

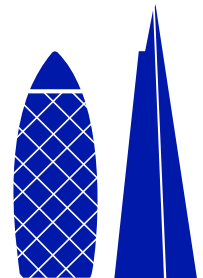
CIBSE HVAC Group: Predicting & Optimising HVAC Performance

Reality Check for TfL's latest Head
Office Building



EVERY JOURNEY MATTERS

Transport for London & the Greater London Authority



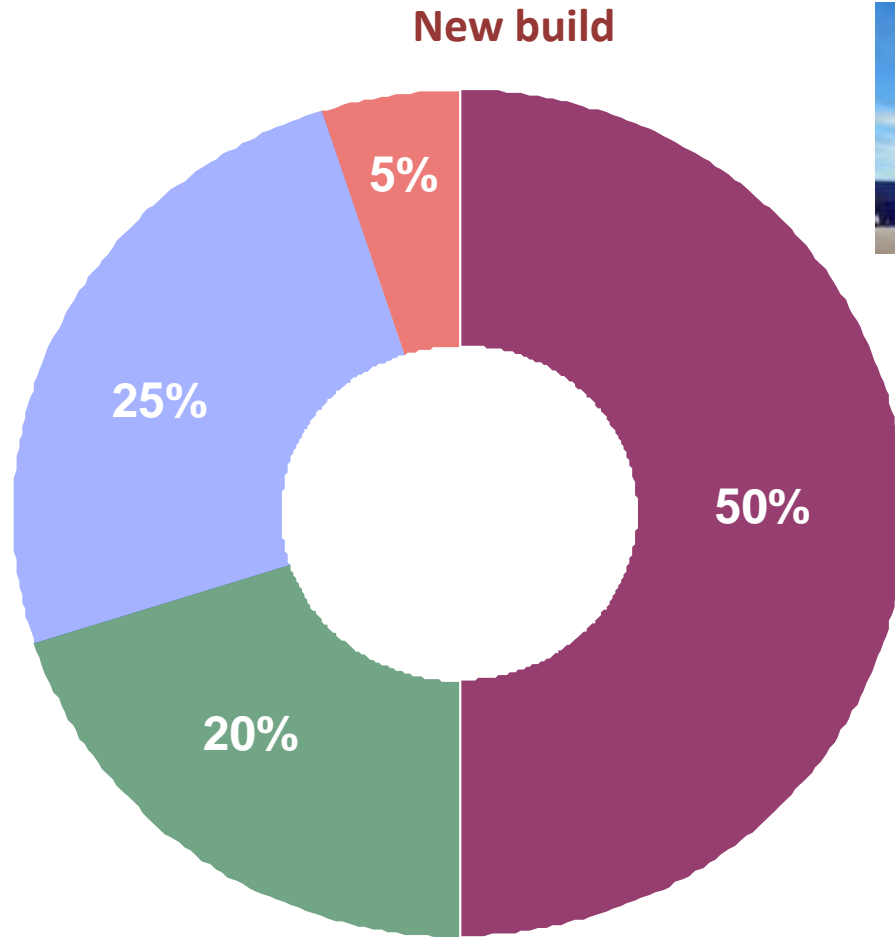
Mayor's CO₂ target – 60% reduction by 2025



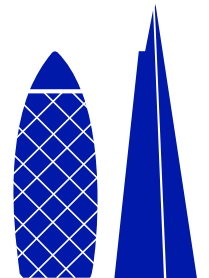
Behavioural change



Energy efficiency

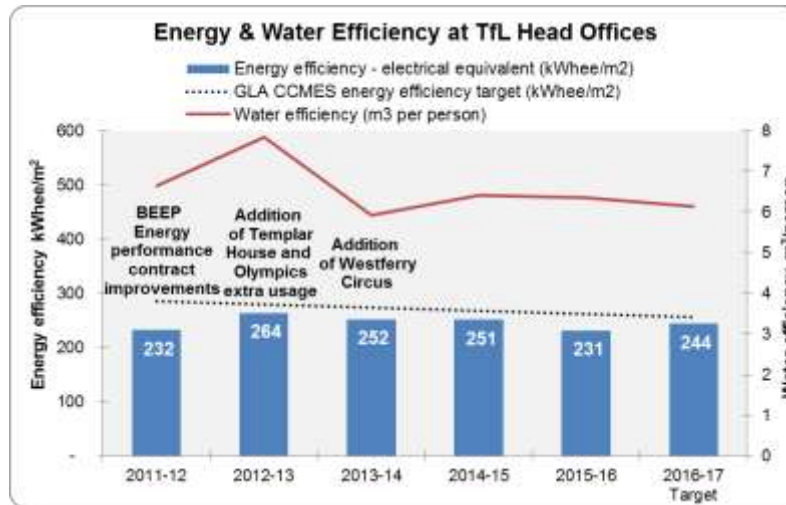
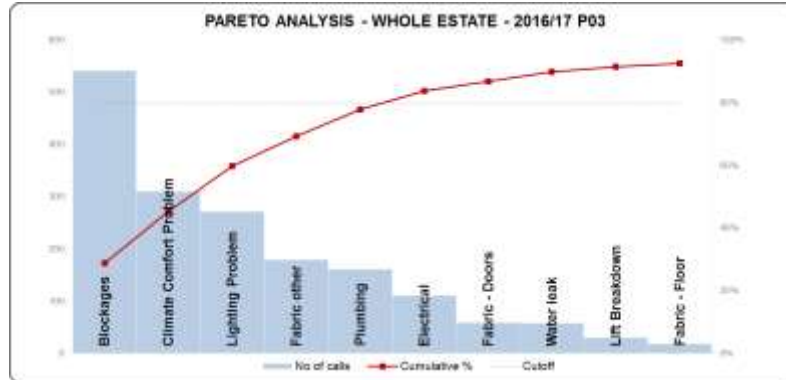


Decentralised energy supply

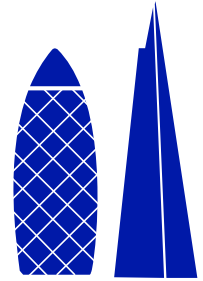


Infrastructure & Sustainability team key work streams

- Asset management and performance
- Utility contract management (£5m pa)
 - GLA 60% CO₂ reduction target by 2025
 - TfL-wide 40% CO₂ reduction 2013-25
 - Head offices 33% water reduction by 2031
- Capex programme (£3m pa):
 - Sponsor & act as Landlord representative
 - Technology review and roll out when appropriate, from LEDs to BMS monitoring enhancements to energy performance contracts
- Maintain external accreditation:
 - Statutory DEC reporting
 - Carbon Trust Standard
 - CHPQA at 2 sites
- Behavioural change campaigns
- Best practice promotion:
 - Better Buildings Partnership
 - CIBSE Task groups



Let's power down!
 You can help save the environment and money.
 Click for more info [Destination Green](#)



Reality check 1: 5ES sold to



Reality check 2: Facade change from BSF to CCF

Summary



Base Design - External Brise Soleil

- 3m Unitised Panels
- Double Glazing / Insulated Spandrel
- External Fixed Brise Soleil
- 55-60 % Visual Light Transmission
- Achieves Base Thermal Insulation Requirements
- Achieves Base Acoustic Performance Requirements
- Number of External Louvres Varies Depending on Orientation



Closed Cavity Facade

- 3m Unitised Panels
- Full Height Triple Glazing
- Automatically Controlled Solar Blind within Cavity - Potential to Reduce Solar Gain beyond Base Requirement (Reduced Energy Consumption)
- 70 % Visual Light Transmission
- Improved Thermal Performance
- Enhanced Acoustic Performance
- Automatic Solar Control Blinds Controlled by Multiple Sensors so more Sensitive to Changing External Conditions



