THE UK'S LEADING COMMERCIAL PROPERTY OWNERS WORKING TOGETHER TO IMPROVE THE SUSTAINABILITY OF EXISTING COMMERCIAL BUILDING STOCK
The BBP is

A collaboration of the UK’s leading property owners who work together to improve the sustainability of the UK’s existing commercial buildings.

Our aim is to

Enable market transformation through sustainability leadership and knowledge sharing across the property industry.
Managing Agents Partnership

- Broadgate Estates
- Capita
- CBRE
- Cushman & Wakefield
- Bilfinger
- GVA
- JLL
- Knight Frank
- MJM
- Savills
- Workman

- 10 Agents
- +26,000 Properties
- ~1 billion Sq ft
Real Estate Environmental Benchmark

Floor area
- Offices: 65%
- Shopping Centres: 35%

£135m energy spend

Graph:
- Absolute energy consumption (GWhelec-eq/year)
- Indexed energy intensity

<table>
<thead>
<tr>
<th>Year</th>
<th>Properties</th>
<th>Energy Consumption (GWhelec-eq/year)</th>
<th>Indexed Energy Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009/10</td>
<td>196</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2010/11</td>
<td>292</td>
<td>93</td>
<td>93</td>
</tr>
<tr>
<td>2011/12</td>
<td>344</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>2012/13</td>
<td>380</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>2013/14</td>
<td>455</td>
<td>82</td>
<td>82</td>
</tr>
<tr>
<td>2014/15</td>
<td>452</td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

BBP: Better Buildings Partnership
Like-for-Like over time

Unadjusted energy (kWh elec. eq.)
BBP Better Metering Toolkit

Freely available for download at:
www.betterbuildingspartnership.co.uk
Setting the scene
Aims of Toolkit

AMR Schematic

General schematic of an AMR metering system and its associated benefits
Why should you use better metering?

**Weekly half-hourly profile of electricity consumption of a commercial office building**

- **Occupied**
- **Unoccupied**

<table>
<thead>
<tr>
<th>Group Name</th>
<th>% Out of hours</th>
<th>Cost</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th Floor</td>
<td>32%</td>
<td>£101</td>
<td>4%</td>
</tr>
<tr>
<td>13th Floor</td>
<td>32%</td>
<td>£80</td>
<td>9%</td>
</tr>
<tr>
<td>7th Floor</td>
<td>37%</td>
<td>£140</td>
<td>-7%</td>
</tr>
<tr>
<td>8th Floor</td>
<td>37%</td>
<td>£128</td>
<td>-6%</td>
</tr>
<tr>
<td>5th Floor</td>
<td>38%</td>
<td>£122</td>
<td>0%</td>
</tr>
<tr>
<td>10th Floor</td>
<td>40%</td>
<td>£147</td>
<td>2%</td>
</tr>
<tr>
<td>15th Floor</td>
<td>40%</td>
<td>£121</td>
<td>-4%</td>
</tr>
<tr>
<td>17th Floor</td>
<td>40%</td>
<td>£122</td>
<td>7%</td>
</tr>
<tr>
<td>9th Floor</td>
<td>41%</td>
<td>£155</td>
<td>0%</td>
</tr>
<tr>
<td>11th Floor</td>
<td>41%</td>
<td>£147</td>
<td>1%</td>
</tr>
<tr>
<td>14th Floor</td>
<td>41%</td>
<td>£113</td>
<td>4%</td>
</tr>
<tr>
<td>12th Floor</td>
<td>42%</td>
<td>£154</td>
<td>2%</td>
</tr>
<tr>
<td>16th Floor</td>
<td>42%</td>
<td>£147</td>
<td>5%</td>
</tr>
<tr>
<td>18th Floor</td>
<td>44%</td>
<td>£116</td>
<td>12%</td>
</tr>
<tr>
<td>Ground Floor</td>
<td>48%</td>
<td>£10</td>
<td>-34%</td>
</tr>
<tr>
<td>3rd Floor</td>
<td>53%</td>
<td>£108</td>
<td>-7%</td>
</tr>
<tr>
<td>4th Floor</td>
<td>53%</td>
<td>£150</td>
<td>8%</td>
</tr>
<tr>
<td>1st Floor</td>
<td>65%</td>
<td>£13</td>
<td>41%</td>
</tr>
</tbody>
</table>
What are typical meters in a building?

- Main Utility Meters
  - Electricity
  - Gas
  - Water
What are typical meters in a building?

- **Sub-meters**
  - Electricity, gas, water, heat / coolth
  - Load specific e.g. server rooms, renewables, HVAC plant
  - Location based e.g. by floor
## Meters

- **Sub-meters**
  - Clear sub-metering strategy required
  - **Key questions:**
    - Is it for energy management or occupier billing?
    - Are there already some sub-meters in the building?
    - What systems do I need to sub-meter?
    - Do the costs outweigh potential savings?

