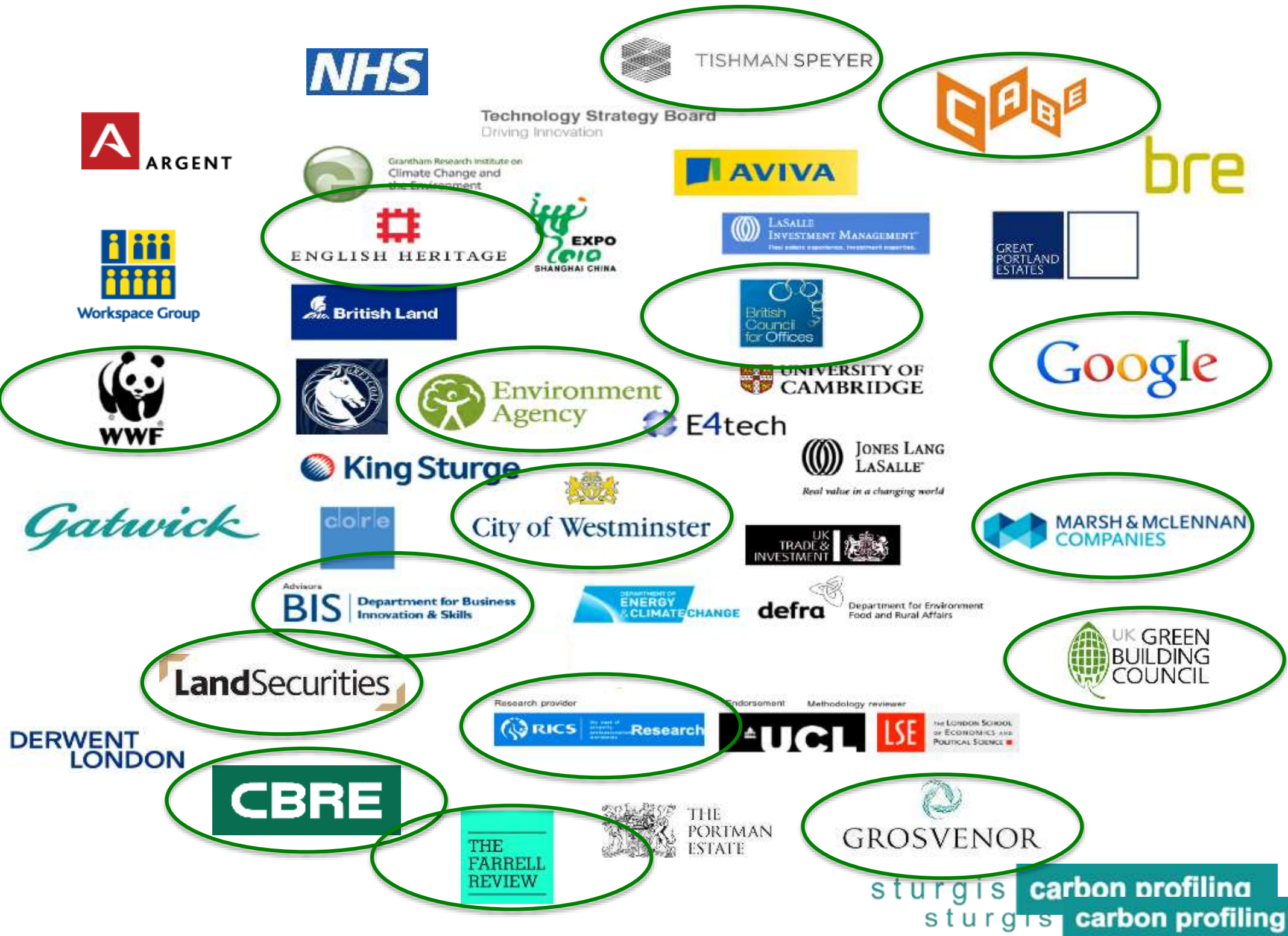




Sturgis Carbon Profiling LLP

Real Estate Carbon Emissions Analysis



NHS

TISHMAN SPEYER

CIBE

ARGENT

Technology Strategy Board
Driving Innovation

bre

Grantham Research Institute on
Climate Change and
the Environment

AVIVA

ENGLISH HERITAGE

EXPO
2010
SHANGHAI CHINA

LASALLE
INVESTMENT MANAGEMENT

GREAT PORTLAND
ESTATES

Workspace Group

British Land

British Council
for Offices

Google

WWF

Environment Agency

Environment
Agency

UNIVERSITY OF
CAMBRIDGE

E4tech

JONES LANG
LASALLE
Real value in a changing world

King Sturge

City of Westminster

MARSH & McLENNAN
COMPANIES

Gatwick

core

UK
TRADE &
INVESTMENT

BIS
Department for Business
Innovation & Skills

DEPARTMENT OF
ENERGY &
CLIMATE CHANGE

defra
Department for Environment
Food and Rural Affairs

UK GREEN
BUILDING
COUNCIL

LandSecurities

Research provider
RICS Research

Endorsement Methodology reviewer
UCL LSE
THE LONDON SCHOOL
OF ECONOMICS AND
POLITICAL SCIENCE

DERWENT
LONDON

CBRE

THE
FARRELL
REVIEW

THE
PORTMAN
ESTATE

GROSVENOR

sturgis carbon profiling
sturgis carbon profiling

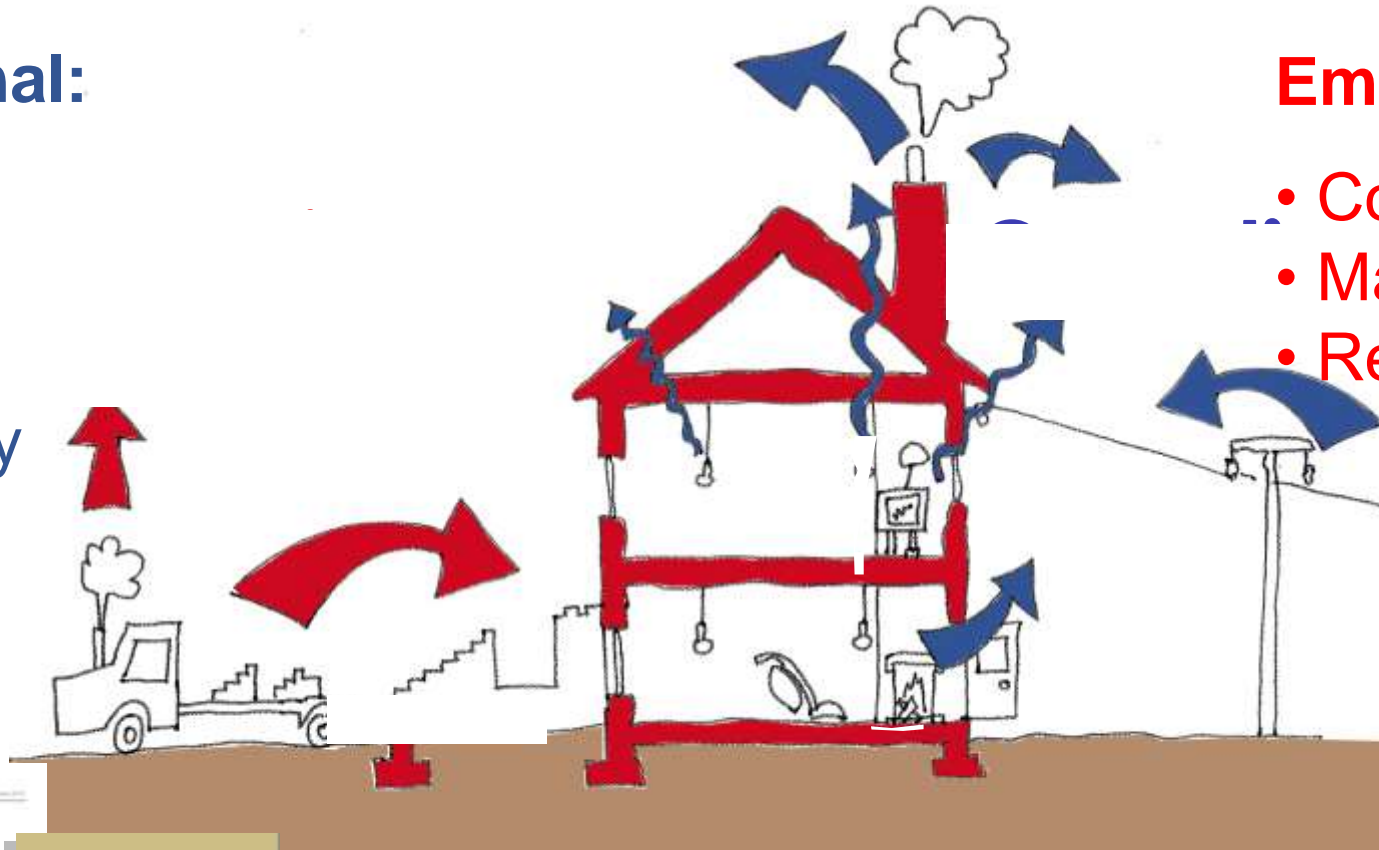
Whole Life Carbon & Financial Analysis

Operational:

- Heating
- Lighting
- Cooling
- Electricity

Embodied:

