Presentation EEE 2021

The Federal Programme for Heating Systems Optimisation in Germany – Evaluation methods and intermediate results

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Arepo consult
Programme design and evaluation scope

- Duration: 2016-2021
- Target: replacement of inefficient heating and hot water circulation pumps and heating system optimisation
- Subsidies: 30% of net investment costs (max. €25,000/site)
- Eligible target groups: private building owners, organisations, municipalities and companies

Programme theory based formative and summative evaluation with regard to:
- Programme achievements
- Programme impact (Suitability, Causality, Unintended effects)
- Cost effectiveness
Programme Theory (simplified)

**Inputs**
- Passing of subsidy directive
- Provision of funding
- Setup of programme administration
- Own funds of target groups

**Activities**
- Development of programme website
- PR measures
- Processing grant applications

**Output**
- Programme use
- Number of hydraulic balancing
- Number of pump replacements
- Disbursed subsidies
- Craft services/investments

**Short term results (Outcome)**
- (More) energy efficient heating
- Energy savings in MWh

**Medium term results (Outcome)**
- Annual CO$_2$-Reduction in t

**Long term results (Impact)**
- More energy efficient building stock
- Reduced primary energy imports
- Pump market development
- Macro-economic impacts
Indicators and data sources

8 thematic clusters

- PR and awareness
- Number of registrations
- Target groups outreach
- Programme Impact
- Multiplier effect
- Economic effects
- Subsidy effectiveness
- Implementation efficiency

Data sources and analyses

- Literature review
- Surveys with users and registered non-users
- Stakeholder interviews
- Programme statistics
- Focus groups
- Market analysis
Programme development

Number of registrations / applications over time (until June 2019)
Main target group (private building owners) well reached

Non-proportional distribution of approved applications and subsidies
Methodology
Calculation of energy / emission savings

Bottom-up calculation of CO₂ reduction

per pump replacement

\[ CR_p = [(1 - \alpha) \times n_p \times ES_{pM}] + [\alpha \times n_p \times ES_p] \times EF_S \]

Whereas

- **CRₚ**: CO₂ reduction through pump replacement
- **nₚ**: Number of annually promoted pumps
- **α**: Share of induced pump replacements in all promoted pumps
- **ESₚM**: Average electricity savings per pump replacement compared to MEPS
- **ESₚ**: Average electricity savings per pump replacement compared to stock
- **EFₜ**: Emission factor electricity (g CO₂ / kWh)

per hydraulic balancing

\[ CR_{HA} = \beta \times n_{HA} \times ES_{HA} \times \Phi F \times EF_W \]

Whereas

- **CRₜₐ**: CO₂ reduction through hydraulic balancing
- **nₜₐ**: Number of annually promoted hydraulic balancing
- **β**: Causality of the programme (in % of all promoted hydraulic balancing)
- **ESₜₐ**: Average heat energy savings per hydraulic balancing (in kWh/m²/a)
- **ØF**: Average heated floor space (in m²)
- **EFₜ**: Emission factor of Ø heating energy mix (g CO₂ / kWh)
Based on user survey (n = 13,911)
Differentiated for pump replacement and hydraulic balancing

Would you also have implemented the measure(s) without the subsidy?

- Total number of responses
  - „Yes, i would have implemented the measure exactly the same.“
  - „Yes, but at a later point.“
  - „Yes, but only a part of the measures.“
  - „No."

Free rider effect
Programme impact (anticipatory effect)
Free rider effect
Programme impact
Programme impact

Significant but expected free rider effect with causality factors of $\alpha = 0.4$ (pumps) and $\beta = 0.52$ (hydraulic balancing)
Programme results

Energy savings

<table>
<thead>
<tr>
<th></th>
<th>Gross 2nd half 2016</th>
<th>Gross 1st half 2017</th>
<th>Gross 2nd half 2017</th>
<th>Gross 1st half 2018</th>
<th>Gross 2nd half 2018</th>
<th>Gross 1st half 2019</th>
<th>Gross Total</th>
<th>Net Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat energy savings</td>
<td>11.13</td>
<td>5.79</td>
<td>26.57</td>
<td>13.82</td>
<td>37.21</td>
<td>19.35</td>
<td>30.02</td>
<td>15.61</td>
</tr>
<tr>
<td>Electricity savings</td>
<td>10.43</td>
<td>4.46</td>
<td>26.17</td>
<td>11.19</td>
<td>27.09</td>
<td>11.61</td>
<td>24.29</td>
<td>22.01</td>
</tr>
</tbody>
</table>

Heat energy savings and Electricity savings in GWh/a
Programme results
Emission savings

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>CO₂ emission reduction (t CO₂ p.a.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Pumps</td>
<td>34,191</td>
<td>248,478</td>
</tr>
<tr>
<td>Big Pumps</td>
<td>810,447</td>
<td>299,655</td>
</tr>
<tr>
<td>Hydraulic balancing</td>
<td>50,367</td>
<td>57,378</td>
</tr>
<tr>
<td>Total</td>
<td>300,218</td>
<td>57,378</td>
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Small pumps: Glandless circulation pumps & warm water circulation pumps
Big pumps: Dry running circulation pumps
## Programme results
### Cost effectiveness: 5 indicators

<table>
<thead>
<tr>
<th>#</th>
<th>Indicator</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Programme administration costs to assess the implementation efficiency</td>
<td>Share of admin costs in total budget 10.58%</td>
</tr>
<tr>
<td>2</td>
<td>Programme induced investments / demand effect</td>
<td>Total gross investments: 308,911,787 €</td>
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<tr>
<td></td>
<td></td>
<td>• induced investments of 108,184,168 €</td>
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<tr>
<td></td>
<td></td>
<td>• free rider 160,942,049 € and</td>
</tr>
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<td>• VAT payments of 39,785,570 €</td>
</tr>
<tr>
<td>3</td>
<td>Cost effectiveness from the perspective of programme beneficiaries</td>
<td>Pumps: most cost-effective w/o subsidies; Hydraulic balancing: only cost-effective w/ subsidies</td>
</tr>
<tr>
<td>4</td>
<td>Cost-effectiveness from a societal perspective</td>
<td>Benefit-cost-ratio: 1.5 to almost 3 (depending on scenario)</td>
</tr>
<tr>
<td>5</td>
<td>Subsidy effectiveness in terms of programme costs compared to energy savings and CO2 emissions reductions</td>
<td>37.29 euro / t CO₂ (gross) and 87.69 euro / t CO₂ (net); leverage effect: 3</td>
</tr>
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*Wuppertal Institut*
Conclusions & preliminary recommendations

- HZO Programme cost-effective and worthwhile for both end-users and the economy as a whole
- Unbalanced distribution of subsidies across target groups and regions
- Utilisation limited by several factors (capacity constraints in the HVAC sector, assumed bureaucracy of application process and lack of overview of energy efficiency promotion programmes)

Preliminary recommendations:
- Explicit target group-specific communication strategy
- Training and further education for the HVAC workforce on technical and subsidy-related questions
- Merging with other promotion programmes (KfW)
Thank you for your attention

Questions?