### Virtual Metering

<table>
<thead>
<tr>
<th>Whole building electricity supply</th>
<th>EM1 Man Utility AMR meter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>'Virtual Meter' calculation VM1=EM1-EM2-EM3</td>
</tr>
<tr>
<td>EM2 AMR Sub-meter</td>
<td>Occupier riser electrical supply for analysis of floor lighting and power loads</td>
</tr>
<tr>
<td>EM3 AMR Sub-meter</td>
<td>Regional server room electrical supply for analysis of baselloads and DEC separables</td>
</tr>
<tr>
<td>VM1 Virtual Meter</td>
<td>All other electrical supplies for analysis of building services HVAC plant loads</td>
</tr>
</tbody>
</table>
# How much will it cost me?

- Cost table provided in Toolkit
- For details on Cost Benefit Analysis see CIBSE TM39
- ECA scheme for tax benefits

<table>
<thead>
<tr>
<th>Component</th>
<th>Option</th>
<th>Initial cost [capital + installation]</th>
<th>Ongoing cost</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal transmission</td>
<td>Hard-wire</td>
<td>£90 per 100 meters of cable</td>
<td>See data collection and storage</td>
<td>This is the capital cost of the cable. The installation costs should be small during a refurbishment but potentially prohibitively expensive during other times.</td>
</tr>
<tr>
<td></td>
<td>Wireless</td>
<td>£175-200 per meter</td>
<td>See data collection and storage</td>
<td>Installation costs not included</td>
</tr>
<tr>
<td>On-site data collection</td>
<td>Bespoke data-logger</td>
<td>£30-70 per meter/channel, stand alone GSM data logger equipment cost £600</td>
<td>See data collection and storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BMS (already present)</td>
<td>£600 per day for commissioning</td>
<td>See data collection and storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Server</td>
<td>£1,000-2,000 per day for commissioning</td>
<td>See data collection and storage</td>
<td></td>
</tr>
<tr>
<td>External transmission</td>
<td>Cellular wireless transmitter</td>
<td>£100-300 per meter</td>
<td>£25-50 per annum</td>
<td>On-going costs are for data transmission only</td>
</tr>
<tr>
<td></td>
<td>Landline</td>
<td>£150-200 per line</td>
<td>£150-£200 per year</td>
<td>On-going costs are for data transmission only</td>
</tr>
</tbody>
</table>

The Enhanced Capital Allowance Scheme

The Enhanced Capital Allowance (ECA) scheme helps reduce the costs of investing in AMR metering systems. It provides tax relief for a range of specified energy saving technologies, including (Automatic Monitoring and Targeting (aM&T) systems). This includes the meters, the meter reading system and the analytical software. The tax relief is not granted on software when using an external service provider, although tax relief can still be gained on the other components of the system. Further details can be found from ECA’s web-site: [www.eca.gov.uk](http://www.eca.gov.uk)
Advanced Meter Systems Schematic
Advanced Meter Systems Schematic

1. Metering
2. Transmission to a central point
3. On-site data collection
4. External transmission for off-site analysis
5. Data storage
6. Data visualisation and analysis
7. Energy management

**Benefits**
- Reduction projects prioritisation
- Benchmarking
- Communication to occupiers / staff
- DECs/CRC & CSR reporting
- Tariff analysis and contract negotiations
- Bill validation financial reporting & budgeting
- Building management made aware of issues

**Data Flow**
- Chatterbox/relay/optical reader
- Data Loggers or Central Server
- External Transmitter
- Data collector
- Utility providers database
- Portal
- aM&T database
- Automatic alarms
- Bills

**Data Transmission**
- Data transmitted directly from meters
- Data for main utility meters only
- Data for all meters

**Data Use**
- Energy Manager
- Bills
- Main & sub-meter analysis
- Automatic alarms
On-site data collection

- Data needs to be collected and stored before further analysis (typically on-site before further transmission)

- Data collection via:
  - Data Loggers
  - Central server / BMS

Many new meters take an all-in-one approach with a combined meter, data logger and transmitter in one unit.
Advanced Meter Systems Schematic

1. Metering
   - Transmission to a central point
2. On-site data collection
3. External transmission for off-site analysis
4. Data storage
5. Data visualisation and analysis
6. Energy management

**Benefits**
- Reduction projects prioritisation
- Benchmarking
- Low carbon retrofits
- Communication to occupiers/staff
- DECs/CRC & CSR reporting
- Tariff analysis and contract negotiations
- Bill validation financial reporting & budgeting
- Building management made aware of issues
External Transmission

