

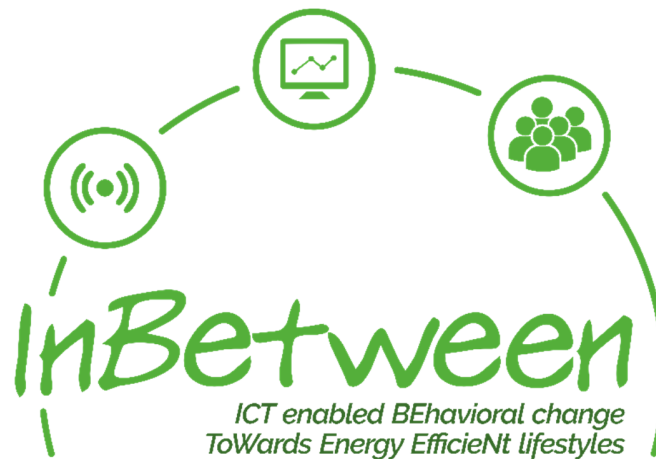


D3.2 A SUMMARY OF SURVEY RESULTS

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DISCLAIMER



D3.2 A SUMMARY OF SURVEY RESULTS



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EXECUTIVE SUMMARY

This deliverable presents a framework for profiling energy users according to their level of agency (consumers' willingness and ability to make their own free choices regarding energy consumption and energy related behavior) and capacity (users' ability to perform the choices they made) as seen through the surveys of the hh of the project's pilot sites. The assumption is that once both agency and capacity are high – energy savings is likely to occur. InBetween seeks to find innovative ways to increase users' willingness and interest in engaging with the project and changing their energy use behavior; and provide them the means and tools to act.

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1 INTRODUCTION

As described in detail in D1.2 & 3.1, a survey was created in order to map the various consumers energy-related practices and constraints; map consumers perceptions of and attitudes toward engagement and toward the technology; and accordingly, profile consumers according to their barriers and opportunities for engagement and for energy-related behavioural change.

In this report we develop consumer energy related profiles with an emphasis on promoting engagement and behaviour change.

2 CHARACTERISTICS OF ENERGY USERS IN DEMO SITES

2.1 RESIDENTIAL BUILDINGS

The residential surveys results highlight differences in occupancy type and energy use patterns between the two demo sites (SON, which includes 8 households (hh) and VIL which includes 33 hh):

Occupancy type and patterns: All hh in SON have at least two residents, and five hh have three residents or more. Twenty hh in VIL have only one resident, and only five have three people or more.

Only two hh in SON are populated during the whole day, compared to sixteen hh in VIL.

Energy use practices: Nearly all hh in both samples have washing machines and dishwashers, however, these are used less frequently in VIL due to the smaller sized hh and hence the lower demand for these energy services.

Overall, the thermal comfort of the residents in SON buildings is better, compared to VIL. In both demo sites thermostats are installed to control the indoor temperature. However, in SON these are used to some extent, while in VIL they are rarely used.

In both SON and VIL most hh think they have already done some behavioral changes to save energy, and many think they cannot reduce their consumption any further.

Flexibility: None of the SON hh are enrolled in Time of Use (ToU) tariffs, due to lack of economic incentive to join such an arrangement. In VIL all hh are enrolled in ToU tariffs.

The VIL hh perceived flexibility of demand - i.e., the perceived ability to change appliances time of use - is currently low. This low flexibility, however, is not necessarily related to energy practices or the need of an energy service at particular time, but rather to the noise associated with the operation of washing machines, dryers and dishwashers, which could affect them and the neighbors if used during 'quiet' hours.

Stated motivation for engagement: In both samples the main motivation for energy savings is economic – i.e. save money, followed by environmental – i.e., protecting the environment. In other words, there are two types of motivations (1) utilitarian – personal, and (2) altruistic – environmental.

Communication: In both sites communication could be done via one of the platforms – smartphone or computer. There is only one hh in VIL which during the time of the survey had only a mobile phone that is not a smart phone.

Interest in engagement: Overall, hh in both SON and VIL are not so interested in engaging with their energy use too often, and prefer only once or twice a month reporting, rather than a daily or weekly engagement.



The most desirable intervention is information on how much money the hh spent and how much would have been saved if it had switched off or replaced a specific appliance. In addition, all hh prefer tailored and reasonable goal setting over comparison to others.

