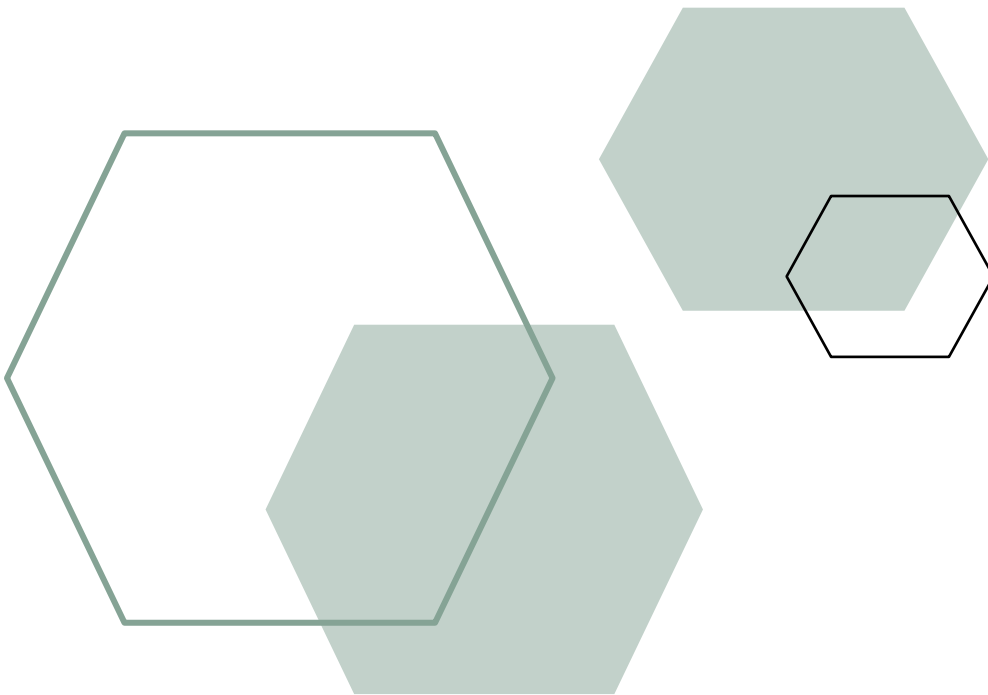


Patrick
Ryan
Associates

**Embodied Carbon
Reduction
69 Park Lane
A Case Study**



Authors

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Overview

Climate change has been a hot topic for the past few decades and scientists have reached a consensus that human-produced greenhouse gases are leading to a global increase in temperature. Carbon dioxide in the atmosphere warms the planet, causing climate change and human activity has raised the atmospheres' carbon dioxide content by 50% in less than 200 years.

We are increasingly feeling the impact of climate change and the state of the environment is worsening. Carbon emissions are a significant part of this. How we can reduce carbon emissions is a key question, and a major challenge, but it requires the total support of individuals across the globe. It is everyone's responsibility to address these issues and the dangers that are arising from them, including those who work in the construction industry and those responsible for the design and engineering of the building façade.

The good news is that change is happening, as more and more people become aware of the impact carbon emissions have on the environment.

According to a study in 2019 by the World Green Building Council, buildings are currently responsible for 39% of global energy related carbon emissions. A further study by the World Business Council for Sustainable Development in 2021 found that a facade can contribute up to 31% of the total embodied carbon of a building. To advocate for a better understanding of the environmental impact of façade designs, the Centre for Window and Cladding Technology (CWCT) has launched this methodology for embodied carbon calculation of facades.

How to calculate the embodied carbon of facades: A methodology

Issue 1, September 2022



Figure 1 - Source CWCT

69 Park Lane, Croydon – A Case Study

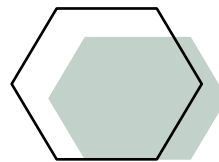
As Façade Designers, Engineers, and Consultants, we play an important role in the construction of the façade, providing advice and assumptions around façade design. How to cut carbon emissions with better performance of facades is an important part of this process and one we take very seriously.

