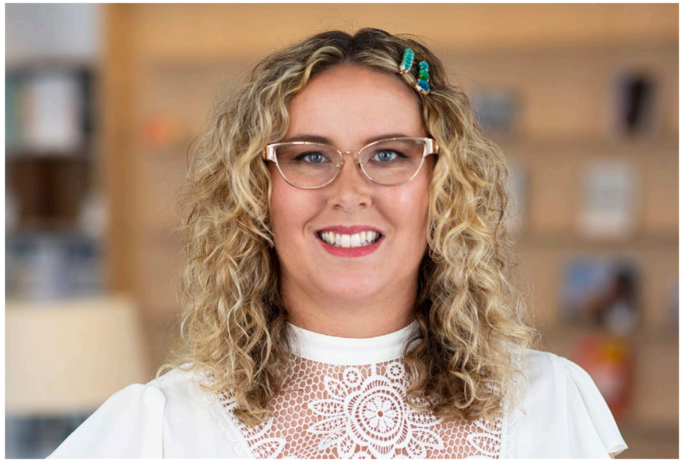
Get Smart About Carbon Reduction/ Net Zero in Schools

Carbon reductions can save money and benefit students, reduce operating costs, and improve operating efficiency.

This session will demystify jargon such as "Carbon Footprint" and "Net Zero" while sharing tactical approaches to carbon reductions at a range of scales from renovations and operational updates at existing facilities and considerations for new buildings.

Nick Perry, RA, LEED AP BD+C

Project Architect, Associate



Marnie Gedey, AIA, RELi, LBB

Project Architect, Associate

Learning Objectives

- Demystify jargon such as “Carbon Footprint” and “Net Zero”
- Identify how carbon reductions benefit students
- Identify how carbon reductions can save money, reduce operating costs and improve operating efficiency
- Discuss tactical approaches to carbon reductions at a range of scales:
    - Renovations and operational updates at existing facilities
    - Considerations for new buildings

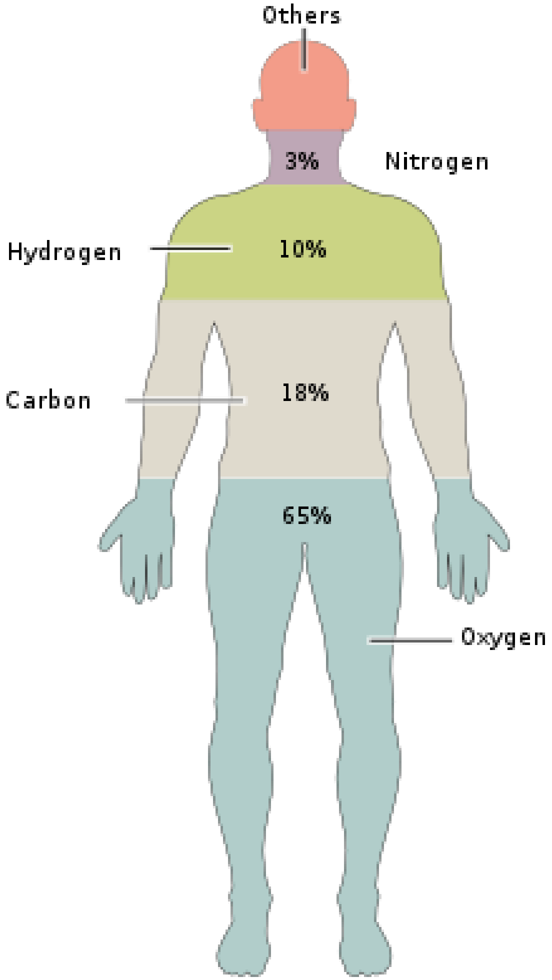
Demystify Jargon


What is carbon?

Carbon is a **chemical element**.

Carbon is one of the most common elements found in living organisms.

Carbon is **constantly cycling between living organisms and the atmosphere**.

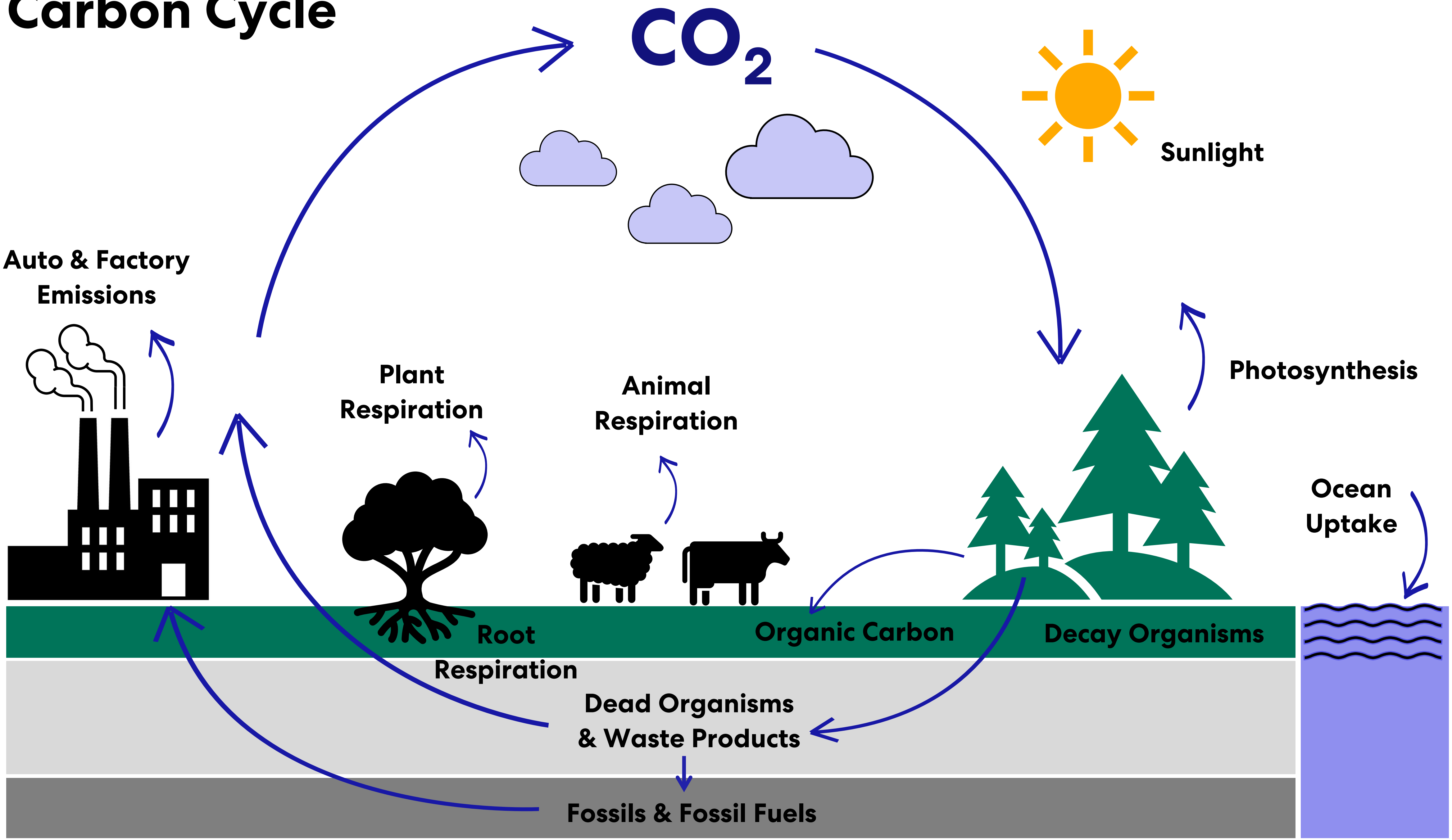

Others
3%
Nitrogen
Hydrogen
10%
Carbon
18%
65%
Oxygen


CO_2
HALF
of the dry weight of wood is carbon that was removed from the atmosphere by the growing tree

The **carbon cycle** refers to the series of processes by which **carbon compounds are interconverted in the environment**, involving the incorporation of carbon dioxide into living tissue by *photosynthesis* and its return to the atmosphere through *respiration*, the decay of dead organisms, and the burning of fossil fuels.

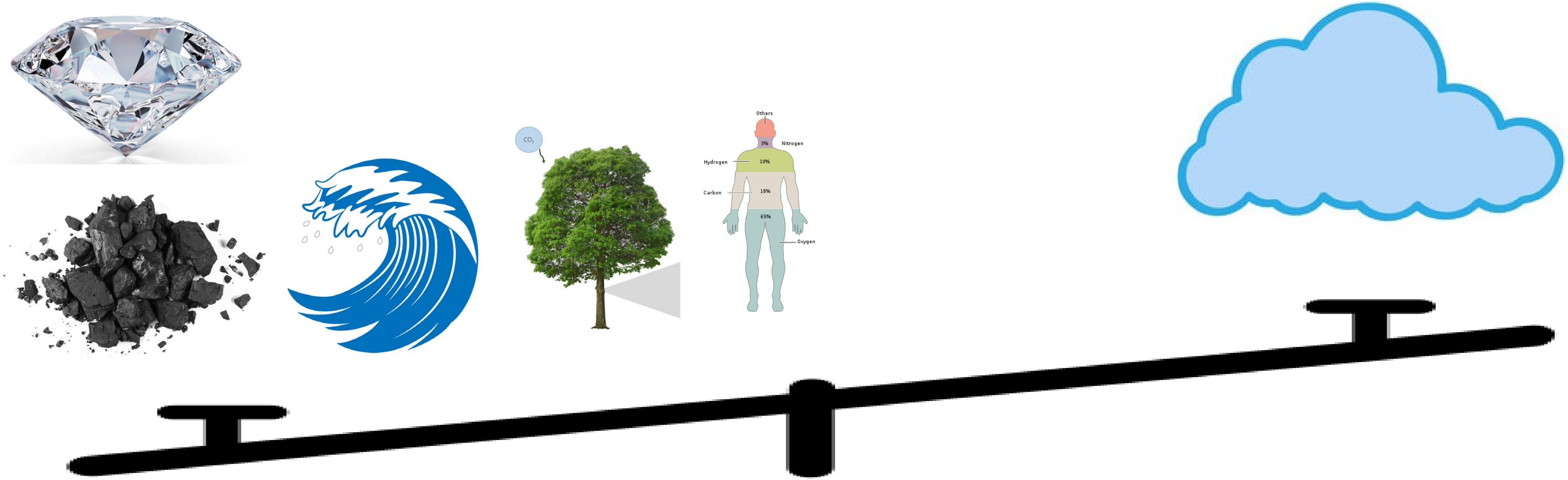
In a chemical reaction mass is neither created nor destroyed. The carbon atom in coal becomes carbon dioxide when it is burned. The carbon atom changes from a solid to a gas but its mass does not change.

Carbon Cycle



A **global carbon budget** determines the input of carbon dioxide to the atmosphere balanced by output (storage) in the carbon reservoirs on land or in the ocean.

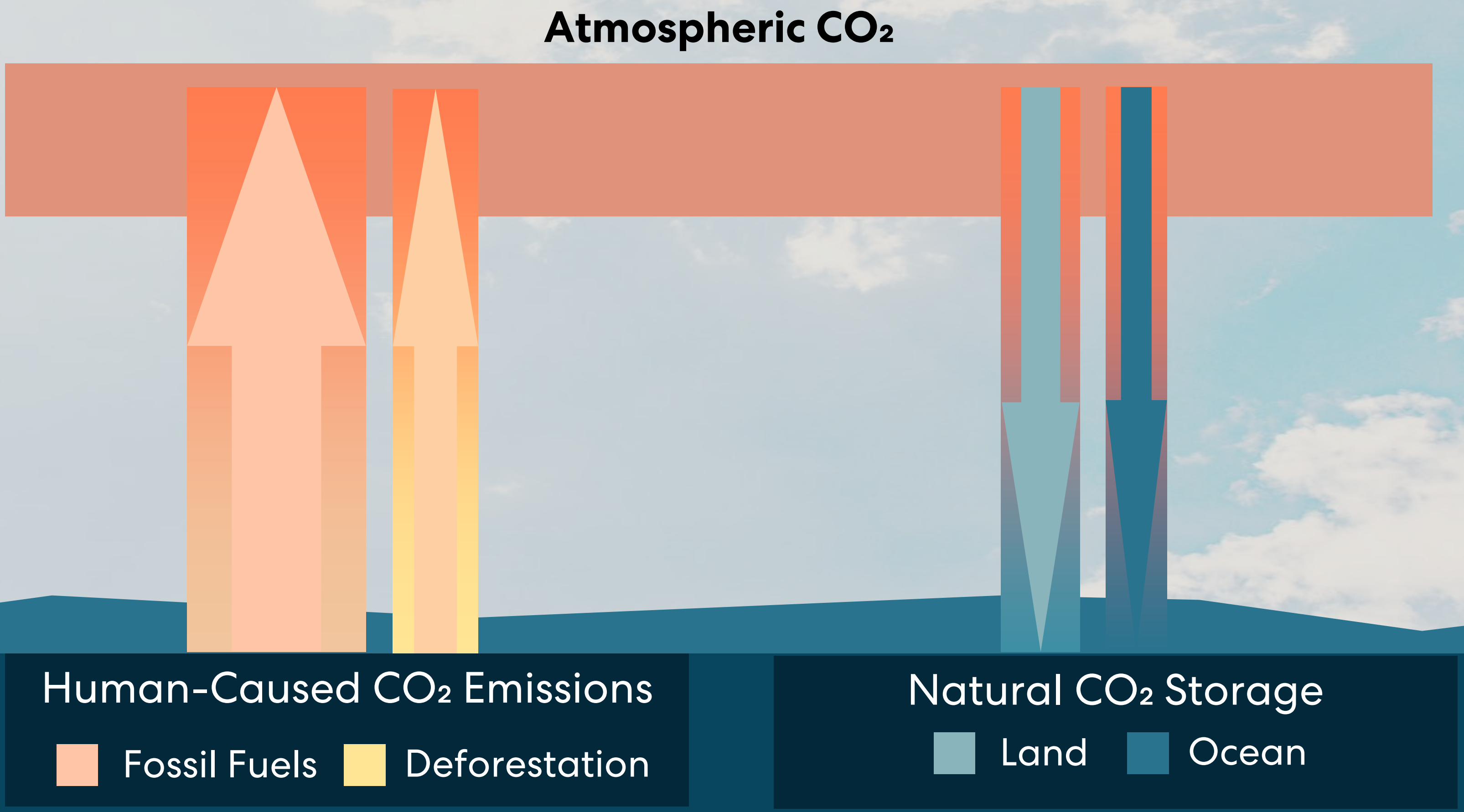
Carbon naturally cycles between a few global **reservoirs**: rocks and sediments, the oceans, living organisms including plants and animals, and the **atmosphere.**



Sources "The Global Carbon Budget" Climate Central, https://www.climatecentral.org/climate-matters/the-global-carbon-budget-2023

