Heat Pumps in the East of England

Paul Bourgeois
Regional Microgen Coordinator
Energy Saving Trust in the East

- Impartial, independent advice service
- 60M citizens to act on climate change
- Energy, Renewables, Transport, Water, Waste
- EST Advice Centre
  - Norfolk, Suffolk and Cambridgeshire
  - Hertfordshire, Bedfordshire and Essex
- Call centre – 0800 512 012
- Network of 11 regional Microgen co-ordinators
Why heat pumps in this region?

- Off gas potential
- Oil, LPG or electric heating
- EoF energy average 20% off gas
  - 6% to 57%
- From 27,720 Home Energy Checks
  - 30% off gas
  - 19% to 50%
- 170,000 off gas households
How does a Heat Pump work?

- Refrigeration system. The refrigeration cycle is an efficient provider of heat as well as cooling.
- There are two principle locations in the transfer of heat;
  - the place where heat is absorbed, (the source), and
  - where it is rejected, (the destination).
- The compressor in the refrigeration system also produces waste heat, and a significant proportion of this can be recovered.
- Hermetically sealed and pressurised, thereby reducing noise, space and heat losses.
- Absorbed heat is transported by refrigerant with low boiling point through a sealed system of pipes and circulated by a compressor.
How does a Heat Pump work?

- A metering device controls the flow of refrigerant.
- Refrigerant boils from a liquid to a vapour then condense back to a liquid.
- Absorption and release of heat into and from the refrigerant.

Courtesy of Grenergy
How does a Heat Pump work?

- Continual process while the compressor is running and circulating the refrigerant.
- High pressure liquid refrigerant is fed through the metering device into the evaporator heat exchanger.
- It evaporates into a vapour by absorption of heat from the heat source (air, water or ground) passing through the heat exchanger.
- The relatively cool return vapour is drawn back to the compressor.
- The cooled return vapour from the evaporator is passed over the compressor motor windings within the heat pump, thus cooling the motor.
How does a Heat Pump work?

- Much of the energy absorbed by the electric motor driving the compressor is absorbed into the refrigerant.
- The combined heat from the source, plus much of the waste energy from the electric motor is then compressed to a high temperature vapour.
- It enters the condenser heat exchanger where it is cooled and condensed into a high pressure liquid ready to begin the cycle again.
- The heat released during the process of condensing the refrigerant to a liquid is rejected via the heat exchanger directly into air or transferred to water to heat the building.
- The air or water temperature at this point could be 43°C to 60°C, depending on the design of the system.
What are the benefits?

• Highly efficient use of energy input
• Lower carbon emissions
• Clean Energy Cashback (Energy Supplier)
  – Proposed Renewable Heat Incentive
  – Microgeneration Certification Scheme (MCS)
Why MCS?

- Clean Energy Cashback
  - Feed In Tariff payments
  - Renewable Heat Incentive payments
- Promoted by DECC, Ofgem and the EST
- Product and Installation company standards
- Annual checks
- Customer care (REAL Assurance)
- Consumer and industry confidence
A Mark of Quality
Renewable Heat Incentive

- Proposed scheme to be in place April 2011 & **grandfathered**
- **RPI, index linked**
  - Up to 5MW thermal and open to at least 2020
- **12% ROI** all technologies **except solar thermal - 6%**
- **Deemed** on small scale (calculated not metered)
- SAP (domestic), SBEM (commercial) & EPC (new build)
- **No Pre-capitalisation** (industry/banks to develop)
- Applies to **New Build and Retrofit**. Audited by Ofgem
- Payments yearly <45kW & quarterly >45kW
- Back-dated to 15th July 2009 if certificated installer
- **MCS up to 45 kW**
<table>
<thead>
<tr>
<th>Technology</th>
<th>Scale</th>
<th>Tariffs (pence/kWh)</th>
<th>Tariff lifetime (years)</th>
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<tr>
<td>Solid Biomass</td>
<td>Up to 45kW</td>
<td>9.0</td>
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<td>Bio gas</td>
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<td>Ground source heat pumps</td>
<td>Up to 45kW</td>
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<tr>
<td>Air source heat pumps</td>
<td>Up to 45kW</td>
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<tr>
<td>Solar thermal</td>
<td>Up to 45kW</td>
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<td>biogas</td>
<td>45kW-500kW</td>
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<td>Ground source heat pumps</td>
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<tr>
<td>Air source heat pumps</td>
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<td>Solar thermal</td>
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<td>20</td>
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<tr>
<td>Solid biomass</td>
<td>500kW and above</td>
<td>1.6-2.5</td>
<td>15</td>
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<tr>
<td>Ground source heat pumps</td>
<td>350kW and above</td>
<td>1.5</td>
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</table>
Technology Monitoring

