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You and Me, Carbon Free: Decarbonizing U.S. Buildings

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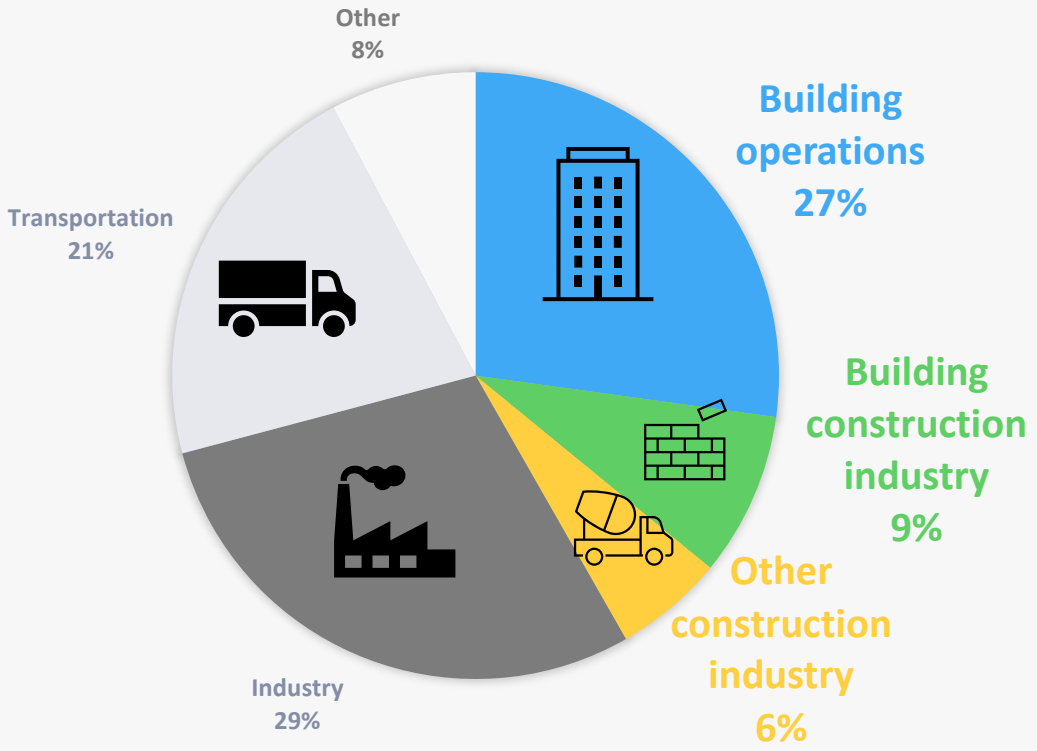
Motivation

