D3.11– LIST OF INTERVENTIONS AND THE ASSOCIATED DEMAND REDUCTION

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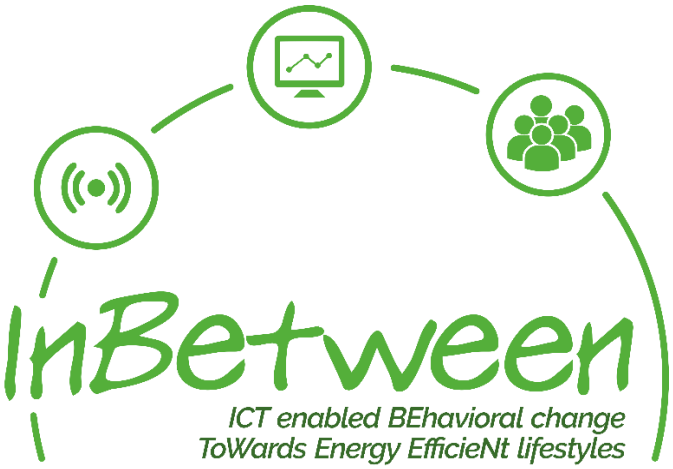

LEADER: IDC

DISSEMINATION LEVEL

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

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DISCLAIMER

The work presented in this document has been conducted in the context of the H2020 of the European community project InBetween (n° 768776). The partners in the project are: Rina Consulting S.p.A., Acciona Construcción S.A., AIT Austrian Institute of Technology Gmbh, Develco Products, The Interdisciplinary Center Herzliya, Institute Mihajlo Pupin, Vilogia S.A, Sonnenplatz Großschönau Gmbh. The content of this report does not reflect the official opinion of the European Union. Responsibility for the information and views expressed in the therein lies entirely with the author(s).

EXECUTIVE SUMMARY

The InBetween project applies a user-centric approach for bringing about energy savings from behavioral change. In this report we aim to evaluate the contribution to changes in consumption due to one specific type of intervention we apply: the notifications. The platform provides different types of notifications and advice, not all of them are related to energy saving (e.g., security, health). Users have the option to tailor the services the app and the web platform offer: to select the notifications they want to receive and to disable the ones which they find irrelevant or unhelpful. The notifications are central to the InBetween project as they provide tailored and 'in-time' recommendations to very specific actions, and thus, are likely to increase both the agency and capacity of the users and lead to energy saving. Do notifications trigger energy savings and lead to action? In this deliverable we present the methodology we apply to correlate between notifications and behavior (energy saving actions, as well as health and security-related actions).

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1 INTRODUCTION

The InBetween project applies a user-centric approach for bringing about energy savings from behavioral change. While D3.9 focuses on practices that changed due to the usage of the app, and the various interventions it offers, among them the energy management services, the benchmarking options and the general saving tips, in this report we aim to evaluate the contribution to changes in consumption due to one specific type of intervention we apply: the notifications.

Figure 1 provides an overview of the platform evaluation approaches and criteria we apply.