In 2017, Patrick Ryan Associates were involved in the 69 Park Lane, Croydon project. We acted as the façade consultants during the RIBA Stages 3, 4 & 5 design stages for the total refurbishment and recladding of the whole curtain wall façade. The decision made was to maintain the original curtain wall steel frame, originally built in the 80's, and simply replacing the vision modules and spandrel panels.

This article evaluates the cost implication and embodied carbon reduction of the choices made following CWCT's guidance published in September of 2022. We also analysed the environmental impact and cost implications should a full replacement of the entire curtain wall system had taken place.



Figure 2 - 69 Park Lane



Whole life carbon cycle

The whole life cycle of a facade is divided into five stages: Product Stage, Construction Process, In-Use, End of Life and Benefits and Loads beyond the building lifecycle, as illustrated in the CWCT methodology below.

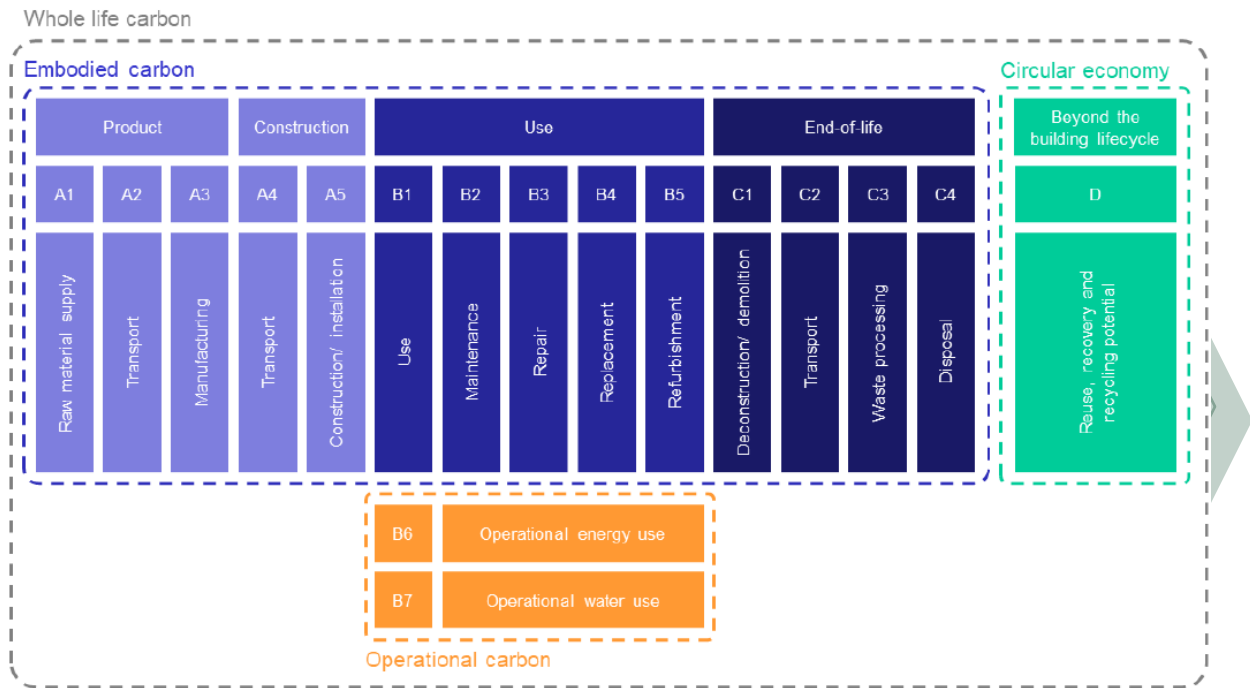


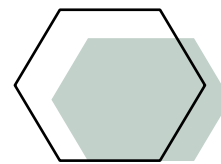
Figure 3 - Whole life carbon (source CWCT)

Representative area and assumptions

A representative area of a façade system has to be taken out to assess the embodied carbon. The total embodied carbon of a project can be assessed by multiplying the results of each façade system, referring to the methodology.

