Gas-fired heat pumps – part of the solution for domestic heating

Rationale:
• 23% of UK energy demand and associated CO₂ emissions are as a result of domestic space heating and hot water supply.
• Even with major improvements in building performance and behavioural change there will still be a major need for heat energy to provide comfort and sanitary hot water.
• There are only two approaches to delivering heat with reduced emissions, which can be used singly, or in combination:
  ▪ Decarbonise the energy supply (whether electricity or gas)
  ▪ Use heat pumps to improve the end use efficiency

What is a heat pump and what are the options?
A heat pump uses high grade energy such as electricity or gas to extract heat from the environment (the outside air, the ground, a river etc.) and to upgrade it to a temperature that can be used for heating and hot water. The Coefficient of Performance of a heat pump, equivalent to the efficiency of a boiler, is the useful heat output / high grade input and is always greater than one. A condensing boiler might have a maximum efficiency of 0.9 (90%).

Examples of COP for a technically good electric and gas heat pump:

<table>
<thead>
<tr>
<th>Heat Pump Type</th>
<th>Heat Extracted</th>
<th>Useful Heat</th>
<th>COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric</td>
<td>2kW</td>
<td>3kW</td>
<td>1.5</td>
</tr>
<tr>
<td>Gas</td>
<td>0.4kW</td>
<td>1.4kW</td>
<td>3.5</td>
</tr>
</tbody>
</table>

So is an electric heat pump ‘better’?
• Not necessarily – if the electricity is made by burning gas at 40% generating efficiency, giving an overall system COP of 1.2 – less that burning gas in the heat pump.
• If the electricity is from renewables (wind, etc.) the electric heat pump provides an almost zero carbon heating solution.
• But for an all-electric solution, not only must we have a completely zero carbon electricity supply system, but the size of the electricity distribution system would need to be doubled or tripled to cope with peak loads.

Most experts agree that a balanced mixture of gas and electric heat pumps will be needed for at least 20 years.

Previous Research at Warwick
Early concept ‘single box’, tested in environmental chamber 2011.

Current research (i-STUTE)
Present concept ‘split system’, evaporator outside house, other components within ‘look and feel’ like a gas boiler.
• Box-for-box exchange for old boiler
• Fits into standard wall-mounted casing
• Designed for retrofit market >90% of annual sales