



Architecture for the 21st Century

- Regenerative design
- Carbon neutrality
- Electrification
- Circular economy



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Understanding Carbon



Embodied Carbon
Manufacture, transport and installation of construction materials

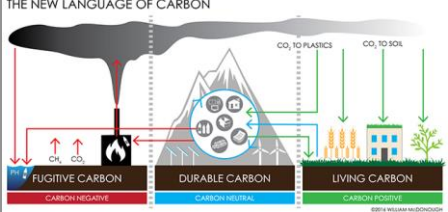
Operational Carbon
Building energy consumption

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William McDonough states that carbon is not a bad thing, so we must change our language to something like this:

THE NEW LANGUAGE OF CARBON



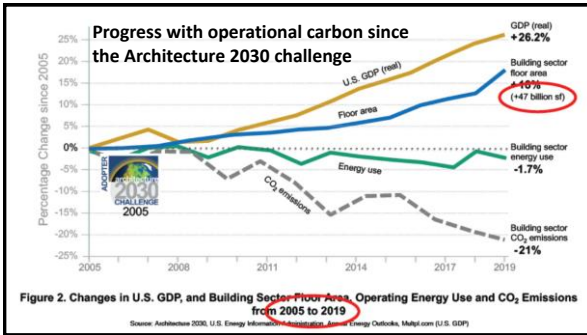
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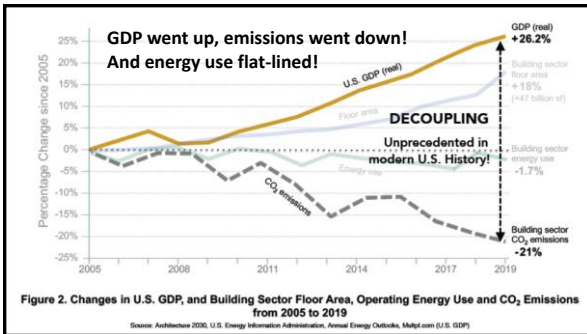
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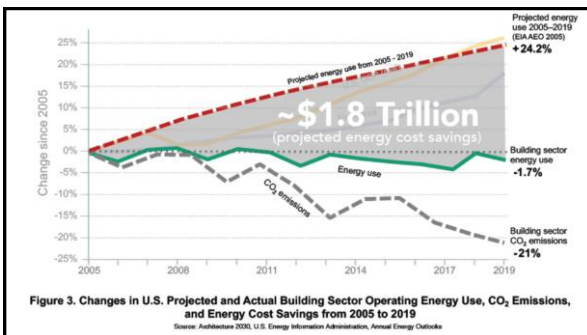
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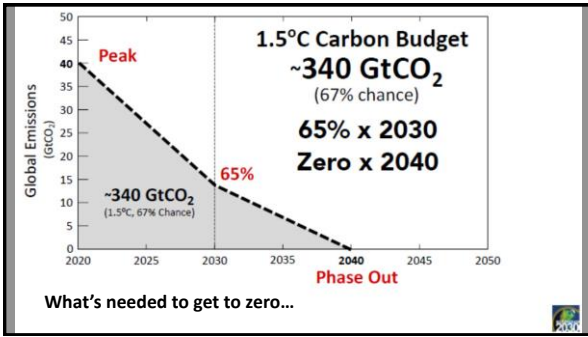
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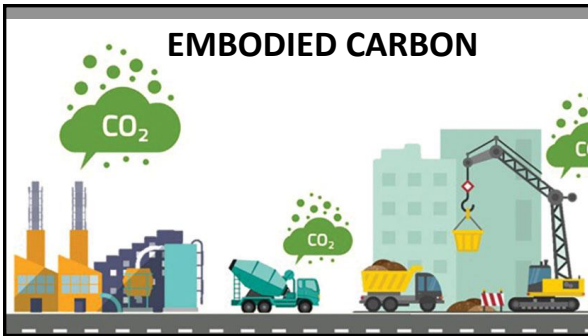
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Zero Carbon in Three Steps

