

Understanding occupancy and behaviour to influence heating system design and specification

Dr James Bishop SFHEA FCABE C.Build E

Recent Collaborating Partners (Research):

Luton Borough Council (UK Local Government)

St Albans City and District Council (UK Local Government)

Dacorum Borough Council (UK Local Government)

Central Bedfordshire Council (UK Local Government)

Summary

Key Interests:

- Net Zero drivers and impact (housing)
- Heating and energy efficiency in built environment
- Mould, damp and condensation in housing
- Innovative cross-disciplinary pedagogic practice (with a focus on climate change responses)



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Recent Projects

Recent funded projects:

'Energetic Lifestyles: Engaging young people in the development and implementation of carbon reduction initiatives'. Luton Borough Council (Funding: Local Government Agency/Improvement and Development Agency for Local Government (IDEA) 2021-22).

'Energetic Lifestyles NZIP Accelerator' project. Luton Borough Council (Funding: Local Government Agency/Improvement and Development Agency for Local Government (IDEA) 2022-23).

'Condensation in Housing: Systems, Engagement and Net Zero'. Dacorum Borough Council (Funding: Local Government Agency/Improvement and Development Agency for Local Government (IDEA) 2022-23).

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Collaborating Partners (Research):

Voytech Systems

Nihuis Industries

Current focus/projects

Occupancy-Driven Predictive Heating Analysis

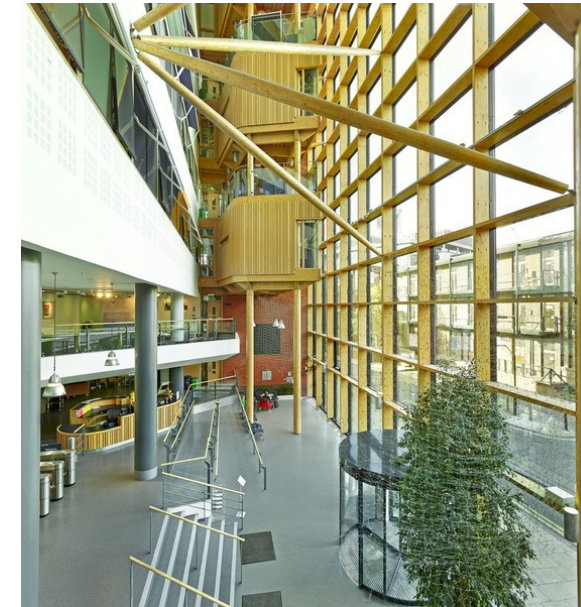
- Internally funded project (LSBU) - in collaboration with technology providers
- Data from LoRaWAN (IoT) sensors to achieve individual monitoring/control of occupied rooms
- Occupancy state/level, air quality and room status information
- Determining control targets for heating
- Occupancy & heating demand modelling for buildings (Digital Twin/3D model)
- 'Active' and 'control' rooms/spaces

- **LSBU Keyworth Building, LSBU Campus, UK**
- Luton Borough Council - Climate Action Teachers Champions CATCh initiative (schools) – **Ramridge Primary School, Luton, UK**

Keyworth Building, LSBU Campus

Source:

<https://www.oliverheinemann.de/projects/lsbu/444.html>



Ramridge Primary School, Luton, UK

Source:

<https://www.ramridge.co.uk/g11/>



Some context – Somerset House, UK (Smart Heating Project Case Study)

A large neoclassical building/complex situated in central London

- Dates back to the 1800s
- Current tenants - organisations centred around arts/education
- 766 radiators



Somerset House

Source: <https://www.somersetthouse.org.uk/plan-your-visit>

The LoRaWAN system at Somerset House:



Device control panel that controls a total of 250 devices.



Range extender that plugs into the sites broadband to accommodate the signal strength to the device panel and the devices.



Note: Digital Display!

Thermostatic Radiator Valve sensor head. Device scanned and sent to the S-BMS control system.



Window/Door Switch sensor. Device scanned and sent to the S-BMS control system.



Temperature room Motion sensor. Device scanned and sent to the S-BMS control system.