After finding a representative area, some key assumptions are listed out:

- Representative area (bay study) A: $3\text{m} \times 3.376\text{m} = 10.128\text{m}^2$ FSA
- Façade Surface Area (FSA) = 6680m^2
- Gross Internal Area (GIA) = 7500m^2
- Façade Form Factor (FFF) = 0.89
- Reference Study Period (RSP): 60 Years
- Raw materials procurement: Europe
- Manufacturers' location: London
- Factory: London
- Distance between factory and site: 6 miles
- Site: Croydon, London



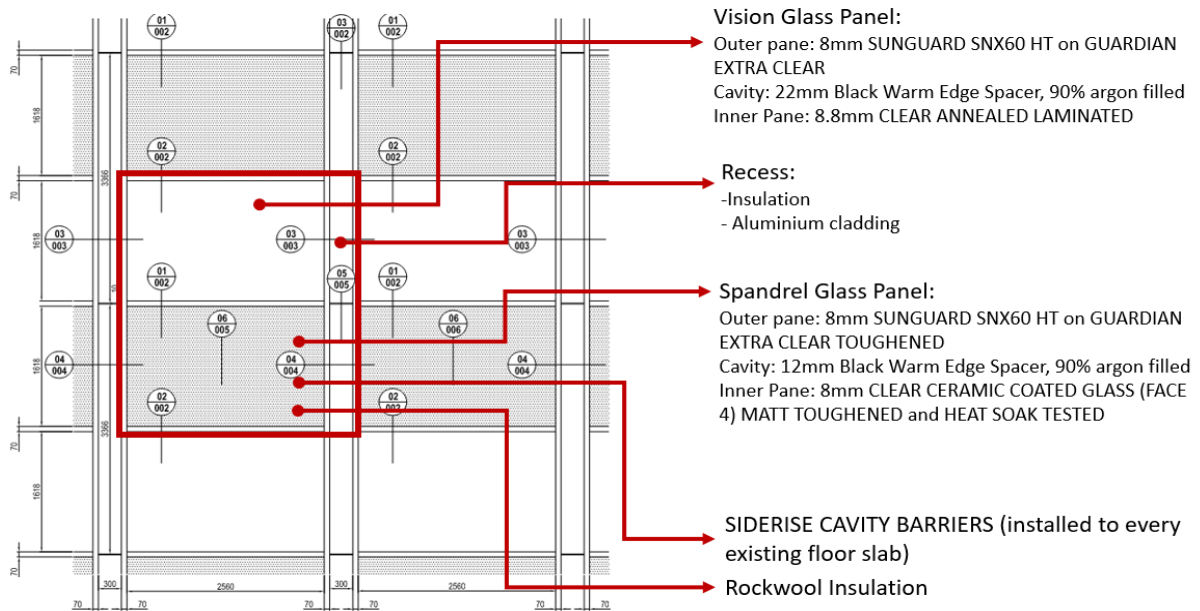


Figure 4 - Representative area of the façade

Partial Replacement vs Full Replacement

Two separate scenarios were studied and analysed for the purposes of this case study:

1. Partial replacement – The curtain wall mullions, transoms and bracketry will remain in situ.
2. Full replacement – The existing curtain wall is to be replaced in its entirety.

Some early thermal calculations were carried at an early stage that allow the design team to ensure that compliance with Approved Document Part L was achieved in both cases.