- Construction
- Maintenance
- Refurbishment



Source: Sturgis Carbon Profiling

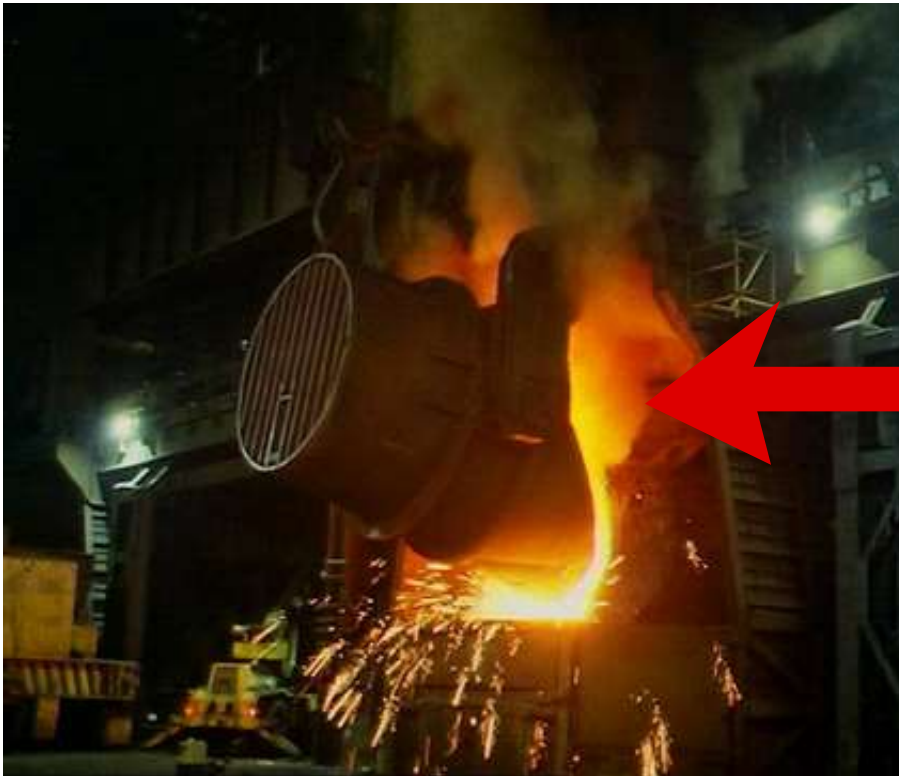


EUROPEAN DIRECTIVE -- CEN TC 350
BRITISH STANDARD -- BS EN 15978

sturgis carbon profiling
sturgis carbon profiling

COST vs BENEFIT

- Embodied Costs



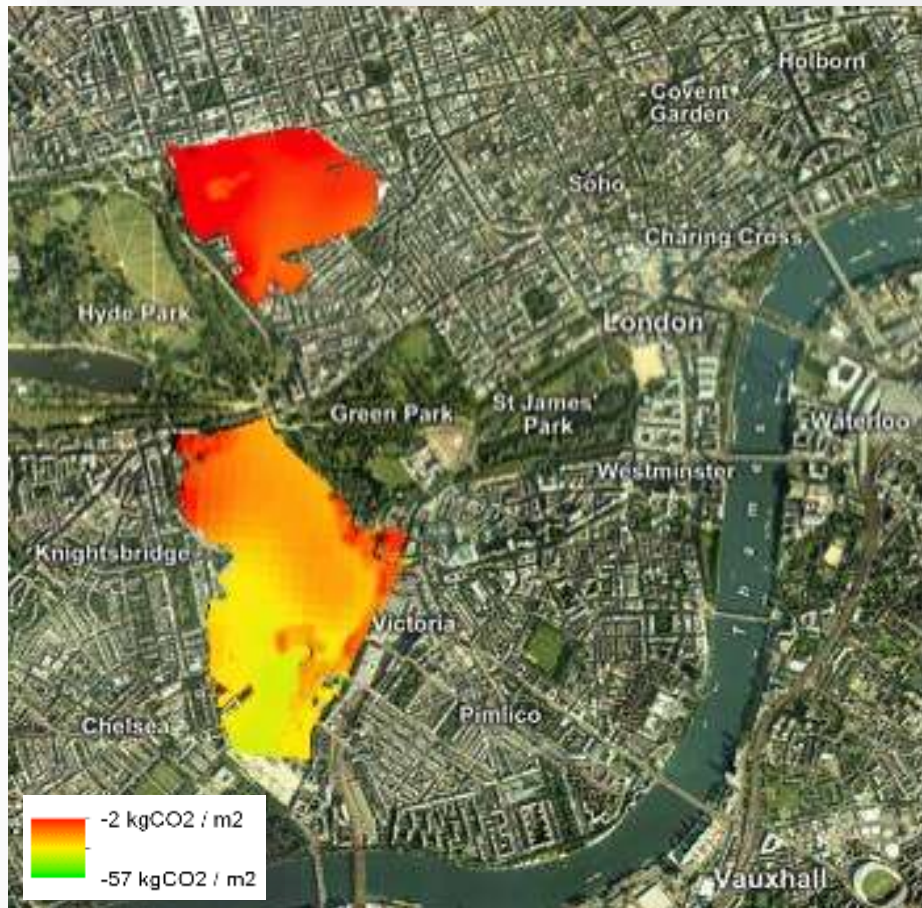
- Operational Benefits



CapCarb vs OpCarb

Grosvenor Retrofit

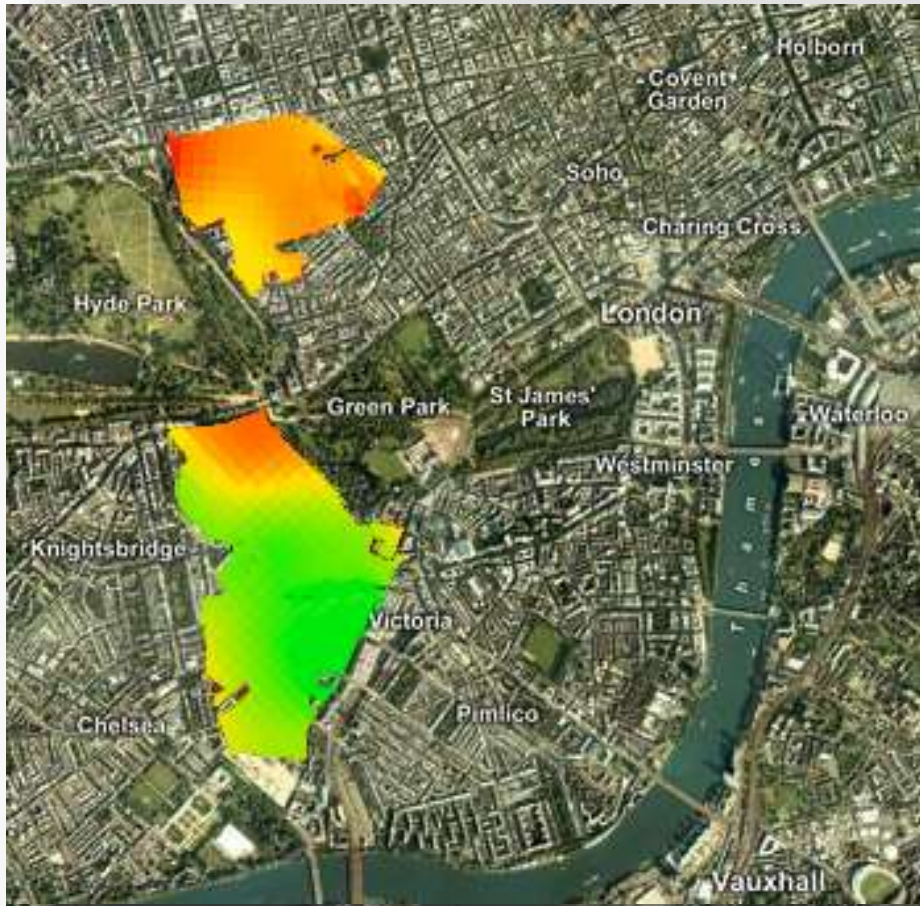
WHAT ARE WE TRYING TO ACHIEVE?



2013

Source: RICS Research undertaken by SCP Climate Change Modelling impact on Commercial Real Estate (2012) incorporated into GIS Grosvenor Greenhouse gas Emission Model (EPC's DEC's stock data etc)

WHAT ARE WE TRYING TO ACHIEVE?



2030

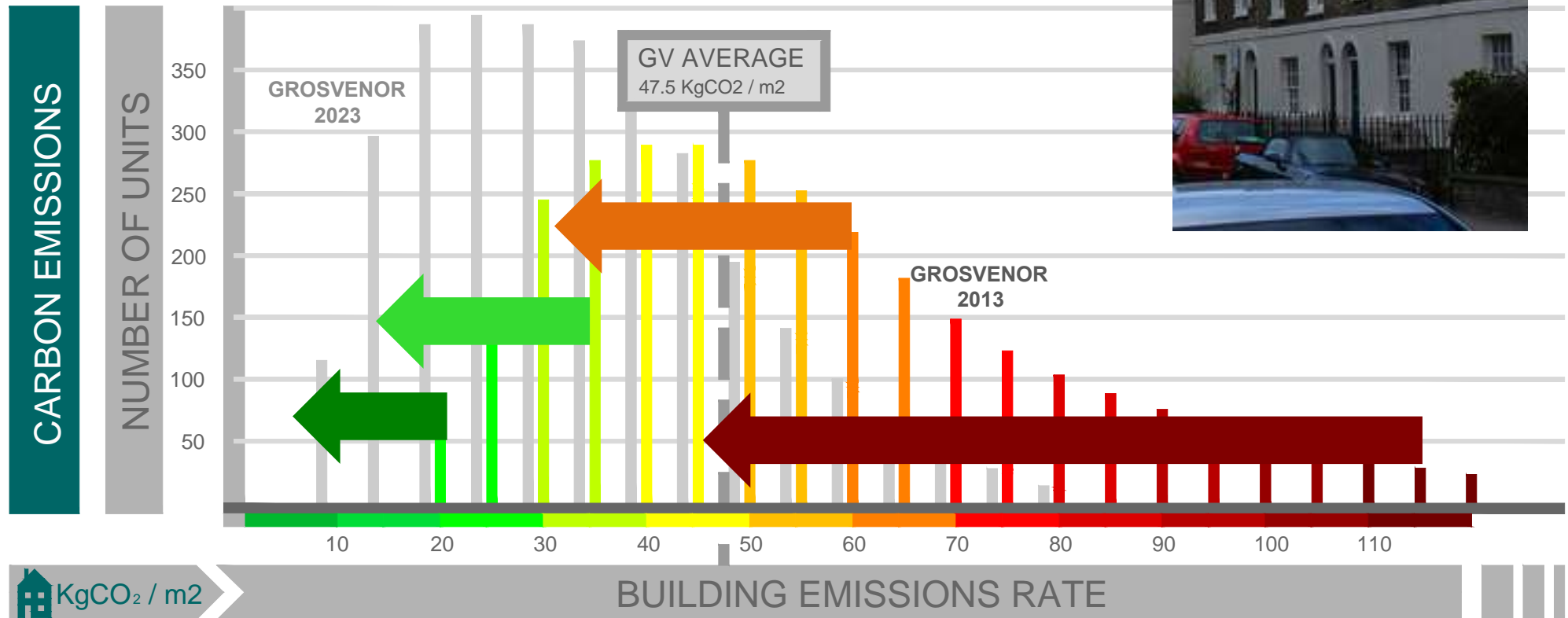
Source: RICS Research undertaken by SCP Climate Change Modelling impact on Commercial Real Estate (2012) incorporated into GIS Grosvenor Greenhouse gas Emission Model (EPC's DEC's stock data etc)

WHAT ARE WE TRYING TO ACHIEVE?

Shifting the energy demand profile of 8,800 properties.



WHAT ARE WE TRYING TO ACHIEVE?



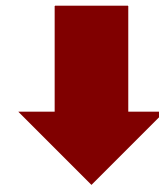
EVERY YEAR



GROSVENOR

x46 Fair rented / Caretakers	35.5 kgCO ₂ /m ²
x41 ExDec	20% reduction
x20 Common Parts	20% reduction
x17 PV Projects	190 kW
x20 Refurbishment	20.0 kgCO ₂ /m ²
x10 Minor Works	20.0 kgCO ₂ /m ²
x5 Passivhaus	9 kgCO ₂ /m ²

47.5
kgCO₂/m²



WHAT ARE WE TRYING TO ACHIEVE?

So 1 years work will save around 455,000KgCO₂ per



**Equivalent to saving
an area of rainforest**

**The same size as the
City of London over
60 years**

WHAT ARE WE TRYING TO ACHIEVE?

So 1 years work will save around 455,000KgCO₂ per



Equivalent to saving
the carbon emission
from making

14 million cups of
tea every year!

WHAT ARE WE TRYING TO ACHIEVE?



OR

Half a million pints!

Strategy

2. Tracking Value



METHODOLOGY

GROSVENOR

Voids / Effective rents
 Eco Label Premium
 Capitalized OpEx savings
 Yield /Cap rates / Stat Obsolesce

PROPERTY	CapEx	RENT	T	ROI	100% CapEx	100% RENT
aviano	-322,4528	82,4808	-0.28	0.000	-441,8011	-349,8218
aviano2	18,98007	2,407678	2.32	0.000	8,094208	18,28865
brn	-4896467	9403647	-0.54	0.000	-4,8134	-1,397794
brn2	8243700	8802375	1.78	0.000	8872398	8786481
brn3	-9871882	2872828	-1.49	0.218	-8212485	-8808241
brn4	-882823	888126	2.51	0.000	8888817	8888829
brn5	48,58848	28,28348	7.25	0.000	8,088751	28,08483
brn6	88,81828	28,18142	6.82	0.000	88,81828	128,4883
brn7	25,28282	18,81828	1.27	0.200	-18,81828	88,28288
brn8	33,48788	28,78838	6.50	0.000	32,74327	128,1483
brn9	71,18838	28,14874	5.53	0.000	31,87827	128,8442
brn10	72,88788	28,88187	2.45	0.914	14,28884	128,8888
brn11	34,82827	21,28888	1.44	0.181	-8,28878	78,28882
brn12	85,51485	11,88788	5.78	0.000	42,84825	87,78158
brn13	-12,38888	8,88888	-1.42	0.137	-28,88888	8,88888
brn14	-124,3888	88,88222	-1.75	0.000	-128,8888	-88,88888
brn15	-118,8411	6,127788	-28.72	0.000	-118,8411	-128,431
brn16	12,78888	21,48242	0.54	0.588	-32,24821	88,8882
brn17	1,828888	5,888844	0.41	0.878	-8,888844	8,27178
brn18	-2,888888	12,87138	-8.80	0.027	-27,88888	81,78881
brn19	282,2887	48,38782	8.88	0.000	127,4888	327,1888
brn20	-14,1887	2,728848	-9.21	0.000	-18,32881	-8,828848
brn21	8,874277	8,888884	8.88	0.882	-11,88887	21,34818
brn22	38,88881	8,22814	3.88	0.000	17,87882	38,78818
brn23	-11,88883	8,75888	-2.32	0.878	-28,5288	-1,88888
brn24	38,52884	7,888888	6.82	0.000	32,52811	38,82818
brn25	128,4788	18,88288	11.71	0.000	182,7282	128,1288
brn26	-22,87888	18,38882	-2.13	0.137	-42,88882	1,888888
brn27	-88,32888	8,87782	-8.23	0.000	-88,12887	-88,32888
brn28	-4482,42	12888,88	-1.88	0.007	-7288,42	-12121,82
brn29	-18,42888	18,72887	-1.44	0.000	-48,74884	-7,518884
brn30	-14,82778	1,884282	-8.18	0.000	-18,38784	-12,38288
brn31	8	1881282				
brn32	-88,88882	18,88178	-8.48	0.882	-87,88882	-18,88882
brn33	-28,12837	12,18887	-2.22	0.027	-35,88288	-3,388818
brn34	11,12318	3,88882	3.12	0.882	6,288718	18,78574
brn35	18,18878	2,172828	8.18	0.000	18,81882	22,82888
brn36	428,228	428,2282	0.81	0.000	848,478	848,432

PROPERTY	CapEx	RENT	T	ROI	100% CapEx	100% RENT
aviano	8,378888	1,788831	5.18	0.000	8,838785	12,72813
brn	-8271384	8821384	-4.74	0.000	-8178887	-2888881
brn2	8821384	8821384	8.88	0.884	-8888882	8878884
brn3	-8821384	8821384	-8.88	0.884	-8888882	8888882
brn4	88,18837	8,88882	12.18	0.000	78,88883	188,1287
brn5	88,12837	7,378888	7.82	0.000	41,78884	88,87818
brn6	11,78888	7,283851	1.81	0.187	-2,318828	28,82882
brn7	8,42887	38,8874	8.88	0.882	-11,78878	88,58818
brn8	71,88888	8,783888	8.18	0.000	36,43888	88,7881
brn9	64,78888	7,388788	5.38	0.888	28,98888	38,88818
brn10	-3,38888	1,888888	-4.37	0.000	-18,28818	-8,888818
brn11	8,418882	3,888888	3.88	0.888	-12,12888	8,888882
brn12	-4,188882	8,188888	-8.21	0.001	-8,888882	8,888882
brn13	8,848887	7,788884	3.37	0.888	6,388887	14,95878
brn14	8,847882	8,188888	2.57	0.813	1,788887	34,9888
brn15	88,84287	24,88274	2.81	0.882	1,888887	128,888
brn16	-8,124221	5,288878	-1.73	0.882	-18,38823	1,188887
brn17	-34,81818	6,878881	-7.51	0.000	-48,81818	-25,72818
brn18	-11,32884	8,938888	-6.18	0.000	-48,88882	-11,71888
brn19	-28,88888	8,428888	-8.42	0.000	-24,81288	-18,38818
brn20	-12,87837	8,821788	-2.78	0.000	-23,21284	-3,888888
brn21	-4,188884	1,488888	-3.48	0.000	-8,888882	-4,888888
brn22	888,188	872,187	8.23	0.882	-128,828	888,88
brn23	8821385	8888888	2.78	0.887	8888882	8888818
brn24	4,788845	1,788845	3.47	0.881	1,288888	7,881887
brn25	4,12818	1884488	5.25	0.000	1,881888	8,88818
brn26	271,5188	78,2882	3.41	0.881	128,5882	427,471

The screenshot shows the Stata 12.0 workstation interface. The main window displays the command window with the following text:

```

STATA (R)
Statistics/Data Analysis 12.0 Copyright 1989-2011 StataCorp.
4905 Lakeway Drive, College Station, Texas 77842 USA
WWW-STATA-CORP: http://www.stata.com
870-528-8600 stata@stata.com 979-536-3465 (fax)

Single-user Stata personal license:
Serial number: 0028838888
LICENSED TO: SAROF ADEGSI
SAROF ROBERTS

NOTE:
1. Now using executable type 'ADO281.dll'
    
```

The Results window shows the output of the command:

```

-----+-----
Variable | Name
-----+-----
    
```

