Embodied Carbon and Circularity in Office Interiors: Part 1

The RESET Standard

April 2022

Foreword

This report daylights the significance of carbon emissions generated by the construction of office interiors (Part 1). It then documents opportunities to reduce carbon emissions and waste by increasing circularity, as exemplified in a case study (Part 2).

The case study focuses on a company transforming traditional office design & fit-out from a linear build-and-waste model to a circular economic model in which the office fit-out is leased as an assembly of demountable and reusable components.

All data for the case study was calculated according to the RESET Material Standard for Carbon and Circularity.
Data for traditional offices is derived from RESET projects as well as OneMetric.

Although results are region specific, the lessons and insights are globally applicable. With active RESET projects in 17 countries, we welcome the opportunity to conduct similar studies in other geographies.

The authorship of this report was independently conducted by GIGA.

The Drivers

Globally, carbon emissions are beginning to affect the value of buildings and infrastructure.

The primary drivers* affecting the transition to a carbon neutral economy include:

Access to Low-cost Financing: Real-estate developers seeking to leverage Green Bonds that are tied to low carbon or net-zero targets.

Government Requirements: Real-estate owners and operators needing to comply with current or upcoming energy use and carbon emission limits.

Market Demand and Tenant Attraction: Real-estate developers and operators seeking to attract best in class tenants.

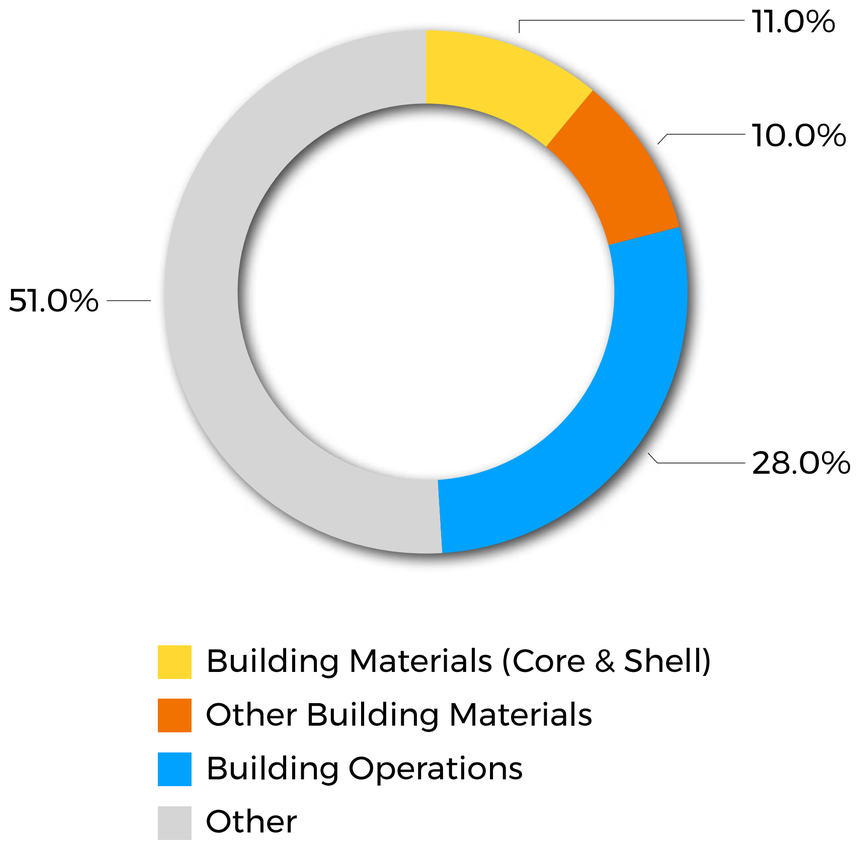
Consumer and Talent Acquisition: Companies seeking to attract best in class customers and talent.

