Integrated Financial and Contracting Tools

Interreg CENTRAL EUROPE
European Union
European Regional Development Fund
TOGETHER

Set of subsidies and incentives integrated with Demand Side Management
D.T2.2.3

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TOGETHER

TOwards a Goal of Efficiency THrough Energy Reduction

Set of subsidies and incentives integrated with Demand Side Management

D.T2.2.3

- PP2 – Energy Agency Vysočiny (EAV)
- PP7 – Hegyvidék (Municipality of 12th District of Budapest)
- PP8 - Slovak Innovation and Energy Agency (SIEA)

Executive summary

Most energy efficiency measures implemented (or yet to be implemented) in Europe involve technological interventions, but will equally have to rely on people adjusting their energy consumption behaviour. This section provides a short overview of the main factors that can influence consumer behaviour in order to generate energy savings.

In the first part (third chapter), authors will provide the reader basic information about possible measures that can be taken or tools that can be used in order to achieve energy savings by behavioural change of the building users. Its goal is to convince the reader that it is possible to achieve better energy efficiency by such simple measures as simple delivering more comprehensive information about the energy consumption to the users, or create a competition between users based on social networks.

Following 6 tools are described:

- Information delivery tools
- Simulation, education and training tools
- Instant feedback tools
- Edutainment and gamification tools
- Financial and economic incentives
- Competition based and social networking tools

The second part (forth chapter) deals with the adjustment of consumers' habits to energy tariffs. The issue of energy tariffs is very broad and there are many different tariff models according to types of energy and also can vary across member states.

In case of electricity energy suppliers allow users to use energy in different price levels – energy tariffs. Usually there are two energy tariffs - high tariff (HT) and low tariff (LT). During the day in certain periods low tariff is applied, in the rest of the time the high tariff. Low tariff is suitable mainly for devices with higher energy consumption i.e. electrical heating, accumulating water heating etc. Thanks to price differences between the energy tariffs, the energy suppliers are able to reduce energy consumption in consumption peaks and establish a more balanced energy demand during the 24 hours of the day. The necessity of dividing the energy consumption is due to limited transmission capacity of the transmission system so the energy suppliers usually use this model of energy tariffs.

In the third part (annex) customized tips are provided for the most typical public building types: buildings with permanent occupants (e.g. public administration offices), educational buildings and buildings mostly occupied by visitors (e.g. libraries, sport centers, cultural centers). In the different building types the behavioural problems are different and specific solutions and actions are needed. This part gives practical and useful hints for organising the most effective DSM actions.

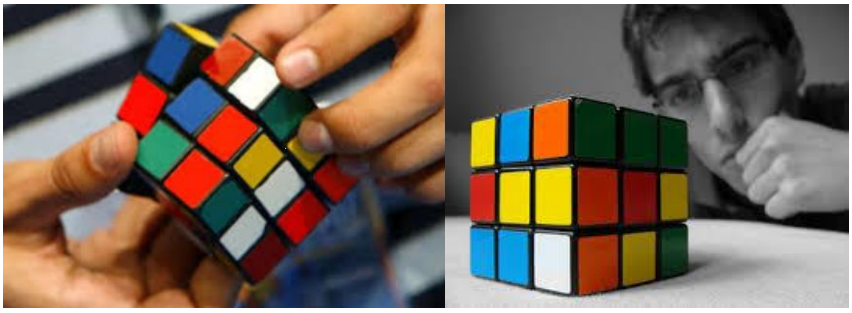
Contents

1. Introduction

The Project TOGETHER offers a transnational capacity building platform, where partners with different levels of knowledge can strengthen their competences together, thus reducing their disparities and promoting actions on both the supply and demand side, in the context of planning EE in public buildings. The main goal of the project is improving energy efficiency and energy saving in public buildings by changing behaviour of building users and promoting energy efficiency measures.

This document provides common guidelines to the partners for drafting their respective pilot project implementation plans and developing the presentation of their Pilot Actions in their pilot buildings clusters with a common framework and visual identity.

This tool is contextualized within the framework of the second objective of the project TOGETHER: if the first project objective "To increase energy efficiency and secure investments thanks to improved multidisciplinary in-house staff skills and thanks to an Alliance system with more engaged and motivated buildings users" calls for the observation and learning of possible tools to be combined together for achieving energy efficiency in public buildings, and the second one "To produce and test the most appropriate combinations of technical, financial and Demand Side Management tools for the improvement of the energy performance of public infrastructures" calls for the practical and concrete implementation of the possible identified measures.



1.1. Project TOGETHER

The three main objectives of the project TOGETHER consist in:

1. Increasing public buildings energy efficiency and securing investments, through the improved multidisciplinary in-house staff capacity building of Public Administrations and the establishment of a system of alliances with more engaged and motivated building users;
2. Producing and pilot testing the most appropriate combinations of technical, financial and Demand Side Management tools for the improvement of the energy performance of public infrastructures, currently in the 8 regional Pilot Actions involving a total of 85 buildings;
3. Codifying the project outcomes into a comprehensive policy package for a large-scale implementation, bringing local buildings governance practices to the centre of ambitious energy saving policies.

In its inception, TOGETHER plans the organisation of an interdisciplinary "Training of Trainers" course for building owners, managers and public decision makers that integrates the traditional technical inputs on

energy management and buildings retrofitting with targeted contributions from behavioural science, economics and psychology, aiming to engage the end users in the building energy performance goals.

The “Training of Trainers” course is completed by the provision of an Integrated Smart Toolkit, including:

1. Guidelines for implementing the innovative EPIC (Energy Performance Integrated Contract) scheme, combining technological devices and behavioural-based components;
2. A set of exemplary models of Energy Management Systems in schools, institutional and other type of buildings;
3. An innovative Building Alliance concept among building owners/managers/users who cooperate within a Negotiating Panel to achieve energy savings to be reinvested through a Reinvestment Action Plan.

Additionally, and by the project’s end, the Partners will jointly elaborate a Transnational Strategy and Mainstreaming Programme, including policy/strategic and operational recommendations for an appropriate follow-up and a sustainable take-up of the project outputs.

1.2. Purposes of this tool

The objective of this tool is to give a theoretical overview and provide practical guidance of demand side management. A set of subsidies and incentives are discussed and personalised tips are provided for the most typical public building types. The listed subsidies and incentives are partly financial, partly social. Financial incentive can be an energy performance contract, social incentive can be an award.

1.3. Usage of this tool

The first and second part of the tool gives a comprehensive theoretical overview about incentives and subsidies applied in demand side management. The time management for a more efficient utilisation of energy tariffs is also discussed.

For personalised practical problem detection and tips for solutions can be found in the annex. For defining a concrete action plan for a public building this toolset should be used and applied.

2. Subsidies and incentives to reduce energy demand with behavioural change

2.1. Introduction

Most energy efficiency measures implemented (or yet to be implemented) in Europe involve technological interventions, but will equally have to rely on people adjusting their energy consumption behaviour. This section provides a short overview of the main factors that can influence consumer behaviour in order to generate energy savings.