3. Project Financing



ECO
Energy Company Obligation



FIT

FEED IN TARIFFS



RHI

Renewable Heat Incentive



ECA

Enhanced Capital Allowances

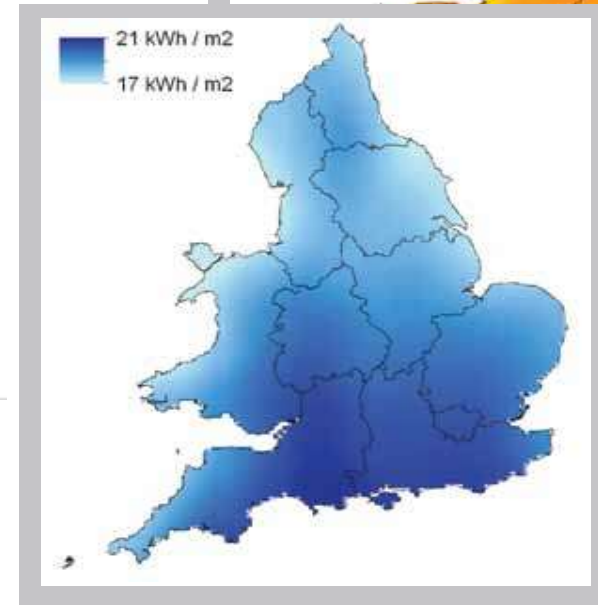
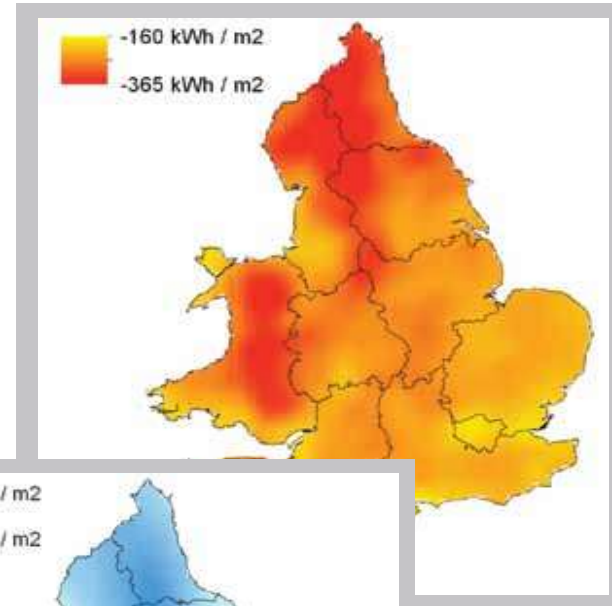
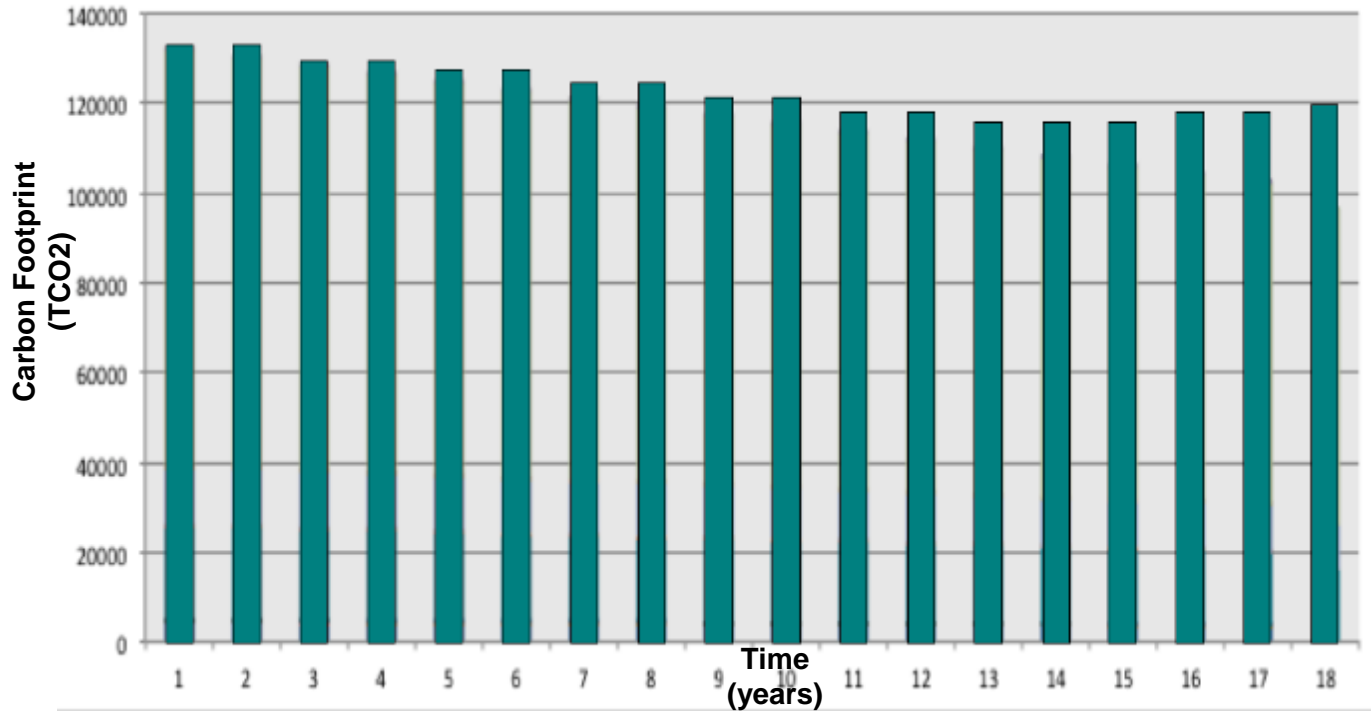


3. Management Dashboard



GROSVENOR

Grosvenor London Estate Building's Carbon Footprint



■ Changes in heating demand

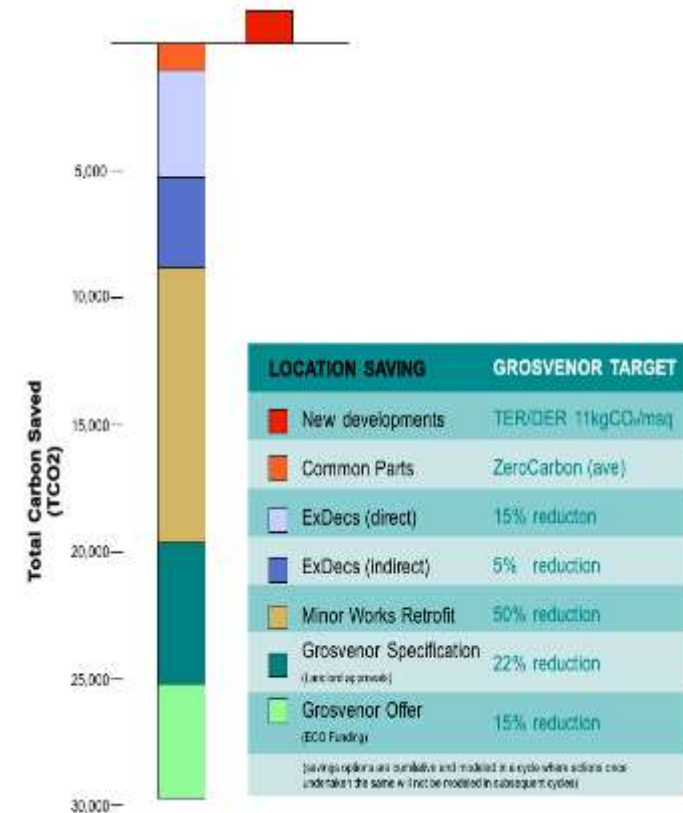
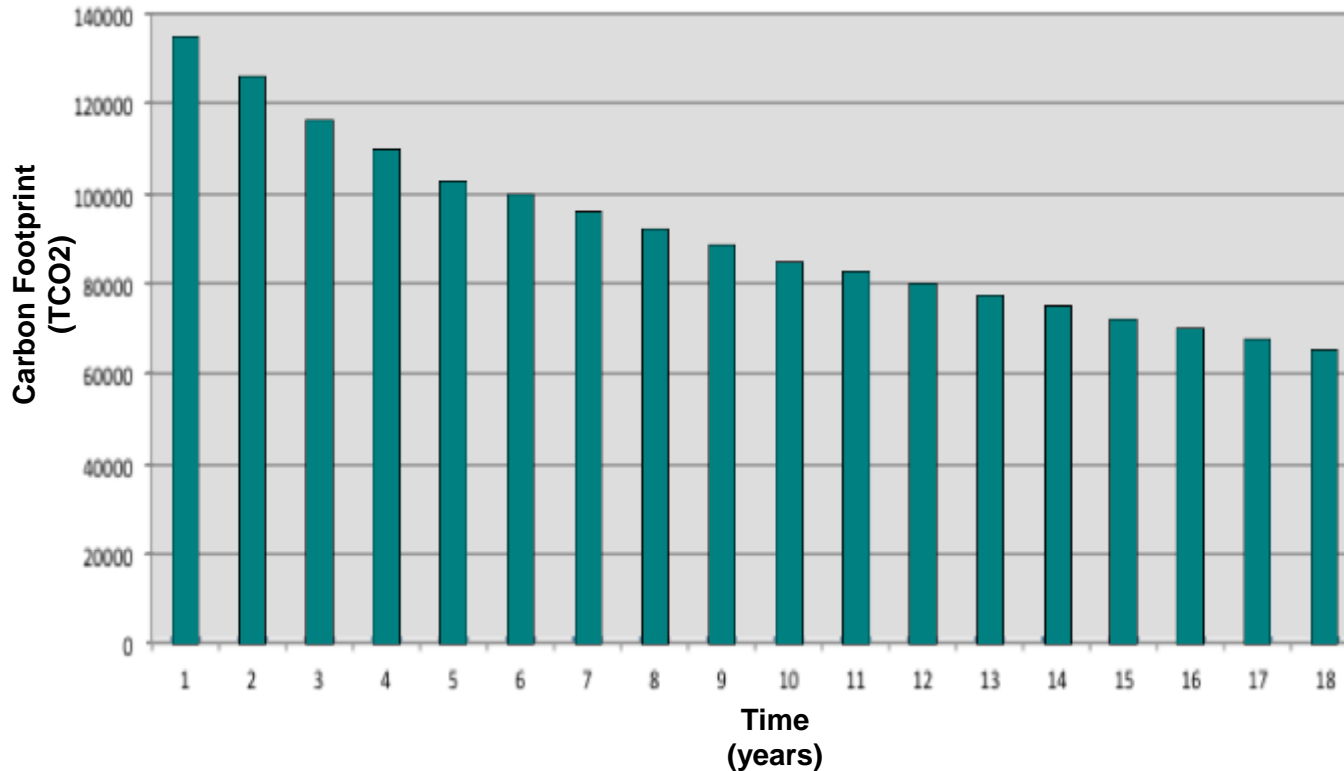
■ Changes in electricity consumption

3. Management Dashboard



GROSVENOR

Grosvenor London Estate Building's Carbon Footprint



- 100% reduction in Direct emissions by 2018
- ROI of 6.75-7.25% Direct
- ROI of 11.5-12.5% Indirect
- Direct Income of £90,000pa
- Indirect Income £240,000pa from 2012

4. Condition Surveys Toolkit



Sustainable Retrofit Scope of Works and Performance Specification

THIS DOCUMENT PROVIDES GROSVENOR WITH A QUICK AND DIRECT WAY TO ASSESS THE FEASIBILITY AND REQUIREMENTS THAT A NEW RETROFITTING PROJECT MAY INVOLVE

DEVELOPED BY STURGIS CARBON PROFILING LPP, IT GATHERS THE EXPERIENCE DEVELOPING RETROFIT SCOPE OF WORKS DURING 2013

THE OPTIONS PROVIDED GENERALLY ADJUST TO ENGLISH HERITAGE RECOMMENDATIONS, WESTMINSTER COUNCIL REQUIREMENTS AND BUILDING REGULATIONS. FURTHER UPDATES ARE STILL REQUIRED.

U VALUES, RISKS AND EXPECTED PLANNING REQUIREMENTS ARE ALSO PROVIDED. HOWEVER, DEFINITE RESULTS WILL ALWAYS DEPEND ON AN ON-SITE TECHNICAL SURVEY.

FOUR QUICK SELECTION STEPS WILL PROVIDE WITH A RANGE OF AVAILABLE STRATEGIES. DEPENDING ON THE PROJECT'S CONDITIONS, USERS WILL NEED TO JUDGE WHICH ONES ARE THE MORE SUITABLE FOR THE PROJECT.

THE OUTPUT CAN BE PRINTED FOR PRELIMINARY PRICING / FEASIBILITY. FURTHER PROFESSIONAL ADVICE BY STURGIS CARBON PROFILING IS REQUIRED TO CONFIRM COMPLIANCE.

A SAMPLE OF THE OUTPUT IS PROVIDED IN THE 'SAMPLE' TAB



THERE ARE TWO BASIC AREAS OF INTERACTION:

SELECT OR FILTER OPTIONS IN THE RED BOXES

INPUT INFORMATION OR SELECT OPTIONS IN YELLOW AREAS

1 2 3 4

EW - Ext works
CP - Common parts
OR - Occupied retrofit
UR - Unoccupied Retrofit

In Conserv. Area?

Listed Building?

Area of intervention

6

SELECT MOST SUITABLE SPECIFICATIONS

ISSUES TO CONSIDER

PREVIOUS IMPLEMENTATION

Specifications

Indicator Products

Reference image

Selected measure

Target U value

Risks

Planning Requirements

Similar intervention in:

6

5

HOW TO USE THE 'SPECIFICATION TOOL'

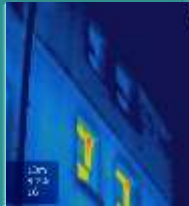
- 1 SELECT SCOPE OF WORKS
- 2 SELECT IF THE PROPERTY IS IN A CONSERVATION AREA
- 3 SELECT IF THE BUILDING IS LISTED
- 4 IF REQUIRED, SELECT SPECIFIC AREA OF INTERVENTION
- 5 FROM THE LIST OF STRATEGIES PROVIDED, ASSESS AND TICK THE MOST SUITABLE ONES FOR THE PROJECT IN THE YELLOW BOXES
- 6 SELECT FILTER DOWN ONLY THE TICKED '✓' BOXES BEFORE PRINTING

Building Assessment

Building Performance Evaluation

Address : Flat 4 – 1/8 Anns Close SW1X 8EG
 Scope : Occupied retrofit
 Value : !
 Project Manager : Andrew Moore
 Program :
 Total Area: 37.70 m²

Carbon reduction
81%
 Reduction without PVs
69%



Tenant savings
£1,018p/a
 Grosvenor savings
£156p/a

fSAP Carbon and Energy Performance Data		Before	After (with PV's)
CARBON PERFORMANCE		165.43 KgCO ₂ /m ² /yr	31.54 KgCO ₂ /m ² /yr
HEATING DEMAND		13,841 KWh/yr	8,410 KWh/yr
LIGHTING DEMAND		376 KWh/yr	386 KWh/yr
RdSAP Energy Performance Certificate		Before	After
EPC		G 12	B 83
Building User Survey Results		Before	After
TENANT COMFORT		/100	/100
Photovoltaic Panels			
CARBON PERFORMANCE			19.40 KgCO ₂ /m ² /yr

Quotes

Other Contents

- MACC
- CONTRACTOR'S REPORT
- ENERGY MONITORING
- THERMAL IMAGES

EPC's are measured in RdSAP 2009 fSAP results are calculated in StromaFSAP 2009 v1.5.0.63 These models provide estimates for the portion of Building Energy consumption legislated for in the UK through Part L and statutory renewable requirements. It is anticipated that additional unregulated emissions will be generated from tenant led demand sources which are not included here.