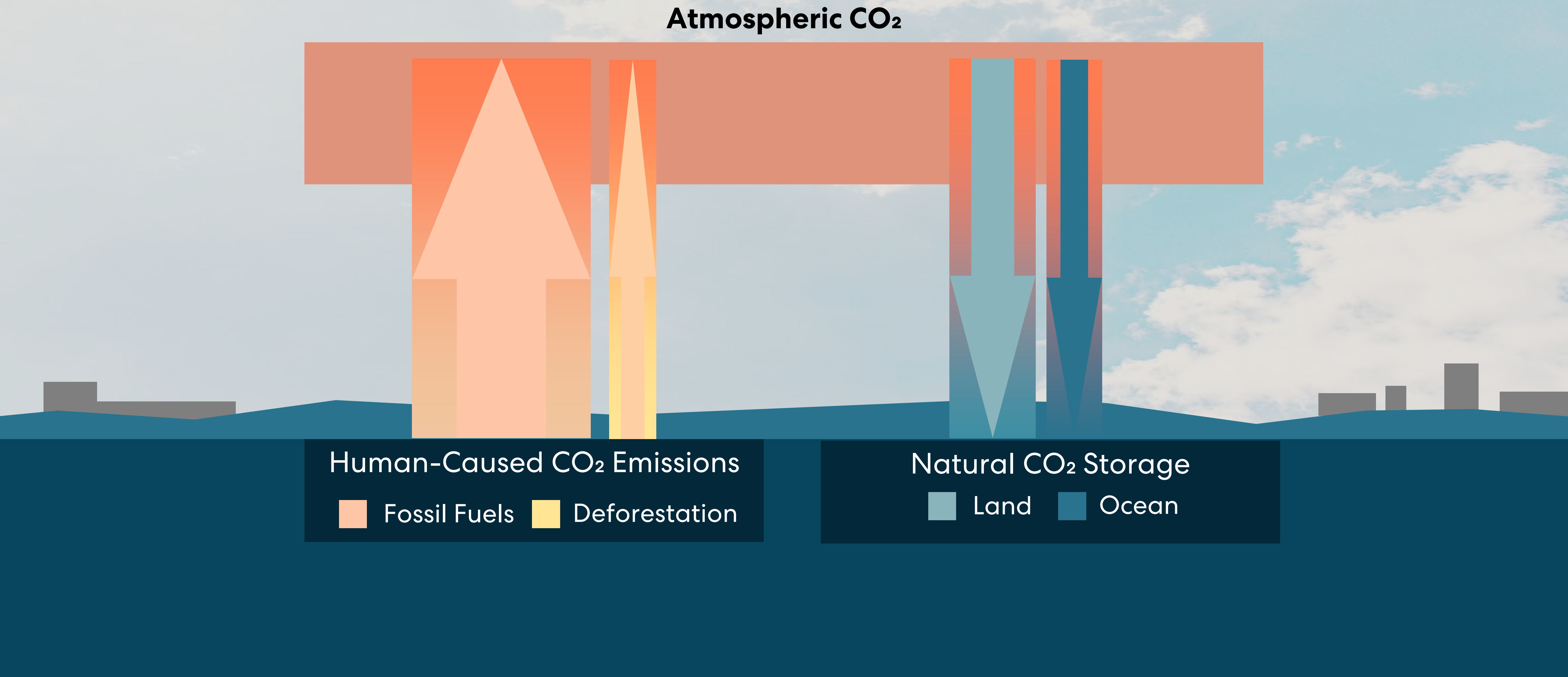
1960s

GLOBAL CARBON BUGET



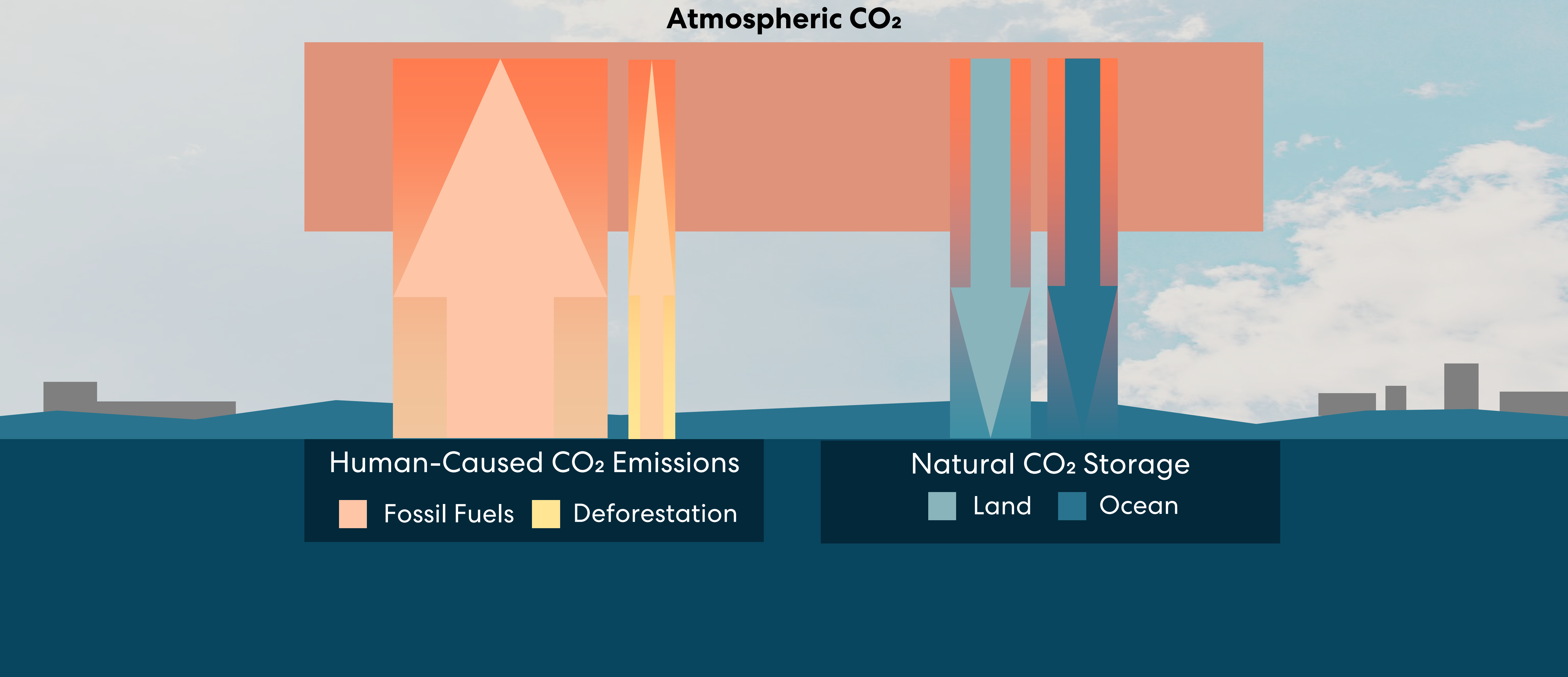
1970s

GLOBAL CARBON BUGET



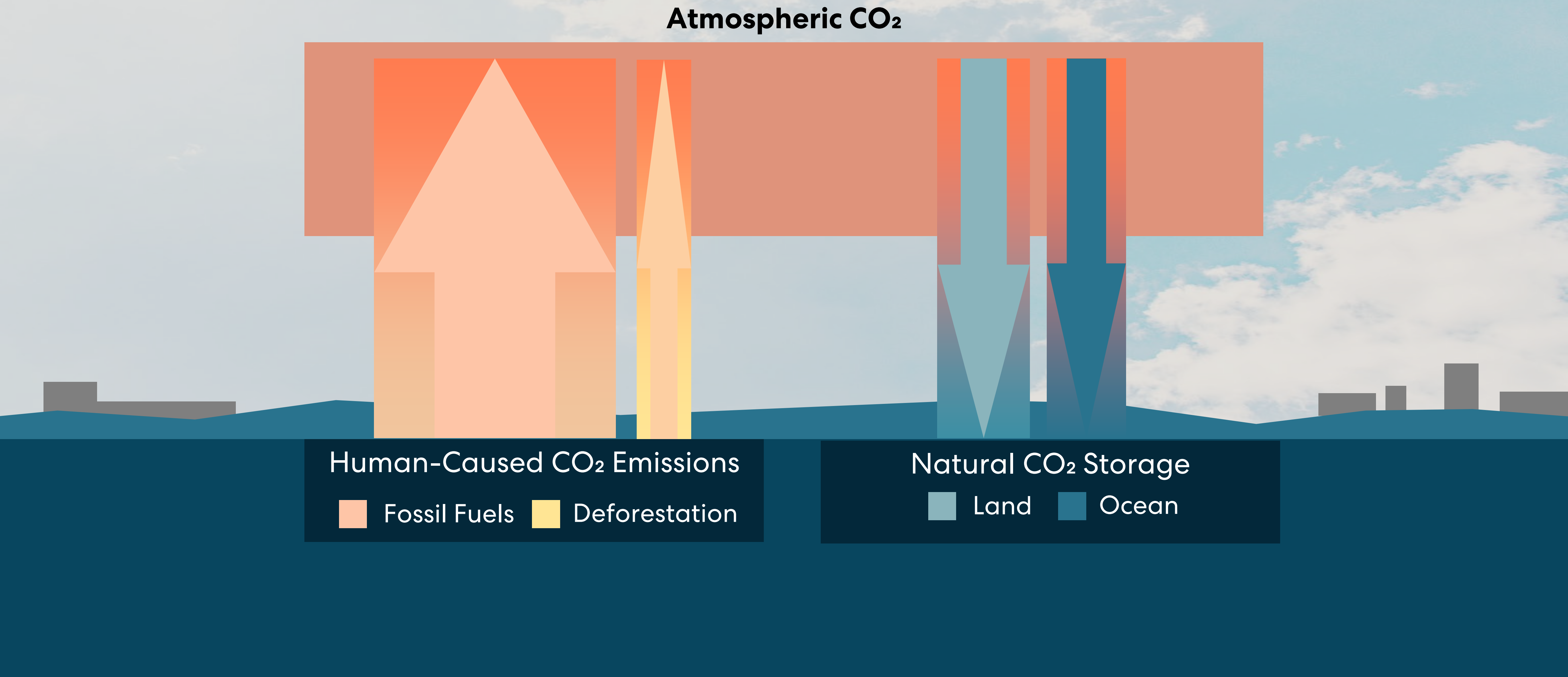
1980s

GLOBAL CARBON BUGET



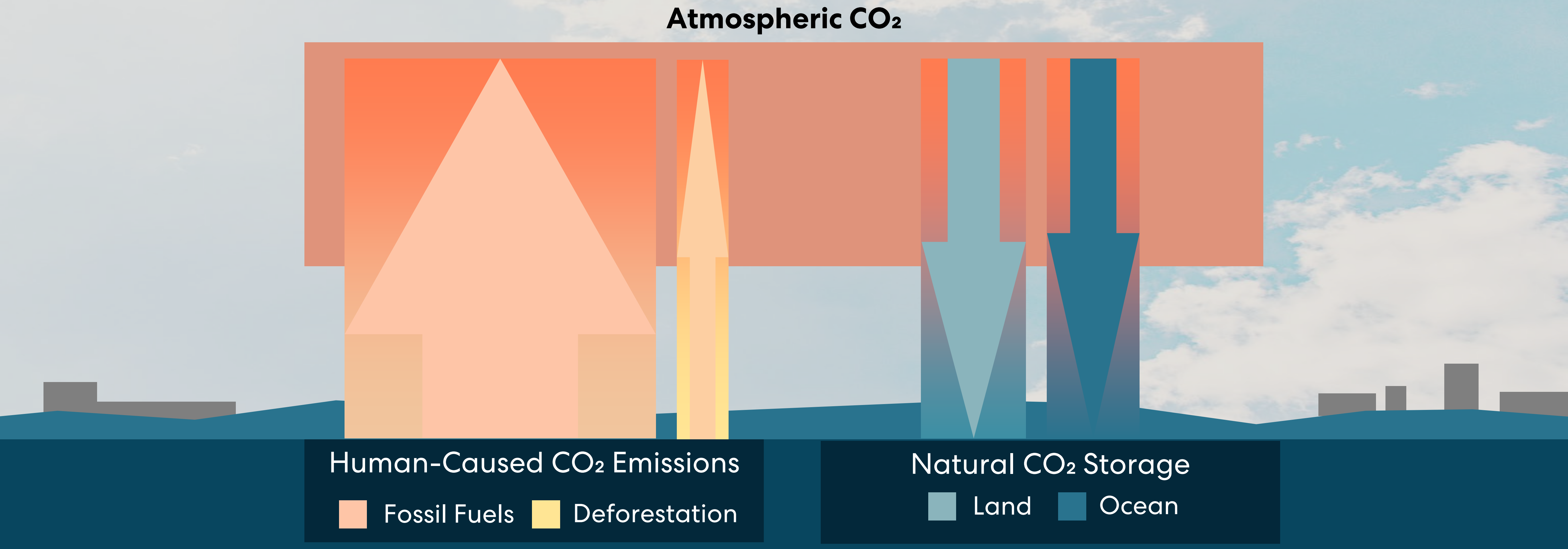
1990s

GLOBAL CARBON BUGET



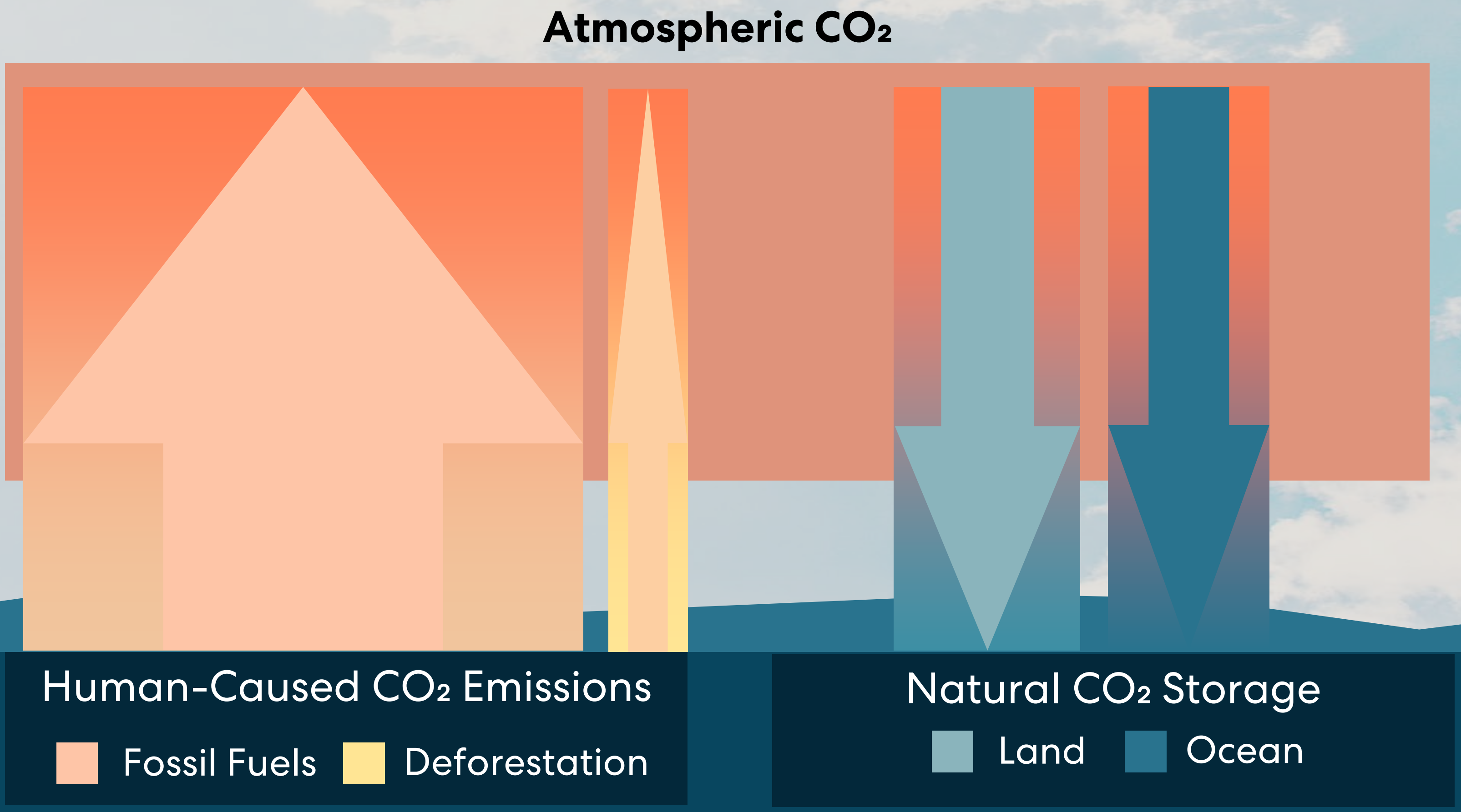
2000s

GLOBAL CARBON BUGET



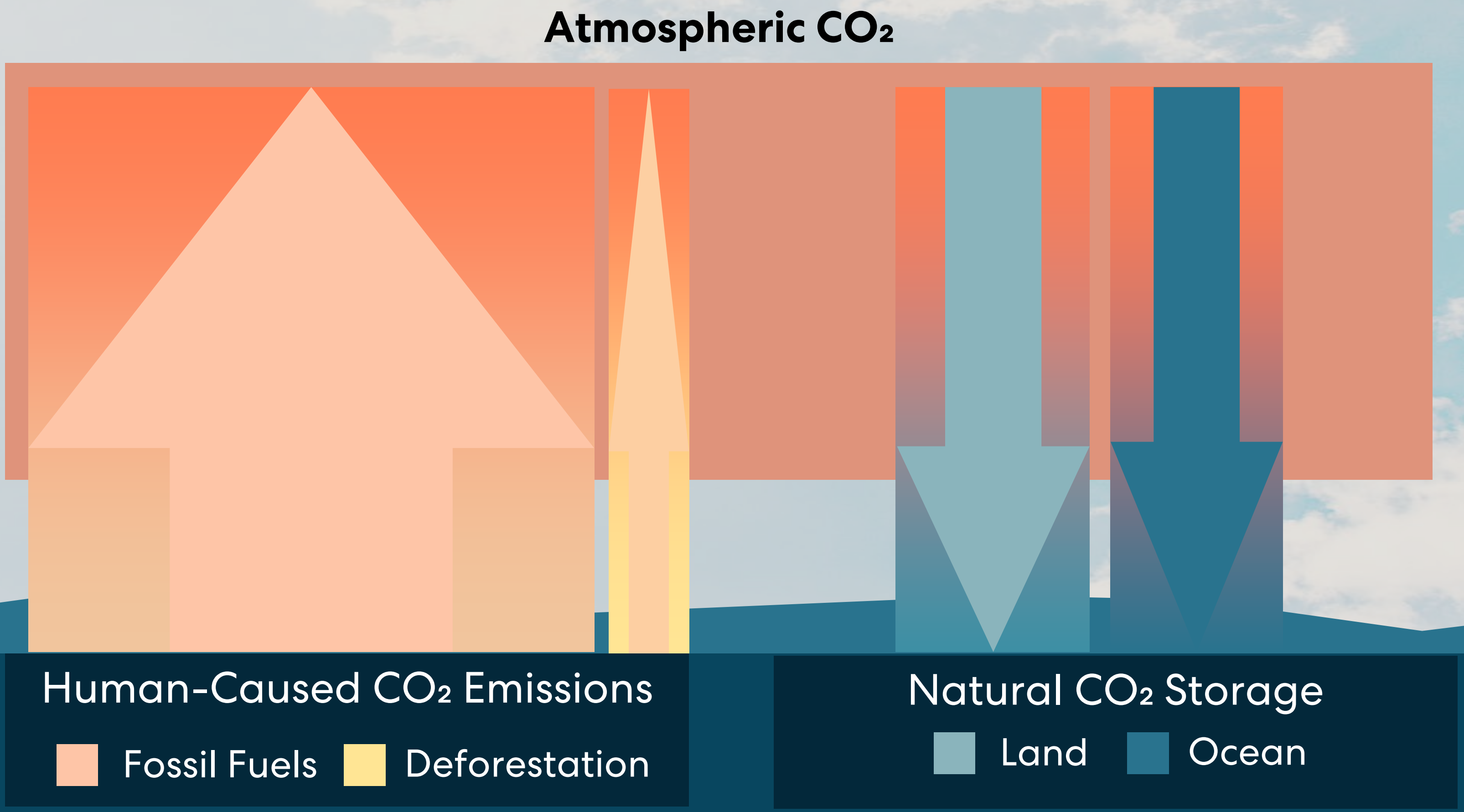
2010s

GLOBAL CARBON BUGET



2020 - 21

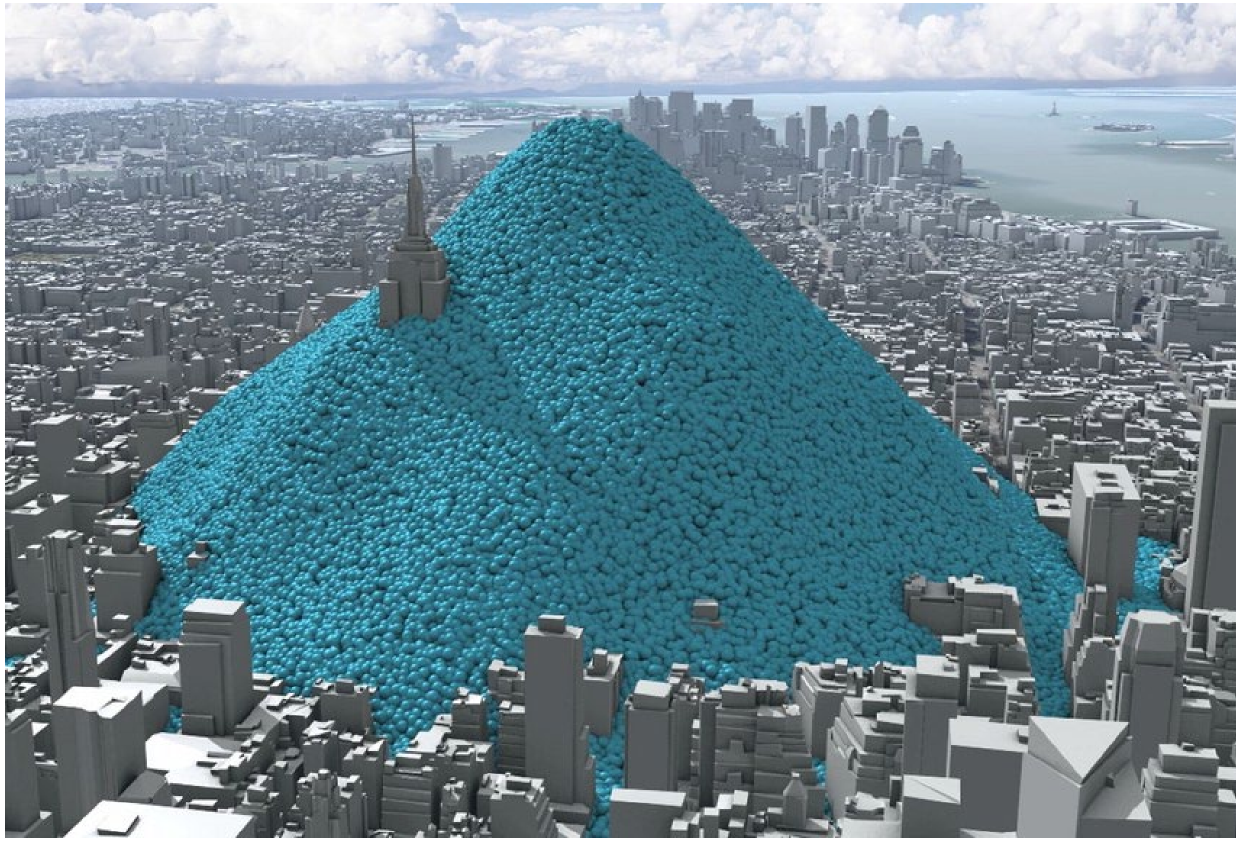
GLOBAL CARBON BUGET



Carbon dioxide is Earth's most important **greenhouse gas**: a gas that absorbs and radiates heat. Unlike oxygen or nitrogen (which make up most of our atmosphere), greenhouse gases **absorb heat** radiating from the Earth's surface and **re-release it in all directions**—including back toward Earth's surface.

Visualizing CO_2e and Carbon Footprint

1 ton



