The Performance Gap: A fifteen year journey

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OVALTINE EGG FARM → BEAUFORT COURT

1930s

2003
BEAUFORT COURT: RENEWABLES
BEAUFORT COURT: CARBON EMISSIONS

Tailored benchmark: ECON 19 type 2&3 Good practice

- Actual year 1
  - Electricity
  - Thermal
  - Renewables
  - Net Total Carbon
KTP STUDY WITH UCL

Objective:
To be able to more accurately model and predict actual energy use

Approach:
- Post occupancy study of 15 schools
- Variability of model input parameters
- Sensitivity analysis
- Probability distribution of modelled energy
SENSITIVITY ANALYSIS

Generic school model – Monte Carlo Analysis

Frequency

Annual CO₂ emissions
CLOSE THE PERFORMANCE GAP BY.....

• Identifying key risks and developing mitigation strategies

• Focusing project team on most significant issues

• Helping client understand importance of operational issues

• Supporting client to plan for handover and building operation

• Provide support into operation
KEYNSHAM CIVIC CENTRE: THE BRIEF

Ultimately, the success of the building will be judged on its operational energy use and resultant carbon emissions. Therefore, the current aspiration is that the development should achieve a DEC rating of A by the end of the second full year of operation.
KEYNSHAM CIVIC CENTRE

2015
CLOSING THE PERFORMANCE GAP: OUR APPROACH

- Low energy design – the easy bit!
- Develop an Energy Budget
- Energy risk management
- Embed in contract
- Aftercare programme – monitoring & fine tuning

⇒ Lessons learnt
01 Structure
02 Daylight + Ventilation
03 Thermal Mass
04 Acoustics
05 Ventilation
06 Lighting
07 Acoustics
08 Lighting
09 Day Lighting
10 Services Distribution
ENERGY BUDGET

- PV
- Regulated
- Unregulated

Net CO₂

- Server (incl cooling)

Kg CO₂/m²/year

- Heating
- Refrigeration and heat rejection
- Lighting
- Small power (incl ICT)
- Other

- Hot water
- Pumps
- Server (incl cooling)
- Catering and vending
- PV
ENERGY RISK MANAGEMENT
LIGHTING

RISK

INADEQUATE CONTROLS INSTALLATION AND/OR COMMISSIONING

USERS DON’T UNDERSTAND CONTROLS OR FIND INCONVENIENT

USE OUTSIDE CORE HOURS NOT ALLOWED FOR, EG FOR CLEANERS

MITIGATION

SIMPLIFY CONTROL STRATEGY

ENGAGE WITH USERS DURING DESIGN

CALCS TO CONSIDER OUT-OF-HOURS USE

MONITOR COMMISSIONING

REVIEW PERFORMANCE POST OCCUPANCY AND FINE-TUNE
EMBEDDING THE ENERGY BUDGET IN THE CONTRACT

Assumptions:

- Lighting
  - Lux levels
  - Power density
  - Controls as specified
- Task lights
  - Hours of operation
  - External illuminance
- 31,000 kWh
- 16,000 kgCO₂
AFTERCARE:
MONITORING & VERIFICATION

Monitor → Review → Identify → Adjust → Monitor
Keynsham - Estimated DEC Rating
Past 12m Cumulative CO2 ratio basis - actual vs budget

DEC Rating Band

A
B
C

DEC rating scale


0 25 50 75
Internal Lighting - energy use per month

58% reduction, year 1 to 1+9mth
**Display Energy Certificate**

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicators of all buildings of this type. There is more advice on how to interpret this information on the Government’s website www.communities.gsi.gov.uk/epc.

**Energy Performance Operational Rating**

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed. They represent comparative energy efficiency. 100 would be typical for this kind of building.

- **A** 0-25: More energy efficient
- **B** 26-50: 36
- **C** 51-75
- **D** 76-100
- **E** 101-125
- **F** 126-150
- **G** Over 150: Less energy efficient

**Total CO2 Emissions**

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO2.

**Previous Operational Ratings**

This tells you how efficiently energy has been used in this building over the last three accounting periods.

**Administrative Information**

This is a Display Energy Certificate as defined in SI 2007/391 as amended.

- **Assessment Software:** EPCsoft Lite
- **EPC Version:** 2.6
- **Assessment Date:** 27/07/2017
- **Assessment Rating:** A

**Technical Information**

- **Annual Energy Use (kWh/m²/year):**
  - Heating: 31
  - Electricity: 38
- **Typical Energy Use (kWh/m²/year):**
  - Heating: 118
  - Electricity: 95
- **Energy from renewables:**
  - 0.0% Heating, 19.7% Electricity
KEYNSHAM: CARBON EMISSIONS

- DEC benchmark (TM46)
- Energy budget, stage D
- Actual year 1
- Actual year 2

Carbon emissions kgCO₂/m²

- Electricity
- Thermal
- Renewables
- Net Total Carbon
WORKED WELL

Client leadership
Passive robust design
Energy Budget/Contract
Limited VE
Contractor is still there !?
Commissioning Manager
Delivered within local authority budget
Client is very proud of the building

COULD DO BETTER

M&E contractor
Lighting controls
BMS
Energy metering
PERFORMANCE GAP

Beaufort Court

- Design Target
- Actual year 2

Keynsham Civic Centre

- Energy budget, stage D
- Actual year 2

Carbon emissions kgCO₂/m²

- Electrical
- Thermal
- Renewables
- Net Total Carbon

MAX FORDHAM
COMPLEXITY HYPOTHESIS

Theoretical energy efficiency

Performance gap

Diminishing returns

Complexity
THE PERFORMANCE GAP IS AS MUCH ABOUT PEOPLE AND COMMUNICATION AS TECHNOLOGY.