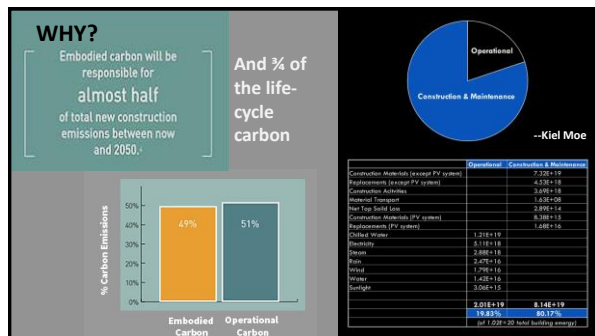
1. Design to the Latest Codes and Standards
2. Design for All-Electric and Renewables
3. Zero Out Embodied Carbon

While steps 1 and 2 will produce zero-carbon building operations, we must also confront the embodied carbon of building construction and materials if we hope to phase out CO₂ emissions by 2040. Architects, engineers, and planners can minimize the embodied carbon emissions from all new buildings, major renovations, infrastructure, and construction by adopting the following three tactics:

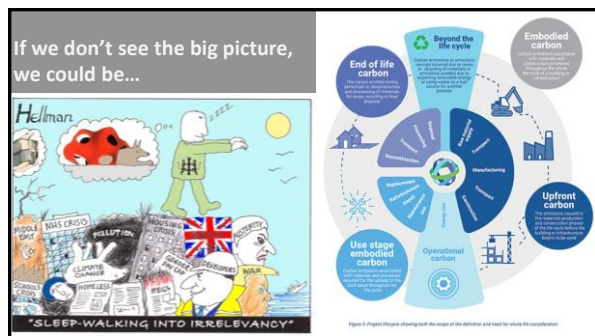
- **Reuse.** Repurpose and upgrade urban areas and existing buildings instead of constructing new infrastructure; use local and recycled materials when available; and design buildings for deconstruction.
- **Reduce.** Infill and densify urban areas to utilize existing infrastructure; reduce material use by optimizing structural systems; and specify low- to zero-carbon materials using comparative tools, such as the [Embodied Carbon in Construction Calculator](#).
- **Sequester.** Use mass timber and glue- or cross-laminated wood from existing sustainably managed forests; use bamboo structural members and panels if available; specify materials that sequester CO₂ in their manufacture or application; and plan and design carbon-sequestering sites, parks, and urban landscapes.



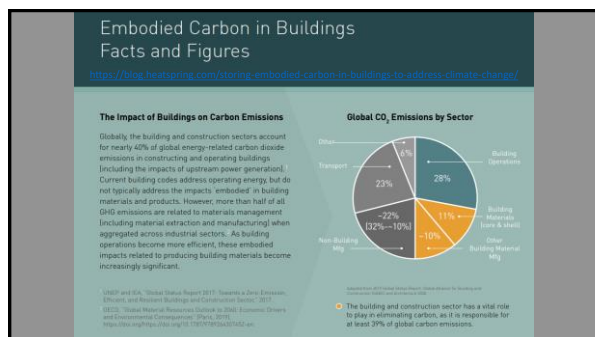
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Embodied Carbon in Construction

Embodied Carbon (EC) makes up most of the 2030 climate impact of a typical new office building. EC is the carbon emitted in producing the concrete, steel, timber, and similar materials it is made from. EC helps construction professionals efficiently quantify, report, and reduce embodied carbon.

Total Carbon Emissions of All Global New Construction from 2020-2050
Based on Best-Practices

EMBEDDED CARBON: 80%
OPERATIONAL CARBON: 20%

Many construction materials can be made to very similar performance standards with 50% or more carbon savings. That's because manufacturing process, mix composition, recycled content, and electricity source have a dramatic effect on the carbon emitted during manufacture. Carbon-aware specification and procurement policies, backed by a contractual requirement to deliver verified EPDs for materials delivered to site, can drive change in the supply chain at low to minimal cost.

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Carbon Smart Procurement

The EC3 tool allows us to assess the embodied carbon of our supply chain to specify and procure lower-carbon options, based on available products, at no cost.

