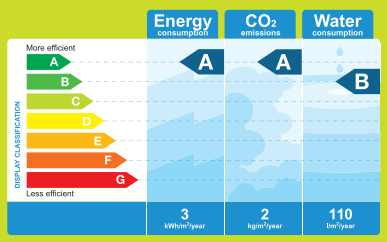
display®

Communicate Your Buildings Energy Rating

The relationship between technical / infrastructural changes, communication campaigns and their impact on energy consumption



Get Power Save Energy!

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Executive Summary

This report presents the findings of the evaluation of the CYBER (Communicate Your Building's Energy Rating) Display® project to assess the effectiveness of communicating a building's energy rating to then reduce its energy consumption. The objective of the Display® Campaign is to show that the Energy Performance of Buildings Directive (EPBD) - that aims to reduce the energy consumption of buildings in Europe - can be significantly accelerated if local authorities can stimulate behavioural change through communicating the performances of their buildings to politicians, technicians, building users, different municipal departments and the public. The report presents the analysis of the Display® database and questionnaires to building users to identify impact of technical changes and behaviour change that affect energy use in buildings. One of the key themes of this report is the unhelpful distinction made between 'technical improvements' and 'behaviour change'**.** A technical improvement *is* the result of someone's behaviour being changed, be it the facilities manager, finance director or energy manager.

This report provides an overview of the broad energy performance trends of buildings in the Display® Campaign database. The evaluation of over 10,000 Display® certificates shows that as a result of involvement in Display®, the trend is of buildings moving 'Towards Class A.' By this we mean there is, overall, a increase in higher rating certificates (A-C) and a decrease in ratings G-D.

The second phase of our analysis was to select a sample of buildings for closer inspection and to understand the specific reasons why some buildings have improved and some deteriorated. We present a set of common factors that appear to lead to improved energy performance, as well as noting unhelpful activities such as the increased burden of IT use and installing air conditioning that can lead to increases in energy consumption. This same sample is then analysed for its communication activities and a further set of common factors are indentified that appear to lead to improved energy performance. We conclude that buildings moving 'Towards Class A' are more likely to:

- Invest in multiple refurbishments especially lighting controls and boiler replacement and avoid using air conditioning where possible;
- Invest in new types of building controls especially heating controls;
- Have a full time energy manager and voluntary environmental champions;
- Organize local media campaigns and use creative promotional materials;
- Attend local and national networking events such as 'national users club event';

Finally, this report concludes that there is in fact no one single measure or 'quick-fix' for moving buildings 'Towards Class A'. Municipalities that demonstrate improved building energy performance are likely to have undertaken a range of voluntary activities that become 'greater than the sum of the individual parts'. The public display of a building energy certificate such as the Display® poster acts as a catalyst for this behaviour change. The poster is not an end in itself, merely a means to an end. The importance and success of the Display® Campaign is in recognizing that the poster is merely a beginning of the journey 'Towards Class A'.

As a result of our research findings we make the following set of recommendations:

- Local municipalities and those responsible for the built environment:
  - There is a need to appreciate the benefits that a 'whole system' approach to energy management can have. Participation in Display® Campaign and producing posters is an

important tool to be used by energy professionals to encourage behaviour change, be that decision makers to choosing to invest in technical improvements *and* communication and public engagement initiatives.
  - Clear guidance is required for what constitutes effective technical improvements – not all interventions are equally effective in reducing energy consumption.
  - Recognise that increasing the size, extending opening hours, installing information technology and installing air conditioning are likely to increase energy consumption of buildings
  - The need for local engagement of stakeholders is also vital, as demonstrated by the user-clubs that many municipalities participate in.
- National stakeholders and policy makers:
  - Participation in national networks is a vital form of engagement and sharing best practice.
  - National certification and harmonization? Having a single system of building energy certification would of course be advantageous – currently energy managers who choose Display® Campaign for the support and resources they provided then face a difficult decision of displaying two posters, their EPBD DEC and their Display® poster, which, due to differences in calculation methodologies occasionally present different ratings.
- European stakeholders and policy makers.
  - The overall trend of the buildings in the Display® Campaign has been 'Towards Class A'. This is a result of municipalities voluntary participating in both community campaigns and technical improvements, not simply producing Display® posters. To that end, any legislative requirement for buildings to have building Energy Certificates is welcomed but must recognise that the certificate is the starting point, not the destination. Municipalities should not see the preparation of their certificates as merely a box to be ticked, but a catalyst to engaging all building-users, from decision-makers and facilities managers to teachers and schoolchildren.
  - National certification and harmonization. A single system of building energy certification at the national and European level would allow for a meaningful comparison of performance and improvement across Europe.

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1 Introduction

The objective of the Display® Campaign is to show that the overall aim of the EPBD, reducing the energy consumption of buildings in Europe, can be significantly accelerated if local authorities can stimulate **behavioural** change by communicating the performances of their buildings to politicians, technicians, building users, different municipal departments and the public.

The Display® project began with the simple aim of 'making buildings more energy efficient through the stimulus of communication programs and the production of a voluntary certificate'.[1] This report presents the findings of the evaluation of the Display® Campaign. Having considered both the broad trends in building performance (outlined in Deliverable 2.2.1) across the range of buildings participating in the Display® Campaign, and the public engagement and communication activities undertaken (Deliverables 2.3.2 and 2.3.3) this report asks the big questions. **What drives the improvements in building performance – is it technical improvements or the behaviour change of building users driven by the display of an Energy Performance Certificate such as Display?** Is it possible, in fact, to separate the two questions? A technical improvement itself may be the tangible result of behaviour change, for example, of the energy manager responsible for a specific building. To that end this report not only addresses deliverables 2.2.2, but also includes findings from deliverable 2.3.4. in an attempt to answer this question as a whole.

Behaviour change is a notoriously difficult concept to measure. In an attempt to meet this challenge this project, (and hence this report) takes a multi-method approach – that is uses both quantitative and qualitative methods to reach its conclusions. We know there is often a gap between people's 'espoused behaviour' – what they *say* they do – and how they *actually* behave. To that end there have been 'objective measures' defined in the project documents to attempt to 'quantify' people's actual behaviour change as evidenced by the change in a buildings rating.

The first half of this report is concerned with presenting the findings of this analysis of the building database to see how the buildings have performed during the time of the campaign. This report

[1] The first specific objective of the project as outlined in Annex1: Description of Action

quantifies the improvements achieved on specific buildings (in terms of their rating) and identifies the common factors necessary to achieve savings in line with EU, national and local national energy reduction targets. The second half of this report will consider the role of building user, the impact of communication campaigns and ask who really is the intended audience of posters displaying a buildings energy rating.