2.2 NON-RESIDENTIAL BUILDINGS

Occupancy type and patterns: The non-residential building sample (only in SON) includes nine very diverse users, with different type of usages, occupancy patterns and numbers along the day, week and year. These nine uses include two of which are residential dwellings in guesthouses)

Energy use practices: Only the guesthouses, conference building, kindergarten and family homes use wet appliances (washing machine, dryers, dishwasher) at all, with a frequency ranging from once a week to three times a day on weekends. Guesthouses have 12 & 32 televisions.

Thermal comfort is overall good and the thermostats are rarely used in most buildings.

Flexibility: None of the buildings are enrolled in ToU tariff.

Stated motivation for engagement: Like in the residential samples, the motivations for saving energy are economic and environmental. Two users do not think they can reduce more energy in their building as they already optimized consumption.

Lack of time to deal with engagement and lack of easily available information are perceived as barriers for action.

Communication: All means of communications are available to the occupiers of the buildings.

Interest in engagement: None of the interventions suggested in the survey was ranked high. Of them, alerts on high consumption was the most desirable one. Comparison to similar types of occupancy was the least desirable intervention.

Like in the residential sector, most occupiers are not so interested in engaging with their energy use too often, and prefer once a month reporting rather than a daily or weekly engagement.

3 FRAMEWORK FOR ANALYSIS AND PROFILING CATEGORIES

There are many barriers for energy-related behavior. In the InBetween project we borrow the 'middle out' framework developed by Parag and Janda (2014)¹ and Parag et al (2017)² to analyze barriers for behavior change and propose means to overcome them. According to the framework, two variables are associated with action and inaction: agency and capacity. 'Agency' refers to consumers' willingness and ability to make their own free choices regarding energy consumption and energy related behavior, and 'capacity' refers to users' ability to perform the choices they made. The likelihood of an energy user to take action (in our case change behavior) is associated with his/her levels of agency and capacity:

- when the levels of both agency and capacity are high, action / behavior change are likely;

¹ Parag, Y. and K. Janda (2014). "More than Filler: Middle Actors and Socio-Technical Change in the Energy System from the "Middle-Out" " Energy Research & Social Science 3: 102-112.

² Parag, Y., S. Zur, et al. (2016). "Levels of consumers' agency and capacity as predictors for electricity demand reduction in the residential sector." Energy Efficiency: 1-15.

- when the levels of both are low, action / behavior change are unlikely;
- when there is a mismatch between the levels (one is high and the other is low), action / behavior change likelihood is uncertain.

Our aim is that all users will have high levels of both agency and capacity.

Figure 1 summarizes the relations between behavioral change and consumers’ levels of agency (willingness) to act and capacity to act.

Figure 1
Capacity
behavior

Capacity to act	High	Not interested in engagement & Capable of reducing demand UNCERTAIN	Interested in engagement & Capable of reducing demand ↓ CHANGE IS LIKELY
	Low	Not interested in engagement & Incapable of reducing demand ↓ CHANGE IS UNLIKELY	Interested in engagement & Incapable of reducing demand UNCERTAIN
		Low	High
Agency (willingness) to act			

Agency,
and

According to this framework, barriers for successful action are either low levels of agency or low levels of capacity. In other words, lack of interest in energy engagement or lack of ability to change energy related behavior and reduce energy consumption. Ideally, once each hh/user's specific agency-related and capacity-related barriers for engagement and action are identified, a unique engagement strategy can be tailored and the InBetween app can be used to approach the user with the appropriate and timely message.

Our methodology is as follow:

- identify the levels of agency and capacity of each consumer (hh or user in public building)
- understand the reasons for low levels of agency and / or capacity
- identify means to increase the levels of consumer’s agency and capacity

(d) tailor set of strategies to approach consumers

As detailed in D3.1, some of the agency related aspects (but not all of them) were collected in the survey. For example, economic, social and environmental motivations for saving energy (section P of the survey), perceived flexibility energy use (which determines the perceived ability to shift the use of appliances from Peak to off-peak times where ToU tariff applies - section M), interest in various types of interventions/motivations to act (sections R & S), etc. Other type of aspects will be determined in later stages of the project, when some equipment is installed and interaction with consumers will begin.

Some of the perceived capacity aspects (ability to act) were explored in the survey (e.g., experience with changing thermostat settings, section P). However, as stated chapter 5 most of the capacity related aspects will be explored later in the project.

Below we focus on the possible reasons for low levels of agency and capacity and identify means to increase the levels of consumer's agency and capacity.

4 LEVEL OF AGENCY

In our context **agency** is defined as **user's interest in saving energy; user's interest in engagement with personal energy consumption; and user's willingness to act in order save energy**. Different sociological, personal, psychological as well as other variables and parameters influence the level of consumer agency. These vary between individuals.

