Building energy modelling

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April 2018

Introduction

Aecom commissioned by TfL to carry out TM54 energy prediction for the S6 building at International Quarters

– Offices served by passive chilled beams and trench heating

– Sophisticated closed cavity facade system

Closed cavity facade system

– Double skin system with single-glazed outer and double-glazed inner

– Cavity is permanently pressurized with dry-air

– Automatic blinds in cavity keep solar to perimeter zones below 40 W/m²

CIBSE TM 54

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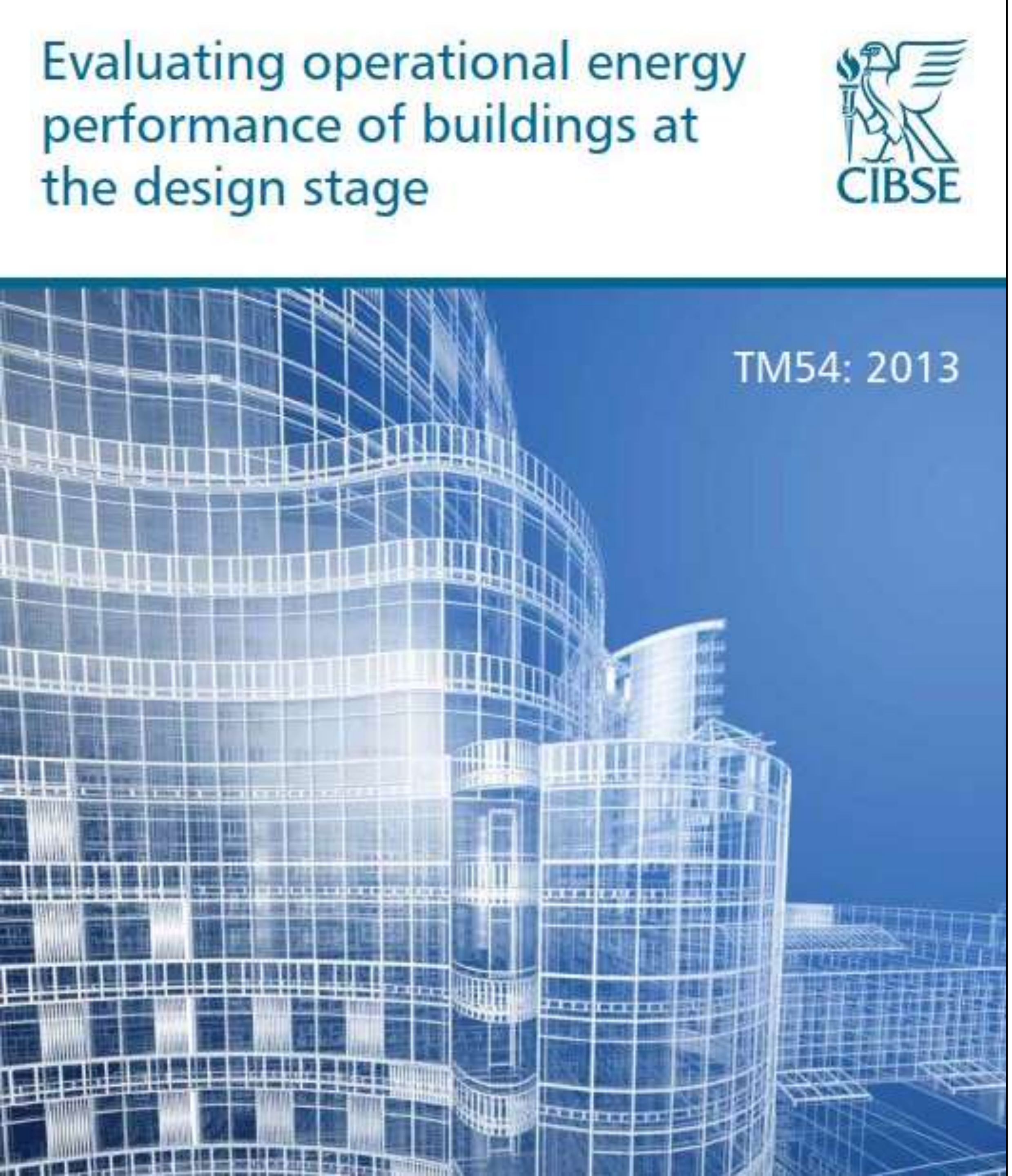