MONITORING EQUIPMENT. INTERIOR RETROFITTING WORKS INSTRUCTIONS (NOT FOR EXTERNAL OR COMMON PARTS WORKS)

BEFORE WORKS START ON-SITE



Hub / CO₂ meters / Temp&RH meters (internal and external)



1. Records of devices and location:

Write down the 6-digit number displayed on the label of each device together with its location (room and position). Refer to issued specification to know how many meters have been installed.

Example: 0123456 - Living room. Lintel level above door to corridor. Left corner.

2. Safe storage:

Unplug, switch off and remove the data emission hub, the CO₂ meters and all the Temperature/RH meters (see pictures above). Keep them in a box or bag protected from dust, together with the location records previously written down.

3. Notification:

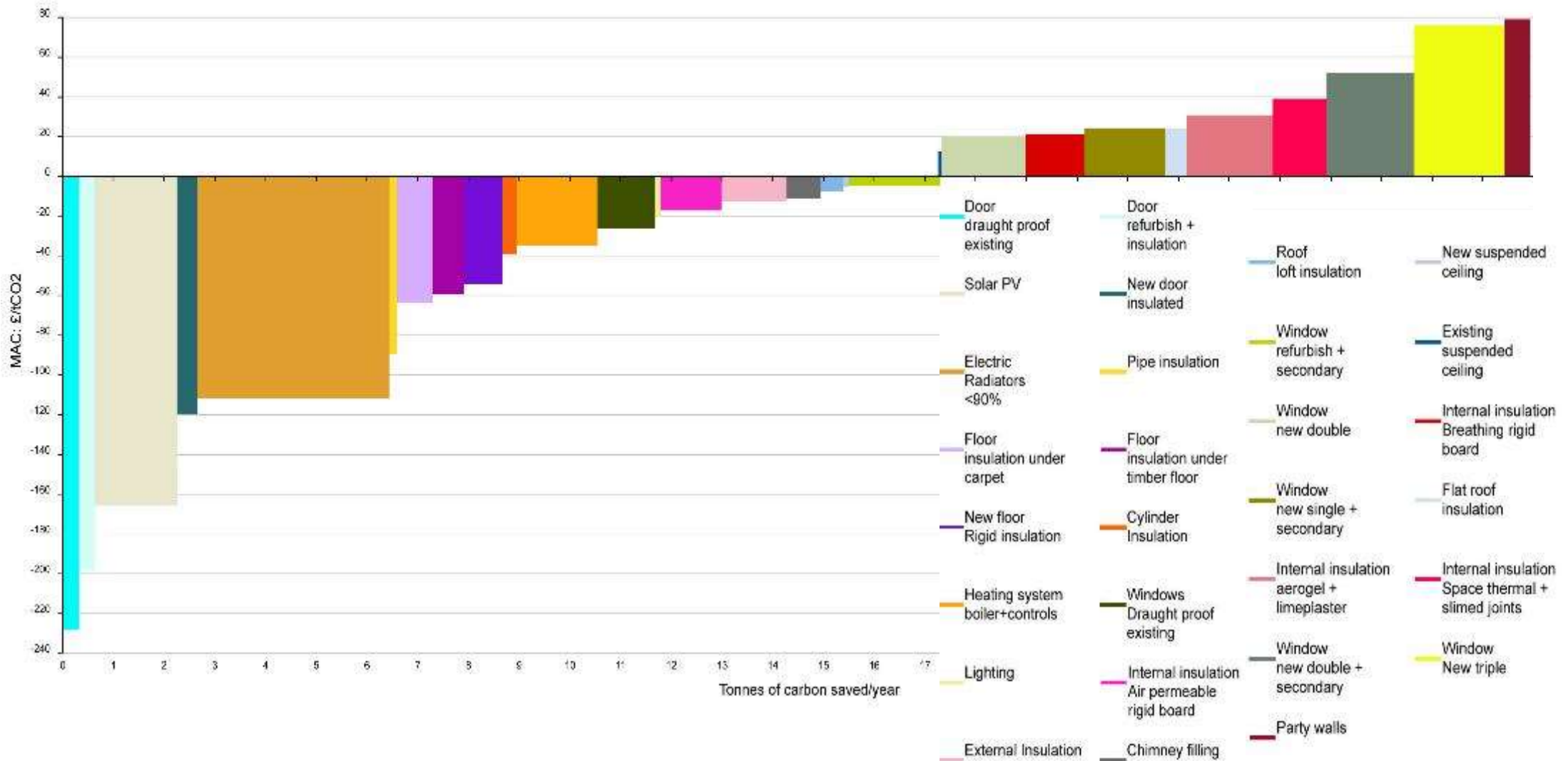
Notify Juan J Lafuente at Sturgis Carbon Profiling (juan.lafuente@sturgis.co.uk / 020 7613 2500) that the equipment has been removed and that works on site start.

Electricity and hot flux meters and emitters

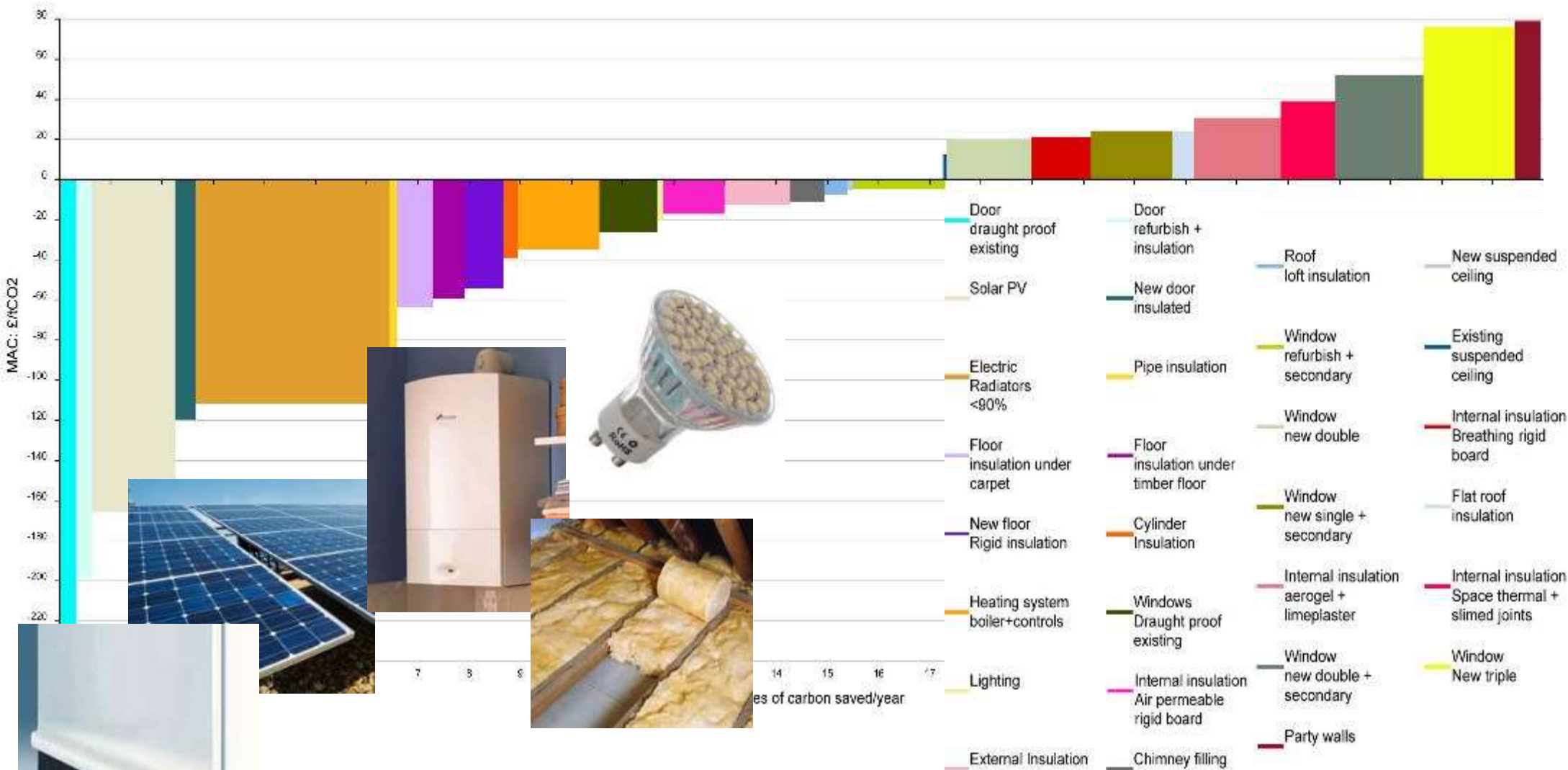


4. No changes

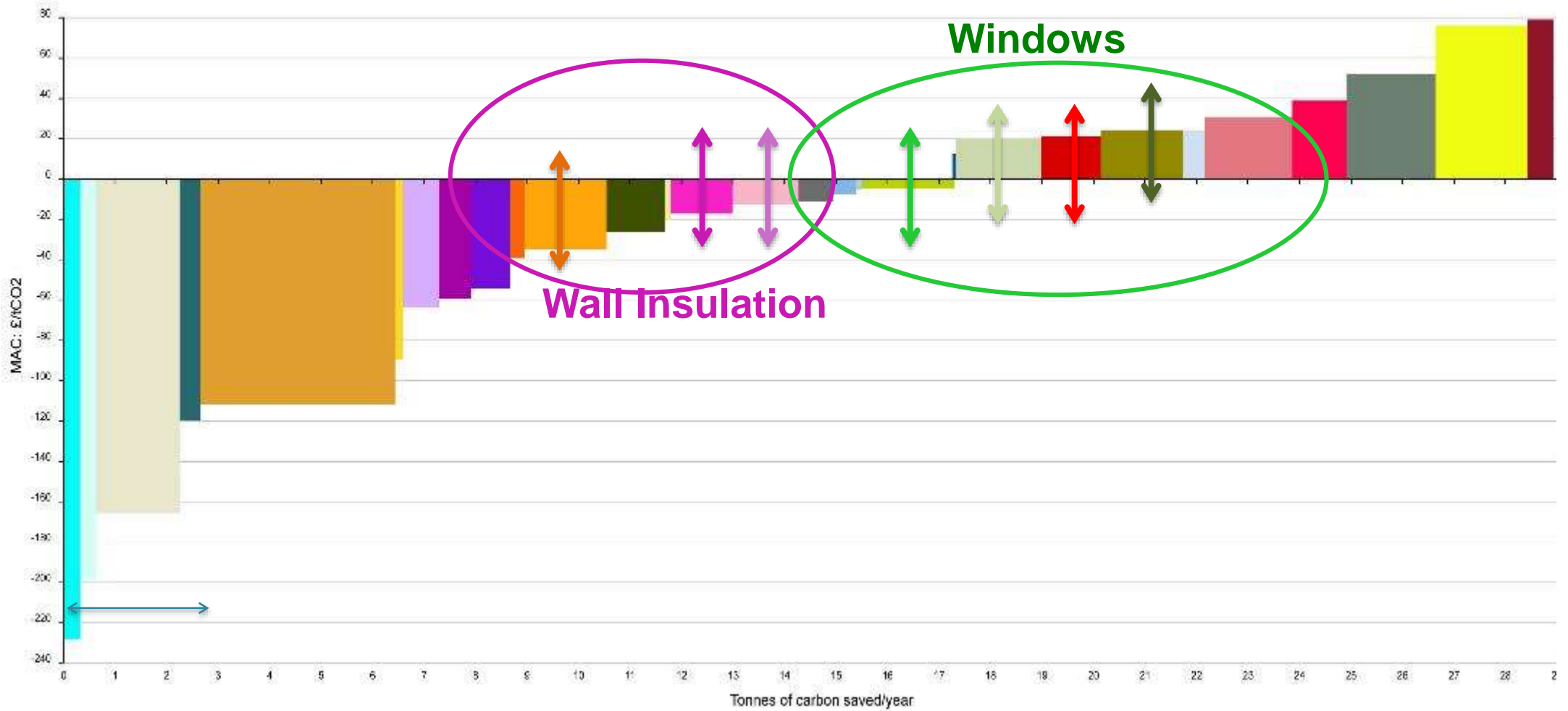
MACC



MACC



MACC

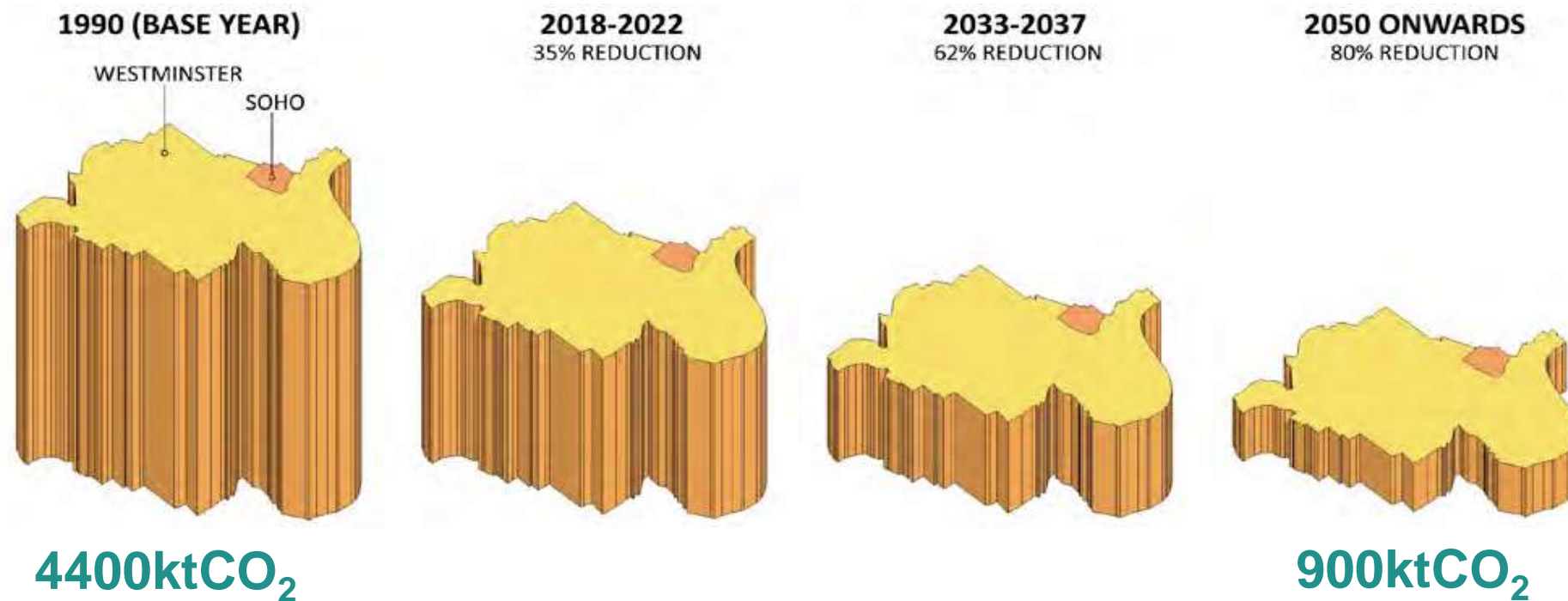


Statutory



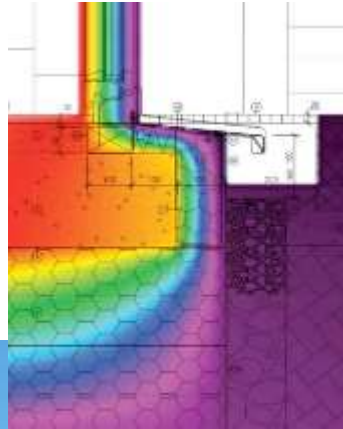
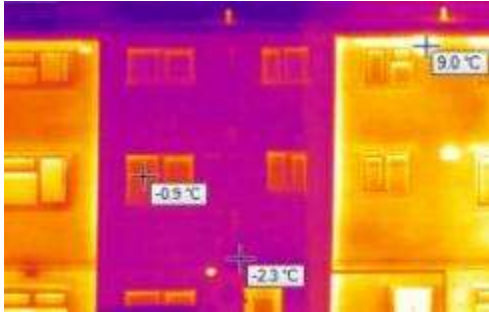
City of Westminster

