d+b facades
OVERCLADDING SPECIALISTS

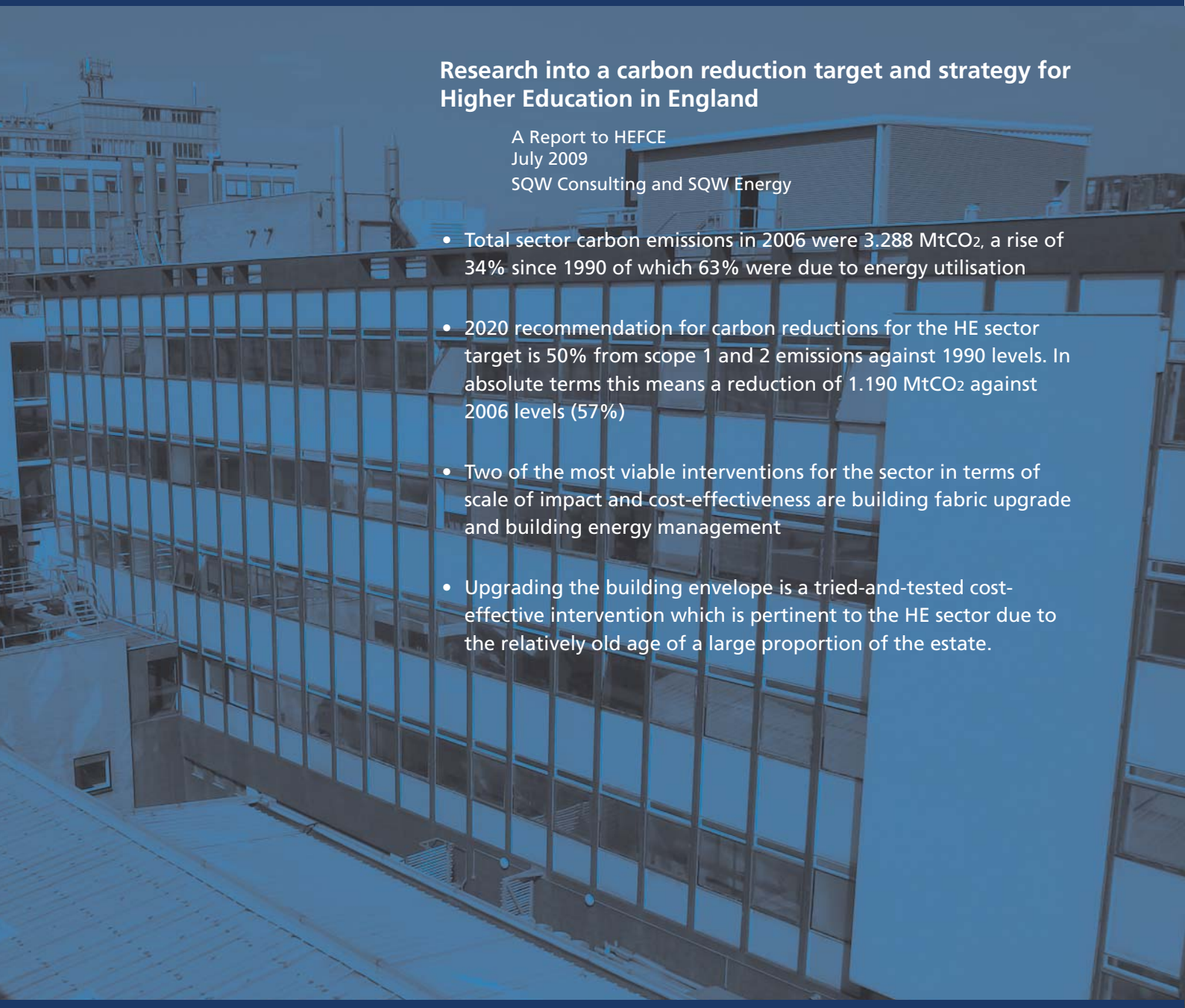
ACE BUILDING, IMPERIAL COLLEGE LONDON

SYNOPSIS OF ENERGY SAVINGS PRODUCED BY EXTERNAL REFURBISHMENT

CARBON REDUCTION TARGET AND STRATEGY FOR HIGHER EDUCATION IN ENGLAND

"Each University and College will need institutional targets that can be measured … the need to act is universal and we can all ensure that our buildings are better insulated and our energy use better controlled"

