BEHAVIOURAL FACTORS’ INFLUENCE ON ENERGY SAVINGS

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PPEC-Demand-side Electricity Efficiency Plan

✓ Promoters (suppliers, network operators, consumer associations, energy agencies, etc.) submit initiatives to improve electricity efficiency in the industrial, commercial and residential sectors.

✓ The annual budget (11,5 Million Euros) of the program is supported by the regulated electricity tariff (regulated third-party access tariff).

✓ Energy efficiency measures, classified in tangible and intangible, are evaluated and ranked by merit order, based on a technical and economical analysis.
PPEC-Demand-side Electricity Efficiency Plan

- **Tangible measures:** installation of physical equipment with a level of efficiency superior to standard (e.g. compact fluorescent lamps or LED lamps).

- **Intangible measures:** dissemination of information or technical skills on energy efficiency practices in order to promote a change in consumer’s behaviours (e.g. energy audits).
Energy savings vs consumer’s behaviour

- Appliance’s energy efficiency
- Income and comfort level
- Consumer’s behaviour

A methodology for evaluating the impact of consumer’s behavioural factor on savings and the results in the ranking of energy efficiency measures promoted by PPEC has been developed.

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Energy savings vs consumer’s behaviour

If savings are very much dependent on behavioural aspect

Lower energy savings

A behavioural factor (BF) is used for each efficiency measure to characterize the likelihood of its energy savings (taking values from 0 to 1).

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Behavioural factors - Application model

✓ Behavioural factors were only applied to tangible efficiency measures.

✓ Behavioural Factors (BF)

**BF$_1$**: Are energy savings dependent on the consumer’s role in the installation and utilization of the equipment?

**BF$_2$**: What is the consumer’s share of the overall cost of the new equipment?

**BF$_3$**: Does the measure target consumer segments with special needs?
**Behavioural factors** - Application model

✓ $BF_1$

Behavioural factors would depend on the type of consumer (industrial, commercial or household).

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>$BF_1$ Household</th>
<th>$BF_1$ Services</th>
<th>$BF_1$ Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>$BF_{1A}$ - Do energy savings depend of the consumer installing the equipment?</td>
<td>No</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>0,9</td>
<td>0,95</td>
<td>0,975</td>
</tr>
<tr>
<td></td>
<td>Yes and other alternatives with low saving performance exist.</td>
<td>0,2</td>
<td>0,6</td>
<td>0,8</td>
</tr>
<tr>
<td>$BF_{1B}$ - Are the energy savings dependent on the consumer’s equipment utilization?</td>
<td>No</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>0,5</td>
<td>0,75</td>
<td>0,875</td>
</tr>
</tbody>
</table>
**Behavioural factors** - Application model

✓ **BF$_2$**

Share of consumer’s participation in the costs of the efficiency measure

\[
\text{Cons\_share} = \frac{\text{Cost paid by the consumer}}{\text{Total cost of the measure}}
\]

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>BF$_2$ Household</th>
<th>BF$_2$ Services</th>
<th>BF$_2$ Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10%</td>
<td>0,9</td>
<td>0,9</td>
<td>0,95</td>
<td></td>
</tr>
<tr>
<td>10-30%</td>
<td>0,95</td>
<td>0,95</td>
<td>0,95</td>
<td></td>
</tr>
<tr>
<td>30-100%</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

What is the share of consumer participation in the costs of the efficiency measure?

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**Behavioural factors** - Application model

![BF3](image)

This hypothesis is only addressing the household segment.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>BF3 Household</th>
<th>BF3 Services</th>
<th>BF3 Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the measure target economically fragile consumer groups?</td>
<td>Yes</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>0.95</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Behavioural factors - Application

✓ The behavioural factor model was applied to a set of energy efficiency measures that were submitted for approval in the PPEC for 2008.

✓ Technologies included in the case study: compact fluorescent lamps (CFL), LED lamps (LED), power strips (with a switcher), cooling (COOL), solar heating (SOLHEAT) and heating pump (HPUMP).
**Behavioural factors - Results**

CFL: compact fluorescent lamps
LED: LED lamps
POWERSTRIPS: plug with switch

SOLHEAT: solar heating
HPUMP: heating pump
COOL: cooling measures

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**Behavioural Factor application to energy efficiency measures**

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Behavourial factors - Results

- BF’s influence:

  - It can change the ranking position resulting from merit order.

  - The use of additional criteria for BF determination \((BF_2\) and \(BF_3\)) does not influence the relative ranking of different technologies (it differentiates measures within the same technology).

  - SOLHEAT and HPUMP measures raised their ranking position.

  - POWER STRIPS measures decreased notably their rank.
**Behavioural factors** – Results for CFL

- **CFL example**

  - The same technology
  - The BF depends on...
    - ... the way they are delivered to the public.
    - ... the consumer groups targeted.
    - ... the share of consumer participation in the cost of the lamps.
  - **CFL is a very cost-effective energy saving solution.**

Ranking of CFL measures considering the BF

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Behavioural factors – PPEC 2009-2010 cost-benefit ratio (CBR) results

CBR with and without the BF

CFL: compact fluorescent lamps
LMS: load management system
SOLHEAT: solar heating
TI: thermal insulation

DB: driving-belt
ESC: electronic speed controller
FREEZ: refrigeration
CA: compressed air
FLUOR: fluorescent lamps
REC: reactive energy compensation

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Conclusions (I)

✔ BF’s influence on the evaluation of the efficiency measures is such that it can change the merit order resulting from the ranking process.

✔ Changing the merit order of a measure can make the difference between achieving the financing approval or not.

✔ Applying BF’s brings the savings expectancy from the theoretical result to a more realistic approach, taking into account the design of the efficiency measures.

✔ When comparing different measures that target the same efficiency technology, the results of applying BF can be observed and can be more visible because the global evaluation of the measures is similar.
**Conclusions (II)**

<table>
<thead>
<tr>
<th>PPEC 2009-2010</th>
<th>Without BF</th>
<th>With BF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CBR</strong></td>
<td>10,65</td>
<td>9,01</td>
</tr>
<tr>
<td><strong>Total €/MWh avoided</strong>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>11,07</td>
<td>13,41</td>
</tr>
<tr>
<td>Commercial</td>
<td>12,00</td>
<td>13,45</td>
</tr>
<tr>
<td>Industry</td>
<td>3,58</td>
<td>3,80</td>
</tr>
</tbody>
</table>

* Total costs (promoter, consumer and PPEC costs) for MWh avoided.
Conclusions (II)

✓ Less optimistic results but more realistic results.

✓ Incentive to better design of next set of efficiency measures.

✓ Merit order more adherent to consumer perspective on the efficiency measures.

✓ The behavioural factor does not account for other behavioural aspects known in the energy efficiency theory: free-ridership, rebound effect, spill over effect.
Thanks for your attention!