NUDGE

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NUDging consumers towards enerGy Efficiency through behavioral science

H2020 EU Research Project

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NUDGE Introduction - Overview

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Introduction

- The holy grail of energy efficiency demands drastic changes in the energy-related behavior of consumers.
- It is critical to better understand all those factors that determine the consumers' behavior and the decisions they make about energy consumption matters.
- Since the 1970s, monetary or in-kind incentives (e.g. discount plans and bonuses) have been used as motivation for affecting consumption decisions.
- Recent studies have identified ways in which behavior can be affected without resorting to financial provisions or incentives of any kind.
- By far the most influential of these studies, the work of Richard Thaler and Cass Sunstein in 2008 introduced the notion of Nudging, as:

  “any aspect of the choice architecture that alters people’s behavior in a predictable way without forbidding any option or significantly changing their economic incentives”
Challenges and Aim

- In the energy domain, behavioral interventions have already been considered as a means to improve the energy-related behavior of end users.

- However, the potential of nudging techniques for energy efficiency has not yet been extensively investigated, mainly to the 5 following limitations that have been typically followed in the application of behavior interventions:
  - are not tailored to the specific psychological or contextual features of individual consumers
  - tend to be behaviorally informed rather than behaviorally tested through real trials
  - are not complemented or compared with traditional incentive schemes (e.g., discounts)
  - do not follow a solid methodology for statistically assessing the results out of trials
  - are not linked with policy making actions

- The NUDGE consortium has identified the aforementioned application gaps as an opportunity that defines the main project aim:

  NUDGE aspires to systematically assess and fully unleash the potential of behavioral interventions towards achieving higher energy efficiency, paving the way to the generalized use of such interventions as a worthy addition to the policy-making toolbox.
Objectives

OBJ1: Tailor the design of behavioral interventions to individual psychological and contextual variables, by leveraging digital platforms, energy data and data analytics.

OBJ2: Execute extensive field trials that address multiple instances of consumer behavior, implementing different mixes of behavior-based and traditional interventions.

OBJ3: Develop a systematic research protocol to continuously measure the impact of the implemented behavioral interventions.

OBJ4: Consolidate the findings of pilots into recommendations reaching out to policy makers and relevant stakeholders.
Consortium

The NUDGE consortium consists of a multidisciplinary team of 11 partners with different backgrounds and expertise, i.e. 4 R&D institutions, 2 policy experts, 1 energy supplier, 2 technology developer SMEs, 1 consumer association, 1 energy cooperative and 1 education expert, striking a good balance between expertise in the design of behavioral interventions and capacity to implement and operationalize these interventions.
WPs and leaders

Behavioral Science inspired approach

WP1: Consumer understanding and behavior analysis

WP2: Design and evaluation of nudging interventions

Pilot based testing and evaluation

WP3: Pilot Preparation and Monitoring

WP4: Implementing energy interventions through field trials

Policy recommendations and outreach

WP5: From pilot trials to policies: Deriving evidence-based policy recommendations

WP6: Dissemination Exploitation and Outreach

WP7: Project management

umec

domX

Fraunhofer

IEECP
Methodology (1/2)

- **Pre-pilot phase mechanisms and tools:**
  - Survey-driven user profiling: profile consumers taking into account a broad set of psychological and contextual variables
  - Design of pilot focused behavior-based and traditional interventions
  - Install energy monitoring and management tools (eg. smart meters, thermostats)
  - Employ digital user interfaces (eg. mobile applications, dashboards) to enable energy consumers to actively monitor and efficiently manage energy flows
  - Deploy a central pilot data platform to automate collection and monitoring of pilot data
Methodology (2/2)

- **Pilot phase mechanisms and tools:**
  - Randomized controlled trials (RCTs) including control-treatment groups
  - Time phasing of multiple interventions within and across pilots
    - Pre-interventions phase (M10-M14)
    - Testing phase (M15-M32)
    - Post-interventions phase (M33-M36)
  - Mixed approach combining surveys and field trials to assess the effectiveness of interventions
  - Automated monitoring of responses and adoption of tested interventions
  - Automatic calculation of pilot KPIs for performance comparison within a pilot and across pilots
  - Evaluation of behaviour change across tested interventions and consumer profiles
  - Design of stakeholder and user profile specific policy recommendations
Pilots

- Five heterogeneous pilots have been carefully planned to experiment with consumers:
  - in five different EU states (Greece, Belgium, Germany, Portugal and Croatia)
  - in different environments (residential, energy communities, schools)
  - belonging to different age groups (young children as well)
  - and income classes (low, medium, high)
  - being served by different energy carriers (electricity, natural gas)
  - including residential prosumers and EV drivers,
  on top of which we apply a broad set of behavioral interventions.