4.1 REASONS FOR LOW LEVEL OF AGENCY

4.1.1 Lack of interest in energy consumption

Energy is transparent – physically and metaphorically – it is a mere means to enjoy comfort and get services such as thermal comfort, food, clean cloths etc. People are interested in the services and some people are simply not interested in the means that enables them to enjoy the services. They appreciate the fact that energy is transparent and want to keep it this way. In addition, often the energy company encourages consumers to pay their energy bills in direct debit, which further reduces the visibility of energy consumption and lessens the opportunities for consumer to engage with it. This is true for both users in the residential and non-residential buildings.

4.1.2 Lack of economic motivation

Economic motivation is utilitarian and the gain (in most cases) is personal for the hh or for the business.

In both demo sites hh pay for every unit of energy they consume. Hence, saving energy equals to saving money. However, in some hh the amount of money that could be saved due to energy saving efforts is small and/or perceived by users as insignificant, hence does not justify the effort. The larger the gap is between the perceived required effort and the anticipated economic gain – the lower is the economic motivation to act.

In the non-residential buildings, in most cases, the persons who make the effort and change behavior are not the same ones that enjoy the economic gains. Indeed, many users in the non-residential building lack any economic incentive to make any effort.

In SON, no hh / user is enrolled in a TOU program. Hence, there is no economic incentive to shift the time of use of appliances.



4.1.3 Lack of environmental motivation

Environmental motivation in most cases is altruistic.

Nearly every unit of kWh generated is associated with some sort of negative environmental externality. These externalities vary between energy sources and technologies, and include air pollution, greenhouse gas emissions (in particular CO₂, which is linked to climate change), water consumption, land use and other. Indeed, the International Energy Agency claims that Negawatts (i.e., energy saved) is the cleanest fuel.

However, many of the negative externalities are not felt directly or immediately by the energy consumers themselves, and this reduces the perceived linkages between the energy consumed and its associated environmental impact. This disconnection between action and effect reduces the environmental motivation to change energy-related behavior. Furthermore, many of the people who are environmentally aware feel that their efforts will result in an insignificant environmental effect. This feeling of insignificance is known as a feeling of 'drop in the ocean', which discourages people to act, and reduces their motivation to make an effort.

In addition, many people are not environmentally aware by nature, do not care about the environment, and are not willing to make an extra effort or change behavior in order to save the environment.

4.1.4 Lack of social motivation

People tend to learn from their social environment and adjust their behavior with the surrounding social norm. If an energy saving social norm exist (regardless of the motivation), it is likely that people will feel obligated to adjust and adopt their conduct of living accordingly. However, if such norm does not exist, the likelihood of energy saving actions is reduced.

Social environment and social norms that support and encourage energy savings are crucial in particular, when the motivation is environmental – that is due to the 'drop in the ocean' feeling, mentioned above. As individual consumption is insignificant, many people feel that there is no point in making the effort and changing their own behavior if no one else joins them and does the same.

4.1.5 A belief that the energy savings potential is exhausted

Many people think that – regardless of their motivation to act - they already have done what they can to save energy and are unable to save more. They do not lack motivation, but rather think they have exhausted their reduction potential and thus do not think there is any point in further engagement.

4.1.6 Fear of loss of comfort

As stated above, energy is a means to achieve desirable services and comfort. People are interested in the services and the comfort and not in energy per se. A barrier to action is the perception that saving energy will necessarily lead to a reduction in their level of comfort or level of services.

Changing habits and routines is often perceived as harming comfort. For the users who are enrolled in TOU programs – shifting the time of use of appliances from peak to off-peak hours will probably lead to a change in existing habits, routines and practices. For the people who can switch from one energy practice to another (e.g., from gas-based heating system to a heat pump) the switching could be perceived as a lessening of comfort.

4.1.7 Fear of unfamiliar technologies

The fear of new unfamiliar technologies varies with age, gender and education. Some people, in particular the elderly, do not use sophisticated technologies on a daily basis and feel helpless and even stressed when



introduced to new technologies. Even if installed in their homes / offices or on their mobile phones, these people are unlikely to use the technology or engage with it.

4.1.8 Lack of trust

Trust is an essential component for engagement. Low levels of trust in the technology or in the people who provide or install it is a barrier for engagement.

Low trust can be the result of lack of, or unclear, information about the technology and how it operates. This may lead to low trust in the validity and credibility of the advice generated by the technology, which, in turn, can lead to inaction.

Inaction could also be due to low trust in the people who provide or install the technology. Lack of transparency regarding the motivation of the installers or feeling that the providers are taking advantage of the users and are using them for their own benefit reduces the motivation to use the technology or engage in the program.