Behavioural models are necessary to understand what consumers do, and why they do so. Such models tend to vary widely by theory, concepts and applications. One important message is that relationships between various factors that influence behaviour and consumption practices and the human element are dynamic, and static, as they are assumed to be in a large body of literature on this topic. They change over time, rendering consumer behaviour and the process of consumption practices development somewhat irrational and to some extent unpredictable. (EEA, 2013)

In this chapter, authors will provide the reader basic information about possible measures that can be taken or tools that can be used in order to achieve energy savings by behavioural change of the building users. Its goal is to convince the reader that it is possible to achieve better energy efficiency by such simple measures as simple delivering more comprehensive information about the energy consumption to the users, or create a competition between users based on social networks.

Following 6 tools will be introduced:

- Information delivery tools
- Simulation, education and training tools
- Instant feedback tools
- Edutainment and gamification tools
- Financial and economic incentives
- Competition based and social networking tools

2.2. Information delivery tools

By information delivery tools can be understood traditional methods of information delivery about the energy consumption such as billing. This type of information delivery is in literature also often referred to as indirect feedback.

Indirect feedback (feedback that has been processed in some way before reaching the energy user, normally via billing) is usually more suitable than direct feedback for demonstrating any effect on consumption of changes in space heating, household composition and the impact of investments in efficiency measures or high-consuming appliances. (Darby, 2006)

However, the [standard] utility bill is a form of feedback in which the feedback loop is too far removed from the use of inputs to have any information value'. But bills can be adapted to show broad trends in consumption over time. First, they can demonstrate how the heating load is spread over the year – something that direct debit payers may be completely unaware of. They can also show how consumption has changed relative to the same period of the previous year, giving the energy user the chance to work out what might have caused the change: a new person in the household, a new boiler or appliance, insulation or the addition of an extension to the house. Bills can also include an annual 'energy report', compare the household's consumption with that of a comparable household (though this is not straightforward), or give a breakdown of how consumption is distributed between end-uses in an average home.

Last but not least, enhanced energy bills can be used to provide feedback to consumers so as to encourage them to change their behaviour. Darby's review (Darby, 2006) also included 13 indirect feedback projects that considered a range of different measures:

- More frequent bills
- Frequent bills based on readings plus historical feedback
- Frequent bills based on readings plus comparative/normative feedback
- Frequent bills plus disaggregated feedback
- Frequent bills plus detailed annual or quarterly energy reports

The key is to provide householders with better, more informative bills on how much energy they use and how much it is costing them, either in monetary or environmental terms. More clearly presented bills would also give households an opportunity to see how much gas or electricity they are saving. A report by the Centre for Sustainable Energy (Roberts and Baker, 2003) concluded that feedback and more informative billing could reduce energy consumption by 5 % to 10 %. (EEA, 2013)

Following table summarises the results of Darby's report (Darby, 2006) with 13 indirect feedback projects:

Table 1: Savings achieved by indirect feedback

Savings:	Unknown	0-4 %	5-9 %	10-14 %	15-19 %	20% and more
Indirect feedback studies (n=13)	3	3	-	6	1	-

It is however important to notice, that the European Environment Agency report (EEA, 2013) concludes that the most successful combination of measures seems to involve both direct and indirect feedback, in order to increase the consumer's awareness on energy consumption and maintain the motivation to actively engage in energy efficiency actions. Direct feedback tools are described in chapter 2.4 of this document.

2.3. Simulation, education and training tools

Nowadays there are new challenges in energy efficiency education. Students, schools, and administrators as institutions move from simply providing technical education on the respective components of the energy industries to a more comprehensive program that also addresses the environmental, political, economic, cultural, and ethical contexts of energy literacy.

Since the 1930s, three major factors have steadily impinged on the reliability and safety of energy flows worldwide. First, insecurity of supply, particularly of oil, has sparked major geopolitical tensions and warfare. Second, pollution from use of fossil fuels and other energy sources has damaged local, regional, and global health. Third, especially since the 1990s, greenhouse gases from fossil fuels have triggered concerns about the destabilization of the earth's climate. Taken together, these factors threaten the long-term prospects for humankind.

Educational institutions are responding only slowly to the existential threats raised by an energy economy based largely on fossil fuels. This chapter speaks to that gap in higher education and concludes that addressing the needs for energy literacy of students, faculty, and administrators involves many issues, some easy to resolve but others hard.

Nevertheless, energy education poses significant challenges for students, faculty, and administrators. It is hard for students, because it is often lacking or difficult to find. In addition, it requires at least some quantitative understanding that makes many students uncomfortable. Conversely, technically-oriented students will need the broad contextual understanding of energy in their work to supplement quantitative skills, and courses addressing these needs may not exist. In general, energy courses and academic programs are still too few and far between.

Energy education is difficult for schools, because it is a new field with heavy demands for cross-disciplinary understanding. Instructors must self-educate, worry about tenure and other rewards for their work, and seek out a new intellectual community. Moreover, it is difficult for administrators, because they must balance resources among new and existing programs and because they may face opposition from internal and outside constituencies.

Energy education may be difficult, but it is possible. Colleges of engineering and community colleges will continue to produce needed expertise about the design and operation of energy infrastructure, but sustainability and environmental studies and other fields must supplement the knowledge of engineers and technicians. Existing programs in environmental and sustainability studies already have achieved success in delivering interdisciplinary education. We urge our colleagues in these programs to embrace the challenges of providing broad, interdisciplinary teaching and learning about energy, which is the prime cause of climate disruption, the largest threat outside of nuclear war to the quest for sustainability. Climate change is one of the fundamental challenges of our times, and investment in energy education is fundamental to meeting that challenge. (Blockstein, 2015)

2.4. Instant feedback tools

Feedback is an essential element in effective learning: this is equally true in domestic and non-domestic settings. There are a number of different feedback types; the reviewed literature suggests that they have a significant role to play in raising energy awareness and changing consumers' attitudes towards energy consumption. Direct feedback covers a range of systems designed to give instant (real-time) access to energy consumption information on a frequent or continual basis. (EEA, 2013)

Examples of direct feedback:

- Direct displays
- Interactive feedback via a PC
- Smart meters
    - operated by smart cards
    - two-way (automatic) metering
- Trigger devices/consumption limiters
- Prepayment meters
- Self-meter-reading
- Meter reading with an adviser

- Cost plugs

2.4.1. Direct displays on monitors separate from the meter

Direct displays are a supplement to the meter. Almost all available meters show electricity consumption, though there is one recorded trial of a display that showed the previous day’s gas consumption in relation to a weather-adjusted target, producing savings of 10% against controls.

With a free-standing display, the meter can be left alone once a transponder is attached. Occupants can look at the displays for instantaneous information and/or information on previous consumption. On some displays, they can also set an alarm to go off when the load rises above a pre-set level.

