TfL-EON LBEG

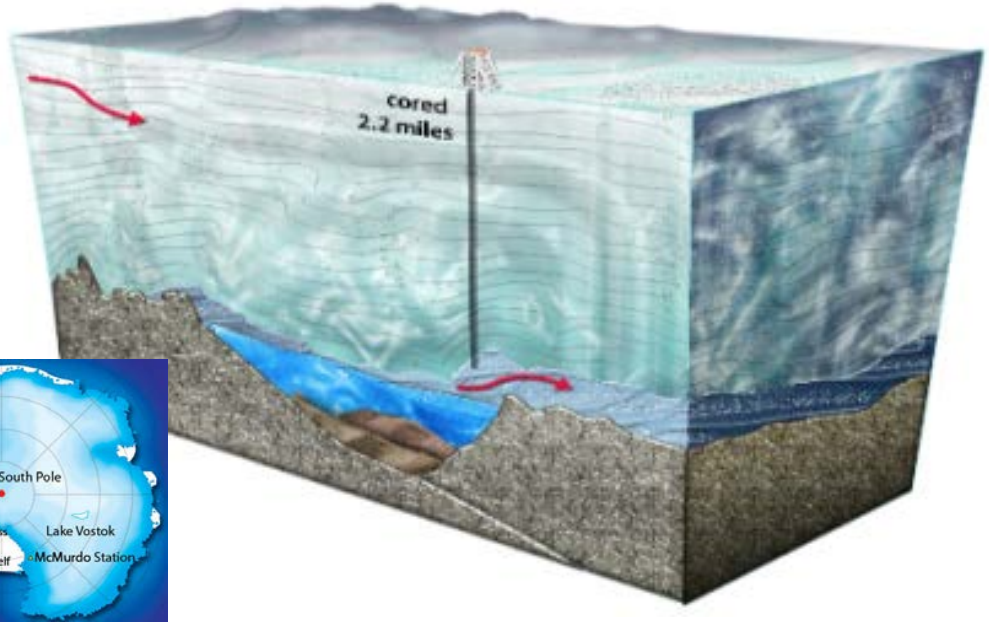
Palestra Re:Fit project update

EVERY JOURNEY MATTERS

The Vostok story...

At the end of the 1970s, a group of Russian and French scientists drilled through a frozen ice lake in the Antarctic at a place called Vostok

After much difficulty, they extracted frozen ice cores from a depth of 2.2 miles. These cores held trapped air bubbles laid down as snow when the ice was formed - representing atmospheric conditions from across the last 400,000 years.



The scientists were able to analyse the density of the ice and trapped air to create a record of the temperature from the Ice Ages to modern day. This showed that aside from relatively short 'interglacial' periods, the last 10,000 years has seen relatively stable temperatures.

Further work analysed carbon dioxide (CO_2) levels over that time as well. The CO_2 level has varied between 200 and 300 parts per million (ppm), with each 100 ppm representing a shift of about 200 billion tonnes of carbon into the atmosphere.

Scientific details: www.agu.org/sci_soc/vostok.html

source: J.R. Petit, J.Jouzel, et al., Nature, 1999 & carbonsense

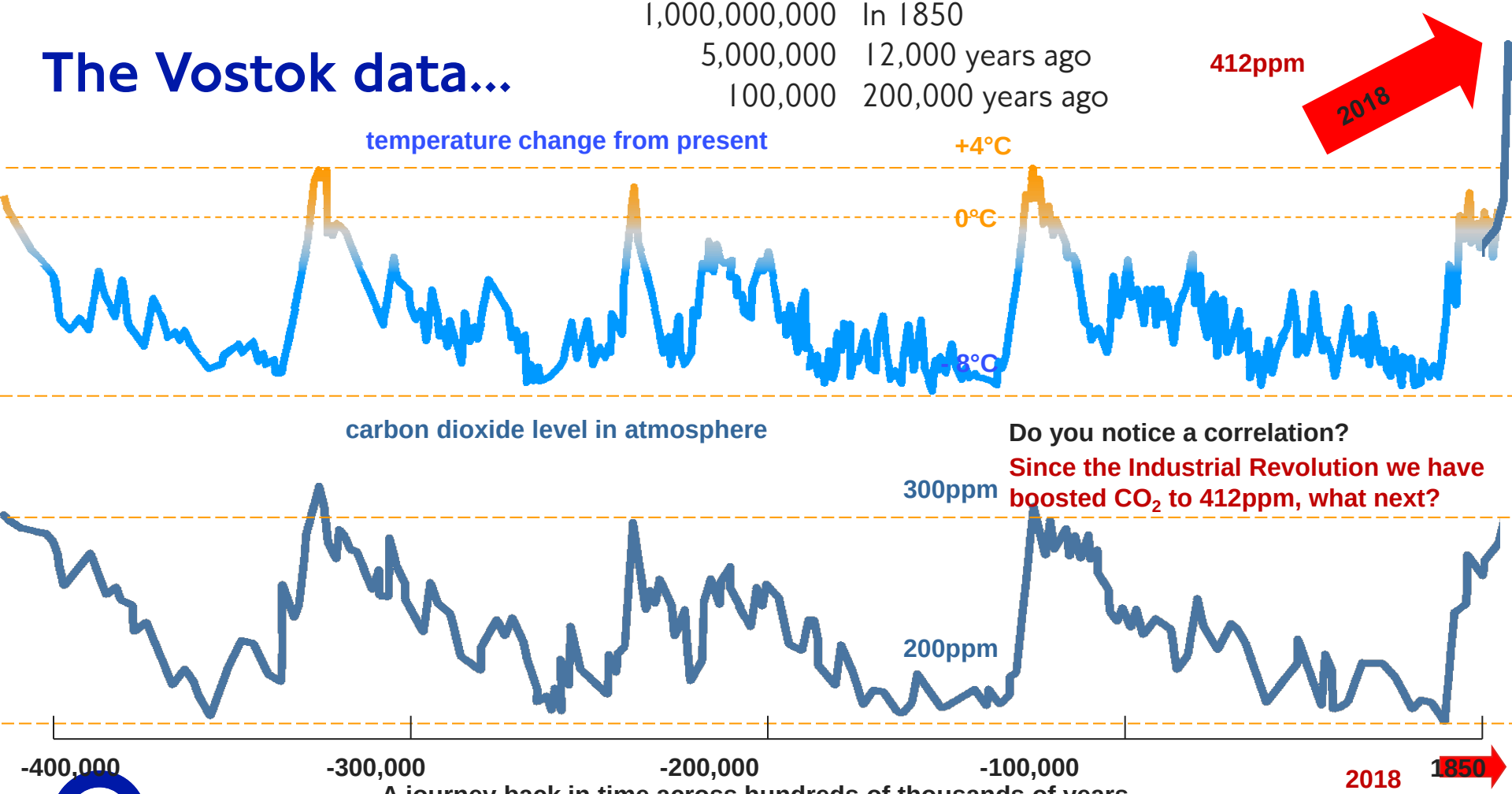
slide design: carbonsense

World populations:

1,000,000,000	In 1850
5,000,000	12,000 years ago
100,000	200,000 years ago

7,800,000,000 Jan'20

The Vostok data...