Reality check 2: The CCF exam question

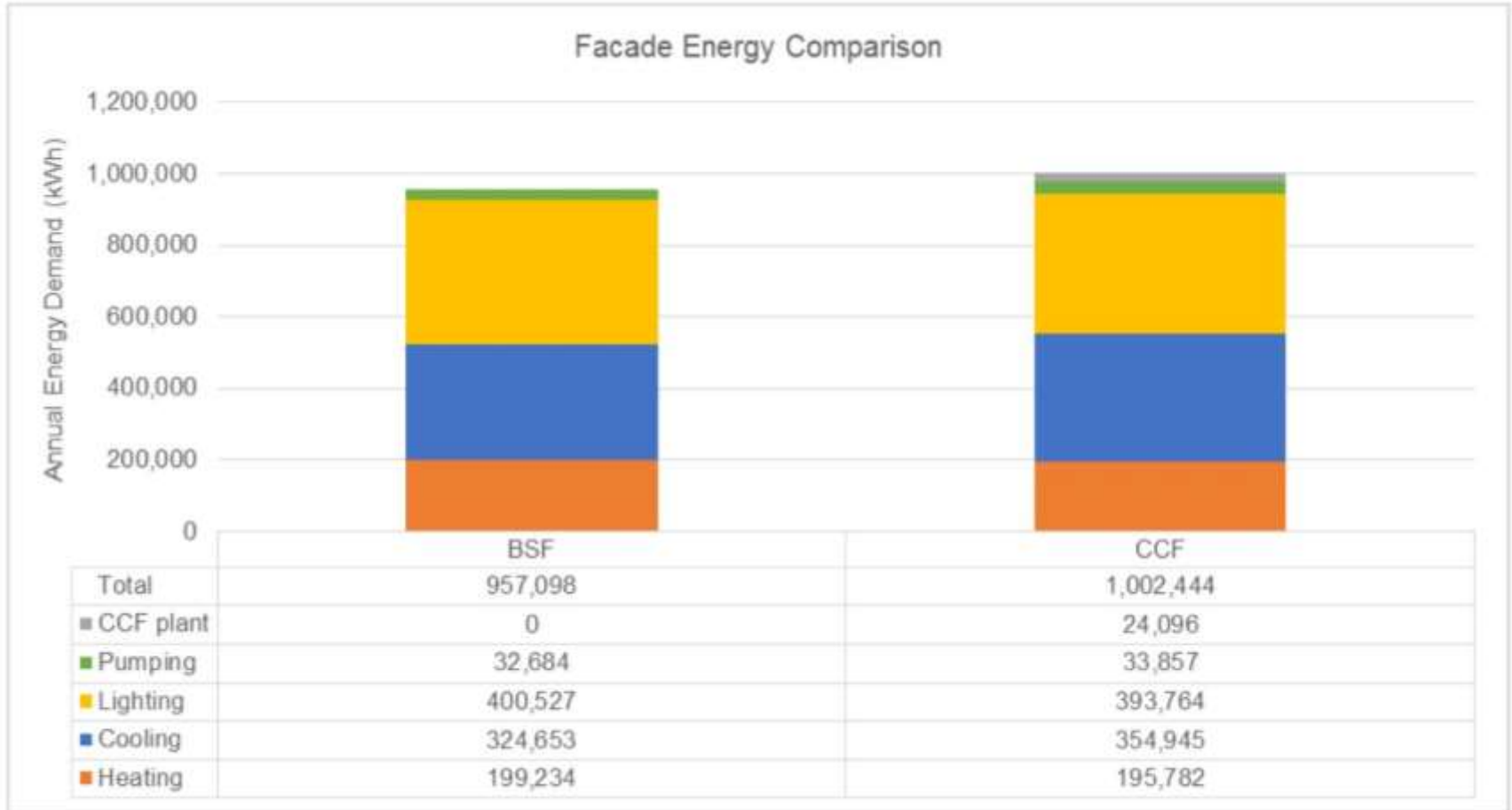


Figure 6 Annual Façade Energy Comparison using CCF BBD Compliance Control Strategy (kWh)

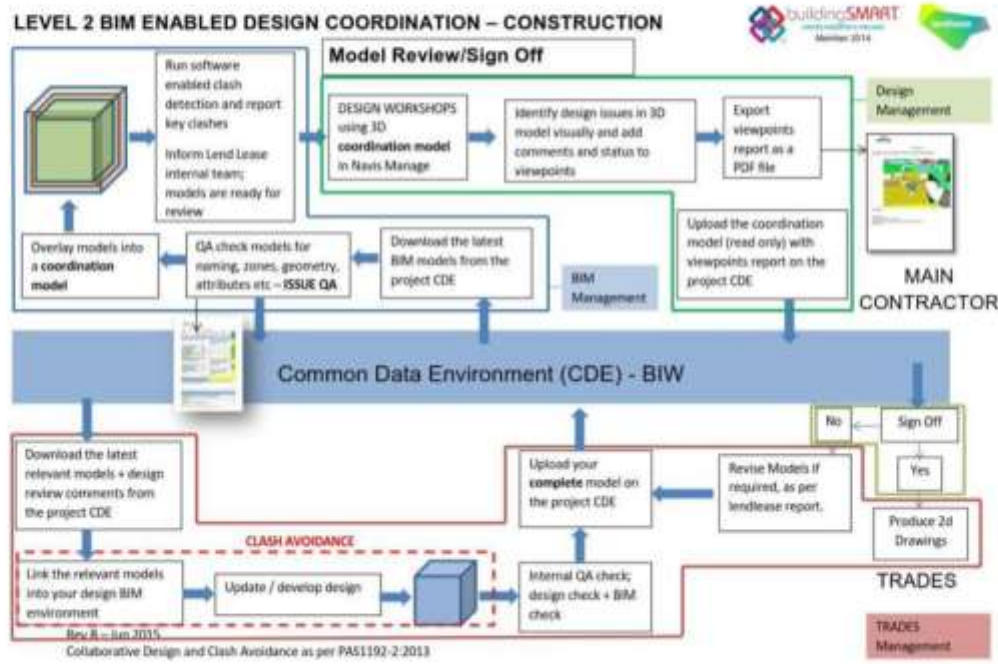


Reality check 3: What is BIM level 2?

THE INTERNATIONAL QUARTER LENLEASE CONSTRUCTION - BIM IMPLEMENTATION PLAN S06 – CAT B

6.0 BIM MODELREVIEW AND SIGN OFF PROCESS

We will adopt the following process as part of our design management and coordination process during construction,