4.1.9 Fear of nuisance

Engagement implies paying attention and dedicating time and effort to learning new things and to performing new activities. The perception that engagement requires proactive behavior and the fear that it will consume a lot of time, often deters people from deciding to engage in the first place.

In addition, the engagement with a mobile app that sends notifications and information once in a while (some might think it is too often) could be perceived as a nuisance rather than helpful.

4.2 STRATEGIES FOR INBETWEEN TO OVERCOME BARRIERS

To overcome the above-mentioned barriers and to increase the level of users' interest in, and willingness to engage in energy saving activities, InBetween needs to deliver added value to the consumers. These added values can be new ones (energy and non-energy³ benefits) or existing ones, which are highlighted in different and attractive ways.

The straightforward value is **meaningful information** that make sense to users and that can help them make better energy saving decisions. The information about energy consumption, for example, can deliver additional value over the just information about past consumption.

The information will be explicit about the **economic value** of switching off appliances, replacing specific inefficient appliances in each particular hh, the return on investment (ROI) period of replacing appliances, switching time of use, switching energy providers, etc. The added value will be quantified (as much as possible) and consider the hh / user occupancy patterns and energy practice characteristics in order **not to harm the comfort level**.

The **environmental added value of the energy saving actions** will be clearly provided and put in context, in perspective and with a point of reference, so people can understand their positive impact on the environment. It is likely that sending positive and encouraging environmental messages (rather than negative ones) will motivate people to participate.

³ Non-energy benefits include for example comfort, health feeling of satisfaction



To tackle the **lack of social motivation barrier**, messages will include information about what others do, what would be a reasonable and ‘fair’ consumption, and also refer to the aggregated savings of all the participants in the project. The message portrayed will be: you are not alone – this is the new norm, this is a group effort.

As for the people who feel that they **already done what they can to lower their energy consumption** – following the KPI analysis, InBetween will provide detailed information about the full energy saving potential, how the hh / user can achieve it, and what will be the associated economic and environmental implication of these additional savings. The KPI analysis might find that, indeed, some people have already done all that is possible to save energy.

The interaction of the users in each demo site will be with a **familiar person**, who knows the buildings’ constraints, understands (at least to some extent) how the technology works and whom the users can easily contact in case of need. Operational manuals will be clear and **easily accessible**. The motivation behind the project will be **explicitly explained**.

From the survey results, it seems that **most users perceive the app as something which will be a nuisance** and are not keen to receive messages often. However, it is likely that the provisioning of tailored advice as well as clearly stated added value will help users to appreciate the app and use it more often.

5 LEVEL OF CAPACITY⁴

In our context **capacity** is defined as **user's ability to perform its own desirable energy saving actions through behavioral change, including the ability to improve efficiency (of appliances or infrastructure)**.

5.1 REASONS FOR LOW LEVEL OF CAPACITY

5.1.1 Daily obligations, practices and family constraint

Some of the energy saving activities require the change of daily routine or practices of the hh /users. Daily routines and activities of hh are determined by the work schedule of the adults, by school hours etc. The routines of users in the non-residential sectors are determined by their job requirement, and most people are unable to change these. For example, in the guesthouse rooms, the practice is that visitors can change the thermostat setting, and the manager is unlikely to intervene.

In hh enrolled in TOU programs, shifting the time of use of some appliances is impossible because they are linked to dinner time (e.g., the use of ovens for cooking) or because turning them on during low tariffs disturb the neighbors and themselves while sleeping (e.g., washing machine).

5.1.2 Technical barriers

Some savings are impossible due to technical reasons related to energy appliances or infrastructure.

The information about technical barriers will be filled after the KPI analysis is completed.

⁴ This section will be completed in a later phase of the project, after baselines are set and KPIs calculated.



5.1.3 Lack of 'know how'

Some people are willing to engage and make the effort to change energy but lack the 'know how'. They do not know how to operate the appliance correctly or how to gain additional savings from it. For example, they have thermostats but do not know how to operate them (or how to operate them correctly) in order to save energy. Indeed, studies show that people do not understand how thermostats work.

5.1.4 Economic barrier

Replacing old inefficient appliances with new efficient ones will result in energy savings without the need to change behavior. However, even if in the long run the replacement makes economic sense, often the upfront cost is too high and prevents the replacement.

Actions such as replacing inefficient wet appliances and boilers and insulating walls and roofs have a relatively short return on investment period.