Figure 7: The scale of the challenge for Westminster



Source: Sturgis Carbon Profiling

Benchmark



bre



GROSVENOR



**127% reduction
Zero Carbon
Emissions!**



St Barnabas Street project designed to achieve EnerPHit certification

Improving Historic Soho's Environmental Performance



sturgis carbon profiling | RAMBOLL | SAMPSON ASSOCIATES | HENSLEY, THRELL & BRIDGEWATER

Wider Benefits



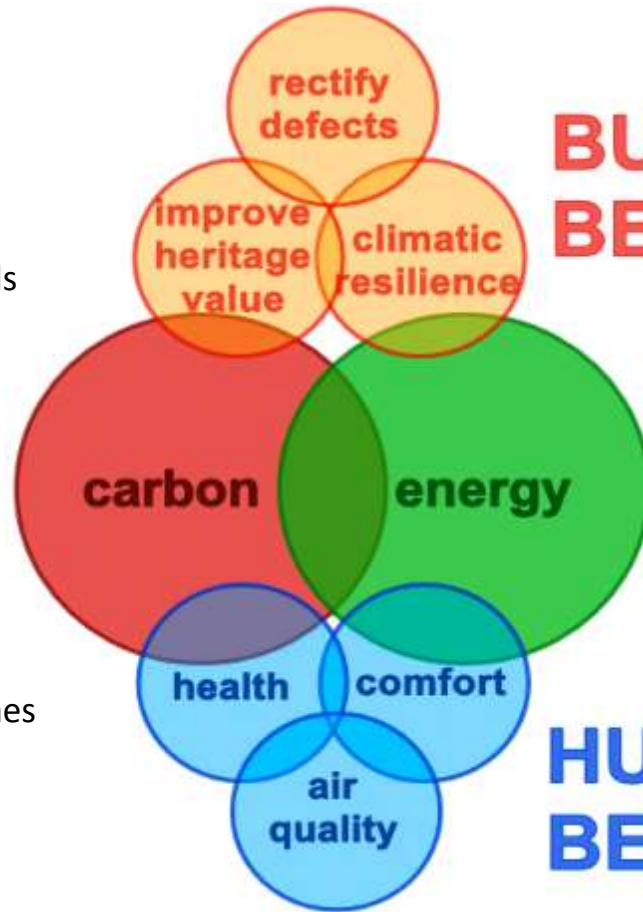
- removal of drafts and street sounds



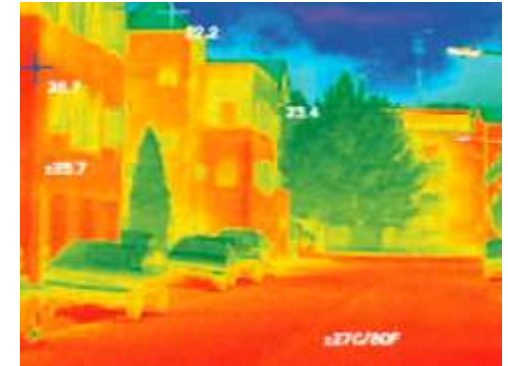
- thermal comfort in weather extremes



- air-borne bacteria, minimizing internal CO2 levels



**BUILDING
BENEFITS**








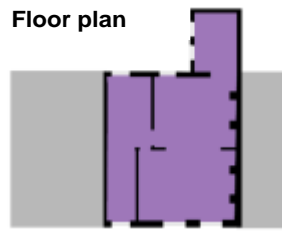
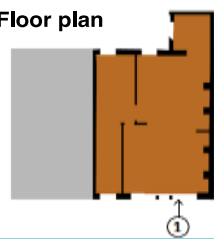
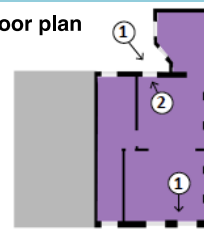

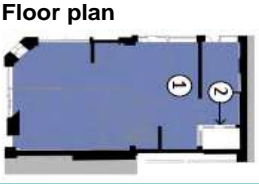
- minimizing heat island effect



- reintroduce historic features

**HUMAN
BENEFITS**

What makes the buildings special

<p>Case study 1</p>	<p>5 Meard Street</p>	<p>Case study 4</p>	<p>35-36 Tavistock Street</p>	<p>Case study 2</p>	<p>82 Mortimer Street</p>	<p>Case study 5</p> <p>Albany House, 314-326 Regent Street</p>
<p>Building Description</p>	<p>Building Description</p>	<p>Building Description</p>	<p>Building Description</p>	<p>Building Description</p>	<p>Building Description</p>	
<p>Designation: Grade II* Listed</p> <p>Year built: 1734</p>	<p>Designation: Grade II Listed</p> <p>Year built: 1733</p>	<p>Designation: Grade II* Listed</p> <p>Year built: 1722</p>	<p>Designation: Grade II Listed</p> <p>Year built: c.1900</p>	<p>Designation: Grade II Listed</p> <p>Year built: 1925</p>	<p>Designation: Grade II Listed</p> <p>Year built: 1925</p>	
<p>Three-bay wide four-storey building with two and three vaults, two under the street in front building and one under the yard behind.</p>	<p>Mid-terrace properties of typical late 19th century appearance, consisting of ground floor and three upper storeys; floors have been re-planned so they accessed off the staircase in no 35. A basement, ground floor and rear part of floor are used as a restaurant.</p>	<p>A private single family residence. The dog-leg stairs remain and have been refaced. The rear elevation has been refaced with 19th century brick. The top (third) floor is a modern addition and there is a flat roof above. A vault under the road is accessed from the house; another seems to have been used as a garden.</p>	<p>A former dentist's surgery, now converted into a restaurant. The building features stone facing and figures on front elevation. Four stories with a mansard roof, mansard roof and basement.</p>	<p>A seven-storey corner office block with a shop at ground level and an adjoining five-storey block in Mortimer Street. Brick built with a section of glazed white bricks to the rear stairwell. Modern office fit-out throughout. Stone facing to street elevations, double mansard with dormers and slate coverings to corner block, and asphalt-covered flat roofs above. Metal framed windows to corner block, large sliding sashes to Mortimer Street block. We only visited a typical upper floor in the corner block.</p>	<p>A seven-storey corner office block with a shop at ground level and an adjoining five-storey block in Mortimer Street. Brick built with a section of glazed white bricks to the rear stairwell. Modern office fit-out throughout. Stone facing to street elevations, double mansard with dormers and slate coverings to corner block, and asphalt-covered flat roofs above. Metal framed windows to corner block, large sliding sashes to Mortimer Street block. We only visited a typical upper floor in the corner block.</p>	
						
<p>Floor plan</p> 	<p>Floor plan</p> 	<p>Floor plan</p> 	<p>Floor plan</p> 	<p>Floor plan</p> 	<p>Location plan</p> 	
<p>Heritage Significance</p> <p>Historical and Evidential Value</p> <p>This building is typical of the early 20th century commercial developments around Oxford Street and, like other buildings in the area, evokes the splendour and confidence of the era. Built in a classical style with Beaux Arts details, it has retained elements of pilaster frames under entablature features on the ground floor despite the introduction of more modern shopfronts.</p> <p>Aesthetic and Communal Value</p> <p>Corner sites play an important role in defining the townscape and creating landmarks to help people navigate their way around unfamiliar parts of the city. Having a distinctive building at this junction therefore has a communal as well as an aesthetic function.</p> <p>Ground floor commercial activities also have communal value, providing an active street frontage as well as services to visitors and local residents.</p>						

What's appropriate

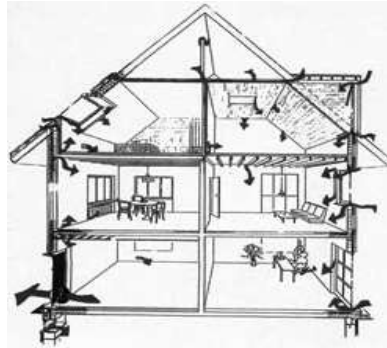
BUILDING ENVELOPE

Base case: A typically non draught proofed building

Draughts can cause up to 20% of the total heat lost in older homes, and can also lead to health problems for occupants.

Draught proofing is one of the cheapest and most cost-effective ways of improving energy performance. It requires little or no specialist skills or equipment.

If draught proofing is only partially complete, air leakage will just increase from the untreated areas to cancel out the effects of the improvements elsewhere. To prevent this occurring, a complete package of draught proofing measures should be carried out simultaneously.



Removing draughts should be the first measure to consider in retrofitting historic buildings.

Issues

Listed Building	Unlisted Building	Specialist advice
-----------------	-------------------	-------------------

Risks

Draughty buildings can lead to health problems such as chills and are often felt to be cold and uncomfortable.

Draught proofing (cost £30-£50/msq)

(may qualify for Warm Front Scheme)

Draught proofing measures should include:

- closing existing holes in building walls (including those covered by internal panelling) with insulant and draught stripping all apertures;
- closing up any holes around pipes coming into the building;
- closing up any holes in the roof or eaves (maintaining background ventilation to these areas);
- draught stripping loft hatches;
- closing up gaps in suspended wooden floors over the ground;
- controlling air leakage from the chimney.

Carbon saving	Cost saving (commercial)		Cost saving (domestic)	
	per msq/yr	per msq/yr	per msq/yr	per msq/yr
11.25kg	£2.18	gas heating	18.3yrs	£2.73
		payback period	14.7yrs	payback period
29.08kg	£5.90	electric heating	6.8 yrs	£7.38
		payback period	5.4 yrs	payback period

Heritage Assessment

Draught proofing has very little impact on the heritage value of the building if the materials used are similar to the existing materials.

Issues

Listed Building	Unlisted Building	Specialist advice
none	none	none

Risks

Reduced air permeability can lead to mould growth. Ensure background ventilation to all voids is retained.

WALLS

Base case: single skin London Stock brick

The base case is a brick wall, about 9-15 inches thick (22-38cm). It may be rendered externally and have paneling or plaster finishes internally.

Single skin walls are typical of 18th and 19th century buildings.



Examples of typical walls in Soho

Issues

Listed Building	Unlisted Building	Specialist advice
-----------------	-------------------	-------------------

Risks

Uninsulated single skin walls are a major source of heat loss from buildings.

Option 1: Insulation behind existing paneling (cost £110-£160/msq)

(may qualify for Warm Front Scheme)

Install mineral wool batten 50mm thick where possible behind existing paneling.

A modest amount of dismantling and reinstatement of existing paneling is required.



Carbon saving	Cost saving (commercial)		Cost saving (domestic)	
	per msq/yr	per msq/yr	per msq/yr	per msq/yr
5.23kg	£1.02	gas heating	133yrs	£1.27
		payback period	106yrs	payback period
13.5kg	£2.75	electric heating	49yrs	£3.44
		payback period	39yrs	payback period

Heritage Assessment

This option has the least impact on the building and is recommended to be undertaken at the same time as draught proofing measures. As no original fabric will be altered, little heritage impact is anticipated if due care is taken in disassembling the paneling.

Issues

Listed Building	Unlisted Building	Specialist advice
Approval not required	Approval not required	Joiner

Risks

Careful disassembly of paneling is recommended to avoid damaging historic features.

Option 2: internal insulation, high efficiency rigid (cost £80-£100/msq)

(may qualify for Warm Front Scheme)

High efficiency ridged polyurethane boards (60mm deep), built out with studs and plastered over. The floor joist end should also be treated, and insulation run through the floors and back along party walls to prevent cold bridging.



Carbon saving	Cost saving (commercial)		Cost saving (domestic)	
	per msq/yr	per msq/yr	per msq/yr	per msq/yr
6.3kg	per msq/yr	£1.22	gas heating	73 yrs
			payback period	£1.53
16.3kg	per msq/yr	£3.31	electric heating	59 yrs
			payback period	£4.14
				22 yrs
				payback period

Heritage Assessment

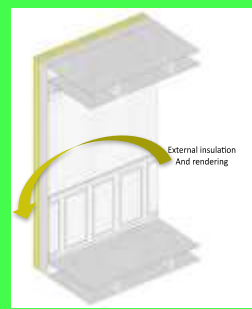
Various historical, evidential and aesthetic impacts need to be considered with reference to the surface being covered and damage by fixings to the original walls behind. Only recommended where most internal original features have been lost.

Issues	Risks
Listed Building Approval required	Specialist advice Architect
Unlisted Building Approval not required	Extra care is needed around thermal bridges (eg windows) to avoid damp and rot problems.

Option 3: External insulation (cost £95-£165/msq)

(may qualify for Warm Front Scheme)

External insulation of 70mm depth and rendering of secondary non original facades such as rear and side elevations.



Carbon saving	Cost saving (commercial)		Cost saving (domestic)	
	per msq/yr	per msq/yr	per msq/yr	per msq/yr
6.41kg	per msq/yr	£1.24	gas heating	104 yrs
			payback period	£1.56
16.55kg	per msq/yr	£3.36	electric heating	84 yrs
			payback period	£4.20
				31 yrs
				payback period

Heritage Assessment

This option has the advantage of allowing the internal finishes of the building to be retained. However it would have significant heritage impacts on the external value of buildings with features of merit that are currently not rendered, and is recommended only for existing rendered rear facades.

