# Adaptive incentives and context-aware triggering for personalized recommendations for energy consumption bahaviour

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## Introduction

The increase of customers becoming active in smart grids (e.g. prosumers) have forced the development of applications to support them to improve their energy management [1]. In this respect, the SIT4Energy project aims to develop end-user tools and recommendations for energy efficient actions to enabling them to realize energy saving potentials. However, motivating users to change their behaviour and persuade them to optimize energy requires understanding their motivations and interests to guide them trough behavioural change [2]. As part of the SIT4Energy project, we propose the development of the SIT4Energy adaptive context-aware triggering service to provide adequate recommendations to motivate users to improve their energy management. It focuses on two main users: for *consumers* to send them recommendations on how to save energy and for *prosumers* to send them recommendations on how to shift their energy consumption.

## Approach

The adaptive context-aware triggering service consisted on sending users personalized recommendations to persuade them to improve energy optimization. The service is composed by a core tip complemented with a personalized incentivisation messages according to some aspects based on behavioural change models, see Fig 1.

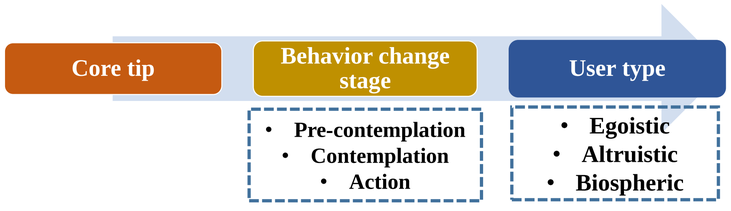


***Figure 1**: Adaptive incentivation service*

In order to provide the most appropriate recommendations, users are classified into behavioural change stage (pre-contemplation, contemplation and action), see Table 1 and user types (egoistic, altruistic and biospheric), see Table 2 based on behavioural change models. In this way, we can provide the so-called personalised recommendations.

| Behaviour change stage | Incentive mechanisms |
|---|---|
| **Pre-contemplation**<br>-unaware of the need to change<br>-no intention to change behaviour<br>-behaviour performed habitually | -Feedback mechanisms (comparison of energy consumption)<br>-Impact visualization showing possible negative impact |
| **Contemplation**<br>-people aware of the need for change and ready to act<br>-factual knowledge about energy saving | -Tips on how to save energy<br>-Goal setting to reduce energy consumption<br>-Keep comfort while saving energy |
| **Action**<br>-take first actions and require continuous reinforcements again slipping back | -Reminders and notification to reinforce positive behaviour |

***Table 1**: Socio-technical behavioural change process model for energy saving*

| Value Assumptions | Description |
|---|---|
| **Egoistic value orientation** | 1. Social Power: control over others, dominance<br>2. Wealth: material possessions, money<br>3. Authority: the right to lead or command<br>4. Influential: having an impact on people and events |
| **Altruistic value orientation** | 1. Equally: equal opportunity for all<br>2. A world at peace: free of war and conflict<br>3. Social justice: correcting injustice, care for the weak |
| **Biospheric value orientation** | 1. Preventing pollution: protecting natural resources<br>2. Respecting the earth: harmony with other species<br>3. Unity with nature: fitting into nature<br>4. Protecting the environment |

***Table 2**: Definition of environmental concerns*

In order identify the user type and the behavioural change stage, users answer initial questionnaires based on behavioural change stage models when they set up the app, see Figure 2.

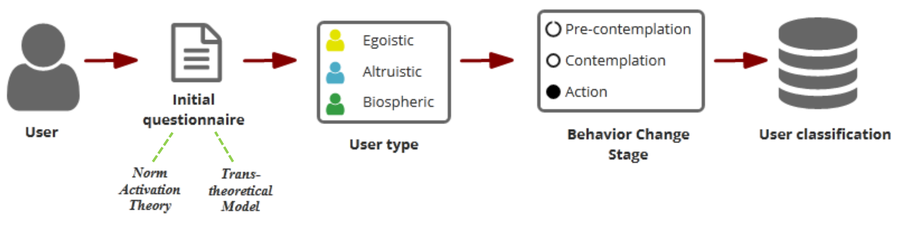


***Figure 2**: Process to classify users into behavioural change stage and user type*

## Adaptive context-aware design

Personalized recommendations are integrated by a core recommendation complemented by an incentive message. However, it is important to identify several aspects to select the most appropriate recommendation and send it to the user through the determined application (e.g. dashboard, mobile app), see Figure 3.