Savings are typically of the order of 10% for relatively simple displays (McLelland and Cook 1979; Dobson and Griffin 1982; Mountain 2006). These are small panels that can be carried around the building, typically showing instantaneous electricity consumption along with cost per hour at the current rate. The most recent displays also show carbon dioxide emissions for a given rate of consumption. They cost £15-£80.

2.4.2. Use of TVs and PCs for display

More complex displays are also being developed, such as a complex interactive online display. What was a few years ago a complicated task is nowadays with the advancement of information technology becoming a cheap and convenient solution. Many commercial companies are providing services of installation energy consumption measurement with direct visualization of the data on PC, on tablet or even on smartphone.

Such metering systems are often using internet for data transfer and store the data on secure remote server which allows the building user or manager to monitor the energy consumption from anywhere. Commercially installed systems nowadays provide very clear and disaggregated information (in table as well as graphical form) which helps in reaching the goals in energy savings. Measured values can be exported for further analysis. Following figure shows and example of data display in various devices.

Figure 1: An example of data display of smart metering system on various devices

A review (Darby, 2006) of 38 different direct feedback projects carried out at various times between 1975 and 2000 demonstrated the potential for energy savings of some types of feedback. Despite challenges in comparing, interpreting and even categorising these studies (as they all contain a different mix of elements), the author concluded that feedback measures have a significant part to play in bringing about energy awareness and conservation.

A total of 21 direct feedback projects were studied and following table summarises the results of Darby's report (Darby, 2006):

Table 2: Savings achieved by direct feedback

Savings:	Unknown	0-4 %	5-9 %	10-14 %	15-19 %	20% and more
Direct feedback studies (n=21)	-	2	8	7	1	3

Last but not least, as mentioned before the European Environment Agency report (EEA, 2013) concludes that the most successful combination of measures seems to involve both direct and indirect feedback.

2.5. Edutainment and gamification tools

Gamification turns a real-world activity into a game to make people more likely to do it. Human brains are wired to enjoy the challenges, positive feedback, and social bonding that games provide. The advent of digital technology has simply amplified the hold that games have always had on us. Over the past five years, utilities and third-party providers have developed scores of games that also motivate and encourage people to save energy.

We should however be careful to distinguish gamified solutions from rewards programs on the one hand and videogames on the other. Rewards programs like frequent flyer miles engage people by promising them a tangible reward in exchange for some action. In gamified solutions, only some players may win such a reward, and the prospect of a prize is not their only reason for playing. In some ways gamified programs are more like videogames, which offer players entertainment, fun, and challenges. But whereas the only point of a videogame is to entertain its players, gamified activities are meant to motivate players to perform real-world actions. (Grossberg et al., 2015)

Another way of putting this is to say that whereas fun is the whole point of videogames, it is simply another way of achieving the whole point of gamification, which is to motivate and encourage people to do something. Gamified solutions use fun to keep players engaged. As Volkswagen's videos on Fun Theory make clear, fun is one of the most powerful tools we can use to motivate positive behaviour change. Creating a piano staircase in Stockholm made 66% more people than normally to choose the stairs over the escalator.

Figure 2: Piano staircase in Stockholm

Collective of authors which worked on a report about Gamified Energy Efficiency Programs (Grossberg et al., 2015) collected information on 53 games for their study, all of them meant to influence behavior around energy efficiency and sustainability. Of these 53, they present case studies of 22 games that could be or actually are part of a utility energy efficiency program.

They include:

- Games in which players undertake and are rewarded for a range of energy savings activities
- Energy savings challenges in which players compete, either individually or on teams, to save the most energy during a particular time period
- Games that employ real-time granular data on players' energy use as feedback for their actions
- Games that make extensive use of virtual worlds

Case study

In this tool, we would like to introduce one of the evaluated games called "Energy Chickens".

Energy Chickens is a virtual pet game that motivates office workers to conserve the energy used by typical office appliances. It was designed by a team of researchers at Pennsylvania State University and tested with 57 workers in a midsize office for 6 months in 2012–2013 (Orland et al. 2014).

At the start of the study, researchers established a baseline energy consumption. Beginning in this pregame period, a poster campaign encouraged workers to conserve energy. Two different posters (changed each week) were placed in high-use areas around the office. They featured reminders to "Turn it off" and "Unplug it".

Then the game began. Players signed a pledge to reduce their energy consumption by 15%, and each received a set of "Turn It Off" stickers to put on their devices. Then a virtual farm populated by up to five animated chickens appeared on each player's desktop. Each chicken on their farm corresponded to one of their appliances. As players unplugged, turned off, and reduced the use of their appliances, their chickens flourished and laid eggs. Conversely, if their energy use increased, their chickens declined and looked sickly. Chicken health was graded on a five-point scale (-2, -1, 0, +1, +2), with baseline or neutral health being "0." As following figure shows.

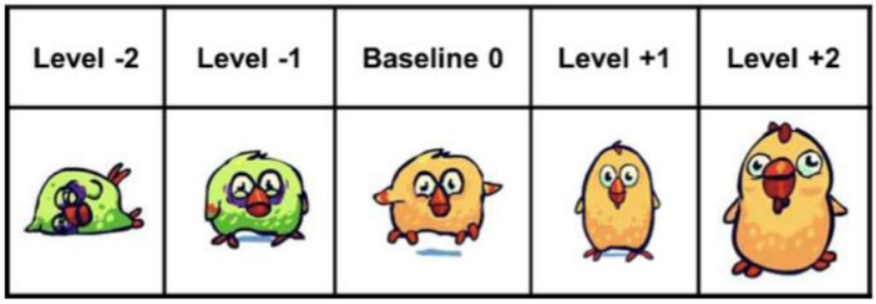


Figure 3: Levels of Energy Chickens' health. Source: Orland et al. 2014

Chickens at levels 0, 1, and 2 laid eggs. These eggs were currency that players could use in a virtual general store selling items for the farm ranging in price from 5 to 200 eggs. Cheaper items included small hats, flowers, and fence posts. Costlier items included fancier hats, fruit bushes, and gnomes. Players' rewards for their energy-saving achievements were limited to virtual eggs and merchandise. At the same time every player received $100 for completing pregame, postgame, and daily surveys regarding their well-being and productivity.

The results of the test were impressive. The researchers found a 13% overall reduction in plug-load energy consumption while the game was being played. Especially striking was a 23% reduction in plug loads on non-workdays. In addition, 69% of participants said that they had become more energy conscious.

Whole report concludes that gamification should not be only about energy savings but also about education. Maybe the best way to think about gamified energy efficiency solutions is to see them as training wheels, a way to introduce people to the intrinsic satisfaction of gliding along on their own two wheels after the game's apparatus is removed. The fact is that saving energy is highly rewarding in itself, and the greatest achievement a game could aim for is to bring out the multiple satisfactions that are there in the first place.

2.6. Financial and economic incentives

There are a number of economic instruments applied to the energy sector. Energy taxation systems across Europe differ due to structural characteristics (existing infrastructure) as well as political choices (revenue raising, protection/promotion of national companies, international competitiveness, etc.).