Reality check 4: Meter choice & commissioning



E Del 47.481 MWh

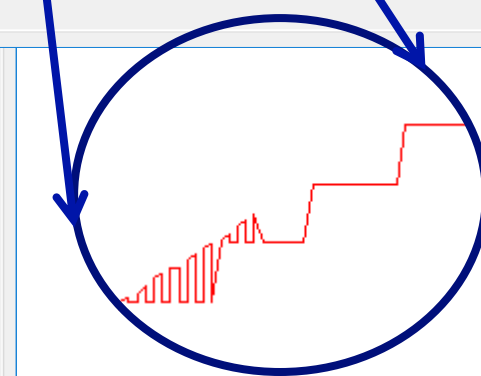
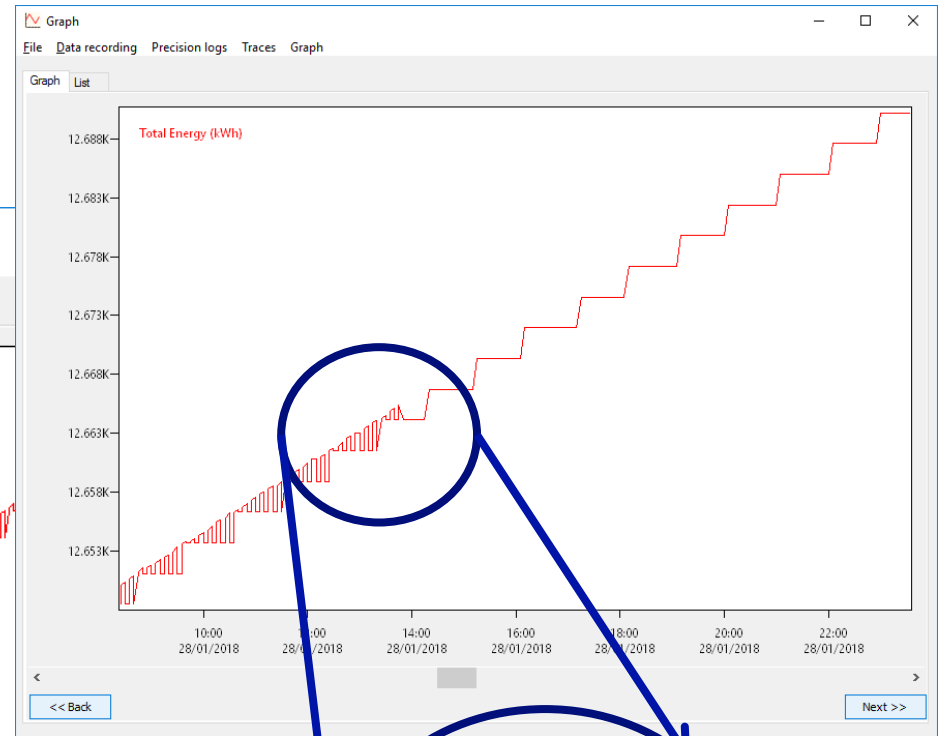
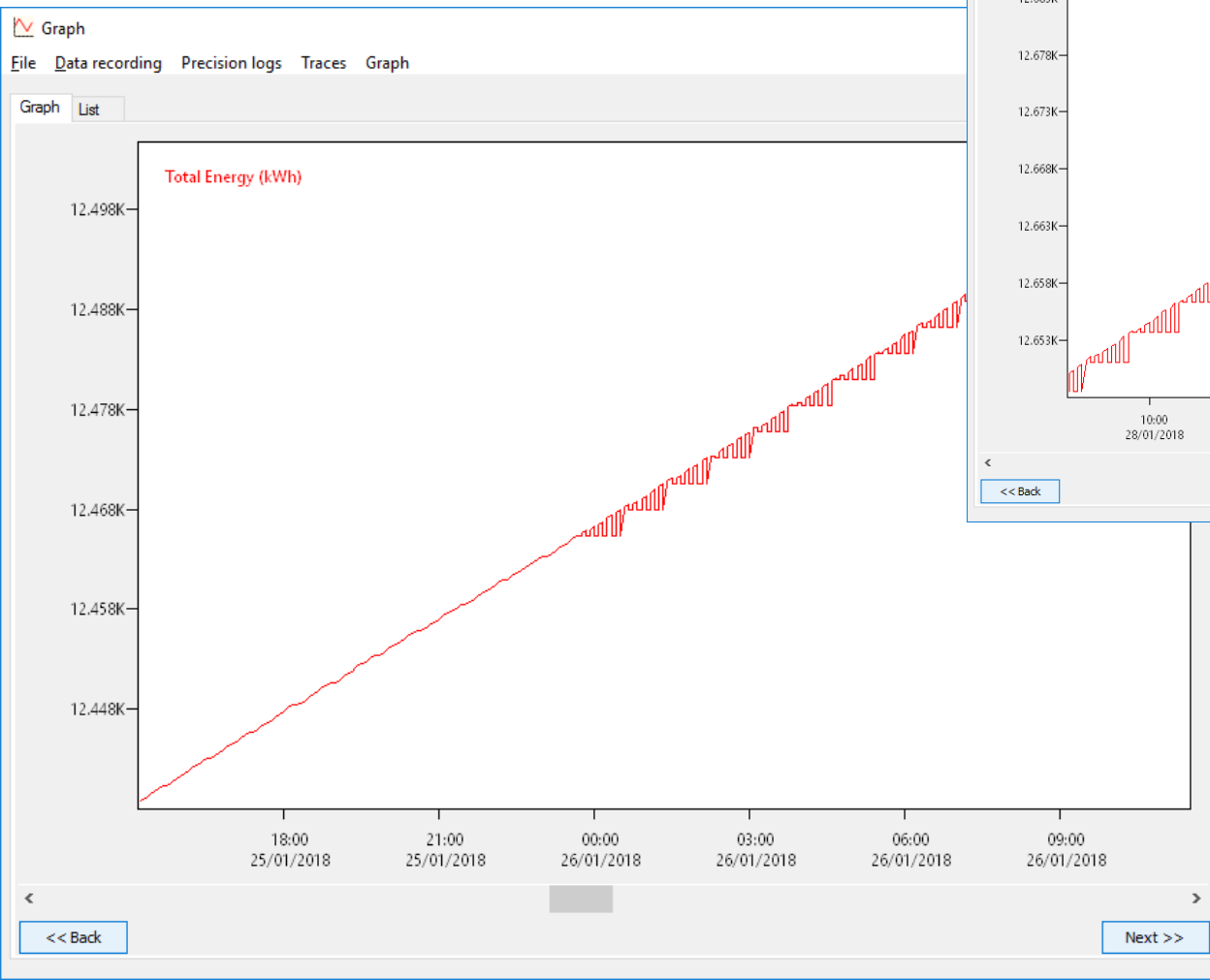
E Del 165.07 kWh

E Del 84.649 kWh

E Del 81.00 Wh

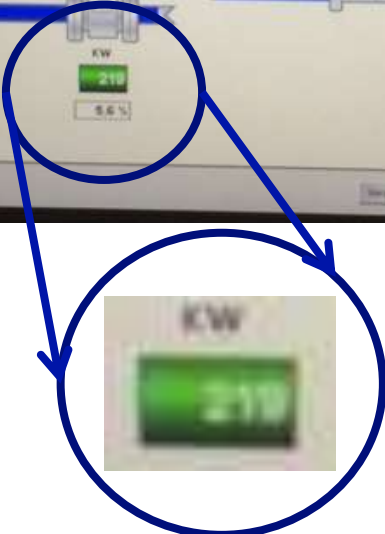
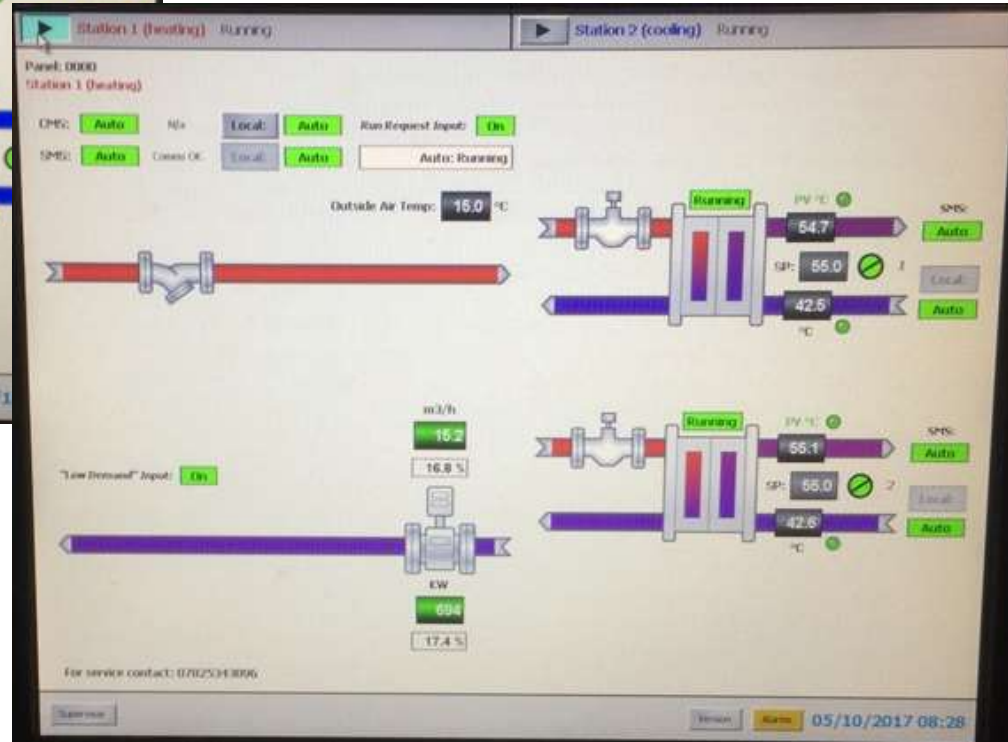
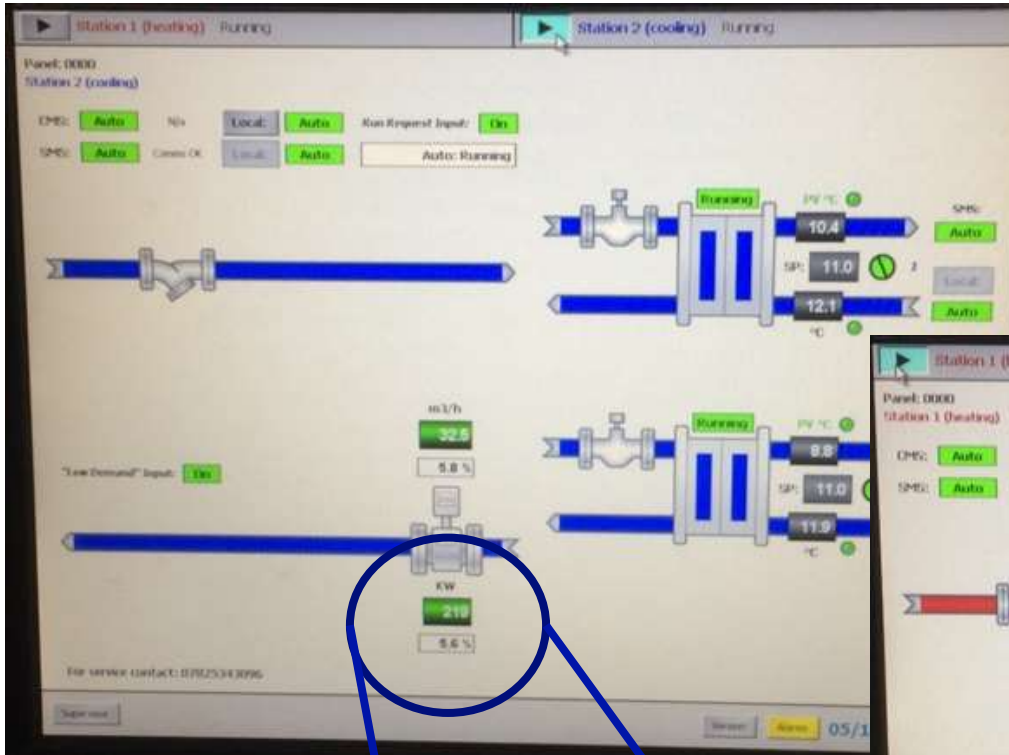