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CARBON IMPACTS OF CONCRETE

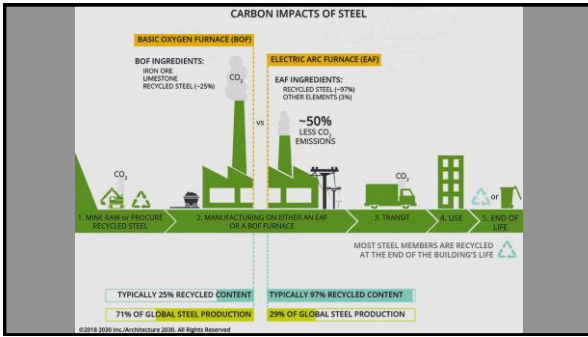
Embodied Carbon varies by material

INGREDIENTS: LIMESTONE, SILICA, ALUMINA, GYPSUM
1. MINING RAW MATERIAL
2. CEMENT MANUFACTURING (1,400-2,000° C)
3. MIXING CONCRETE
4. TRANSPORT
5. USE
6. END OF LIFE

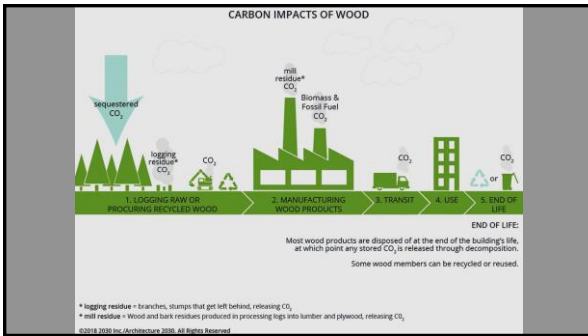
COMPONENTS OF CONCRETE: AIR, CEMENT, WATER, AGGREGATE

END OF LIFE: Concrete can be ground up at the end of its useful life to make aggregate for new concrete. * If exposed to air, concrete will absorb some CO₂.

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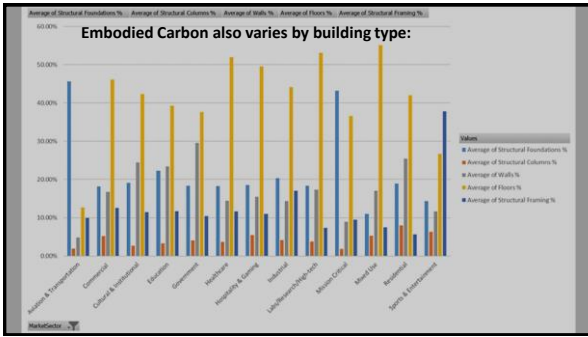
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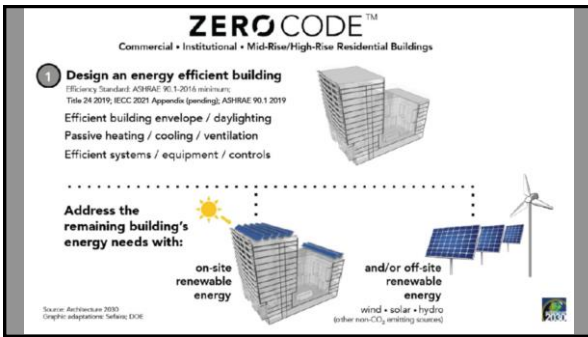
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The Building Decarbonization Coalition estd. Oct 2019 offers a free guidebook.

DESIGN PROFESSIONAL'S GUIDE TO
DECARBONIZATION OF THE BUILT ENVIRONMENT

<https://www.collaborativedesign.org/building-decarbonization-practice-guide>

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CLF Carbon Leadership Forum

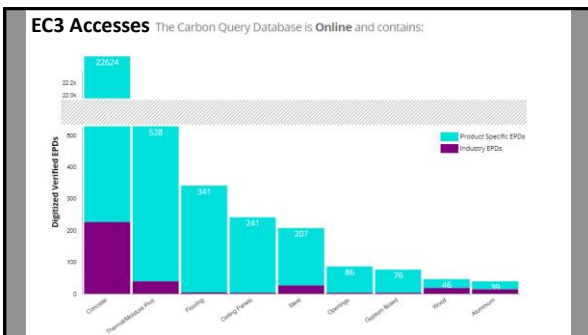
HOME ABOUT PROJECTS RESOURCES NEWS AND EVENTS SPONSORS EMBODIED CARBON NETWORK CONTACT