Issues	Risks
Listed Building Approval unlikely	Specialist advice Architect
Unlisted Building Conservation Area consent	Extra care is needed around weathering details, sills and copings, to avoid water ingress

Examples

Option 1:

Insulation behind existing paneling



Complexity:

This is a simple measure and recommended for all buildings.



Suggestion:

A survey of the paneling may help owners to understand the complexity of paneling disassembly before beginning work.

Option 2:

Internal insulation, high efficiency rigid



The complexity of the works depends on a great deal on the number of window and door openings, as these will need to be relined as a consequence of the walls being built out.



Some manufacturers can measure up the walls and carry out cutting and painting off-site to speed up installation and reduce mess.

Option 3:

External insulation



This will require an external scaffold to be installed and careful detailing around windows, eaves and the ground to minimise cold bridging and water ingress.



This option is best considered alongside periodic maintenance works, such as repainting, in order to keep costs as low as possible.

Technology

Internal Wall Insulation – TODAY

0.60 U-Value



U-Value
2.3



U-Value
0.6



U-Value
0.35



U-Value
0.15



**POOR
VIABILITY!**



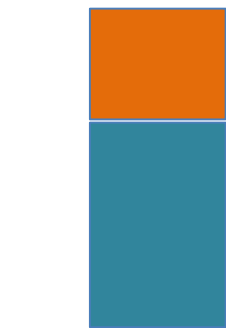
Internal Wall Insulation – NEW

0.50 U-Value



Material (£/msq)

Labour (£/msq)



£110-140



£100-120



£90-120



£60-90



£70-100

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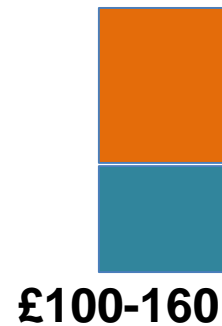
Internal Wall Insulation – FURTHER

0.35 U-Value



Material (£/msq)

Labour (£/msq)



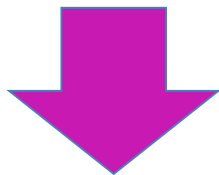
Internal Wall Insulation – NEXT

0.35 U-Value

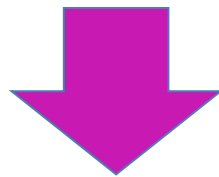


Material (£/msq)

Labour (£/msq)



£75



£70



£100-160



£70-90



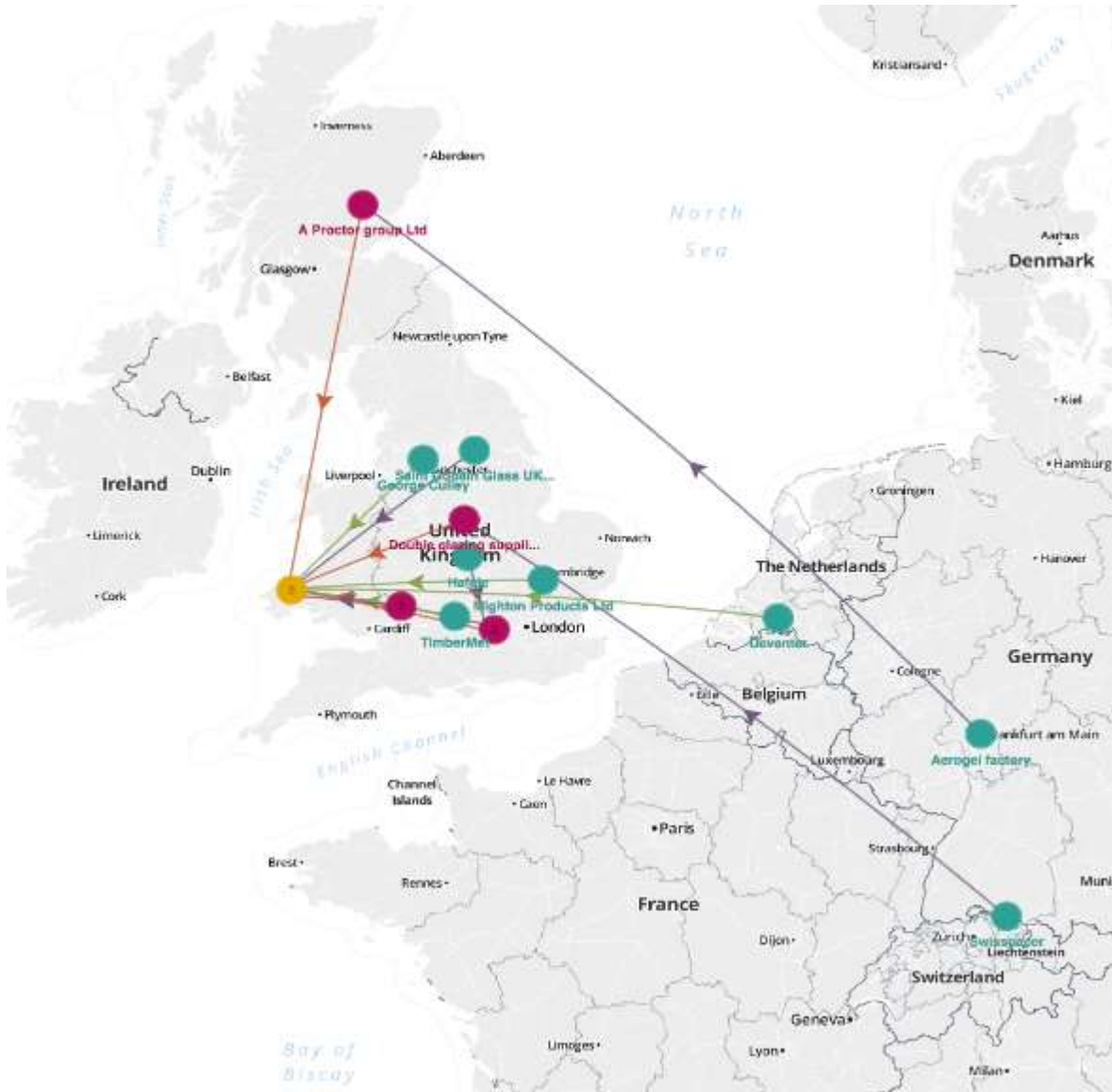
£80-100

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Key Innovation Mapping

4. Utilizing **local manufactures** to reduce transport cost and improve the Carbon Footprint



We calculated carbon emissions associated with travel of various components to be **20.0 kgCO₂e per unit** by selecting local suppliers and manufacturers, we limited total deliveries to **500km**.

Carbon Profiling

Date of assessment	2014	adapted from bid file
Assessor	MG	
Name of Manufacture	Triple glazed PH sash windows	
Source of data:	ICE database	
General description	Cardiff PH sash window	
	Window Area: 1.23m(w)*1.48 (h)	

Name of product	Raw material	Comment (if nay)	Area	Volume	Density	Mass	Carbon factor	TOTAL Embodied Carbon	% from electricity
PHI sash	Timber: Sustainably managed	Accoya timber	0.78000	0.0608	630	38	290.00	17.6	13%
	Aluminium (extruded general)	Aluminium 3mm capping, 1.5 times for over lapping	0.00000	0.0000	2700	0	9.08	0.0	57%
	Steel (virgin)	Stainless steel spacers	0.00050	0.0000	7800	0	2.89	0.1	0%
	Glass-toughened	Toughened glass	1.41000	0.0056	2500	14	1.35	19.0	25%
	0.0	Argon Gas	0.00000	0.1872	1.65	0.31	0	0.0	0
	Glass-toughened	Toughened glass	1.41000	0.0056	2500	14	1.35	19.0	25%
	0.0	Argon Gas	0.00000	0.1872	1.65	0.31	0	0.0	0
	Glass-toughened	Toughened glass	1.41000	0.0056	2500	14	1.35	19.0	25%
	Paint: general	Paint	0.78000	0.0008	1000	1	2.91	2.3	76%
	Aerogel	Aerogel spacer	0.02000	0.0001	14.0	0	4.20	0.0	42%
	Aerogel	Aerogel frame	0.70920	0.0355	14.0	0	4.20	2.1	42%
	Nylon (Polyamide) 6 Polymer	Spacer polysulphade assumpt	0.12000	0.0006	1150	1	9.14	6.3	42%
	0.0	Mastic	0.05000	0.0003	1150	0	5.70	1.6	0
	Polyurethane Rigid Foam	Spacer foam	0.12000	0.0018	30	0	4.84	0.3	42%
Total product area (if known)	1.8	m2	Product summary		N/A	81.6	N/A	87.4	Kgco2e
Cost					kg/m2	44.8		1.1	KgCO2e/Kg
					kg/E	#DIV/0!		48.0	KgCO2e/m2
								48.03	KgCO2e/E
								19%	% of mass made by electricity

5. Utilizing accurate embodied carbon assessment in design process



We calculated the total Whole Life Carbon emissions of Cardiff PassivHaus Sash window to be **48.0 kgCO2e/m2** which is 25% less than comparable triple glazed window and 47% more than new double glazed unit.

Internal Wall Insulation - Fixing

Sta Stuck



Easy

Twist Fix



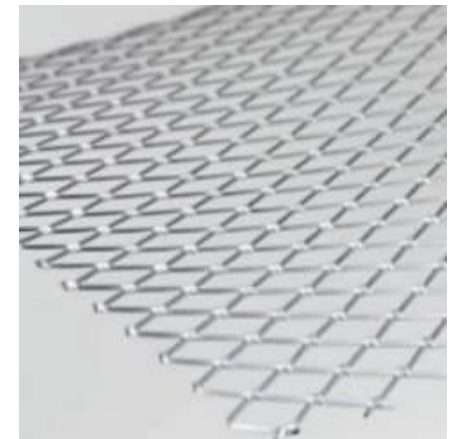
Harder

Batten



Harder

EML

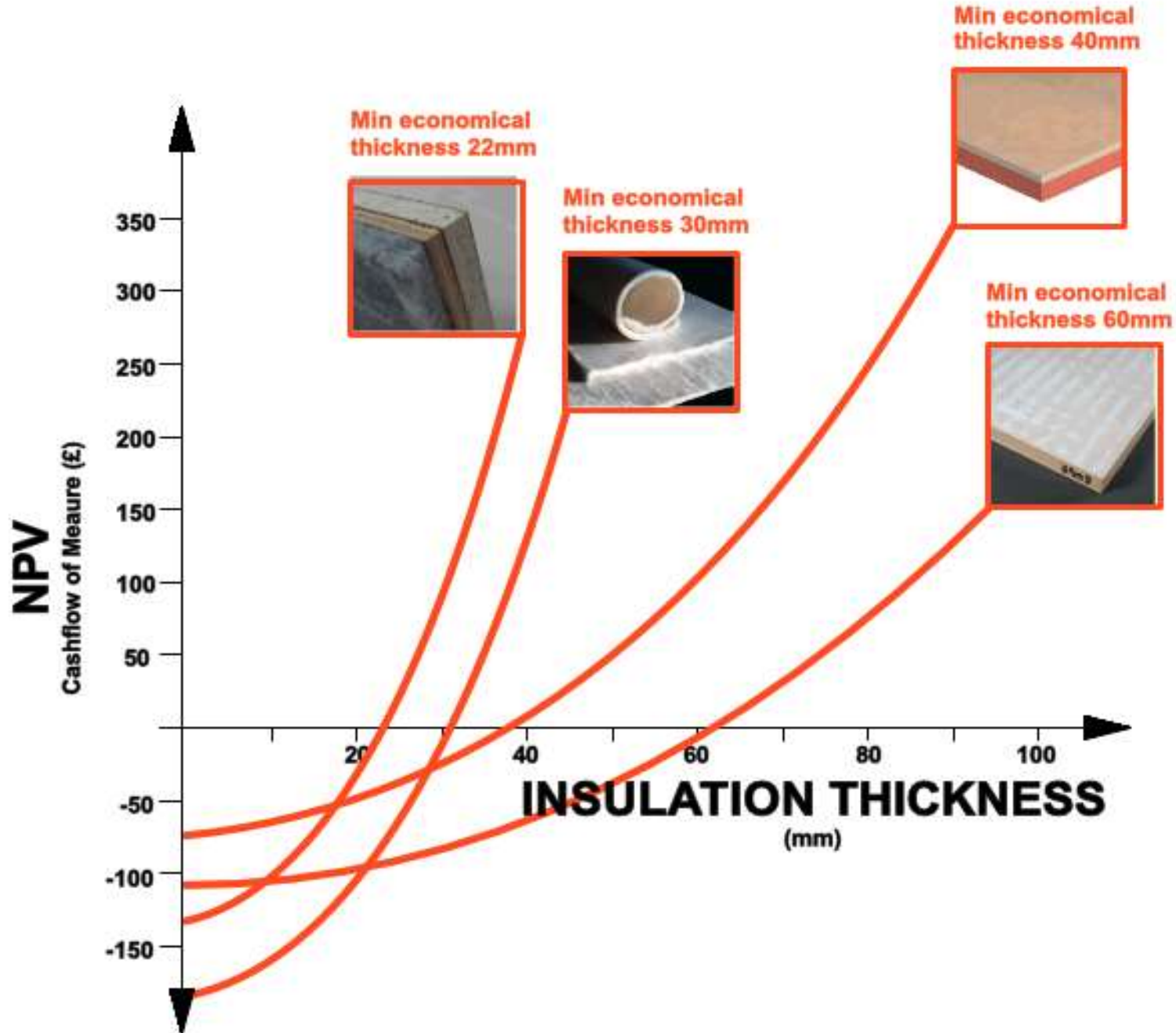


Nightmare



twistfix

Internal Wall Insulation – Min. Thickness



Triple Glazed Secondary

TRIPLE GLAZED SECONDARY SASH

phA

basic component



Window cost: £ 1,700

Annual savings: £ 370*

Annual reduction: 1,820 kg CO₂*

WLC savings: -108,300 kg CO₂*

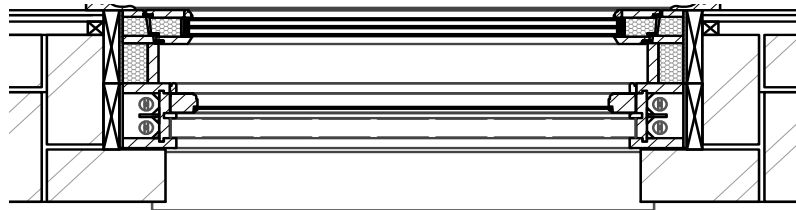
Visual appropriate: Yes

Fabric integrity: Yes

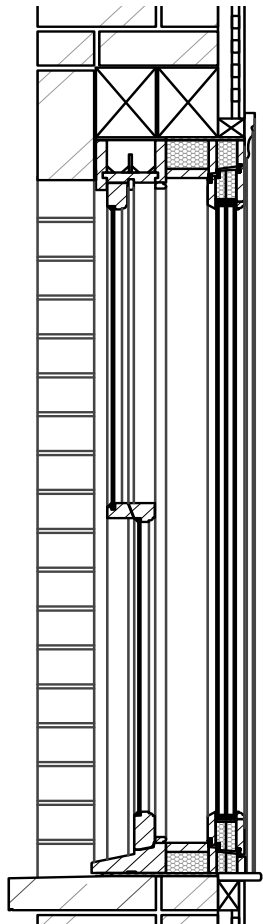


Measurement	Item	WPHW Triple Glazing Secondary
frame dimensions [m]	Width	1.230
	Height	1.480
	Aw [m²]	1.820
	Lf [m]	6.122
	Af [m²]	0.646
U-value of the frame (U _f) [W/m ² K]	Bottom	0.638
	Top	0.659
	Side top	0.659
	Side bottom	0
	Meeting rail	0
	Average U_f [W/m²K]	0.490
Edge Bond		Swisspacer [®]
glass length (l _g) [m]	Bottom	0.930
	Top	0.930
	Side top	1.119
	Side bottom	1.119
	Central section	0.930
	Lg [m]	5.958
	Ag [m²]	1.041
	Ug [W/m²K]	0.700
th. bridge of edge bond (Ψ _g) [W/mK]	Bottom	0.025
	Top	0.025
	Side top	0.025
	Side bottom	-
	Central section	-
	Average Ψ_g	
Window U-value (U_w) [W/m²K]		0.74
Ψ_{opaque} [W/mK]		0.098
Potential Passivhaus Efficiency Class		phA