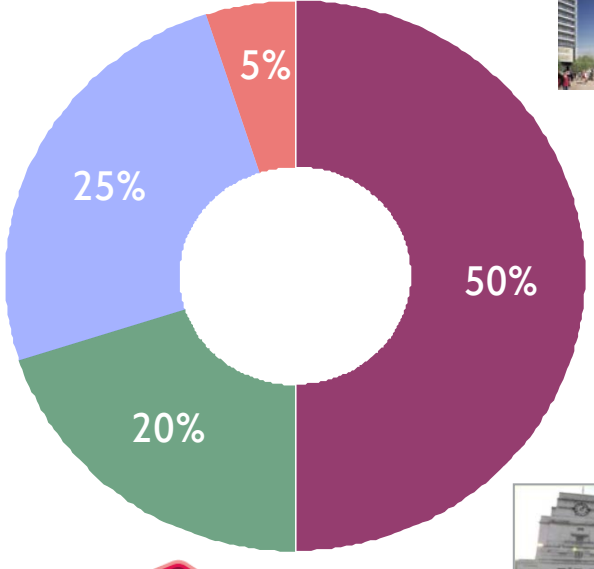
Scientific details: www.agu.org/sci_soc/vostok.html source: J.R. Petit, J.Jouzel, et al., Nature, 1999

EVERY JOURNEY MATTERS

What is London doing about it?

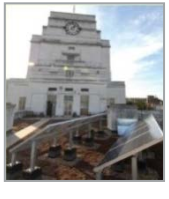
New build

Behavioural change



Decentralised energy supply

Energy efficiency



RE:FIT
BUILDING ENERGY EFFICIENCY FOR TOMORROW

The Mayor of London has set a target to reduce carbon emissions across the city as a whole by 40 per cent by 2022 (based on 1990 levels), with the city aiming to be carbon-neutral by 2050

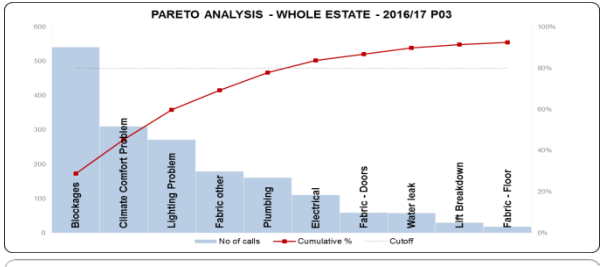
(OR 2030 from the latest manifesto tweets...)

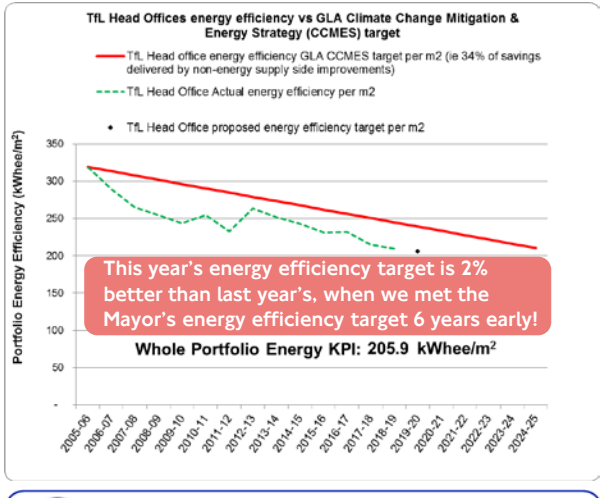
For buildings in London, this can be delivered through four key areas:

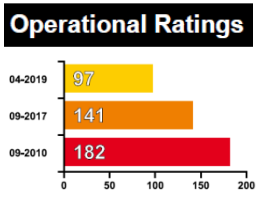
- **New build** – while a small area across London, this is a significant driver for TfL, with our Palestra, Pier Walk and Endeavour Square office hubs being influenced by our energy standards during construction;
- **Decentralised energy** – working to self generate heat, power and cooling to reduce grid demand as well as improvements being made to the wider electricity grid. Palestra's fitout was heavily influenced by this;
- **Energy Efficiency** – new technical solutions such as better/more efficient lighting; and also Heating, Ventilation & Air conditioning (HVAC) and fabric insulation refurbishments;
- **Behavioural change** – Changing how staff occupy and use our buildings can make a huge difference, from everyone turning off their PC every night to managing our 24/7 buildings & accommodation strategy better.

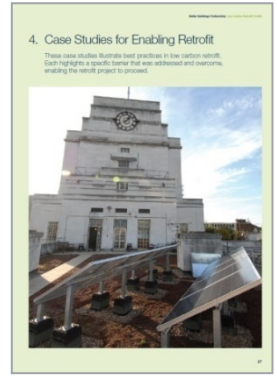
TfL Estates Management work streams

- **Asset management and performance:**
  - Analysing when and why things go wrong and setting standards for the way things should be done
- **Utility contract management:**
  - Paying the bills – circa £4.5m a year – and ensuring they are accurate and performance is on target!
- **Asset replacement programme:**
  - Planning and making things right
  - Technology review and roll out when appropriate, from LEDs to BMS monitoring enhancements to energy performance contracts
- **Maintain external accreditation:**
  - Proving things are getting better and obtaining benefits such as climate change levy gas cost reductions
  - Statutory Display Energy Certificates, Carbon Trust Standard, and Combined Heat and Power Quality Assurance (CHPQA) at 2 sites
- **Behavioural change campaigns:**
  - Persuading our colleagues and contractors to help
- **Best practice promotion:**
  - Researching what other people are doing to tackle the same issues via Better Buildings Partnership membership & CIBSE task groups





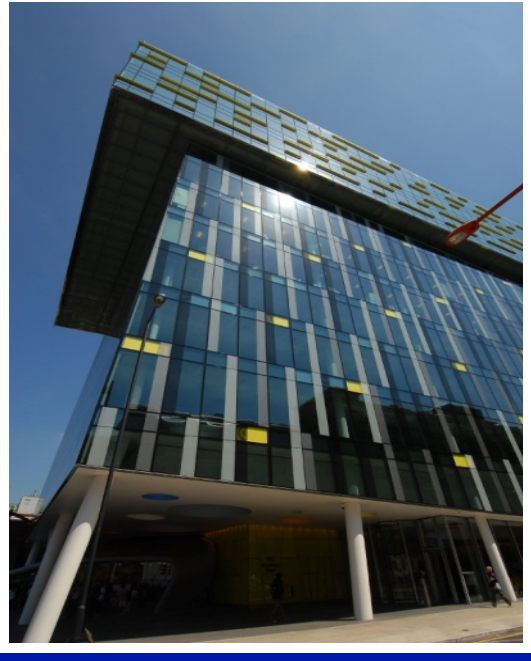




The Palestra building: TfL fitout in 2008

The brief…

- Relocate 2500 staff in improved facilities
- Reduce running costs
- Minimise energy & water usage
- Improve BREEAM rating to Excellent
- Maximise ‘Tri-Generation’ opportunity
- Maximise recycling
- Payback within TfL’s lease period
- Improve cycling facilities