Technical memorandum 54

This document outlines the areas where building energy modelling can be improved.

Similar to energy modelling required by ASHRAE 90.1 for Leed which focuses on HVAC plant

Reasons for more accurate energy modelling

During design stage

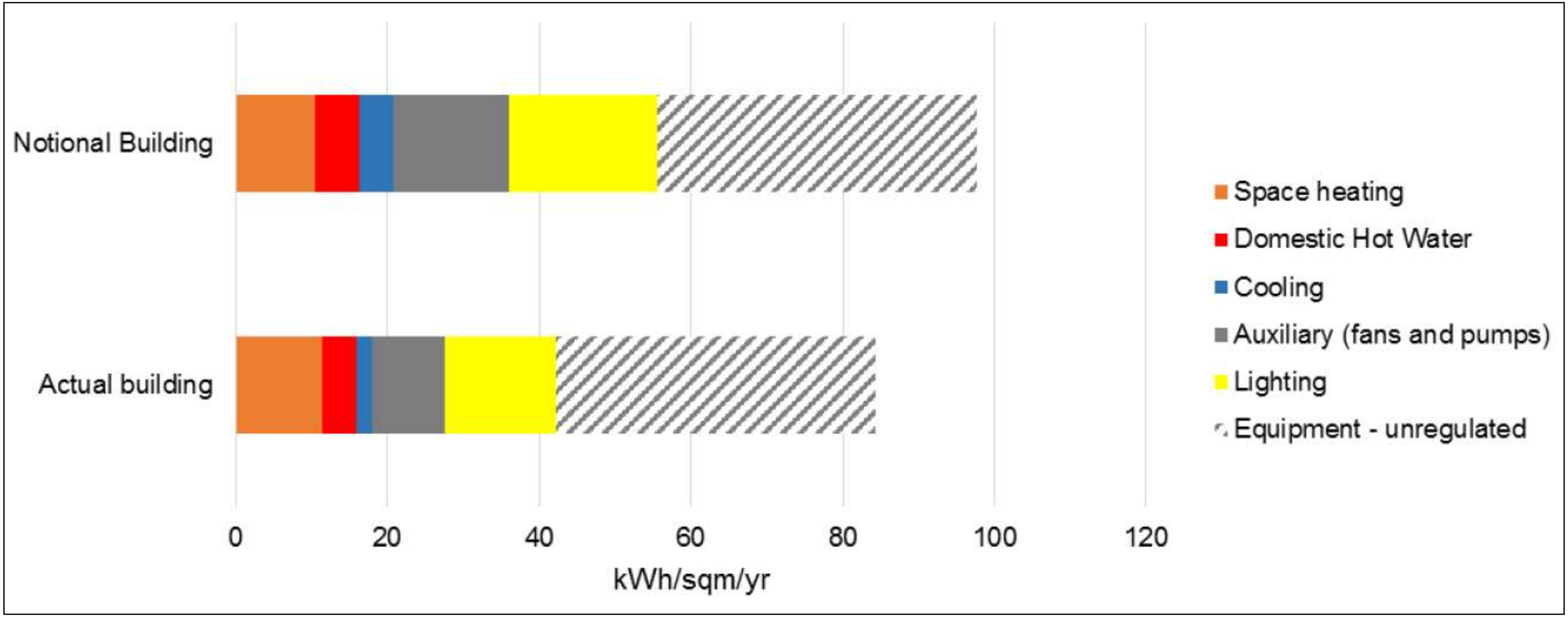
– Better understanding operational cost (e.g. for use in life cycle analysis)