- Efficient control of heating and DHW preparation for Natural Gas boilers in Greece
- Interdisciplinary project-based education on home energy consumption for children in Belgium
- Optimization of EV charging with self-produced PV power in Germany
- Healthy homes for long-lasting energy efficiency behavior in Portugal
- Promoting distributed self-production for local Energy communities in Croatia
## Indicative nudges per pilot

<table>
<thead>
<tr>
<th>Efficient control of heating and DHW preparation for Natural Gas consuming boilers in Greece</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facilitating:</strong> Prompt users to change the default temperature setting of available heating schedules</td>
</tr>
<tr>
<td><strong>Deceive:</strong> Visualize the environmental consequences of non-efficient actions (e.g. overheating)</td>
</tr>
<tr>
<td><strong>Social Influence:</strong> Comparison with similar households in the same neighborhood, city, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interdisciplinary project-based education on home energy consumption for children in Belgium</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facilitating:</strong> Provide easy, understandable information on own household consumption</td>
</tr>
<tr>
<td><strong>Social Influence:</strong> Social comparison with households of classmates</td>
</tr>
<tr>
<td><strong>Confront:</strong> Define impact of a certain action in monetary or environmental measures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optimization of EV charging with self-produced PV power in Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facilitating:</strong> Suggest alternative periods for EV charging</td>
</tr>
<tr>
<td><strong>Reinforcement:</strong> Point out that EV charging is advised during periods of high PV production</td>
</tr>
<tr>
<td><strong>Reinforcement:</strong> Provoke feelings of environmental responsibility to drive efficient EV charging</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Healthy homes for long-lasting energy efficiency behavior in Portugal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social Influence:</strong> Prompt users to follow individual targets towards improving health conditions for their family</td>
</tr>
<tr>
<td><strong>Facilitating:</strong> Suggest alternative means for improving indoor environment conditions that take into account the impact on overall energy use (e.g. ventilation to reduce indoor pollutant concentrations when outdoor temperature/humidity conditions permit)</td>
</tr>
<tr>
<td><strong>Fear:</strong> Inform parents that prevailing outdoor air quality is not optimal for energy-efficient house ventilation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Promoting distributed self-production for local Energy communities in Croatia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social Influence:</strong> Social comparison with members of the cooperative</td>
</tr>
<tr>
<td><strong>Social Influence:</strong> Leverage commitment of individuals to common goals of the cooperative</td>
</tr>
<tr>
<td><strong>Social Influence:</strong> Invoke feelings of reciprocity by advising members to consume when PV energy is available</td>
</tr>
</tbody>
</table>
Expected Pilot impact

- Direct engagement of at least 450 households in the 5 countries (> 1000 consumers)
- At least 2 different interventions will be tested in each pilot. (> 10 in total)
- More than 200 public officers, private actors and other stakeholders engaged
- Energy savings and investments

<table>
<thead>
<tr>
<th>Pilot</th>
<th>Saving (%)</th>
<th>Final energy Savings in kWh/a</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE1</td>
<td>7.5% (525kWh/a)</td>
<td>525*100 households=52,500kWh/a</td>
<td></td>
</tr>
<tr>
<td>DE2</td>
<td>35% (2,450kWh/a)</td>
<td>2,450 * 50 households = 122,500 kWh/a</td>
<td>32,000 E*50 = 1,600,000 Euro</td>
</tr>
<tr>
<td>BE</td>
<td>5% (175kWh/a) electricity/ (750kWh/a) gas</td>
<td>(175 +750)* 50 households = 46,250 kWh/a</td>
<td>100E *50 = 5,000 Euro</td>
</tr>
<tr>
<td>PT</td>
<td>7% (257 kWh/a) el/ (55 kWh/a) gas</td>
<td>(257+55)* 100 households = 31,200 kWh/a</td>
<td>100E* 100= 10,000 Euro</td>
</tr>
<tr>
<td>GR</td>
<td>15% (1,350kWh) 5% (450kWh)</td>
<td>1,350<em>100 households +450</em>50 additional = 238,000 kWh/a</td>
<td>100 *150 Euro =15,000 Euro</td>
</tr>
<tr>
<td>HR</td>
<td>5% (150kWh)</td>
<td>150kWh *100 households = 15,000kWh/a</td>
<td>PV: 1,200 E/kWh<em>100</em>4= 480,000 Euro</td>
</tr>
<tr>
<td>Total</td>
<td>505,450kWh/a</td>
<td>2.11 m Euro</td>
<td></td>
</tr>
</tbody>
</table>
**Expected Replication potential**

- Replication potential expected to impact a total of 15,000 households
- Expected energy savings and investments

<table>
<thead>
<tr>
<th>Pilot</th>
<th>Potential replicants (households)</th>
<th>Estimated Energy savings (MWh/a)</th>
<th>Estimated Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>3,500</td>
<td>3,500*2,450kWh/a=8,575MWh/a</td>
<td>32,000E*3,500=112m E</td>
</tr>
<tr>
<td>BE</td>
<td>5,000</td>
<td>5,000*925kWh/a=4,625MWh/a</td>
<td>100E*5,000=0.5m E</td>
</tr>
<tr>
<td>PT</td>
<td>300</td>
<td>300*312kWh/a=93.6MWh/a</td>
<td>100E *300 = 0.03m E</td>
</tr>
<tr>
<td>GR</td>
<td>5,000</td>
<td>5,000*1,800kWh/a=9,000MWh/a</td>
<td>100E*5,000=0.5m E</td>
</tr>
<tr>
<td>HR</td>
<td>1,270</td>
<td>1,270*150kWh/a=190.5MWh/a</td>
<td>1,200E<em>4</em>1,270=6.09m E</td>
</tr>
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</table>
NUDGE Survey

- Help us to reach a broader audience for studying the **energy consumption within households and opinions on energy issues**:
  - [https://ghentunipss.eu.qualtrics.com/jfe/form/SV_0BNIaYZmySIeWRD?Q_Language=EN](https://ghentunipss.eu.qualtrics.com/jfe/form/SV_0BNIaYZmySIeWRD?Q_Language=EN)
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Thank you!

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