Palestra – the initial results

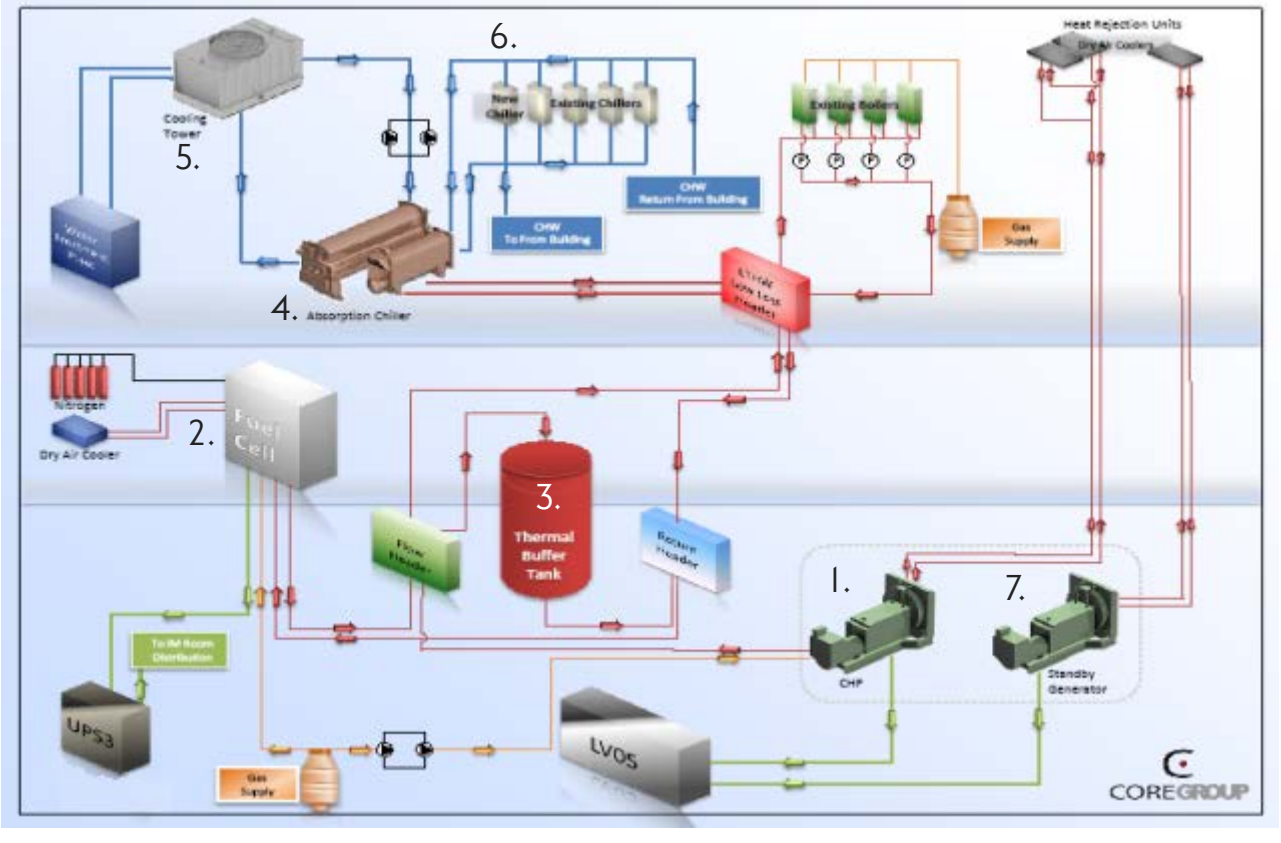
- Increased occupant satisfaction
- Improved productivity
- Flexible, modern workspace
- BREEAM Excellent rating achieved
- Beating benchmarks for office floor power & water
- High recycling rates
- Record number of cyclists

CIBSE BUILDING PERFORMANCE AWARDS 2012 WINNER
RECOGNISING EXCELLENCE IN MAKING BUILDINGS WORK

One of two new rainwater harvesting tanks

Mechanical systems overview

1. 834kW electric gas combined heat and power (CHP) engine
2. 200kW electric fuel cell CHP
3. 75 cubic metre thermal store to even out the heat supply and demand
4. Absorption chiller to use the CHPs' excess heat to provide cooling to the building
5. Cooling tower to then get rid of excess absorption chiller heat
6. New electric "free cooling" chiller to provide more efficient base load cooling
7. Electrical generator and infrastructure to provide resilient supplies to support our operations
8. Rainwater harvesting tanks and pumps to use rainwater to flush toilets and urinals

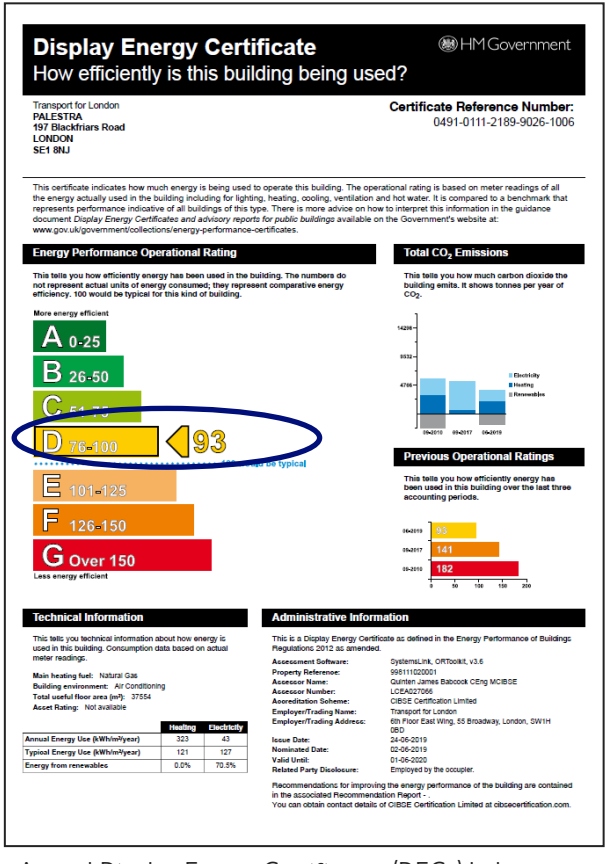


Following major construction works, the Tri-Gen system was fully commissioned in spring 2009, but…

Energy performance reporting – first decade

Over the next nine years the following happened:

- In 2012, TfL instigated a redesign of electrical resilience infrastructure to accommodate for additional 24/7 staff operation within the building
- This required the fuel cell Combined Heat & Power (CHP) unit to be put in to stasis for two years, which led to various equipment failures within the unit. Since 2015, TfL has been working to bring the fuel cell back online
- In 2013 TfL commissioned a study by Verco to investigate why the original gas CHP system did not work as originally designed. This led to various recommendations, with the system turned off while an energy performance contract via the GLA's REFIT framework was procured
- In 2015 E.ON were appointed to carry out the design & build energy performance contract, with works completed in November 2017 guaranteeing £111k a year in savings and an 8 per cent energy efficiency improvement
- In May 2019 we smashed those targets, saving £442k, improving energy efficiency by 22 per cent and carbon emissions by 7 per cent!



Display Energy Certificate
How efficiently is this building being used?

HM Government

Transport for London
PALESTRA
197 Blackfriars Road
LONDON
SE1 8NJ

Certificate Reference Number:
0491-0111-2189-9026-1006

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 comparative energy efficiency. 100 would be typical for this kind of building.

More energy efficient
A 0-25
B 26-50
C 51-75
D 76-100 93
E 101-125
F 126-150
G Over 150
Less energy efficient

Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2.

