Department of Energy & Climate Change

# GSHPA Technical Seminar: IEA Heat Pump Programme

26th November 2014

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Science & Innovation

# Introduction

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# Introduction

## What is the Heat Pump Programme

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## IEA Implementing Agreement on Heat Pumping Technologies

- VISION: The Programme is the foremost worldwide source of independent information and expertise on environmental and energy conservation benefits of heat pumping technologies (including refrigeration and air-conditioning). The Programme conducts high value international collaborative activities to improve energy efficiency and minimise adverse environmental impact.

- MISSION: **The Programme strives to achieve widespread deployment of appropriate high quality heat pumping technologies** to obtain energy conservation and environmental benefits from these technologies. It serves policy makers, national and international energy and environmental agencies, utilities, manufacturers, designers and researchers.

**Signatories** : Austria | Canada | Denmark | Finland | France | Germany | Japan | Korea, Republic of | Netherlands | Norway | Sweden | Sweden | Switzerland | United Kingdom | United States |

For more information: http://www.heatpumpcentre.org

# Introduction

## What does the Heat Pump Programme do?

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## 3 Key products

**Research Annexes –** Typically task shared, participants provide own funding/research. One country appoints an operating agent to manage the project. 44 Annexes to date, 10 currently active, 3 open for new participants.

**Conference -** Every three years the IEA Heat Pump Programme stages the international IEA Heat Pump Conference. “Global Advances in Heat Pump Technology, Applications and Market” was the theme for the 11th IEA Heat Pump Conference held in Montreal

**Newsletter -** The IEA HPC Newsletter is a quarterly newsletter/journal. The aim with the newsletter is to present heat pump technology, markets and market development, and information from annexes in the Programme.

# Research Annexes

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| | |
|---|---|
| Annex 44 | Performance indicators for energy efficient supermarket buildings pumps |
| **Annex 43** | **Fuel-driven sorption heat pumps** |
| **Annex 42** | **Heat Pumps in Smart grids** |
| Annex 41 | Cold Climate Heat Pumps (Improving low ambient temperature performance of Air-Source Heat Pumps) |
| Annex 40 | Heat pump concepts for near zero-energy buildings |
| Annex 39 | A common method for testing and rating of residential HP and AC annual/seasonal performance |
| **Annex 38** | **Systems using solar thermal energy in combination with heat pumps** |
| **Annex 37** | **Demonstration of field measurements on heat pump systems in buildings - Good examples with modern technology** |
| **Annex 36** | **Quality installation and maintenance** |
| Annex 35 | Application of Industrial Heat Pumps |
| Annex 34 | **Thermally Driven Heat Pumps for Heating and Cooling** |
| Annex 33 | **Compact Heat Exchangers in Heat Pumping Equipment** |
| Annex 32 | Economical Heating and Cooling Systems for Low Energy Houses |
| Annex 31 | **Advanced Modeling and Tools for Analysis of Energy Use in Supermarkets** |
| Annex 30 | Retrofit Heat Pumps for Buildings |
| Annex 29 | Ground-Source Heat Pumps Overcoming Market and Technical Barriers |
| Annex 28 | Test Procedure and Seasonal Performance Calculations for Residential Heat Pumps with Combined Space and Domestic Hot Water Heating |
| **Annex 27** | **Selected Issues on CO2 as Working Fluid in Compression Systems** |
| **Annex 26** | **Advanced Supermarket Refrigeration/Heat Recovery Systems** |
| Annex 25 | Year-Round Residential Space Conditioning Systems using Heat Pumps |

| | |
|---|---|
| **Annex 24** | **Absorption Machines for Heating and Cooling in Future Energy Systems** |
| Annex 23 | Heat Pump Systems for Single-Room Applications |
| **Annex 22** | **Compression Systems with Natural Working Fluids** |
| **Annex 21** | **Global Environmental Benefits of Industrial Heat Pumps** |
| Annex 20 | Working Fluid Safety |
| Annex 19 | Cancelled |
| **Annex 18** | **Thermophysical Properties of Environmentally Acceptable Refrigerants** |
| Annex 17 | Experiences with New Refrigerants in Evaporators |
| **Annex 16** | **IEA Heat Pump Centre** |
| Annex 15 | Heat Pump Systems with Direct Expansion Ground Coils |
| Annex 14 | Working Fluids and Transport Phenomena in Advanced Absorption Heat Pumps |
| Annex 13 | State and Transport Properties of High Temperature Working Fluids and Non-Azeotropic Mixtures |
| Annex 12 | Modelling Techniques for Simulation and Design of Compression Heat Pumps |
| Annex 11 | Stirling Engine Technology for Application in Buildings |
| Annex 10 | Technical and Market Analysis of Advanced Heat Pumps |
| Annex 9 | High-Temperature Industrial Heat Pumps |
| Annex 8 | Advanced In-Ground Heat Exchange Technology for Heat Pump Systems |
| Annex 7 | New Development of the Evaporator Part of Heat Pump Systems |
| Annex 6 | Study of Working Fluid Mixtures and High-Temperature Working Fluids for Compressor-Driven Systems |
| Annex 5 | Integration of Large Heat Pumps into District Heating and Large Housing Blocks |
| Annex 4 | IEA Heat Pump Centre |
| Annex 3 | Heat Pump Systems Applied in Industry |
| Annex 2 | Vertical Earth Heat Pump Systems |
| **Annex 1** | **Common Study of Advanced Heat Pumps** |