Reality check 4: Is the BMS meter data trustworthy?

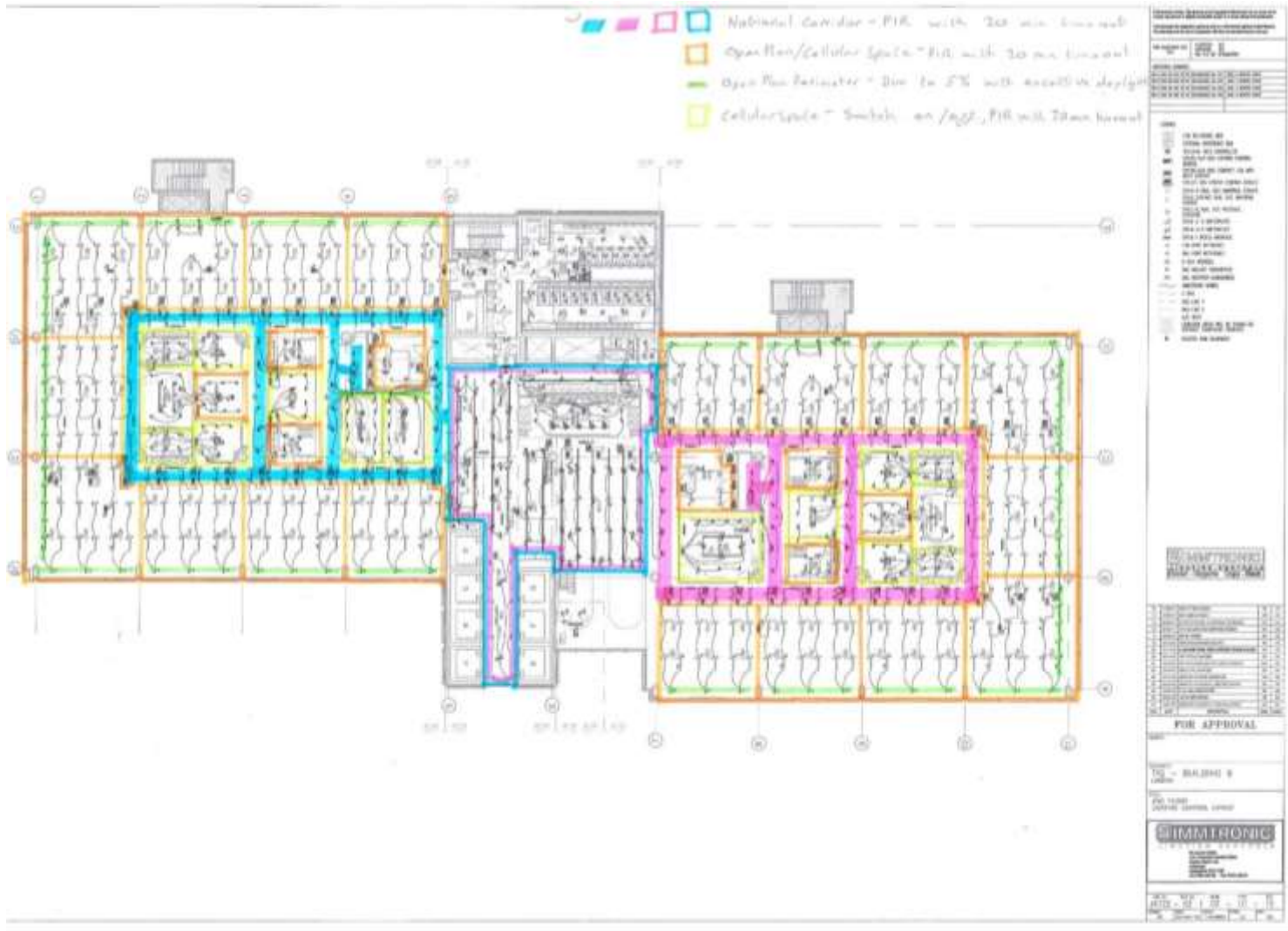


EVERY JOURNEY MATTERS

Reality check 4: And what about the incoming heat/coolth?



Reality check 5: Lighting & Glare



Reality check 5: Lighting & Glare

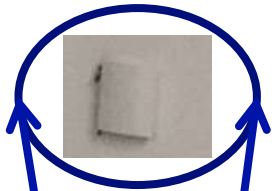
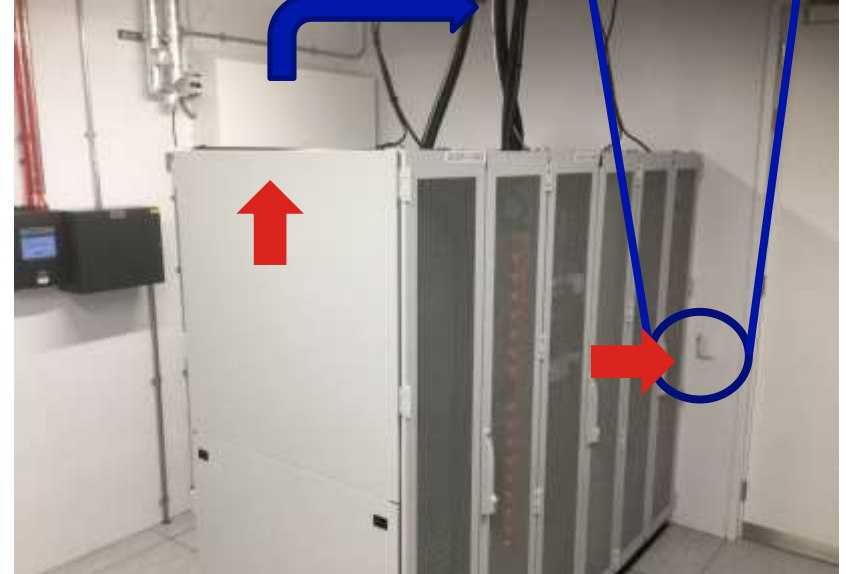


Reality check 6: Occupants and Server rooms



OpSim Room

Please do not close the doors as the machines in this room runs 24/7 and requires ventilation



Reality check 7: Demand Logic

Building Performance Action: FCU-GF-008 - Comms Rm (Plant/Asset)

This unit shows full cooling effort despite not appearing to have any cooling demand.