– More reliable comparison of design options

Practical completion and beyond

– Used in the commissioning and optimization of building systems

Part L compliance results



Energy model for Building S6

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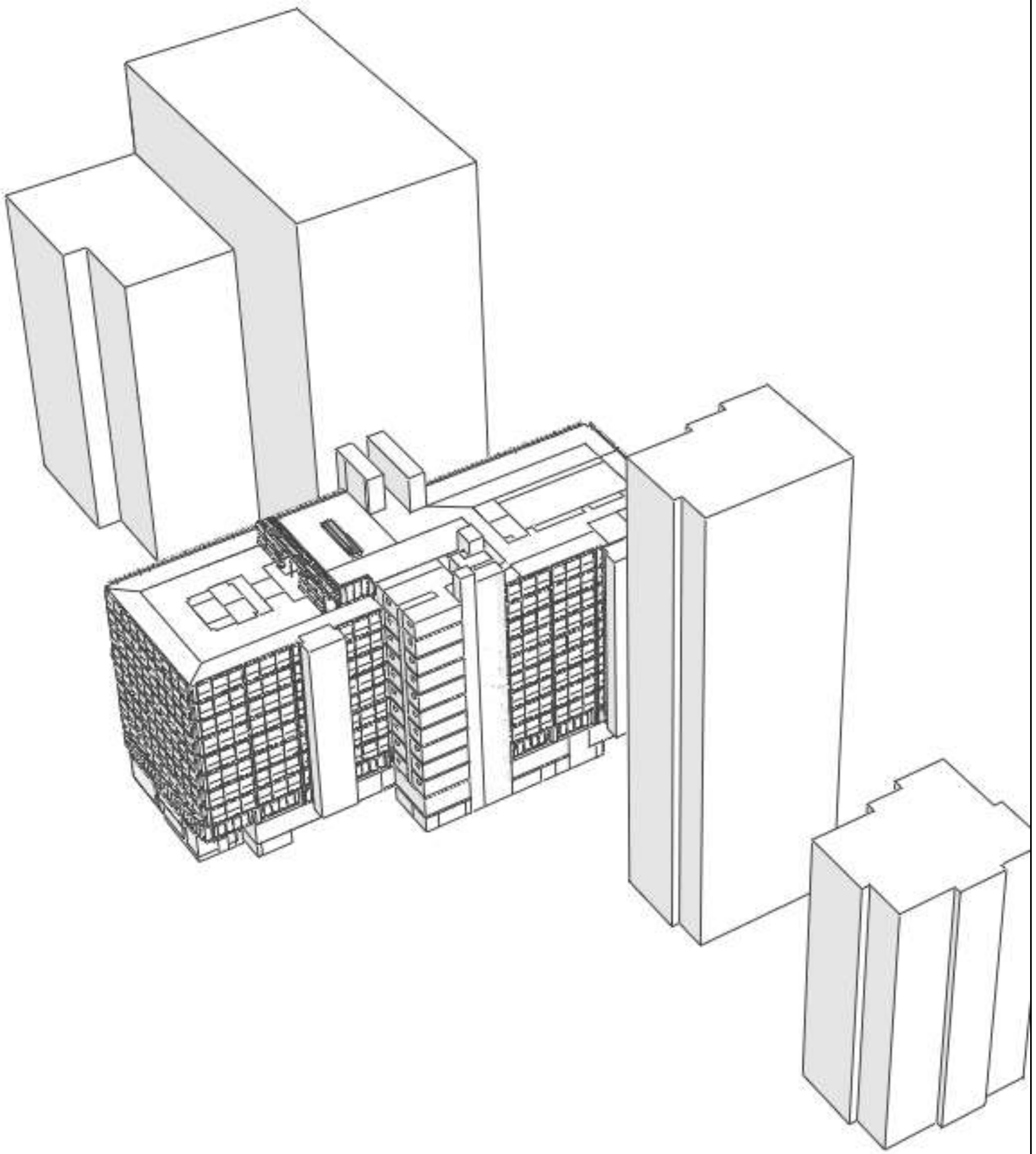