54 million tons (per year)

The amount of greenhouse gases emitted by a person, group, process, or thing.

16 tons CO_2e

Average Person in US

623 tons CO_2e

Average K12 School

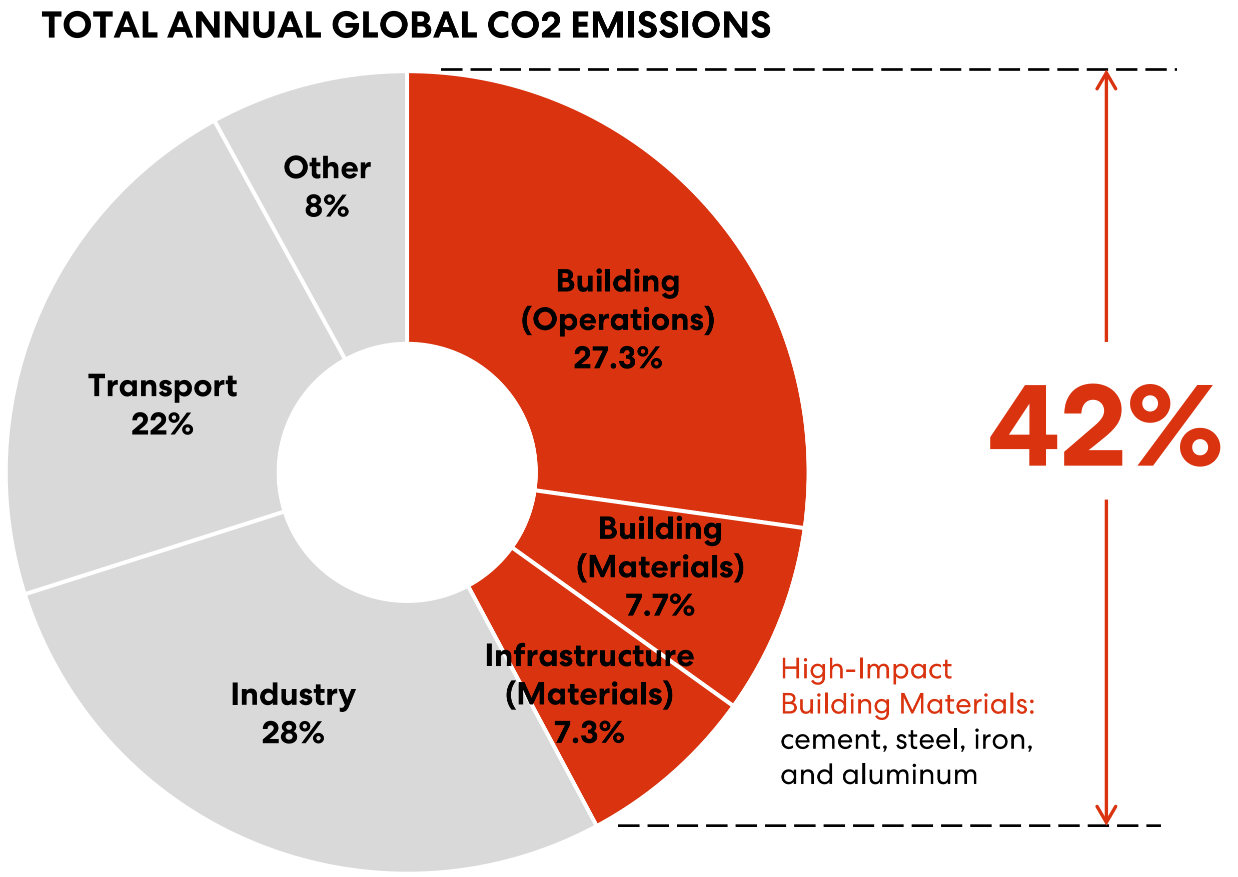
72 million tons CO_2e

All US K12 Schools

Sources: Calculate Your Carbon Footprint. The Nature Conservancy. https://www.nature.org/en-us/
Fast Facts. National Center for Education Statistics. https://nces.ed.gov/fastfacts/display.asp?id=84
It Has to Be A Priority: Why Schools Can't Ignore the Climate Crisis. Education Week
https://www.edweek.org/leadership/it-has-to-be-a-priority-why-schools-cant-ignore-the-climate-crisis/2022/05

The built environment is responsible for 42% of annual global CO_2 emissions

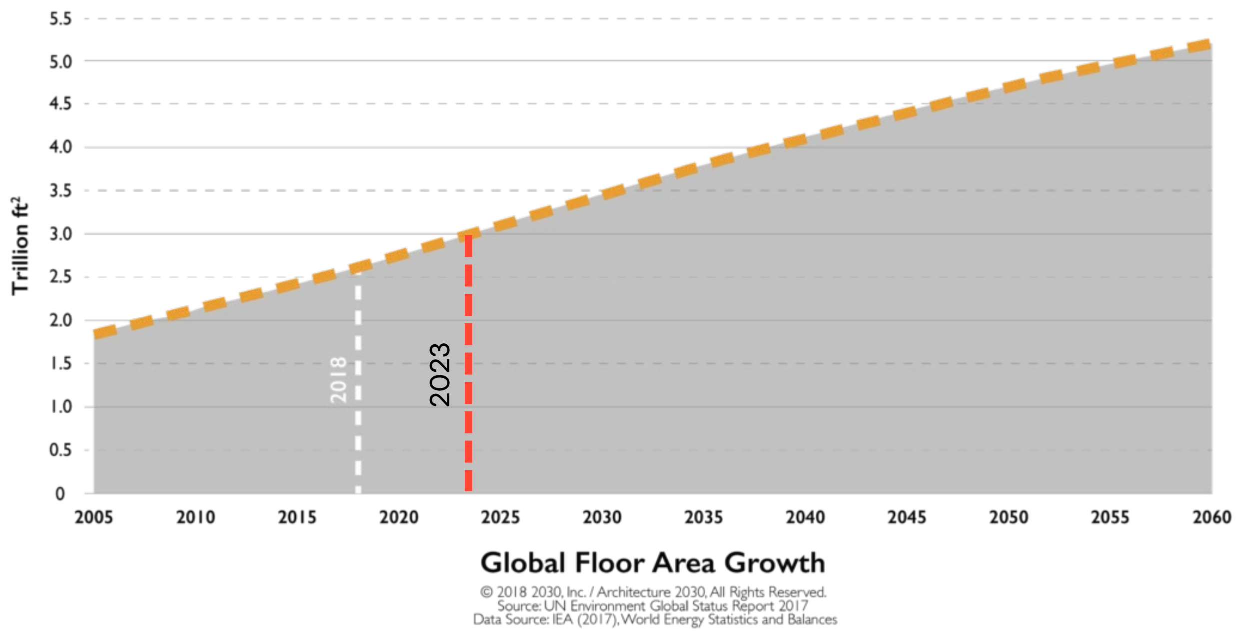
Of those total emissions, operations are responsible for approximately 27% annually