Building Performance Actions

Status	Subject	Description	Your ref	Account
Action required	Tfl 5 Endeavour Square - meeting room CO2 points (Lab View Object)	A couple of CO2 setpoints are set to 1.0		Tfl 5 Endeavour Square
Action required	Tfl 5 Endeavour Square - meeting room occupancy (Lab View Object)	RPI - 21 of 112 fan fault points (binary) can be		Tfl 5 Endeavour Square
Completed	5 Endeavour Square - AHU fans (MPW)	AHU-RF-04 (Toilets) not running since		Tfl 5 Endeavour Square
Completed	5 Endeavour Square - AHU fans (MPW)	AHU-RF-01 not running from Tue 28 Nov,		Tfl 5 Endeavour Square
Completed	5 Endeavour Square - air system CAV dampers (MPW)	Numerous CAV outputs at 100%, is this		Tfl 5 Endeavour Square
Completed	CHW Tenants Pump 7 (Plant/Asset)	these pumps serve SER, comms rooms		Tfl 5 Endeavour Square
Completed	FCU-GF-006B- Security Rm (Plant/Asset)	Despite full cooling effort during test no		Tfl 5 Endeavour Square
Completed	FCU-MZ-001 (Plant/Asset)	Unusual valve operation, Further		Tfl 5 Endeavour Square
Completed	L05_Nth_05-12_60 (Plant/Asset)	shunt fan expected to be enabled,		Tfl 5 Endeavour Square
Completed	L05_Nth_28_D_38 (Plant/Asset)	no expected valve exercising,		Tfl 5 Endeavour Square



Reality check 8: Design for Performance

Energy Action undertook an Independent Design Review of the building simulation report and building services specification. They made recommendations covering:

- Simulation
- Air Handling Units
- Commissioning
- Comms
- Low Temperature Hot Water
- Miscellaneous HVAC
- Lighting
- Security
- Chilled Water
- Building Management System
- Power

109 observations, including 88 recommendations, were made. Each recommendation was categorised as an opportunity that was major, moderate, small or significant but unquantified. Given the building was close to practical completion, many recommendations could not be acted upon. Recommendations that it may still be possible to act on mainly related to adjustments in control strategies of heating, cooling, ventilation and lighting.

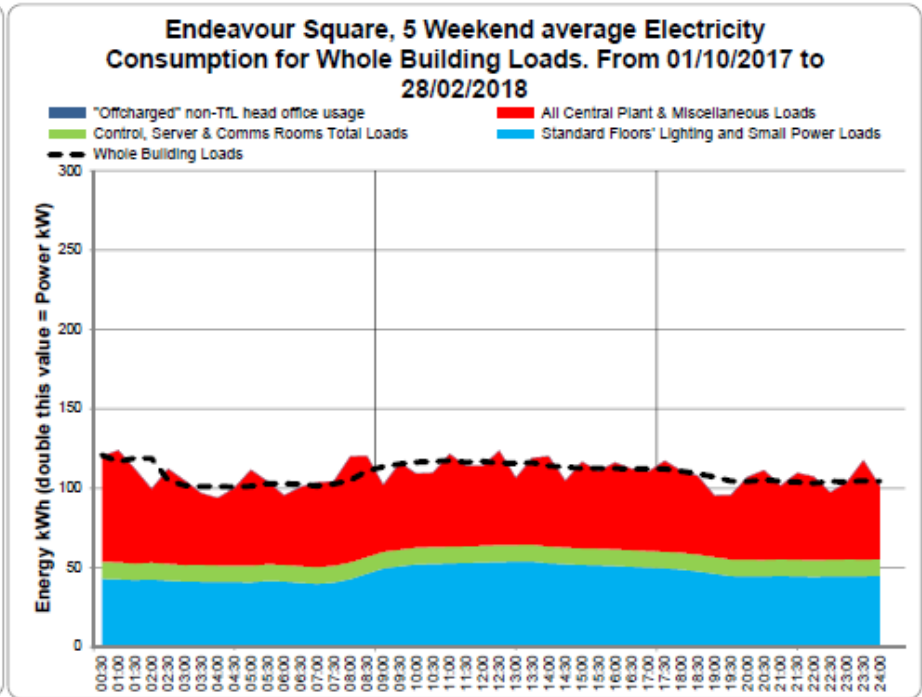
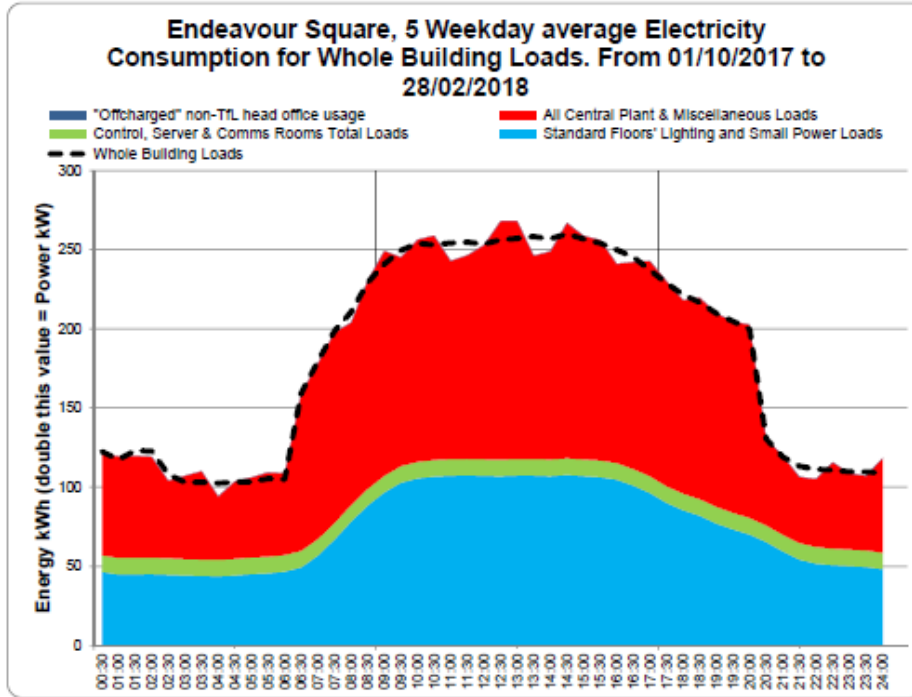
The number of the different types of recommendations are summarised below:

Summary of types of recommendations:

	Too late to implement	May be possible to implement	Totals
Major opportunity	4	11	15
Moderate opportunity	12	11	23
Small opportunity	24	6	30
Unquantified	14	6	20
Totals	54	34	88



Reality check 9: Actual performance: Whole building

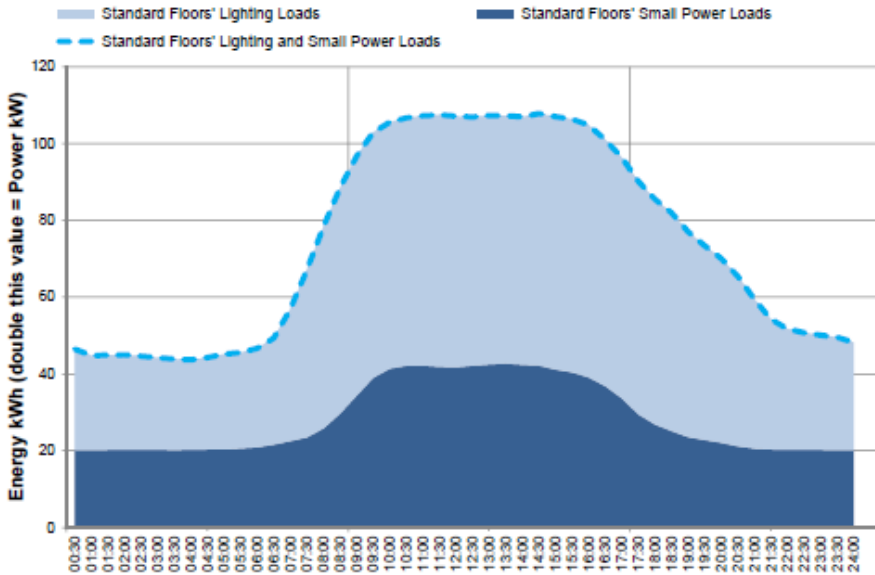


	In hours weekly total (0700-1800 M-F)	Out of hours total M-Su	Annual estimate of Out of hours cost M- Su, £	Out of hours M-Su, %
Whole Building Loads	26,900 kWh	27,492 kWh	£157,253	51%
"Offcharged" non-TfL head office usage	2 kWh	6 kWh	£32	70%
All Central Plant & Miscellaneous Loads	14,734 kWh	13,796 kWh	£78,911	48%
Control, Server & Comms Rooms Total Loads	1,153 kWh	2,367 kWh	£13,537	67%
Standard Floors' Lighting and Small Power Loads	10,974 kWh	11,351 kWh	£64,930	51%

