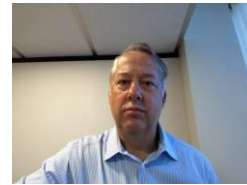
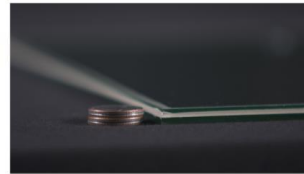
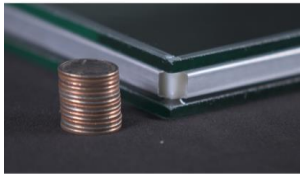




# Carbon analysis and emerging glass technology

Kyle Sword - Manager Business Development  
NSG Pilkington



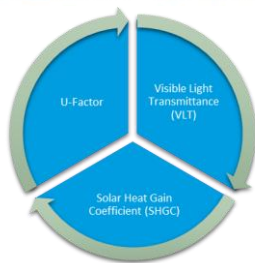
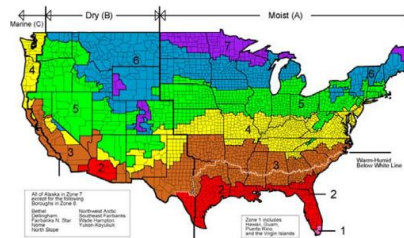
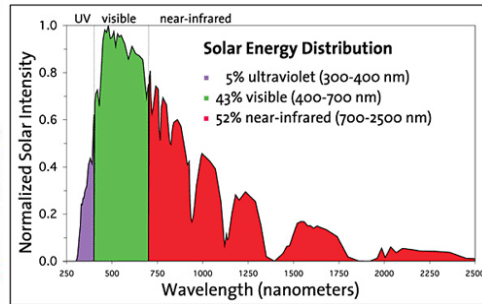
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## Glass buildings have been singled out as climate disasters. Can they be reformed?

Tightening building standards could mean it's curtain call for glass towers. Some innovators say otherwise.

BY JOHN LORINC  
APRIL 22, 2021



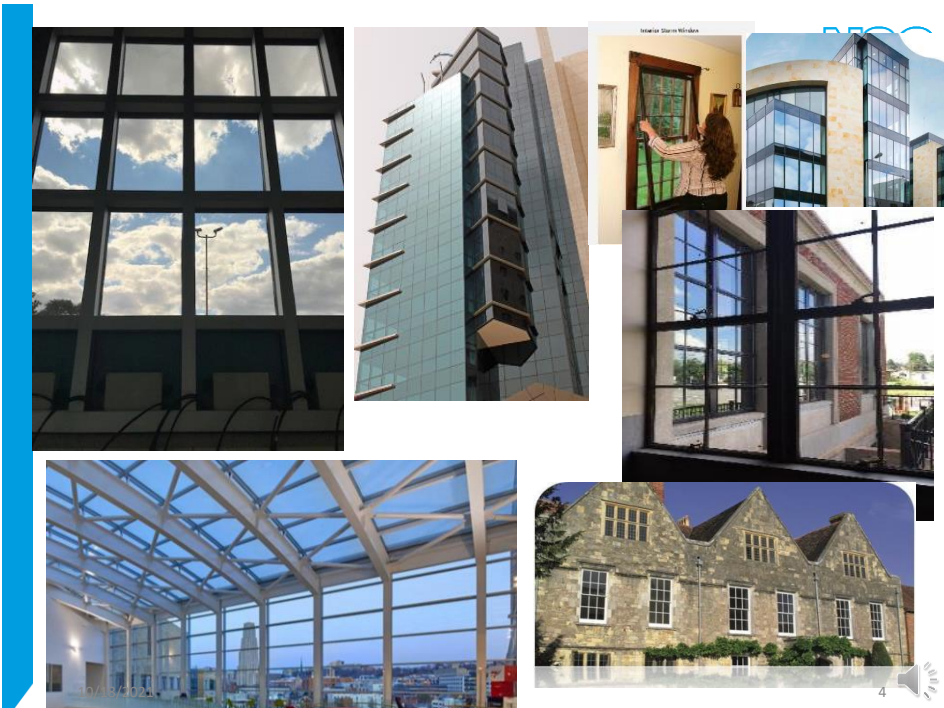
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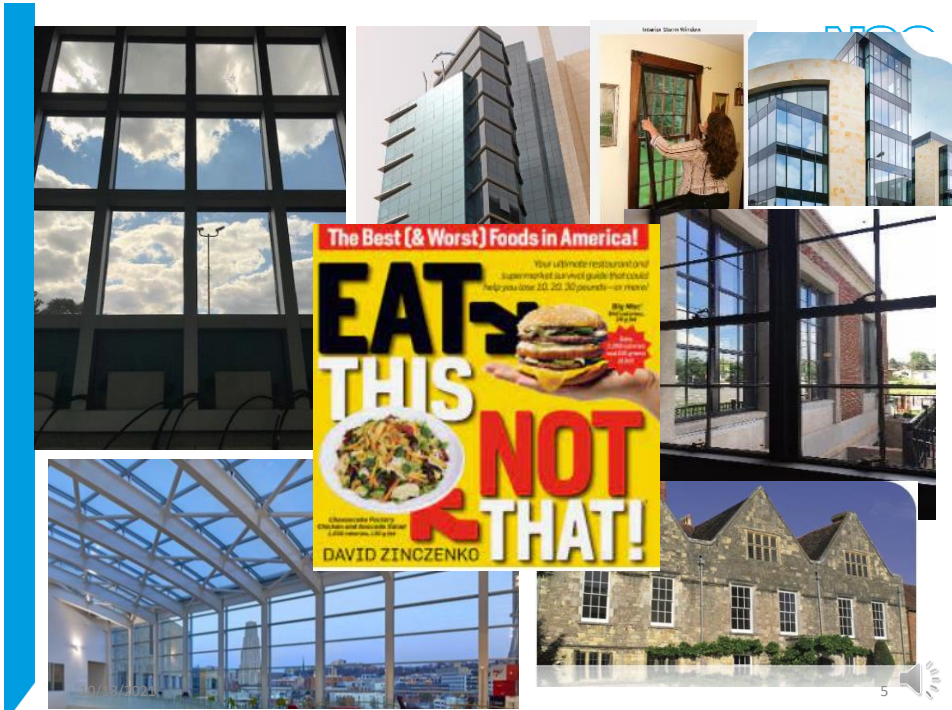
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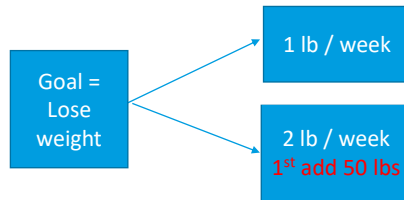
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## Counting Carb<sub>(on)</sub>S – 40% buildings