EMBODIED CARBON IN CONSTRUCTION CALCULATOR (EC3) TOOL

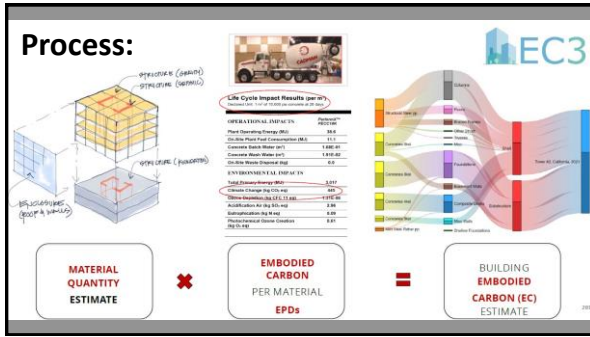
Increasingly the building industry and building owners are becoming aware that materials matter and are seeking ways to evaluate the emissions associated with making these materials. Until now, they have not had a reliable or efficient way to compare them. The free, cloud-based, open-access Embodied Carbon in Construction Calculator (EC3) tool simplifies this complex problem, giving users the information they need to make more informed decisions on embodied carbon, allowing them to enact positive change. Collaborating partners first demonstrated the product at Greenbuild, November 19-22, 2019 in Atlanta, GA.