# Introduction

## Current IEA research annexes

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| Annex number | Title | Participating countries |
|---|---|---|
| 44 | Performance indicators for energy efficient supermarket buildings pumps | ***Netherlands,*** *Norway, Sweden. Open for new participants.* |
| 43 | **Fuel-driven sorption heat pumps** | ***Germany*** *, UK, France, Italy, S. Korea, USA. Open for new participants.* |
| 42 | **Heat Pumps in Smart grids** | ***Netherlands****, UK, Finland, Germany, South Korea, France, Denmark, Switzerland and US. Open for new participants.* |
| 41 | Cold Climate Heat Pumps (Improving low ambient temperature performance of Air-Source Heat Pumps) | ***US,*** *Austria and Japan. The Annex is still open for new participants.* |
| 40 | Heat pump concepts for near zero-energy buildings | ***Switzerland****, Canada, France, Germany, Sweden, USA, Japan, the Netherlands and Norway* |
| 39 | A common method for testing and rating of residential HP and AC annual/seasonal performance | *Austria, France, Germany, Japan, the Netherlands, South Korea, US,* ***Sweden*** *and Switzerland* |
| 38 | Systems using solar thermal energy in combination with heat pumps | ***Switzerland****, Germany, UK* |

# Introduction

## Heat Pump Conference

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**11th International Energy Agency Heat Pump Conference - Montreal, May 12-16, 2014**

- 300 abstracts were submitted from 32 countries

The Conference had a 5 day programme:

- 1 day HPP Annex workshops
- 3-day conference - with three parallel tracks, oral presentations, and poster presentations. 325 attendees from over 30 countries
- 1 day side event - The Canadian “7th National Ground Source heat pump business and policy forum” had 175 attendees.


http://www.iea-hpc2014.org/

# Introduction

## Heat Pump Newsletter

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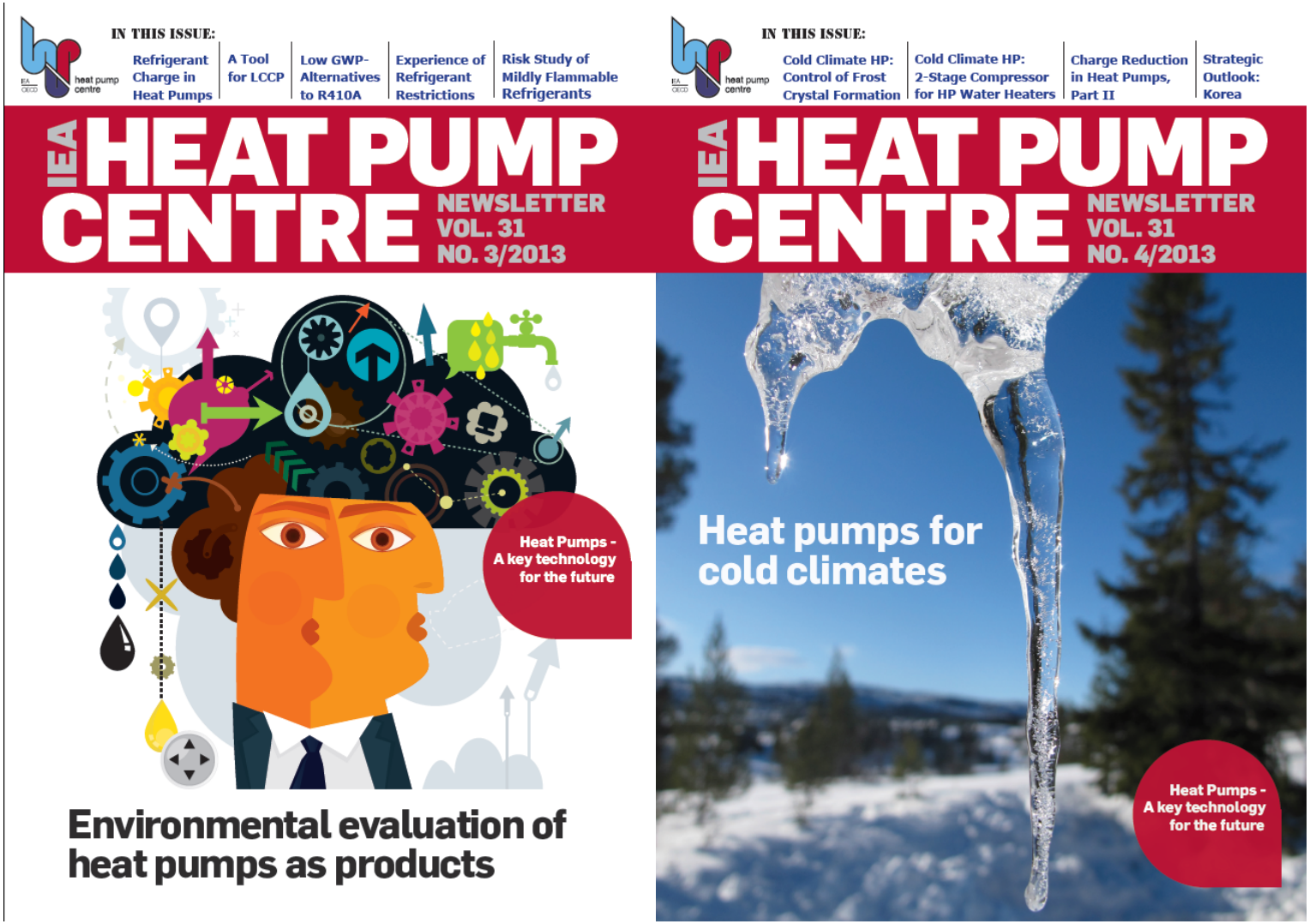