Sir Alan Langlands
Chief Executive, HEFCE



Research into a carbon reduction target and strategy for Higher Education in England

A Report to HEFCE
July 2009
SQW Consulting and SQW Energy

- Total sector carbon emissions in 2006 were 3.288 $MtCO_2$, a rise of 34% since 1990 of which 63% were due to energy utilisation
- 2020 recommendation for carbon reductions for the HE sector target is 50% from scope 1 and 2 emissions against 1990 levels. In absolute terms this means a reduction of 1.190 $MtCO_2$ against 2006 levels (57%)
- Two of the most viable interventions for the sector in terms of scale of impact and cost-effectiveness are building fabric upgrade and building energy management
- Upgrading the building envelope is a tried-and-tested cost-effective intervention which is pertinent to the HE sector due to the relatively old age of a large proportion of the estate.

EXECUTIVE SUMMARY

Imperial College London is presently evaluating options for external refurbishment to two elevations of the ACE building with the principal aims of reducing energy consumption and carbon emissions, consistent with meeting its obligations to HEFCE's Carbon Reduction Commitment. These two measures are directly correlated and proportional to one another.

As most replacement facades will deliver similar levels of thermal performance, the most important consideration is the longevity of the overcladding system comprising rainscreen and replacement windows. System longevity is the single most influential determinant of cumulative economic and environmental benefit. D+b facades' system has an expected in-service life of 60 years and will deliver economic and environmental savings throughout its installed life.

d+b facades has provided Imperial College London with budget costings (c.£0.9m) to overclad the South and West elevations of the ACE building. Based upon actual energy consumption data provided by the University for this building, the financial benefit following partial external refurbishment is calculated to be £76k per annum assuming the energy source is electricity, equivalent to an annual energy saving of 36%. These calculated savings are consistent with actual energy savings delivered from completed projects undertaken by d+b facades . Energy costs are rising sharply and are forecast to continue to do so. At a rate of increase of 9% per annum and electricity as the sole source of energy, the capital cost of the refurbishment project is fully rewarded within 9 years.

Applying internationally-accepted conversion factors to these forecast reductions in energy consumption, it is possible to estimate carbon savings. The absolute carbon reduction benefit is directly linked to the energy source. Based upon electricity as the sole source of energy, d+b facades' solution for Imperial College London's ACE building would reduce its carbon consumption by 648 tonnes per annum.

65% of a University's entire carbon footprint is derived from energy utilisation, consequently achieving an up to five-fold improvement in thermal performance through overcladding of existing buildings is highly effective in achieving a headline carbon reduction figure. d+b facades' system reuses a building's embodied energy with predominantly recycled materials and extends the building's life by circa 60 years, thus saving substantial amounts of carbon otherwise associated with replacing buildings.

The case for overcladding is compelling and fully satisfies the environmental, financial and social sustainability issues that need to by addressed by Imperial College London.

ACE BUILDING, IMPERIAL COLLEGE LONDON: SYNOPSIS OF ENERGY SAVINGS PRODUCED BY EXTERNAL REFURBISHMENT

Energy use is directly correlated to thermal insulation performance of a given building, thus improving an existing building through provision of high-quality overcladding will deliver substantial economic benefits. These may be accurately quantified by calculating the energy usage of the existing structure and that of the same structure post-refurbishment using U-values.

1. The Existing Building

These calculations are based on the South and West elevations of the ACE building. The building is assumed to be of the following construction:

- Windows: 618 m^2 4mm single glazed.
- Spandrels: 1,406 m^2 75mm thick solid concrete panels 10mm asbestos cement backing board, 24mm air cavity & 10mm chipboard internal finish.
- Roof: 1,998 m^2 250mm concrete slab with 75mm screed, 25mm cork insulation and 20mm asphalt finish.