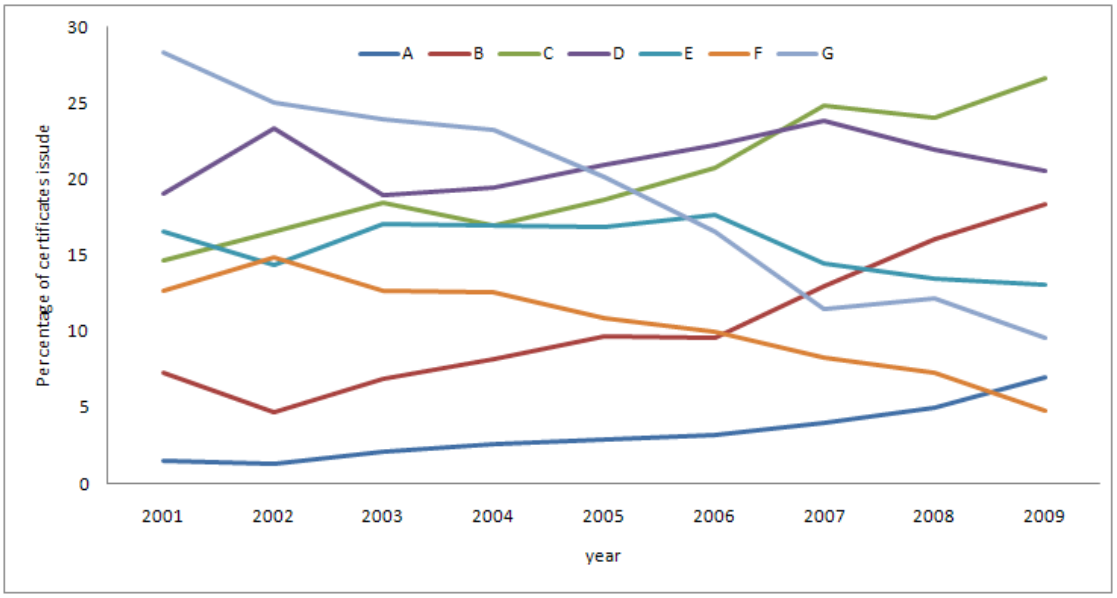
2. Initial Facts and Figures – The Big Picture

2.1 Overview

Almost 40% of the European Union's final energy consumption is building related. The energy performance of buildings directive (EPBD) aims to reduce this building related energy consumption. Cities and towns participating in the display campaign of take the lead in the implementation of the energy performance of buildings directive. They have used the display certificates have as part of a wider communication engagement campaign to reduce energy consumption in buildings. For the past decade, almost 500 local and regional authorities in Europe have been involved in the development of the display campaign, voluntary scheme initiated by Energy Cities in 2001. Over 22,000 energy-rating labels were issued by the 28 participating European nations for 10,522 buildings between 2001 and 2009. Countries such as France and Great Britain have issued the majority of certificates with Switzerland, Ukraine and Finland following close behind.

Over time the clear trend has been an increase in the number of A rating energy certificates issued, and a steady decrease in the number of both F and G rating energy certificates. Figure 1 shows an increase in the number of A, B,C and D energy certificates issued. However, the number of A certificates is still a relatively low percentage of the total number. The majority of certificates issued are C and D. Figure 1 also shows that whilst the trend for G ratings is decreasing, the number of G certificates being issued is still relatively high.

Figure 1:Energy rating certificates issued between the years 2001-2009 for each rating



There has clearly been an improvement in performance of these municipal buildings, but how much and what is the major cause of this improvement is addressed in the next section.

2.2: Methodology for analyzing movement

The aim of the research was to investigate whether buildings have improved their performance as a result of their involvement in the Display® Campaign, by:

- technical changes made to the buildings,
- displaying the label, or
- through undertaking communication with building users.

It is essential to first identify which buildings have changed their energy ratings during the course of the Display® Campaign, thus a methodology was developed to assess this change. Each building's energy rating label was used to establish its progress.

Two methods were considered to measure this change:

1. comparison between the earliest and latest performing certificates
2. comparison best and worst certificates.

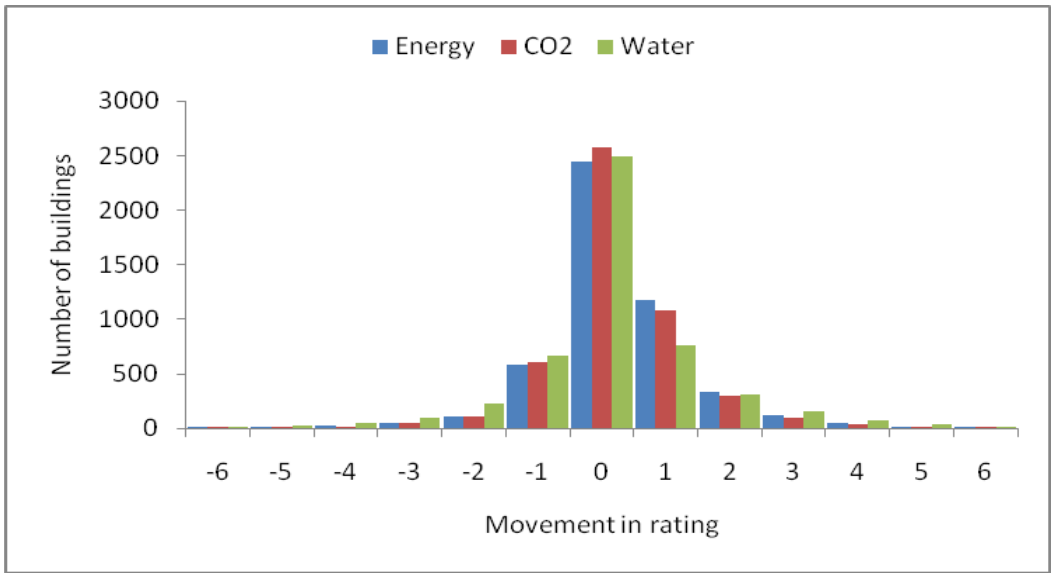
A building's performance is not just 'one-way', it can deteriorate as well as improve. A significant improvement in a building's performance might have occurred some years before, but subsequently

deteriorated. The second method does not use the most recent building performance information. It will identify only a maximum improvement or deterioration in building performance, not the latest performance of the building. The first method provides us with a better picture of the overall performance of a building over time. It shows the latest building performance information. The first method was therefore adopted. A core metric was designed to represent the effectiveness of efforts to improve building energy performance, based on the progression of display energy ratings for a given building over time. In order to capture the overall success, irrespective of *when* changes were made, the metric was based on the entire period of available data. Ratings are provided between A to G, where A is the highest possible rating achieved by the building and G lowest. Ratings were given a numerical value in ascending order with incremental value of 1 starting from lowest building rating (G). Using this methodology, for each building with two or more certificates issued, the earliest and latest energy ratings are determined. The difference between these ratings is calculated to indicate the magnitude of change.