Source: Architecture 2030. Why the Built Environment? https://architecture2030.org/why-the-built-environment/

Carbon Context

Global Building Stock will double in area by 2060



Perkins&Will

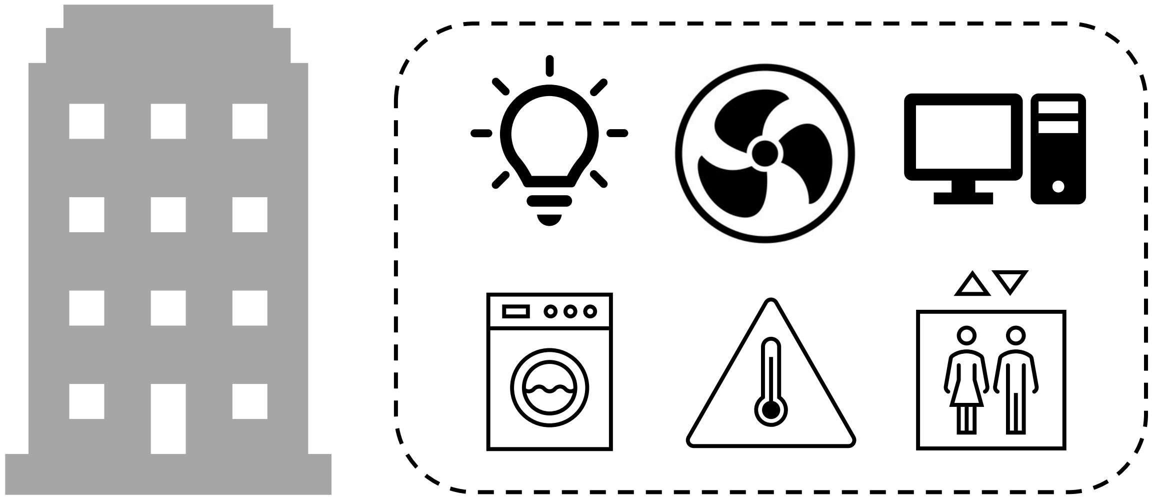
Source: (Data: Architecture 2030 Manhattan Image: Max Touhey)

Embodied Carbon vs. Operational Carbon

CO_2 emitted in extraction, manufacturing, transportation, and installation of all materials & processes to make the building

Embodied Carbon

CO_2 emitted in operation of the building



Operational Carbon

U.S. Grid Fuel Mixes Based on eGRID 2020

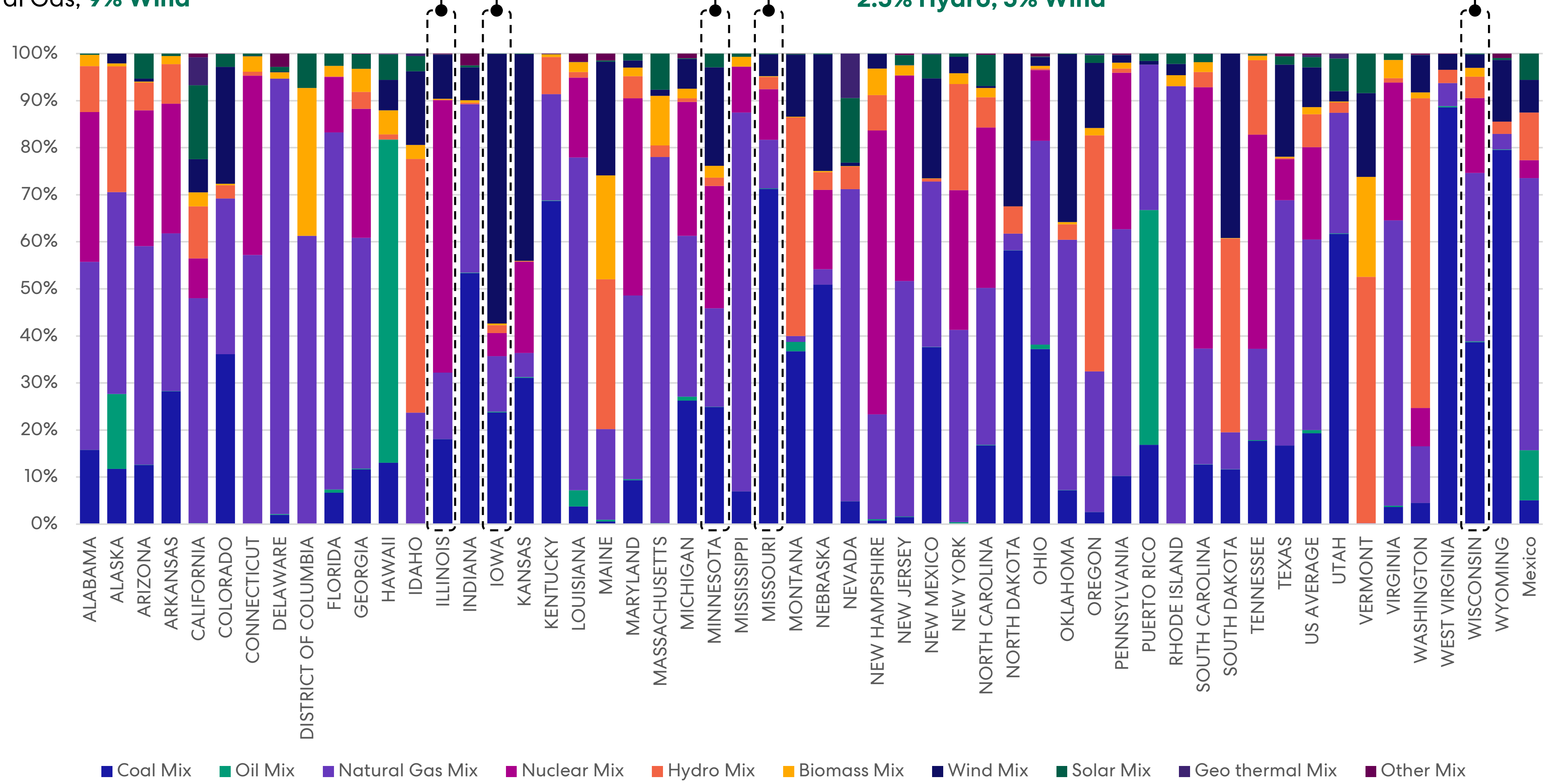
Iowa:
57% Wind, 24% Coal, 12% Natural Gas, 5% Nuclear

Illinois:
58% Nuclear, 18% Coal, 14% Natural Gas, **9% Wind**

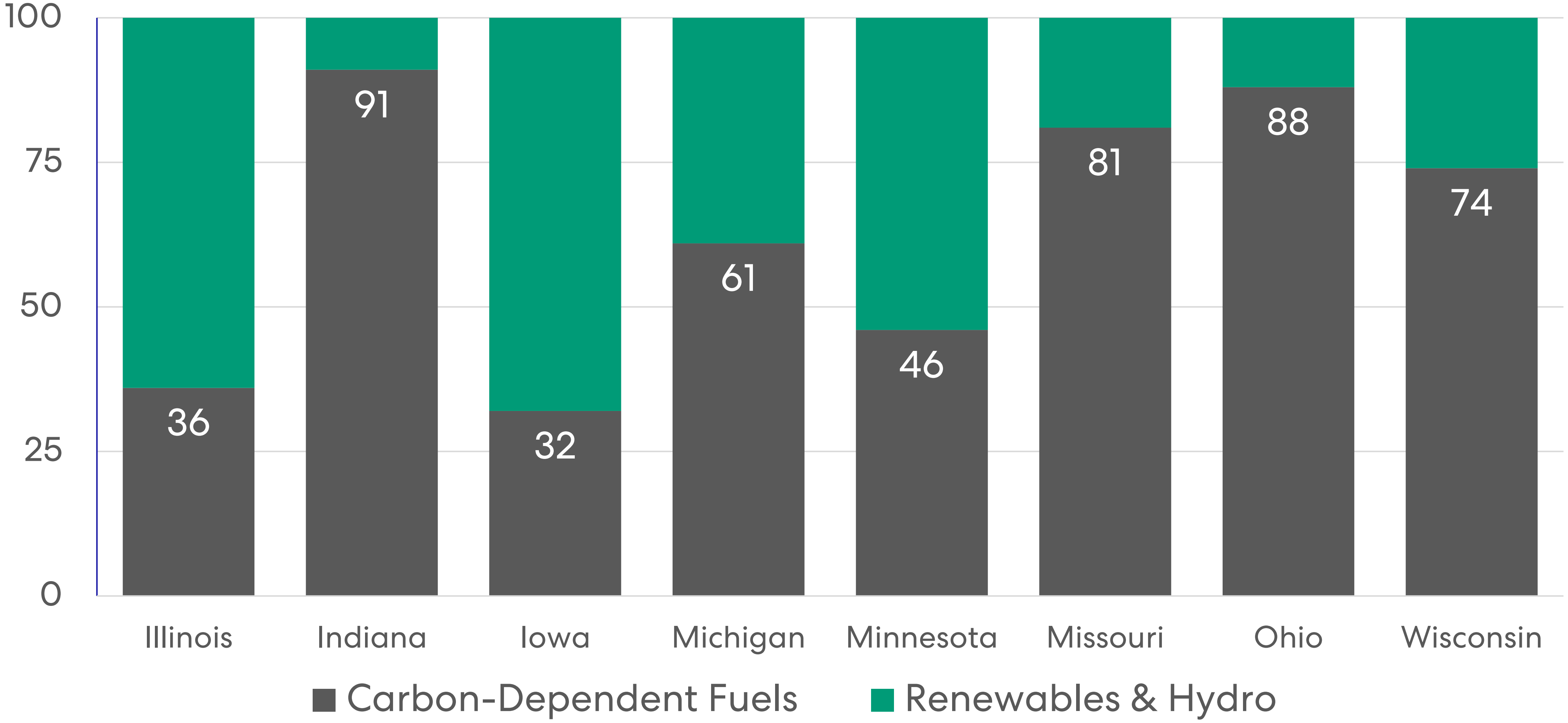
Minnesota:
25% Coal, 21% Natural Gas, 26% Nuclear, **3% Hydro, 21% Wind, 3% Solar, 2% Biomass**

Missouri:
71% Coal, 10% Natural Gas, 11% Nuclear, **2.5% Hydro, 5% Wind**

Wisconsin:
38% Coal, 36% Natural Gas, 16% Nuclear, **5% Hydro, 2% Biomass, 3% Wind**

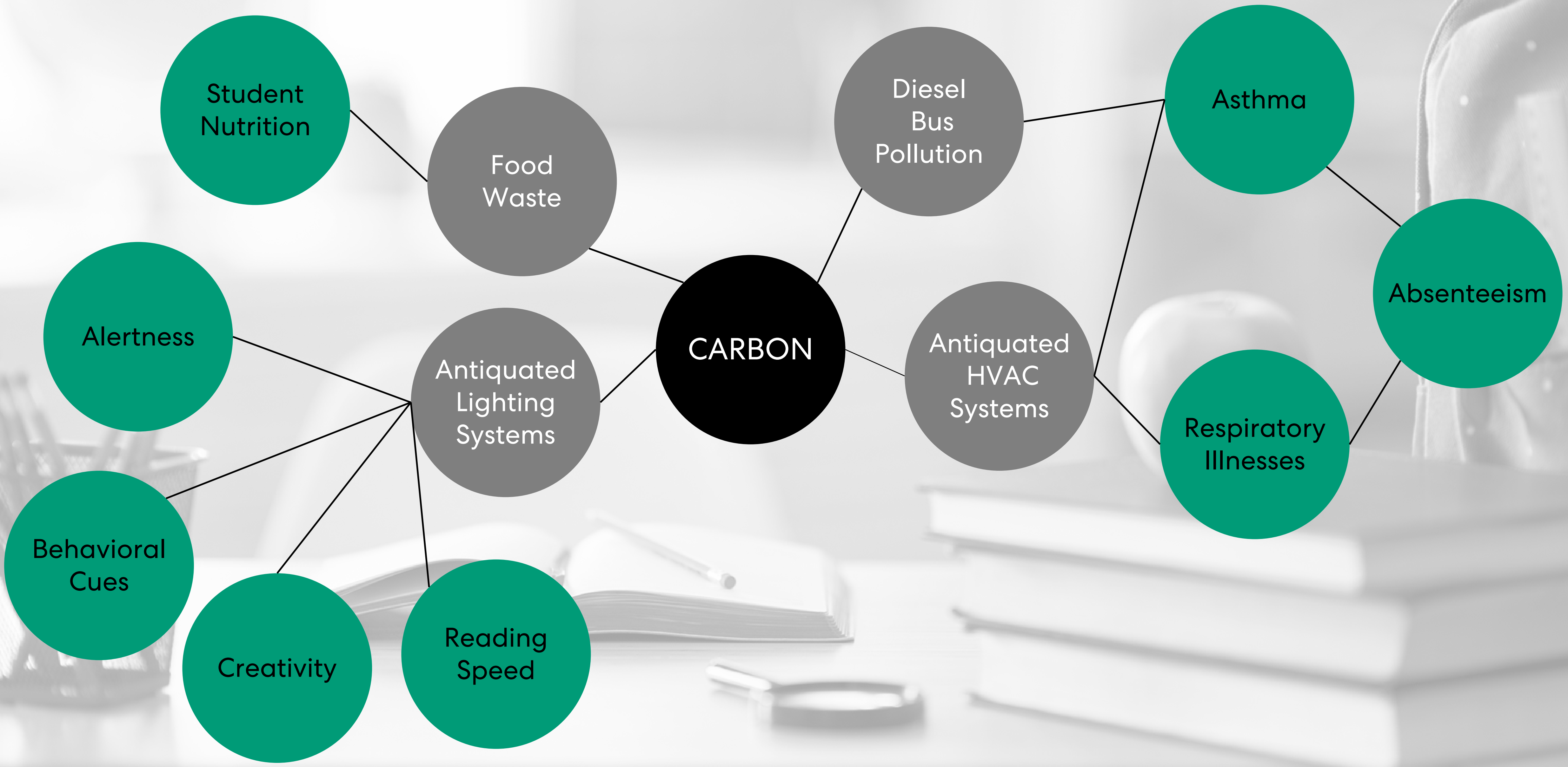


Midwest State's Grid Fuel Mixes Based on eGRID 2020



Carbon’s Impact

Carbon's Impact on Health & Learning

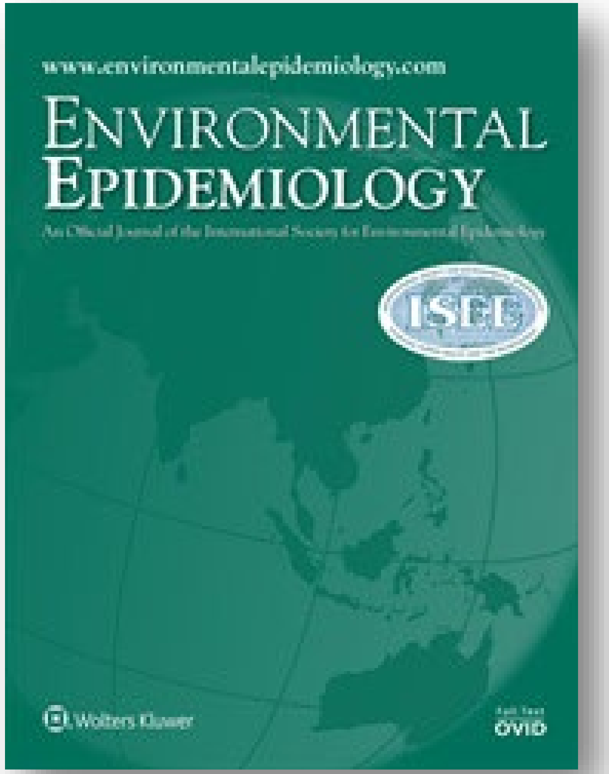


Air Pollution Impacts Student Performance

Study of the impact of ***ambient air pollutants*** *and association with* ***average academic test scores*** *of* ***3rd to 8th grade students*** *conducted from 2010 to 2016*