Energy model for Building S6

- Created in IES software and incorporates the apHVAC module
- Each close cavity facade module is treated at separate thermal zone
- Automatic blinds modelled dynamically (solar and daylight)

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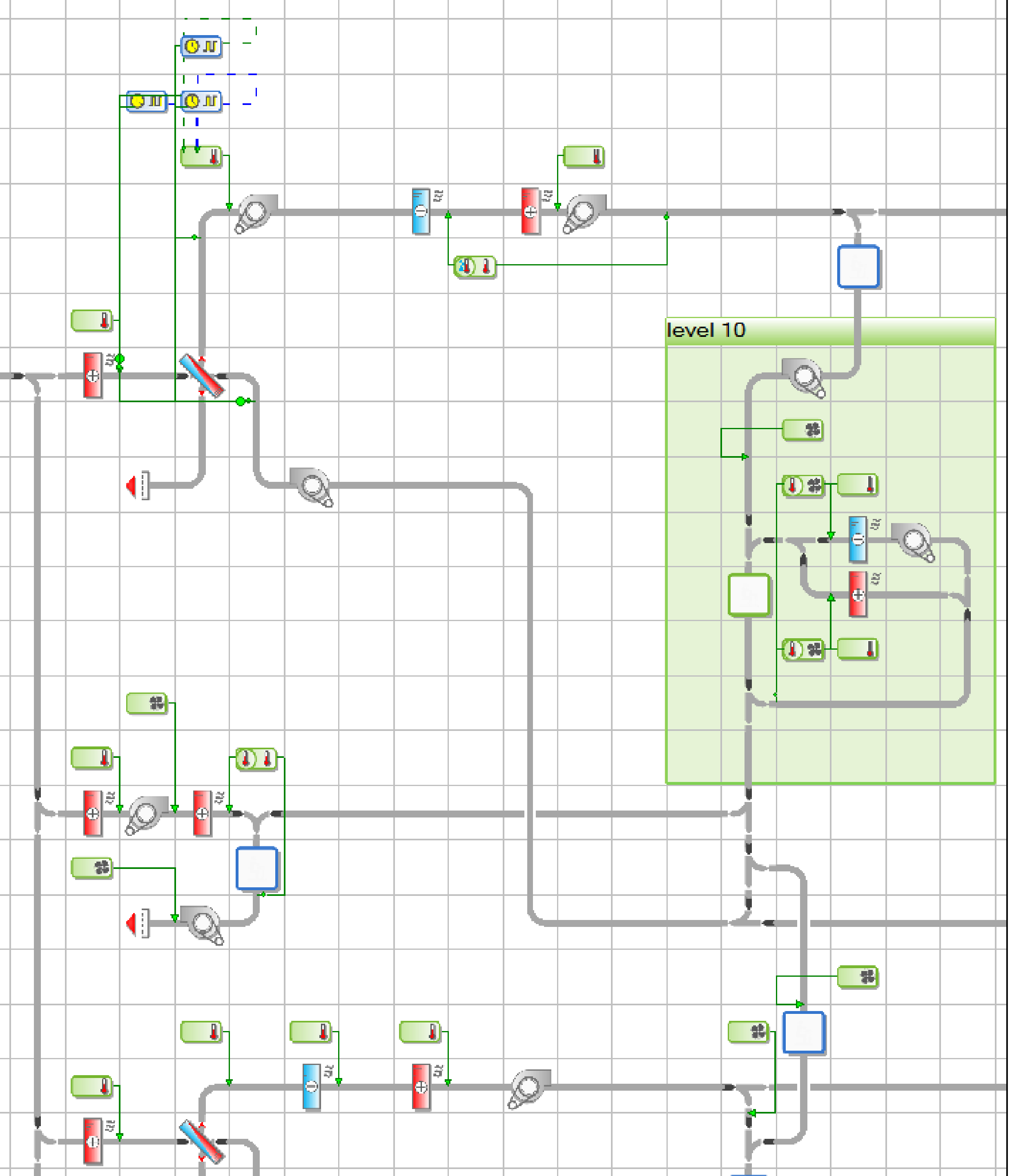