Globally, buildings account for more carbon emissions than any other sector



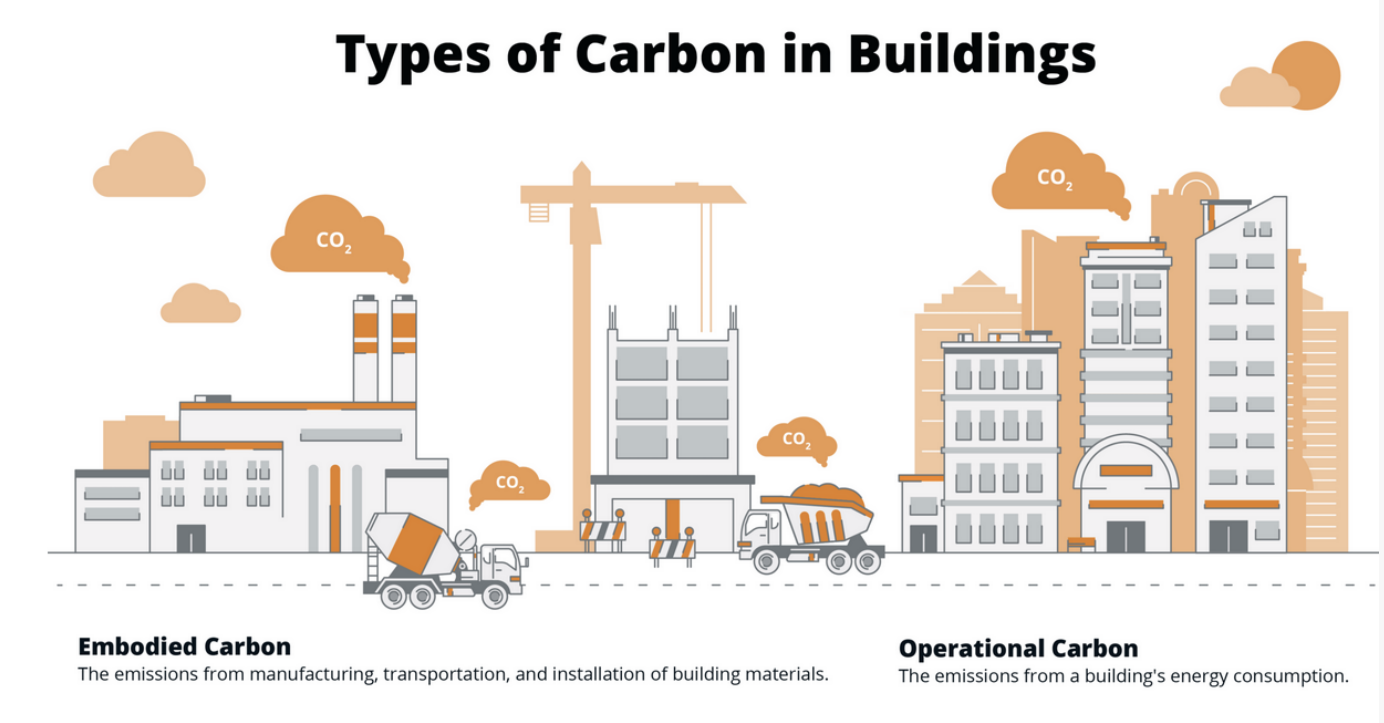
Global CO_2 Emissions by Sector

GlobalABC (2022) Global Status Report for Buildings and Construction

Motivation

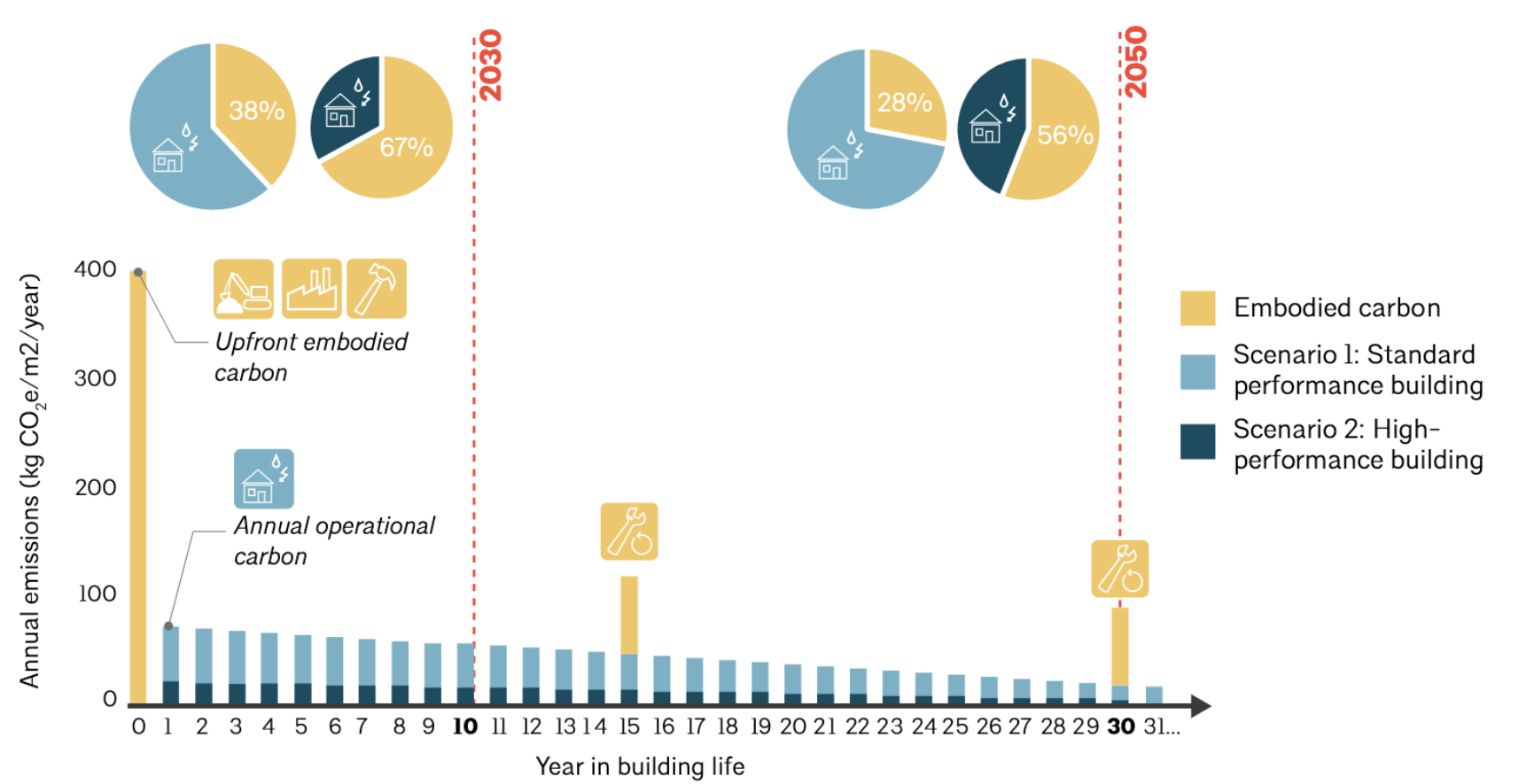
Two forms of carbon emissions in buildings

