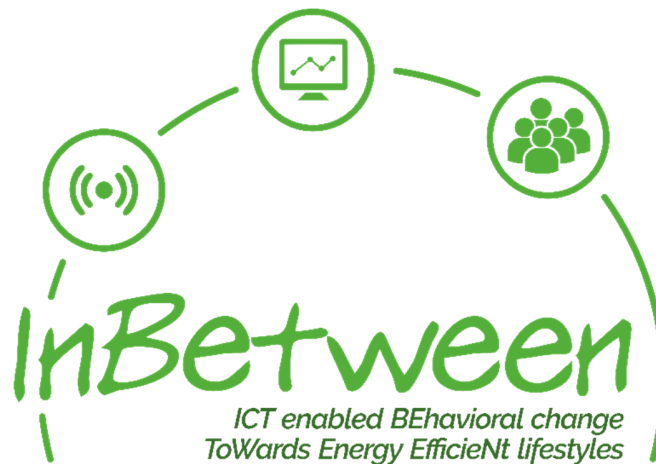**D1.3 CONSUMER ENERGY-RELATED PRACTICE PROFILES**
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LEADER: IDC

DISSEMINATION LEVEL: PU

PU	Public	x
CO	Confidential, only for members of the consortium (including the Commission Services)	

HISTORY

Version	Description	Lead author	Date
V0	First draft	IDC	23.4.18
V1	Updated version and comments from peer review process	ACC, RINAC and IDC	27.4.18
Final	Final	IDC	29.4.18
Revised	Revised after change in SON non residential building	IDC	31.7.18

DISCLAIMER

EXECUTIVE SUMMARY

We include in this deliverable description of the data and some statistical analysis, plus text identifying (a) existing energy practices and behaviour (b) interest in engagement.

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1 INTRODUCTION

The data gathered by the survey in both demo sites (SON – residential and non-residential buildings, and VIL – residential only) was statistically analysed to identify the following:

   (a) Information regarding household (hh) occupancy patterns.
   (b) existing energy practices and behaviour (use of appliances, thermal comfort, perceived flexibility)
   (c) motivations and interest in energy behaviour change
   (d) preferred intervention / engagement option

2 DATA ANALYSIS AND SUMMARY

2.1 SON RESIDENTIAL

2.1.1 Overview

A total of eight hh with a total of 21 residents are participating in the project's pilot and all have completed the survey, three of which were families with children. The residents' ages range from 4-78. Three people did not provide their age.

Table 1 SON residential – occupancy

No of people in hh	Frequency
2	3
3	2
4	2
5	1
Age	
Range	4-78 year
Average (stdv)	35 (23)
Median	39

2.1.2 Occupancy pattern

In two hh, residents work from home. In five out of eight hh, the house is empty between 9:00-13:00 during the week, and during the rest of the day at least one resident is home. During the weekends, all of the hh are full (residents are home).

2.1.3 Use of whitegoods

Washing machines are used at least 2-3 times a week in all hh.
Dryers are less common, only found in two hh where they are used between 1-3 times a week.
All hh have dishwasher which is used daily.
Five hh have electric ovens, which are in use between 1-3 times a week.

2.1.4 Thermal comfort

Seven hh have heating systems.

None of the hh have cooling systems.

Six hh have thermostats to control indoor temperature and they all use it. However, the frequency of changing the setting varies between hh – two rarely change it, two change it once in a while, two often.

Most residents enjoy sufficient thermal comfort in the winter with only one hh sometimes feeling too cold in the winter. Most residents enjoy sufficient thermal comfort in the summer with only one sometimes feeling too hot in the summer.

2.1.5   Time of Use (ToU) tariffs
None of the hh have ToU tariffs, as it is not considered a smart economic choice.

2.1.6   Motivation for saving energy
All hh are interested in saving energy.   The main reasons are (1) saving money and (2) protecting the environment. While all interested in saving energy, two hh do not think they can reduce more energy as they have already optimized consumption. One hh indicated that more information could help the hh save more energy.

2.1.7   Communication
All hh have all the communication options – mobile, smart phone, computer and internet.
One hh does not have computer.

2.1.8   Engagement
All hh are interested or very interested in setting reasonable and achievable goals for consumption reduction, based on the information they provided, and with tailored advice.