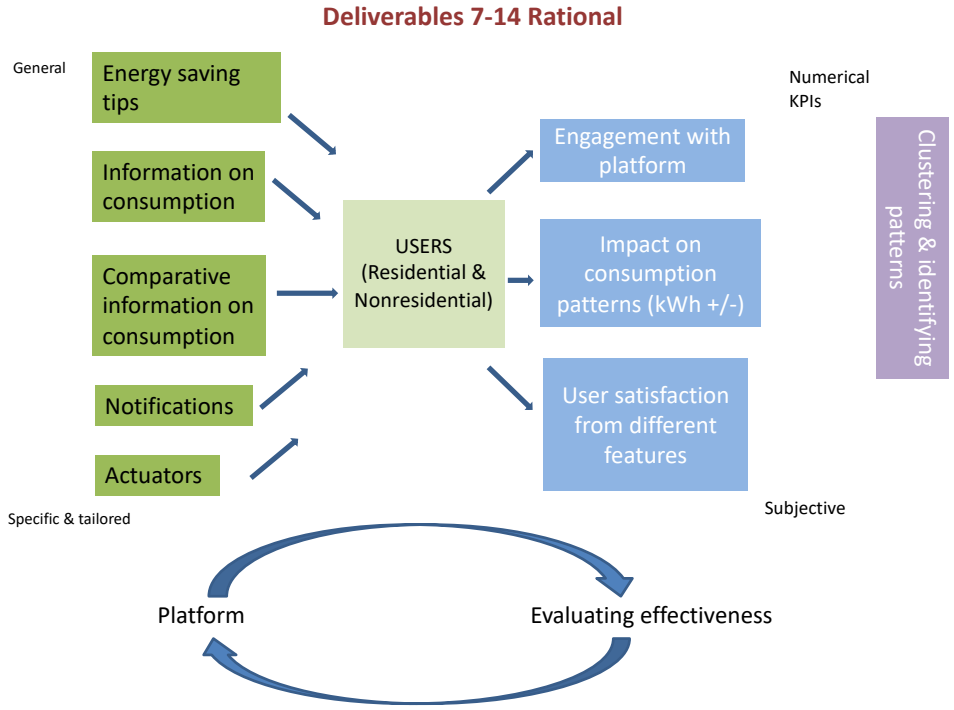

Figure 1: An overview of the user-centric approach

2 THE IMPACT OF NOTIFICATIONS ON ENERGY CONSUMPTION

2.1 OVERVIEW AND RATIONALE

InBetween applies a user-centric approach and allows users to manage their energy use and schedule the operation of selected appliances according to their own needs. The platform provides different types of notifications and advice, not all of them are related to energy saving (e.g., security, health). Users have the option to tailor the services the app offers: to select the notifications they want to receive and to disable the ones which they find irrelevant or unhelpful. The notifications are central to the InBetween project as they provide tailored and 'in-time' recommendations to very specific actions, and thus, are likely to increase both the agency and capacity of the users and lead to energy saving.

Do notifications trigger energy saving and lead to action? In this deliverable we present the methodology we apply to correlate between notifications and behavior (energy saving actions, as well as health and security-related actions).

To be able to correlate between notifications and actions, three conditions need to be fulfilled:

(1) users should receive notifications for at least one month. While users can take action from the first notification they receive, a period of one month is needed in order to examine whether their interest in receiving notifications and reacting to them do not erode over time.

(2) indications are needed regarding actions that took place (e.g., use of energy management option to turn off appliances, changes in consumption, change in temperature).

(3) feedback from users is required regarding the usefulness of the notification.

2.2 CHALLENGES

One challenge in associating notifications to actions is that sometimes a notification triggers an action, but the action itself takes place much later - one hour or even more. In addition, even if the action took place soon after the notification, we cannot always see an immediate change in consumption (or other measurements). We therefore need to decide:

(a) what is the length of time between notification and action in which we can relate the two?

(b) how to account for non-detectable actions?

Due to the delay in installations that, in turn, led to a delay in the use of the app, at the time we are preparing this report only two person that was interviewed received notifications. In addition, we have not yet implemented an option in the app for users to indicate whether they find the notification useful or not. Thus, in this report we present the methodology and part of the data on the notifications that were sent so far. In the coming months we will add the user feedback feature to the app. In the next deliverable (D3.12) we will present the full analysis.

Figure 2 presents an overview of the methodology for evaluation the effectiveness of notifications.