Some context – Somerset House, UK (Case Study)

Cloud-based data collection / interpretation (dashboards)



Summerset House
Source: <https://www.somersetthouse.org.uk/plan-your-visit>

System: graham.warner@nijhuisindustries.com

User: User

Documents: User: Sites

- Sites
 - ENGINEERS
 - Somerset House
 - SHNew Block 1: OPEN
 - SHNew Block 2: OPEN
 - SHNew Block 3: OPEN
 - SHSouth Wing 1: OPEN
 - SHSouth Wing 2: OPEN
 - SHWest Wing 1: OPEN
 - SHWest Wing 2: OPEN

Main Control System Menu

Siteid: 145280
Login: ENGINEER

Zone	Mode	Heating	Setpoint	Sensor	Alarm
Second Floor/S1	OCCUPIED	ON	21.0 °C	20.7 °C	OK
Second Floor/S2	OCCUPIED	ON	21.0 °C	20.2 °C	OK
Second Floor/S3	OCCUPIED	OFF	21.0 °C	21.7 °C	OK
Second Floor/S4/5	OCCUPIED	ON	21.0 °C	20.6 °C	OK
Second Floor/S6	OCCUPIED	ON	21.0 °C	19.9 °C	OK
Second Floor/S7	OCCUPIED	ON	21.0 °C	21.0 °C	OK
Second Floor/S8/10	OCCUPIED	ON	21.0 °C	21.0 °C	OK
Second Floor/S11	OCCUPIED	ON	21.0 °C	20.9 °C	OK
Second Floor/S12	OCCUPIED	OFF	21.0 °C	20.9 °C	OK
Second Floor/S13	OCCUPIED	ON	21.0 °C	21.1 °C	OK
Second Floor/S14	OCCUPIED	OFF	21.0 °C	19.9 °C	OK
Second Floor/S16	OCCUPIED	ON	21.0 °C	20.3 °C	OK
Second Floor/S17/18	OCCUPIED	ON	21.0 °C	20.9 °C	OK
Second Floor/S19A	OCCUPIED	ON	21.0 °C	20.9 °C	OK
Second Floor/S20	OCCUPIED	ON	21.0 °C	21.1 °C	OK
Second Floor/S21	OCCUPIED	OFF	21.0 °C	21.6 °C	OK
Second Floor/S22	OCCUPIED	ON	21.0 °C	20.6 °C	OK
Second Floor/S23	OCCUPIED	OFF	21.0 °C	24.5 °C	OK
Second Floor/S24	OCCUPIED	ON	21.0 °C	20.0 °C	OK
Second Floor/S19B	OCCUPIED	ON	21.0 °C	20.9 °C	OK
Second Floor/S8	OCCUPIED	OFF	21.0 °C	19.8 °C	OK

West Wing 3rd floor Zones Room numbers and room space temperatures

Siteid: 145280
Login: ENGINEER

Cloud: SH/West Wing 2

Dashboard: 17: Second Floor/S20

COMMISSIONING MODE

Overview

Control Zone 17 Second Floor/S20
TRV Zone Type: TRV Central Control

Zone Operation	Value
Zone Operation	Auto
Zone Run Advance	ON
Zone Run Inhibit	OFF
Zone Mode	OCCUPIED
Heat Available	1.00
Heat Demand	2.00

Occupied Room Setpoint: 21.0 °C
Current Setpoint: 21.0 °C
Zone Sensor: 21.2 °C

Graph: Zone Sensor (blue line) vs Current Setpoint (red line) over time (12/12/22 to 14/12/22).

Individual Room set point data & an operational Room/TRV Sensors graph.