http://www.heatpumpcentre.org/en/newsletter/previous/Sidor/default.aspx

# Introduction

## What is the National Team?

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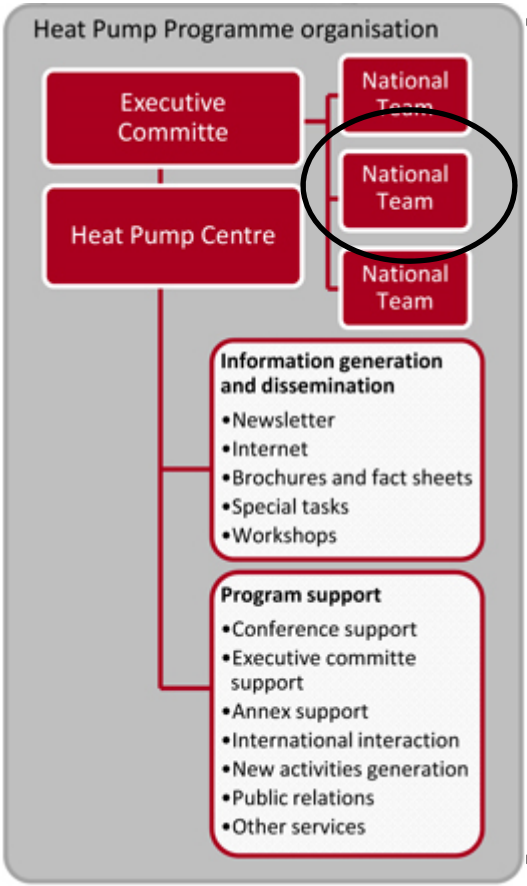


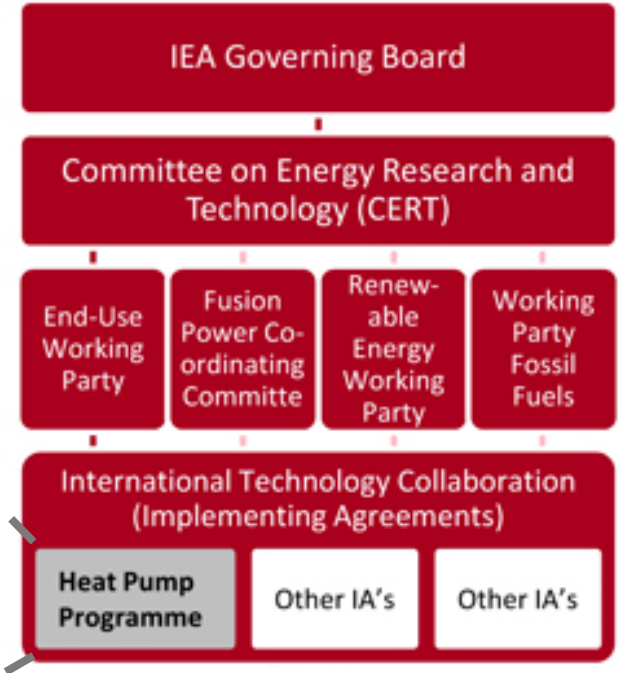


- Work of the National Team includes
- Generation of ideas to new HPP activities/projects of interest to their country,
- Participation in HPP activities/projects,
- National information dissemination and promotion,
- Bringing industry and researchers together in an international network