Also a free resource—
<http://www.carbonleadershipforum.org/projects/ec3/>

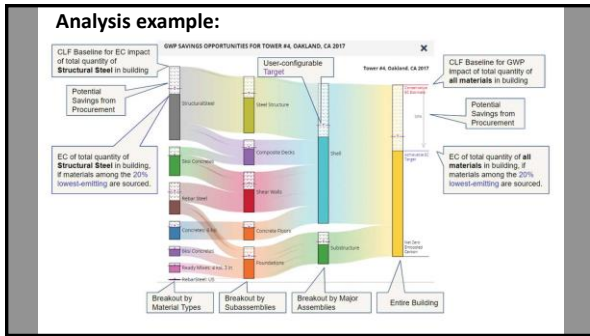
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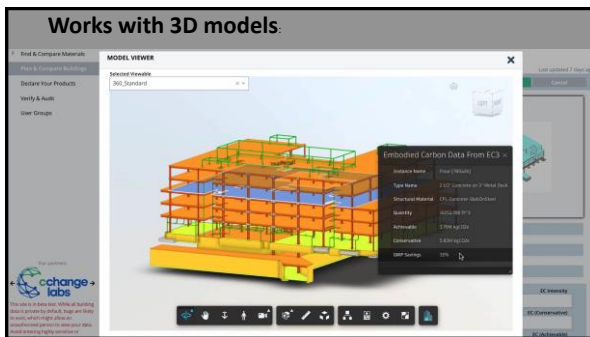
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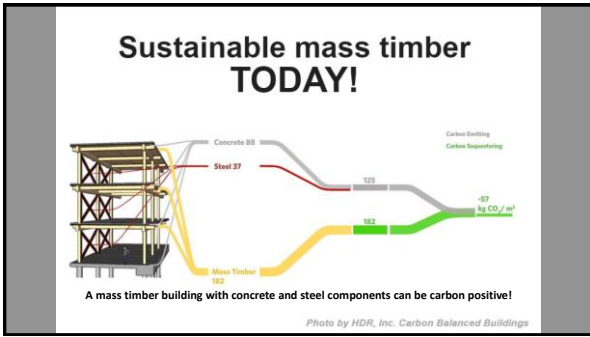
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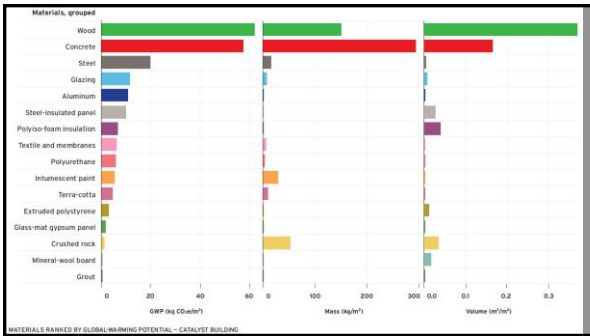
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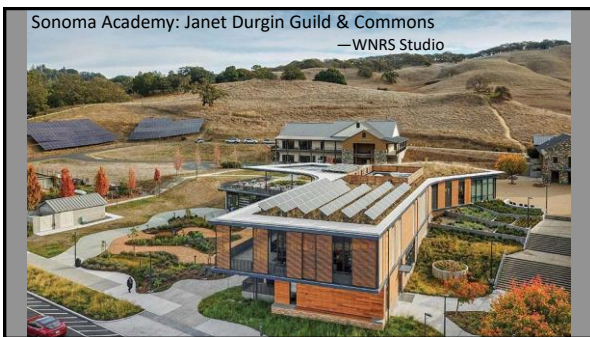
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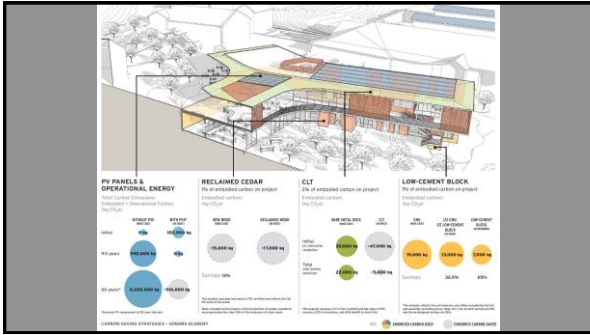
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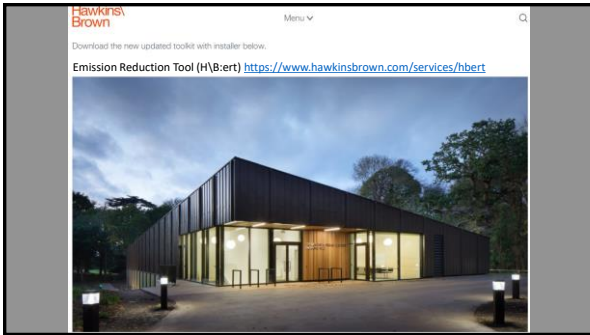
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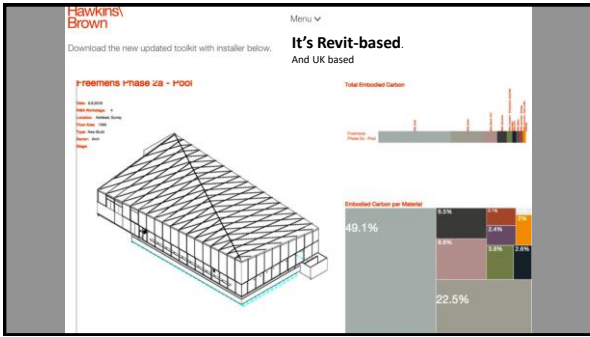
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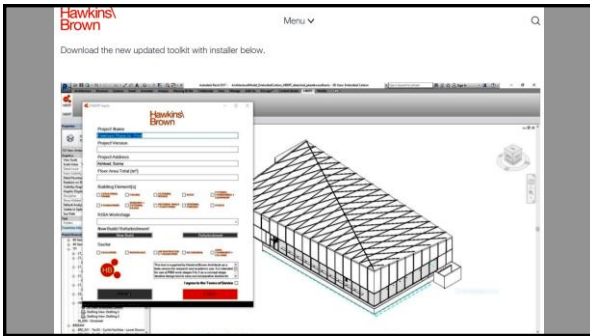
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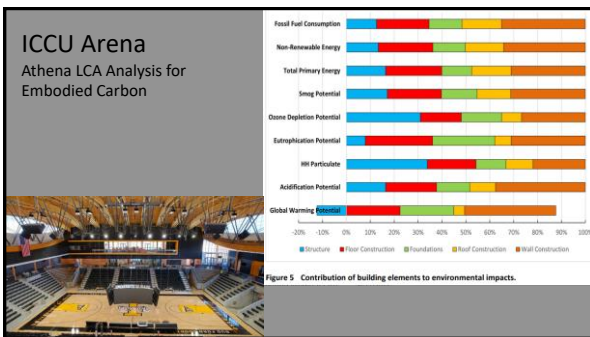
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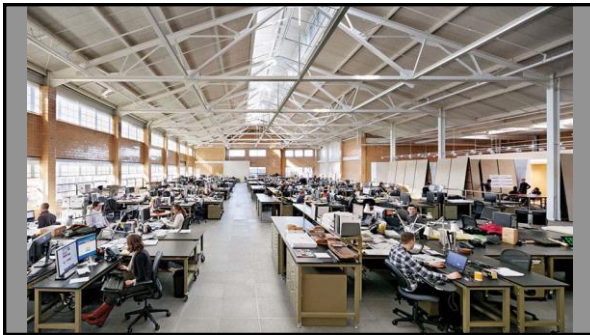
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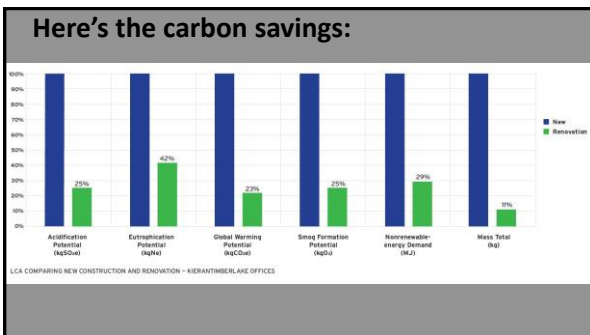
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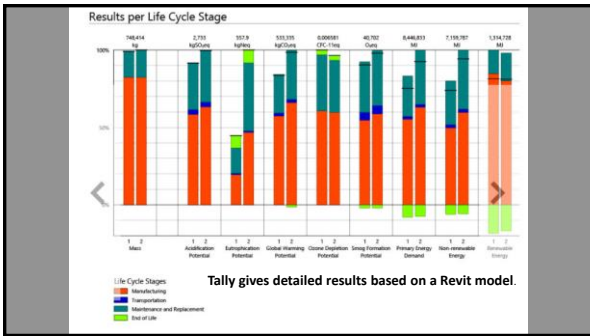
JULY 13, 2016 MARCH 11, 2015