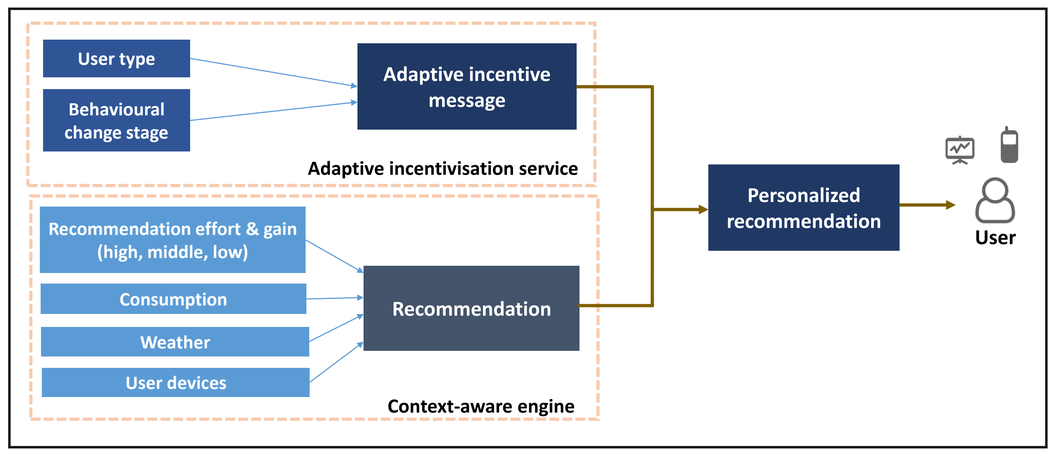


***Figure 3**: Adaptive context-aware triggering service design*

## Adaptive personalised recommendations

In order to manage recommendations, the service monitors information such as local weather forecast, user devices, etc., and based on set of conditions, the algorithm applies several rules to select the most appropriate core tip. Subsequently, it is complemented by the incentivisation message and it is sent to the user through the application. For example, to provide a recommendation for a user that is already interested in saving energy (*behavioural change stage: action*) and his/her main interest is to save money (*user type: egoistic*), the first step is identify the correspondent core tip (Figure 4a), then, to select the correspondent behaviour change stage (Figure 4b), then to select the user type (Figure 4c) and finally to identify the correspondent incentivisation message (Figure 4d). The final recommendation will be the following:

*"Continue saving energy and money! Turn off lights when you leave your working room or don't need them"*

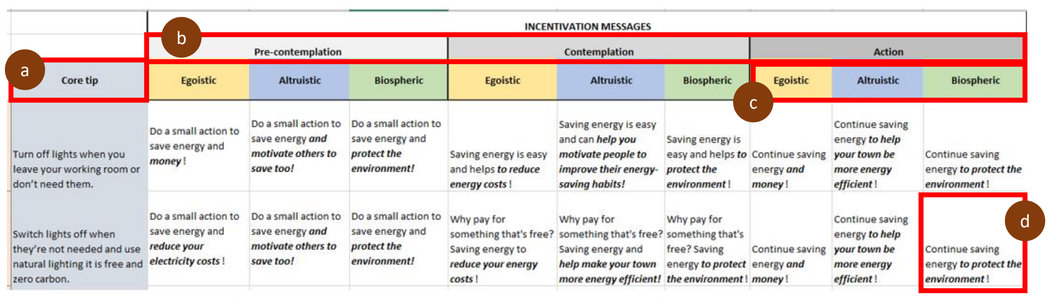


***Figure 4**: Process to integrate a recommendation message*

To keep providing personalized recommendations as the user progress on saving energy, the system apply several rules to consider several parameters, see Figure 5. Based on the results, it offers incentivisation messages based on the appropriate behaviour change stage. In this way, we expect to continue persuading users to keep saving energy.

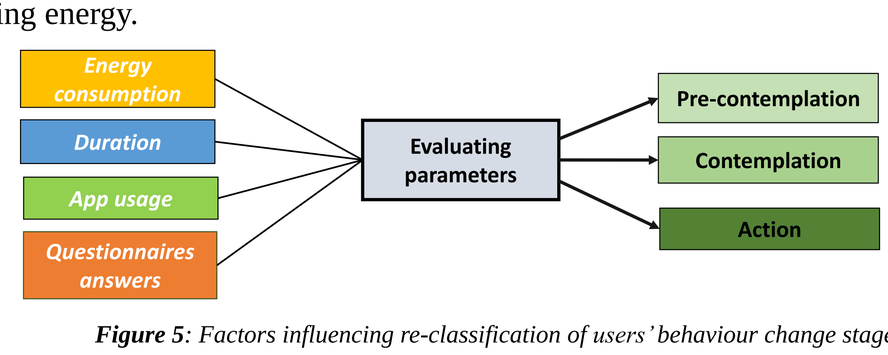


***Figure 5**: Factors influencing re-classification of users' behaviour change stage*

## References

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## Key facts

**Project Name:** Smart IT for Energy Efficiency & Integrated Demand Management
**Programme**: Greek-German Bilateral Research and Innovation Cooperation, 2016
**Scientific Coordinator**: Prof. Dr. Ing. Jasminko Novak (HOST)
**Consortium Coordinator:** Dr. Dimitros Tzovaras (CERTH)
**Consortium**: 4 partners from 2 countries
**Further Info**: https://sit4energy.eu

## The partners

HOST Hochschule Stralsund University of Applied Sciences
stadtwerk haßfurt
ITML
CERTH CENTRE FOR RESEARCH & TECHNOLOGY-HELLAS

## Funding agencies

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