# Introduction

## UK National Team

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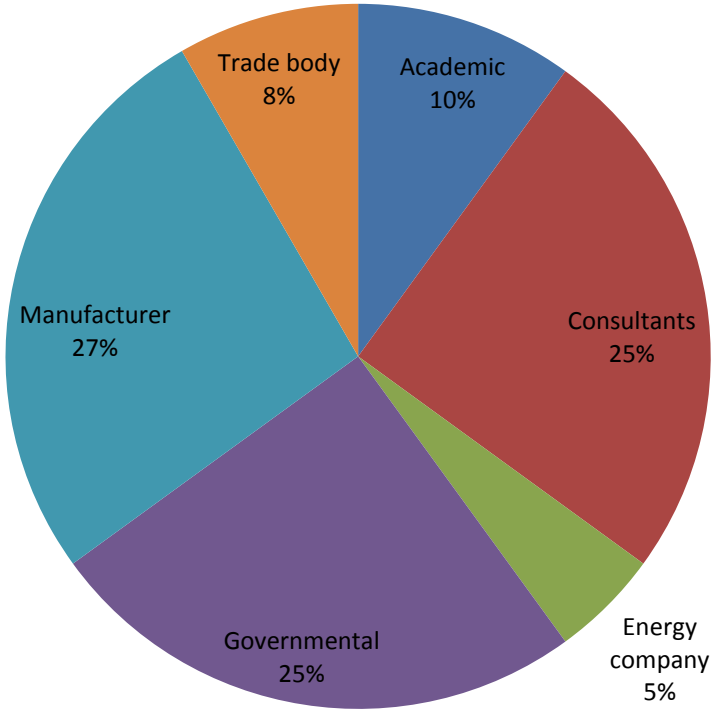
**Last Meeting August 2014**

60 attendees from across the industry

Presentations on:

- Water Source Heat Pumps – real project experiences (RNLI, National Trust)
- Hybrid heat pumps in the Netherlands
- Market adoption of hybrid and gas heat pumps in the UK
- Large heat pumps for district heating

**2014 National Team Attendees**



# Project Case Studies

## Annex 39 – A common method for testing and rating seasonal heat pump performance

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Objectives

- Common calculation methods for SPF using a generalized and transparent approach, based on lab measured data.
- Establish comprehensive test methods based on further development of existing test standards. The test standards should include test conditions needed for the future SPF calculations.
- A method to evaluate additional heat pump performance, e.g. Carbon Footprint, Primary Energy Saving or Energy Savings.