- Operational
- Embodied



Source :https://www.greenbiz.com/article/how-lay-foundation-net-zero-carbon-building-projects and CarbonCure

Motivation



Source: AIA-CLF Embodied Carbon Toolkit for Architects – Introduction https://carbonleadershipforum.org/toolkit-1-introduction/

Motivation

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Majority of US waste is from demolition of the built environment

Source: https://www.epa.gov/sites/default/files/2020-11/documents/2018_ff_fact_sheet.pdf

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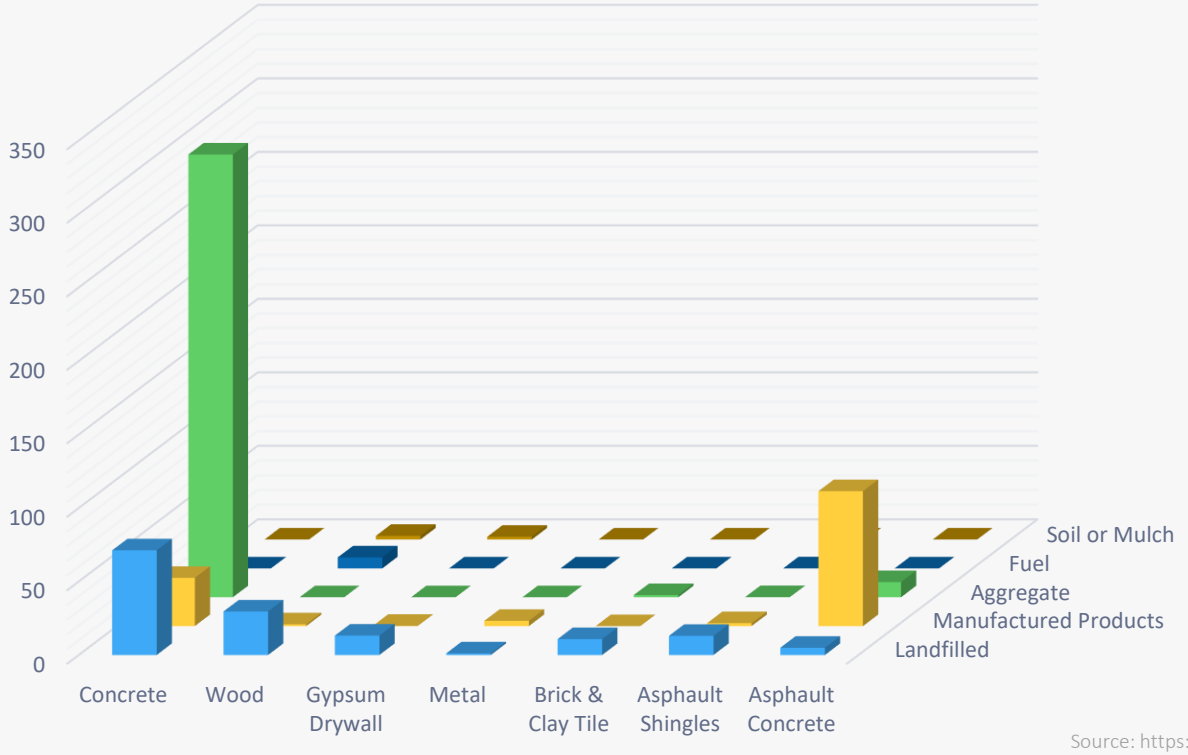
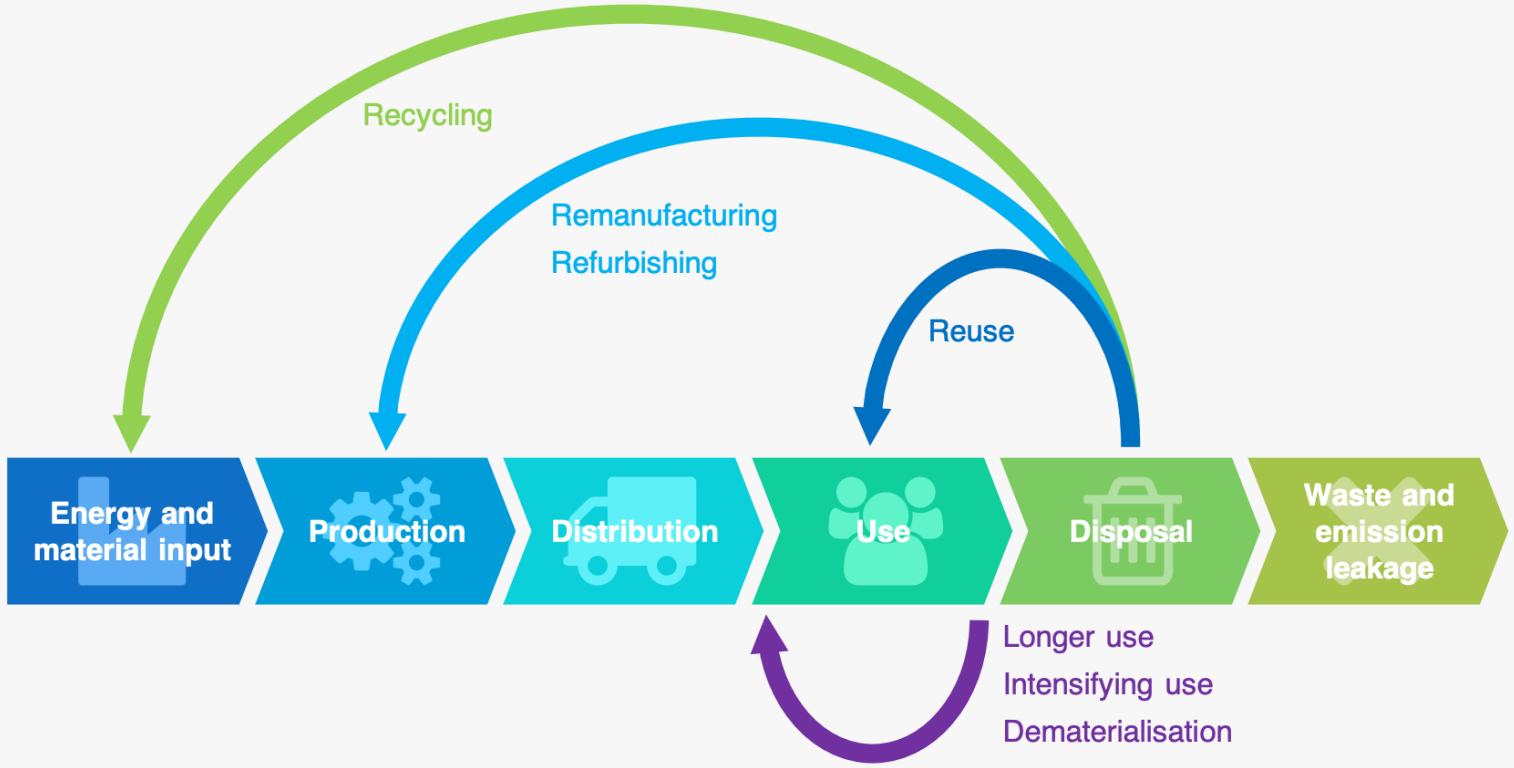
Million tons of waste reuse vs. landfilling (2018)



Source: https://www.epa.gov/sites/default/files/2020-11/documents/2018_ff_fact_sheet.pdf

Circular economy



Source: https://en.wikipedia.org/wiki/Circular_economy

Key elements of a circular economy:

- Design out waste and pollution in extraction, processing, manufacturing, construction, and demolition processes
- Keeping products and materials in use for as long as possible

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Motivation

Buildings will play an important role in reducing carbon emissions, significantly contributing to our long-term goal of a carbon pollution-free society.