Funding for energy efficiency measures takes place via either central/local government in the form of subsidies for specific investment (usually involving a technical measure), or private investment at the community scale (e.g. utilities). By financial and economic incentives can be therefore usually understood:

- Subsidies
- Levies
- Surcharges
- Taxes
- Bonuses
- Tax differentiations
- Tax refunds
- financial instruments such as interest free loans
- rewards and penalties

Even though rewards can be effective if they are designed well; however, research has shown that the effects of rewards and incentives are not always maintained for the long term — in most cases, they last only for as long as the intervention is in place. (Martiskainen, 2007)

Three ERDP (Energy Demand Research Project) trials employed financial incentives to reduce consumption but only Scottish Power saw reductions in consumption when the incentives were applied — only in the case of credit customers with smart meters and only for short periods.

2.7. Competition based and social networking tools

Social media and competition based games can play a big role in energy savings. Social media is custom made for bringing conservation front and center. It's now clear, based on behavioral researchers, that money isn't the biggest motivator in cutting energy use. Instead, it is a sense of belonging, achievement, competition, ease of use, sustainability — all these factors play crucial roles. (huffingtonpost.com)

That is why social media, with its connections, sharing, comparing, and real-time updates, can motivate people the way that will not happen if the same information is communicated via a website, pamphlet in the mail, or advertisement on a bus. Social media can accomplish a few crucial tasks. It can:

- Create a way to compete
- Share Tips Smartly
- Target a message

Collective of authors which worked on a report about Gamified Energy Efficiency Programs (Grossberg et al., 2015) collected information on 53 games for their study, all of them meant to influence behaviour around energy efficiency and sustainability. One of the games was an application called Opower Social Energy App which uses social media and is based on competition, therefore it is a perfect example for this chapter.

The Opower social energy application is a web-based tool available for smartphones, developed in partnership with Facebook and the Natural Resources Defence Council (NRDC). According to Marcy Scott Lynn, who leads sustainability programs at Facebook, "The app is intended to make saving energy social and create a conversation about the merits of energy efficiency that doesn't currently happen" (Alliance 2012). Opower, NRDC, and Facebook launched their social energy app on April 3, 2012.

Application works with or without Facebook. With its Facebook integration, the Opower app is geared toward a younger audience that is fully comfortable with social media and the sharing of personal information online. It may deter some users who care about energy efficiency but who are not ready to broadcast their usage data to their social networks—even though one can decline Opower's invitation to "post to Facebook for you."

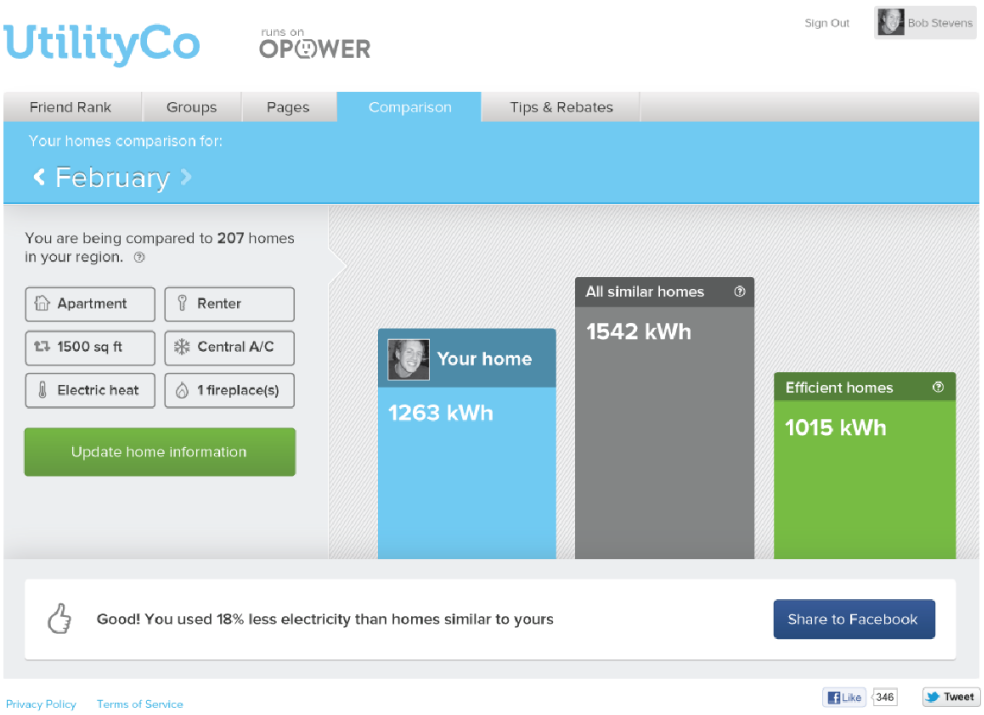


Figure 4: Opower's energy use comparision

One of Opower's main features is to compare your home against similar homes. This can be done without connecting to Facebook. You are asked for basic details about your home, beginning with the cost of last month's electricity bill. After saving this data, the app compares your energy efficiency to comparable homes across the United States (figure above).

Once logged in through Facebook, Opower asks, "Feeling competitive?" and offers a button that you can click to invite friends. A Groups tab lets you form a group of friends, co-workers, or neighbours, with the goal of promoting friendly competition. Once the group members sign up and include their data, Opower produces monthly reports ranking each person or household according to their energy usage.

A Ways To Save tab offers tips under the categories of appliances, cooling, heating, lighting, water heating, and other. Clicking on each tip leads to further information: an explanation of why the action is beneficial, estimated financial costs and benefits, and the amount of time before the change will pay for itself. The explanations are fairly informative and detailed. However, in contrast to some other games from the report, these actions are merely recommendations; they are not linked to points, pins, badges, or other virtual or real rewards. (Grossberg et al., 2015)

3. Optimisation of energy demand with respect to energy tariffs

3.1. Introduction

The issue of energy tariffs is very broad and there are many different tariff models according to types of energy and also can vary across member states.

In case of electricity, energy suppliers allow users to use energy in different price levels – energy tariffs. Usually there are two energy tariffs - high tariff (HT) and low tariff (LT). During the day in certain periods low tariff is applied, in the rest of the time the high tariff. Low tariff is suitable mainly for devices with higher energy consumption i.e. electrical heating, accumulating water heating etc.

Thanks to price differences between the energy tariffs, the energy suppliers are able to reduce energy consumption in consumption peaks and establish a more balanced energy demand during the 24 hours of the day. The necessity of dividing the energy consumption is due to limited transmission capacity of the transmission system so the energy suppliers usually use this model of energy tariffs.

3.2. Building administrators – setting up of time management

Building administrator should have an overview of their current energy consumption and optimize the operation of their buildings according to energy tariffs – Set up appropriate time management and motivate building users to comply it.