### Operational Carbon

- Carbon emissions from use of energy to heat and power a building

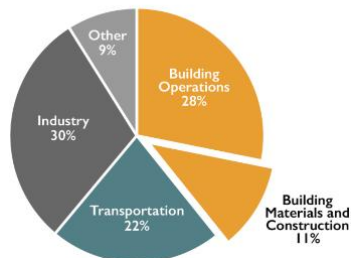


### Embodied Carbon

- Carbon emissions from manufacturing, production, and transportation of building materials

• **Goal** – reduce overall carbon impact / usage

Global CO<sub>2</sub> Emissions by Sector



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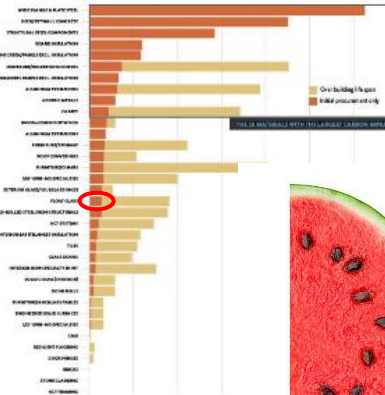
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# Embodied - Glass and window impact

- Glass – skin of building
  - Structural elements - majority
- Improve operation performance with minimal embodied impact
  - Right size glass
  - Better gas
  - Longer life
  - Buy local
  - Design strategy

UNDERSTANDING THE IMPACT OF MATERIALS

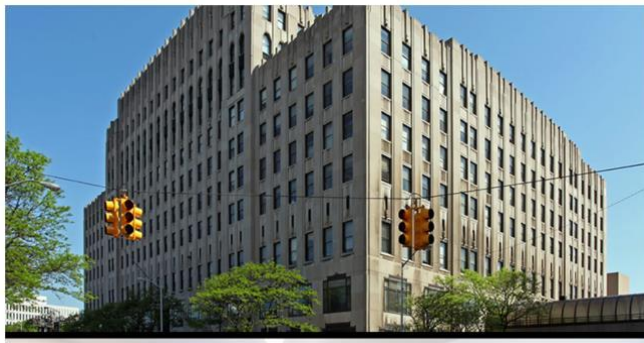
The impact of commonly used building materials, both at total greenhouse gas (GWP) and over a building's expected life span of 60 years (yellow). Structural materials have the highest embodied impact over time, because they are heavy and typically increase in total impact as replacement add up.