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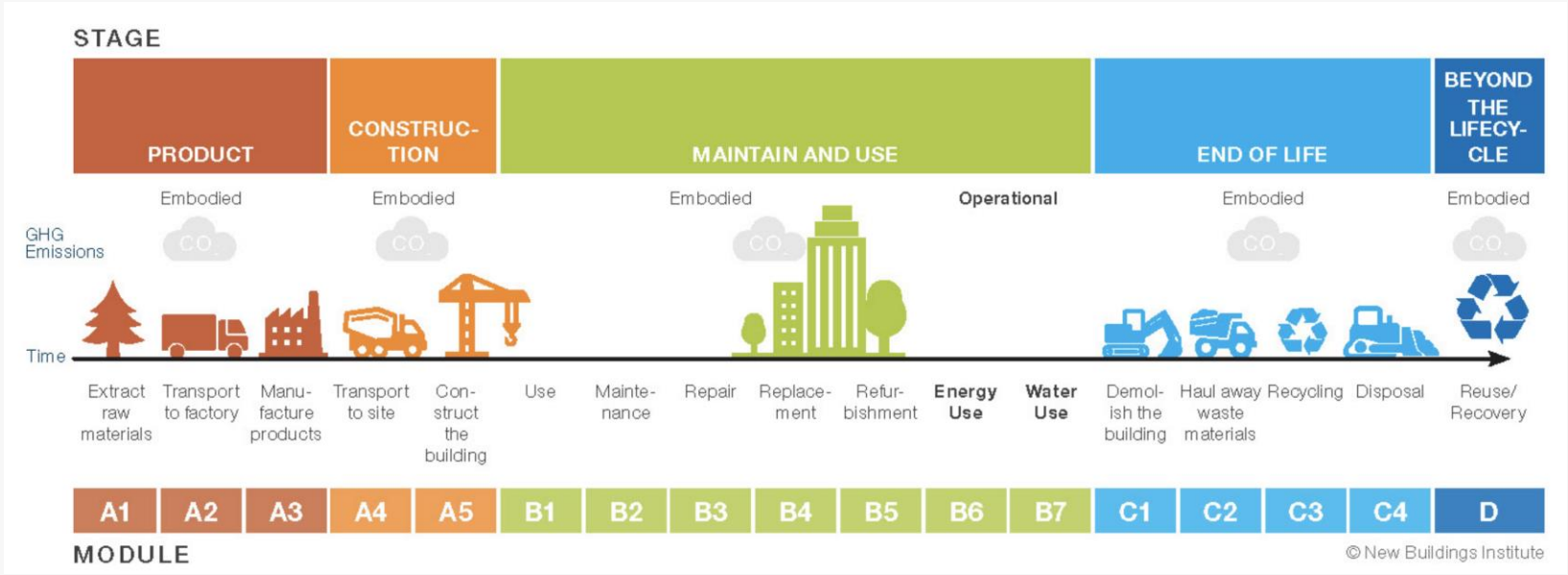
What can we do?

There are multiple pathways to reducing carbon emissions from buildings, from considering reductions in operational and/or embodied emissions and minimizing waste. Let's consider a few examples.

Embodied Carbon



Source: https://newbuildings.org/code_policy/embodied-carbon

- Renovate and reuse
- Repurpose materials
- Low carbon materials
- Locally sourced materials