Previous Operational Ratings

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

93
141
182

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 floor area (m²): 37554
Asset Rating: Not available

	Heating	Electricity
Annual Energy Use (kWh/m²/year)	323	43
Typical Energy Use (kWh/m²/year)	121	127
Energy from renewables	0.0%	70.5%

Administrative Information

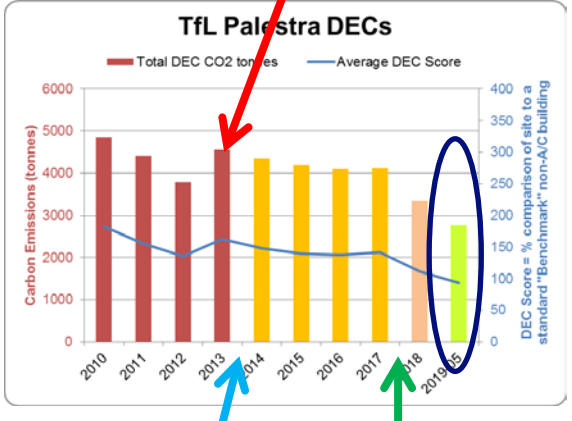
This is a Display Energy Certificate as defined in the Energy Performance of Buildings Regulations 2012 as amended.

Assessment Software: SystemsLink, ORToolkit, v3.6
Property Reference: 99811020001
Assessor Name: Quinten James Babcock CEng MCIBSE
Assessor Number: LCEA027066
Accreditation Scheme: CIBSE Certification Limited
Employer/Trading Name: Transport for London
Employer/Trading Address: 6th Floor East Wing, 55 Broadway, London, SW1H 0BD
Issue Date: 24-06-2019
Nominated Date: 02-06-2019
Valid Until: 01-06-2020
Related Party Disclosure: Employed by the occupier.

Recommendations for improving the energy performance of the building are contained in the associated Recommendation Report -.
You can obtain contact details of CIBSE Certification Limited at cibsecertification.com.

Annual Display Energy Certificates (DECs) help us track performance. We're now better than a typical non-air conditioned office building!

Additional 24/7 TfL occupancy from Jun'12



CHP turned off Nov'13 following Verco analysis and report

E.ON's pipework modifications complete and CHP recommissioned Nov'17

Hot water pipework & Gas CHP Improvements

The project included:
Splitting the roof LTHW pipework to hold off the boilers;
New high efficiency controllable chiller;
Pipework & control mods to allow Pumps 9&10 to swap direction;
New DHW plate heat exchangers & cylinders.

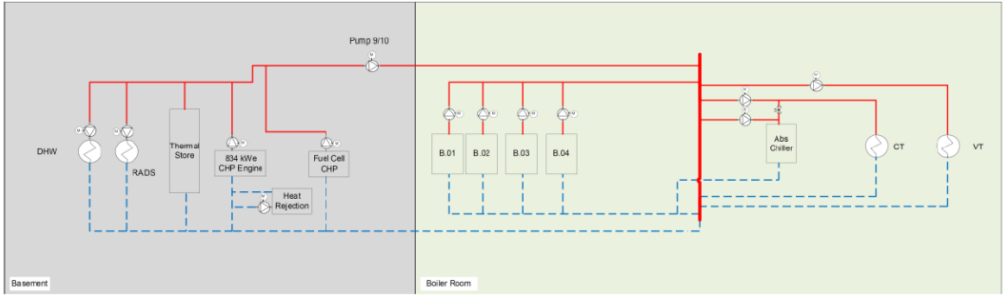


Figure 1: Existing Conceptual Configuration

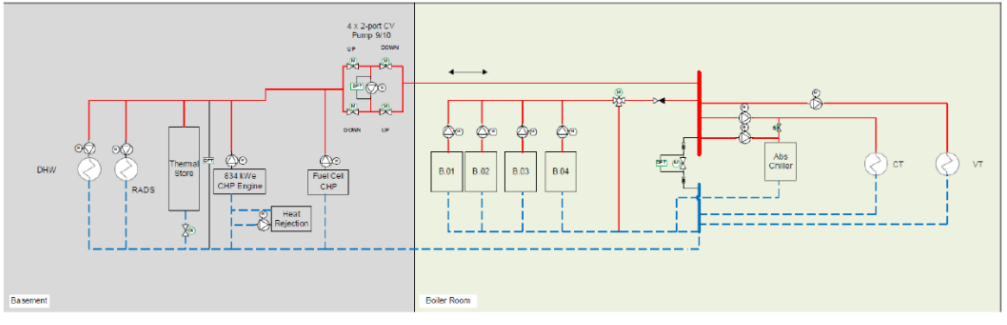


Figure 2: Design Conceptual Configuration

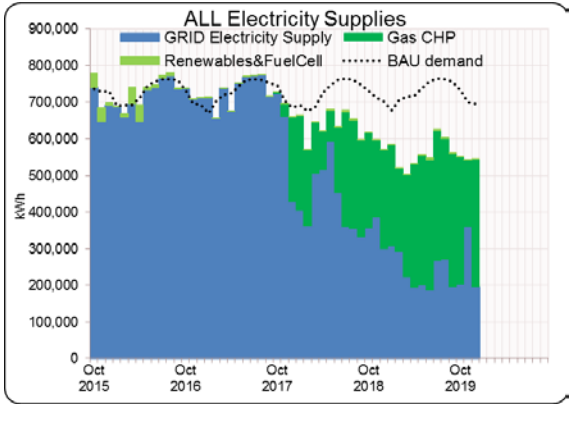
e·on

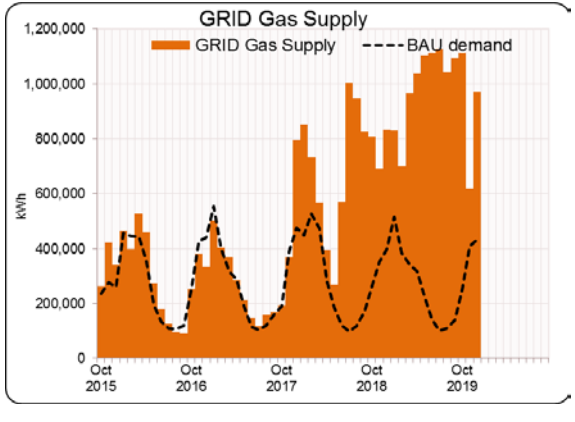
RE:FIT
BUILDING ENERGY EFFICIENCY FOR TOMORROW

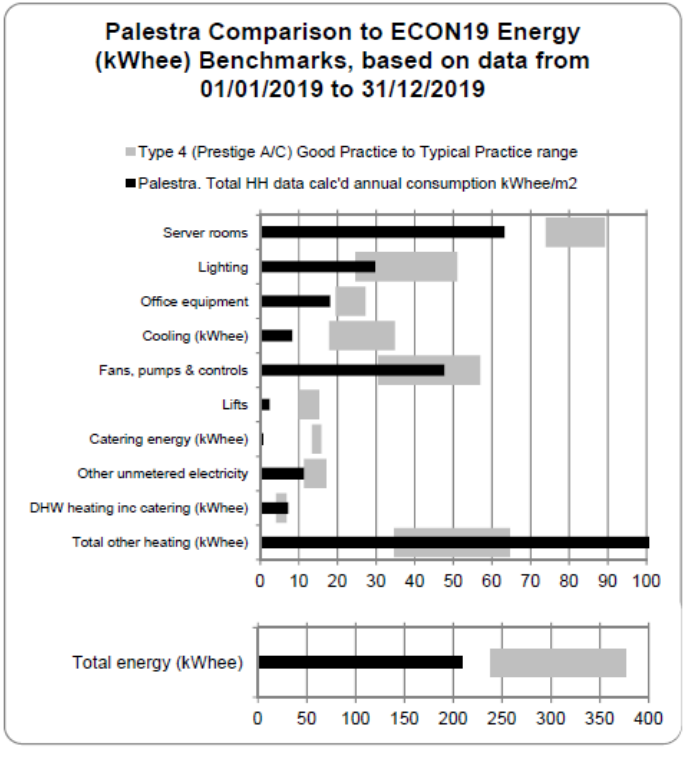
CIBSE BUILDING PERFORMANCE AWARDS 2019 WINNER

How low can we go?