IES apHVAC module

– The apHVAC module is mainly used for ASHRAE 90.1 modelling

– Time consuming to set-up HVAC system

– More flexibility in modelling actual HVAC configuration

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Main reason for using apHVAC module

- **Dehumidification energy required for chilled beams**
- **Pre-heat coil energy not accounted for in normal simulation**
- **Energy recovery both in terms of sensible and latent**
- **Air transfer between zones (e.g. floor plenums, WC make-up air)**
- **Better accounting of fan and pump energy**

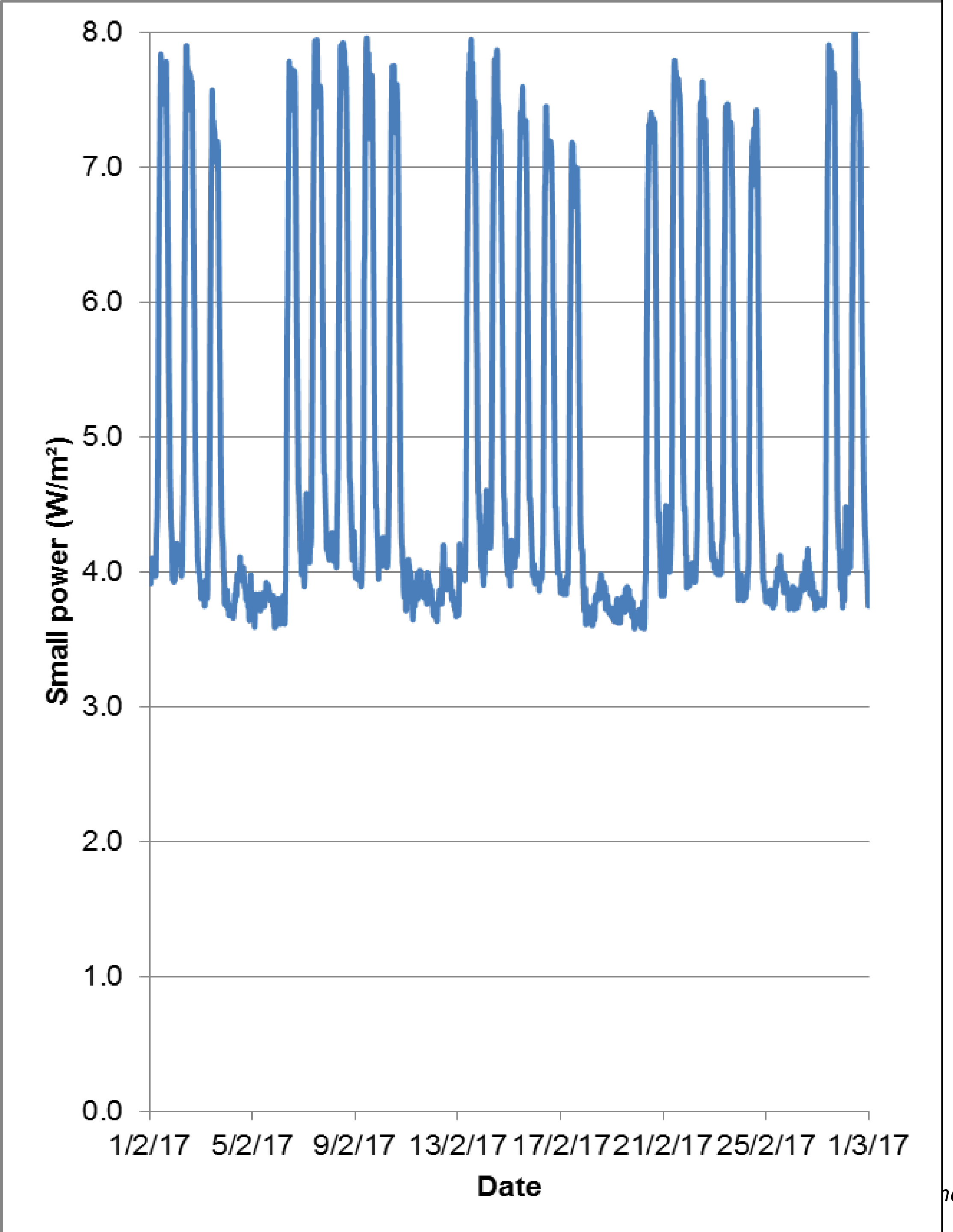
