Heat pumps for your home
Mon 12 Oct 2020, 7.30-9pm

Andy Hamilton  researcher/lecturer/consultant
Tom Bragg  Cambridge Carbon Footprint
Nicola Terry  CCF/consultant
Rules for the day

• Please keep your microphone off unless asked to contribute
• Use chat for questions
  • Nicole will monitor and interrupt Andy if needed for clarification
  • Other questions will be saved for the Q&A periods (one in the middle, the rest at the end)
• We are recording
• The slides will be available soon after the event
Why do we want a heat pump for our home

• Options for decarbonising heat in our home
  • Heat pump, hydrogen or hybrid

• Is it affordable?
  • Renewable heat incentive
  • Flexible tariffs for electricity (e.g. Octopus Agile)

• What is involved?
  • May need changes to radiators/heat emitters too
  • Efficiency depends on how you run it
    • More critical than with a gas boiler
Introducing Andy

• Carbon Co-op heat pump seminar series
• Lives in the peak district
• Has used a heat pump at home for several decades, with iterative upgrades
• Understands how they work and how to get the best out of them
A Heat Pump for your Home

Andy Hamilton
12<sup>th</sup> October 2020

Contact: andyham@gmail.com

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Dedication

To SHELTER

• Covid eviction moratorium end - 1st October

• Shelter has launched an appeal

• https://england.shelter.org.uk/donate
Background Information

  – Currently out of print, being revised, but available as an ebook

• Also see John Cantor’s Web site:- heatpumps.co.uk

• Building Research Establishment - BRE Group
  Testing and research on Heat Pump equipment, updated 2019
  – Bregroup.com/heatpumpefficieny/index.jsp
Content

• HP technical aspects

• HP performance:- CoP, Flow temp, Cycling etc

• Effective systems and their installation
Topics

• The Heat Pump Challenge

• Heat Pumps – A retrofit solution?

• The Procurement process
The Heat Pump Challenge

• Can you apply the technology?

• Can you find an installer who is able to install an effective system?

• Will your installer be motivated to install an effective system?
Heat Pumps – A retrofit solution? 1

• Poor performance of UK HPs shown in Energy Saving Trust - EST – reports

• Report 1, 2008, ASHP have average CoP of 1.8

• Report 2, 2013, ASHP Average CoP of 2.82
  – improved 2008 installations and limited to Mitsubishi Grundfoss and Daikin. No figures after 2013

Results from Mitsubishi field trail and BRE discussed later
Heat Pumps – A retrofit solution? 2

HP installation must be integrated with other retrofit techniques, such as:-
Insulation, Solar gain, Air movement, Thermal store,

Need to reduce Heat Loss to output of HP, at time of installation or later

E.g. For Semi, floor area 150 sq metres, target
- 6 kW Heat Loss, 20 degrees inside, 0 degrees outside
- 5kW output ASHP – In operation, 1 kW Electricity input
The Procurement process

1. Decide on the Heat Pump to be installed – Type, Make and model, and output size
2. Choose an Installer
3. Design the system
4. The Installation process
5. Daily operation of your HP

*** Caution!! You need to get all 5 right! ***
The Procurement process

Decide on the Heat Pump to be installed
Heat Pump Types

• Ground Source, GSHP: Suitable for new build as excavator on site.

• Water Source, WSHP: Suitable water source?
  – River Thames - London apartments,
  – The sea - Swedish airport

• Air Source, ASHP: Suitable for Retrofit
  – Air to Water: for conventional central heating
  – Air to Air: for blown air space heating
Heat Pumps - GSHP

- Ground source: Extensive excavation, or boreholes, needed to collect ground heat.
- Problems with heat collection system
- High cost - £10,000 plus
- An option for new build domestic or larger buildings
- E.g. New build care homes - Rendesco
Heat Pumps – ASHP: Air to Water

- High reliability potential as factory built
- Main unit is external

- Potential to perform well in mild climate
  Few days in the year in the UK below 3 degrees
  Warm air source? E.g. Sun trap, London underground

- Replacement for Gas Boiler - runs at lower temperature
  Cost £2,500 - £10,000
Heat Pumps – ASHP: Air to Air

ASHP is heat source for “fan heater”
  – Good for “open plan” living space
  – Cost from £500
  – Forced Air Central Heating is possible
  – Simple device – potentially reliable and efficient

Common in Canada, Australia etc. New to UK

Potential as a hybrid HP/Gas system
ASHP with Supplementary Heating

ASHP with an output less than Heat Loss at 0 degrees, supplemented by direct electric (fan heater etc), can be more efficient than an ASHP matching Heat Loss. E.g. Heat Loss=6kW, choose 5kW ASHP, **not** 6kW plus (BRE)

Supplementary Heating can be a Wood Stove, Fan heater, Gas fire, etc.

An Air to Air (A2A) ASHP can be used to reduce central heating gas consumption. A cheap retrofit intervention.

Tom installed an A2A ASHP in February 2020......
Air To Air

- Better COP - lower output T
- low cost, easy installation
  total £2,250, incl VAT
- **Could** be used for cooling

BUT:
- Normally only heats one room
- No RHI
Which ASHP?

