Retail refrigeration

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Retail refrigeration

- Temperature control, carbon emissions increase at consumer end of cold chain
- 40-70% of energy in supermarkets used for refrigeration
- UK retail refrigeration ~ 9-10 TWh/year
  - ~75% chilled, ~25% frozen
- 1.5% of UK energy used by retail
- ~7.3 Mt CO₂ (~26% direct, ~74% indirect)
WP 2.1 Retail chilling and freezing

- WP2.1.1 – Technologies will be initially investigated and sifted
- WP2.1.2 – In parallel with WP2.1 technologies will be investigated experimentally and a physical proof of concept and a prototype will be developed
- WP2.1.3 – Non technical barriers preventing uptake of new technologies, such as customer reaction, implementation, cost-benefit models, end user (supermarket) incentives will be assessed
- WP2.1.4 – The final part of this work package will involve a trial of the prototype in-store with ASDA
WP 2.1

WP 2.1.1 Technologies initially investigated and sifted

Road map

WP 2.1.2 Technologies investigated experimentally and a physical proof of concept prototype developed

WP 2.1.3 Non technical barriers preventing uptake of new technologies assessed

WP 2.1.4 Trial of the prototype in-store with ASDA
WP 2.1 Retail chilling and freezing

- WP2.1.1 – Technologies will be initially investigated and sifted
- WP2.1.3 – Non technical barriers preventing uptake of new technologies, such as customer reaction, implementation, cost-benefit models, end user (supermarket) incentives will be assessed
- Update of retail road map to identify best technologies
  - Retrofit (technologies that can be fitted in situ to a cabinet)
  - Refit (technologies that can be applied when refitting store)
  - Future technologies (technologies available in the future)
Retrofit

- Refrigerants
- Floating head pressure
- LED lights
- EC Evaporator fan motors
- EC Condenser fans motors
- Suction pressure control
- Doors on cabinets
- Store dehumidification
- Anti-sweat heater controls
- Better cabinet loading
- Short air curtains
- Back panel flow
- Occupancy sensors and controls for cabinet lighting
- Strip curtains

- Night blinds
- Liquid pressure amplification
- Risers or weir plates
- Defrost controls
- Store lighting
- Radiant heat reflectors
- Store temperature control
- Cabinet temperature control
- Training
- Cleaning and maintenance
- Re-commissioning
- Covers
- Loading – duration and temperature
Refit and future

- Cabinet selection
- Secondary systems
- Water loop systems
- CO2 refrigeration technology
- Borehole condensing
- Dynamic demand
- Ground source
- Pipe insulation/rifling/reduced pressure drops
- Anti-fogging glass
- Optimisation of cabinet air flow
- Evaporative condensers
- High-efficiency evaporators and condensers
- Refrigeration system contamination
- SLHE
- Nanoparticles
- Heat pipes and spot cooling
- Anti-frost evaporators
- Fans
- Economisers
- Electronic expansion valves
- Reflective packaging
- Insulation e.g. VIPs
- Off-cycle losses
- Cabinet location
- Desuperheating/heat recovery
- Variable speed drives (integral)
- Internet shopping
- Supermarket cold store
- Vending cabinet concepts
- Polygeneration
- Adsorption
- Absorption
- Novel building fabric
- High-efficiency compressors
- Centralised air distribution
- Store light (natural)
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rating</th>
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<tbody>
<tr>
<td>Quality of information</td>
<td>1-5</td>
</tr>
<tr>
<td>Barriers to staff/customers</td>
<td>L,M,H</td>
</tr>
<tr>
<td>Availability barriers</td>
<td>L,M,H</td>
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<tr>
<td>Limits to commercial maturity</td>
<td>L,M,H</td>
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<tr>
<td>Ease of use of installation</td>
<td>L,M,H</td>
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<tr>
<td>Technology independence</td>
<td>L,M,H</td>
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<tr>
<td>Maintainability</td>
<td>L,M,H</td>
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<tr>
<td>Legislative concerns</td>
<td>L,M,H</td>
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<tr>
<td>Energy savings</td>
<td>%</td>
</tr>
<tr>
<td>Scope of application</td>
<td>All, specific systems</td>
</tr>
<tr>
<td>Direct emissions</td>
<td>0%</td>
</tr>
<tr>
<td>Cost (payback)</td>
<td>£</td>
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</tbody>
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Baseline store (Asda W-S-M) for model

<table>
<thead>
<tr>
<th></th>
<th>TOTAL kW</th>
<th>% of store main</th>
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<tbody>
<tr>
<td><strong>REFRIGERATION</strong></td>
<td>158.9</td>
<td>39.73%</td>
</tr>
<tr>
<td><strong>HVAC</strong></td>
<td>48.9</td>
<td>12.23%</td>
</tr>
<tr>
<td><strong>LIGHTING</strong></td>
<td>85.8</td>
<td>21.45%</td>
</tr>
<tr>
<td><strong>FOOD PREP</strong></td>
<td>63.2</td>
<td>15.80%</td>
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<tr>
<td><strong>SMALL LIGHTING &amp; POWER</strong></td>
<td>0.0</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>89.21%</strong></td>
</tr>
</tbody>
</table>

- Missing 10% energy!
- Currently matching cabinets to refrigeration power
- Need detailed info on HVAC, lighting and food prep
WP2.1.2

• WP2.1.2 – In parallel with WP2.1 technologies will be investigated experimentally and a physical proof of concept and a prototype will be developed

• Roadmap used to identify the technologies that have the best potential for improvement
  – Probably multi-deck chilled cabinet
  – Only commercially available technologies
  – Some technologies will not be suitable for a multi-deck or compatible
WP2.1.2

Likely current technology candidates:

Cabinet:
1. Doors
2. LED lights
3. ECM fan motors
4. Occupancy sensors
5. SLHE
6. Anti frost evaporator
7. Insulation

Refrigeration system:
1. Floating head pressure
2. Changing refrigerant
3. Suction pressure control
4. ECM condenser fans
5. LPA
6. Evaporative condensers
WP2.1.2

1. Cabinet sourced and tested
   - Selected technologies incorporated
     - Cabinet re-tested
   - Savings from cabinet modifications for supermarket calculated
     - Before/after applied to standard ASDA store model
       - Measurements of heat extracted in ASDA store
         - Compared using refrigeration system models

2. Overall savings for whole system calculated
   - Savings from refrigeration system modifications for supermarket calculated using validated model