**From interviews of companies using the RESET Standard and Tools.*

CO_2 in Real-Estate

Globally, the building sector accounts for approximately half of all carbon emissions, of which ~28% is from building operations and ~21% from new construction.
Within new construction, the carbon footprint of building materials used for core & shell* is estimated to be equivalent to that from interior finishes.

It is worth noting that these figures do not include carbon emissions from transportation, construction, maintenance, demolition and disposal.



Source: Adapted from Carbon Leadership Forum and Architecture 2030

Steel, reinforced, concrete, aluminum, glass, etc. used in the construction of a building's structure, mechanical systems and exterior walls.

The Interiors Problem

In many of the world's largest markets the lifecycle of office interiors generates approximately 190 kg of CO_2 and 77 kg of waste per square meter as per data from RESET projects*.

In top-tier office towers that attract stable multi-national tenants, the average lease and life of interiors is about 8.5 years, regardless of whether the location is New York or Shanghai**. For less stable tenants office leases and the life of their interiors is 2-3 years due to rapid changes from growth, shrinkage or adaptation to new workplace requirements.

The design lifespan of office towers is 50 years, as per code and/or average use.

Taking an average of 2.5 years as the lifecycle of an office interior translates into up-to 20 interior fit-outs over the life of the building.

** Results from the world's largest markets (U.S. and China) are similar, each averaging ~190 kgCO2e/m2. 77kg of waste for China.*
*** Avison Young, Sigthlines June 14 2021. GIGA Survey of 12 top-tier landlords in Shenzhen, Shanghai & Beijing.*

Build. Waste. Repeat.

The Interiors Problem

Based on these figures, an average 30 story office tower generates ~3,420 tonnes of CO_2 per year in tenant fit-outs alone.
To put these numbers into context, 342,000 mature trees would be required to offset these emissions annually*.

The same tenant fit-outs create ~1,386 tonnes of waste per year, enough to fill an entire office floor every 12 months.

In other words, if office towers were unable to dispose of waste from interior fit-outs they would become vertical landfills in just under 30 years.

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** 10kg / tree / year based on the Winrock International Forest Landscape Restoration (FLR) Carbon Storage Calculator.*