- HPs come in a much wider range of performance and reliability than cars
- Japanese have invested £1 Billion in HP research – given to their manufacturers
- ASHP can be noisy
- 10 years without maintenance is possible
- Small is beautiful
Expected ASHP performance

• My 2010, 5kW Ecodan - seasonal CoP of 2.7 initially, improved to 3.6, about 4 from 2015

• Mitsubishi Field Trial, 60 ASHPs, CoPs 1.5 to 3.6

• EST 2013 average of 2.8 CoP (1.8 in 2008)

• Target CoP - 2.5 is OK, - better than 3 is good
May 2013 to May 2014, monthly, CoP 3.61 – Green Line

View the historic performance of the Ecodan system. Add and remove items from the chart using the checkboxes below.

- Energy In (kWh)
- Immersion Energy In (kWh)
- Energy Out (kWh)
- Flow Temperature (°C)
- Return Temperature (°C)
- Flow Rate (l/min)
- Inside Temperature (°C)
- Outside Temperature (°C)
- Humidity (%RH)
- Cylinder Temp - Top (°C)
- Cylinder Temp - Middle (°C)
- Cylinder Temp - Bottom (°C)
- COP (COP)

Average COP 3.61
Total Energy Out 8112kWh
Average Outside Temp 10.3°C
Average Inside Temp 18°C

Export Data
Group data by Minute

www.mitsubishielectric.co.uk | Download Ecodan Brochure | Logout
Sizing your ASHP

• Energy Survey needed – for sizing ASHP, and planned insulation improvements
• Match output of ASHP to Heat Loss *after improvements*
• Low ASHP output is OK as Heat Loss usually lower than calculated.
• E.g. 5kW output HP for 6kW Heat Loss
• A matched pair of ASHP can be effective
The Procurement Process  2

Choose an Installer
Choose an Installer

• Select specialist in the Make of ASHP chosen

• “Approved Installer” may not be good

• Find out who your ASHP manufacturer uses to remedy problem installations **OR**

• Select an installer who has put in a well performing system for someone you know
The Procurement Process

Design
Design of an efficient system

- Avoid complexity for reliability and efficiency

- Monitoring system essential for tuning system to achieve high CoP

- Low flow temperature, in radiators - 35 to 40 degrees
  
  ASHP Efficiency is related to Flow temp – External temp

- Low output ASHP with appropriate Heat Emitters, for efficiency
Design of Heat Emitters

- Sufficient radiators and/or under floor heating
- Under floor heating – 25 mm or larger pipes
- High output radiators: double, triple, fan assisted
- Check radiator output calcs for each room
- Small radiators for “Buffer Zones”
Design – cycling and sizing

• Performance over 2 hours of 2 ASHPs

• Next slides:- poorly set up ASHP
  • Outside temp 11.9 c  CoP  1.13

• Following slide:- well set up ASHP
  • Outside temp  9.9 c     CoP  5
Pontefract: 10 minute On-off cycles, CoP 1.13, ASHP oversized
Pontefract: System has CoP of 2 in winter
Well sized ASHP, CoP of 5, 1kW input, output fall to 4kW and CoP fall to 4, over 2 hours
The Procurement Process

Installation
Installation

• Check quality of work, integrity of insulation etc. – take photos candidly

• Discuss issues and changes with Installer

• Written communication is a record

• Provide beverages and snacks

• If work is poor quality, you can change installers
The Procurement Process

Operation
Operation

- Monitor tells you the story – worth the cost

- Is the thermostat causing cycling and low CoP?

- Avoid cycling: Run on timer
  - or set on/off to 1 hour min delay if possible

- Use monitor to find out how effective your system is when working for 2, 3, or 4 hour sessions

- Cold day performance - less than 0 degrees on next slide
24 hours: 10 am to 10 am, -0.5 to -2 degrees, CoP 2.74
December 2015, Average temp 7.5, CoP 4.31

Average COP 4.31
Total Energy Out 1174 kWh
Average Outside Temp 7.5°C
Average Inside Temp 18.1°C
My thanks to the following:

• AECB members
  – John Cantor - Heat Pumps
  – Nick Parsons – Energy Survey & Retrofit insulation
  – Peter Wilkinson - Bank Nook Extension
  Also
  – World heat – Heat Pump installation
  – Mitsubishi & Trystan Lea – Heat Pump monitoring
  – Keith Trippier – Bank Nook joiner etc for 40 years
  – Prof Lubo Jankovic – for successfully applying chaos theory to Retrofit

Contact me: andyham@gmail.com
Bank Nook 1977
Thermal Imaging Training

Get trained at one of these & borrow a camera:

Tue 3rd Nov, 7:30-9:00 pm
Wed 2nd Dec, 6:00-7:30 pm
Thu 14th Jan, 7:30-9:00 pm
Tue 23rd Feb, 6:00-7:30 pm
Solar Together

new [Cambridgeshire Solar Together scheme](#)
uses group-buying for solar panels, plus optional battery
to bring you these at lower cost.
More Online Tours & Talks

openecohomes.org/autumnseason

Please write feedback in Chat:
- What did you enjoy?
- Suggestions for improvement?

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