Alerts: Two hh are very interested in receiving alerts every time their energy consumption is higher than a threshold that they define, and with tips as to how they can reduce consumption. Four hh are not interested in this option and two are somewhat interested.

Comparison: Two hh are interested in information about their consumption compared to similar households. Three are not so interested and three are somewhat interested.

Frequency: Seven hh want this sort of information only once a month, and one hh would like to have it on a daily basis.

See tables below regarding the interest in various engagement options (note the small sample):

what degree you would be interested in the following (1 not at all-----5 very much)	Average	stdev	mode	median
Help you set **reasonable and achievable goals for consumption reduction**, based on the information you have provided above, and provide you with advice accordingly.	3.625	0.744024	3	3.5
Send you **alerts** every time your energy consumption is **higher than a threshold** that you define, and provide tips as to how you can reduce consumption	2.5	1.511858	1	2.5
Provide information about **your consumption compared to households similar to yours** (in terms of size, occupancy, weather etc.), and provide advice how to reduce your demand.	3	1.309307	4	3

To what extent would you be interested in the following information (1 not at all--- 5 very much)	Average	stdev	mode	median
How much money you could have saved if you had switched off or replaced specific appliance?	2.625	1.407886	1	3
How much energy was consumed by each room every day	1.125	0.353553	1	1
How much energy was consumed by each room every week	1.125	0.353553	1	1
How much energy was consumed by each room every week	1.125	0.353553	1	1
How much emissions (carbon) you emit in a day/week?	1.625	1.407886	1	1
How much money you spend on energy each day?	1.875	1.125992	1	1.5
How much money you spend on energy each week?	1.875	1.125992	1	1.5
How much money you spend on energy each month?	1.875	1.125992	1	1.5

Table 2 SON residential - interest in various interventions and engagement options

2.2   SON NON-RESIDENTIAL

2.2.1   Overview

The usage of the non-residential buildings vary and includes two offices with mix usage (congress buildings, which includes offices, training and congress rooms, and a building with community administration and music room), kindergarten, elementary school, gym, and two guesthouses (large and small) which also serve as family homes (a combination of private and commercial use). In this section (2.2) we will use the general term 'building' for all types of usage.

Overall, nine surveys were completed: five by administrative workers, two by guesthouse owners and two by the owners of attached family homes.

All the people who replied to the survey make energy related decisions in their building (e.g., turning on/off appliances, heating systems, etc.).

2.2.2   Occupancy pattern

The number of employees and users of these buildings ranges between 4-120. On a daily weekday basis the school and the kindergarten are the most populated buildings (54 & 35, respectively). The small and larger guesthouses when full populate 75 and 120 people (respectively).

Most buildings are occupied during week days in the mornings and afternoons, and empty during evenings and nights. In addition, most buildings are empty during weekends and holidays. The school and kindergarten are empty over the summer holiday. The training and conference building is occupied over the weekends between 9:00-20:00, but between 17:00-20:00 only one person is in the building. Information was not provided about the occupancy pattern of the Gym.

The guesthouses and the private family homes within them have a different occupancy pattern, with the guesthouses operating mainly between April and October, with one of them having around 5000 spent nights per year (no information about the other).

2.2.3   Use of appliances

Most buildings have electric appliances and whitegoods. The kindergarten has an eight year old washing machine which is used once a week, dishwasher, refrigerator, oven and coffee machine. The training and congress building which host people for events have highly efficient appliances (A+ and higher), including a washing machine used twice a week, two dishwashers used twice a day and freezer with high energy rating.In addition, it has electric oven, stove induction cooktop, which are used occasionally, coffee machine, TV set and 5 computers, which are used daily and 12 appliances which fall under the 'Hi-fi, media station, entertainment (DVD, etc.)' definition, which are used occasionally.

The mix uses building with community administration and music room has two old (17 year old) fridges, coffee machine and three computers.

Most buildings have at least one computer and three buildings also have printers.

The private homes have washing machines and dryers, and use them up to three times a week and once a week (respectively), they also have television, computers, dishwasher and oven, used on a daily basis. The larger guesthouse has three washing machines, which are used mainly over the weekends and a dryer, which is used once a week. It also has a sauna and steam bath, used occasionally. (No information about the usage of washing machine and dryer is provided on the smaller guesthouse). The guesthouses have 12 and 32 televisions, and several coffee machines. The larger guesthouse also has a sauna.