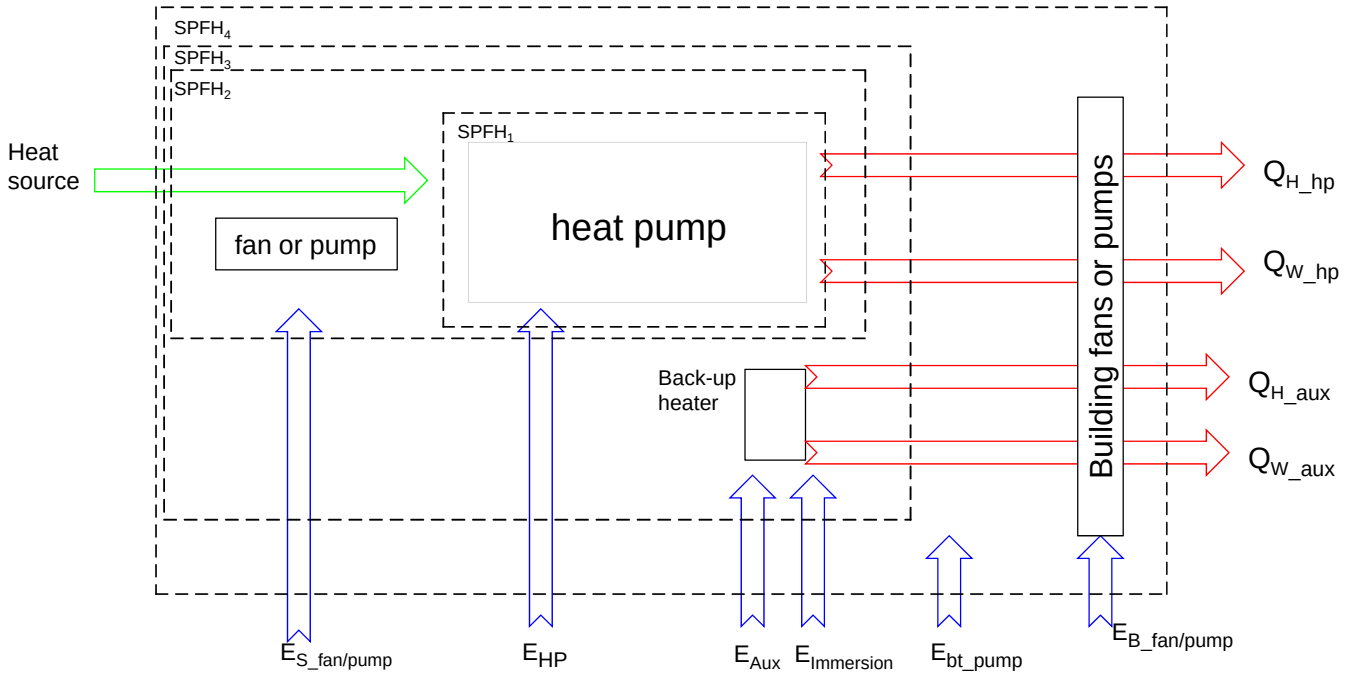
**Participants**

Austria, Finland, France, Germany, Japan, Netherlands, South Korea, US, **Sweden**, and Switzerland

# Project Case Studies

## Annex 39 – A common method for testing and rating seasonal heat pump performance

Department of Energy & Climate Change




**System boundaries for space and water heating circuits, as defined in the SEPEMO project**

# Project Case Studies

## Annex 35 – Industrial Heat Pumps Applications

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Objectives

The objective of the Annex is to reduce the use of energy and emissions of greenhouse gas emissions by the increased application of heat pumps in industry, by

- Generating information for policy makers
- Developing information for key stake holders in industry and its supply and consulting chain and for policy makers
- Getting insight in business decision processes
- Increasing the knowledge and information about IHP's, database and getting existing information available
- Applying new technologies and identifying the needs for technological development
- Creating a network of experts
- Finding synergy with renewable energy production to increase flexibility of the grid

**Participants**

Austria, Canada, Denmark, France, **Germany**, Japan, Netherlands, South Korea, Sweden

http://www.ecleer.com/web/guest/industry/projects/iea

# Project Case Studies

## Annex 35 – Industrial Heat Pumps Applications

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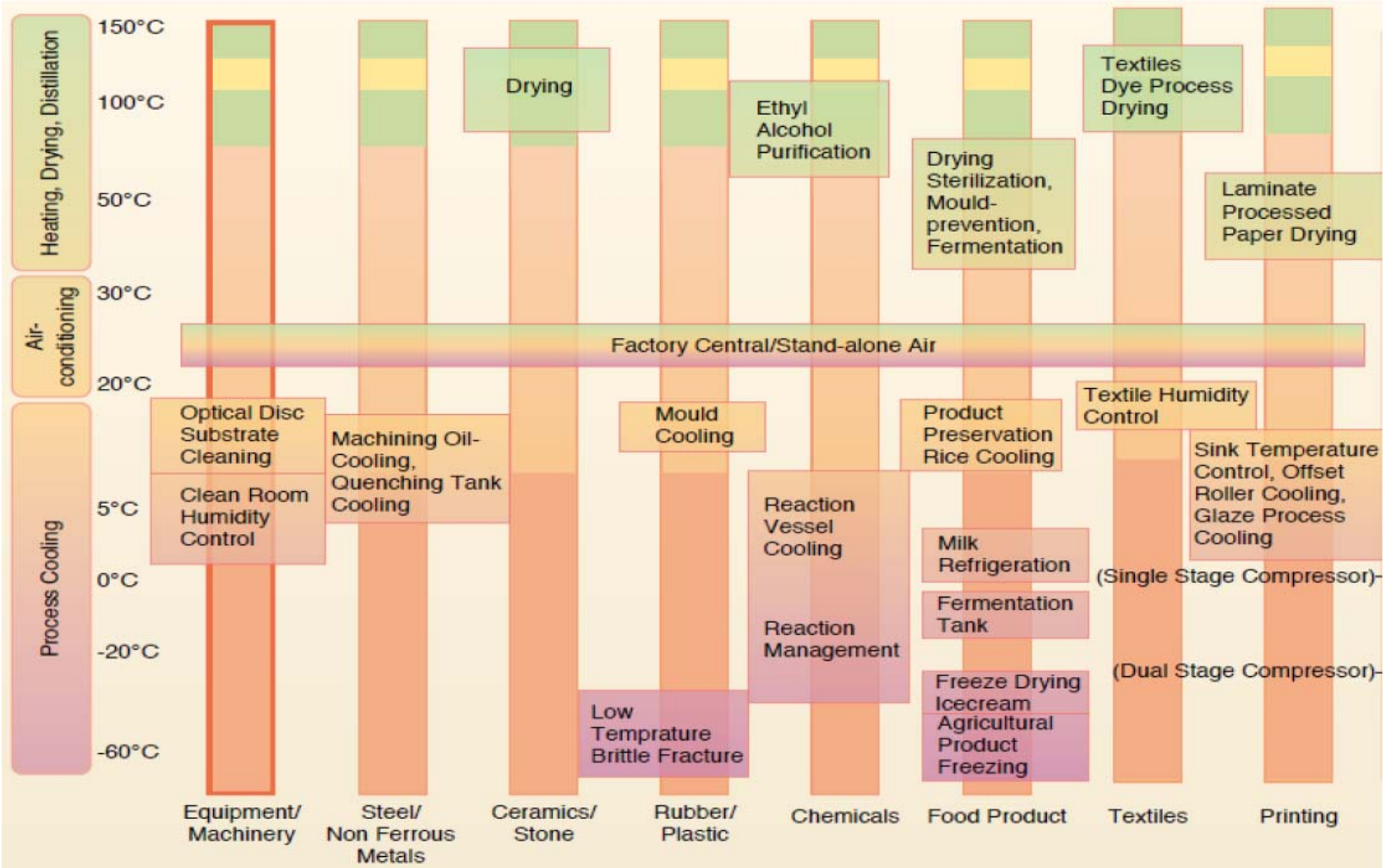