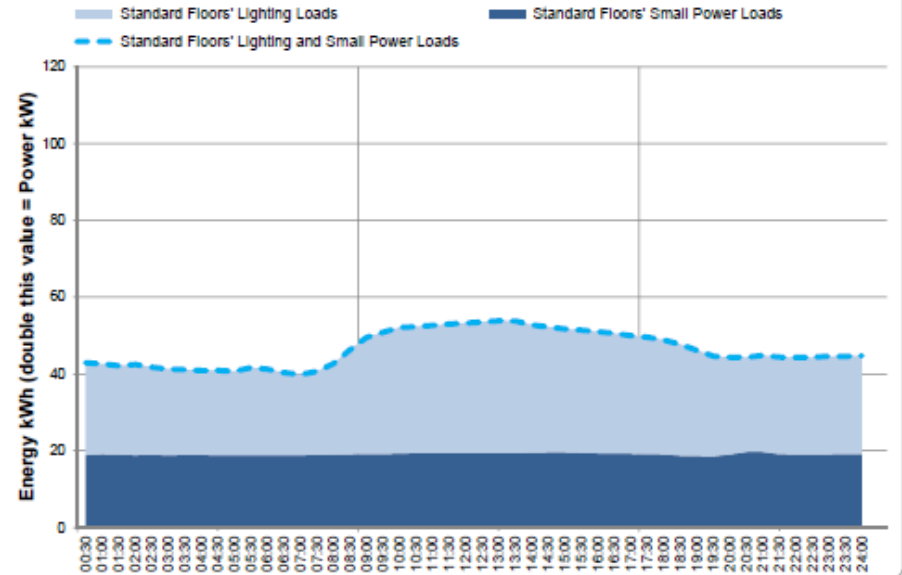


Reality check 9: Actual performance: Tenant floors

Endeavour Square, 5 Weekday average Electricity Consumption for Standard Floors' Lighting and Small Power Loads. From 01/10/2017 to 28/02/2018



Endeavour Square, 5 Weekend average Electricity Consumption for Standard Floors' Lighting and Small Power Loads. From 01/10/2017 to 28/02/2018

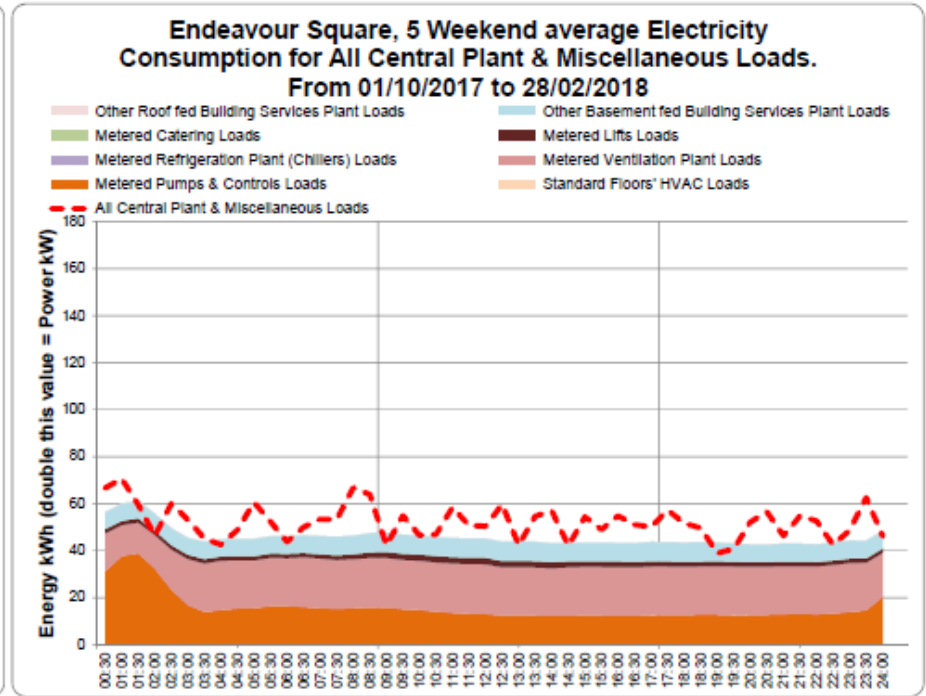
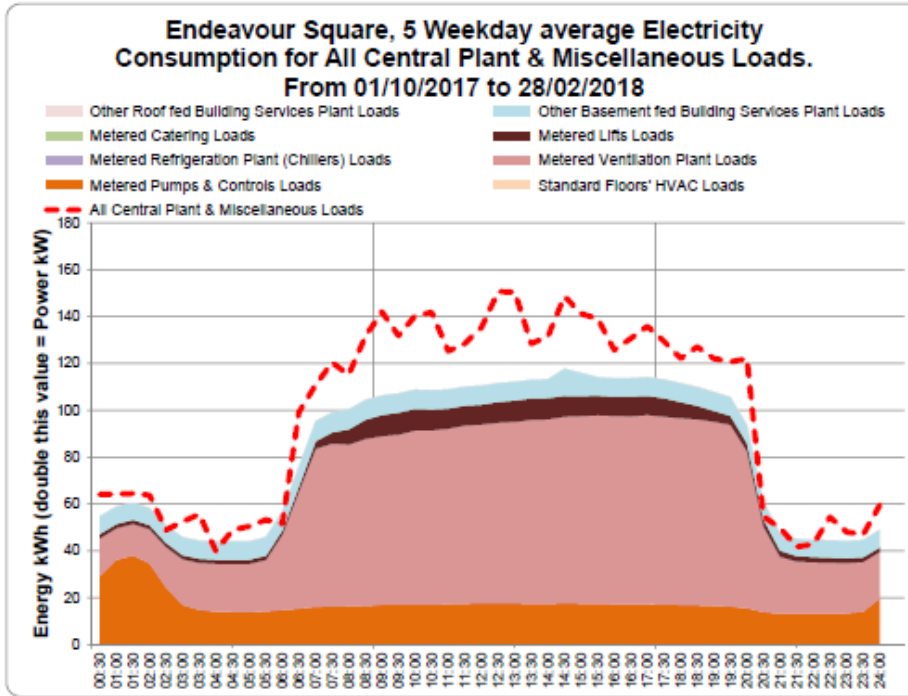


	In hours weekly total (0700-1800 M-F)	Out of hours total M-Su	Annual estimate of Out of hours cost M- Su, £	Out of hours M-Su, %
Standard Floors' Lighting and Small Power Loads	10,974 kWh	11,351 kWh	£64,930	51%
Standard Floors' Lighting Loads	6,865 kWh	6,784 kWh	£38,805	50%
Standard Floors' Small Power Loads	4,109 kWh	4,567 kWh	£26,125	53%

Well controlled, normally occupied floors should have an out of hours % closer to 15%