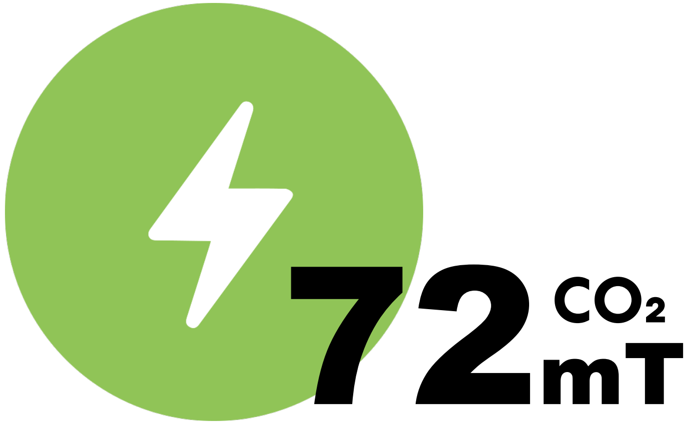
Lower average test scores in Math and English language / arts

Nationwide study aggregates more than 250 million academic achievement tests from 10,921 US school districts

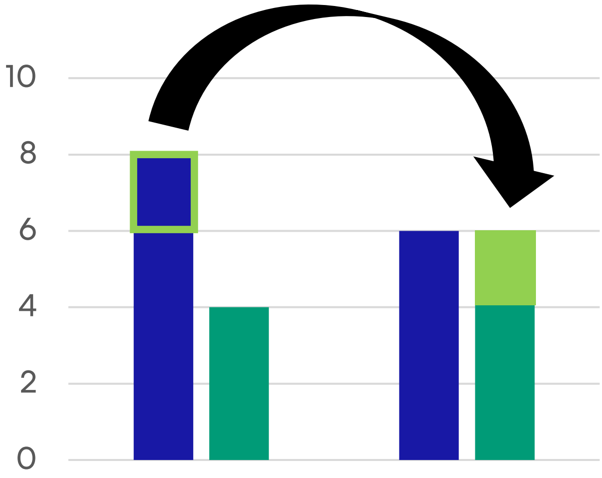


December 2021 issue of research journal of the International Society for Environmental Epidemiology
Authors: Wenxin Lu, Daniel A. Hackman, and Joel Schwartz. Published by Wolters Kluwer Health, Inc.

Budget Impacts of Carbon Reduction



K-12 schools annually spend $8 billion on energy (second only to salaries) and emit an estimated 72 million metric tons of carbon dioxide.



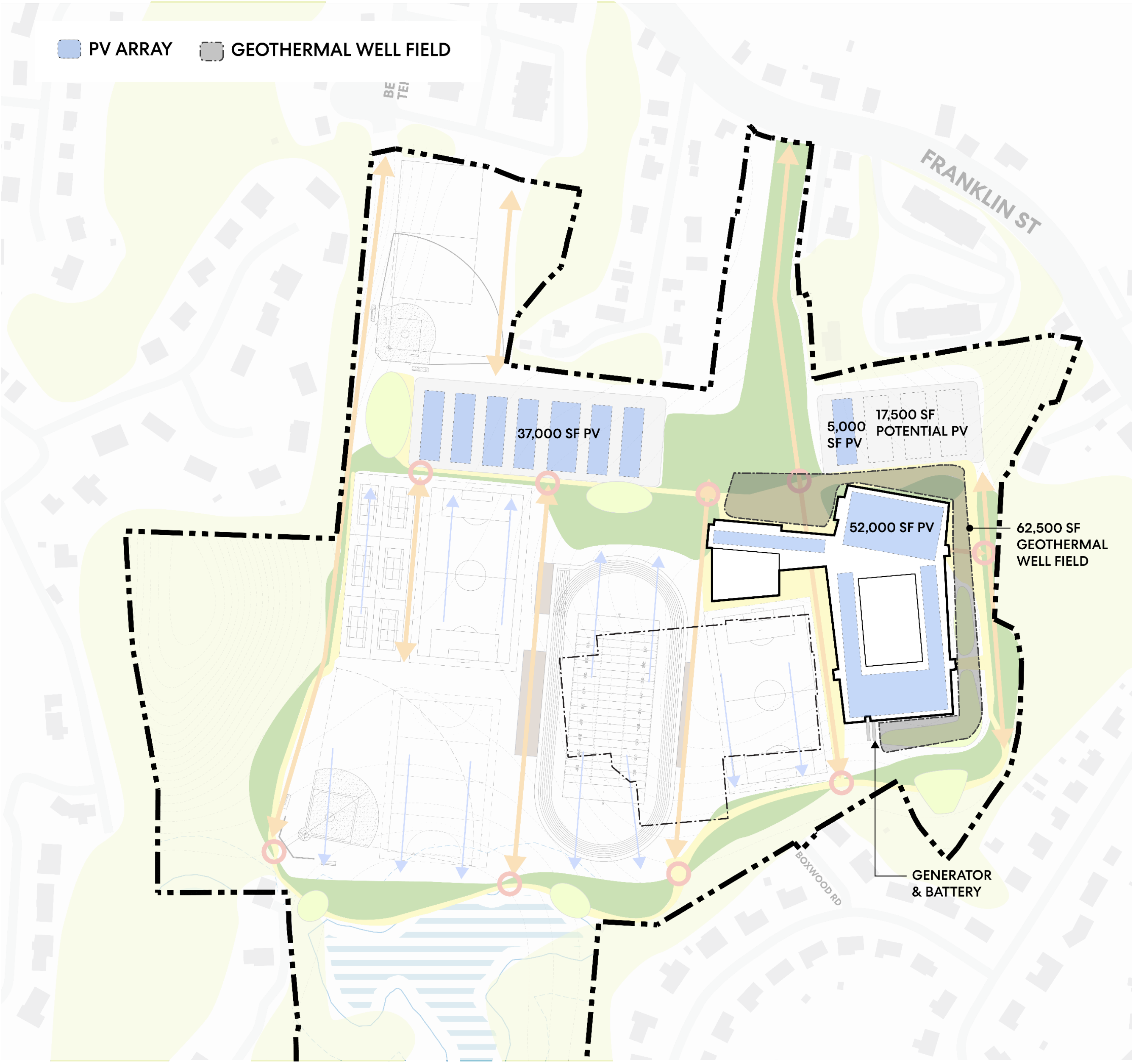
An average school solar system has 900-1,200 panels and generates 300kw. Solar projects can save school districts millions of dollars over a solar project's 25-year life. This money can be reallocated to teaching and learning priorities.

Sources: "It Has to Be A Priority: Why Schools Can't Ignore the Climate Crisis. Education Week, https://www.edweek.org/leadership/it-has-to-be-a-priority-why-schools-cant-ignore-the-climate-crisis/2022/05
Why Develop School Food Waste Reduction Programs?. Natural Resources Council of Maine, https://www.nrcm.org/sustainability/school-food-waste-reduction-programs/

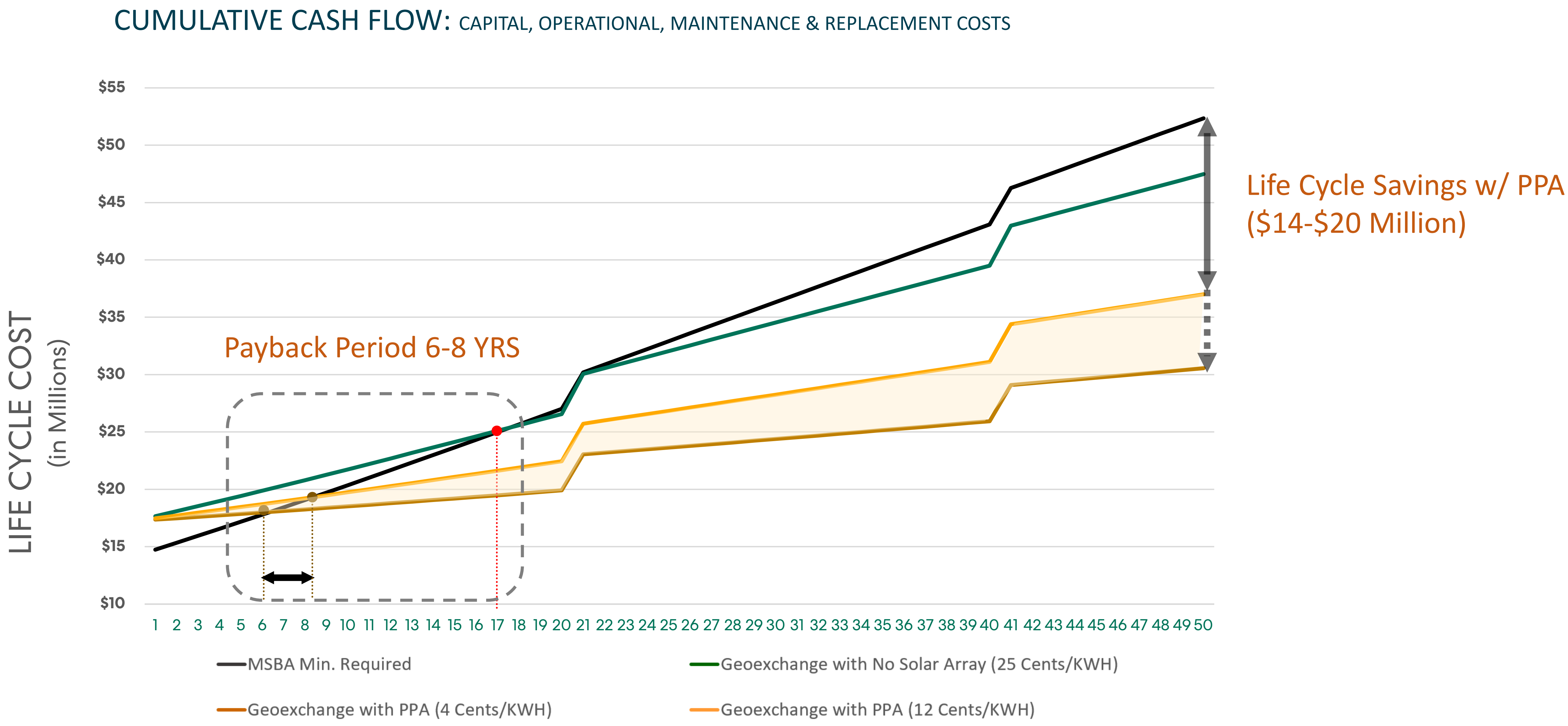
High-Performance Building

- **Closed Loop Geoexchange System**
  - Energy use intensity target (EUI) of 25
  - Allows for zero net energy
  - Additional Incentives from state and Utilities
  - No fossil fuels, additional water savings
- **Solar Power Purchase Agreement**
  - Low upfront costs to Owner
  - Powers an all-electric building
  - Reduced electricity bill
  - Contract to be approved at town meeting

Study for Stoneham High School
Stoneham, MA



Life Cycle Cost Assessment

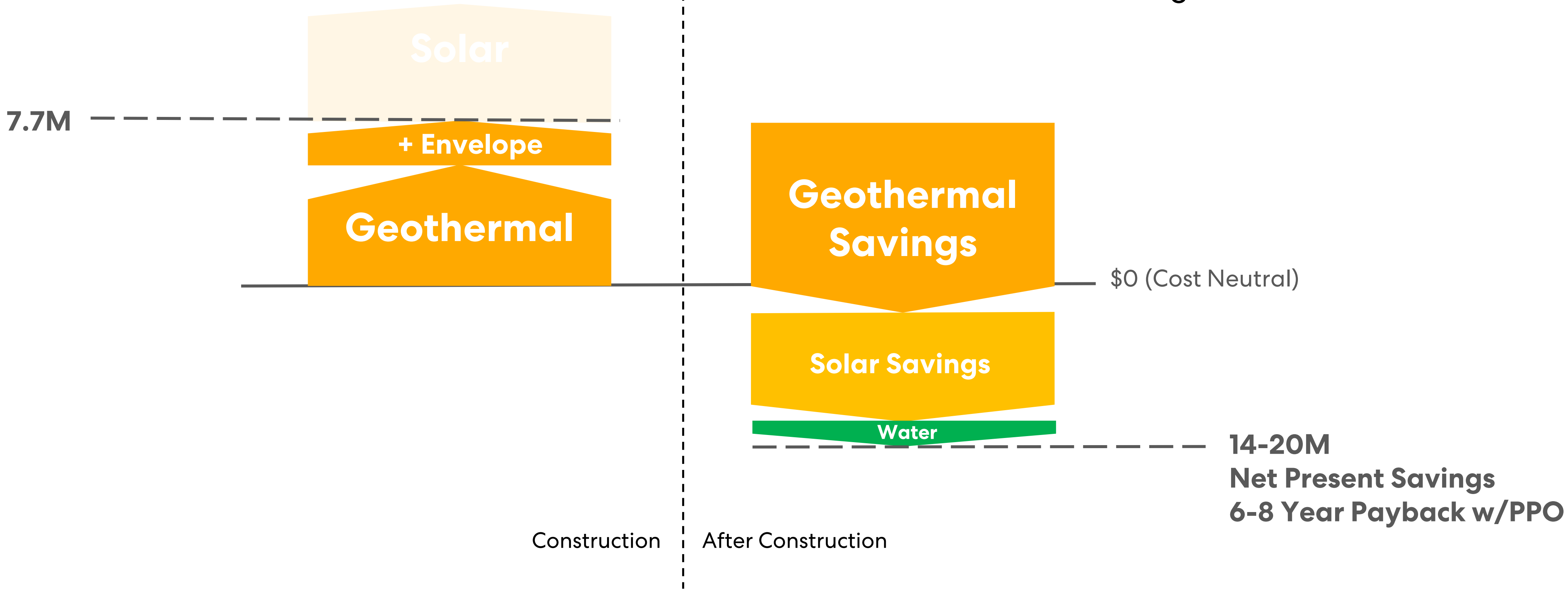


ZNE Savings to Stoneham

ZNE Upfront Premiums

Life-Cycle Savings

The **carbon reduction** equivalent of planting an area as big as the Middlesex Fells and preserving it for the life of the building



“Think about the economic advantages. If you’re producing your own energy, that’s huge and should be available to all schools”

- Laura Schifter
Founder, K12 Climate Action Plan

Source: “Why Schools Need to Look at Their Own Carbon Footprint” Harvard Graduate School of Education, https://www.gse.harvard.edu/ideas/usable-knowledge/21/11/why-schools-need-look-their-own-carbon-footprint

2 CO_2 **mT**

School districts waste 530,000 tons of food (excluding milk) annually, resulting in nearly 2 million metric tons of carbon dioxide and landfill fees of $41 million.