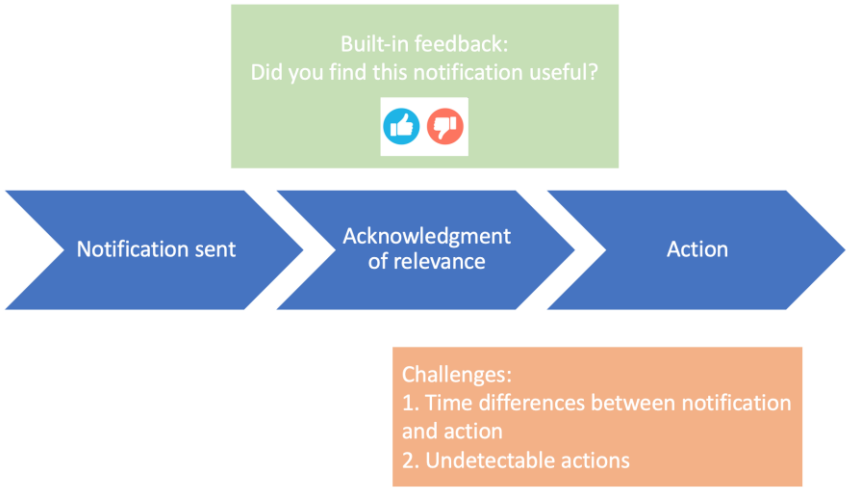

Figure 2: Evaluating the effectiveness of tailored notifications

3 THE NOTIFICATIONS

To avoid an overload of notifications that could annoy users, and to learn about the dynamics of consumption vis-à-vis the notifications that we can send, we decided that in the first round of the app release (two months), only a limited number of notifications would be sent, as described below. The types and frequencies will be re-evaluated later in the project. We also decided to use language and phrases which will not be perceived as too intimidating or invading users' privacy (i.e., the app as 'big brother'). See table 1 for details.

In addition, we applied the following general rule:

General rule: NO notifications between 22:00 – 08:00 (local time).

There are several types of triggering events causing different types of notification. Namely, these are *energy conservation events*, *security issue events* and *health issue events*. Also, the ECM supports any combination of them yielding complex events.

The ECM has been developed as a real-time service which is able to trigger *notifications*/alarms almost instantaneously when the triggering *event* happens. The triggering *event* is considered to be active when the specific logical *condition* is met (e.g. "window is open" AND "heater in that room is ON").

However, for the sake of filtering the potential noise in the data as well as to make the platform less sensitive for very short disturbances (e.g. someone opened a window to ventilate for a couple of minutes), the ECM introduced a *trigger timeout* which represents a time interval between the moment when a *condition* is met and a corresponding *event* is considered to be active. Once the *event* is active, a notification is being fired from the cloud platform towards both the mobile app (SEM) and the web app (WiTMo).

In case the *event* is active for a longer period, the ECM service will fire one or more notifications to make sure the end user is aware of the existing issue. However, in order to avoid over-disturbing end-users with notifications, the ECM is using a so called *notification timeout*, which represents a time interval between the two consecutive notifications when a corresponding *event* is active continuously.

Finally, both *trigger timeout* and the *notification timeout* are parameters related to each triggering *event/notification* type and can be adjusted according to the relevance of the *event* and individual end-user preferences.