# Project Case Studies

## Annex 42 – Heat Pumps in Smart Grids

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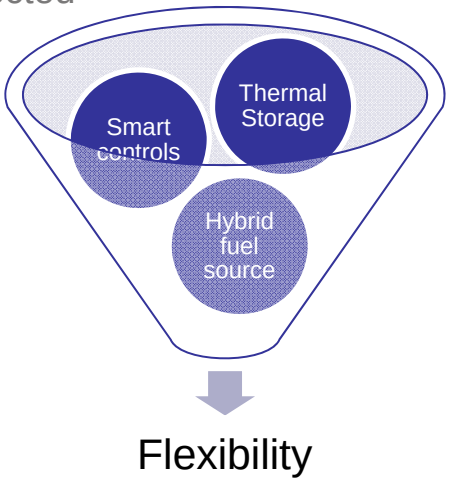
Objectives

- To investigate the level of flexibility different heat pump systems can provide
- In particular for the UK, focussing on the potential to shift peak electricity demand to reduce the potential impact on the local electricity distribution network.
- To investigate the potential impact and opportunities of a more connected "smart" energy system




Outputs so far

- Country reports (UK, USA, Germany, S. Korea, Netherlands, France, Switzerland)
- UK review of modelling and demonstration projects
- Review of "smart" heat pump products
- Evidence gap analysis

https://www.gov.uk/government/publications/heat-pumps-in-smart-grids

**Participants**

Germany, France, **Netherlands**, S. Korea, USA, Denmark, Austria, Switzerland.

http://www.annex42.com

# Project Case Studies

## Annex 43 – Fuel Driven Sorption Heat Pumps

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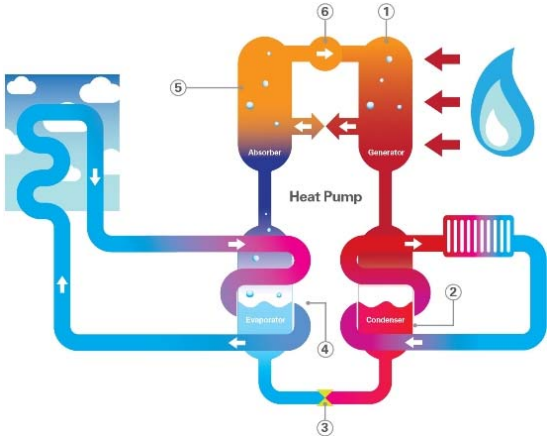