Field Trials
– Micro-wind
– Heat pumps
– Solar water heating
– Condensing boilers
– LED lighting
– Heating controls, Insulation
– Future…
  • Smart home energy management
  • Micro CHP
The Heat Pump Trials
Heat Pump Field Trials

- Heat pumps are a proven technology in Europe but relatively new to the UK
- Monitor a representative sample of ~85 in-situ domestic installations
- Calculate performance
- Investigate technical performance & customer behaviour
- Investigate potential carbon & cost savings
- Peer-reviewed methodology
Project Funders

Northwest Regional Development Agency

DEPARTMENT OF ENERGY & CLIMATE CHANGE

The Scottish Government

EDF Energy

e-on UK

British Gas

SCOTTISHPOWER

npower

NIE Energy

Worcester Bosch Group

BAXI

Mitsubishi Electric

Danfoss

NIBE

Scottish and Southern Energy plc

earth energy

energy saving trust
# Site Selection

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Source</th>
<th>Sink</th>
<th>Property Type</th>
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<tr>
<td>Dimplex</td>
<td>Air</td>
<td>Underfloor</td>
<td>1 Bed Semi</td>
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<tr>
<td>Thermia</td>
<td>Borehole</td>
<td>Air Blown</td>
<td>Bungalow</td>
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<tr>
<td>Nibe</td>
<td>Slinky</td>
<td>Heating</td>
<td>3 Bed Semi</td>
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<tr>
<td>IDM</td>
<td>Aquifer</td>
<td>Radiators</td>
<td>House</td>
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<tr>
<td>IVT</td>
<td>Exhaust Air</td>
<td>DHW</td>
<td>4 Bed House</td>
</tr>
<tr>
<td>Global Energy</td>
<td>Pond</td>
<td>Space Heating</td>
<td>3 Bed House</td>
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<tr>
<td>Heat King</td>
<td>Ground</td>
<td>Heating Only</td>
<td>1 Bed Flat</td>
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<tr>
<td>Baxi</td>
<td>Panels</td>
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<td>Barn</td>
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<td>Ecodan</td>
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<td>Worcester Bosch</td>
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<td>Kensa</td>
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</table>
Generic Monitoring Design

- Ambient Air Temp
- Lounge Temp
- Bedroom Temp

Emitter

- H2
- T2

DHW INDIRECT CYLINDER

- H1
- T1

Immersion Heater

Heat pump

- E1
- E2

Electricity Supply to Heat pump

Source

- Ground Temp

Electricity Supply to Heat pump

- Mains Water

Water Supply to Heat pump

- H2

Electricity Supply to Heat pump

- E1
Temperature measurements

- 2x internal air temperatures
- External temperature
- DHW temperature
- Customer satisfaction with temperatures
System boundaries

• Agreed in discussion with UK and EU experts
• 4 variables reported
  – Coefficient of Performance
  – Seasonal Performance Factor
• For both Heat Pump and whole system
Peer Review

• Roger Nordman
  – SP Technical Institute of Sweden (SEPEMO co-ordinator)

• Fabrice Rognon
  – Planair Consulting (formerly of the Swiss Federal Office of Energy)

• Marek Miara
  – Fraunhofer Institute, Germany

• Energy Technologies Institute
• Wide consultation with relevant stakeholders
# Timeline

<table>
<thead>
<tr>
<th>What</th>
<th>When</th>
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<tbody>
<tr>
<td>Data analysis complete</td>
<td>Fri 14&lt;sup&gt;th&lt;/sup&gt; May</td>
</tr>
<tr>
<td>EST to send draft report to funders &amp; peer review</td>
<td>Thu 27&lt;sup&gt;th&lt;/sup&gt; May</td>
</tr>
<tr>
<td>EST to develop key messaging</td>
<td>w/c 1&lt;sup&gt;st&lt;/sup&gt; June</td>
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<tr>
<td>Peer review received</td>
<td>Thu 10&lt;sup&gt;th&lt;/sup&gt; June</td>
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<tr>
<td><strong>Steering group meeting</strong></td>
<td>Fri 11&lt;sup&gt;th&lt;/sup&gt; June</td>
</tr>
<tr>
<td>Public and technical report complete</td>
<td>25&lt;sup&gt;th&lt;/sup&gt; June</td>
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<tr>
<td>Briefing of EST staff</td>
<td>w/c 28&lt;sup&gt;th&lt;/sup&gt; June</td>
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<tr>
<td>Formal consultation with key stakeholders</td>
<td>w/c 5&lt;sup&gt;th&lt;/sup&gt; July</td>
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<tr>
<td>Prepare for launch - Handover to Comms, and press teams</td>
<td>w/c 12&lt;sup&gt;th&lt;/sup&gt; July</td>
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<tr>
<td><strong>Publish final report</strong></td>
<td>By 31&lt;sup&gt;st&lt;/sup&gt; July</td>
</tr>
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</table>
Thanks

Questions?