Reality check 9: Actual performance: Central plant



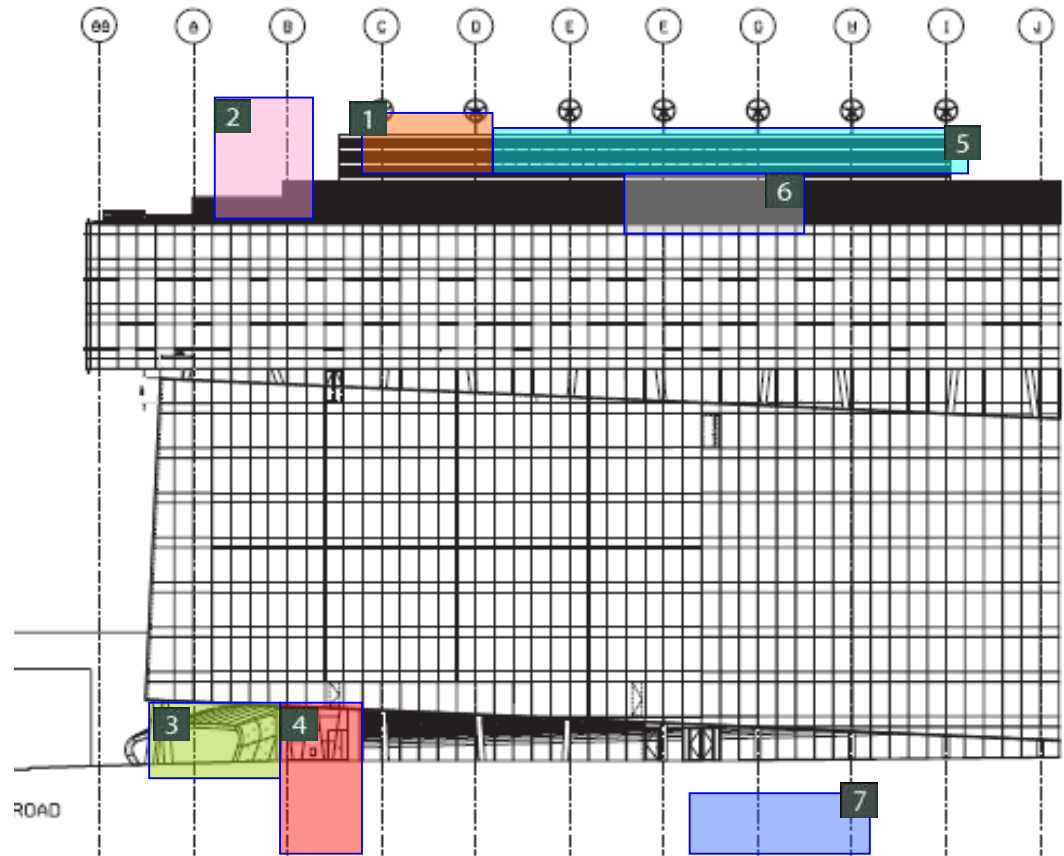
	In hours weekly total (0700-1800 M-F)	Out of hours total M-Su	Annual estimate of Out of hours cost M-Su, £	Out of hours M-Su, %	
All Central Plant & Miscellaneous Loads	14,734 kWh	13,796 kWh	£78,911	48%	
Other Roof fed Building Services Plant Loads	0 kWh	0 kWh	£0	0%	(Currently not sub-metered)
Other Basement fed Building Services Plant Loads	918 kWh	1,740 kWh	£9,952	65%	(Car Park, Security and Reception)
Metered Catering Loads	0 kWh	0 kWh	£0	0%	(Currently not sub-metered)
Metered Lifts Loads	918 kWh	530 kWh	£3,031	37%	
Metered Refrigeration Plant (Chillers) Loads	0 kWh	0 kWh	£0	0%	(Currently not sub-metered)
Metered Ventilation Plant Loads	8,426 kWh	6,129 kWh	£35,059	42%	
Metered Pumps & Controls Loads	1,889 kWh	3,905 kWh	£22,339	67%	
Standard Floors' HVAC Loads	0 kWh	0 kWh	£0	0%	(Included in floor lighting and power)



Reality check 10: Energy performance contracts - Palestra



- 1 Absorption Chiller
- 2 Cooling Tower
- 3 Fuel Cell
- 4 Thermal Store
- 5 Existing Chillers
- 6 Existing Boilers
- 7 CHP



Original performance – 2010-13

London Underground
24/7 Control Rooms
installed Jun'12

Display Energy Certificate

How efficiently is this building being used?

Transport for London
PALESTRA
197 Blackfriars Road
LONDON
SE1 8NJ

Certificate Reference Number:
0991-0113-2189-9096-1006

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 including for lighting, heating, cooling, ventilation and hot water. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information in the guidance document, Display Energy Certificates and advisory reports for public buildings available on the Government's website at: www.gov.uk/government/collections/energy-performance-certificates.

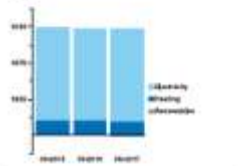
Energy Performance Operational Rating

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



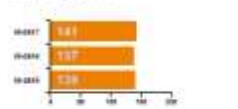
Total CO₂ Emissions

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.



Technical Information

This tells you technical information about how energy is used in this building. Consumption data based on actual meter readings.

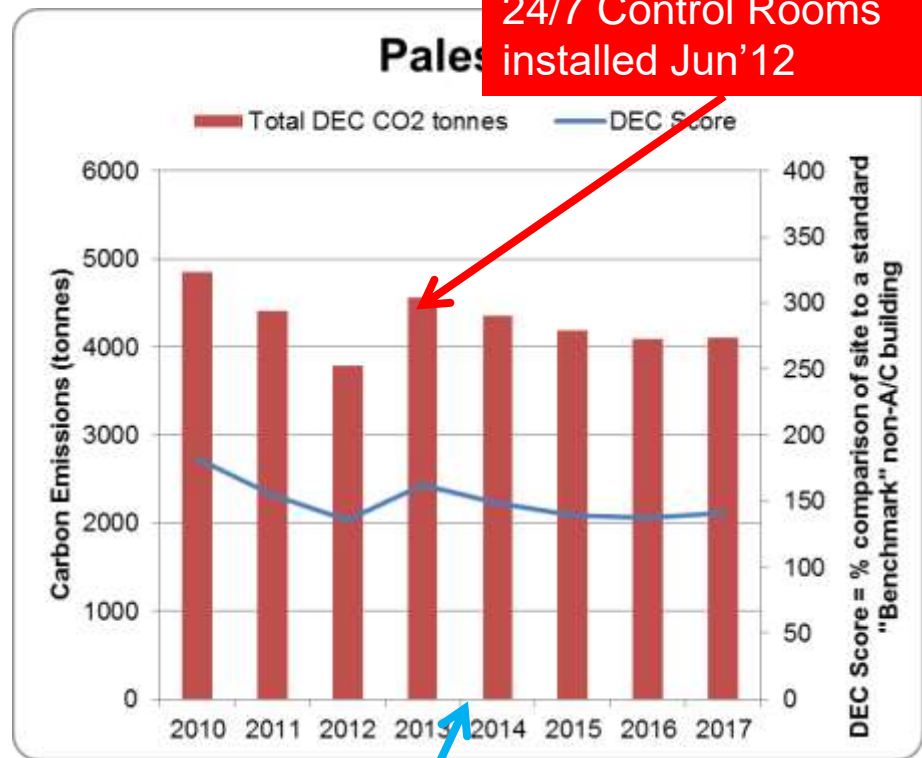
Main heating fuel: Natural Gas
Building environment: Air Conditioning
Total useful heat area (sqm): 2755
Asset Rating: Not available

	heating	cooling
Annual Energy Use (kWh/year)	122	137
Typical Energy Use (kWh/year)	118	134
Energy from renewables	0.2%	0.6%

Administrative Information

This is a Display Energy Certificate as defined in the Energy Performance of Buildings Regulations 2012 as amended.

Assessment Software: SYSTEMA360 CERTTRACK v3.6
Property Reference: 19811102001
Assessor Name: GURAN JAMES BALEOCK Eng MCIBSE
Assessor Number: L08/A02704
Accreditation Scheme: CIBSE Certification Limited
Employer/Trading Name: Transport for London
Employer/Trading Address: 65 Fleet Street Wing, 11 Broadwalk, London, EC4A 3DF
Issue Date: 08-10-2017
Revised Date: 20-03-2018
Valid Until: 23-03-2018
Related Party Disclosure: Employed by the assessor
Recommendations for improving the energy performance of the building are contained in the associated Recommendations Report.
You can obtain contact details of CIBSE Certification Limited at cibsecertification.com.



CHP turned off
Nov'13
following Verco
analysis and
report

Pipework
modifications
complete and CHP
recommissioned
Nov'17



Reality check 10: Energy performance contracts - Palestra

- £500k REFIT project
- Guaranteed £110k energy performance improvement
- Revised pipework design
- Recommissioned gas CHP controls
- Automatic operation for first time in 10 years
- Potential savings up to £350k per year