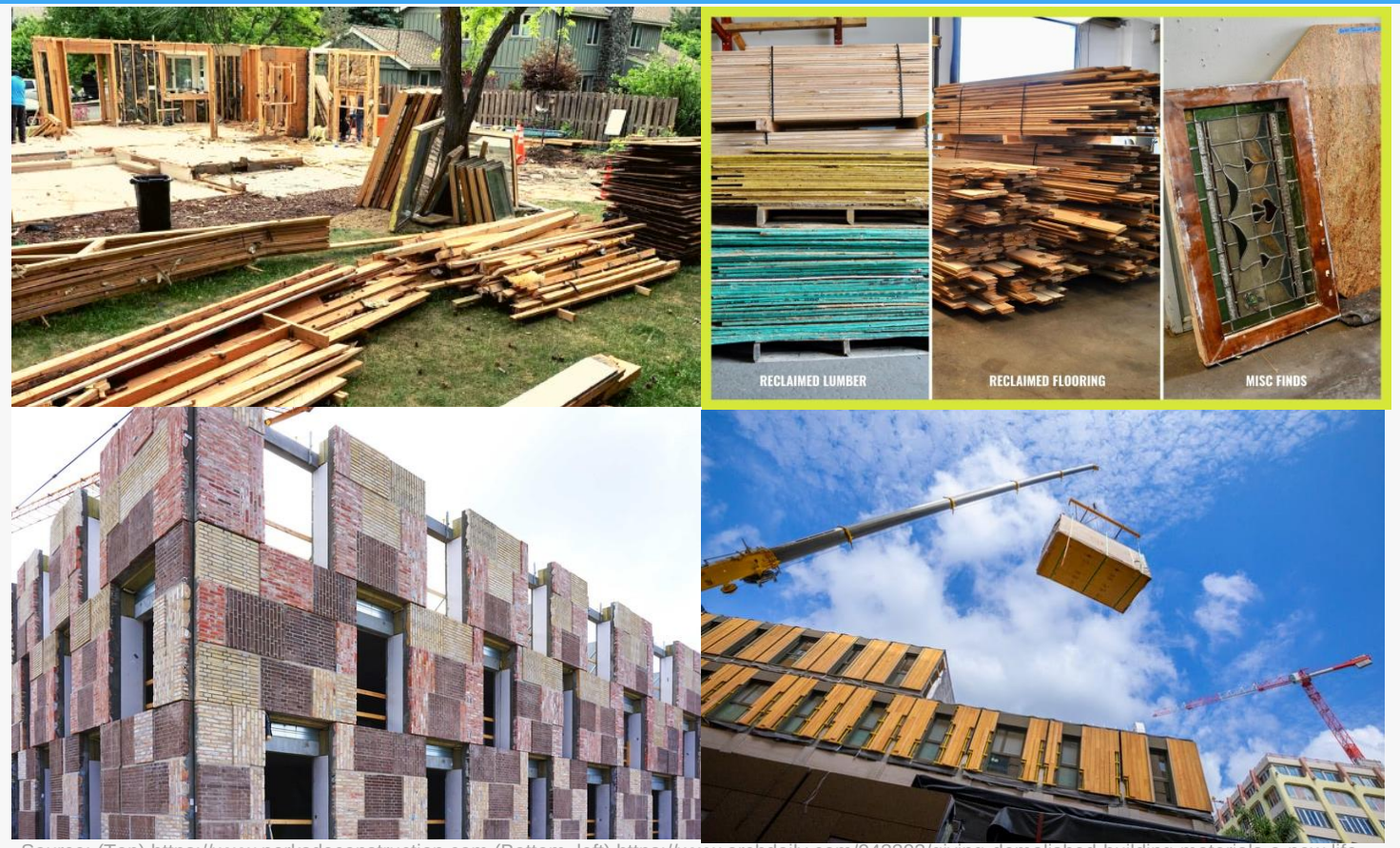
Operational Carbon

- Energy efficiency
  - Use less = emit less
- Electrification
  - Use electricity, which is shifting towards carbon-free
  - Burning fossil fuels will never be carbon-free
- Distributed Energy Resources and controls
- Automatic fault detection and diagnostics

Source: https://www.netzerocarbonguide.co.uk/guide/where-to-start/what-is-a-net-zero-carbon-building/summary

Waste Reduction

- Building demolition practices
- Recovering, reusing, remanufacturing practices of and for building materials
- Reuse practices of existing commercial buildings for residential use
- Industrializing on-site building construction process



Source: (Top) https://www.perksdeconstruction.com (Bottom, left) https://www.archdaily.com/943293/giving-demolished-building-materials-a-new-life-through-recycling (Bottom, right): https://onekeyresources.milwaukeetool.com/en/industrialized-construction

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The Challenge

This challenge asks students to develop an innovative solution that will reduce carbon emissions in buildings. Students can focus on any aspect related to carbon emissions, including but not limited to embodied carbon, operational carbon, and waste reduction.

Additional Resources

Embodied carbon resources

- https://www.aia.org/articles/70446-ten-steps-to-reducing-embodied-carbon
- https://carbonleadershipforum.org/clf-architect-toolkit/

Energy Resources

- https://www.eia.gov/

Circular Economy/Waste Resources

- https://ellenmacarthurfoundation.org/topics/built-environment/overview
- https://www.epa.gov/smm/sustainable-management-construction-and-demolition-materials

Market Transformation Resources

- https://www.aceee.org/research-report/u1715

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Thank You!

www.jumpintostem.org