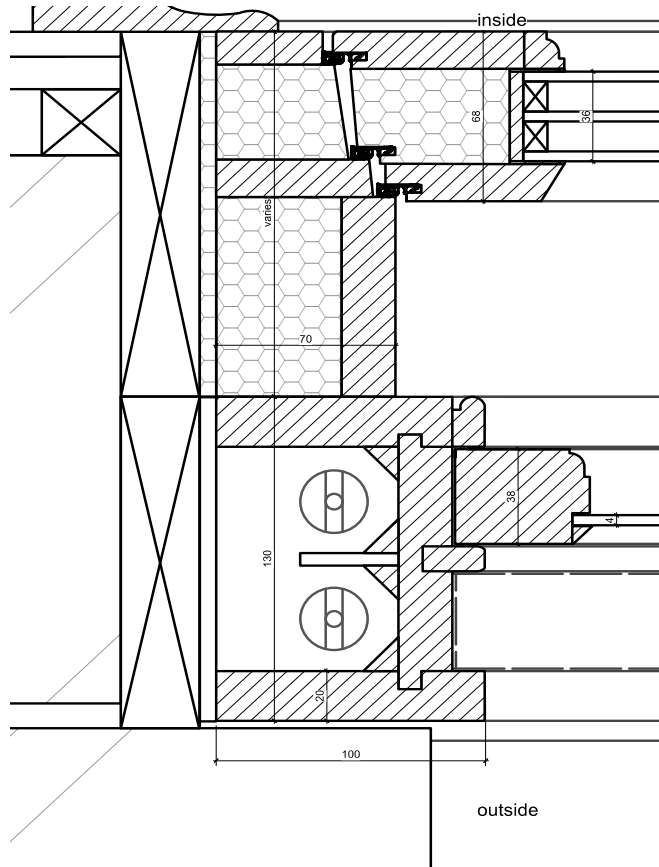
Triple Glazed Secondary



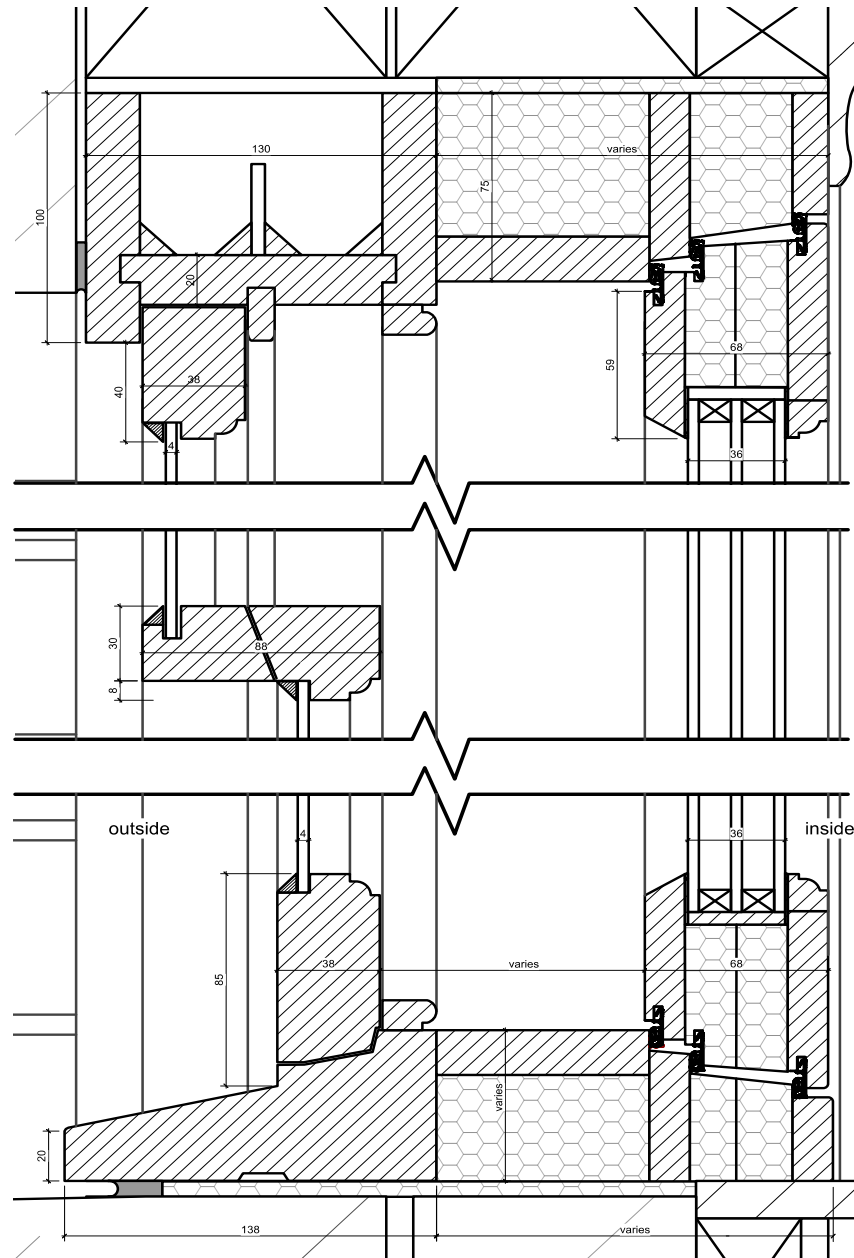
1 Window Plan
Scale 1:10@A3



2 Window Section
Scale 1:10@A3



3 Detail Plan
Scale 1:2@A3



4 Detail Section
Scale 1:2@A3

1- Do not scale this drawing. The Contractor is to verify all dimensions & conditions on site and report any discrepancies to the Architect before proceeding.
2- This drawing is to be read in conjunction with all relevant project documentation.
3- This drawing is subject to the approval of the appropriate Statutory Authorities.

sturgis carbon profiling

STURGIS CARBON PROFILING LLP
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Hackney Road London E2 8DD
(T) +44 (0) 20 7613 2500
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mail@sturgis.co.uk www.sturgiscarbonprofiling.com

Project: WPHW

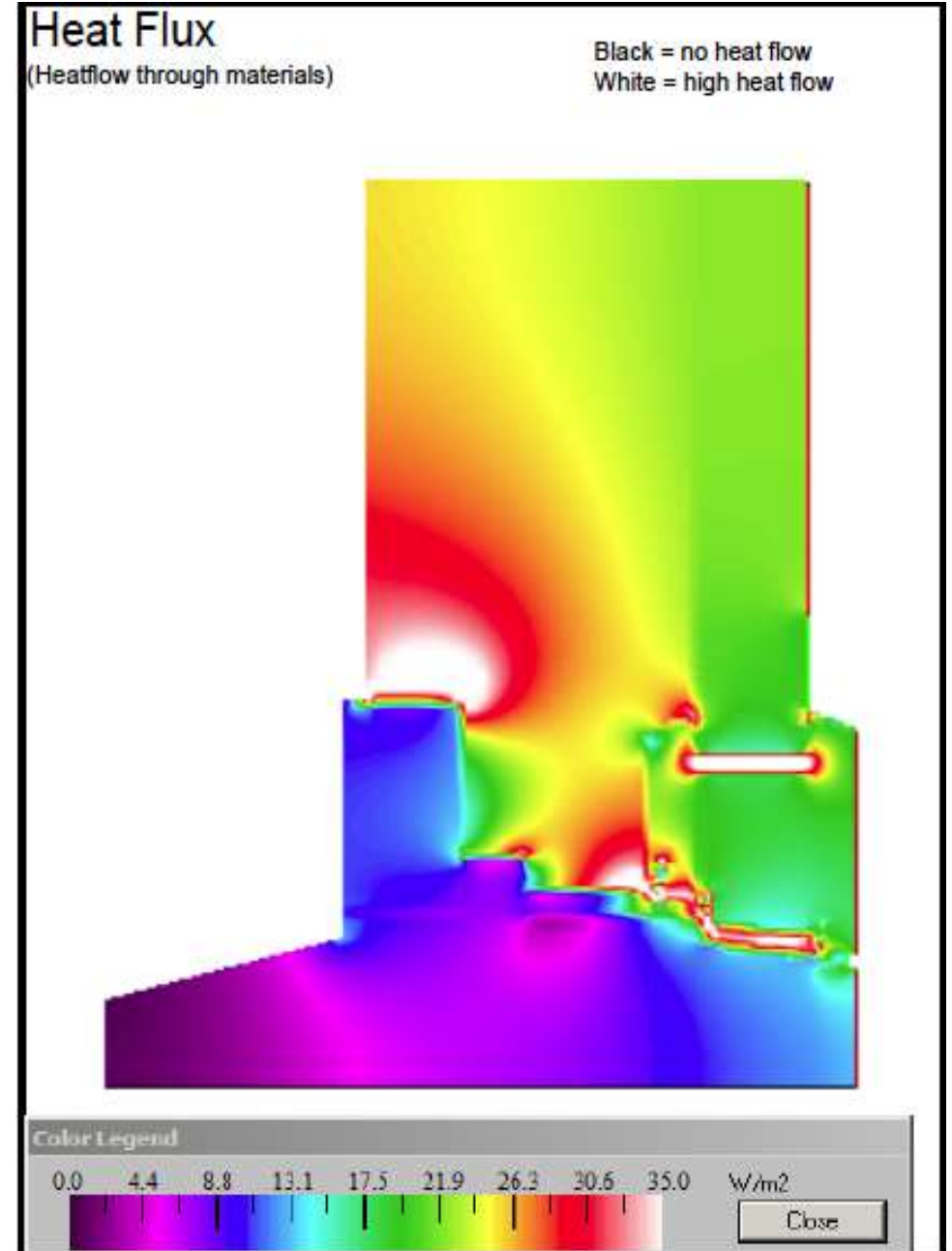
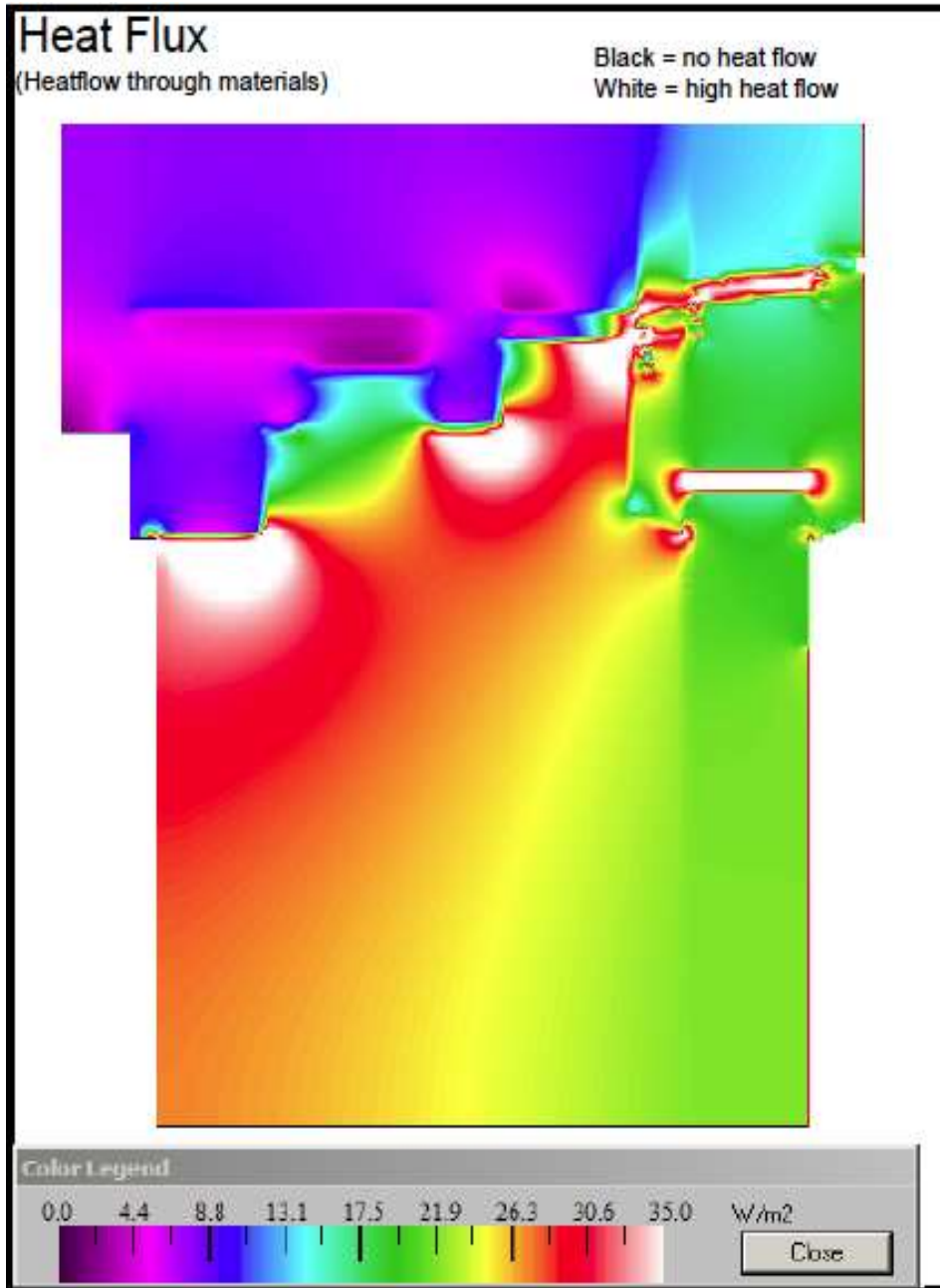
Title: SECONDARY GLAZING DETAILS