The rate of heat loss of the existing building is calculated from the U-values of the component elements and the overall rate of heat loss using their elemental areas. In order to determine the benefit to be derived from overcladding two of the four elevations, and for the purpose of supporting the internal business case, it is assumed that the elemental composition of the North and East elevations is the same as for the South and West. Additionally, that the areas covered by the two projecting solid screens on the South elevation have the same U-value as existing spandrels. Numbers in the following table have been rounded and reflect all four elevations as described above.

Element	Area (m^2)	U-value (W/m^2K)	Heat loss (W/K)	Average U-value (W/m^2K)
Windows	1,238	5.00	6,188	
Spandrels	2,813	1.90	5,345	
Roof	1,990	0.79	1,579	
Ground Floor	1,998	0.12	240	
Totals	**8,047**		**13,351**	**1.95**

2. ACE Building Post-Refurbishment

d+b facades overcladding proposal to Imperial College London includes the following improvements to the South and West elevations:

- Windows: High-performance timber/aluminium composite units, double glazed.
- Walls: As existing, but with the addition of 150mm insulation, 50mm air cavity and 3mm aluminium rainscreen.

The heat loss calculation is based upon the following table (numbers are rounded):

Element	Area (m^2)	U-value (W/m^2K)	Heat loss (W/K)	Average U-value (W/m^2K)
Retained windows (North and East)	619	5	3,094	
Replacement windows (South and West)	514	1.2	617	
Retained walls (North and East)	1,406	1.9	2,672	
Overclad walls (South and West)	1,511	0.28	423	
Roof	1,998	0.79	1,579	
Ground Floor	1,998	0.12	240	
Totals	**8,047**		**8,624**	**1.55**

Actual energy consumption data supplied by Imperial College for the ACE building shows the present annual energy consumption to be 3,130,482 kWh and the cost of energy is 6.9p per kWh for electricity. If electricity is the sole source of heating energy, the annual cost of energy for the ACE building is £216k.

Based upon U-values, following refurbishment of the South and West elevations of the ACE building d+b facades' solution will deliver an estimated annual energy saving to Imperial College of £76k.

3. Capital Payback

The budget price of the proposed cladding works is c.£0.9m. Using the calculated annual energy saving of £76k (Section 2.), the capital payback period attributable solely to the energy savings derived from external refurbishment may be determined. Energy costs have risen sharply in recent years and this trend is expected to continue. The following table of cumulative energy savings assumes that the cost of energy is increasing at 9% per annum.

Year	Existing Annual Energy Cost (£)	Annual Energy Cost After Refurb (£)	Annual Saving (£)	Cumulative Saving (£)
1	216003.29	139536.71	76466.58	76466.58
2	235443.59	152095.01	83348.57	159815.15
3	256633.51	165783.57	90849.94	250665.10
4	279730.52	180704.09	99026.44	349691.53
5	304906.27	196967.45	107938.82	457630.35
6	332347.84	214694.52	117653.31	575283.66
7	362259.14	234017.03	128242.11	703525.77
8	394862.46	255078.56	139783.90	843309.67
9	430400.09	278035.64	152364.45	995674.12
10	469136.09	303058.84	166077.25	1161751.38
11	511358.34	330334.14	181024.20	1342775.58
12	557380.59	360064.21	197316.38	1540091.96
13	607544.85	392469.99	215074.86	1755166.82
14	662223.88	427792.29	234431.59	1989598.41
15	721824.03	466293.60	255530.44	2245128.85
16	786788.20	508260.02	278528.18	2523657.03
17	857599.13	554003.42	303595.71	2827252.74
18	934783.05	603863.73	330919.33	3158172.06
19	1018913.53	658211.46	360702.07	3518874.13
20	1110615.75	717450.50	393165.25	3912039.38

This table shows that payback of the total project cost from energy savings alone is just under 9 years. Payback would be reduced still further if other financial considerations such as eliminated maintenance costs are factored-in.