Basic steps for setting up an appropriate time management:

- Discover the tariffs set in the energy supply contract
- If necessary change the contract for a more appropriate tariff
- Discover the current energy consumption profile of the building and compare it to the tariff schedule, find gaps
- Setting up a time management of the building in order to introduce a more appropriate energy consumption profile
- Communication/Promotion of the new time management to all staff/users of the building
- Regular time management compliance check

3.2.1. Discover the tariffs set in the energy supply contract

Each building administrator should have an overview of the energy sources used in the building. There are few basic questions each building administrator should be able to answer:

- What kind of energy supply contract has been arranged with energy supplier?
- What prices and conditions are set in the energy supply contract?
- Are the prices appropriate, does exist an offer with lower prices?
- Does the building use two tariffs (high tariff and low tariff)?
- If yes, at what time of the day are the tariffs switched?

If the building administrator knows the answers for this question the next step can be applied.

3.2.2. Current energy consumption profile of the building

In order to set up an energy consumption profile a chart of Building occupancy progress can be used in line with D.T.3.1.2 – Technical and users profile of the building. In addition to the data of building occupancy, monitored energy consumption can also be analysed where available to have an overview how the energy consumption correlates with the building occupancy.

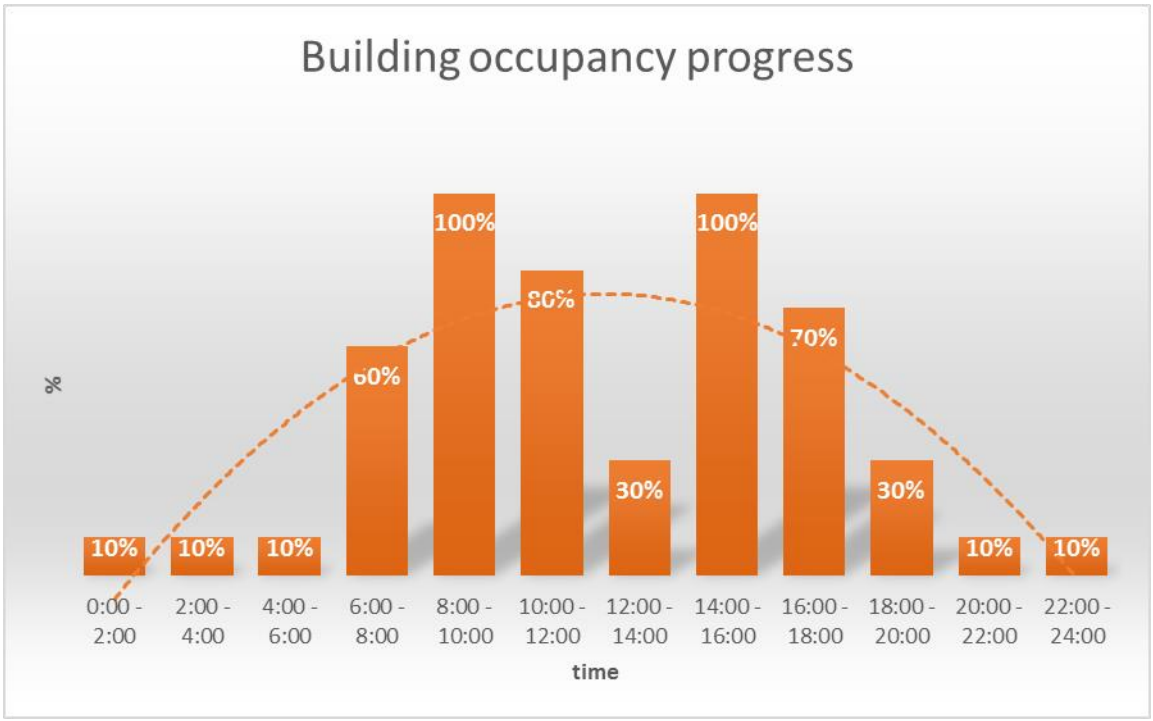


Figure 5: Building occupancy progress

Table 3: Building occupancy progress

Time of the day	% of occupancy of the building	Energy consumption (kWh)
0:00 - 2:00	10 %	-
2:00 - 4:00	10 %	-
4:00 - 6:00	10 %	-
6:00 - 8:00	60 %	-
8:00 - 10:00	100 %	-
10:00 - 12:00	80 %	-
12:00 - 14:00	30 %	-
14:00 - 16:00	100 %	-
16:00 - 18:00	70 %	-
18:00 - 20:00	30 %	-
20:00 - 22:00	10 %	-
22:00 - 24:00	10 %	-

Example:

It is obvious that in administrative buildings there are peaks in electric energy consumption in the morning when all the employees come to work and make a cup of tea or coffee. On the other hand, there is a valley in consumption when people go out for lunch.

All these cases should be monitored and described in Energy consumption profile of the building. The setting up of the measured energy consumption profile is simple using installed smart meters in the pilot buildings. If smart metering is not implemented, there is possibility for manual data collecting as well at least during office hours, ideally every 30 minutes. Based on this data it is easy to get an overview of energy consumption progress in the building.

3.2.3. Setting up a time management of the building in order to introduce a more appropriate energy consumption profile

In this step, the time management of the “consumption processes” is discussed. The approach of time management can be very specific and is usually based on the concrete situation in the building and its operation, therefore it is discussed through some examples on time management improvements as follows.

Project office – printing and plotting of documentation in off-peak period

All the employees of the project office can prepare the documentation of a project during office hours (which is usually within the high tariff period), but the printing and plotting of the documentation can be realised during low tariff periods. Due to the large number of documents it can lead to significant savings.

Optimization of working hours of the cleaning staff

Cleaning staff use hot water and in certain types of public buildings (schools, public administration office buildings) it is typically heated by electricity. For the hot water preparation it is advised to use low tariff. So it is good to optimize working hours of cleaning staff according to the energy tariff – in LT periods or if hot water is prepared using storage tanks with programmable thermostat immediately after the LT periods to have enough hot water (to avoid water heating in HT periods).

Shift work in the building

In case of shift work in the building it is recommended to strengthen shift load during low tariff periods and reduce shift load during high tariff periods.

Connection of accumulation devices to tariff switch

The accumulation devices (electric hot water production or room heating with buffer tanks)should be directly connected to tariff switches and heat generation should work only during LT periods.

3.2.4. Communication/Enforcement of the new time management to all users of the building.

The users have to be familiar with the new time management to be able to follow it. Ways of promotion can be different according to the building function and the type of users:

- Educational buildings
- Administrative buildings
- Building for health services
- Building for sport activities
- Cultural buildings

The approach of promotion and enforcement of new time management is very different according to the type of users of the building. It is not possible to elaborate one common scheme for promoting the newly introduced time management. The easiest way of promotion can be realized in **educational buildings**, where pupils/students can directly participate in the "new" activities within games or contests (actions on behavioural change for improving energy efficiency). Users of **administrative buildings** are different – they are adults, they spent 8-9 hours per day on average in the building, they work in the building and must fulfil their duties. Therefore the fulfilment of the new time management should be part of their duties and they can be motivated positively (rewards for compliance the rules) or negatively (penalties). In other building types (b**uilding for medical services, buildings for sport activities, cultural buildings, etc.**) can be characterised by many different users during the day who visit the building just for short periods. The promotion and engagement of them is not an easy task and can be based on posters, notes, stickers, etc.

