Overview

- Why does BEES matter?
- Research aims
- Scope
- Methodology
  - Survey
  - Modelling
Why does BEES matter?

• Economic studies show that improved energy efficiency can save money, bolster productivity, increase growth, reduce inflation and improve health outcomes.

• The energy use of UK non-domestic buildings is responsible for 12% of UK end-use greenhouse gas emissions (non-domestic buildings use 25% of all energy consumed).

• Currently, DECC relies on data collected in the 1990s in the Non-Domestic Energy and Emissions Model (N-DEEM), to provide information on energy end-use in non-domestic sectors.

• As an important user of energy and contributor to emissions stronger up to date and accurate evidence of energy use in this sector is needed to inform DECC’s important strategic decisions.
Research Aims

Aim:
• Update the evidence base for energy use and abatement in Non-Domestic buildings across England and Wales

Research Questions:
• Update understanding of how energy is used (for different end uses in each building type and in aggregate), for a snap-shot in time
• Update understanding of how energy use can be abated
• Understand qualitatively the barriers and facilitators of energy abatement
Floor area (m²) by sector
(Adapted from UCL, 2012)

Cum. Floor area (m²) by subsector
(Adapted from UCL, 2012)
<table>
<thead>
<tr>
<th>Sector</th>
<th>Sub-Sector</th>
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<th>Sub-Sector</th>
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<tbody>
<tr>
<td>Education</td>
<td>Nursery</td>
<td>Retail</td>
<td>Small Shops (Food &amp; Non-Food)</td>
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<tr>
<td></td>
<td>Primary School</td>
<td></td>
<td>Large Shops (Food &amp; Non-Food) (&gt;750m²)</td>
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<td></td>
<td>Secondary School</td>
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<td>Hypermarket/Superstore (&gt;2,500m²)</td>
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<td>University (residential &amp; non-residential)</td>
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<td>Showrooms (Vehicle &amp; Non-Vehicle)</td>
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<td>Health</td>
<td>Health Centres</td>
<td>Community</td>
<td>Community Halls</td>
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<td></td>
<td>Hospitals (NHS &amp; Private)</td>
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<td>Places of Worhsip</td>
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<tr>
<td>Emergency Services</td>
<td>Police Stations</td>
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<td>Nursing Home</td>
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<td>Prisons</td>
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<td>Libraries/Museums/Galleries</td>
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<td>Courts</td>
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<tr>
<td></td>
<td>Fire/Ambulance Stations</td>
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<tr>
<td>Military</td>
<td>MOD Buildings</td>
<td>Leisure</td>
<td>Theatres/Cinemas/Concert Halls</td>
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<tr>
<td>Offices</td>
<td>Commercial Offices (inc Central &amp; Local Gov)</td>
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<td>Clubs (not sports)</td>
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<tr>
<td>Hospitality</td>
<td>Restaurant</td>
<td>Sports</td>
<td>Sports Centres (with/without pools)</td>
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<td>Pub</td>
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<td></td>
<td>Hotel</td>
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<td>Takeaway</td>
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<td></td>
<td>Café</td>
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<td></td>
<td>Factories &amp; Industrial Buildings</td>
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Methodology

- Informed by 2013 pilot study into different methodology options

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<thead>
<tr>
<th>Component</th>
<th>Purpose</th>
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| 4,000 Telesurveys| - 20-25 minutes  
- Aimed at Energy/Facilities managers  
- Collects basic data on building, equipment, usage & energy management  
- 'Core' questions and 'Sector Specific' questions tailored to building type |
| 300 Site Audits | - Recruited from telesurvey respondents  
- 0.5 - 1.5 days depending on building type/complexity  
- Validates data and collect more detailed building energy data and is basis for abatement calculation  
- 1hr qual interview on barriers and drivers to Energy Efficiency |
| Modelling       | - Converts Survey answers into estimate of consumption via end use (heating, lighting, cooling etc.)  
- Calculates abatement & grossing |
Methodology - Survey

