6%	+/- 4%
Relative consumption change between 2005 and 2002-2004 (after HDD correction)	-11,5%	-8,5%	+0,5%	+6,5%
Average variability for 2002-2004 electricity consumption (without heating)	+/- 8%	+/- 11%	+/- 6%	+/- 4%
Relative consumption change between 2005 and 2002-2004	-11%	-8,5%	+0,5%	+6,5%
Average variability for 2002-2004 HDD corrected heating consumption	+/- 3,5%	+/- 5,5%	(heating consumption represents, respectively for site 1 and 2, 30% and 12% of the total annual consumption)	
Relative heating consumption change between 2005 and 2002-2004 (after HDD correction)	-12,5%	-9%		

The consumption change is significant in comparison to the average variability for two sites:
- site 1 (full action package) with a significant decrease (-11,5% vs. +/-6%)
- site 5 (control site without any action) with a significant increase (+6,5% vs. +/-4%)

Moreover, a deeper statistical analysis[14] based on the monthly consumption data from January 2002 to December 2005 confirms a significant decrease for sites 1 and 2. These results are consistent with the figures presented in Table 5 above. So the impact of the campaign seems very positive.

The above analysis plead in favor of the causality between the actions and the consumption decrease. Moreover the comparison of the consumption changes between sites 1 and 4 is consistent with the comparison of the awareness impact of both actions packages. But this causality has to be

[13] site 3 energy consumption were not available while making this paper
[14] the linear model introduces a triple statistical correction : HDD and month in winter (variations due to heating and lighting), average outer temperature in summer (cooling)

confirmed by a month by month analysis with comparisons between sites and a good knowledge of all the other events, which could have had an influence on energy consumption. For instance, the change of heating consumption for site 1 could be due to a change of the heating system settings.

Conclusions from the case study

The original approach based on the commitment theory appears to be very efficient. 75% of the employees who attended the information meeting voluntary committed themselves into the operation. 80% of the employees said they have changed their behavior towards energy. And the total electricity consumption decreased by around 10% for the period of the campaign.

Two other results of the case study are particularly interesting:
- direct contacts really improve the involvement of the building users in the operation
- good practices are more broadly applied when they require little effort and/or do not change the user comfort

The economical assessment was made through the calculation of the cost of the avoided kWh. Two extreme scenarios were used, with different set of assumptions:
- optimistic scenario: all the electricity consumption decrease is due to the operation and the operation costs don't include the time passed in the meetings by the employees
- pessimistic scenario: only the electricity consumption decrease without heating are accounted as energy savings, and the operation costs include the meeting time for the employees

Moreover, as there is no evidence yet for the lasting of the savings, only the savings achieved during the operation are accounted.

The result is a cost of avoided kWh between 1 and 4 c€ (taxes not included). For comparison the average purchasing price is 6,5 c€(taxes not included)/kWh for this kind of customer. Moreover, it has to be noticed that this operation is a pilot one. So its cost could surely be reduced in case of reproduction (for example, the design costs). This applies particularly in case of pursuing the actions in the same buildings. The gained savings should be even more cost-effective in case of a long-term strategy.

There is no available case study which enables a direct comparison between this operation based on awareness actions and another operation based on investments into control systems for specific end-uses as lighting. A measurement campaign was made within the Eco Energy Plan to better know the energy consumption of office equipment and lighting (ENERTECH – 2005), but no feedback is available about actual energy savings in similar conditions (same kind of building, of activity, etc.).

Moreover, awareness actions have not to be compared with "technical" actions as alternative options, i.e. to select one alone. The comparison is useful to prioritize action plans, i.e. to know the magnitude order of both, improvement that could be reached and corresponding costs. But the actions should be thought in a global view, for example within an energy management system, or even beyond energy issues, within the global policies of the company. For instance, the awareness actions can also be part of the organizational culture of the company.