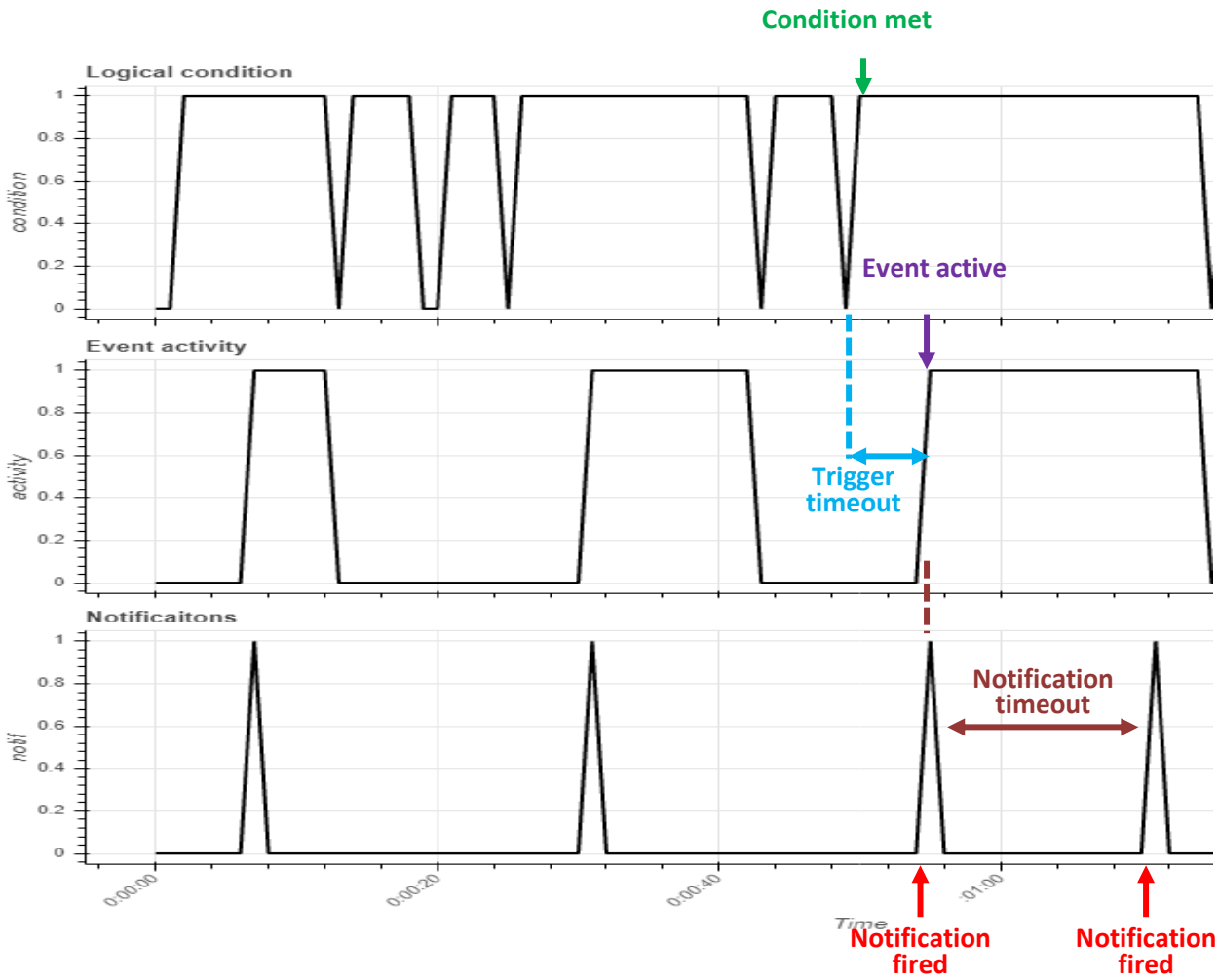

Figure 3: Working principle for the notification timing in the ECM

Legend for Notifications:

"Te" = *Timeout for event* (i.e. time delay for the first notification

"Tn" = *notification* (i.e. time delay for next notification(s)

"inf"= not limited

3.1 TYPE OF NOTIFICATION

The selected notifications (accompanied text presented below in Table 1):

Energy conservation notifications:

1. Heating is turned on while a window is opened within the same room;

Te = 10 mins, Tn = 10 hours

2. The temperature in a room is greater [25°C] than a predefined threshold while the heating is turned on;

3. The house is unoccupied while the heating is on. Te = 1 hour, Tn = inf

*after 1 month, and depending on data, we might reduce the threshold to 24°C.

Security issues:

4. The house is unoccupied while a window is open; Te = 1 hour, Tn = inf

Health issues:

5. Unhealthy air quality has been detected in a room with all the windows closed; Te = 1 min, Tn = 30 mins

6. Unhealthy air quality has been detected in a room with all the windows opened; Te = 1 min, Tn = 30 mins [This situation is unlikely]

*Depending on data, we might change the threshold to 'poor' quality.

Energy conservation and security issue:

7. The house is unoccupied while a window is open and the heating is turned on. Te = 1 hour, Tn = inf

Periodic report:

We also decided to send users a periodic report once every two weeks . Depending on data, the report will include information about: how many notifications were sent and the type of notifications / estimated savings (in terms of energy, money and carbon, if possible) sent to each user.

Not covered: For SON: notifications were not sent about estimated (not metered) PV generation and recommendations on consumption shift to align with production.

Table 1: The notifications and text

Title	**Body**
Energy Conservation Event	Windows are open while the heating is on. Room: %s Open windows: %s Running devices: %s
Severe Health Issue Alert	Unhealthy air quality has been detected with all windows closed! Consider ventilating if possible or vacating the premises temporarily. Room: %s
Energy Conservation Alert	Temperature in a room is over %s degrees while the heating is on. Consider turning the heating off. Room: %s Running devices: %s
Security Alert	Your home appears to be unoccupied while windows are open! Open windows: %s

Energy Conservation Alert	Your home appears to be unoccupied while the heating is on. Running devices: %s
Severe Health Issue Alert	Unhealthy air quality has been detected! Consider vacating the premises temporarily. Room: %s
Energy conservation and security alert	Your home is unoccupied while a window is open and the heating is turned on. Running devices: %s Open windows: %s

3.2 SENT NOTIFICATIONS: SUMMARY

Table 2 presents information of the type and frequency of notifications sent to each user in the indicated period of time.