-14%

With minimal interventions, elementary schools participating in a food waste reduction program cut waste by 14%. If all schools achieved this we would avoid 200,000 tons of CO_2 and save $6 million.

Sources: "It Has to Be A Priority: Why Schools Can't Ignore the Climate Crisis. Education Week, https://www.edweek.org/leadership/it-has-to-be-a-priority-why-schools-cant-ignore-the-climate-crisis/2022/05
Why Develop School Food Waste Reduction Programs?. Natural Resources Council of Maine, https://www.nrcm.org/sustainability/school-food-waste-reduction-programs/
Food Waste Warriors. World Wildlife Organization. https://www.worldwildlife.org/stories/food-waste-warriors

Lighting costs account for 17% of a typical school's energy end uses, or 12 million metric tons of carbon dioxide.

K12 schools can save 45-60% on energy use by optimizing lighting equipment. Adding controls and dimming can increase savings to 70%

Source: "Better Buildings: K-12 Lighting Toolkit" US Department of Energy, https://betterbuildingssolutioncenter.energy.gov/k-12-lighting-toolkit

“Lighting is one of those investments where the ROI is attractive and visible, often the first step in major school energy efficiency upgrades.”

- US Department of Energy

Source: “Better Buildings: K-12 Lighting Toolkit” US Department of Energy, https://betterbuildingssolutioncenter.energy.gov/k-12-lighting-toolkit

Life Cycle Financial Modeling

Life Cycle Cost Analysis for HVAC Options

30 year life-cycle cost analysis for three HVAC system options.

Type of Analysis .... Public Sector Lifecycle Analysis
Type of Design Alternatives .... Independent
Length of Analysis .... 30 yrs
Discount Rate .... 2.25 %

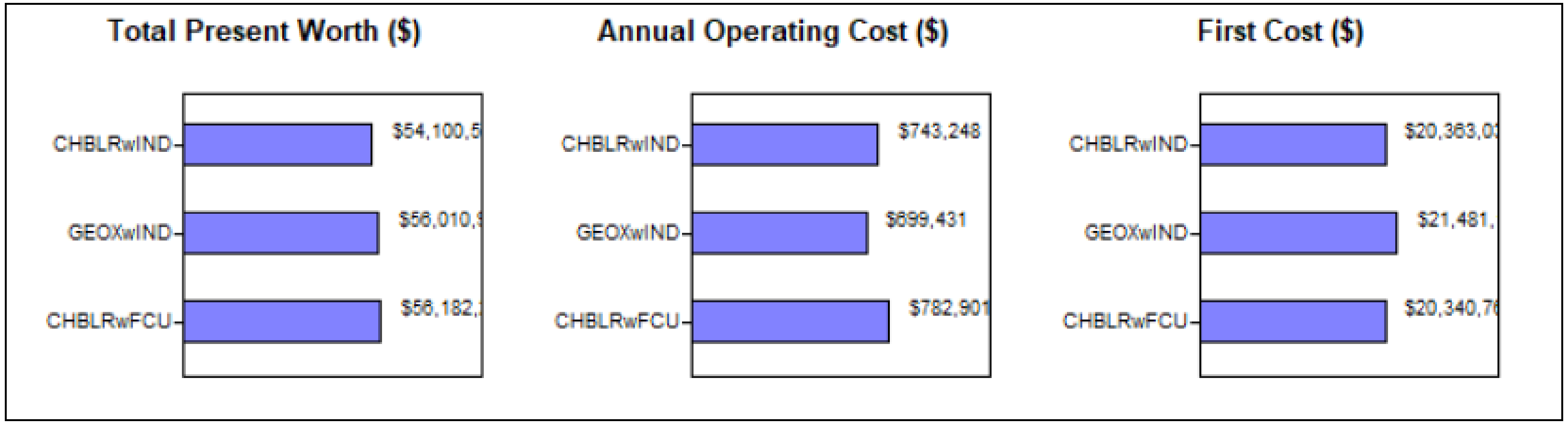


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value ($)
Lowest Total Present Worth	Chiller/ Boiler with Induction	$54,100,534
Lowest Annual Operating Cost	Geo-Exchange with Induction	$699,431
Lowest First Cost	Chiller/ Boiler with Fan Coil Units	$20,340,759

Table 2. Design Cases Ranked by Total Present Worth

Design Case Name	Design Case Short Name	Total Present Worth ($)	Annual Operating Cost ($/yr)	First Cost ($)
Chiller/ Boiler with Induction	CHBLRwIND	$54,100,534	$743,248	$20,363,034
Geo-Exchange with Induction	GEOXwIND	$56,010,898	$699,431	$21,481,139
Chiller/ Boiler with Fan Coil Units	CHBLRwFCU	$56,182,200	$782,901	$20,340,759

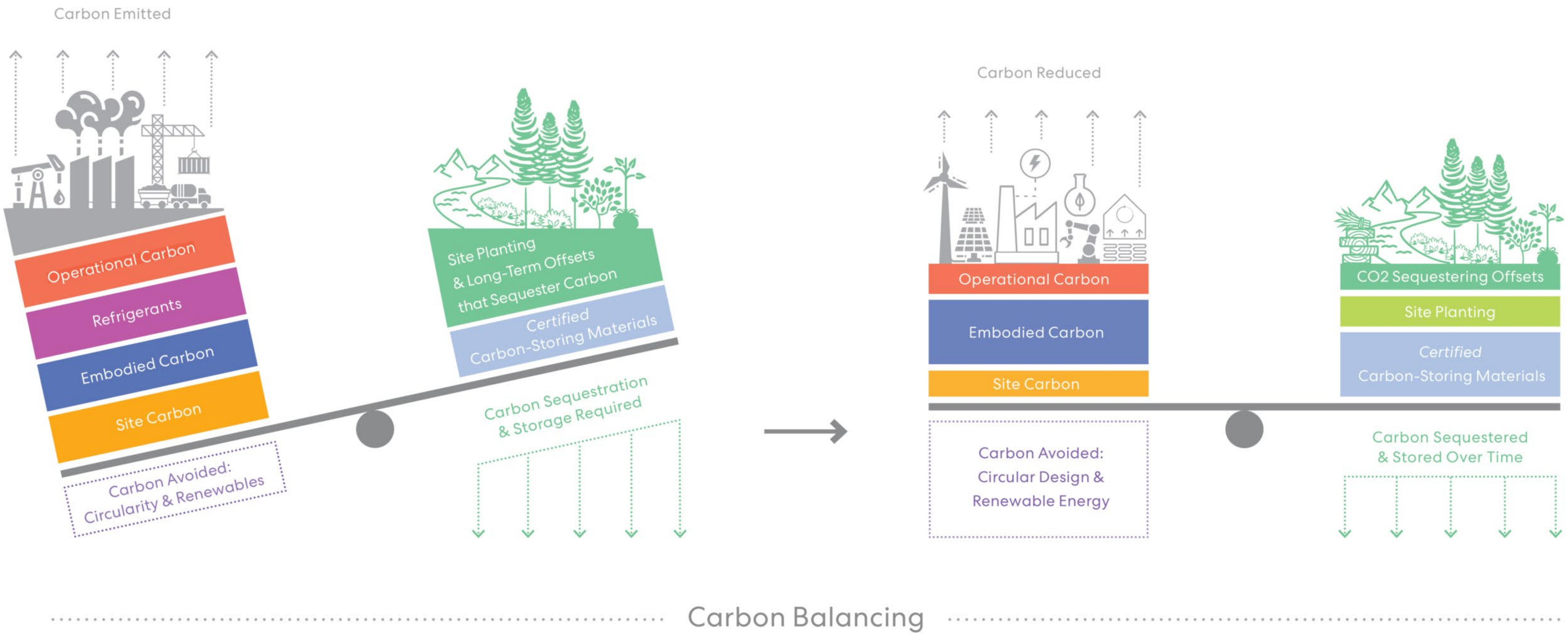
“It is arrogant for a design team to present to me only the first costs associated with building systems…it shows me you think the project ends when your design work is done.”