3.3. Building users – time management compliance

Building users have different engagement and relationship to the building depending on the building function (educational, administrative, etc. - see chapter above) and the type of users. Building administrators must check time management compliance according to the building type and should choose different approaches for different type of users such as:

- Adult / children
- Visitors / permanent users

Thus, there are 4 combinations of users, which requires different approaches:

- Adult visitors
- Adult permanent users
- Children visitors
- Children permanent users

Certainly, further classification might be necessary in special cases.

3.3.1. Adult visitors

Adult visitors can be informed about measures taken in the building, but they cannot be forced to take actions. The time management can be realised by opening hours, lighting regulation rules during the day, but definitely not by forcing any behavioural change of the visitors. Information posters and signs might have an effect.

3.3.2. Adult permanent users

Adult permanent users of public buildings are mainly staff of the building (i.e. administrative building). Their behaviour can be monitored and can be influenced by many different positive or negative motivation actions (as described in previous chapter).

3.3.3. Children visitors

This group is very similar to the first one (adult visitors). The time management can optimize only operational measures, which are not based on behavioural change of the building users. It is very difficult to realize any behavioural change on children visitors.

3.3.4. Children permanent users

Children permanent users are students or pupils of school building. This group of users is probably the easiest for setting up a new time management and checking its compliance. There defined schedule can be closely linked to the time management. It is easy to monitor who stayed where and when and in case of any rule violation who should be warned/punished. The compliance check can be taken as a game for pupils i.e. a supervisor can be appointed to checks if the lights are off when leaving the class.

4. Conclusion

In the first part of this tool, authors have provided the reader with basic information about possible measures that can be taken or actions that can be used in order to achieve energy savings by behavioural change of the building users. It specially focused on possible ways how to motivate the user to save energy.

During the processing of the topic and literature study, it became clear that some of the introduced tools are becoming very popular (mainly the untraditional ones) and other (traditional methods) are becoming obsolete. Studies have proven that for example financial motivation is not so significant and lasting as for example more untraditional methods as creating a competition between users or for example transferring energy saving in to a game. This is especially notable in this age full of information technology (with smartphones and social media) which makes it easy to collect, process, visualize and share the data.

In chapter 3 time management issues are discussed to profit from different energy tariffs during the day. However such actions are possible, only when differentiated tariffs available.

Different building types require different DSM actions, because of users have different relationship with the building. From this aspect buildings can be classified as follows:

- Buildings occupied by regular users with main activity of learning
- Buildings occupied by permanent staff
- Buildings occupied by users of occasional activities
- Buildings occupied by regular users with main activity of living

A personalised toolset for the listed building types can be found in the annex.

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Glossary

EAV –	-	Energy Agency Vysočiny
EE	-	Energy Efficiency
EPIC	-	Energy Performance Integrated Contract
HT	-	High Tariff
LP	-	Lead partner
LT	-	Low Tariff
PP	-	Project Partner
SIEA	-	Slovak Innovation and Energy Agency (SIEA)

List of Figures

List of Tables

Appendix: DSM toolsets for characteristic building types

4.1. Buildings occupied by regular users with main activity of learning

Building types:

schools, kindergardens, university buildings

User characteristics:

This building type can be characterised by different users. First, permanent staff (mostly teachers, but also administrators, maintenance staff) working all year long weekdays in office hours. In summer their presence is significantly decreased for 1-2 months. Second, students, children (in kindergardens) who can be considered also as permanent users, with similar occupancy profile as teachers, but in certain caes they spend less hours than teachers in the building. Third, cleaning staff working mostly early mornings and/or late afternoons. Their number is low, but their behaviour can have a significant impact on the building's energy consumption. Forth, in certain building types there are also visitors, like parents in kindergardens or primary schools who also might have an impact on energy use (entrance door left open).

Building characteristics:

These buildings often have a significant heat loss through the roof and to the ground due to low number of floors. The glazed ratio is also often high to increase daylight, so shading and the appropriate use of shading can be important. The most significant energy demand belongs to heating, particularly in kindergardens, where high indoor air temperatures are maintained for the childrens' comfort. Hot water consumption is moderate in these buildings. Cooling is not typical, because the hot periods overlaps with summer brakes. Demand on fresh air is high influencing heating energy demand. Some buildings are equiped with central mechanical ventilation system. Lighting is often switched on, particulary during winter season.

Main behavioural problems:

- Overheating to avoid any complaints
- Not proper use of programmed heating (if exists)
- Entrance door opened many times in the mornings and in the afternoons when workers / students / children arrive or leave the building
- Windows left open in the brakes too long or left open after leaving the room
- Lights left on after leaving the classroom
- Lights left on in common spaces after closure
- Wasting water for cleaning
- Taps left open
- Hot water temperature set too high

Stakeholders involved:	**Objectives, tasks and responsabilities:**	**DSM actions to engage stakeholder:**
Building owner: Municipality	• Signing the most appropriate contract with utility companies • Setting up energy performance contract with building manager • Fund raising and cost allocation on EE investments • Invest in:	• Financial and economic incentives • Education and training tools

	○ audits ○ smart metering system ● trainings and DSM and communication actions ● small (and large) EE measures	
Building manager	● Get informed ○ know the building ○ know the users ○ know the consumption ○ be aware of gaps and problems ○ discover the current energy consumption profile ○ participate in trainings ○ study audits and certificates about the building ● Ensure proper settings for an efficient use of building shell and technical building systems ○ appropriate thermostat program for heating, hot water and cooling, etc. ● Prepare decision making: ○ recommendation for EE investments ○ recommendation to change for proper contract with utilities ○ setting up a time management for a more appropriate energy consumption profile ● Communication with owner ● Communicate proper building use with occupants ● Communicate roles and tasks (e.g. with cleaning staff) ● Organise discussions and events ● Prepare and install information panels, signs, instructions ● Regular time management compliance check	● EPC (energy performance contract) ● Bonuses ● Education and training tools ● Information delivery tools: ○ indirect feedback (utility bills) ○ more frequent bills / reading of meters ● Instant feedback tools ○ Smart meters ○ Direct displays ○ Interactive feedback via a PC

Building occupants: Students	• Learn how to use the building in an efficient way and act: o switch off lights after use o close taps after use o close windows and external doors after use o use proper cloths for the season to avoid discomfort and complaints	• Education and training tools • Instant feedback tools o Direct displays on energy consumption • Edutainment and gamification tools • Competition based and social networking tools • Social awards (e.g. green energy class) • Information panels, signs, posters placed on the proper place
Children (kindergarden)	• Learn environmental basics • Learn to avoid wasting water and ressources • close taps after use • learn to use water saving toilet flush	• Education and training tools (applied by teachers) • Edutainment and gamification tools • Information panels, signs, posters placed on the proper place
Teachers and administrators	• Learn how to use the building in an efficient way and act: o switch off lights after use o close taps after use o close windows and external doors after use o use proper cloths for the season to avoid discomfort and complaints o etc.	• Financial, economic and social incentives o bonuses o rewards and penalties o social awards • Information panels, signs, posters placed on the proper place