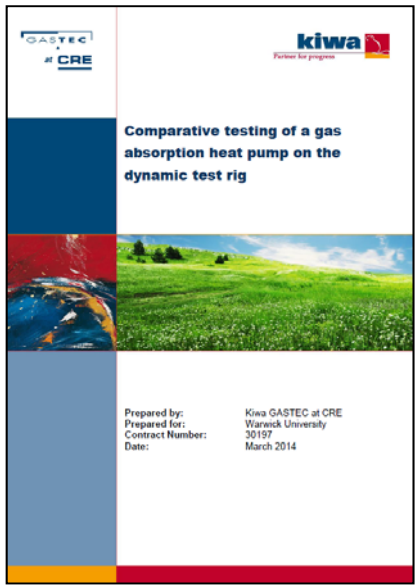

Objectives

- Field test of different fuel driven heat pumps
- Compare different system configurations e.g. different sources
- Evaluate different technologies for different applications e.g. retrofit versus new buildings
- Classification of system schemes, generic system layout

Outputs so far

- UK Market Report
- Current State of the Art
- Review of Potential Sorption Materials
- Performance Testing of a Gas Driven Heat Pump

https://www.gov.uk/government/publications/fuel-driven-heat-pumps




**Participants**

France, **Germany**, UK, South Korea, Italy, USA, Denmark

https://www.annex43.org/

# Future Projects

## Heat Pumps in District Heating

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### New DECC Study

Oct 2014 – March 2015

Contractors: Element Energy and Carbon Alternatives

Desk based review of the potential for heat pumps integrated into district heating systems.

### Research Objectives

- Are large heat pumps capable of delivering high temperature heat for a conventional heat network?
- What is the relative performance/cost of building integrated heat pumps with different heat network scenarios?
- How does heat network delivery temperature affect the potential for heat pumps for new and retrofit networks?
- What particular heat pump systems offer the best performance under particular scenarios i.e. water-source (rivers, lakes, sea), ground-source, air-source.
- Compare these heat network scenarios with a counterfactual based on conventional technologies and processes.

# Future Projects

## Heat Pumps in District Heating

Department of Energy & Climate Change

- **Task 1 – Data collection**
  - A desk based literature review and data collection of existing heat network projects.
- **Task 2 – Case studies**
  - Case studies of heat networks in which heat pumps are a significant technology.
- **Task 3 – Simulation modeling**
  - Development of a heat network simulation model capable of simulating a variety of system scenarios.
- **Task 4 – Scenario analysis**
  - An analysis of specific scenarios which provide the most insight for future DECC policy.
- **Task 5 – Reporting and dissemination**
  - A final report presenting the data collected, case studies and modeled results.

# Future Projects

## Focus on Ground Source Heat Pumps

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**Proposed Research Needed from US National Team**

- Further modeling work:
  - Long term validation of ground heat exchanger models.
  - Increased capabilities of ground heat exchanger models.
- Field and laboratory measurements of:
  - Multi-mode, multi-speed heat pump performance
  - Internally controlled circulating pump performance
  - System performance
- Commissioning and fault detection.
- Modeling of multi-speed variable speed heat pumps for energy analysis and design.

# Other DECC Activities

## Heat Pump Roadshows

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- 2012 DECC Roadshows for Social Housing
  - to explain the MCS heat pump installation standards to social landlords. The aim was to allow them to act as informed customers. Around 1/3 of the social housing associations subsequently installed heat pumps through the RHPP.
- 2015 New DECC Roadshows
  - We will be employing a contractor to run 6-7 roadshows for the domestic sector – private and social housing, new build and retrofit. These will explain the MCS standards and RHI.
  - The contractor will also run 6-7 roadshows for the non-dom sector. This will cover a variety of heat pump systems. It will also cover combined heating and cooling ground source heat pumps.
  - These roadshows will take place in Spring/Summer 2015
  - Invitation to tender published, deadline 9th January 2015.

https://online.contractsfinder.businesslink.gov.uk/Common/View%20Notice.aspx?site=1000&lang=en&NoticeId=1638926

# Summary

## How you can get involved

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- Get in touch if you would like to be part of the UK National Team.
- Are there any research annexes you would like to join which DECC are not participating in?
- Are there any topics you would like to propose as a new research annex?
- Would you like to receive regular email updates (monthly/bi-monthly) on the Heat Pump Programme?

Department of Energy & Climate Change

Any other questions, please get in touch.