Screening

Organisation
- Organisation size
- Business activity

Building
- Ownership arrangements
- Occupancy of premises
- Space Activities
- Working practices
- Age and structure
- Dates of recent renovations
- Existence of external area

Sector Specific Questions

Exceptional Uses
- Existence of exceptional energy uses
- Existence of low carbon/renewable energy

Building Services

Energy Management
- Energy management systems
- Organisational energy management

Follow on
- Recruitment for Site Surveys

Follow on

KEY
- Not tailored by subsector
- Limited tailoring
- Complete tailoring
• Energy intensity is defined & calculated on a space by space basis & aggregated to building level
• Based on a floor area breakdown of m² of each **space type** (50-60 in model)
• Each **space type** is a dataset of **tree diagram parameters** for each energy end use & servicing level
The model uses a **tree diagram basis** to generate an energy use prediction at an **end use level of resolution** (26 end uses heating, lighting, ventilation, etc.).

The hypothesis calculation shares a common basis with the energy calculations used to generate predictions from survey responses.

Abatement calculation through manipulation of tree diagram variables.

**Questions on lighting type (e.g. LEDs)**

**Questions on usage & controls**

## Building Energy Hypothesis Model

<table>
<thead>
<tr>
<th>BEES - Modelled End Uses</th>
<th>Lifts</th>
<th>Heating</th>
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</thead>
<tbody>
<tr>
<td>Catering</td>
<td>Hot water</td>
<td></td>
</tr>
<tr>
<td>Distributed catering electric</td>
<td>Space cooling</td>
<td></td>
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<tr>
<td>Cooled storage</td>
<td>Ventilation</td>
<td></td>
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<tr>
<td>Entertainment lighting</td>
<td>Pumps</td>
<td></td>
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<tr>
<td>Entertainment equipment</td>
<td>Controls</td>
<td></td>
</tr>
<tr>
<td>Laundry electric</td>
<td>Humidification</td>
<td></td>
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<tr>
<td>Medical</td>
<td>Internal lighting</td>
<td></td>
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<tr>
<td>Laboratory</td>
<td>Display Lighting</td>
<td></td>
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<tr>
<td>Pool/leisure</td>
<td>External lighting</td>
<td></td>
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<tr>
<td>Other Normal</td>
<td>Small power</td>
<td></td>
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<tr>
<td>ICT equipment</td>
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</tbody>
</table>

### Lighting - Internal

- **kWh/m²/year**
- **Electricity**

### Load intensity

- **W/m²**

### Full load hours

- **hrs/yr**

### Questions on lighting type

- **Illuminance**: lux
- **Efficiency**: W/m²/100 lux

### Questions on usage & controls

- **Hours available**: hrs/yr
- **Lighting control effectiveness ratio**
- **Utilisation factor ratio**
Methodology – energy prediction & abatement

Create “Iconic” building
- Space type breakdown
- End uses

Calibrate (vs. DEC/NEED)
- Existing benchmarks

BEES fieldwork
- Telesurveys
  - summary insight
- Site surveys
  - Verification
  - Detailed insight
  - Abatement inputs
  - Barriers interview

Initial Hypothesis model

Calibrate (vs. DEC/NEED)

Calibrate (vs. BEES fieldwork)

Final Hypothesis model

Processed telesurvey records
- End use breakdown

Processed telesurvey records

Abatement Measure Inventory
- End use breakdown
- Abatement potential

Abatement Calculations

Grossing Calculations

Final Dataset

Applicability of measures

Calibrate (vs. BEES site surveys)
Next steps

- The project has been in the field since summer 2014 with **fieldwork nearing completion**.

- Currently undertaking a range of **quality assurance** activity including comparison to non-domestic NEED consumption data together with “shadow” modelling by using a University’s model.

- Need to **disclosure check** results as some sites will be influential, some sub-sectors are based on small samples and some organisations contribute a high proportion of sites in some sub-sectors.

- Plan to **publish** full report together with sector specific reports by Spring 2016.