- By May 2019, we had achieved a D-rated DEC score of 93, which compares very favourably to the G-rated 182 score from 2010 (when the original project handed over a CHP running 24/7 at full output).
- In the 12 months to the end of December 2019 we saved £520k in building utilities running costs and improved annual energy efficiency by 24 per cent and carbon emissions by 7 per cent
- Compared to industry benchmarks we have taken a building (that was already 27 per cent better than Typical consumption) and improved it to 45 per cent better than Typical and 12 per cent better than Good!

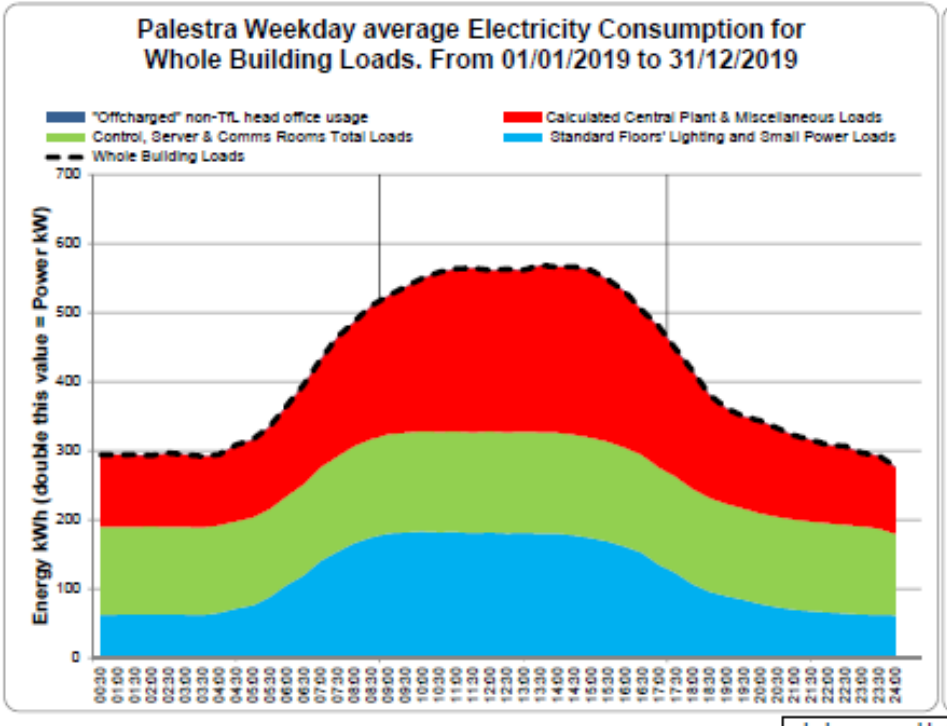


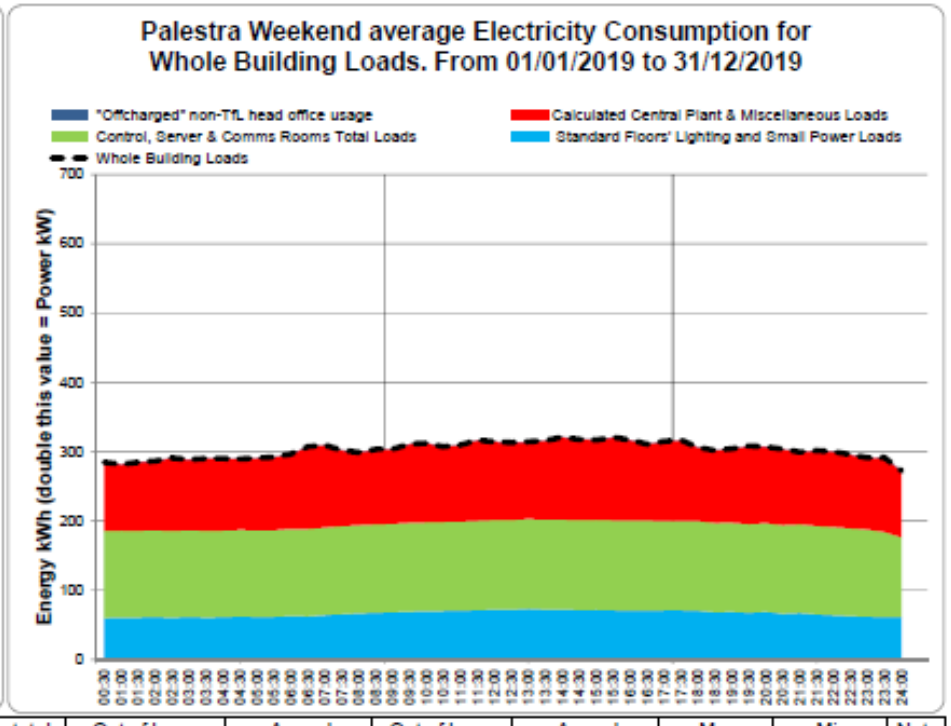




However, the industry benchmarks comparison above suggests there are still areas that can be improved, from lighting & HVAC controls to occupant engagement to switch off PCs when they leave.
A 93 score D-rated DEC is a great result given the 100 score is effectively a non-fully air conditioned "mixed mode" standard occupancy density building, but we aim to find out how low we can go!

Surely we just have to turn stuff off?