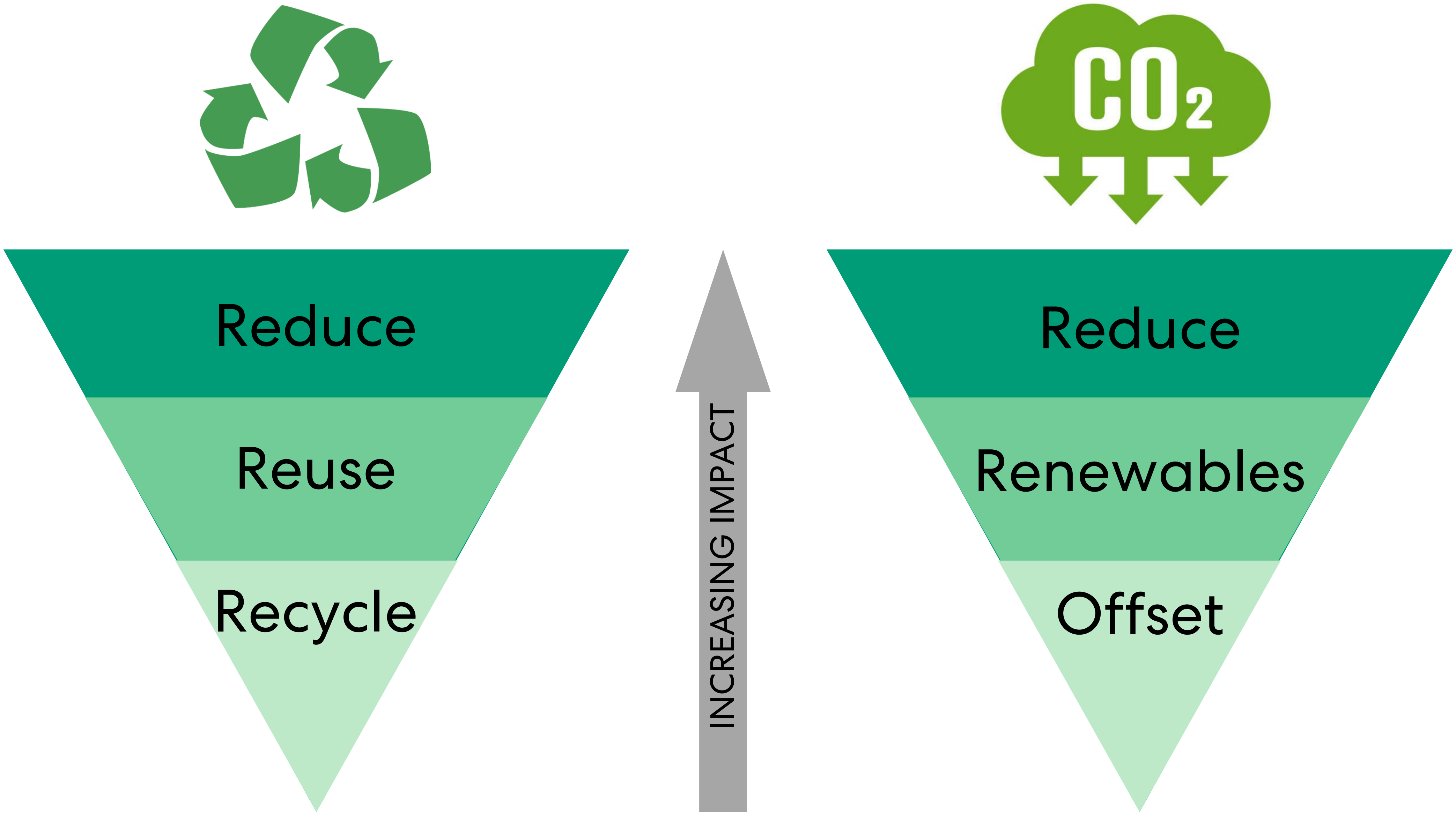
-Client, Stoneham High School

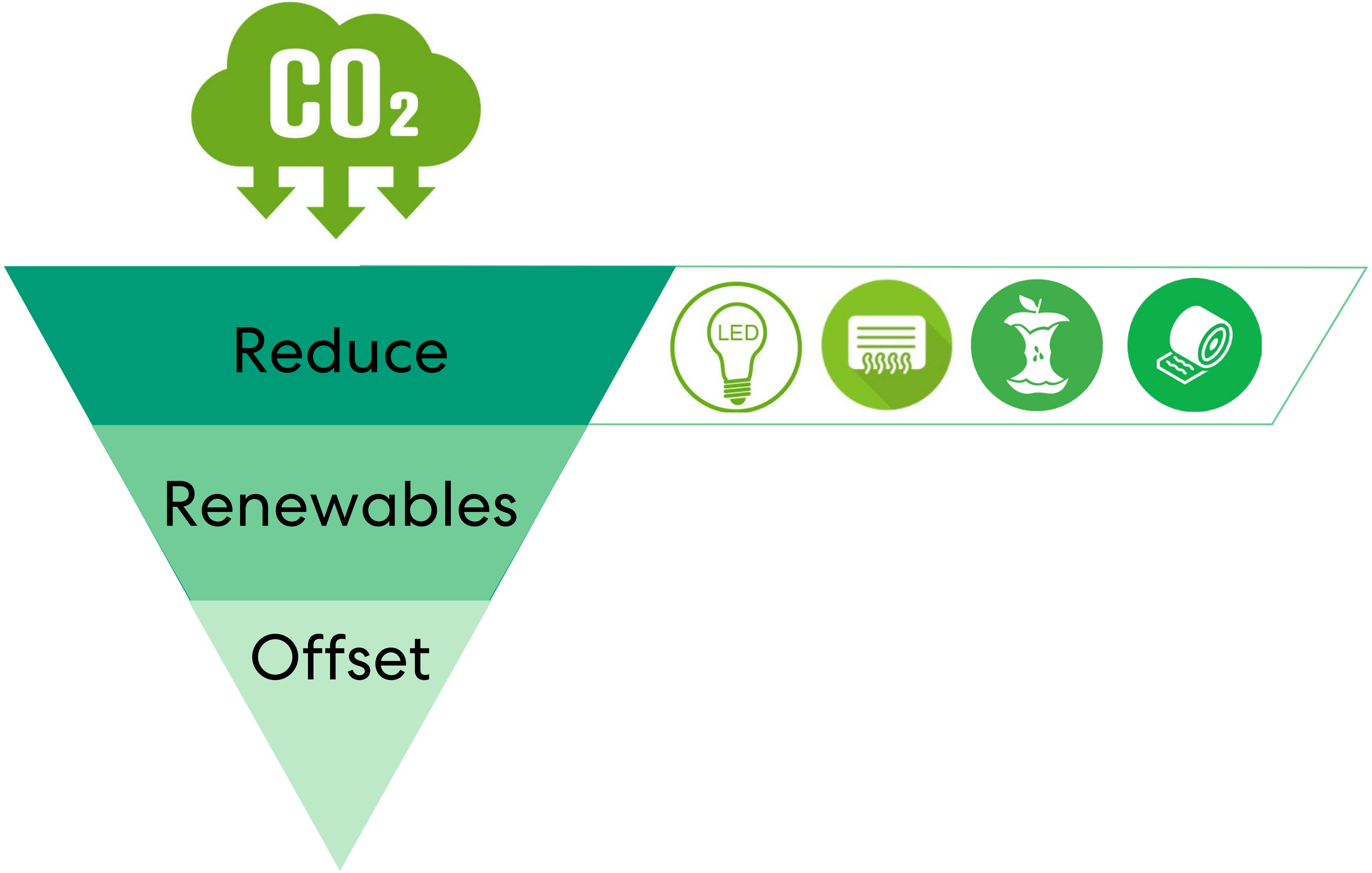
Carbon Reduction Tactics

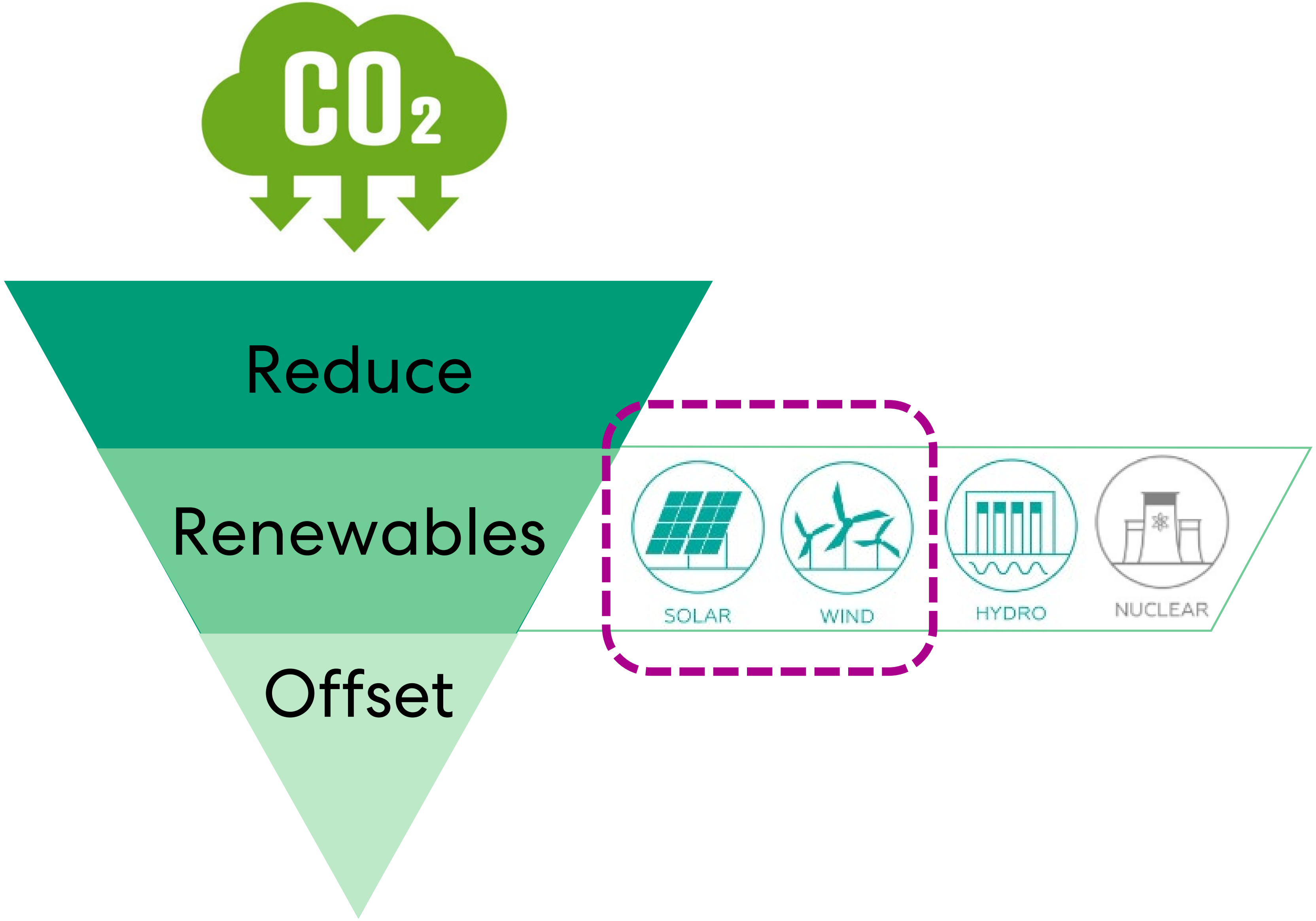
A “**Net Zero Whole-Life Carbon**” asset is where the sum total of all asset-related **GHG emissions**, both operational and embodied, are minimized, meet local carbon, energy and water targets, and with residual “offsets” **equal zero**.

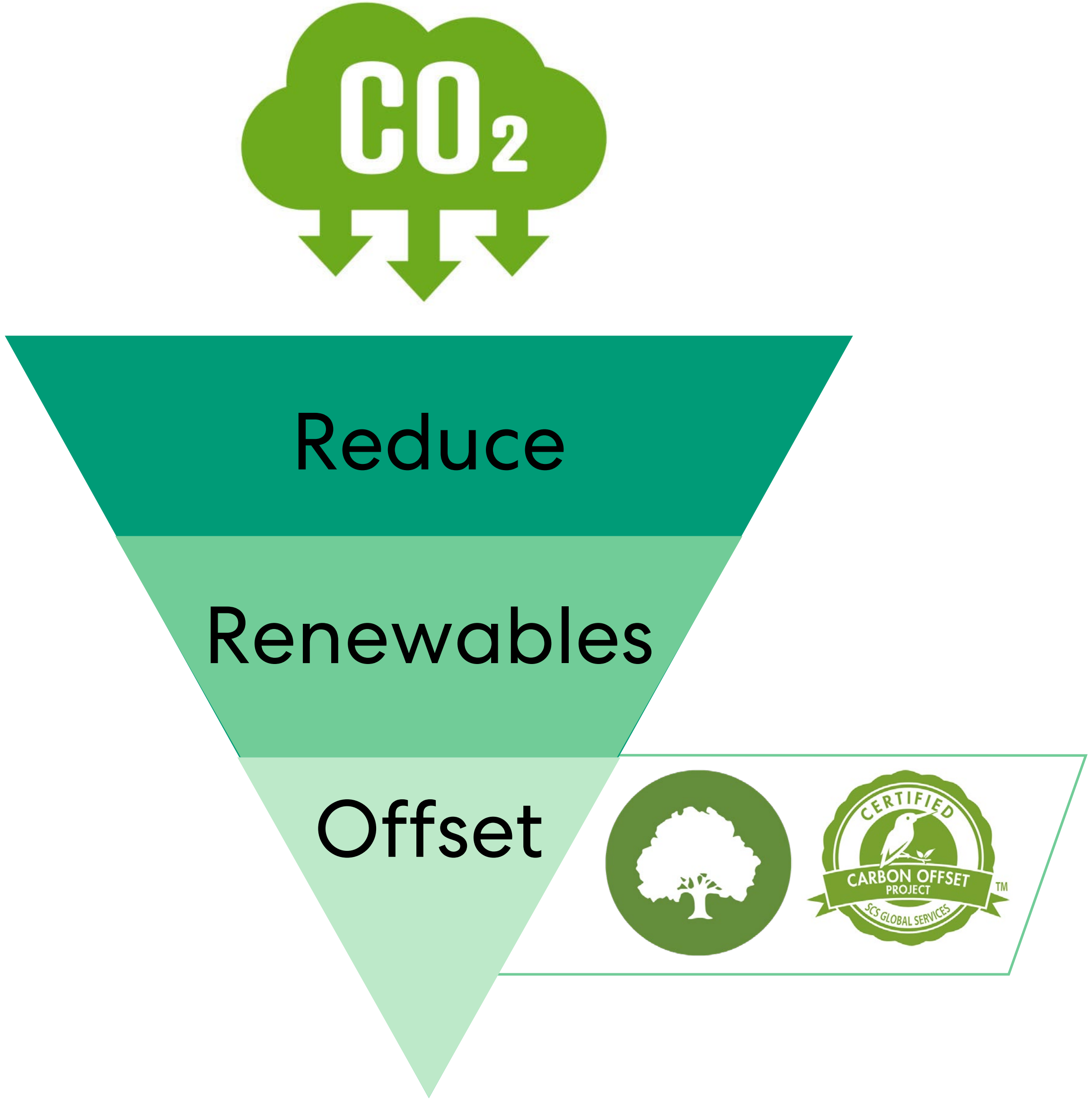
Carbon Balancing

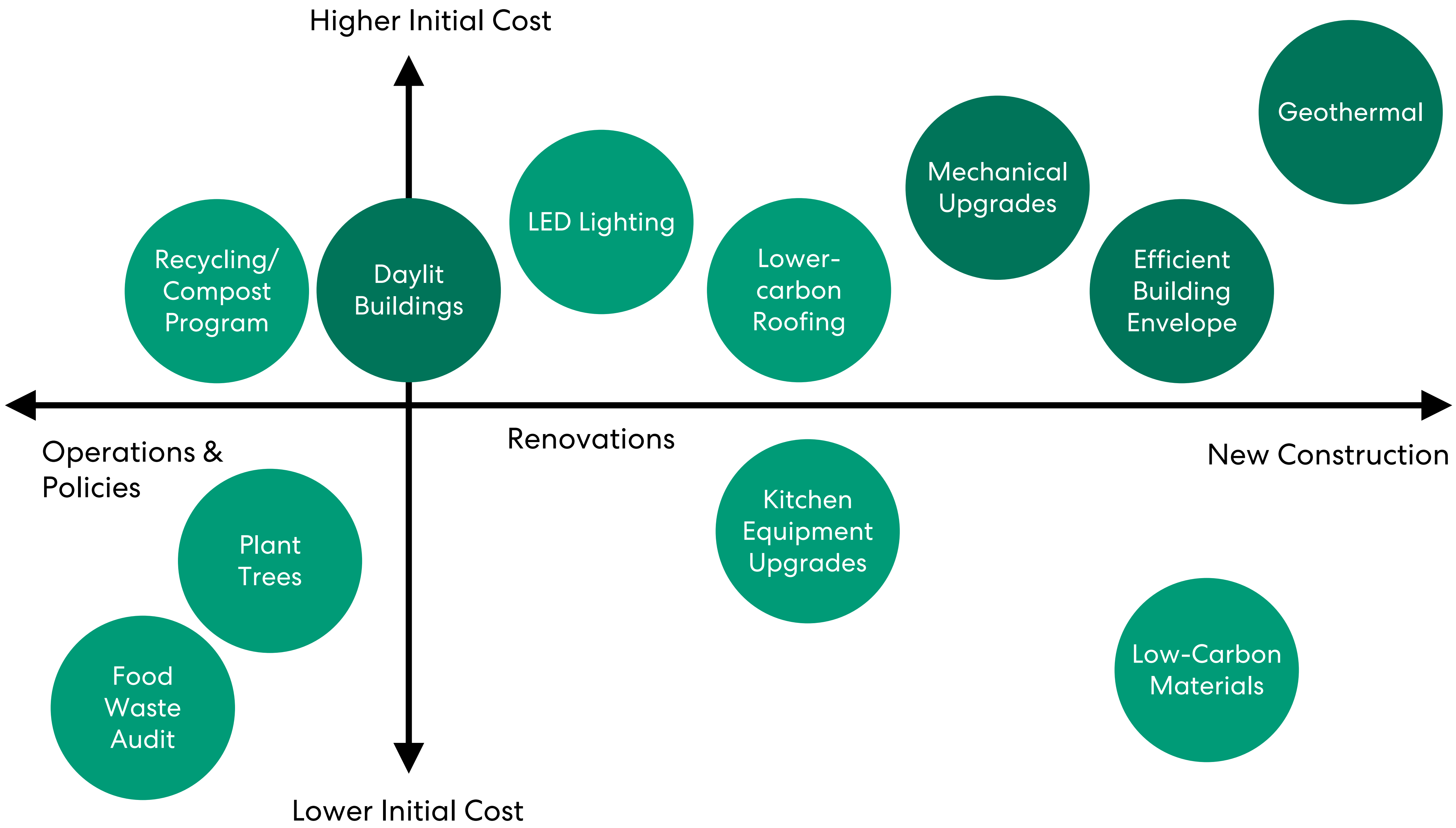



CO2
Reduce
Reuse
Recycle
INCREASING IMPACT
Reduce
Renewables
Offset

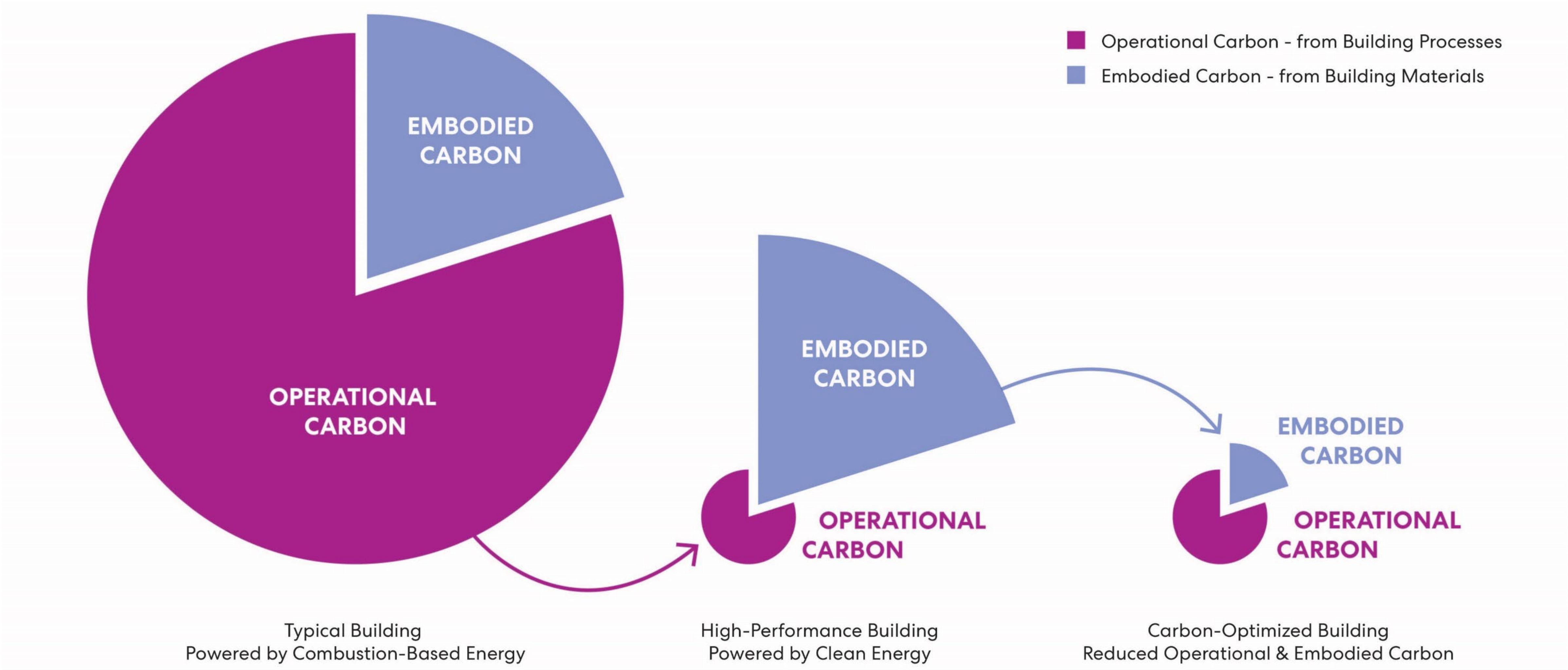

CO2
Reduce
Renewables
Offset
LED


CO2
Reduce
Renewables
Offset
SOLAR
WIND
HYDRO
NUCLEAR


CO2
Reduce
Renewables
Offset
CERTIFIED
CARBON OFFSET
PROJECT
SCS GLOBAL SERVICES


Higher Initial Cost
Geothermal
Mechanical Upgrades
LED Lighting
Recycling/ Compost Program
Daylit Buildings
Lower-carbon Roofing
Efficient Building Envelope
Renovations
Operations & Policies
New Construction
Kitchen Equipment Upgrades
Plant Trees
Food Waste Audit
Low-Carbon Materials
Lower Initial Cost

Reducing Operational & Embodied Carbon



Embodied Carbon—Up Front Design Decisions

Make carbon smart decisions up front.

