Background

- Buildings account for 40% of Europe's total energy consumption and about 75% of buildings in EU MS are considered as insufficient in terms of energy efficiency (EC 2016)

- Supporting schemes in EE and RES in buildings in place.
  - (Ex ante) evaluation of the programmes in place usually (e.g. Sayeg P, Bray D. 2012, Carley S, Browne TR. 2013, Clinch JP, Healy JD. 2001, Karásek J, Pavlica J. 2016)

- However, detail and accuracy of the monitoring system of the programmes varies greatly

- ex post evaluations of the real outcomes are still inadequate (Le Den X 2016, Webber P, Gouldson A, Kerr N. 2015)
Motivation

• To evaluate the real outcomes of the energy efficiency and RES programmes
• To bring insight into the relation between expected and real emission savings.
  – Reasons behind the differences

• Based on ex post on-site inspections carried out within the programme
  – as a prerequisite by the buyers of AAUs.
Green Savings Programme overview

- Ran in 2009 – 2012, administered by the State Environmental Fund
- Total allocation CZK 20.29 billion
- Residential buildings – insulation, low-energy building construction, RES
- CO₂ reduction of 800,000 tons per year. In total, 73,916 applications were paid by the end of 2012.
Inspections

• 206 measures inspected in 124 objects
  – Focus on combinations of measures
• On site, the process of inspection went as follows:
  – Controlling of the project documents,
  – Determination of the real energy consumption before and after implementation of the measures,
  – Compliance check of the implemented measures to the project documentation, photo documentation,
  – Protocol on the inspection.
<table>
<thead>
<tr>
<th>Identification No of application</th>
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<tbody>
<tr>
<td>Applicant</td>
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<tr>
<td>Type of applicant</td>
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<td>Address</td>
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<td>Region</td>
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<tr>
<td>Type if building</td>
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<td>Code of EE measure</td>
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1. **Administration part of inspection**

Findings related to the administrative part of the project or related to the contractor.

Availability of the invoices for energy after implementation of EE measures:

2. **Physical part of inspection**

Findings related to the physical part of inspection:

Description of the figures included as an annex of the protocol:

3. **Results of inspection**

Overall evaluation:

Results of analysis; energy consumption evaluation of heating hot water preparation after implementation measures in case of energy invoices available:

Signature of head of inspection group

Energy expert signature

Applicant signature
Inspections, cont.
Inspections, cont.

• Evaluation of the data

  – Quantitative
    • the real ex-ante and ex-post energy consumption
    • compared with the calculated energy and CO$_2$ emission savings from the project documentation.

  – Qualitative
    • Semi-structured interviews with the applicants
    • about the process, initial expectations, duration of construction works, and overall satisfaction
    • explanations to the differences in real and expected savings
Results

Difference between expected and real CO$_2$ emission savings

![Bar chart showing the difference between expected and real CO$_2$ emission savings. The chart is divided into seven categories: Real savings > expected savings and Real savings < expected savings. The categories are: -100 to -61%, -60 to -41%, -40 to -21%, -20 to -1%, 0 to 20%, 21 to 40%, 41 to 60%, 61 to 80%, and 81 to 100%. The number of projects in each category is indicated by the height of the bars.](image-url)
Results, cont.

• Factors influencing the difference between expected and real outcomes
  – Methodical factors
    • Unavailability of invoices or low level of detail of the invoice
    • Wrong categorization of heat sources
    • Additional heat source - fireplace
    • Reference values
  – Behavioural factors
    • Usage of homes (temperature, heated area, life changes)
    • Number of occupants
Results, cont.

• Further aspects discovered during the inspections
  – overall satisfaction with the implementation of the measures (suppliers)
  – Quality and experience with low energy houses construction
  – Benefits: lower bills, higher comfort
  – Principal-agent problem
  – Additionality of the measures
Conclusions

• ex post evaluation should be a common part of the energy efficiency programme
  – To avoid deception
  – To provide data for learning

• rules or calculations taking into account behaviour of the building user should be set up
THANK YOU FOR YOUR ATTENTION.

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References