e-on

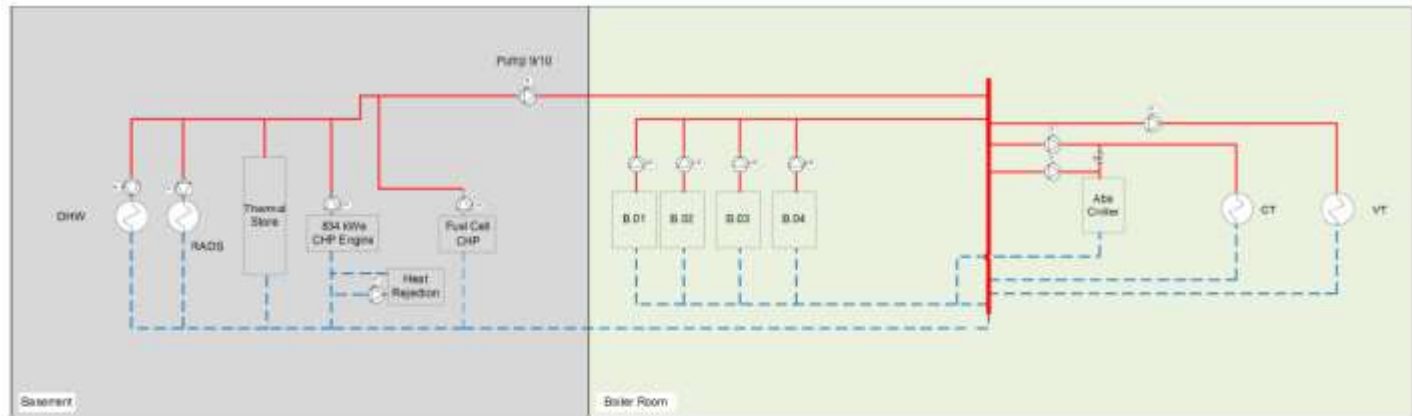


Figure 1: Existing Conceptual Configuration

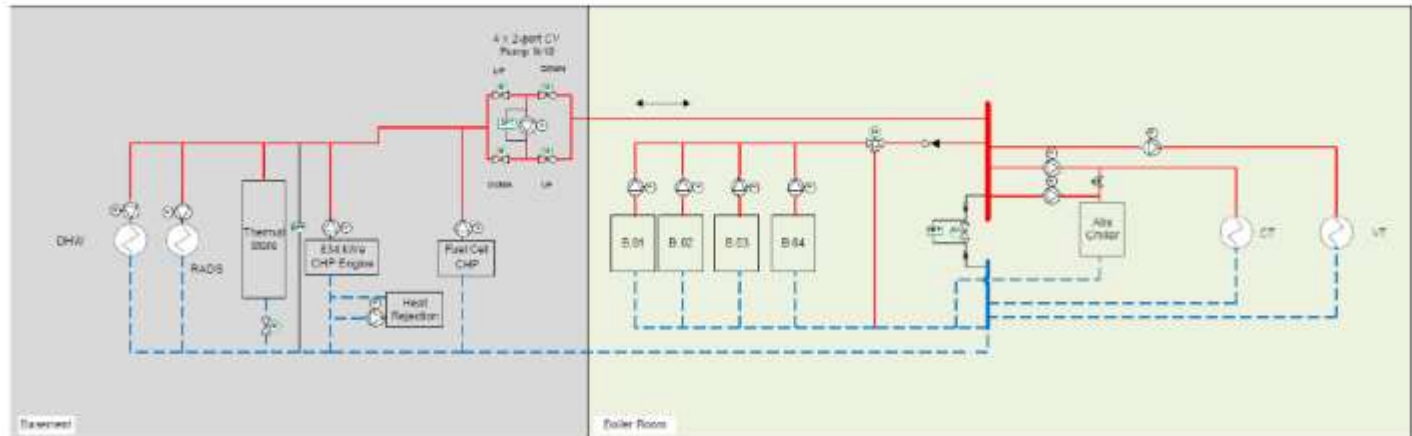
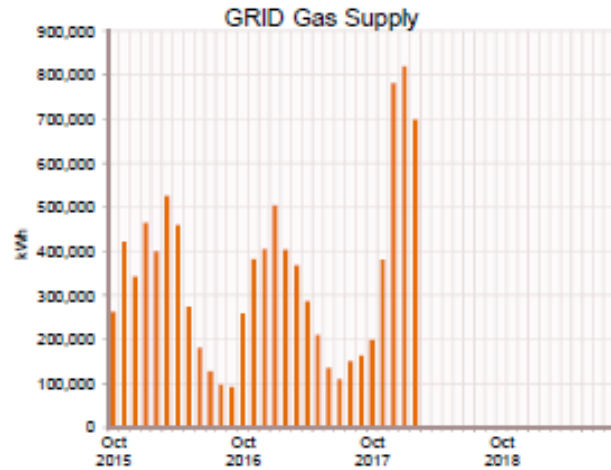
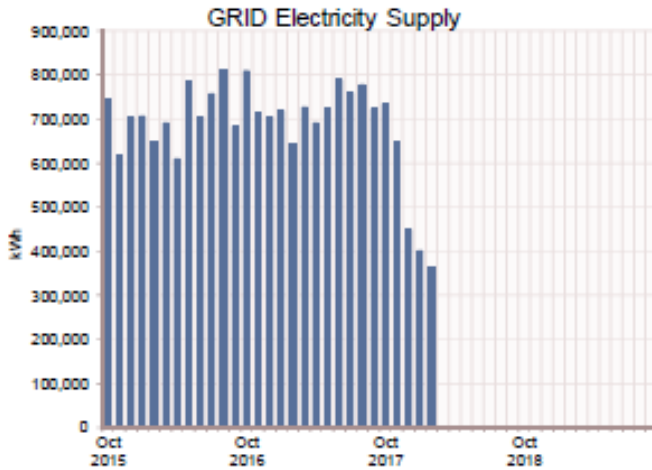


Figure 2: Design Conceptual Configuration



Reality check 10: Energy performance contracts - Palestra



Electricity
10213-ELE4-009
Palestra - elec main - ME3 - G1 Gas CHP Output - CHPQA M
Gas CHP Supply

Month	2015 - 16 kWh	2016 - 17 kWh	2017 - 18 kWh	2018 - 19 kWh
Oct	0	0	7,928	
Nov	0	0	40,876	
Dec	0	0	228,167	
Jan	0	0	253,750	
Feb	0	0	208,926	
Mar	0	0		
Apr	0	0		
May	0	0		
Jun	1	0		
Jul	1	0		
Aug	0	0		
Sep	0	0		
Total	2	0	739,647	0

Heating degree days
Thames Valley

Basis for BAU heating and electricity models

Month	2015 - 16 HDD	2016 - 17 HDD	2017 - 18 HDD	2018 - 19 HDD	Days/ month
Oct	116	118	76		31
Nov	172	248	233		30
Dec	182	262	293		31
Jan	310	350	276		31
Feb	304	227	325		28
Mar	290	159			31
Apr	207	140			30
May	79	66			31
Jun	33	18			30
Jul	24	9			31
Aug	17	19			31
Sep	18	47			30
Total	1,742	1,663	1,203	0	365

Savings Assessment

Basis for BAU heating and electricity models						Energy kWh electrical equivalent										Energy Costs		
						Without gas CHP & better controls ie Modelled Data				Actuals with gas CHP & better controls				£ savings 2017-18				
Month	2015 - 16 HDD	2016 - 17 HDD	2017 - 18 HDD	2018 - 19 HDD	Days/ month	Month	2015 - 16 kWh	2016 - 17 kWh	2017 - 18 kWh	2017 - 18 CO2 tonnes	2015 - 16 kWh	2016 - 17 kWh	2017 - 18 kWh	2017 - 18 CO2 tonnes	Free Elec £	Total Saving		
															£/month	£/day		
Oct	116	118	76		31	Oct	843,719	909,633	822,230	370	850,888	911,411	813,701	366	£862	-£932	-£30	
Nov	172	248	233		30	Nov	746,132	884,359	864,572	390	786,943	866,041	797,974	360	£4,443	-£6,650	-£222	
Dec	182	262	293		31	Dec	838,897	882,715	880,856	398	840,152	866,285	760,739	345	£24,802	-£19,439	-£627	
Jan	310	350	276		31	Jan	909,846	943,953	876,269	396	891,984	919,850	728,010	331	£27,583	-£23,795	-£768	
Feb	304	227	325		28	Feb	847,891	801,269	888,920	402	806,602	803,323	641,757	291	£22,710	-£30,522	-£1,090	
Mar	290	159			31	Mar	877,958	849,939			901,297	873,883						
Apr	207	140			30	Apr	756,723	804,273			793,057	805,364						
May	79	66			31	May	864,004	796,195			892,899	806,563						
Jun	33	18			30	Jun	760,400	836,601			776,374	842,041						
Jul	24	9			31	Jul	808,222	802,589			807,712	802,737						
Aug	17	19			31	Aug	859,416	825,542			850,825	836,984						
Sep	18	47			30	Sep	732,166	785,260			720,748	786,806						
Total	1,742	1,663	1,203	0	365	Total	9,845,376	10,122,327	4,332,846	1,956	9,919,481	10,121,287	3,742,181	1,694	£80,400	-£81,338	-£539	

Model vs Actual checks (should be 100%)

99% 100%

Energy & carbon efficiency variances: -14% -13% , and £81338 cost savings!



Any Questions?