New Version of Tally® is Released *Tally®* Analysis at the Brown School of Engineering

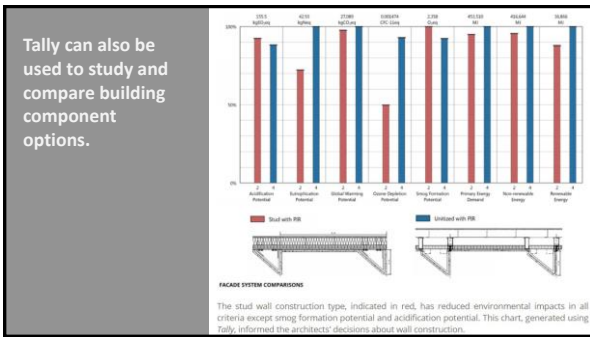



Throughout the design for Brown University's new School of Engineering, architect KarimTimberlake used Tally to aid in the selection of building materials based on the environmental impacts.

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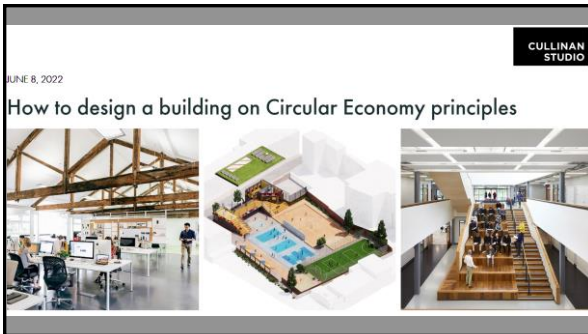
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Cullinan's nine key circular economy principles for designing a building

<https://www.cullinanstudio.com/news-update/circular-economy-design-principles>

- Reusing existing structure and materials –
- Sourcing reclaimed materials –
- Consulting with the local community –
- Designing for flexibility –
- Seeing the building as a 'materials bank' –
- Designing waste out of construction process –
- Leasing instead of buying –
- Reducing energy use –
- Aiming for net positive biodiversity –

Cullinan Studio's RIBA National Award-winning design for the National Automotive Innovation Centre, includes flexible workplace, meeting and social spaces, as well as moveable walls, making it highly adaptable to the future needs of its users.

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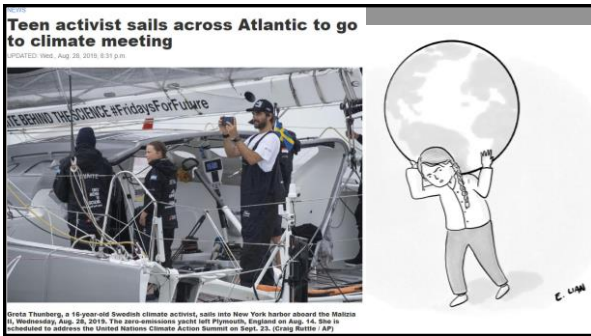
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