Energy storage and smart heat pumps in (smart) grids

A project idea developed by:
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Stephan Renz (Chair HPT)
Peter Wagener (Operating Agent Annex)
Agenda for today

• Introduction Peter Wagener & BDH
• Brief introduction project idea;
• Energy storage in a changing energy system: Storage & Heat Pumps in a smart grid;
• Steps to start a new combined Annex.
Business Development Holland b.v.
Introduction
BDH

Renewable energy in domestic housing, smart grids and heat pumps

‘Strategic thinking, pragmatic doing’

Knowledge development and advanced online tooling
What does BDH?

‘We are strategy- and process consultants in renewable energy in domestic housing, smart grids and heat pumps. We help our customers to bring abstract strategies into practical results’

**ScenarioTool.nl:**
Herewith scenario’s on street, urban area, town, province can be made within matter of hours, i.s.o. weeks

**Warmtepompplein.nl:**
The independent information portal for end consumers for heat pumps in NL.

**Warmtepompstrategie.nl:**
Knowledge on heat pumps, based on a ‘knowledge menu’ approach. From brainstorm upto strategic approach, for economics, technology application and emissions effects.

**Annex 42 & 45 International Energy Agency:**
International knowledge dissemination on (hybrid) heat pumps and heat pumps in smart grids in domestic housing.

**Dutch Heat Pump Association:**
Industry organization for heat pumps for domestic and commercial application. BDH facilitates chairmanship and project management.
The idea behind an combined Annex
Energy in the old days

Fossil generated electricity

Natural gas powered heating

Diesel/petrol fueled mobility
Where we are heading for...

Electricity from renewable source

Heat pumps

Energy storage electricity, heat, power2gas, power2heat

Electric mobility
Generation, consumption and storage of energy get integrated

Fossil generated electricity

Energy storage: electricity, heat, power2gas

Electricity from renewable source

Smart heat pumps

Electric mobility

Natural gas powered heating

Diesel/petrol fueled mobility
Domestic energy consumption Netherlands 2016

Natural gas (heating & DHW)

11 billion m$^3$ gas
= 400 PJ energetic value
= 110 TWH$_{th}$
= 80 TWH$_{th}$ primary demand at SCOP = 3.5 of heat pump
= approx. 23 TWh$_{elec}$

Electrical power (Domestic)

3.500 KwH/house
x 7.5 million houses
= approx. 26 TWH$_{elec}$

END USERS IN DOMESTIC HOUSING, COMMERCIAL BUILDINGS AND INDUSTRY
Urban energy system based on 100% renewable energy

Source: Fraunhofer ISE
Urban energy system based on 100% renewable energy

Where does the combined Annex come in?
New integral solutions required

Heat battery = Electrical heat pump + (TCM) storage
Combined Annex from

IEA TCP ECES ‘Energy storage’
and
IEA TCP HPT ‘Smart heat pumps’
Even partly electrification requires storage, thermal and electrical, to manage this challenge.
Now items and issues are scattered and not connected.
Loose items and issues to be connected

- Heat Pump Manufacturer
- Storage Electrical
- Storage Thermal
- EV Vehicle 2Grid
- Monitoring
- Aggregator
- End Consumer
- Control Options
- Government
- DSO
- Power Supplier
Which problem will we solve?
Even more, which opportunity do we offer?

• Developing and exchanging knowledge to:
  – Handle (intermittent) renewable power supply and renewable heat supply, to manage increasing asynchronous demand for power and heat.
  – Increase use of renewable power and heat, in domestic housing and on urban area level, to reduce CO₂ emissions.

• Concrete:
  – Facilitate energy grid stability;
  – Optimize renewable energy production to match specific demand;
  – Create flexibility in energy form (i.e. electricity vs gas or heat and cold, DSM etc).
Which problem will we solve?
E.g. which opportunity do we offer? (2)

- Energy storage and heat pumps creates efficiency and flexibility in the overall energy system;
- New integral solutions are required to match the variable renewable production and load;
- Heat Pumps + Storage + Smart Grids
  >> Smart Energy system will provide possible solutions for an ‘increasing problem’
- Example: ‘Sun, wind, heat pumps’ initiative in NL, this NEEDS this knowledge of probable solutions
Program for 2 TCP’s combined in 1 Annex could be:

1. Charting the waters:
   1. Existing projects and programs;
   2. How can we connect the 2 TCP’s into 1 solid project frame.
2. What kind of new projects do we need?
3. Start needed projects as much as feasible;
4. Modelling and simulation of configurations;
5. Connectivity and monitoring;
6. Communications & dissemination.
Probable deliverables

- Overview of running projects and developments;
- Reference guide for storage/hp solutions;
- Models for estimating flexibility results;
- Component and system modelling;
- Comparison of storage & heat pumps with other technologies in terms of their energetic and economic performance;
- Performance evaluation and quality assessment;
- Proposal on technical procedures to be included in future standards for determination of the performance of storage combined with heat pumps;
- Regulatory recommendations;
- Website, workshops, newsletter articles, publications, ppt’s on congresses, etc. etc.
Innovation focus of the Annex on:

– Technological and economic requirements:
  • Compact and robust;
  • Safe, durable, affordable and reliable;
  • Integral part of the system

– Economic-regulatory:
  • market access;
  • market design;
  • security of investments;
  • regulatory hurdles.
Perspective on this Annex idea within ECES

1. Increasing Storage Density
   - PCM and TCM storage for urban area
   - Small scale pure electrical storages
   - PCM with seasonal storage for peak shaving

2. Sensible Thermal Storage
   - Pumped Thermal Energy Storage (PTES)
   - Underground Thermal Energy Storage (UTES)
   - High temperature UTES for industrial waste heat

3. Hybrid Energy Storage Options
   - Power to heat
   - Power to gas

Scope essentials
### Potential participating countries in combined Annex

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<tr>
<th>COUNTRY</th>
<th>Membership TCP</th>
<th>Interest in combined Annex?</th>
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Table updated after both ExCo meetings May 2017
Next steps...

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- ✔ Gauge interest during ExCo meetings ECES and HPT;
- • Gauge interest potential participants ECES and
- • Draft 1st version of project outline;
- • Organisational set up / reporting structure;
- • Comments and feedback step;
- • Draft 1st version of Legal Text;
- • Organize meeting central in Europe (Freiburg) to discuss;
- • Project budget and financing (Task sharing ECES vs cost sharing HPT)
- • Finalize Legal Text;
- • Meeting to approve Legal Text and formal participation;
- • Provide both ExCo’s with concrete request for approval;
- • Projected start of Annex (1st project meeting Fall 2018)
Thank you for your attention.

Energy storage and smart heat pumps combine essential technologies. Let’s make it work together!

Thank you for your attention.