Other benefits of using apHVAC module

– **Cooling coil latent loads (e.g. FCUs)**

– **Can account for weather compensation**

– **Detailed chiller / boiler performance algorithms give more reliable seasonal efficiency predictions**

– **More flexibility in modelling how HVAC plant is controlled**



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Measured data from Tfl offices

- Office equipment
- Lifts (29 kWh/year/workstation)
- Servers (57 kW)
- DHW (3.8 ltr/workday/workstation)

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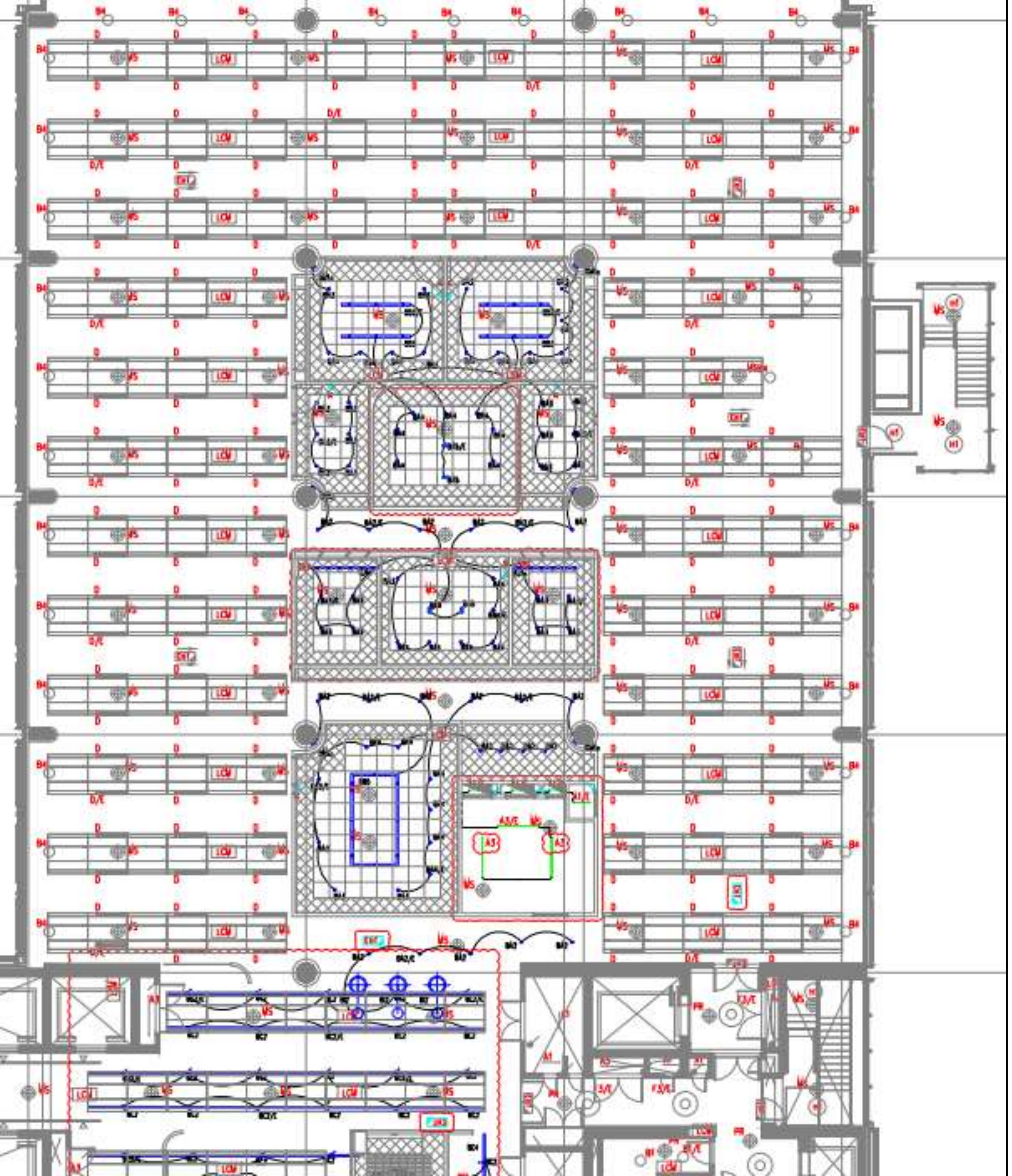