	• Help in educating students and children on the o importance of saving resources o on the efficient use of the building	
Cleaning and maintenance staff	• Learn how to use the building in an efficient way and act: o switch off lights when left on o close taps after use o avoid wasting water o close windows and external doors when left open o use proper cloths for the season to avoid discomfort and complaints o etc. • Maintain information panels and signs on EE installed in the building	• Education and training tools • Financial, economic and social incentives o bonuses o rewards and penalties o social awards • Information panels, signs, posters placed on the proper place
Building visitors: parents	• Learn how to use the building in an efficient way and act: o close external doors after entering/leaving or when found open o dress children in proper cloths for the season to avoid discomfort and complaints o etc.	• Information panels, signs, posters placed on the proper place

4.2. Buildings occupied by permanent staff

Building types:

municipal administration buildings, governmental administration buildings office buildings

User characteristics:

The most important user type in this building category is the permanent administrative staff working all year long weekdays in fix office hours. Cleaning staff is also important, they work mostly early mornings. Their number is low, but their behaviour can have a significant impact on the building's energy consumption. Finally, usually there are also public visitors who also might have an impact on energy use (entrance door left open, taps left running).

Building characteristics:

These buildings often have a significant heat loss through windows if glazed ratio is high in order to increase daylight, so

shading and the use of shading can be important. The most significant energy demand belongs to heating and in certain cases cooling. Hot water consumption is moderate in these buildings. Cooling is frequently applied, because staff must be dressed in a formal way no matter what the weather is like. Some buildings are equiped by central mechanical ventilation system. Lighting is often switched on, particulary during winter season.

Main behavioural problems:

- Overheating /overcooling, particularly in case of employees working near large glazed areas to avoid comfort complaints
- Overcooling because of too formal dressing requirements
- Not proper use of programmed heating and cooling (if programmable thermostat exists at all)
- Entrance door opened many times when workers or visitors arrive or leave the building
- Windows left open when heating / cooling system running
- Not properly used shading in winter
- Not properly used shading in summer
- Lights on during daytime, because tables are not positioned well to achieve enough daylight
- Lights left on after leaving the office
- Lights left on in common spaces after closure
- Office equipment running when not used
- Office equipment running during peak electricity periods
- Hidden consumption of office equipment out of office hours (low power mode)
- Wasting water for cleaning
- Taps left open
- Hot water temperature set too high

Stakeholders involved:	**Objectives, tasks and responsabilities**	**DSM actions to engage stakeholder**
Building owner: *Municipality*	• Signing the most appropriate contract with utility companies • Setting up energy performance contract with building manager	• Financial and economic incentives • Education and training tools

	• Fund raising and cost allocation on EE investments • Allow casual dressing for the staff if possible, particularly in hot periods • Invest in: o audits o smart metering system o trainings and DSM and communication actions o small (and large) EE measures	
Building manager	• Get informed o know the building o know the users o know the consumption o be aware of gaps and problems o discover the current energy consumption profile o participate in trainings o study audits and certificates about the building • Ensure proper settings for an efficient use of building shell and technical building systems o appropriate thermostat program for heating, hot water and cooling, etc. • Prepare decision making: o recommendation for EE investments o recommendation to change for proper contract with utilities o setting up a time management for a more appropriate energy consumption profile • Communication with owner	• EPC (energy performance contract) • Bonuses • Education and training tools • Information delivery tools: o indirect feedback (utility bills) o more frequent bills / reading of meters • Instant feedback tools o Smart meters o Direct displays o Interactive feedback via a PC

	• Communicate proper building use with occupants
	  o Communicate roles and tasks (e.g. with cleaning staff)
	  o Organise discussions and events
	  o Prepare and place information panels, signs, instructions on proper places
	• Regular time management compliance check	

Building occupants:
 	
Administrative staff
	• Learn how to use the building in an efficient way and act:
	  o switch off lights after use
	  o switch off office equipment when not used
	  o avoid hidden consumption (switch off LOPOMO)
	  o close taps after use
	  o close windows and external doors after use
	  o don't open windows in case of mechanical ventilation
	  o use shading devices in a proper way
	  o wear proper cloths for the season to avoid discomfort and complaints
	  o etc.
		• Financial, economic and social incentives
		  o bonuses
		  o rewards and penalties
		  o social awards
		• Information panels, signs, posters placed on proper places

Cleaning and maintenance staff	• Learn how to use the building in an efficient way and act:
	  o switch off lights when left on
	  o close taps after use
	  o avoid wasting water
	  o close windows and external doors when left open
	  o use proper cloths for the season to avoid discomfort and complaints (casual cloths when allowed)
		• Education and training tools
		• Financial, economic and social incentives
		  o bonuses
		  o rewards and penalties
		  o social awards
		• Information panels, signs, posters placed on the proper place

	o etc. • Maintain information panels and signs on EE installed in the building	
Building visitors: parents	• Learn how to use the building in an efficient way and act: o close external doors after entering/leaving or when found open o dress children in proper cloths for the season to avoid discomfort and complaints o etc.	• Information panels, signs, posters placed on the proper place

4.3. Buildings occupied by users of occasional activities

Building types:

cultural buildings, conference halls, libraries, museums, concert halls, theaters, cinemas, sport centers, swimming pools, health centers, hospitals

User characteristics:

The most important user type in this building category is represented by the visitors who come into the building only oocasionally for a couple of hours to do sporting activities, to entertain or to spend free time. Opening hours varies according to the function, in sport buildings all day long, except nights, for theaters in the evenings, for museums during daytime. Most buildings are open whole year long, all days of the week. There is a smaller user group, the permanent operating staff for technical, service, administrative and cleaning purposes. Cleaning and technical staff have an imortant role, because their behaviour can have a significant impact on the building's energy consumption. Health centers and hospitals are slightly different, becasue the permanent medical staff has a significant role as well.

Building characteristics:

These buildings often have a compact building shell with low glazed ratio, but there are examples for the opposite case (large glazed facades for representative purposes). The most significant energy demand belongs to heating, ventilation and in certain cases cooling. Hot water consumption is moderate in these buildings except for sport centers and swimming pools where visitors often take a shower. Central mechanical ventilation and climatisation is frequently applied, because natural ventilation is often not sufficient and internal heat loads are high due to the high number of visitors. Artificial lighting has an important role as well, paricularly in case of low glazed ratio when they must continuously be swiched on during operating hours.

In addition, in case of certain functions there is an important technological energy demand and internal heat load: special lighting equipment and stage technology in theaters, cine-projectors in cinemas, lighting for exhibition items, swimming pool technology, hospital technology, etc.