$$\Delta = (\text{latest} - \text{Earliest})$$

The resultant metric, Δ represents the change in rating experienced by the building. Negative values indicate deterioration, positive values indicate improvement. An analysis of these values forms the basis of the report. For example *if* the earliest certificate is of higher rating e.g. "A" (numeric value 7) in year 2001 and latest rating is in year 2008 and is "E" (numeric value 3). The movement in rating calculated will be -4 (Latest-Earliest) and if the case is vice versa it will be +4. Negative movement in rating implies deterioration over time. Figure 2 shows the results of this initial analysis and the **clear trend of buildings improving.**

Figure 2: Movement of buildings between the first and latest rating



At the end of this first section is it clear then that during the course of the Display® Campaign there has been an *overall* improvement in the performance of buildings in the Display database – put simply, whilst many buildings have stayed the same (as shown by the zero movement in rating), more buildings have seen an increase in their rating than have seen a decline.

2.3 Research limitations

The Display® database was developed as a communication tool. The database that can be easily used by municipal energy managers to generate the Display® certificates as part of a wider campaign. It was not designed to gather and store 'research' data for academics. This places some limitations on the use of this database as a research tool. The database is not static. It changes with time and municipalities can update their data (including previous year's data) as their data quality and availability improves. The following results should therefore be viewed as indicative rather than absolute. Also, calculating and comparing the average movement of two groups of buildings based on a single factor will not show the interlinking relationships of all the factors. Any resulting change in average movement might be due to the combined result of more than one refurbishment and/or other measures. Finally, the average movement is based on the total energy consumption. This total cannot be separated into electricity or heating. However, certain kinds of refurbishment have impact on electricity but not on heating and other types might have effect on heating but not on electricity.

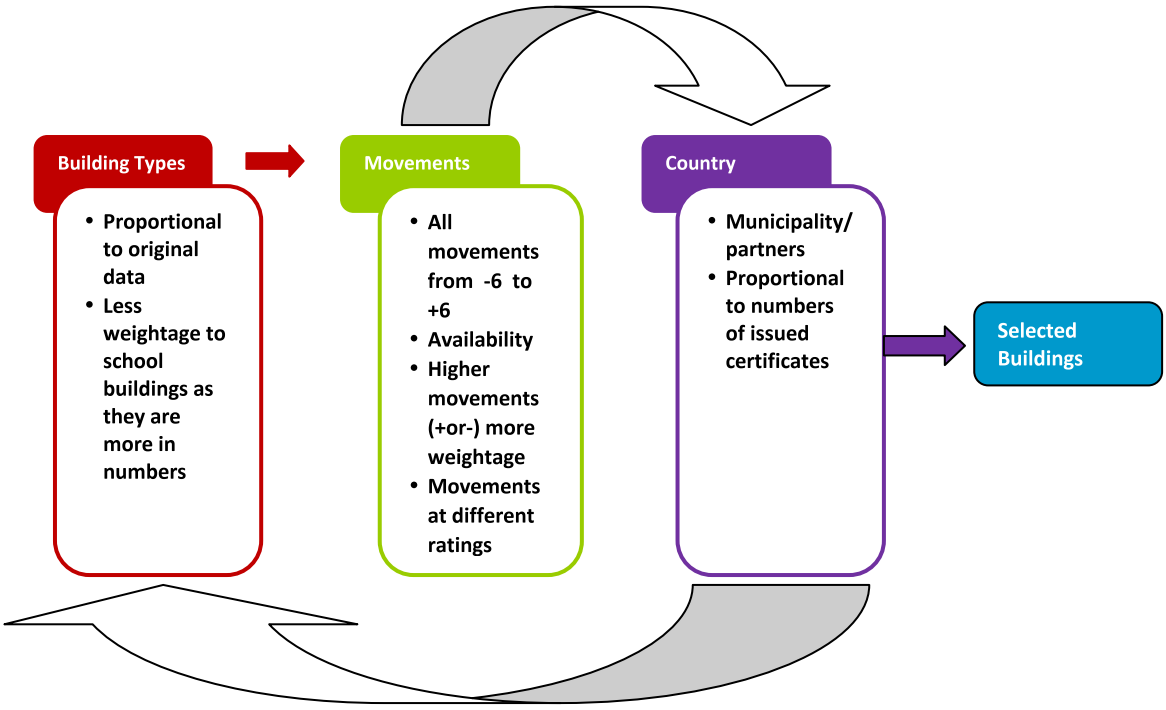
3. Methodology for analyzing the buildings

The Display database contains over 10,000 certificates from 28 countries. A sample was selected, based on the building type, their average movement and their country. Those buildings with only one certificate were excluded from the analysis, since the purpose was to analyse changes in ratings of time. Additional information was requested via an on-line survey from a sample of 751 buildings.

3.1 Selection of Buildings

In order to have maximum possible representation of all types of buildings across different countries in their different state of performance, the selection was based on three parameters shown in Figure 3: building types, movement and country.

Figure 3: Methodology for selection of buildings



The approach was to select buildings with different types of movement from +6 to -6. More weight was given to buildings with higher change in movement (e.g. +6, +5 or -6, -5) as buildings with such large change in rating are very few in number. Buildings with a "1" movement could occur if building rating changes from B to A or from G to F, similarly for negative movement). A total of 751 buildings were selected from the 5,586 buildings that had multiple certificates.

4 The impact of technical improvements on building performance: Results from technical analysis and surveys:

The following sections describe the impact of the different technical improvements carried out buildings in the Display® database. They are based on the analysis of 286 questionnaires. The analysis of the movement of the building certificates in the database showed that there was a tendency for buildings with lower energy certificates (D, E, F and G) to show greater positive change than those with higher certificates (A, B and C). Similarly, those buildings with high certificates (A, B and C) have a greater

tendency to reduce their certificates over time. Once a building has achieved a relatively high certificate, it can be difficult for this relatively high level of certificate to be maintained.

4.1 The impact of refurbishment

The first analysis was to test whether the buildings that have been refurbished perform better than those that haven't. Between 2001 and 2009, 33% of the 286 buildings underwent no refurbishment; 33% had one type of refurbishment and 18% had three or more types. In general, new windows, lighting controls and replacement of boiler are the most common types of refurbishment. However, when comparing the average movements of individual groups three types of refurbishment stand out as positively affecting average movement: wall insulation, lighting controls and replacing the boiler. Since the differences in average movement compared to other types are relatively high it suggests these three types of refurbishment are the most effective in improving building energy performance.