The U-values achieved in both instances have been highlighted in the following tables:

Table 1 - U-values Partial Replacement v Total Replacement

U-value Typical Curtain Wall								
Partial Replacement	Curtain wall transmittance	A m ²	U W/(m ² K)		l m		ψ W/(m K)	
	Mullion-window	A _m	0.22	U _{m,w-s}	5.39	2.47		0.08
Transom-window	A _t	0.26	U _{t,ns-s}	4.62	5.12		0.13	
Mullion - Spandrel Panel	A _{ns}	0.25	U _{ns}	5.64	l _{mp}	2.53	ψ _{m,p}	0.20
Transom- Spandrel Panel				4.62	l _{tp}	5.12	ψ _{t,p}	0.13
Window	A _w	3.89	U _w	1.00	-		-	
Spandrel Panel	A _p	3.79	U _p	0.33	-		-	
Curtain Walling	A _{cw}	8.67	U _{cw}	1.40	-		-	

U-value Typical Curtain Wall								
Total Replacement	Curtain wall transmittance	A m ²	U W/(m ² K)		l m		ψ W/(m K)	
	Mullion-window	A _m	0.22	U _{m,w-s}	1.80	2.47		0.08
Transom-window	A _t	0.26	U _{t,ns-s}	1.80	5.12		0.13	
Mullion - Spandrel Panel	A _{ns}	0.25	U _{ns}	2.00	l _{mp}	2.53	ψ _{m,p}	0.20
Transom- Spandrel Panel				2.00	l _{tp}	5.12	ψ _{t,p}	0.13
Window	A _w	3.89	U _w	1.00	-		-	
Spandrel Panel	A _p	3.79	U _p	0.33	-		-	
Curtain Walling	A _{cw}	8.67	U _{cw}	1.04	-		-	

Results

The results of this study can be summarised in the table as follows:.

Table 2 - Results of the analysis - Partial v Full Replacement

	<u>Partial replacement</u>	<u>Fully Replacement</u>
U-value	1.4 W/m2K	1.0 W/m2K
Construction Cost	£ 5.65M	£ 10M
Embodied CO2 Emission	1328 Ton	2000 Ton
CO2 emissions due to electricity per year	286 T CO2e per year	204 T CO2e per year
Estimation of the CO2 emissions due to electricity in the next 20 years	5720 T CO2	4080 T CO2

Our views and comments following the above results are:

- Clearly the partial replacement solution will have a saving of 50% on the embodied carbon emissions.
- There will also be a considerable cost saving as the construction cost in case a full replacement had taken place would have doubled.
- Definitely from our client's perspective it is a great result.

Are we looking at the entire picture though? What would have been the environmental impact in the next 20 years? Based on our results the U-values in question could have been improved by an additional 40% if the full replacement solution was adopted.

The bottom two rows of the results on the above table indicate the yearly impact of CO2 emission and the effects of them in the next 20 years respectively.

In the long run the full replacement would have been a better solution for the environment.

Most people, who are not involved in this process, may have no idea how much embodied carbon is emitted into the atmosphere, and how it impacts our planet and our health. A video released via YouTube by NASA, uses a new super HD view of how carbon dioxide in the air moves around the world with the wind flow. They used an ultra-high-resolution computer model, 64 times greater than typical climate models where each pixel grid size is four miles wide. This video offers a direct insight into global carbon dioxide. You can find the video in the link below:

<https://www.youtube.com/watch?v=d8DKty07vOU>

What Does the Future Hold?

Human activity, such as burning fossil fuels and deforestation, is creating a surplus of carbon dioxide and other greenhouse gases in the atmosphere, which is causing an increase in global temperatures. If the rate at which we emit carbon does not dramatically slow down, this increase could have catastrophic effects upon our weather systems, increase sea levels, displace millions of people, and cause many species to become extinct.

Planting billions of trees has been suggested as one of the quickest and most cost-effective ways of fighting the climate emergency, as trees absorb and store (sequester) carbon.

We are facing a threat to the future of our planet, an issue that is much too important to ignore and is now embedded into our psyche and our approach at Patrick Ryan Associates to the role we play in the design of a building façade.

We need to take action that will be monitored and reviewed in an effort to strive to continue cutting carbon emissions, so that we can all enjoy our planet for a long time to come.

We must all be critical in our choices and the environmental impact should be one of our top priorities in the decision we are making.

For more information about the services provided by [Patrick Ryan Associates](#), please contact us:

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