Main behavioural problems:

- Taps left open
- Not proper use of programmed heating, cooling and mechanical ventilation (if programmable thermostat exists at all)
- Entrance door left open when visitors arrive or leave the building
- Windows left open
- Lights left on after closure
- Wasting water for cleaning
- Hot water temperature set too high
- Energy waste related to technology:
    - Pools left open out of operating hours (cover foil recommended)
    - Hidden (low power mode) consumption of technological units out of operating hours
    - etc.

Stakeholders involved:	**Objectives, tasks and responsabilities**	**DSM actions to engage stakeholder**

Building owner: Municipality	• Signing the most appropriate contract with utility companies • Setting up energy performance contract with building manager • Fund raising and cost allocation on EE investments • Invest in: o audits o smart metering system o trainings and DSM and communication actions o small (and large) EE measures	• Financial and economic incentives • Education and training tools
Building manager	• Get informed o know the building o know the users o know the consumption o be aware of gaps and problems o discover the current energy consumption profile o participate in trainings o study audits and certificates about the building • Ensure proper settings for an efficient use of building shell and technical building systems o appropriate thermostat program for heating, hot water and cooling, etc. • Prepare decision making: o recommendation for EE investments o recommendation to change for proper contract with utilities o setting up a time management for a more appropriate energy consumption profile • Communication with owner	• EPC (energy performance contract) • Bonuses • Education and training tools • Information delivery tools: o indirect feedback (utility bills) o more frequent bills / reading of meters • Instant feedback tools o Smart meters o Direct displays o Interactive feedback via a PC

	• Communicate proper building use with occupants
	  o Communicate roles and tasks (e.g. with cleaning staff)
	  o Organise discussions and events
	• Prepare and place information panels, signs, instructions on proper places
	• Regular time management compliance check	

Building occupants:
Permanent staff
Cleaning and maintenance staff
	• Learn how to use the building in an efficient way and act:
	  o switch off lights after use
	  o switch off technological equipment when not used
	  o avoid hidden consumption (switch off LOPOMO)
	  o close taps after use
	  o check regularly and close windows and external doors
	  o don't open windows in case of mechanical ventilation
	  o use shading devices in a proper way
	  o wear proper cloths for the season to avoid discomfort and complaints
	  o etc.
		• Education and training tools
		• Financial, economic and social incentives
		  o bonuses
		  o rewards and penalties
		  o social awards
		• Information panels, signs, posters placed on proper places

Building visitors	• Learn how to use the building in an efficient way and act:
	  o close taps after use
	  o switch off lights after use (e.g. in toilets)
	  o close external doors after entering/leaving or when found open (if not automatic)
	  o etc.
		• Information panels, signs, posters placed on the proper place

4.4. Buildings occupied by regular users with main activity of living

Building types:

dormitories, senior homes, homeless shelters

User characteristics:

This building type can be characterised by different users. First, permanent tenants (in dormitories students, in senior homes elderly or disable people) who might show various behavioural pattern. Second, staff (teachers, administrators, medical staff, social workers) working all year long, partly full day, partly in weekdays during office hours. In dormitories occupancy is decreased in summer except in touristic areas where they are often used as used hostels. Third, cleaning staff working in certain periods of the day. Their number is low, but their behaviour can have a significant impact on the building's energy consumption. Forth, in dorms there can be events, like parties in certain evenings with a high number of young external guests and internal tenants. During such events high ventilation rates and cooling demand might appear.

Building characteristics:

These buildings can be various in size and shape (particularly dorms). The most significant energy demand belongs to heating, but hot water consumption is also important. Cooling and ventilation are not typical to keep investment and operation costs low. Some part of the buildings used for common activities (party rooms, dining rooms) can be equipped with mechanical ventilation system. Lighting in common spaces is often switched on, which might be inevitable for safety reasons to support disabled people.

Main behavioural problems:

- Overheating to avoid any complaints
- Not proper use of programmed heating (if exists)
- Entrance doors opened
- Windows left open in common rooms
- Windows left open in private rooms
- Lights left on in common rooms
- Lights left on in private rooms
- Wasting water for taking a shower
- Taps left open in common bathrooms
- Hot water temperature set too high
- Office equipment (laptops) not switched off when not used (in dorms)
- TVs running all day long in senior homes

Stakeholders involved:	**Objectives, tasks and responsabilities:**	**DSM actions to engage stakeholder:**
Building owner: Municipality	• Signing the most appropriate contract with utility companies • Setting up energy performance contract with building manager • Fund raising and cost allocation on EE investments	• Financial and economic incentives • Education and training tools

	• Invest in:
	  o audits
	  o smart metering system
	• trainings and DSM and communication actions
	• small (and large) EE measures	

Building manager	• Get informed
	  o know the building
	  o know the users
	  o know the consumption
	  o be aware of gaps and problems
	  o discover the current energy consumption profile
	  o participate in trainings
	  o study audits and certificates about the building
	• Ensure proper settings for an efficient use of building shell and technical building systems
	  o appropriate thermostat program for heating, hot water and cooling, etc.
	• Prepare decision making:
	  o recommendation for EE investments
	  o recommendation to change for proper contract with utilities
	  o setting up a time management for a more appropriate energy consumption profile
	• Communication with owner
	• Communicate proper building use with occupants
	• Communicate roles and tasks (e.g. with cleaning staff)
	• Organise discussions and events
	• Prepare and install information panels, signs, instructions
		• EPC (energy performance contract)
		• Bonuses
		• Education and training tools
		• Information delivery tools:
		  o indirect feedback (utility bills)
		  o more frequent bills / reading of meters
		• Instant feedback tools
		  o Smart meters
		  o Direct displays
		  o Interactive feedback via a PC

	• Regular time management compliance check	
Building occupants: Tenants	• Learn how to use the building in an efficient way and act: o switch off lights after use o close taps after use o close windows and external doors after use o use proper cloths for the season to avoid discomfort and complaints o switch of TVs and laptops after use (LOPOMO not enough)	• Education and training tools • Instant feedback tools o Direct displays on energy consumption • Edutainment and gamification tools • Competition based and social networking tools • Social awards (e.g. green energy class) • Information panels, signs, posters placed on the proper place
Permanent supporting and administrative staff	• Learn how to use the building in an efficient way and act: o switch off lights after use o close taps after use o close windows and external doors after use o use proper cloths for the season to avoid discomfort and complaints o etc. • Help in educating tenants on the o importance of saving resources o on the efficient use of the building	• Financial, economic and social incentives o bonuses o rewards and penalties o social awards • Information panels, signs, posters placed on the proper place
Cleaning and maintenance staff	• Learn how to use the building in an efficient way and act: o switch off lights when left on o close taps after use	• Education and training tools • Financial, economic and social incentives o Bonuses

	o avoid wasting water o close windows and external doors when left open o use proper cloths for the season to avoid discomfort and complaints o etc. ● Maintain information panels and signs on EE installed in the building	o rewards and penalties o social awards ● Information panels, signs, posters placed on the proper place
Building visitors: relatives	● Learn how to use the building in an efficient way and act: o close external doors after entering/leaving or when found open o dress children in proper cloths for the season to avoid discomfort and complaints o etc.	● Information panels, signs, posters placed on the proper place