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Thank you

# IEA Annex process

## Setting up a new annex

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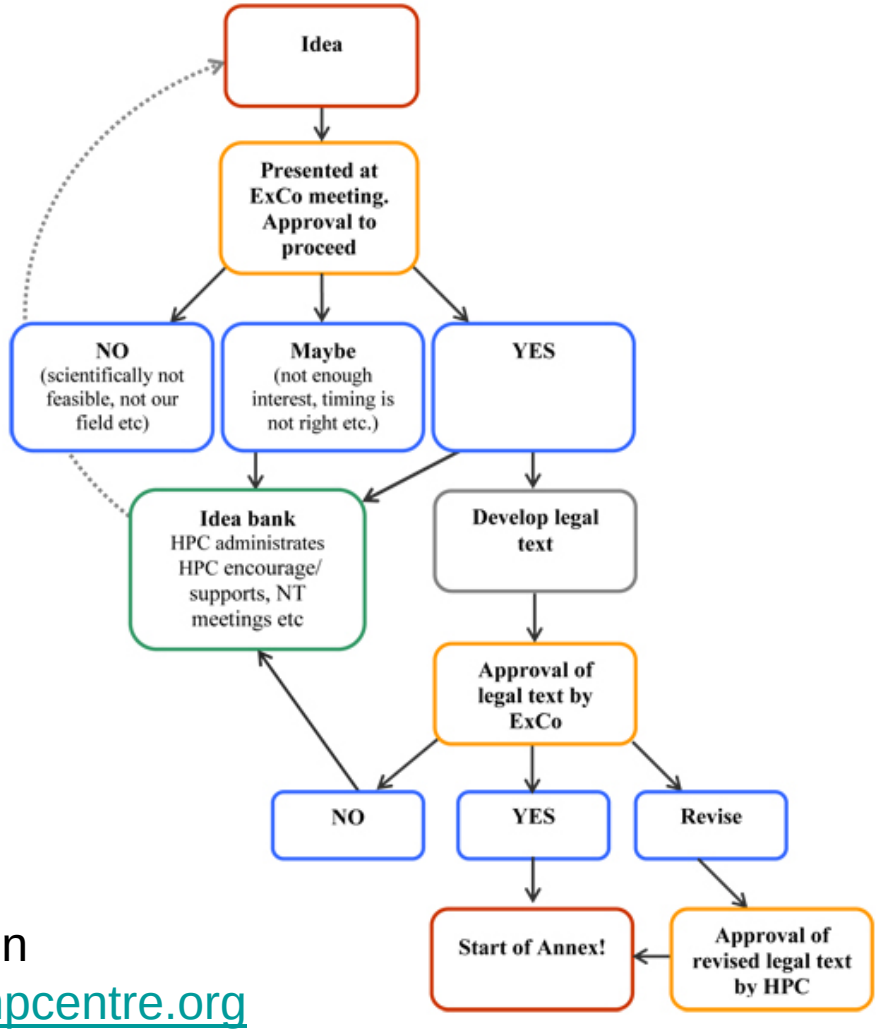


For more information
http://www.heatpumpcentre.org

# IEA Annex process

## Joining an existing annex

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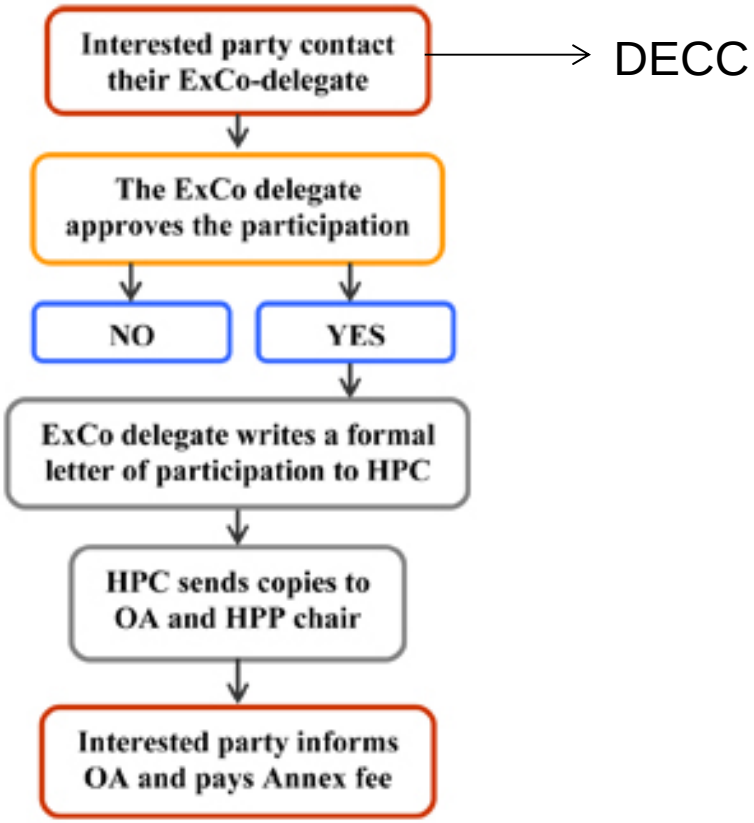


For more information
http://www.heatpumpcentre.org