Lighting energy

– Design values of ~5 W/m²

– Parasitic load for controls and emergency/exit lighting ~0.5 W/m²

– Around 75 lighting control modules in typical floor

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Miscellaneous loads

– Reception infiltration and air-curtains

– Plant room extract fans

– Compressor/dehum/blinds motors for closed cavity facade (~20 MWh/year)

– Kitchen equipment (walk in freezers, ovens, etc)

– Kitchenettes on each floor (i.e. hot drinks, glass wash, microwave, fridges)

Weather data

Weather data	Period	HDD	CDD	Source
London TRY weather data	1984 to 2013	1778	267	CIBSE
Thames Valley – 20 year average	1996 to 2016	1832	389	VESMA
St James park – 5 year average	2012 to 2016	1666	360	BIZEE
Islington 2030 (a1b 50%) TRY	2020 to 2050	1466	417	Prometheus
Islington 2050 (a1b 50%) TRY	2040 to 2070	1321	527	

Unknowns

- Heating and cooling systems fighting
- Actuators not working properly or not closing completely
- Accuracy of temperature sensors
- Unknown parasitic loads

Predicted energy demand

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Comparison of “year one” energy demand

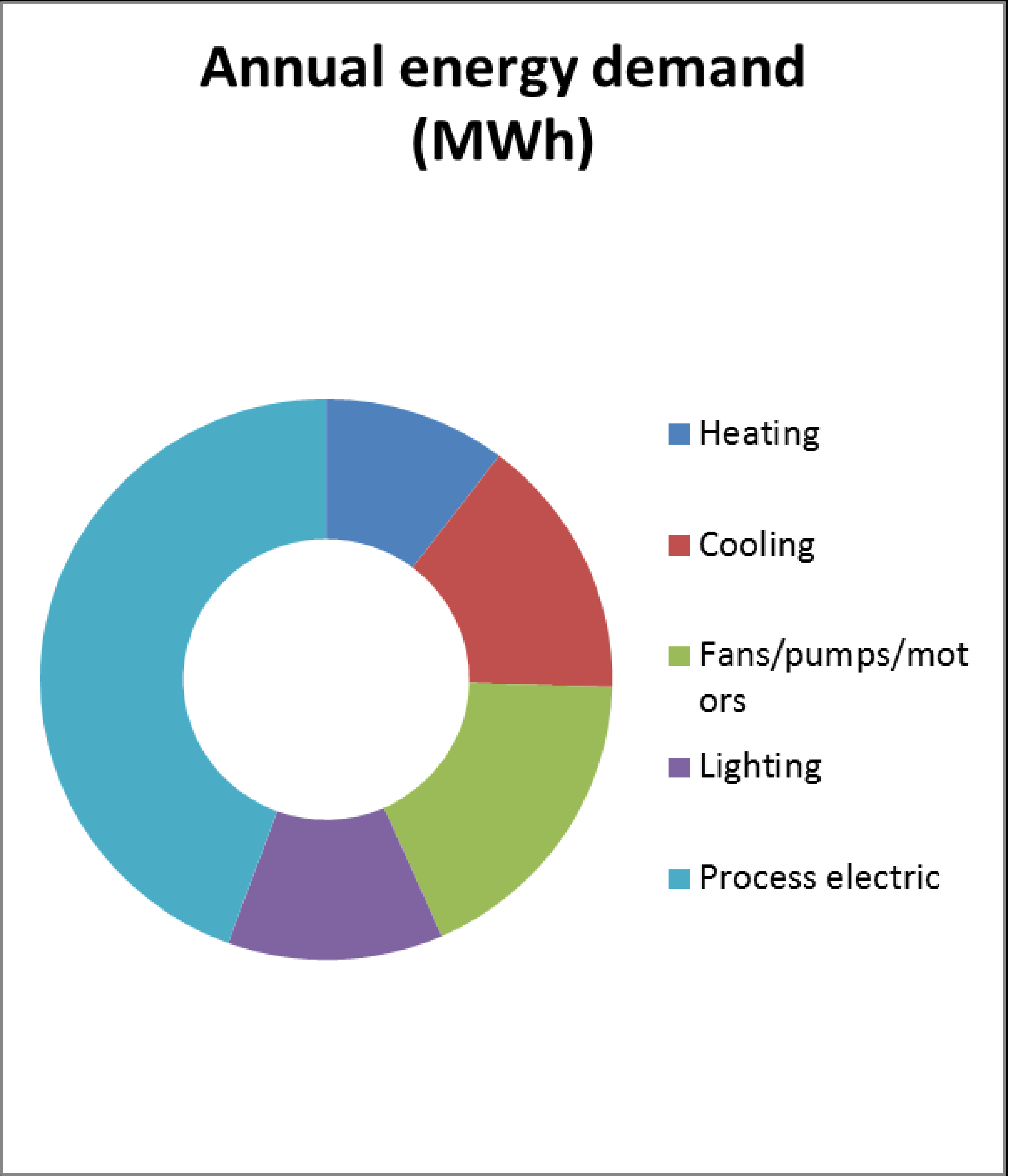
MWh/year	Heating	Cooling	Fans/pumps/motors	Lighting	Process electric
Part L minimum	1848	2024	673	545	1741
Single skin with shading	1550	2116	678	545	1741
Close cavity facade	1567	2292	703	478	1741

Close cavity facade with different TRY tapes

MWh/year	Heating	Cooling	Fans	Pumps	Lighting
London TRY	1603	2089	634	53	474
Islington 2030 TRY	1530	2496	634	64	473
Islington 2050 TRY	1471	2646	634	68	473

Comparison of annual carbon and cost

	London TRY		2030		2050	
	tonCO2	£	tonCO2	£	tonCO2	£
Part L minimum	805	229,707	838	237,919	849	240,003
Single skin with shading	800	224,124	834	233,263	845	235,742
Close cavity facade	795	224,265	833	234,403	845	237,336



Areas for optimization

– Reducing dehumidification energy with heat-pipes

– Varying primary air supply conditions seasonally

– Minimize fan run hours

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