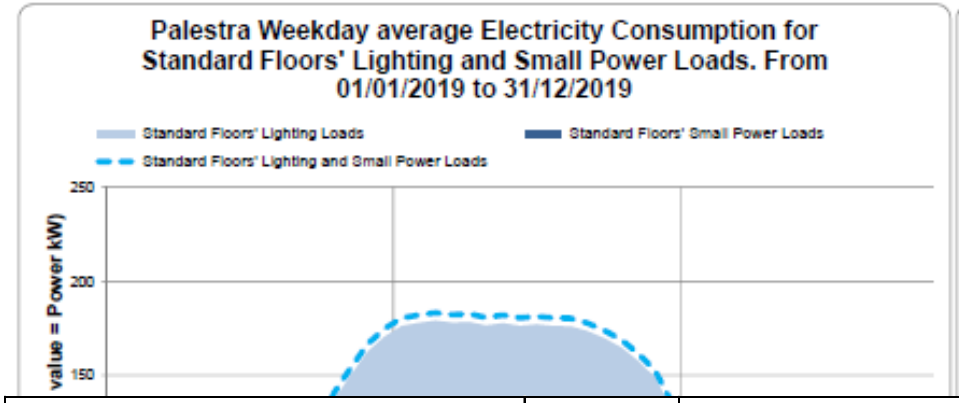


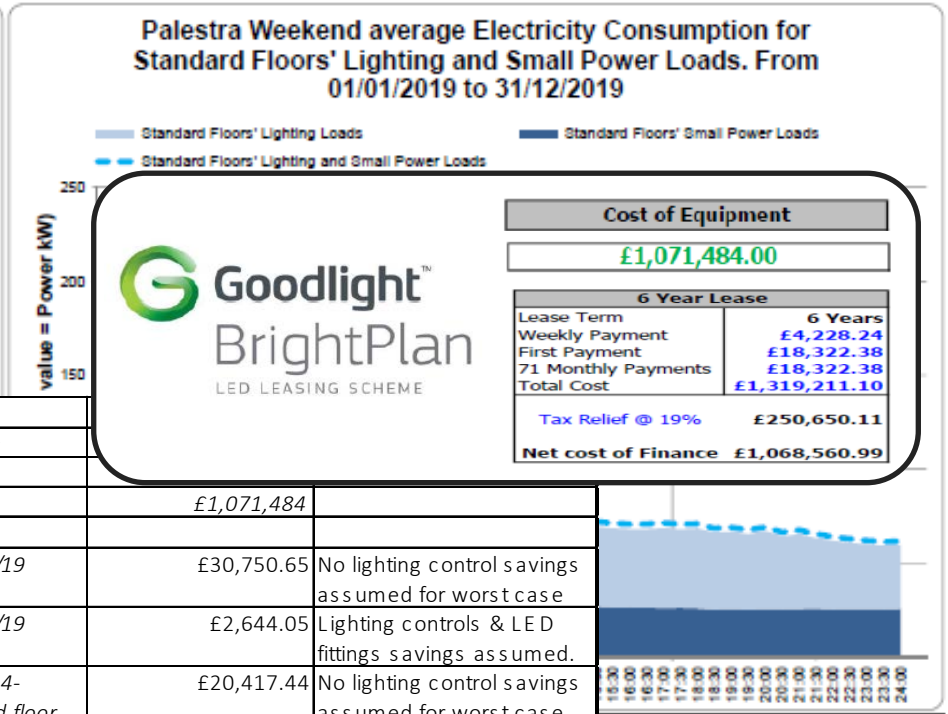


	In hours weekly total (0700-1800 M-F) kWhee	Out of hours total M-Su kWhee	Annual estimate of Out of hours cost M-Su, £	Out of hours M-Su,%	Annual estimate of Total cost, £	Max demand, kW	Min demand, kW	Note ref
Whole Building Loads	58,146 kWh	71,004 kWh	£443,064	55%	£805,893	1136.7kW	544.3kW	
"Offcharged" non-TfL head office usage	0 kWh	0 kWh	£0	0%	£0	0.0kW	0.0kW	1
Calculated Central Plant & Miscellaneous Loads	23,904 kWh	25,746 kWh	£160,653	52%	£309,815	485.8kW	190.9kW	
Control, Server & Comms Rooms Total Loads	15,778 kWh	28,910 kWh	£180,396	65%	£278,850	292.6kW	229.8kW	
Standard Floors' Lighting and Small Power Loads	18,464 kWh	16,349 kWh	£102,015	47%	£217,228	366.6kW	120.2kW	
Whole Building CHP Electricity input savings	30,284 kWh	43,300 kWh	£270,192	59%	£459,161	588.3kW	322.1kW	

Notes: 1 (No metering data provided)

Is it the lighting control or the people?





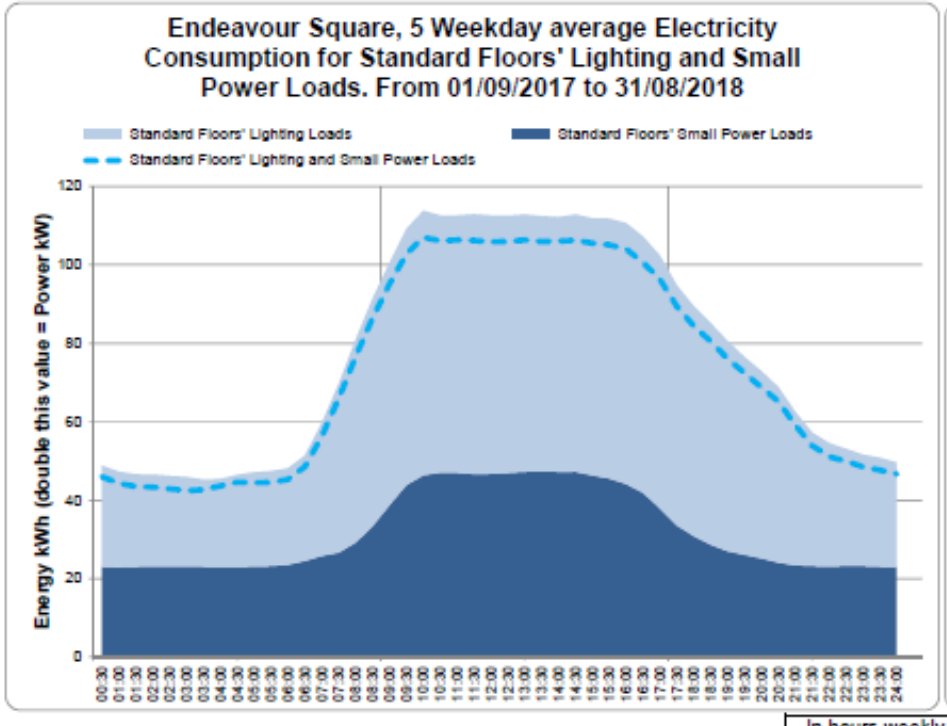
BAU Capex costs	BAU £	*Notes*		
Lighting replacements	£30,000	*Estimate for next 10 years*		
Capex sub-total	*£30,000*		*£1,071,484*	
BAU ongoing 10-year Total simple costs				
Annual In hours electricity at current loading for non-24/7 floors	£71,861	*Data from 01/06/18-31/05/19*	£30,750.65	No lighting control savings assumed for worst case
Annual Out of hours electricity at current loading for non-24/7 floors	£61,789	*Data from 01/06/18-31/05/19*	£2,644.05	Lighting controls & LED fittings savings assumed.
Annual electricity at current loading for 24/7 floors	£47,714	*6th floor data from 01/07/14-30/06/18 & doubled for 2nd floor*	£20,417.44	No lighting control savings assumed for worst case
Total cost of ownership	**£1,843,642**		**£1,609,605**	
		10 year TCO Saving	£234,037	8.4 year payback

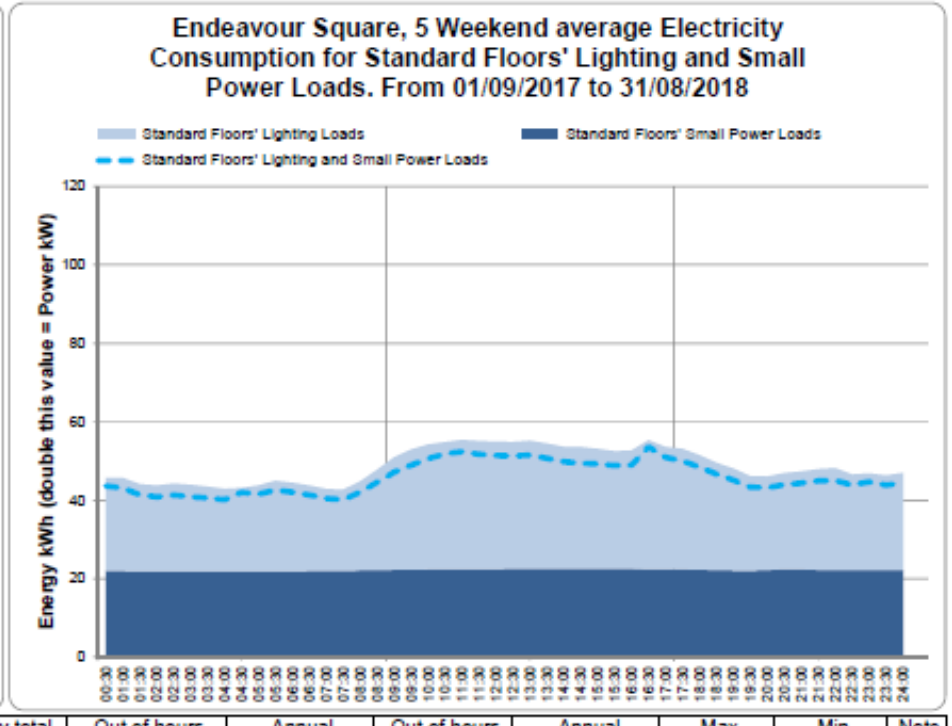
			Max demand, kW	Min demand, kW	Note ref
			366.6kW	120.2kW	3
			216.2kW	65.0kW	
			143.0kW	50.3kW	

Assumptions

Electricity rate	£0.12	£/kWh *(this is current but will increase over next 10 years)*
Current total electricity for non-24/7 floors	1,113,755	kWh
Current out of hours electricity for non-24/7 floors	514,909	kWh
Current in hours electricity for non-24/7 floors	598,845	kWh
24/7 floors lighting loads	397,614	kWh
LED fittings savings % (from Lightboss calcs)	43%	
LED controls out of hours savings % estimate	90%	

LEDs vs fluorescents, & what are the parasitic loads?