Figure 4: Average movement for different types of refurbishment

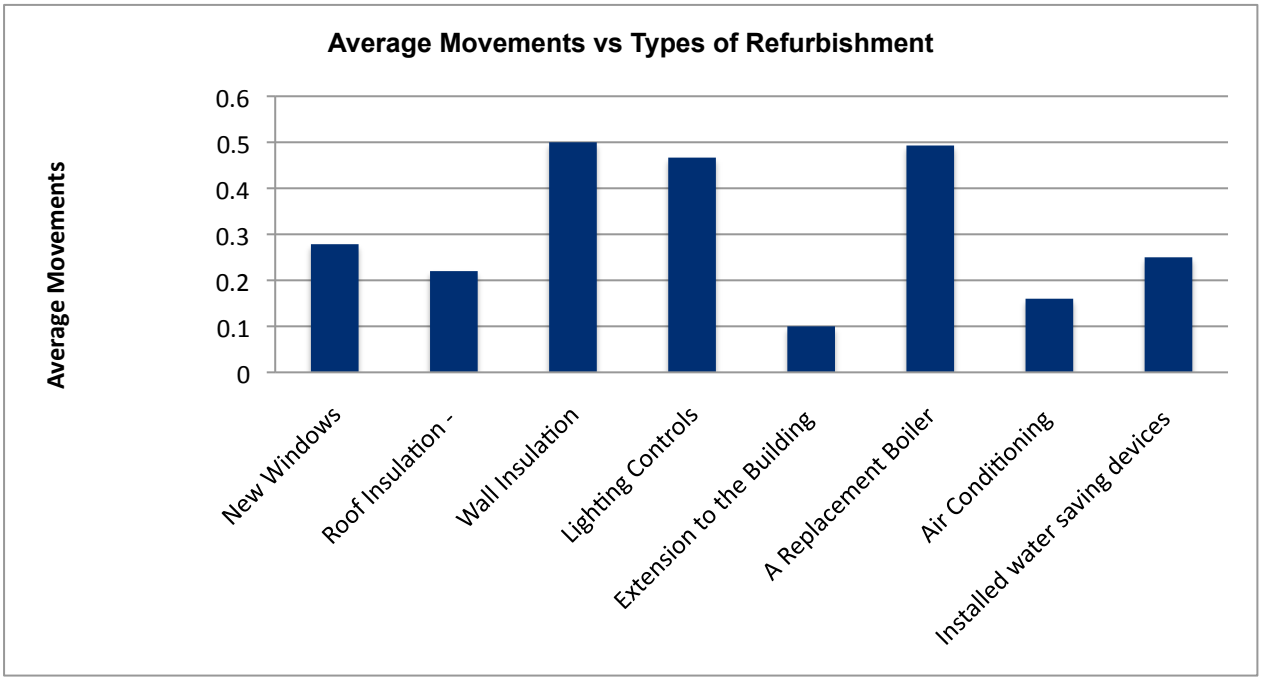
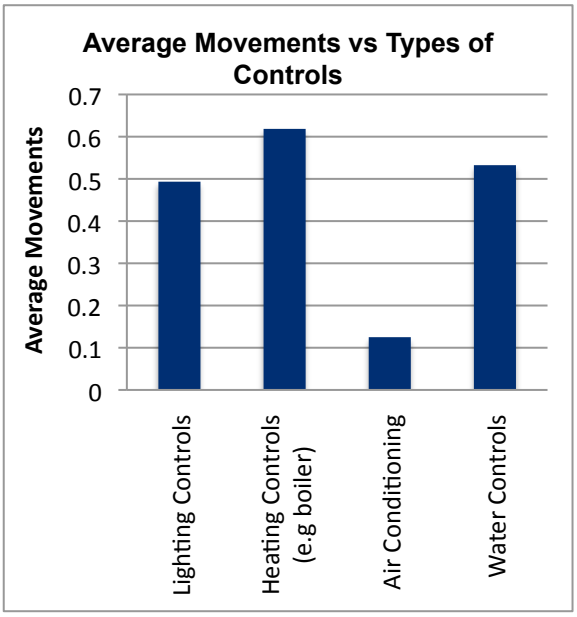


Figure 4 shows that shows that wall insulation, lighting controls and replacement boilers are they types of refurbishment that have the biggest impact on the Display® certificate

4.2 The impact of controls

Refurbishment in and of itself though has limited impact. The way a building is controlled is a key factor.[2] Between 2001 and 2009 40% of the 286 buildings invested in improved controls. 15% changed one type of control and 25% two or more types of controls. Lighting controls, heating controls and water controls were the most common types of control adopted. When comparing the average movements of individual groups under each type of controls, heating controls has the highest average movements (see Figure 5). There were 16 buildings that had changes in air conditioning compared with 76 of the other three types of control. The average movement of the buildings that invested in controls is higher than those buildings that have no investment.

Figure 5: Impact of controls on building performance



[2] Note here we are referring to 'formal' investment in controls rather than 'controlling' lights better for example by simply switching them off when not in use.

4.3 The impact of frequency of metering

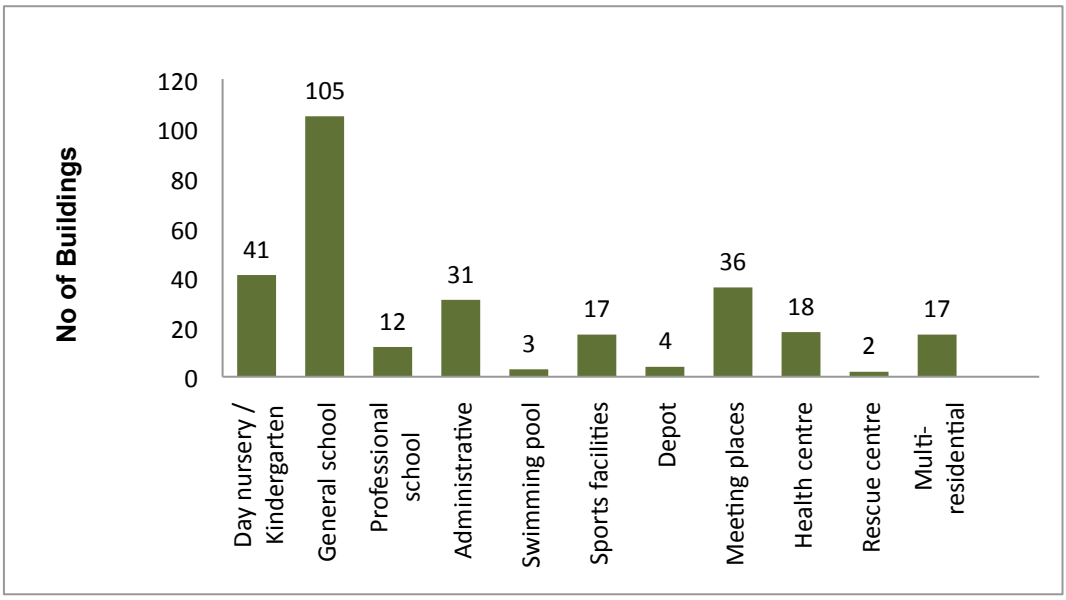
Monthly metering is most common for electricity meter readings (by 53% of all the buildings). Only 13% of the buildings have 30 minute/15minute metering. However, some buildings had access to electricity data recorded on the half hourly basis. At present, sub hourly data in European municipalities is relatively uncommon. In the future, it is expected to be widespread. There is therefore the possibility to calculate a display certificates on a more frequent basis. Certificates could be calculated on a monthly, weekly or on a daily basis. They could also be made available online.