5.1.5 Ownership (of hh / business)

In rented homes and in non-residential buildings the tenants / users and landlords often have different motivations to act. While the hh tenants will enjoy lower energy bills if the efficiency of their building is improved, they cannot invest in the building fabric, as they have no claim in it. The landlords, on the other hand, have no economic incentive to improve the efficiency of their buildings, because they will not benefit from the lower energy bills. Often, users, even if they want to save energy are legally unable to do so.

5.1.6 Potential fulfilled

If indeed the energy savings potential of a building is exhausted – no further action can be taken.

The information about further potential for demand reduction in the demo sites will be filled after the KPI analysis is completed.

5.1.7 Passive personality

Some people are more passive than others. They might have the knowledge and the motivation but they need someone / machine to make the actual actions. For these people, the option of remote control their appliances by a machine, or even a third party might be attractive.

5.2 STRATEGIES FOR INBETWEEN TO OVERCOME BARRIERS

Overall, it is harder to overcome barriers related to capacity.

The KPI analysis will determine the technical characteristics of the buildings and the potential energy savings that will arise from specific sets of actions. The data analysis will provide us with what advice we will be able to provide based on the information / analysis that will be done on the data, and what will be the nature of the messages we will be able to send the users.

The app will be able to help overcome the barriers related to **technical explanations and 'know how'**. Clear information about specific actions that can be taken and specific instructions are needed here. The app will also be able to connect between the 'know how' and the user motivations and frame a message accordingly. For example, the app will be able to advise users as to what actions need to be taken to save x amount of money / reduce y emissions. As a significant amount of the energy in buildings is used for heating, special attention will be dedicated to advising on how to use thermostats correctly and efficiently.



The app will include the option of two-way communication through which the users can provide feedback to the system or consult with the app (the project) regarding energy savings.

The KPI analysis will help us to determine what is the **demand reduction potential of each hh / building** and point at additional (reasonable) potential for savings in hh that feel that they have already fulfilled their potential savings. Advice on 'how to do' will be as tailored as possible.

And last, for the **passive people** – ideally, we will offer remote control through smart plugs (or similar) for at least some appliances. These will ease the control and operation of appliances.

6 TEMPORAL ASPECT OF BARRIERS

6.1 PRE-INSTALLATION BARRIERS

Many of the barriers mentioned above reduce the will of hh and users to participate in the project from the outset. In particular, lack of perceived energy and non-energy benefits which will arise from the project and the fear that it will be too demanding and become a nuisance. Some of these barriers are clearly demonstrated in the survey results.

As decisions are still being made as to which technology and sensors will be implemented where, and accordingly, what the added value of the project will be to the users, it is difficult to plan the ideal deployment strategy.

6.2 POST INSTALLATION BARRIERS

Once the technology is deployed, a set of new barriers are likely to appear. These include issues related to the user interface design, clarity of messages displayed, and consumer energy illiteracy; loss of excitement (enthusiasm) over time and lack of interest in the technology or the information (beyond the first couple of weeks); mismatch and irrelevance of the information displayed to consumer needs and expectations; consumer inability and limited flexibility to actually act upon the information. These barriers are likely to reduce the effectiveness of the technology in delivering demand reduction or behavior change.

It is suggested that, if possible, the frequency of engagement be monitored and that after a period of time, feedback be gathered from the users (and changes made accordingly).

The two way communication will enable the Inbetween project to benefit from the users feedback with regards to some planning/forecasting activities. For example, user could say that for the next two weeks he will be away, and this will help the forecaster immensely.

7 CONCLUSIONS

The above analysis proposes a framework for profiling energy users according to their level of agency and capacity. The assumption is that once both agency and capacity are high – energy saving is likely to occur. InBetween seeks to find innovative ways to increase users' willingness and interest in engaging with the project and changing their energy use behavior; and provide them the means and tools to act.

The following barriers for engagement are proposed:

- (a) Reasons for low levels of user's agency
 - Lack of interest in energy
 - Lack of economic motivation
 - Lack of environmental motivation



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- Lack of social motivation
 - A belief that the energy savings potential is exhausted
 - Fear of loss of comfort
 - Fear of unfamiliar technologies
 - Lack of trust (in technology and the people behind the project)
 - Fear of nuisance
- (b) Reasons for low levels of users' capacity
- Daily obligations and family constraint
 - Technical barriers
 - Lack of know how
 - Economic barrier
 - Ownership (of hh / business)
 - Potential fulfilled
 - Passive personality (remote control)

In order to overcome these barriers, the added energy and non-energy benefits and values of the InBetween project and the tool /app it proposes will be clearly highlighted to the users. The advice will be tailored to the users' needs, characteristics, constraints and capabilities.

However, the analysis is incomplete and data from the KPI analysis is essential for complementing the profiling categories.