annex42: Heat pumps and smart grids

IEA Symposium on Demand Flexibility and RES Integration
Content

1. Structure and approach
2. Findings so far
3. The road ahead
4. Challenges
5. Questions

So much to tell and only 15 min...
The presentation will be available on www.annex42.com!
1 Structure and approach – Why this annex?

Largely installed heat pump systems oppose both opportunity and threat for the grid:
1) A heat pump can shift electrical power to heat
2) It will be the largest electricity consumer in the house
3) It can ramp up in minutes and postpone for day’s with thermal storage
4) It’s predictable in demand for day ahead

Annex42 will come with rules, guidelines and best practices for smart heat pumps
1 Structure and approach - Participants

All research institutes
No market parties?

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1 Structure and approach – Tasks

Try to find answers to big questions:
Task 1:
What kind of grid problem is your country facing, how big and how urgent is it?
What is the potential for heat pumps in the domestic market?

Task 2:
Design four case scenario’s for your country
   Building type/ heat pump type/ thermal storage / control

Task 3:
How much of the problem can you solve with case scenario 1, 2, 3, or 4?
   What is the potential flexibility heat pumps can offer?
What is the price to pay for this solution(s)?
   Efficiency loss; size of the buffer; investments; comfort; infrastructure etc.

Task 4:
What’s the road ahead? What are the foreseen implementation barriers?

Task 5:
How can we let the world know we are working on this?
### 2 Findings so far – Benchmark for flexibility

<table>
<thead>
<tr>
<th>Differentiator</th>
<th>Benchmark position: What characteristics would maximise flexibility?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Drivers for HP in smart grid / flexibility</td>
<td>The country faces an immediate challenge to which flexibility offers a solution (therefore policy &amp; industry driven to stronger action)</td>
</tr>
<tr>
<td>2. Potential size of flexible HP resource</td>
<td>Large HP market / high growth&lt;br&gt;Hydronic HP &amp; underfloor heating&lt;br&gt;Commonly use storage</td>
</tr>
<tr>
<td>3. Building characteristics – impact on flexibility</td>
<td>New buildings, well insulated&lt;br&gt;Lots of space (i.e. for storage)</td>
</tr>
<tr>
<td>4. Energy prices / structures / tariffs – impact on flexibility</td>
<td>Low elec price, high gas/other fuel prices encourage HP market growth&lt;br&gt;Flexible tariffs an enabler for HP flexibility</td>
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<tr>
<td>5. End-users – impact on flexibility</td>
<td>Constant heat need (not bursts of heat)&lt;br&gt;High level of experience to know how best to engage customers&lt;br&gt;High proportion owned properties (more control over choice of system)</td>
</tr>
</tbody>
</table>
2 Findings so far – Flexibility ‘score’

<table>
<thead>
<tr>
<th>Differentiator</th>
<th>UK</th>
<th>DE</th>
<th>FR</th>
<th>NL</th>
<th>KR</th>
<th>US</th>
<th>CH</th>
<th>DK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall score</td>
<td>![Yellow]</td>
<td>![Yellow]</td>
<td>![Yellow]</td>
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2 Findings so far – How to create flexibility

Building type, heat pump type and storage size create more or less flexibility potential

But..

Different signals and levels of control will have large impact on unlocking it!

Demand response signals to heat pumps

- Electricity price signals – NL, FR, KR;
- Availability of renewable generation – FR, DE, UK;
- High demand period anticipated; heat pump to reduce power draw (turn off, reduce speed, etc.) – US, UK, CH;
- Ancillary grid services (frequency and/or voltage level) control – US
- Continuous, “one-way” live signal to heat pump from aggregator
- Two-way communications - AT (for one scenario), US
3 The road ahead

1. Calculations and simulations are currently being executed, results expected in the end of 2016
   • What is the flexibility that can be offered in typical situations? (the case scenario’s)

2. Defining the roadmap for smart heat pumps
   • Identifying implementation barriers
   • Finding possible solutions to overcome them
4 Challenges – Conflict on interests

Customer needs
Heat Pump which maximise end-user comfort and experience (i.e. requires ‘non-smart’, optimal operation of the heat pump)

Utility needs
Heat Pump which maximises demand-side flexibility (i.e. can be switched off for relatively long periods of time – which is non-optimal operation)

Smart Heat Pump requirements
Heat Pump which minimises the impact of a heat pump shutdown on the end-user comfort (e.g. intelligent use of storage to ‘de-couple’ the HP operating pattern from the heat demand patterns of the home) and/or enhances the end-user experience (e.g. enable customer financial benefits)

(taken from smart ready heat pumps in UK task 1)
4 Challenges – The progress of other research area’s

PCM

< VERSUS >

WATER BUFFER 300 LITER

Annex 42 meeting 18/19 June 2015 London

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4 Challenges – The world is moving fast!

Home battery systems from a complete other market:

- Tesla;
- Mercedes-Benz;
- Toyota?
- Volkswagen?

High capital
Can mass produce
And react fast
The largest flexibility trader owns no grid?
→ That’s should terrify utilities!
“A severe constraint on the development of a Smart Grid is the lack of integration and interoperability of devices, data, and applications.”

Steven Collier Chairman, IEEE Smart Grid Education Committee Director, Smart Grid Strategies, Milsoft Utility Solutions
4 Challenges – The world is moving fast, but the smart grid world is still in chaos

- On/off
- Forced ‘on’
- Forced ‘off’
- Normal operation based on heating demand

That is not really ready!

- No price signals
- Concerned Grid operators
- Inflexible electricity price
- Unknown benefit
- No governmental action
Thank you for your attention!

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