Only 13% of the buildings had their Energy consumption measured on a sub hourly basis. Comparing the performance of these 13% with the sample as a whole, showed a slightly positive relationship. That is, those buildings with energy recorded on a sub hourly basis tended to perform slightly better than the other buildings. The telephone interviews suggested that this was because the energy managers were able to take a greater interest in buildings. They were able to analyse weekly profiles and rapidly identify any potential excessive energy or water consumption. The buildings therefore tended to be more closely monitored. A number of buildings with half hourly data were analysed in more detail. This analysis showed the savings achieved by the relevant energy managers when they either invested in energy efficiency improvements.

4.4 The impact of age and type of buildings

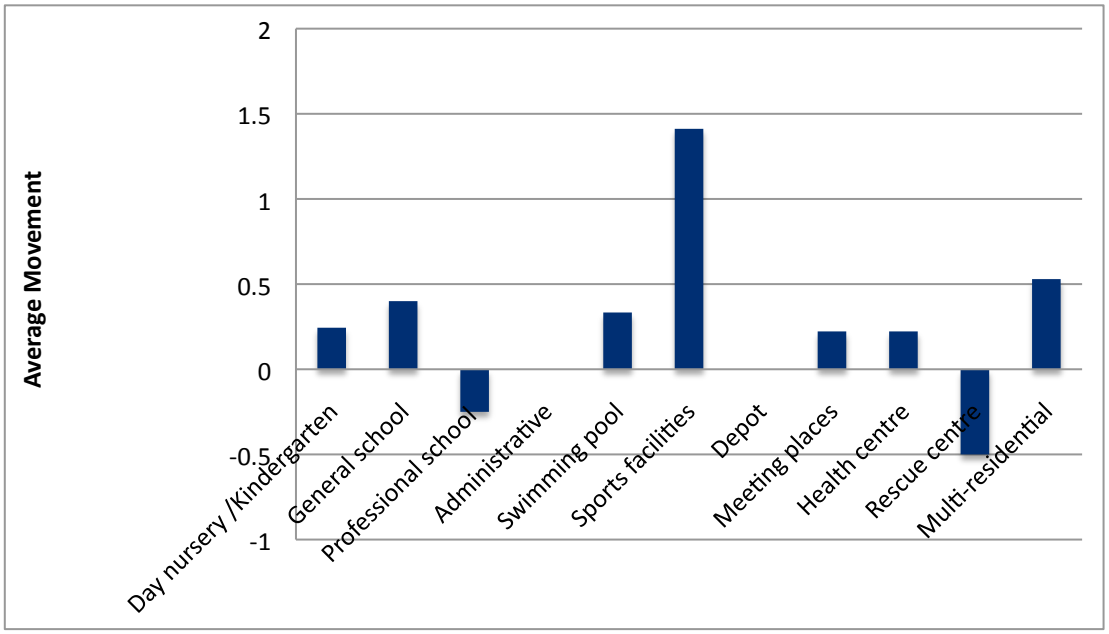
The analysis of the impact of a showing on the buildings performance was relatively inconclusive. The date at which a building was built should have an impact on its energy consumption, since energy standards will have improved over time. An older building, therefore, should be expected to have a poorer performance - assuming that no energy efficiency works have been carried out. However, the reality is that energy efficiency works will have been carried out on many of these older buildings and that the older the building, the greater the potential for energy savings. In terms of the sample analysed, the majority of the 286 buildings are schools (see Figure 6). There are only four types of buildings that have more than 30 buildings within the 286 buildings: day nurseries, general schools, administrative buildings and meeting places.

Figure 6: Types of Buildings



While both professional schools and rescue centres have negative average movement; sport facilities have the highest average movement. The average movement for each type of building is seen below in Figure 7.

Figure 7: Movement compared with Type of Building



The four types of buildings that had more than 30 buildings day nurseries, general schools, administrative buildings and meeting places were examined in more detail. They were compared with technical changes that have been undertaken in the buildings. New windows, lighting controls and replacement of boiler are the most common types of refurbishment for all the types of buildings except administrative buildings, which had more air conditioning installed.

In general, lighting controls, heating controls and water controls were the more common types of control adopted for all the four types of buildings. This is again the same as for the 286 buildings. There is no particular difference that can be identified between the analysis of the total 286 buildings and the analysis of the four individual building types. General schools have far more investment in the lighting controls, heating controls and water controls, given that General schools have the highest average movements among the four types of building; it seems to suggest these three types of controls have more impact on the building energy performance.

4.5 Common Factors leading to increase in building performance

In order to examine whether there are common factors contributing to the improvement of a building's energy performance, buildings that demonstrated positive movement/ improvement were analysed. This analysis compared the percentage of buildings with positive movement (121 in total) that had implemented one technical change with the 286 buildings that have taken the same technical changes. The key question is whether those buildings with positive movements have invested on common types of technical changes to the buildings or whether they have invested more on specific types of technical changes.

Lighting controls, new windows and boiler replacement were the most common types of refurbishment. However, these buildings have invested more on lighting controls, boiler replacement, new windows and roof insulation; equally on wall insulation; and less on extension, air conditioning and water saving device than the 286 buildings (this is seen in Figure 8 where the blue column exceeds the red, indicating greater investment).