Siteid: 145280
Login: ENGINEER

Cloud: SH/West Wing 2

Dashboard: 17: Second Floor/S20

COMMISSIONING MODE

Devices

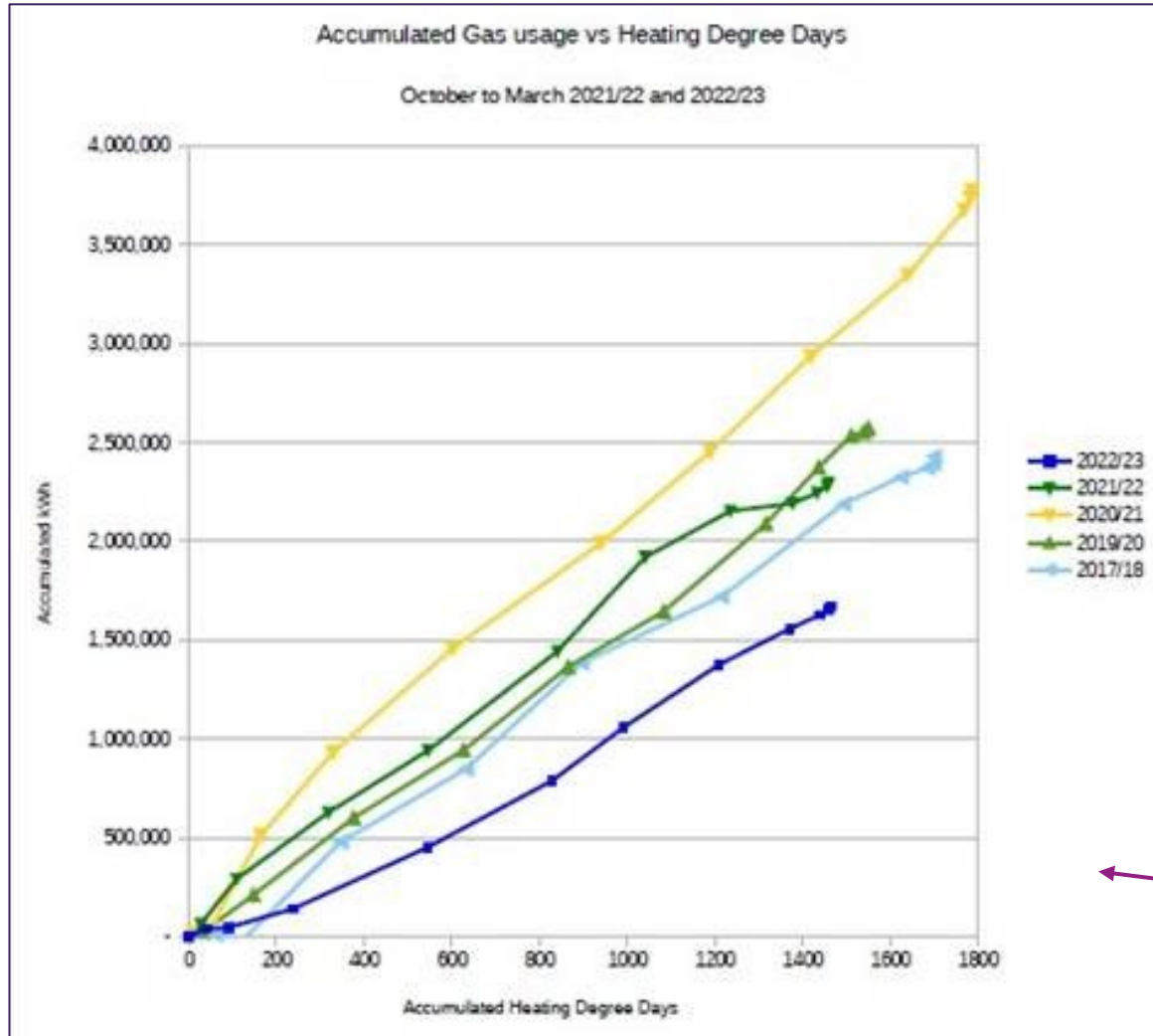
Sensors	Ref	Flags	Room	RH %	Motion
S/20/RESP1	K01RES-0000	🟢	21.30 °C	28 %	0

TRVs	Ref	Flags	Head	Target	Open	Demand
S/20/TRV1	4VQ2037725WALX	🟢	29.8 °C	21.0 °C	28.0 %	1
S/20/TRV2	DZB,K36941ME9	🟢	30.3 °C	21.6 °C	26.9 %	1

Individual Room data & Room/TRV Sensors info

Slide images/content courtesy of Nijhuis Industries

Some context – Somerset House, UK (Case Study)



This project proposed and managed by NSI saved Somerset House over million Kilowatts of gas.

Initial analysis of the data indicates around 30% savings overall on utilities bills, but as the analysis progresses, further saving are anticipated.

Please note: The data collected was only for two thirds of the heating season (2022/23). There should be further savings from this winter period (October to March). Once the data is received this will facilitate calculation of detailed payback on investment

This graph captures the gas usage data from 2017 to the end of 2022/23 heating season at Somerset House

Thank you for listening!