The Shift in Focus

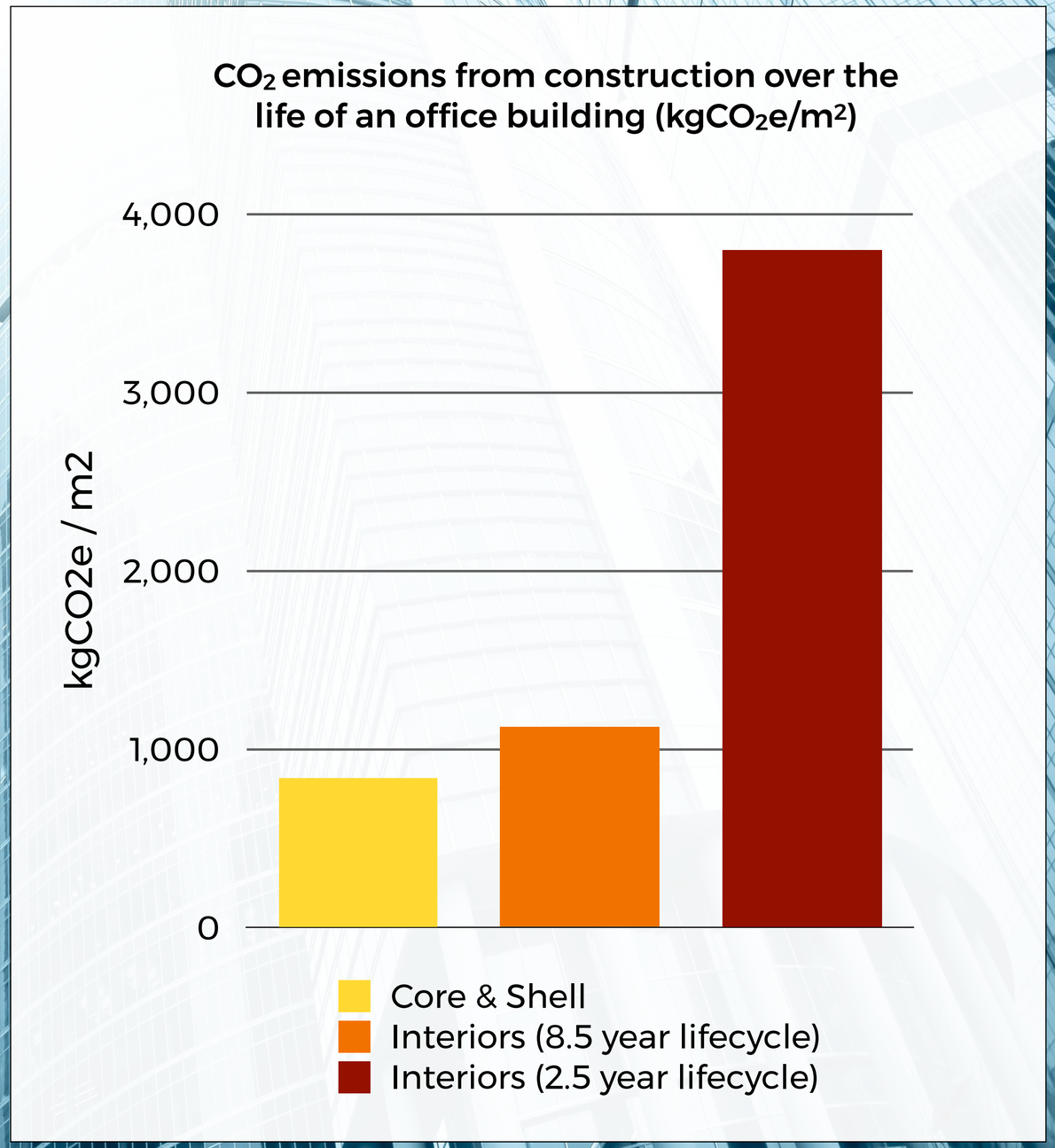
When carbon emissions from the construction of office interiors are calculated over the design lifespan of a building, the importance of those emissions come into sharp focus:

- At best, carbon emissions from tenant fit-outs are approximately equivalent to that of the entire building core & shell*.
- At worse, they are approximately four times higher.

Given the magnitude of these emissions, the construction of interiors represents a large scale opportunity for reductions in carbon and waste. It is very likely that this sector will become a key area of focus for policy makers seeking to achieve national reduction targets.

The need for flexibility of office tenants is unlikely to change and the average life of office interiors is unlikely to get longer. As a result, the office fit-out process and lease terms are most poised for change.

**Results from the world's largest markets (U.S. and China) are similar, each averaging ~840 kgCO2e/m2.*



Embodied vs. Operational

For every square meter of office building constructed in the China, it will take about 19 years for carbon emissions from daily operations to catch-up with those from the construction of core & shell (embodied)*.
(Figure 1.5)

When carbon from interior fit-out is factored in, the time required for operational emissions to catch up with embodied emissions doubles, stretching to 37 years*.
(Figure 1.6)

As buildings integrate more renewable energy sources, operational emissions will decrease, further highlighting the significance of embodied carbon in the built environment**. For example, in New York City 54 years are required for operational emissions to match embodied.

** Sources: U.S. Department of Energy, EIA, Annual Energy Outlook 2020. Urban Green Council, NYC's Energy and Water Use Report 2020. Avison Young, Sigthlines June 14 2021. RESET Project Data.*

*** Compared to office buildings, the higher energy use intensity of manufacturing makes it more challenging for renewables to decarbonize embodied carbon in the near to mid term.*

