

# How Can You Build a Greener Boston?

Boston's historic buildings encapsulate both a rich history of the city and the potential to aid in offsetting the construction industry's environmental impact. This handout outlines the carbon cost of a building's fundamental parts and how preservation can be used as an agent of climate action.



## Upfront Embodied Carbon

Upfront Embodied Carbon (UEC) refers to the greenhouse gas emissions released before a building or infrastructure is used. These emissions are frontloaded and embodied within structural materials. Embodied Carbon is responsible for 11% of global GHG emissions, making our built environment critical to counteracting the impacts of climate change in urban centers. Through rehabilitating existing buildings to incorporating existing building elements into new developments, you can leverage the building industry to protect your city's future.



## Building Frame

### Wood

#### Dimension Lumber<sup>1</sup>

Median | **3.93** lbCO<sub>2</sub>e/ft<sup>3</sup>

High | **6.24** lbCO<sub>2</sub>e/ft<sup>3</sup>

### Steel<sup>2</sup>

Median | **5.27** lbCO<sub>2</sub>e/lb

High | **6.6** lbCO<sub>2</sub>e/lb



## Foundation

### Masonry

#### Brick<sup>3</sup>

Median | **6.06** lbCO<sub>2</sub>e/lb

### Concrete<sup>4</sup>

Median | **21.41** lbCO<sub>2</sub>e/ft<sup>3</sup>

High | **29.34** lbCO<sub>2</sub>e/ft<sup>3</sup>



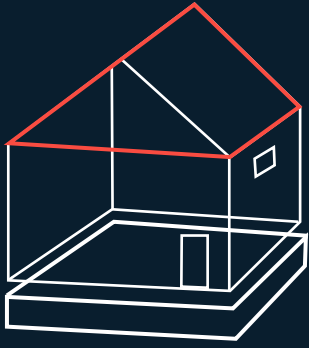
## Sheathing

### Wood<sup>5</sup>

Median | **3.93** lbCO<sub>2</sub>e/ft<sup>3</sup>

High | **6.24** lbCO<sub>2</sub>e/ft<sup>3</sup>



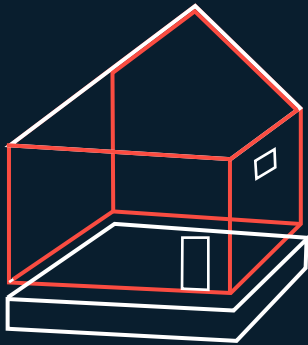


## Roofing

Metal Panels<sup>6</sup>  
Median | **3.13** lbCO<sub>2</sub>e/ft<sup>2</sup>  
High | **5.33** lbCO<sub>2</sub>e/ft<sup>2</sup>

Asphalt<sup>7</sup>  
Median | **3.63** lbCO<sub>2</sub>e/ ft<sup>2</sup>  
(building SF)

Slate<sup>8</sup>  
Median | **0.013** lbCO<sub>2</sub>e/lb



## Facade Treatments

Brick<sup>9</sup>  
Median | **6.06** lbCO<sub>2</sub>e/lb

Wood<sup>10</sup>  
Median | **3.93** lbCO<sub>2</sub>e/ft<sup>3</sup>  
High | **6.24** lbCO<sub>2</sub>e/ft<sup>3</sup>

Vinyl Siding<sup>11</sup>  
Median | **2.03** lbCO<sub>2</sub>e/ ft<sup>2</sup>  
siding

Metal Panels<sup>12</sup>  
Median | **3.128** lbCO<sub>2</sub>e/ ft<sup>2</sup>  
siding  
High | **5.32** lbCO<sub>2</sub>e/ ft<sup>2</sup> siding

## Your Building's Estimated Embodied Carbon:

For reference...



**6,400 pounds of carbon** heats the average American home for a year<sup>13</sup>



**500,000 pounds of carbon** drives 48.9 gasoline powered cars for a year<sup>14</sup>



**750,000 pounds of carbon** is equivalent to 42.9 homes' energy use for one year<sup>15</sup>



# Sources

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- <sup>1</sup> Carlisle, S., Waldman, B., Lewis, M., and Simonen, K. (2021). 2021 Carbon Leadership Forum Material Baseline Report, (version 2). Carbon Leadership Forum, University of Washington. Seattle, WA. July, 2021.
- <sup>2</sup>Ibid.
- <sup>3</sup>Marwa Dabajeh, Jukka Heinonen, Deena El-Mahdy, Dalya M. Hassan, A comparative study of life cycle carbon emissions and embodied energy between sun-dried bricks and fired clay bricks, *Journal of Cleaner Production*, Volume 275, 2020, 122998, ISSN 0959-6526, <https://www.sciencedirect.com/science/article/pii/S0959652620330432>.
- <sup>4</sup>Carlisle, S., Waldman, B., Lewis, M., and Simonen, K. (2021). 2021 Carbon Leadership Forum Material Baseline Report, (version 2). Carbon Leadership Forum, University of Washington. Seattle, WA. July, 2021.
- <sup>5</sup>Ibid.
- <sup>6</sup>Ibid.
- <sup>7</sup> Magwood, Chris, et al. “Integrative Carbon Building: Embodied Carbon, Net Positive Carbon, and the New Carbon Architecture.” NESEA, Northeast Sustainable Energy Association - BuildingEnergy, <https://nesea.org/session/integrative-carbon-building-embodied-carbon-net-positive-carbon-and-new-carbon-architecture>.
- <sup>8</sup> Hammond, Geoffrey, and Craig Jones. Embodied Carbon - The Inventory of Carbon and Energy (ICE). Edited by Fiona Lowrie and Peter Tse, University of Bath, Oct. 2011, <https://greenbuildingencyclopaedia.uk/wp-content/uploads/2014/07/Full-BSRIA-ICE-guide.pdf>.
- <sup>9</sup> Marwa Dabajeh, Jukka Heinonen, Deena El-Mahdy, Dalya M. Hassan, A comparative study of life cycle carbon emissions and embodied energy between sun-dried bricks and fired clay bricks, *Journal of Cleaner Production*, Volume 275, 2020, 122998, ISSN 0959-6526, <https://www.sciencedirect.com/science/article/pii/S0959652620330432>.
- <sup>10</sup>Carlisle, S., Waldman, B., Lewis, M., and Simonen, K. (2021). 2021 Carbon Leadership Forum Material Baseline Report, (version 2). Carbon Leadership Forum, University of Washington. Seattle, WA. July, 2021.
- <sup>11</sup> Cai, Hao, et al. “Building Life-Cycle Analysis with the GREET Building Module: Methodology, Data, and Case Studies.” Argonne National Laboratory , Oct. 2021, [https://greet.es.anl.gov/publication-greet\\_building\\_method\\_2021](https://greet.es.anl.gov/publication-greet_building_method_2021).
- <sup>12</sup>Carlisle, S., Waldman, B., Lewis, M., and Simonen, K. (2021). 2021 Carbon Leadership Forum Material Baseline Report, (version 2). Carbon Leadership Forum, University of Washington. Seattle, WA. July, 2021.
- <sup>13</sup> “The Energy Costs of Cooling and Heating a Home.” NPR, NPR, 27 Aug. 2007, <https://www.npr.org/templates/story/story.php?storyId=13941744>.
- <sup>14</sup> “Greenhouse Gas Equivalencies Calculator.” EPA, Environmental Protection Agency, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>.
- <sup>15</sup> “Greenhouse Gas Equivalencies Calculator.” EPA, Environmental Protection Agency, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>.