2.2.4 Thermal comfort

All buildings have thermostats and occupants can use them, but rarely do so (never or rarely). In the larger guesthouse and the attached family home, the thermostats are used often. Overall, the thermal comfort of the buildings' occupants is good. All those who replied to the survey do not feel too cold in the winter or too hot in the summer.

2.2.5 ToU

None of the buildings pay ToU tariff.

2.2.6 Motivation for saving energy

All the people who filled the survey claim that they and their colleagues are interested in saving energy. The main reasons are (1) saving money and (2) protecting the environment. While all are interested in saving energy, two do not think they can reduce more energy as they already optimized consumption. Five replied that the main barriers for reducing consumption are the lack of time or insufficient easily available and meaningful information regarding electricity consumption.

2.2.7 Communication

All buildings have all of the communication options – mobile, smart phone, computer and internet - and they are in use during worktime.

2.2.8 Engagement

On a scale of 1 (not at all) to 5 (very much) - all replies (except the large guesthouse and the conference building) indicate a low interest in setting reasonable and achievable goals for consumption reduction, based on the information they provided, and with tailored advice. Five were interested in receiving alerts when their consumption is higher than a pre-set threshold. A low-medium interest (2-3) exists in comparison to similar users (e.g., gyms with gyms, etc.). As for the frequency of engagement - seven want this sort of information once a month or less, one wanted it once a year, and the large guesthouse wants it on a weekly basis.

what degree you would be interested in the following (1 not at all-----5 very much)	Average	stdev	median	mode
Help you set **reasonable and achievable goals for consumption reduction**, based on the information you have provided above, and provide you with advice accordingly	2.55	1.13	2	2
Send you **alerts** every time your energy consumption is **higher than a threshold** that you define, and provide tips as to how you can reduce consumption	2.88	1.36	4	4
Provide information on **your consumption compared to usage similar to yours**, and provide advice how to reduce demand	2.16	0.98	2.5	3

Table 3 SON non-residential – interest in various interventions and engagement options

While saving money and protecting the environment were the main motivations for saving energy, and lack of information was mentioned as a barrier for action, relatively low interest was registered in all types of information.

To what extent would you be interested in the following information (1 not at all--- 5 very much)	Average	stdev	median	mode
How much money you could have saved if you had switched off or replaced specific appliance?	1.89	0.78	2	2
How much energy was consumed by each room every day	1.44	0.89	1	1
How much energy was consumed by each room every week	1	0	1	1
How much energy was consumed by each room every week	1.33	0.5	1	1
How much emissions (carbon) you emit in a day/week?	1.44	0.89	1	1
How much money you spend on energy each day?	1.44	0.89	1	1
How much money you spend on energy each week?	1	0	1	1
How much money you spend on energy each month?	1.33	0.5	1	1

Table 4 SON non-residential – interest in various interventions and engagement options

2.3   VIL RESIDENTIAL

2.3.1   Overview

Surveys on 33 hh with a total of 54 people were filled. Note however, as not all the questions in the survey were answered by all, some of the statistics below do not add up to 33.

The vast majority of the hh have a single resident. The residents' ages ranges from 1-70.

No of people in hh	Frequency
1	20
2	8
3	3
4	1
5	1
Age	
Range	1-70
Average (stdv)	36.8(21)
Median	36.5

Table 5 VIL residential – occupancy

2.3.2   Occupancy pattern:

On weekdays, 16 hh are populated during the entire day, 12 hh are empty between 9:00-17:00, one hh is empty between 9:00 and 13:00, three hh are empty until 20:00. During weekends all the hh are populated.

2.3.3   Use of whitegoods and other appliances

33 hh have washing machines, which is commonly used two to three times a week. 14 hh have dryers, which are used two to three times a week or less. 13 hh have dishwashers, which are used every other day. All hh have refrigerators (one hh has 2). All hh have freezers (but most of them combined with the fridge).

The relatively low usage of wet appliances (washing machine, dryers and dishwasher) is likely linked to the high number of small hh (two or less people in hh).

31 hh have a microwave cooker and most use them daily. 29 hh have a coffee machine, used a few time a day. Five hh do not have a computer, three hh have 2 computers and one hh has 3 computers.