Figure 1.5: Core & Shell Only

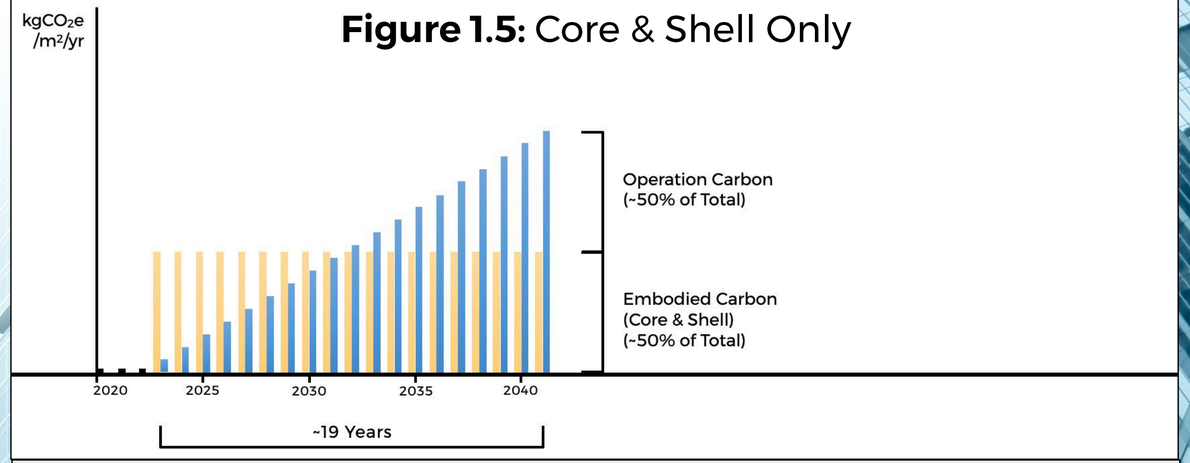
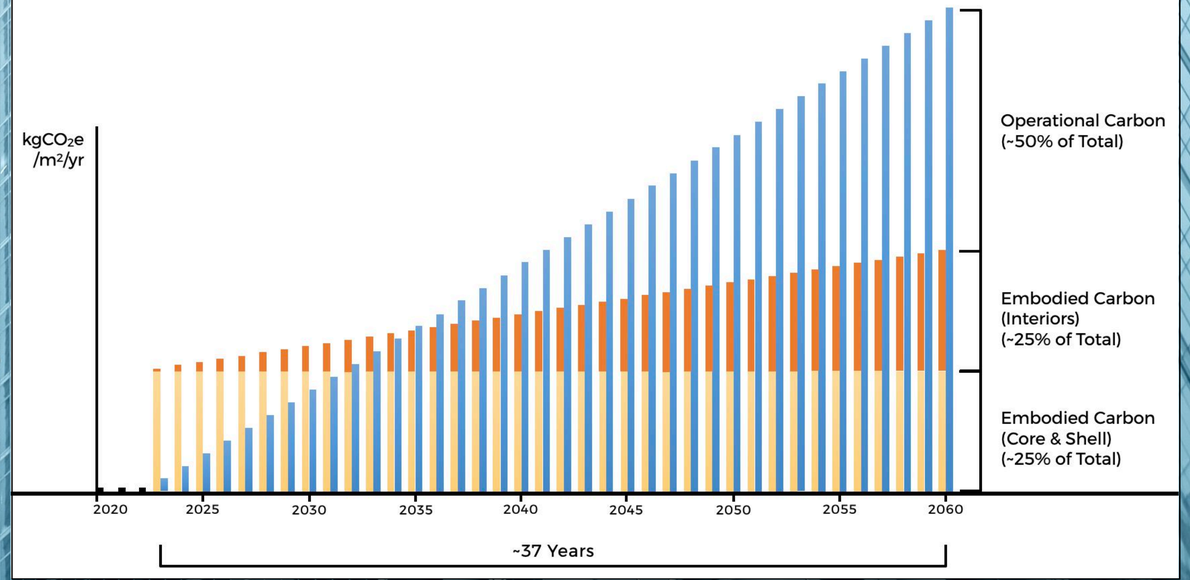
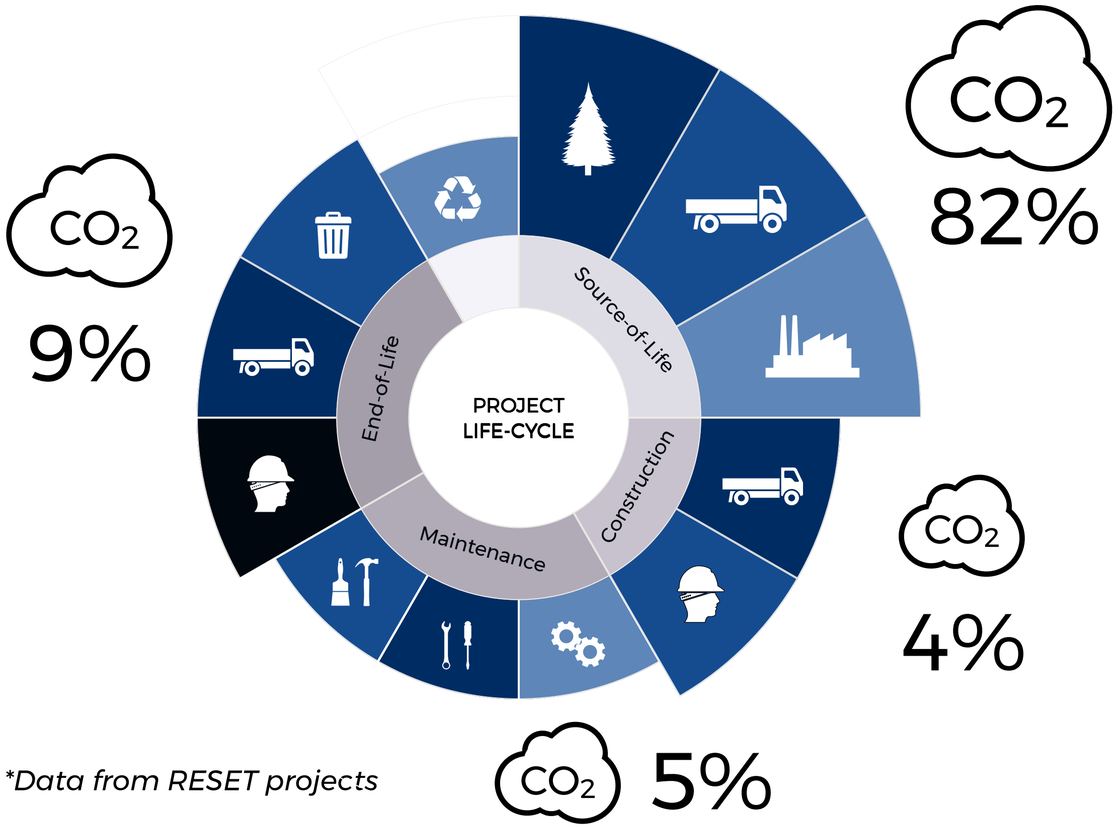


Figure 1.6: Core & Shell + Interiors



Carbon...

Approximately 91% of CO_2 emissions in the fit-out of office interiors comes from the sourcing and disposal of building materials and products*.



*Data from RESET projects

and Circularity

Only ~6% of interior fit-out materials and products in offices are recycled, leaving ~94% destined for landfill*.

Carbon...

and Circularity

The pursuit of low-to-zero carbon emissions in construction is often focused almost exclusively on the search for low-to-zero carbon materials. However, the largest reductions in carbon typically come from the ability of materials and products to be disassembled and reused.

In the case of office interiors, the ability to disassemble and reuse all components twice would reduce carbon by ~45%. In other words, almost half of all carbon emissions associated with the construction of office interiors would be eliminated.

If the lifespan of materials and products were doubled again, allowing them to be disassembled and reused four times, carbon emissions would be reduced by ~68%. And this is not yet accounting for the use of low-carbon materials.

Achieving this would require the industry to rethink how office interiors are designed, built and leased.

Yet, the opportunity to reduce carbon by at least 45-68% in the world's most intensive industry is too great to ignore.