BPE CASE STUDY
STOCKPORT
PENNYWELL
PETCHEY
ACADEMIES

DR JUDIT KIMPIAN
AHR
Building Performance?

A **resource efficient** way of providing...

... a healthy, comfortable, safe, environment over a building's life span

*Source: Artist Maria Arceo*
How do we measure energy and comfort?

Meters and submeters reconciled

Data logging for °C, CO₂, %RH

Occupier Survey and interviews
Get REAL about building energy consumption

Our figures show that on average, buildings consume between 1.5 and 2.5 times predicted values.

CarbonBuzz will help you close the gap between calculations and actual building performance.

Get Started or Find out more

Upload
- Download template to gather data
- Register to add new project
- Enter project details and energy consumption

Share
- Add users to your account
- Specify their access rights
- Share a locked or an editable project across organisations
- Publish project to add attributable data to the public domain

Compare
- Compare your design estimate against operational energy use
- Find out how your building performs against others
- Study the end use composition and contributing factors of other projects
Innovate UK AHR Building Performance Evaluations

BPE programme aims:
Target building performance?
Effectiveness of low-carbon measures?
Causes of any performance issues?
AHR BPE projects compared to CarbonBuzz published and anonymised projects
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- Pennywell Academy
- Petchey Academy
- Loxford School
- Stockport Academy
- Tremough Innovation Centre
- Brine Leas Sixth Form
- Pool Innovation Centre
Performance Gap | calculated vs operational data medians
Sector by sector data | calculated vs achieved performance

- **Schools**
  - Heat: 1.48
  - Electricity: 1.9

- **Offices**
  - Heat: 1.59
  - Electricity: 1.71

- **Universities**
  - Heat: 1.2
  - Electricity: 2.3
Compliance vs predicting measured energy use

Compliance calculations are not predictions and evaluate a building’s energy performance potential while disregarding major energy risk factors:

EPC
As Built
Building & System
Properties
Standard
conditions

+ All equipment
Appliance
IT
Lifts
External lights
Special equipment
Etc. see list in CB
Controls

+ As built Factors
Actual system and fabric performance inc controls
Commissioning
Metering
Energy management setup

+ Management Factors
Hours
Occupancy
Zoning, set points, schedules
FM regime
Maintenance
Occupant engagement
Actual weather & climate

Legislation has brought about improved fabric performance but an unintended consequence is increased energy consumption, cost and building fragility due to complex technical systems.
Innovate UK CarbonBuzz Forecast Beta tool assists users to estimate total energy use of schools and offices from EPCs. More data is needed to make the tool more robust.
Building properties

Stockport Academy

- Simple layout
- Central atrium
- Steel frame
- Cavity walls
- Full mech vent, + ch beams
- GSHP, UFH
- PIR with daylight dimming
- Part L fabric only, EPC B
- BMS
- Traditional contract

Petchey Academy

- Simple layout
- Central atrium
- Concrete frame
- Lightweight cladding
- Full mech vent
- Cooling with HR
- PIR and absence detection
- Pre-Part L ~EPC C
- BMS
- D&B contract

Pennywell 360 Academy

- ‘Village’ layout
- Large internal breakout areas
- Open plan primary teaching
- Steel frame
- Lightweight cladding & blockwork
- Part L fabric, EPC B
- Mixed mode + earth ducts
- Biomass boiler
- BMS
- D&B contract
Forensics

O&M OK but patchy on BMS
GSHP not lead system
AHU inverters not enabled
CO2 sensors missing
Faulty AHUs
No out-of hour, half-term or holiday operation set
Lighting controls
High server loads

O&M patchy
server room and data hub rooms on the same cooling circuit as the rest of the building
Out-of hour heating & cooling
AHU inverters not enabled
Lighting controls
Metering

O&M patchy
High lighting loads
Metering
BMS – installation, profiling, logs
Zoning not enabled
BMS snapshot: there is both heating and cooling demand for the GSHP units, the control valves linking the sliding header arrangement to the low temperature hot water loop are closed and, therefore, gas-fired boilers take the lead for heating.

External lighting consumption dropped at Pennywell following BPE

Lights next to sun pipes on

Sub-meters installed for chillers in Petchey Academy are not wired up and do not report the electricity intake of the chillers.

Boiler flow temperature is around 70°C over the whole weekend indicating out of hours and unwanted boiler operation.
Energy performance targets | Petchey Academy 360

Petchey Academy
CarbonBuzz sector: Education
Benchmark category: Schools and seasonal public buildings
Completion date: 1/8/2007

Design data
106.4 kWh/m²/yr

Actual data
143.3 kWh/m²/yr

Add New Record

CIBSE TM46 Benchmark
User specified benchmark data - TM22 spreadsheet (6/6/2013)

TM22 operational - TM22 spreadsheet (6/6/2013)

Bills (4/6/2013)
The real performance gap | building size and complexity of services is a major risk

Potential saving on average £50K/yr for buildings >10,000m²
**Occupier feedback** | Architecture is a key determinant of building performance

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247 kWh/m² 290 kWh/m² 211 kWh/m² 166 kWh/m² 125 kWh/m²

“This building makes me feel human”
Conclusions | Costs and risks associated with the Performance Gap

Capital cost of unused/underutilised equipment: Metering, BMS, sensors and controls, AHU inverters, actuators, LZCs, etc. can amount to 2-5% of capital cost

Misplaced value engineering: fabric performance and air-tightness, all openings, floor to floor heights, thermal mass, entrance lobbies, seasonal commissioning, daylighting, controls, training, manuals & log book – compliance or architecture?

Increased management, maintenance and energy costs: between 15-44% of total annual energy costs could be saved amounting to potentially tens of thousands of pounds per year

Mitigation costs: ~ 50% of annual energy costs – Soft Landings with energy disclosure approximately 0.1% of construction budget

Profit loss of consultants and contractors

Productivity loss for occupiers and FM

Policy change is needed to encourage disclosure – reinforce DECs
Conclusions | the cost of POEs

50% of our time went on gathering energy data

20% on chasing client, consultant and contractor teams for design vs as-built data

25% on analysis of the data gathered and additional energy modelling

5% on gathering occupant feedback

Collection and benchmarking must be the contractors responsibility
Targeting Operational Energy Use | Keynsham Civic Centre DEC A target

64% of CO2 emissions are due to ICT.
New types of contracts are needed to enable data sharing from start to end
Some of the design features won:

• Timber windows with 150mm acoustic louvres
• Floor to floor heights – 3.05m
• Vent voids
• Lighting: light shelves, task lighting and voids to North
• Thermal Mass incorporating cooling pipe work
Architecture is a key beneficiary of performance contracting.
ENERGY PEOPLE BUILDINGS

MORE ABOUT OUR BOOK

With Hattie Hartmann and Sofie Pelsmakers