All hh have a TV set, 15 hh have one set, 14 hh have two sets, 4 hh have three sets. 23 hh have Hi-fi, media station or entertainment (DVD, etc.) system.

2.3.4   Thermal comfort

All hh have a heating system and none have a cooling system.
All hh have a thermostat to control indoor temperature, but 29 hh never use it.

On a scale ranging from '1' – never to '5' – very often: From the people who answered this questions – 5 never feel too cold in the winter, while the rest feel that their house is sometimes too cold in the winter: eight hh marked '2', 11 hh '3', one marked '4' and seven hh feel too cold in the winter very often (i.e. '5'). None of the participants marked 'never'.

Nine hh have never felt that their house is too hot in the summer ('1') , three hh marked '2', eight hh marked '3', three marked '4' (often) and four marked '5' (very often).

2.3.5   ToU

All hh are enrolled in ToU tariffs.

Perceived flexibility of appliance use:

Washing machine:

21 residents claim they cannot shift the time of use of their washing machine to low tariff because they mention it will make noise that disturbs them during the night, as well as the neighbours. Eight hh cannot shift the use for other reasons, for example, one hh does not use it at night due to the risk of fire, one hh operates the washing machine depending on needs. Three hh already operate the washing machine on low tariff hours. Four hh replied that they can shift the time of use.

Dishwasher

Three residents claim they cannot shift the time of use of their dishwasher to low tariff (some because they mention it will make noise that disturbs them during the night, as well as). Four hh already operate the dishwasher on low tariff hours. Five replied that they can shift the time of use.

Dryer

Eleven hh cannot shift the time of use of their dryers to low tariff, out of which, eight because they fear it will make noise that disturbs the neighbours, and one does not use it at night due to the risk of fire.

Electric oven
30 hh claimed they cannot shift their oven time of use, out of which 28 hh because the low tariff is not compatible with meal time, and 2 hh due to noise.

2.3.6   Motivation for saving energy
27 residents are interested in saving energy. Six are not interested.
The main motivation for saving energy is the combination of saving money and protecting the environment (18 residents) followed by saving money only (seven residents). One resident mentioned the environmental reason only.
16 residents think their hh can reduce its energy consumption, while 15 do not think they can.
19 residents think their hh already made behavioural changes to reduce energy consumption.
One resident replied that easily available information about the hh electricity consumption, as well as energy saving advice would help reduce energy. One resident replied that a better heating system will enable energy saving.

2.3.7   Communication
Overall, all hh have at least one kind of communication channels. 31 have mobile phones, 26 smart phones, 27 have computer and 32 have internet connections.

2.3.8   Engagement
Goal setting: 13 hh are interested or very interested in setting reasonable and achievable goals for consumption reduction, based on the information they provided, and with tailored advice. Eight hh are not interested or not at all interested. The rest are somewhat interested.
Alerts: 17 hh are interested and very interested in receiving alerts every time their energy consumption is higher than a threshold that they define, and with tips as to how they can reduce consumption. Seven hh are not interested at all in this option, and three are not interested. The rest are somewhat interested.
Comparison: Nine hh are interested in information about their consumption compared to similar households, out of which three are very interested and six are interested. 14 are not interested, out of which 12 are not interested at all, and two are not interested.
Frequency: 10 hh want this sort of information only once a month, 9 hh would like to have it once every two weeks, 10 once a week, and two are not interested. See tables below regarding the interest in various engagement options (note the small sample):

what degree you would be interested in the following (1 not at all-----5 very much)	Average	stdev	mode	median
Help you set **reasonable and achievable goals for consumption reduction**, based on the information you have provided above, and provide you with advice accordingly.	3.21	1.26	4	3
Send you **alerts** every time your energy consumption is **higher than a threshold** that you define, and provide tips as to how you can reduce consumption	3.35	1.55	5	4

Provide information about **your consumption compared to households similar to yours** (in terms of size, occupancy, weather etc.), and provide advice how to reduce your demand.	*2.58*	*1.42*	*1*	*3*

Table 6 VIL residential – interest in various interventions and engagement options

To what extent would you be interested in the following information (1 not at all--- 5 very much)	Average	stdev	mode	median
How much money you could have saved if you had switched off or replaced specific appliance?	3.61	1.41	5	4
How much energy was consumed by each room every day	2.06	1.29	1	1.5
How much energy was consumed by each room every week	2.83	1.62	2.5	1
How much energy was consumed by each room every week	2.95	1.51	4	3.5
How much emissions (carbon) you emit in a day/week?	2.43	1.45	1	2
How much money you spend on energy each day?	1.98	1.18	1	2
How much money you spend on energy each week?	2.80	1.70	1	2.75
How much money you spend on energy each month?	3.64	1.63	5	4

Table 7 VIL residential – interest in various interventions and engagement options

3   SUMMARY AND CONCLUSIONS

As presented above we had two samples of residential buildings, in which residents differ significantly on social, behavioural, and normative characteristics. We had one sample of non-residential/ public buildings are used for different purposes.