General conclusions

Success factors for raising awareness operation in the service sector

The main success factors detected through the case study and the analysis of the available experience feedback are:
- the involvement of the head-management
- the realization of a preliminary survey to define a baseline and to better target the actions
- the coordination of the operation by a specific operation team which is representative of all the

building users
- the monitoring of the results and their communication to all the building users
- the motivations used to involve the building users (savings sharing, award system, etc.)
- the originality of the communication means, their consistency and the clearness of the messages

The evaluation of raising awareness operation in the service sector

Raising awareness operations need good quality evaluation:
- to insure the reliability of the experience feedback, both for experience sharing and to perpetuate the involvement of the building users
- to detect the success factors
- to establish causality between energy savings and awareness actions

The energy savings results based on a simple monitoring of consumption data, the most used kind of results in the available experience feedback, have to be considered with precaution. Indeed the assessed energy savings (generally from 5 to 10%) have the same (or even smaller) magnitude order as the "natural" variability of the energy consumption. Therefore, the analysis of the causality between the energy savings and the implemented actions require a detailed analysis taking into account all the factors which may have a significant influence on the consumption (see the researches done about benchmarking energy efficiency of buildings as in CHUNG et al. – 2006).

However, even if it has always been difficult to clearly establish the causality between energy savings and raising awareness activities, the "gross" results of most of the case studies of such operation in the service sector are positive and encouraging. The conclusions of our case study also go in this direction. Raising awareness operations represent a potential which is not to be sneezed at. This deposit could be particularly cost-effective. But the reliability of the energy savings assessment is a key factor for the development of raising awareness operations at a broader scale. It should then be worked to define an evaluation method agreed by all the involved stakeholders. A basis for such a method could be deduced from the case study presented in this paper.

Moreover, the lasting of the impacts is another key issue. Because these actions are reversible by nature. About the persistence of the savings, "various investigations reach different results, but there is a tendency that the longer the trial period, the longer lasting the effects" (HENRYSON et al. 2000). Education and training actions in the industry was studied by the Energy Center of Wisconsin to develop systematic model to define actions "that delivers consistent, measurable and significant results in terms of lasting energy efficiency behavior change" (ANDERSON et al. – 2005). But no literature gives such results for awareness actions in the service sector.

Prospects: including raising awareness actions in white certificates systems

Raising awareness activities could be more broadly included in the service offers for energy management of buildings, as in the offers of some ESCo[15] in North America. For instance in Canada, guidebooks are made to encourage this (OEEC – 2004).

Furthermore, standard actions for raising awareness in the service sector could be defined so that they could be included in white certificates systems. Indeed, these actions represent a significant deposit, cost-effective and easy to reach. They can also take part in the development of energy services offers. Therefore, they totally fit with the objectives of white certificates systems. Moreover, these actions are not widespread yet. Their inclusion in white certificates systems could help a change of scale, from exemplary operations to common practices. The available feedback highlights the success factor needed to make these operations easily reproducible.

However the issue of the energy savings evaluation is not totally solved yet. The evaluation of some

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actions already included in white certificates system is not without any uncertainties neither. But the evaluation quality is here of particular importance, because awareness actions are reversible. Two possibilities of inclusive evaluation are to be further studied:

- when the awareness action is linked with another standard action: validation of a fixed relative bonus. For example, if an awareness action is implemented together with another standard action, the white certificate value of this standard action would not be 100% of the fixed energy savings, but 110%.

- for awareness actions alone: the calculation of the energy savings could be based on a fixed percentage of the global standard energy consumption of the building. This standard energy consumption would be assumed to be the consumption for a "normal" use of the buildings (with the same comfort level), as defined in the European Directive on the Energy Performance of Buildings or in labeling system (cf. Display™ campaign). Then the energy savings validation would be based on the energy bills.

The potential for raising awareness operations is significant. The available experience feedback highlights the key factors to insure the success of future operations. But the experience sharing and the development of operation remain restricted to a circle of "initiated" stakeholders. A larger dissemination of best practices could be achieved by defining reliable evaluation methods and including awareness actions in white certificates systems.

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