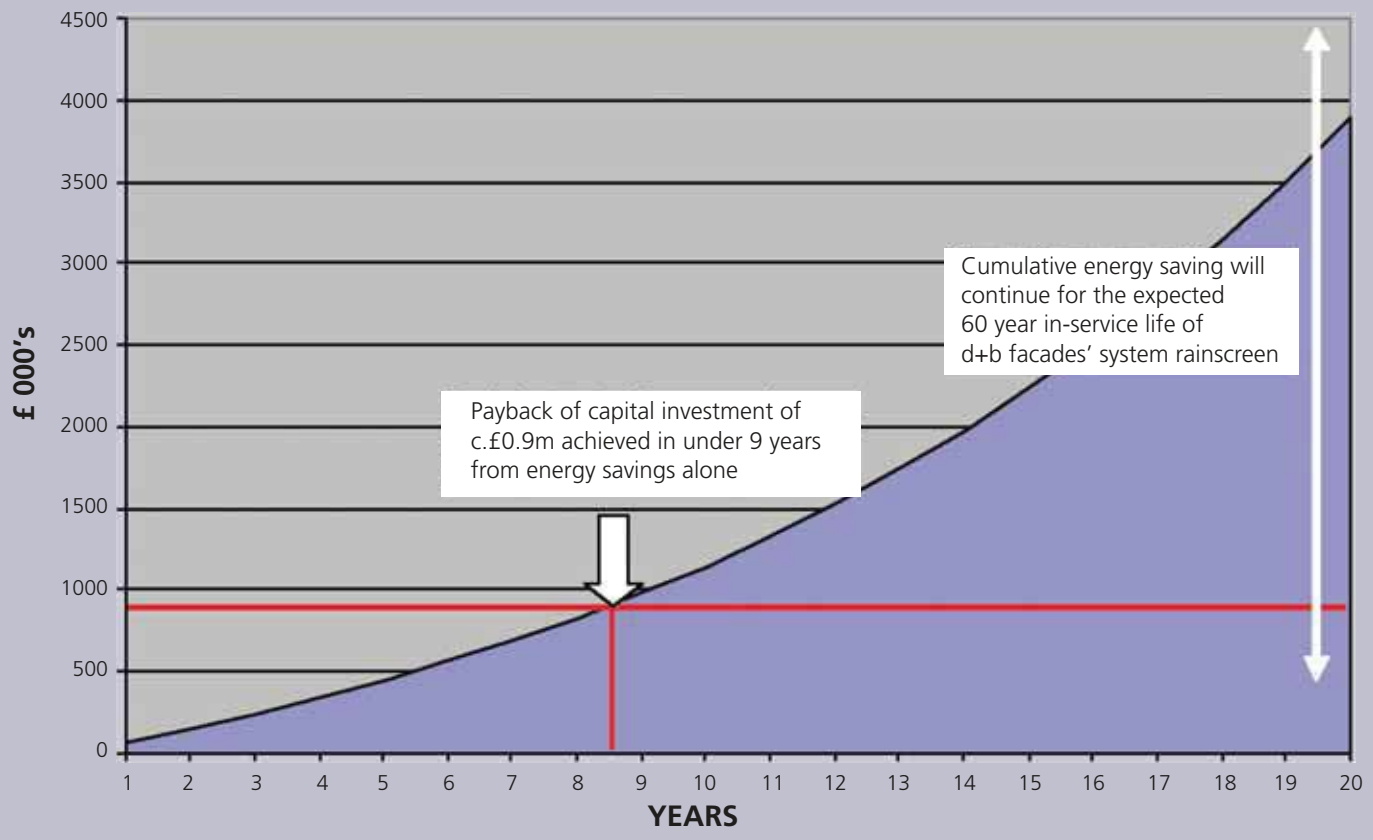
Importantly, this economic benefit will be delivered throughout the anticipated 60 year in-service life of d+b facades' rainscreen system, therefore growing annual savings in energy costs will be realised for more than 50 years after the initial capital investment has been rewarded.

Carbon Reduction Calculation:

Estimation of carbon reduction resulting directly from the proposed overcladding of the South and West elevations of the ACE building has been made using an internationally-accepted conversion factor of 0.54 for electricity.

It is calculated that refurbishment of the existing building's South and West elevations using d+b facades' system will achieve annual reductions in carbon of 648 tonnes for Imperial College.

Energy Savings (£m) and Payback Post-Refurbishment of the South and West Elevations of the ACE Building, Imperial College London, Assuming Source of Energy is Electricity, Cost of Energy is 6.9p per kWh and Energy Costs Increase at 9% Per Annum



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