Figure 8: Refurbishment for positive movement buildings

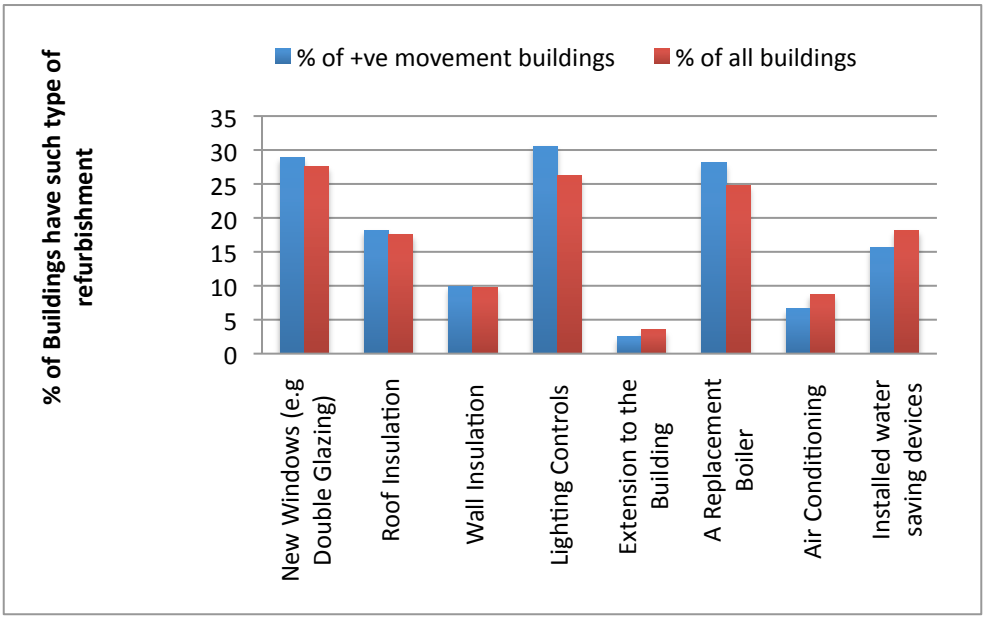
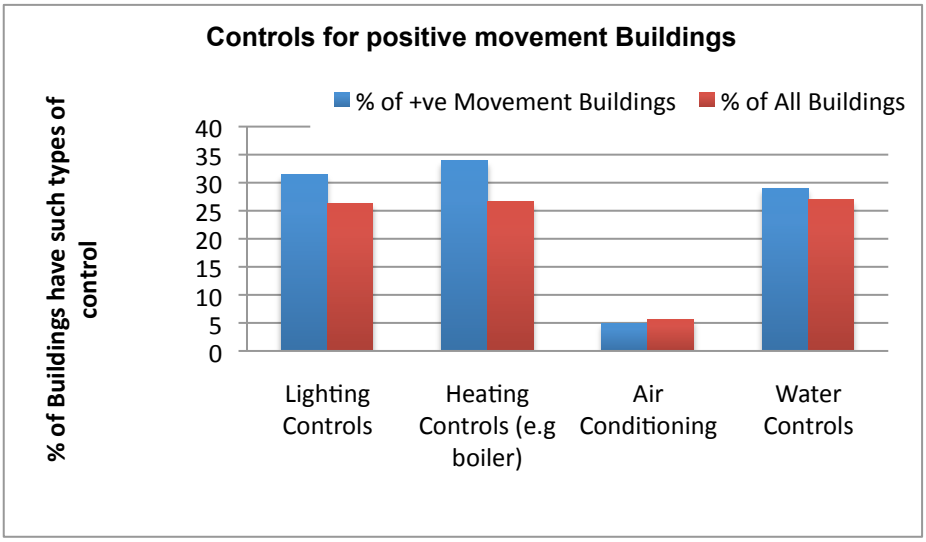


Figure 9: The effect of Controls for positive movement in buildings



The differences are even greater in terms of controls; buildings with positive movements have invested more on lighting controls, heating controls and water controls and less on air conditioning (see Figure 9). There are 7.3% more buildings with positive movements have invested on heating controls. When making comparisons with a full time paid energy manager and environmental champion, there are about 3% more buildings with positive movements that have a full time paid energy manager than all buildings, and there are about 2.2% more buildings with positive movements that have an

environmental champion. This suggests a full time paid energy manager has a positive impact on the building energy performance.

The following factors appear to be more common in buildings with positive movements:

- Greater investment in multiple refurbishments especially lighting controls, heating controls and boiler replacement;
- More likely to have a full time energy manager and environmental champion.

Those buildings that had decreased have had improvements that increased the annual energy consumption. For example, schools that were refurbished and this refurbishment included extensions to the building. These larger schools then operated for additional hours, resulting in overall increases in energy consumption. Secondly, those buildings that had air conditioning installed that increased energy consumption. Finally, buildings that were designed to be energy efficient yet had a far greater use of information technology, most notably schools. The building's overall energy consumption increased or stayed the same, due to the increased electricity consumption from computers and other information technology.

4.6 Effect of technical improvements

The Display® database was designed to store data on the Display® campaign itself. It was not specifically to collect data to evaluate the savings achieved over time. Nevertheless, the analysis of the data held in the database shows that technical measures generally increase the rating of the building. However, changes in user behaviour (that is, the operation of the building) also has an impact on the display energy certificate. It is therefore difficult to separate the effects of technical and behavioural aspects on building energy performance. Technical and behavioural need to be implemented together and then the behavioural changes maintained in order to achieve high Display® certificates.

5. Impact of communication campaigns on user awareness and building performance

5.1 The extent of communication campaigns

Each partner in the CYBER Display consortium had to undertake a range of communication and engagement activities. They are outlined in the project handbook and form eight categories of activities.

1. Education/Training programmes - with building managers and administrators;
2. Communication Activities - for at least three general events per year;
3. Internal Communication – use of newsletters, intranet, CYBER Display ambassadors for the buildings, etc.;
4. Local Energy CYBER Display Days - Organising a specific Local Energy CYBER Display Day per year – different activities, high media exposure;
5. Schools Programme - detailed programme for education of teachers and learners;
6. Local Press Articles and Media Relations;
7. Local Communication Materials - Conception/production of local communication materials e.g. flyers, leaflets, banners, posters, stickers, etc.;
8. Staff Training Workshops - Conception/production of local communication materials e.g. flyers, leaflets, banners, posters, stickers, etc.

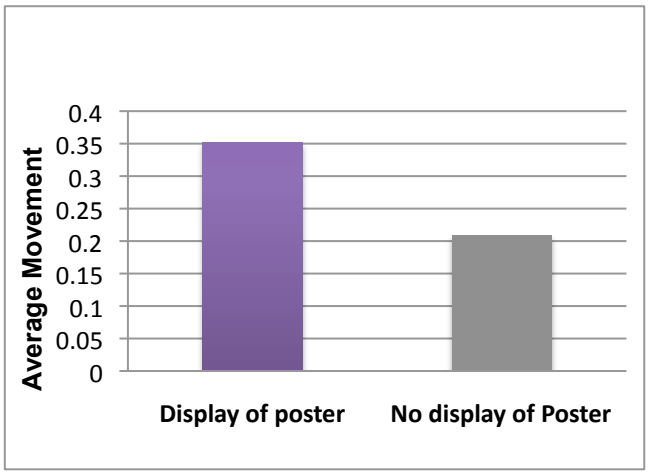
For the purposes of our evaluation each partner was asked to administer a survey to their intended audience of their communication activities. The results could then be used as a benchmarking tool or 'baseline' of people's attitude and awareness of energy, buildings and climate change. The intention was that once the communication activities had been completed the survey could be re-administered and differences in responses can be observed.

