

Tall Buildings in Numbers

Emissions-Reduction Strategies

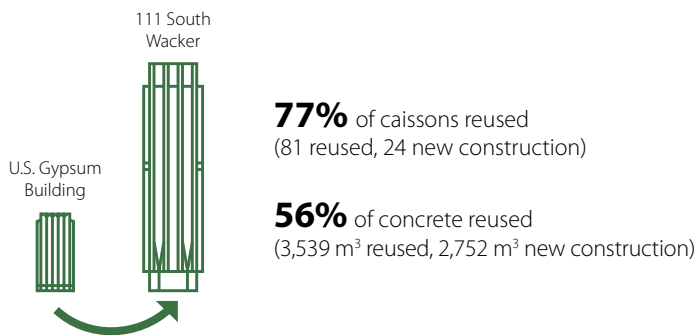
The construction sector accounts for 39 percent of all global emissions, so to avoid catastrophic climate-related disasters, these emissions must be reduced significantly, with many predicting that all buildings must be net-zero carbon by 2050 to meet our climate goals. Strategies have been deployed internationally to reduce a building's emissions, but these must work together to ensure that for every quantity of greenhouse gas released into the atmosphere, the equivalent quantity is also removed as an outcome of the building's design. This study explores some tall buildings that have employed creative strategies to reduce emissions. For more details, visit the accompanying paper on page 12.

Strategies for Reducing Embodied Carbon

Embodied Carbon: This is the amount of carbon emitted during the construction of the building. This also includes the emissions from manufacturing and transporting building materials to site, and handling of the materials at the end of the building's life.

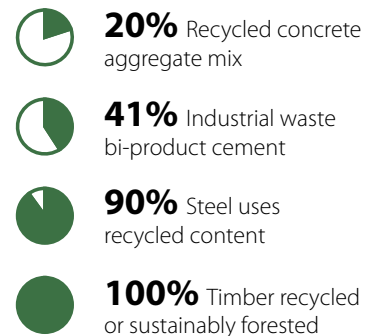
Reuse

111 South Wacker, Chicago, reused materials from the U.S. Gypsum Building, which was previously located on the site.



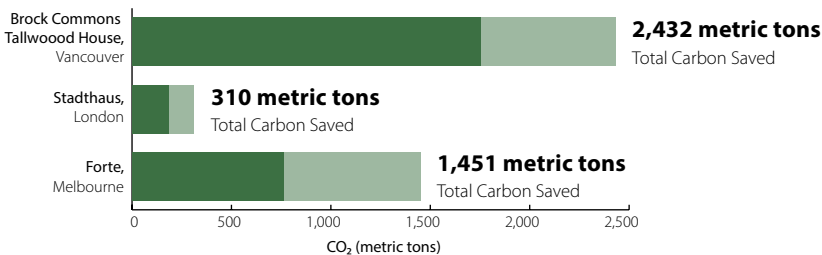
Recycling

1 Blich Street, Sydney, used recycled materials to reduce embodied carbon.



Mass Timber

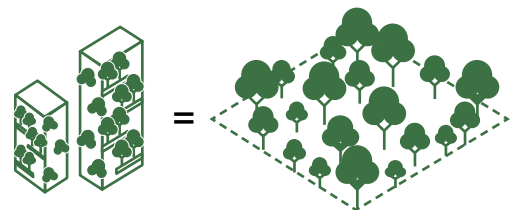
Timber stores carbon in built structures that would otherwise be released into the atmosphere.



■ Carbon Sequestered ■ Avoided Carbon Production

Vegetation

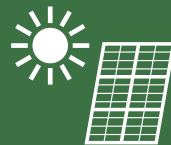
The exterior balconies of Bosco Verticale, Milan, host **700** trees, **5,000** shrubs, and **11,000** ground plants. This is the equivalent of **1 hectare** of forest cover, which stores **25.1** metric tons of CO₂.*



*US average for urban forests (Source: USDA Forest Service)



At 82 meters (270 feet), **The House at Cornell Tech**, New York City, is the tallest building to be certified by Passive House, a set of rigorous energy-efficiency standards.