- Analogue phone line
- Wireless mobile communications (GSM)
- Alternative options include: IT network and Power Line Communications
Advanced Meter Systems Schematic

<table>
<thead>
<tr>
<th>1 Metering</th>
<th>2 Transmission to a central point</th>
<th>3 On-site data collection</th>
<th>4 External transmission for off-site analysis</th>
<th>5 Data storage</th>
<th>6 Data visualisation and analysis</th>
<th>7 Energy management</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>Chatterbox/relay/optical reader</td>
<td>Data Loggers or Central Server</td>
<td>Data transmitted directly from meters</td>
<td>Data collector</td>
<td>Data for all meters</td>
<td>Bills</td>
<td>Reduction projects prioritisation</td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td>External Transmitter</td>
<td>Data for main utility meters only</td>
<td>Utility providers database</td>
<td>Main &amp; sub-meter analysis</td>
<td>Energy Manager</td>
<td>Low carbon retrofits</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td></td>
<td>Portal</td>
<td>Automatic alarms</td>
<td></td>
<td>Communication to occupiers/staff</td>
</tr>
<tr>
<td>Heat</td>
<td></td>
<td></td>
<td></td>
<td>aM&amp;T database</td>
<td></td>
<td></td>
<td>DECs/CRC &amp; CSR reporting</td>
</tr>
<tr>
<td>Cooling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tariff analysis and contract negotiations</td>
</tr>
</tbody>
</table>

- **BENEFITS**
  - Reduction projects prioritisation
  - Benchmarking
  - Communication to occupiers/staff
  - DECs/CRC & CSR reporting
  - Tariff analysis and contract negotiations
  - Bill validation financial reporting & budgeting
  - Building management made aware of issues
Analysis – comparing similar buildings
Analysis – comparing demand over time

- Light blue bars: consumption during occupied hours.
- Dark blue bars: consumption during unoccupied hours.

Baseload: The constant demand that is always required regardless of the time of day.
Analysis – comparing different areas of a building
TfL Case study: Cranbourn Street

- 5 story office (2,260m²)
- 2006
  - Used existing AMR electricity meter to collect gas and water main utility data
- 2009
  - Installed 36 sub-meters to meet CIBSE TM39 guidance:
    - HVAC plant, server rooms
    - Tenant lighting & small power
    - £19,000 for full installation
TfL Case study: Cranbourn Street

- Data communication method
  - hard wired cables and landline

- Self-collection and transfer to own aM&T software
  - Currently changing data collection process

- Benefits:
  - Improved DEC rating
  - Reset HVAC timings
  - Focus staff engagement
The power of BMS data – BBP case study

These Comfort Tracker graphics show improvements in temperature management between September 2015 and January 2016, with fewer spaces too hot or cold and more spaces with well-controlled temperatures.

This Major Plant Watchdog graphic flagged air handling units running out of hours (red).

This Rogue Finder identified individual faulty fan coil units making plant run unnecessarily.

http://www.betterbuildingspartnership.co.uk/bbp-members-use-big-data-improve-comfort-and-efficiency
Keeping in touch with the BBP
Importance of Metering

20 April 2016

Peter Tse
BSRIA Principal Design Consultant
Innovate UK BPE Assessor
The Backdrop

- £8m Innovate UK BPE programme
- Closing the loop between theory and practice
- Look at what has worked well & what has led to under-performance in operation
- 48 Non-domestic projects
  - Offices, retail, healthcare, libraries, industrial, hotels, schools and higher education, visitor centres, community centres
- Overall an exemplary portfolio
The built environment experts

- At least two years of energy use data
- Assessment of annual energy use.
- Analysis of energy demand profiles.
- Occupant satisfaction survey.
- Investigation of issues arising.
- Spot checks and recording measurements as necessary.
- Technical review of building and equipment performance.
- Performance and usability of controls and BMSs.
- Reliability, maintenance and maintainability.
- Structured reviews with occupants and management.
- Suggestions for improvement.
- Comparison with results from other buildings.
Compliance - Building Regulations, DECs etc.

If it can’t be measured, how can you manage it!

Drill down to end uses
Meeting of the BPE teams

Challenges
Level of metering
Meters not connected
Current transformers
Renewables

- Clean
- Renewable
- Free
BMS

- Or EMS
- Storage / Overwriting
- Access
Industry epidemic
Potential solutions

- Projects had support of programme
- Building regulation – mandatory commissioning of systems
- Guidance/training for contractors
- Softlandings
- Improve metering guidance
- Provision of commissioning code
Building energy metering

TM39 & New Commissioning Code
The process so far
Capturing 2 years of data - not that easy
Many challenges
There needs to be a change in approach
If it can't be measured, how can you manage it!
Thank you for listening

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