To that end the remaining analysis is based on information contained in the 281 returned 'building user' surveys which contains a series of questions on the role of communication campaigns, covering not only members of the CYBER Display consortium but local authorities partaking in the Display campaign in general (sometimes more active than the consortium members). Further details are given in the report on Deliverable 2.3.4, the finding are summarised in the following sections.

5.2 How was the poster used?

The first analysis is a simple test of whether the buildings that have displayed a poster would perform better than those buildings that have not displayed a poster, by calculating and comparing the average movement of the two groups. Over 75% of the buildings surveyed physically displayed their posters. This might suggest the display of the poster is quite common but it has to be taken into account that energy managers in a building that have the poster displayed might have higher tendency to complete the survey. The result shows that the average movement of the buildings that have displayed a poster is higher than those that have not displayed a poster (see Figure 10).

Figure 10: Impact of showing Display on movement

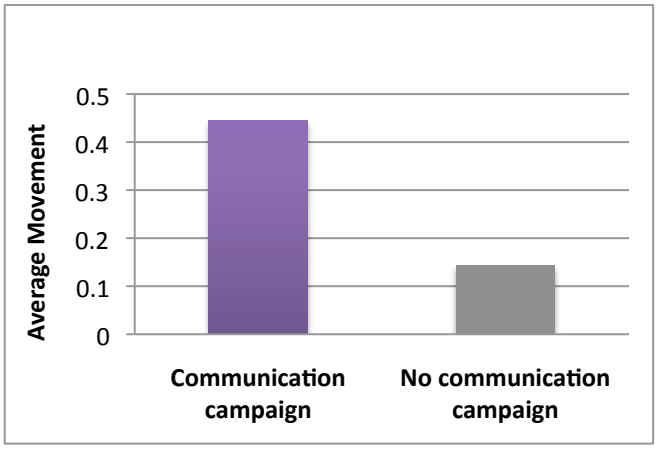


In total 271 posters were displayed, with the earliest starting in 2006, and the A3 poster was the most popular display size. The majority (86%) of the posters were displayed at the entrance of the building and 9.3% on the outside of the building; other places included teacher's staff rooms, classrooms and caretaker's rooms. In addition to knowing *where* the poster is shown, it is important to understand to *whom* it is shown. As well as displaying the certificates in prominent positions such as building entrances, the posters were presented to a whole range of people in the organisations from the leaders of the organizations to the caretakers as well as more general users of the building and members of the public.

5.3 The impact of the communication campaigns on building users

61% of buildings had carried out communication campaigns. The first analysis is a test of whether the buildings that have implemented communication campaigns perform better than those that have not. This is done by calculating and comparing the average movement of the two groups of buildings. The result shows that the average movement of the buildings that have carried out communication campaign is higher than those buildings that have no communication campaign (see Figure 11).

Figure 11: Average movement compared with communication campaign

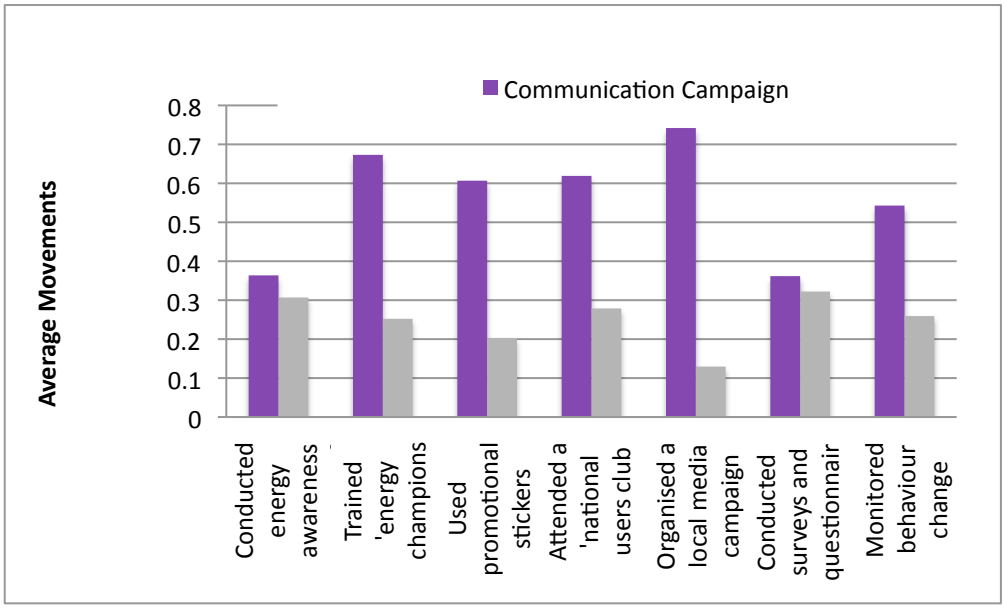


The most popular activities identified were conducted energy awareness training for staff and building users, organized local media campaigns and used promotional stickers. However when comparing the average movements of individual groups under each types of communication campaign the following have the highest average movement (see Figure 12).

- organized a local media campaign
- trained 'energy champions'
- attended a 'national users club event'
- used promotional stickers.

This suggests these four types of communication campaign are the most effective in the improvement of building energy performance. Behaviour change also demonstrates quite high average movements, but the most popular (communication campaign, conducted energy awareness training of staff and building users), have the second lowest average movements.