Scale: AS ANNOTATED	Date: 31/07/14
Drawn by: MFG	Checked by: MFG
Drawing No.: C1401_303_003	Revision: D

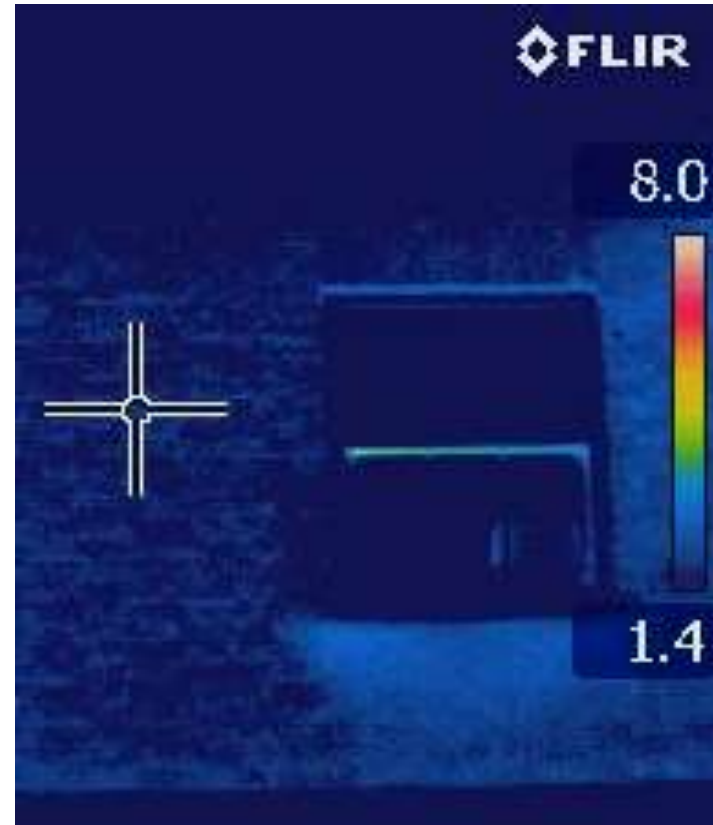
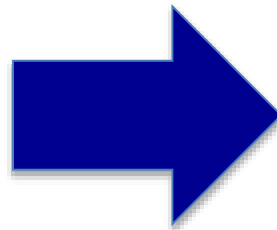
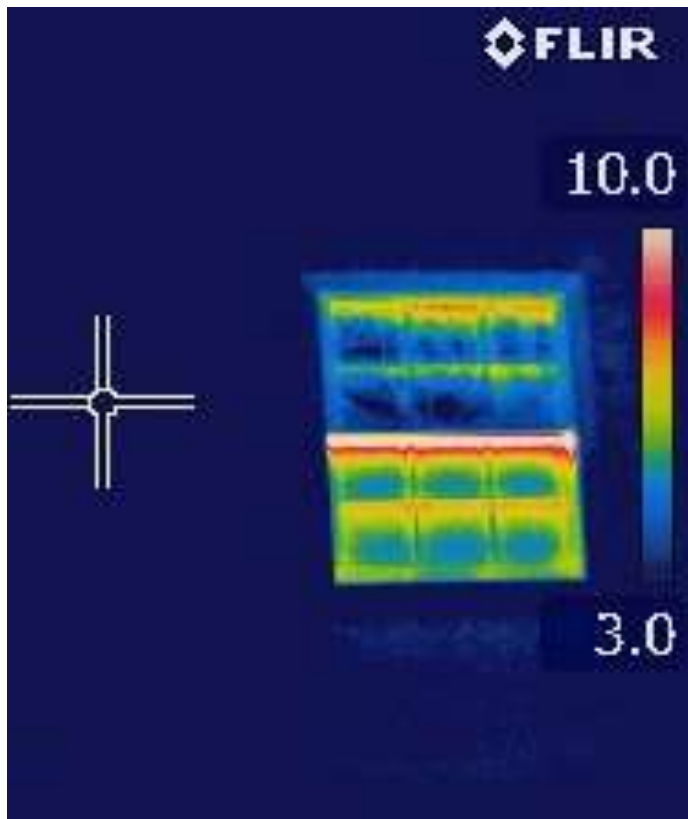
DRAFT
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Triple Glazed Secondary



Performance Checking



TEST 2
Up to 27% reduction in
building energy demand

Thank you!

THANK YOU

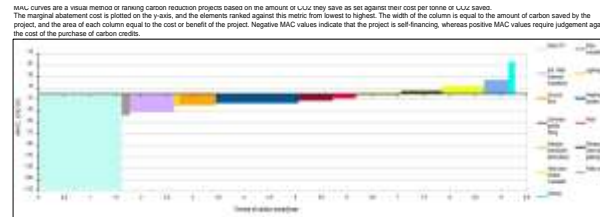
AND.....



HOW MUCH **CARBON** CAN YOU,
SAVE?

Monitoring - Scope

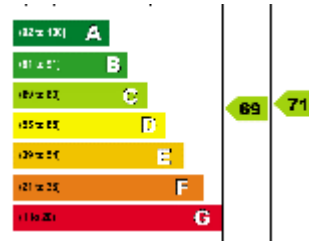
MACC



Note: Installation of panels is recommended. It is a cost-effective measure as it will improve the efficiency of the dwelling. Cost will vary depending on air infiltration.

Post-Occupancy Evaluation

EPC

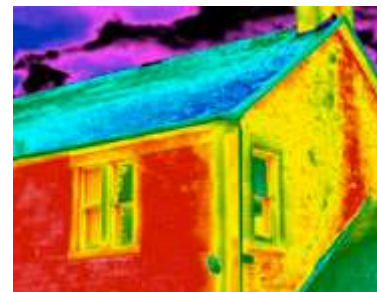


Contractor Satisfaction Survey PAS 2030

Geo-Monitor

fSAP Emission Model

Thermal Image



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EPC- Confirmation Forms

Sustainable Retrofit Scope and Performed Retrofitting Works



Property Details				
Address				
Scope of Retrofit Measures				
Item Number	Specification	Implemented measure ✓	Thickness/ no. units	Mention any changes to specification
1	ADD 3: PHOTOVOLTAIC (PV) PANELS Solar PV array with invertor connected to utility for generating part/make up of electrical requirements	✓	20	
2	CEILING 1: NEW SUSPENDED CEILING WITH ROCKWOOL			
3	CEILING 2: EXISTING SUSPENDED CEILING + ROCKWOOL	✓	50	
4	CHIMNEY 1: CLOSURE OF EXISTING FLUE WITH PERLITE			
5	DOOR 1A: DRAUGHT PROOF EXISTING DOOR Replace old draught door with draught proof door	✓		
6	DOOR 1B: REPAIR/REPLACE EXISTING DOOR + THERM INSULATION Close all gaps between door frame and floor/ceiling/ceiling of space from inside door to interior space	✓		
7	DOOR 2B: NEW INSULATED DOOR Replace the existing door with insulated door frame and frame draught door with glazing, new glazing and seals to existing, with internal glazed argon filled panels. Draught proof to all edges, include insulated threshold.			
8	FLOOR 1: NEW INSULATION UNDER CARPET Lay 100mm thick and 10-14 mm sheet of water proofable insulation underneath carpet			
9	FLOOR 2: NEW 25MM ATTACHED WOOD BOARDS TIMBER FLOOR Add mineral wool insulation between joists and install vapour control layer. Check if any gaps in floor are visible.			
11	FLOOR 3: NEW FLOOR WITH MINERAL WOOL INSULATION			
13	GLAZ 1A: DRAUGHT PROOF EXISTING WINDOWS			
16	GLAZ 1B: REPAIR/REPLACE EXISTING + SECONDARY GLAZING Rehabilitate and draught proof existing windows. Replace all glass panes with low-e glass where U > 1.0. Replace existing secondary glazing in rooms to improve thermal insulation glazing	✓	16	
14	GLAZ 2: NEW DOUBLE GLAZED WINDOWS + SECONDARY GLAZING Low-e glass of argon in between U < 1.0, with secondary glazing			
15	GLAZ 3A: NEW DOUBLE GLAZED WINDOWS Low-e glass of argon in between U < 1.0 and U < 2.0 (consider triple glazing)			
16	GLAZ 3B: NEW DOUBLE GLAZED WINDOWS + SECONDARY GLAZING Low-e glass of argon in between U < 1.0 and U < 2.0 with secondary glazing			
17	GLAZ 4: NEW TRIPLE GLAZED WINDOWS			
18	HEAT 1: ELECTRIC RADIATORS Replace all existing electric radiators with efficient electric radiators			
19	HEAT 2A: NEW AIR SOURCE HEAT PUMP WITH AIR SOURCE HEAT EXCHANGER Domestic scale central heating system with condenser COPU system. At least 92% efficiency. Programmable room thermostat. Boiler control. TTR or TRV radiators, except bedrooms with manual thermostat. Full control system only.	✓		
21	HEAT 2B: NEW AIR SOURCE HEAT PUMP Replace existing gas boiler with air source heat pump of efficiency minimum 90%.			
22	HEAT 3: CYLINDER INSULATION Fit insulation to outer panels of the main water tank			
23	INS 10: EXTERNAL INSULATION Use mineral wool fibre panels			
24	INS 11: EXTERNAL INSULATION Use space thermal wrap at roof joints			
25	INS 12: INTERIOR INSULATION Use breathing rigid foam	✓	50	
26	INS 13: INTERIOR INSULATION Use mineral wool panels			
27	INS 3: EXTERNAL INSULATION External insulation on exterior walls from existing surface			
28	INS 4: PARTY WALLS Use mineral wool panels			
29	LIGHT 1: ENERGY EFFICIENT LED LIGHTS Replace all lighting with LED energy saving cover glass.			
30	OTHER 1: Introduce cycling line			
31	OTHER 2: NEW SHOWERS The new hot water cylinders will use water on demand	✓		
32	WIND 1: LIGHT SCREENS Install 25mm x 25mm mesh screen to reduce up draft to 300mm above profile			
33	ROOF 2: FLAT ROOF INSULATION Add rigid foam insulation on top of existing or staggered insulation using battings			
34	WATER 1: NEW TOILETS Install dual flush toilets. Avoid with full backing tiles in kitchen to avoid backflow	✓		

Contractor Representative
 Name:
 Signature:



Metrics

Total CO2
Saved



TCO_2

Best
Performance



KWh/m
 sq

Highest
Efficiency



£(spend)/
 KgCO_2

Eaton Square PV's

**Largest
PV array on
listed buildings
in London**

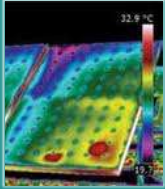

Building Performance Evaluation




Address : 123 Ebury Street
SW1W AG


Scope : Photovoltaics
Value : £ 2,301,264
Project Manager : Marchin Bozniak
Program :


Carbon reduction

100%

fSAP Carbon and Energy Performance Data		Before	After
	CARBON PERFORMANCE	1,178,215 <small>KgCO₂/m²yr</small>	526,150 <small>KgCO₂/m²yr</small>
	HEATING DEMAND	N/A <small>KWh/yr</small>	N/A <small>KWh/yr</small>
	LIGHTING DEMAND	N/A <small>KWh/yr</small>	N/A <small>KWh/yr</small>

RdSAP Energy Performance Certificate		Before	After
	EPC	D 60	B 89

Building User Survey Results		Before	After
	TENANT COMFORT	00/100	00/100

Quotes


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Other Contents

- MACC
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- THERMAL IMAGES


carbon profiling

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123 Ebury Street – External Dec’s

**Most satisfied
tenant**



Building Performance Evaluation




Address : Flat 1–123 Ebury St. SW1W 9QU


Scope : External Works
Value : £ 120,000
Project Manager : Paul Whitcher
Program : 2 weeks


Carbon reduction

45%

fSAP Carbon and Energy Performance Data		Before	After
	CARBON PERFORMANCE	87.98 <small>KgCO₂/m²·yr</small>	48.38 <small>KgCO₂/m²·yr</small>
	HEATING DEMAND	14,275 <small>KWh/yr</small>	7,850 <small>KWh/yr</small>
	LIGHTING DEMAND	450 <small>KWh/yr</small>	247 <small>KWh/yr</small>

RdSAP Energy Performance Certificate		Before	After
	EPC	D 57	C 70

Building User Survey Results		Before	After
	TENANT COMFORT	70/100	88/100


Quotes

Putting a new roof on my flat has been wonderful. I have not even turned on the heating this winter.

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33P Eaton Square – Occupied Retrofit

Best Performing Flat in Estate

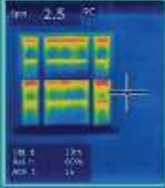

Building Performance Evaluation






Address : 33P Eaton Square
SW1W 9AG

Scope : External Works
Value : £ 100,000
Project Manager : Michael Levey
Program : Abc

Carbon reduction

97%

fSAP Carbon and Energy Performance Data	Before	After
 CARBON PERFORMANCE	31.55 KgCO ₂ /m ² /yr	0.92 KgCO ₂ /m ² /yr
 HEATING DEMAND	14,647 kWh/yr	8,621 kWh/yr
 LIGHTING DEMAND	445 kWh/yr	458 kWh/yr
RdSAP Energy Performance Certificate	Before	After
 EPC	B 82	A 97
Building User Survey Results	Before	After
 TENANT COMFORT	00/100	00/100

Quotes

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St Marks Mansions – Unoccupied

Highest reduction from Passive measures

Building Performance Evaluation

Address : 4 St Marks Mansions
N4 3QS

Scope : External Works
Value : £ 110,000
Project Manager : Paul Whitcher
Program : 3 weeks

Carbon reduction

92%

fSAP Carbon and Energy Performance Data		Before	After
	CARBON PERFORMANCE	75.37 <small>KgCO₂/m²-yr</small>	6.03 <small>KgCO₂/m²-yr</small>
	HEATING DEMAND	27,318 <small>KWh/yr</small>	2,185 <small>KWh/yr</small>
	LIGHTING DEMAND	634 <small>KWh/yr</small>	51 <small>KWh/yr</small>

RdSAP Energy Performance Certificate		Before	After
	EPC	E 42	C 80

Building User Survey Results		Before	After
	TENANT COMFORT	00/100	00/100

Quotes

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