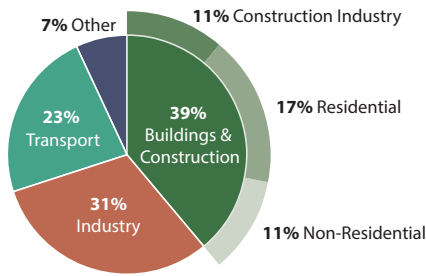


The **C.I.S. Solar Tower**, Manchester, includes over 7,000 photovoltaic modules on its façade, which generate an estimated 333,000 kWh of electricity each year.

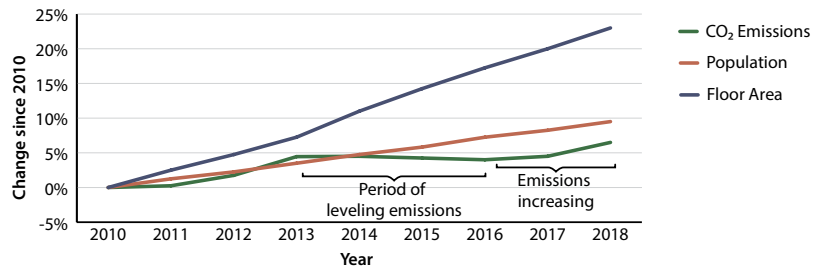
Emissions: An Overview

Operating buildings drives 28 percent of CO₂ emissions globally, while 11 percent comes from the construction of buildings and building materials. As the amount of built floor area and human population worldwide continue to rise, so too have operational and construction-related emissions.

Proportion of Worldwide Carbon Emissions Generated, 2019



Changes in Floor Area, Population, and Energy-Related CO₂ Emissions Globally, 2010–2018



Sources: Adapted from IEA (2019a), *World Energy Statistics and Balances* (database), iea.org/statistics and IEA (2019b), *Energy Technology Perspectives*, buildings model, iea.org/buildings. Redrawn by CTBUH.

Strategies for Reducing Operational Carbon

Operational Carbon: This is the amount of carbon emitted while a building is in use. In addition to the emissions from typical operation, such as heating and cooling, this also includes emissions from ongoing maintenance of the buildings.

	Post Turn Bonn, 2002	Manitoba Hydro Place Winnipeg, 2008	1 Bligh Street Sydney, 2011	Doha Tower Doha, 2012	One Angel Square Manchester, 2013	The Edge Amsterdam, 2014	Tower at PNC Plaza Pittsburgh, 2015	The House at Cornell Tech New York City, 2017
Automatic Solar Blinds			●			●	●	
Building Orientation to Sun Optimized		●		●		●		●
Double Skin Façade	●	●	●		●		●	
Energy Recovery Ventilation (ERV) and Variable Refrigerant Flow (VRF) Systems								●
Hybrid Trigeneration Plant for Heating, Cooling, and Electricity			●					
Natural Ventilation	●	●	●		●	●	●	
Passive Solar Screens				●				
Solar Chimney		●					●	
Triple-Glazed Windows								●
Underground Thermal Storage	●	●			●	●		
Total Reduction of Operational Carbon	79% reduction in energy use	70% reduction in energy use	42% reduction in CO ₂ emissions	20% reduction in heating/cooling load	80% reduction in CO ₂ emissions	70% reduction in energy use	50% reduction in energy use	75% reduction in heating/cooling load

This chart highlights just some of the primary methods to reduce energy load and overall CO₂ emissions of eight studied exemplar buildings with the percentage reduction overall indicated.



Marco Polo Tower, Hamburg, utilizes sound-insulating air louvers, which allow natural ventilation in the building, but limit noise pollution from outside.



The combined heat and power system in One Angel Square, Manchester, is fueled by recycled cooking and rapeseed oil, some of which comes directly from farms operated by The Co-operative Group, the building's developer.