Table 2: Notification list for the period November 18th 2019 until January 14th 2020

Id	Title	Body	Total count	Per user
2	Energy Conservation Event	Windows are open while the heating is on. Room: %s Open windows: %s Running devices: %s	39	vil136:2 vil150:5 vil214:1 vil255:14 vil319:4 vil421:6 sonb7:2 sonbd:5
7	Severe Health Issue Alert	Unhealthy air quality has been detected with all windows closed! Consider ventilating if possible or vacating the premises temporarily. Room: %s	697	vil136:13 vil150:6 vil255:11 vil591:1 vil882:6 sonb7:4 sonb13:32 sonbd:624
11	Energy Conservation Alert	Temperature in a room is over %s degrees while the heating is on. Consider turning the heating off. Room: %s Running devices: %s	470	vil150:141 vil319:258 vil421:15 vil591:2 vil882:54
13	Security Alert	Your home appears to be unoccupied while windows are open! Open windows: %s	30	vil150:1 vil255:13 vil421:1 vil882:1

				sonba:4 sonbe:10
14	Energy Conservation Alert	Your home appears to be unoccupied while the heating is on. Running devices: %s	708	vil117:44 vil136:49 vil150:43 vil214:73 vil255:63 vil319:117 vil421:52 vil527:57 vil552:10 vil591:70 vil741:2 vil882:56 sonb7:28 sonb13:19 sonbe:1 sonbd:24
18	Severe Health Issue Alert	Unhealthy air quality has been detected! Consider vacating the premises temporarily. Room: %s	43	sonbd:43
19	Energy conservation and security alert	Your home is unoccupied while a window is open and the heating is turned on. Running devices: %s Open windows: %s	65	vil136:1 vil255:45 vil319:1 vil421:2 vil552:1 vil882:1 sonbf:14

While many notifications were sent (the report indicates that some users received tens of them) in reality, due to technical reasons, the vast majority of users did not receive any notification so far. There are three main reasons for this: 1) some users do not have android phones and the web based platform has not been launched yet, 2) some android phone users have not yet installed the app even though they have been informed about its readiness and availability, and 3), the service was not launched in SON until beginning of January 2020.
Moreover, for the early installations done in VIL demo site, some motion sensors were not installed in the most appropriate way, inducing some mistaken interpretations (room detected as empty while it is occupied). The consequence is that some mistaken notifications are being sent to the concerned dwellings. This will be soon rectified.
Therefore, at this point in time, we are unable to evaluate the effectiveness of this service.

4 SECOND-STAGE IMPROVEMENTS

A set of improvements for the app have been reported below, and will be later on included in D3.12 (released in October 2020).

4.1 ENGAGEMENT MEASUREMENTS

In the near future we are planning to add to the app a built-in feedback feature, which will be sent periodically, and in which we will ask users “was this notification helpful”?.

We will use the ‘thumbs up’ and ‘thumbs down’ symbols for users to reply.

While this is not an accurate or very informative form of feedback, its simplicity increases the likelihood that users will cooperate and this will give us a ‘quick and dirty’ indication about the usefulness of the notifications to users. We will also be able to check that users actually receive notifications, and gather data on specific notifications that were disabled by users. This, together with further interviews and a workshop that will take place in May 2020, will give us a more comprehensive idea about the usefulness of the notifications as perceived by users themselves, and to further work on the correlation between notification and action.

In the next deliverable (D3.12) we will present the information and statistics from the built-in feedback, the disabled notifications and the insights from the workshop.

4.2 EVALUATING BEHAVIOURAL CHANGES DUE TO NOTIFICATIONS

In the next months, when more data is available, we will be able to examine whether we can detect changes in consumption (or any other parameter) after a notification is sent, and how soon after a notification was sent a change is detectable. For example, can we detect action or change in energy consumption after a notification about heater operating in an empty room?

In D3.12 we will present the relations (qualitative and quantitative) between the use of different features of the notifications and energy savings.

In addition, we will present information on energy savings against three benchmarks, and in association to the type and number of notifications that were sent to each user:

1. Previous year
2. Previous month
3. Changes in ranking compared to other users (benchmarking)

5 CONCLUSIONS

Overall, the platform is functioning well and notifications have been sent. Due to delay and technical reasons, users have only recently started to receive notifications.

In the next few of months we will add a built-in feedback feature allowing users to easily indicate if they find the specific notification useful. We will also have data about the actions that took place and measurements of energy saving. This, together with data from the workshop and interviews will allow us to associate notifications with actions.