	In hours weekly total (0700-1800 M-F) kWhee	Out of hours total M-Su kWhee	Annual estimate of Out of hours cost M-Su, £	Out of hours M-Su,%	Annual estimate of Total cost, £	Max demand, kW	Min demand, kW	Note ref
Standard Floors' Lighting and Small Power Loads	10,873 kWh	11,158 kWh	£63,823	51%	£126,016	214.1kW	80.2kW	3
Standard Floors' Lighting Loads	6,923 kWh	6,616 kWh	£37,845	49%	£77,445	134.8kW	41.2kW	
Standard Floors' Small Power Loads	4,611 kWh	5,240 kWh	£29,970	53%	£56,346	94.7kW	43.7kW	

Notes:

3 (Includes floor HVAC loads)

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

Staff Behavioural Change

Destination Green

#mythbusters

What should I do with my PC when I leave the office?

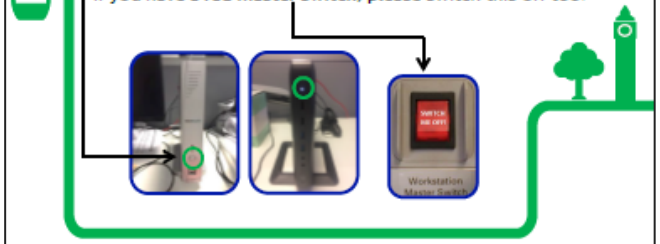
Let's power down!

⏻ = £

In head offices, 55% of energy is currently used 'out of hours'. Help save the environment, and money, by switching off before you go home.

Thin clients – Select Log off from the start menu, press the ⏻ button on the computer and then switch off your monitor and all other equipment.

If you have a red master switch, please switch this off too.

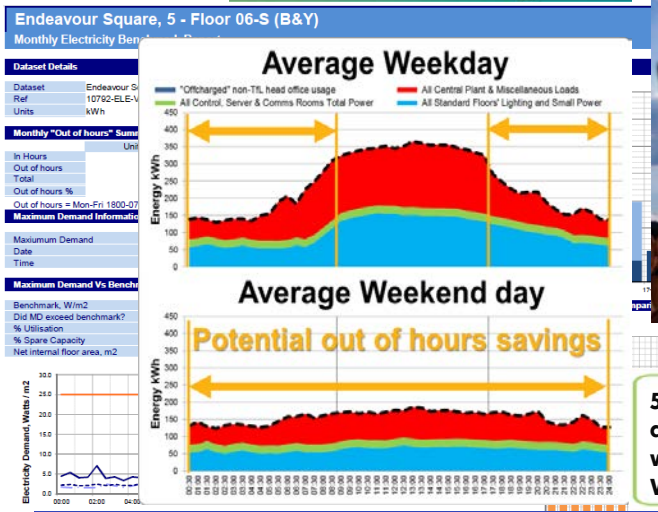


Thick clients – Select Shut down from the start menu then switch off your monitor and all other equipment.

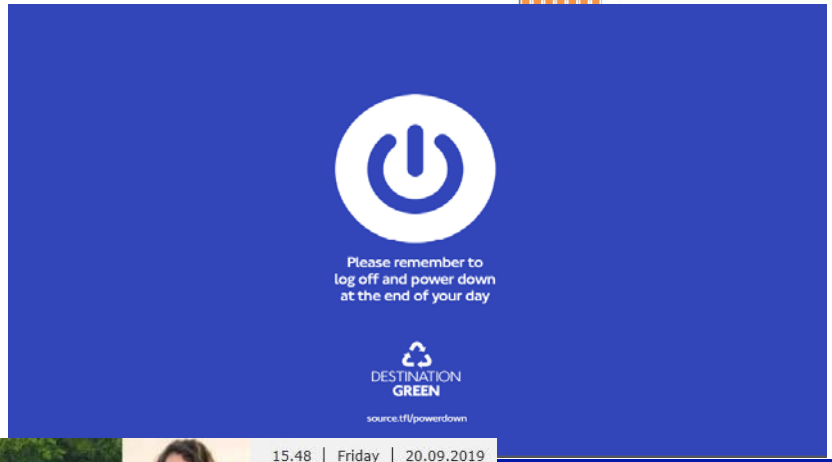
Please visit Source.tfl/powerdown

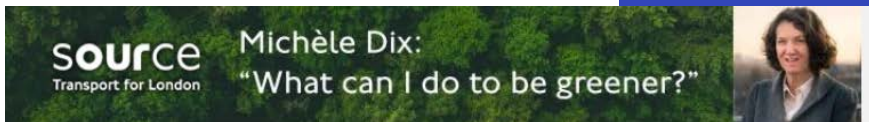
EVERY JOURNEY MATTERS

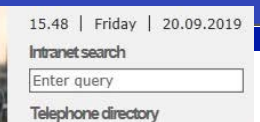
Destination Green



57 % of our electricity usage was during the night and at the weekend, which cost £35k per week! We can all do more to # Powerdown