Figure 12: Average movement compared with communication campaign



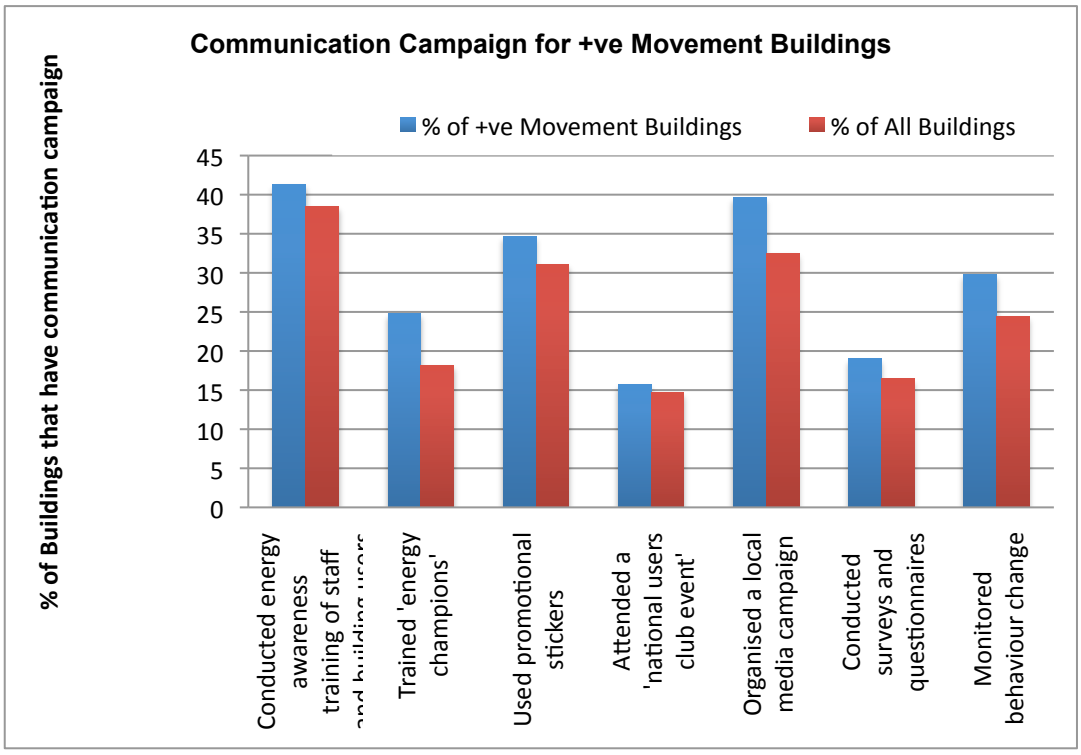
Comparing the average movements of the buildings that have had a communication campaign with those that have not, shows that all types of the communication campaigns lead to higher average movements for buildings than those that have no campaign. This further supports the argument that communication campaigns have a positive impact on the improvement of building energy performance. The greatest difference is seen in the "organised a local media campaign". This is not to suggest that that media itself drives the improvement, rather we suggest that those who likely to engage in media campaigns will have undertaken other activities that they believe are worth communicating to the media and promoting to a wider audience. If you are willing to involve the media then the likelihood is you will have been active in other areas. The media campaign is then the tip of a much bigger 'communication' iceberg.

5.4 The quantitative effect of displaying poster on building performance: Common Factors

In order to examine whether there might be common factors contributing to the improvement of building energy performance the final analysis focuses on the buildings with positive movement/ improvement in building energy performance. The analysis compares the percentage of buildings with positive movement that have taken certain types of communication campaign with the 286 buildings

that have taken the same communication campaign. The most popular types of communication campaigns are: energy awareness training of staff and building users, local media campaigns and using promotional stickers. When comparing the buildings with positive movements with the sum of all buildings, buildings with positive movements have more communication campaigns on every level, especially local media campaign, trained 'energy champions' and monitoring behaviour change (see Figure 13).

Figure 13: Effectiveness of common Factors for communication campaigns



6. Policy Implications and Recommendations

The results of the analysis show that participation in the Display® Campaign has had a positive impact on many of the municipalities and energy agencies involved. But the certificate *merely* acts as a catalyst, not an end in itself. Given what we know about the impact of 'top-down' information-deficit models of communication campaigns – simply putting a certificate on a wall that tells people what rating a building is will not in isolation be a powerful communication tool. The Display® Campaign views the production

of the certificate as just the starting point for engaging stakeholders in the wider issue of energy efficiency. The research has shown that the certificate provides a vital opportunity to engage with building users and the wider public. The technical improvements undertaken by buildings and facilities manager, estates departments and energy managers are as much a behaviour change as the habits of those who use public buildings on an infrequent basis.

The most common energy efficiency measures implemented by participants in the Display® Campaign were new Windows, lighting controls and replacement boilers. The energy efficiency investment measures that had the greatest effect on the Display® certificate were wall insulation, heating control, lighting control and boiler replacement. Some improvements, such as installation of air conditioning and extension to existing buildings resulted in building Display® certificates staying the same or actually deteriorating. This was due to the increased energy consumption from the new air conditioning at the larger building. In addition, increased hours of use in buildings also increased energy consumption, so resulting in a reduction in the Display® certificate rating. It was difficult to separate the effects of investment in energy efficiency measures with the changes in the operation of buildings due to the Display® Campaign itself. However, operational and behavioural issues are crucial to maintaining good performance in higher rated buildings. In these buildings, there is limited. Further technical improvement, therefore, the operational aspects of the building are crucial to maintaining a good energy rating. Behavioural change is the key to maintaining buildings at high ratings. Overall, it is clear that a combination of energy efficiency measures and campaign results in a "moving towards class A".

There is no 'magic bullet' to technical improvements. Whilst there are common factors: notably installing wall insulation, lighting controls, heating controls, new boilers and avoiding installing air conditioning – it is a combination of factors that are more likely to see an increase in a buildings performance.

Based on the research findings we make the following recommendations;

Local municipalities and those responsible for the built environment:

- There is a need to appreciate the benefits that a 'whole system' approach to energy management can have. Participation in Display® Campaign and producing posters is an important tool to be used by energy professionals to encourage behaviour change, be that decision makers to choosing to invest in technical improvements *and* communication and public engagement initiatives.

- Clear guidance is required for what constitutes effective technical improvements – not all interventions are equally effective in reducing energy consumption.
- Recognise that increasing the size, extending opening hours, installing information technology and installing air conditioning are likely to increase energy consumption of buildings
- The need for local engagement of stakeholders is also vital, as demonstrated by the user-clubs that many municipalities participate in.

National stakeholders and policy makers:

- Participation in national networks is a vital form of engagement and sharing best practice.
- National certification and harmonization? Having a single system of building energy certification would of course be advantageous – currently energy managers who choose Display® Campaign for the support and resources they provided then face a difficult decision of displaying two posters, their EPBD DEC and their Display® poster, which, due to differences in calculation methodologies occasionally present different ratings.

European stakeholders and policy makers:

- The overall trend of the buildings in the Display® Campaign has been 'Towards Class A'. This is a result of municipalities voluntary participating in both community campaigns and technical improvements, not simply producing Display® posters. To that end, any legislative requirement for buildings to have building Energy Certificates is welcomed but must recognise that the certificate is the starting point, not the destination. Municipalities should not see the preparation of their certificates as merely a box to be ticked, but a catalyst to engaging all building-users, from decision-makers and facilities managers to teachers and schoolchildren.
- National certification and harmonization. A single system of building energy certification at the national and European level would allow for a meaningful comparison of performance and improvement across Europe.