3.1   RESIDENTIAL SAMPLES

The residential sample in SON includes eight hh, all with at least two residents, and five with three residents or more. On VIL there are 33 hh, from which 20 have only one resident, and only five have three people of more. Only two hh in SON are populated during the whole day, compared to 16 hh in VIL.
Nearly all hh in both samples have washing machines and dishwashers, however, these are used less frequently in VIL due to the smaller hh and the lower demand for these energy services.

Overall, the thermal comfort of the residents in SON buildings is better compared to VIL. In both samples thermostats are installed to control the indoor temperature. However, in SON these are used to some extent, while in VIL they are rarely used at all. ***This means that increasing awareness to thermostats and improving residents understanding of how to use their thermostats could lead to a greater engagement and could be a promising strategy for delivering energy savings. Another approach with the same goal would be to complete the services for the thermostat to make it more useful and understandable.***

None of the SON hh are enrolled to ToU tariffs, due to lack of economic incentive to join such arrangement. In VIL all hh are enrolled to ToU tariffs. (this was actually a pre-setting done at the building commissioning, and none of the tenants changed it. Some of the tenants did not know about the possibility of the lowfare/high fare hours.

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 the neighbours. *Hence, it might be that installing noise reduction technologies (which are not expensive), will enable residents to shift their time of use to off peak hours and save money.*

The main motivation for energy saving in both samples 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. *It is therefore suggested that to increase the motivation for changing behaviour the messages and nudges sent to hh should highlight not only the selfish - economic benefits but also the altruistic -environmental benefits associated with the saving.*

In both SON and VIL most hh think they have already done some behavioural changes to save energy, and many think they cannot reduce their consumption further. *The KPI assessment should reveal if indeed the saving potential is already fulfilled, and if not – point at the existing potential.*

Communication with SON and VIL hh should not be a problem and could be done via at least one of the platforms – smartphone or computer. At the time of the survey there was only one hh in VIL which had only a mobile phone (not a smart phone).

Overall, hh in both SON and VIL are not so interested in engaging with their energy use too often, and prefer a once in a month reporting, rather than a daily or weekly engagement. *In selecting intervention and engagement strategies tailored for each hh, the frequency of messaging should be carefully considered, to prevent hh from feeling they are being annoyed and consequently withdrawing from the project.*

The most desirable intervention is information on how much money the hh spends on energy each month and how much money would have been saved if the hh had switched off or replaced a specific appliance. In addition, all hh prefer the least the option of comparison to others.

3.2   NON-RESIDENTIAL SAMPLE

The non-residential buildings sample is very diverse, with different type of usages, occupancy patterns and numbers along the day, week and year.
Only the guesthouses, conference building, kindergarten and family homes use wet appliances (washing machine, dryers, dishwasher), with a frequency ranging from once a week to three time a day on weekends. Guesthouses have 12 & 32 televisions.
No building is enrolled to ToU tariff.

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

Like in the residential samples, the motivations for saving energy are economic and environmental. *However, in the non-residential buildings, aside from the guesthouses and the family homes – the occupiers of the building*

do not benefit themselves from the money saved due to their behaviour change. Hence, it might be that messages highlighting the altruistic – environmental benefits would be more effective than utilitarian - economic ones.

Lack of time to deal with engagement and lack of easily available information were mentioned as a barriers for action. The InBetween app which will provide tailored and timely information as well as alerts could help overcome such barriers.

All means of communications are available to the occupiers of the buildings.
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 a once in a month reporting, rather than a daily or weekly engagement. *In selecting intervention type and engagement strategy for each occupier and building type the frequency of messaging should be carefully considered to prevent them from feeling they are being annoyed and withdrawing from the project.*