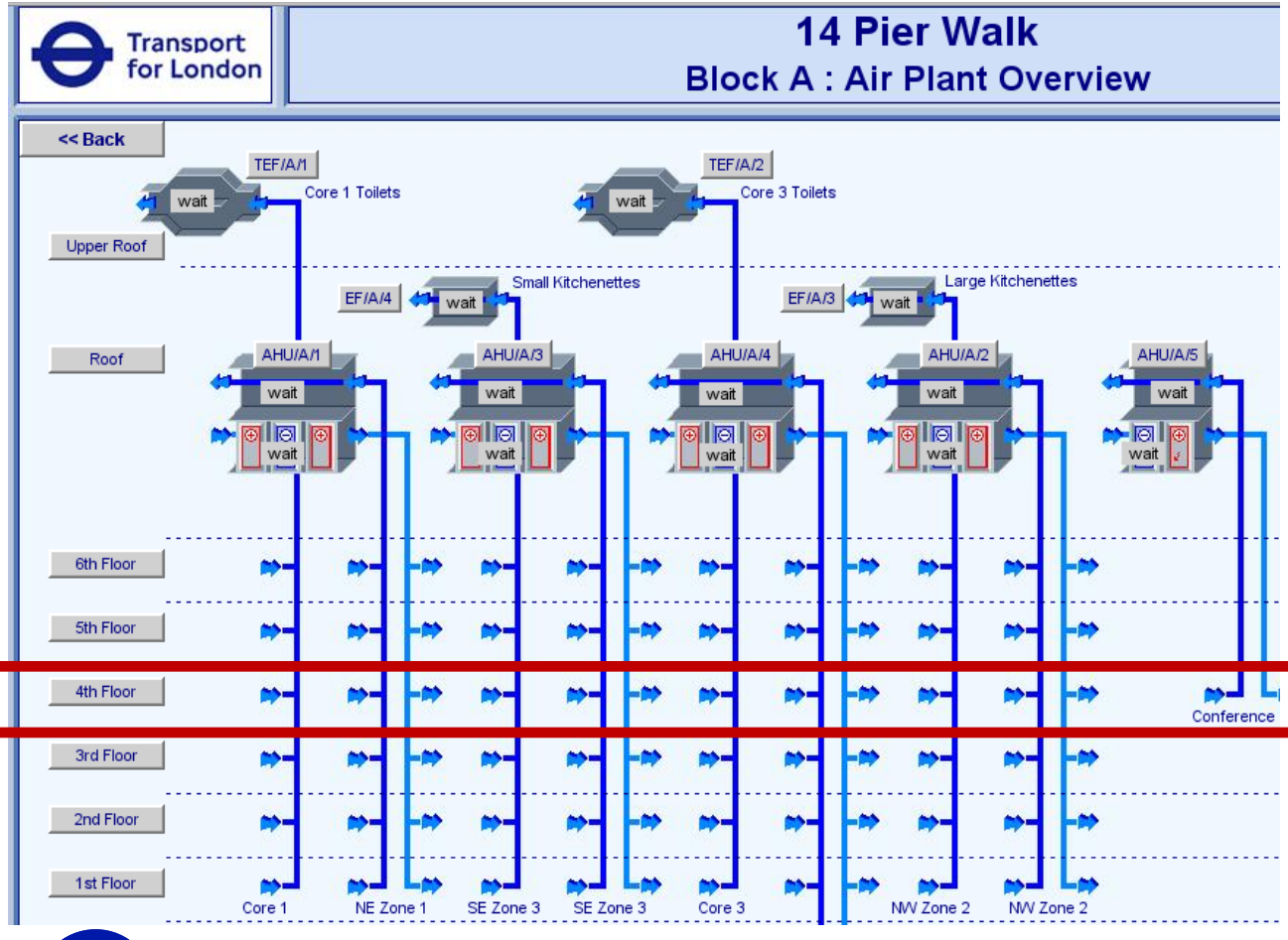




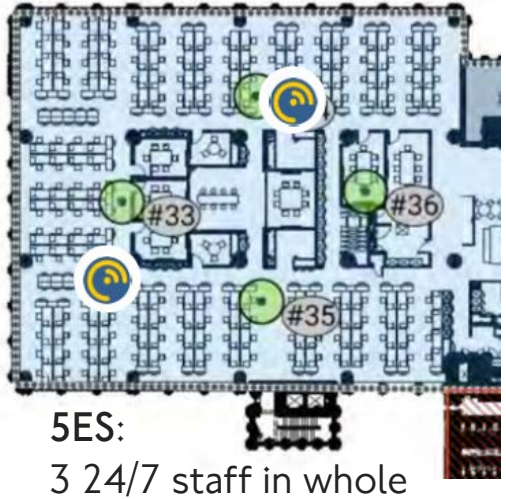


EVERY JOURNEY MATTERS

We need designers and occupiers to think holistically



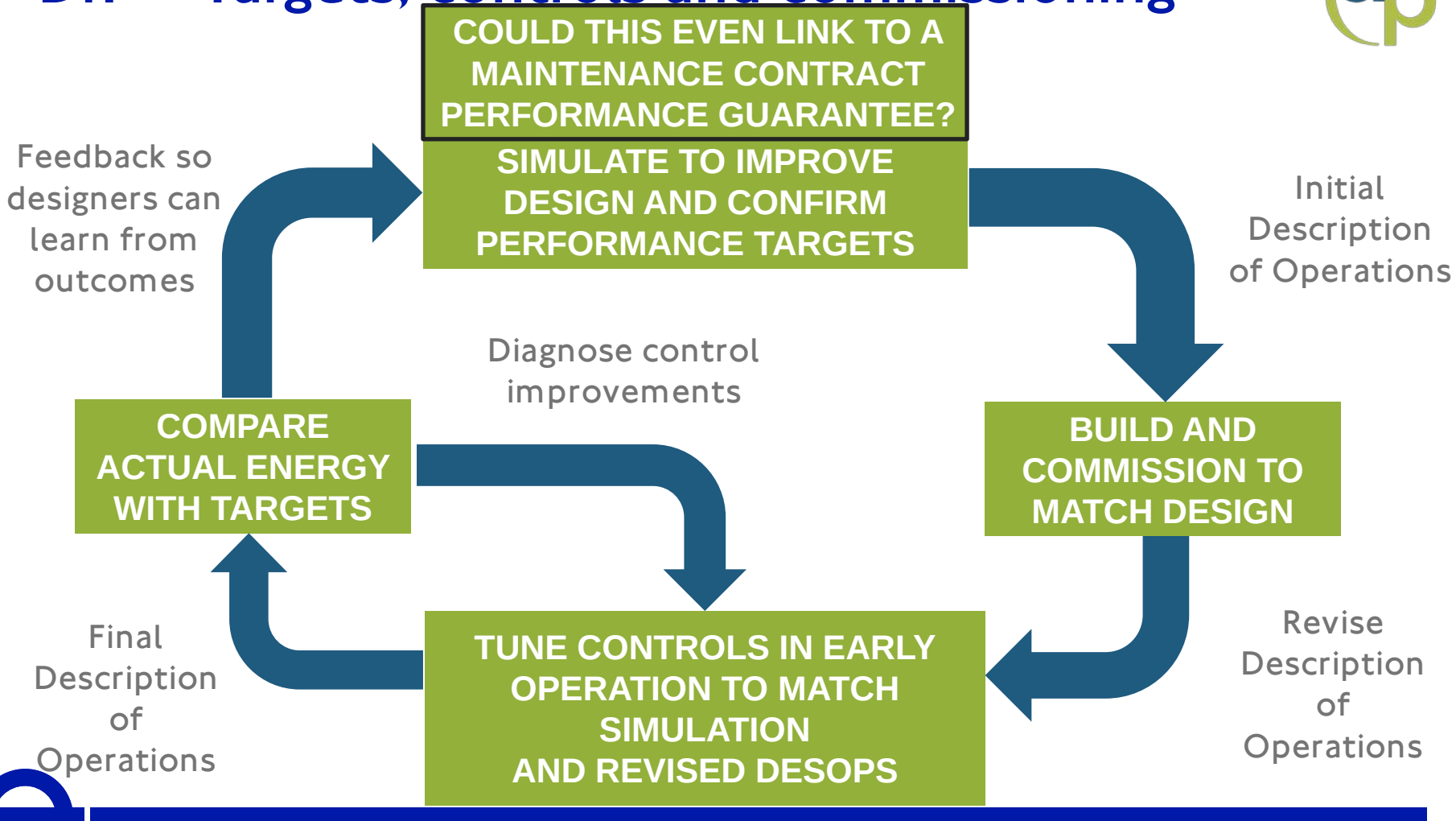
LightFi occupancy sensor



5ES:
3 24/7 staff in whole of Stratford building

24/7 staff on one floor

DfP = Targets, controls and commissioning



To find out more
please contact:
Quinten.Babcock@tube.tfl.gov.uk