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# Albert Kahn office building – Detroit



The Kahn

- 1931
- 11 story
- 320,000 ft<sup>2</sup> building, 17,500 ft<sup>2</sup> glazing area
- 700 bronze, double-hung windows, monolithic 1/4" glass

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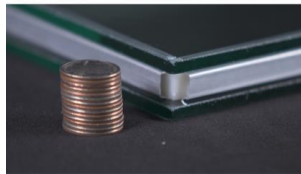
# The Kahn



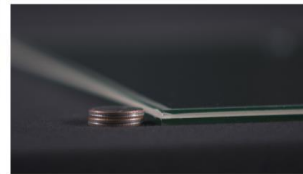
Existing building – ¼” monolithic (reference)

1. Storm windows (steel)
2. Storm windows (Aluminum)
3. VIG re-glaze
4. Replacement Aluminum windows

Typical IGU – 1” Thick



VIG – ¼” Thick



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EPD - Environmental Product Declaration	
	GWP
	kg CO2 eq
Glass	1430 per ton
Steel	1220 per ton
Aluminium	6570 per ton

Frame impact		
	kg CO2e / m2 glazing	
	DGU	TGU
Wood	40	64
PVCu	52	76
Aluminium	76	100



## Analysis

### Software:

Energy Plus  
DOE Commercial reference buildings

### Building:

Existing building pre-1980  
Climate Zone - ne 5a – Chicago, IL  
Large office (498,558 ft2 – 12 floor)  
mixed humid

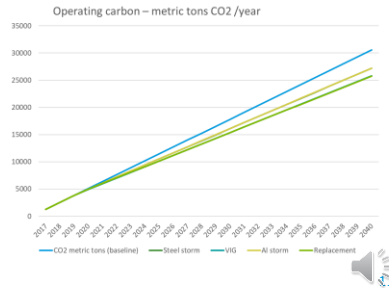


# DOE reference building



	Reglazing with VIG	Storm window (1/4")	Al storm windows (1/4")	Al replacement windows
Embodied carbon total (metric tons CO2 eq)	25	41	59	99
Operating carbon annual savings (metric tons CO2 eq)	-226	-161	-161	-233
Total Y1 carbon impact (metric tons CO2 eq)	-201	-120	-102	-134
Embodied carbon debt payback (months)	1	3	3	5
Breakeven point - Years payback for embodied carbon				11

Current operating carbon (metric tons CO2 eq) 1273



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# Key learnings



1. Building re-use / upgrades
2. Embodied material choices matter
3. Time-based carbon – save now

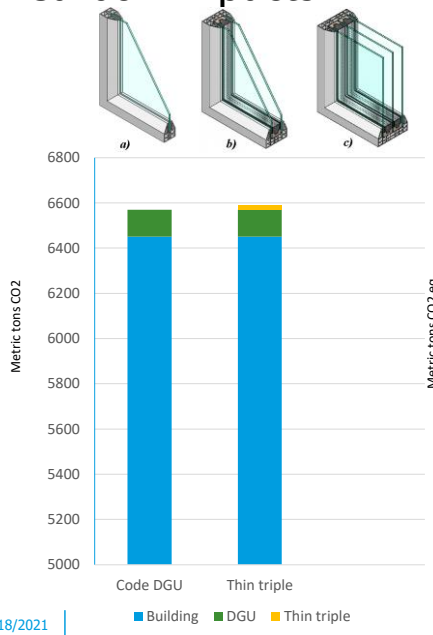
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# Emerging technology

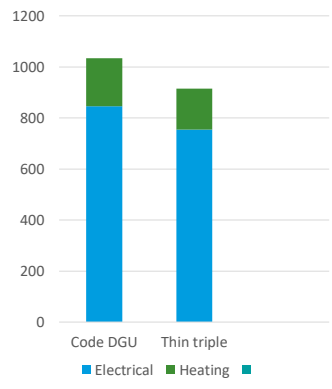


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## Carbon impacts



## Operating carbon



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## Key learnings



1. Building re-use / upgrades
2. Embodied material choices matter
3. Time-based carbon – save now
4. Material reuse
5. Operating carbon / renewable - still large impact
6. Design – low embodied impact / high return operating savings
7. Emerging technology → better windows

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