Envelope: Consider quantity of glass

Structure: Timber < Mixed < Concrete/Steel

Interiors: Less is more

Site: Trees and native plantings

* Retain/ Salvage existing (if applicable)

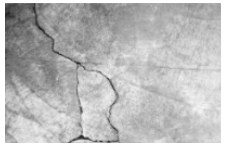
→

Samuel Brighouse Elementary School
Richmond, BC
Photo by Nic Lehoux

Embodied Carbon
Material Type & Quantity

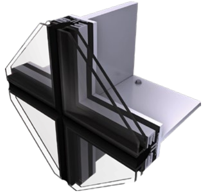
Identify Hot Spots

Perform a Life Cycle Assessment (LCA)
to determine high impact material categories



Concrete

Steel



Glazing Assemblies

Insulation

Gypsum

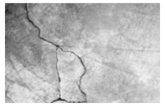
Carpet

→

Lisle Elementary School
Lisle, Illinois

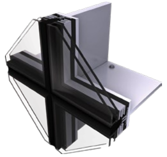
Embodied Carbon—Material Type and Quantity

Optimization



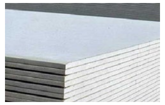
Concrete

Steel



Glazing Assemblies

Insulation



Gypsum

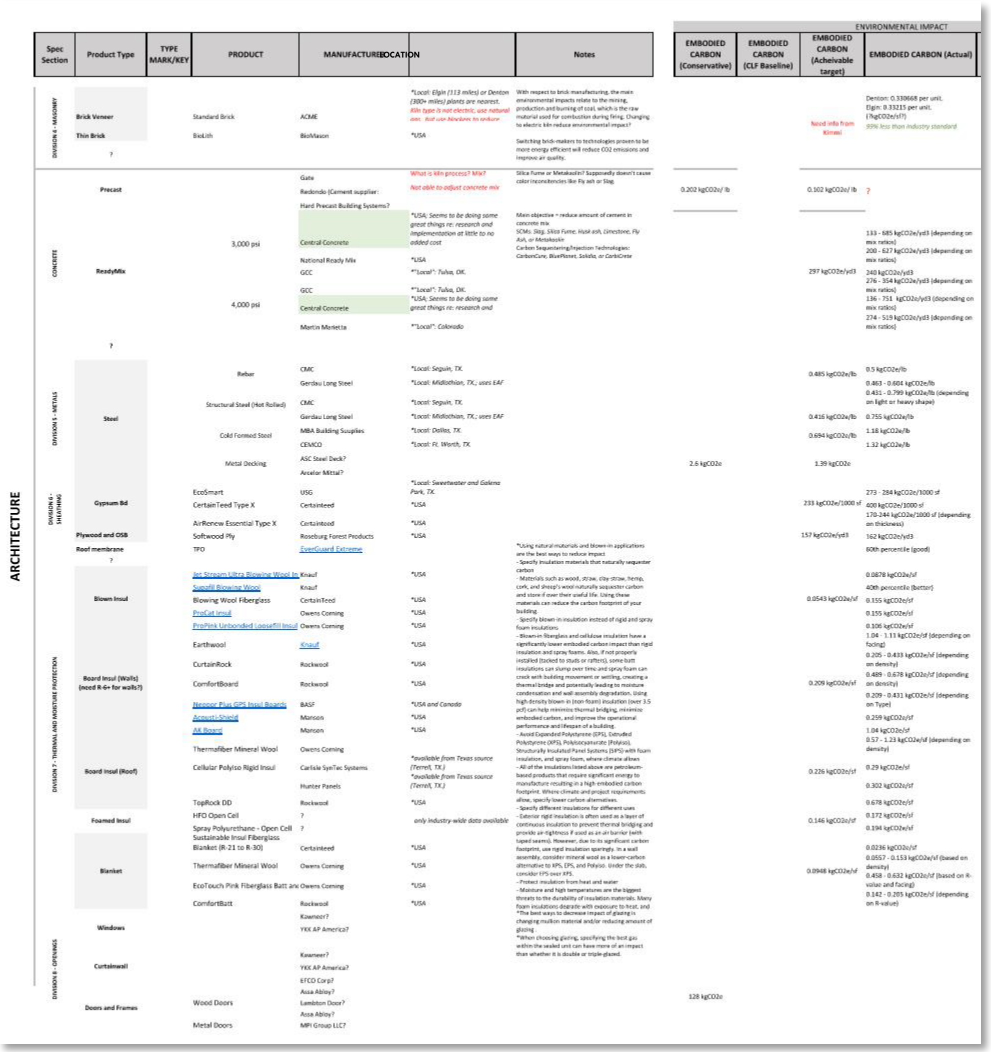
Carpet

Search for Lower Carbon Solutions

EC3

Sustainable Minds

Product Comparison Schedule



ARCHITECTURE

Spec Section	Product Type	TYPE MARK/KEY	PRODUCT	MANUFACTURER	LOCATION	Notes	EMBODIED CARBON (Conservative)	EMBODIED CARBON (CLF Baseline)	EMBODIED CARBON (Acheivable target)	EMBODIED CARBON (Actual)
DIVISION 4 - MASONRY	Brick Veneer		Standard Brick	ACME	*Local: Elgin (113 miles) or Denton (300+ miles) plants are nearest. Kiln type is not electric, use natural gas, but use blockers to reduce	With respect to brick manufacturing, the main environmental impacts relate to the mining, production and burning of coal, which is the raw material used for combustion during firing. Changing to electric kiln reduce environmental impact?			Need info from Kimmi	Denton: 0.330668 per unit. Elgin: 0.33215 per unit. (?kgCO2e/sf?) 99% less than industry standard
	Thin Brick		BioLith	BioMason	*USA	Switching brick-makers to technologies proven to be more energy efficient will reduce CO2 emissions and improve air quality.				
	?									
CONCRETE	Precast			Gate Redondo (Cement supplier: Hard Precast Building Systems?	What is kiln process? Mix? Not able to adjust concrete mix	Silica Fume or Metakaolin? Supposedly doesn't cause color inconcistencies like Fly ash or Slag	0.202 kgCO2e/ lb		0.102 kgCO2e/ lb	?
	ReadyMix		3,000 psi	Central Concrete	*USA; Seems to be doing some great things re: research and implementation at little to no added cost	Main objective = reduce amount of cement in concrete mix SCMs: Slag, Silica Fume, Husk ash, Limestone, Fly Ash, or Metakaolin Carbon Sequestering/Injection Technologies: CarbonCure, BluePlanet, Solidia, or CarbiCrete			297 kgCO2e/yd3	133 - 685 kgCO2e/yd3 (depending on mix ratios)
				National Ready Mix	*USA					200 - 627 kgCO2e/yd3 (depending on mix ratios)
				GCC	*"Local": Tulsa, OK.					240 kgCO2e/yd3
			4,000 psi	GCC	*"Local": Tulsa, OK.					276 - 354 kgCO2e/yd3 (depending on mix ratios)
				Central Concrete	*USA; Seems to be doing some great things re: research and					136 - 751 kgCO2e/yd3 (depending on mix ratios)
				Martin Marietta	*"Local": Colorado					274 - 519 kgCO2e/yd3 (depending on mix ratios)
	?									
DIVISION 5 - METALS	Steel		Rebar	CMC	*Local: Seguin, TX.				0.485 kgCO2e/lb	0.5 kgCO2e/lb
				Gerdau Long Steel	*Local: Midlothian, TX.; uses EAF					0.463 - 0.604 kgCO2e/lb
			Structural Steel (Hot Rolled)	CMC	*Local: Seguin, TX.					0.431 - 0.799 kgCO2e/lb (depending on light or heavy shape)
				Gerdau Long Steel	*Local: Midlothian, TX.; uses EAF				0.416 kgCO2e/lb	0.755 kgCO2e/lb
			Cold Formed Steel	MBA Building Suupplies	*Local: Dallas, TX.				0.694 kgCO2e/lb	1.18 kgCO2e/lb
				CEMCO	*Local: Ft. Worth, TX.					1.32 kgCO2e/lb
			Metal Decking	ASC Steel Deck?			2.6 kgCO2e		1.39 kgCO2e	
				Arcelor Mittal?						
DIVISION 6 - SHEATHING	Gypsum Bd		EcoSmart	USG	*Local: Sweetwater and Galena Park, TX.					273 - 284 kgCO2e/1000 sf
			CertainTeed Type X	Certainteed	*USA				233 kgCO2e/1000 sf	400 kgCO2e/1000 sf
			AirRenew Essential Type X	Certainteed	*USA					170-244 kgCO2e/1000 sf (depending on thickness)
	Plywood and OSB		Softwood Ply	Roseburg Forest Products	*USA				157 kgCO2e/yd3	162 kgCO2e/yd3
	Roof membrane		TPO	EverGuard Extreme						60th percentile (good)
	?									
DIVISION 7 - THERMAL AND MOISTURE PROTECTION	Blown Insul		Jet Stream Ultra Blowing Wool In	Knauf	*USA	*Using natural materials and blown-in applications are the best ways to reduce impact - Specify insulation materials that naturally sequester carbon - Materials such as wood, straw, clay-straw, hemp, cork, and sheep's wool naturally sequester carbon and store it over their useful life. Using these materials can reduce the carbon footprint of your building. - Specify blown-in insulation instead of rigid and spray foam insulations - Blown-in fiberglass and cellulose insulation have a significantly lower embodied carbon impact than rigid insulation and spray foams. Also, if not properly installed (tacked to studs or rafters), some batt insulations can slump over time and spray foam can crack with building movement or settling, creating a thermal bridge and potentially leading to moisture condensation and wall assembly degradation. Using high density blown-in (non-foam) insulation (over 3.5 pcf) can help minimize thermal bridging, minimize embodied carbon, and improve the operational performance and lifespan of a building. - Avoid Expanded Polystyrene (EPS), Extruded Polystyrene (XPS), Polyisocyanurate (Polyiso), Structurally Insulated Panel Systems (SIPS) with foam insulation, and spray foam, where climate allows - All of the insulations listed above are petroleum-based products that require significant energy to manufacture resulting in a high-embodied carbon footprint. Where climate and project requirements allow, specify lower carbon alternatives. - Specify different insulations for different uses - Exterior rigid insulation is often used as a layer of continuous insulation to prevent thermal bridging and provide air-tightness if used as an air barrier (with taped seams). However, due to its significant carbon footprint, use rigid insulation sparingly. In a wall assembly, consider mineral wool as a lower-carbon alternative to XPS, EPS, and Polyiso. Under the slab, consider EPS over XPS. - Protect insulation from heat and water - Moisture and high temperatures are the biggest threats to the durability of insulation materials. Many foam insulations degrade with exposure to heat, and				0.0878 kgCO2e/sf
			Supafil Blowing Wool	Knauf						40th percentile (better)
			Blowing Wool Fiberglass	CertainTeed	*USA				0.0543 kgCO2e/sf	0.155 kgCO2e/sf
			ProCat Insul	Owens Corning	*USA					0.155 kgCO2e/sf
			ProPink Unbonded Loosefill Insul	Owens Corning	*USA					0.106 kgCO2e/sf
	Board Insul (Walls) (need R-6+ for walls?)		Earthwool	Knauf	*USA					1.04 - 1.11 kgCO2e/sf (depending on facing)
			CurtainRock	Rockwool	*USA					0.205 - 0.433 kgCO2e/sf (depending on density)
			ComfortBoard	Rockwool	*USA				0.209 kgCO2e/sf	0.489 - 0.678 kgCO2e/sf (depending on density)
			Neopor Plus GPS Insul Boards	BASF	*USA and Canada					0.209 - 0.431 kgCO2e/sf (depending on Type)
			Acousti-Shield	Monson	*USA					0.259 kgCO2e/sf
			AK Board	Monson	*USA					1.04 kgCO2e/sf
	Board Insul (Roof)		Thermafiber Mineral Wool	Owens Corning						0.57 - 1.23 kgCO2e/sf (depending on density)
			Cellular Polyiso Rigid Insul	Carlisle SynTec Systems	*available from Texas source (Terrell, TX.)				0.226 kgCO2e/sf	0.29 kgCO2e/sf
				Hunter Panels	*available from Texas source (Terrell, TX.)					0.302 kgCO2e/sf
			TopRock DD	Rockwool	*USA					0.678 kgCO2e/sf
	Foamed Insul		HFO Open Cell	?						0.172 kgCO2e/sf
			Spray Polyurethane - Open Cell	?	only industry-wide data available				0.146 kgCO2e/sf	0.194 kgCO2e/sf
	Blanket		Sustainable Insul Fiberglass Blanket (R-21 to R-30)	Certainteed	*USA					0.0236 kgCO2e/sf
			Thermafiber Mineral Wool	Owens Corning	*USA					0.0557 - 0.153 kgCO2e/sf (based on density)
			EcoTouch Pink Fiberglass Batt an	Owens Corning	*USA				0.0948 kgCO2e/sf	0.458 - 0.632 kgCO2e/sf (based on R-value and facing)
			ComfortBatt	Rockwool	*USA					0.142 - 0.205 kgCO2e/sf (depending on R-value)
DIVISION 8 - OPENINGS	Windows			Kawneer? YKK AP America?		*The best ways to decrease impact of glazing is changing mullion material and/or reducing amount of glazing *When choosing glazing, specifying the best gas within the sealed unit can have more of an impact than whether it is double or triple-glazed.				
	Curtainwall			Kawneer? YKK AP America? EFCO Corp?						
	Doors and Frames			Assa Abloy?						
			Wood Doors	Lambton Door?			128 kgCO2e			
				Assa Abloy?						
			Metal Doors	MPI Group LLC?						

Embodied Carbon Test Case: Roof Replacement

Product Comparison

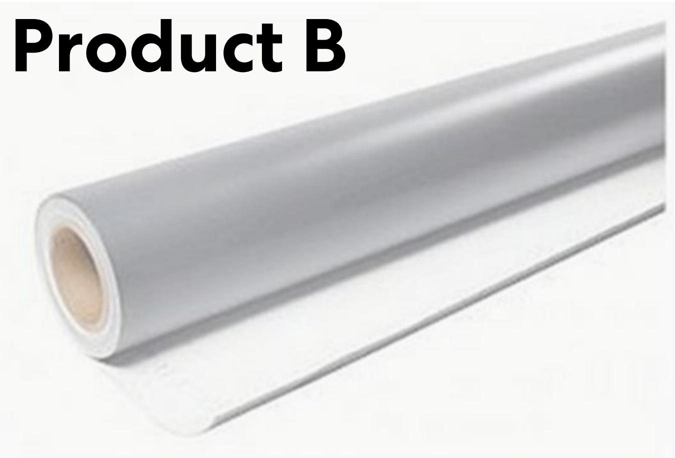
Product A

PVC Single-Ply Roofing

60 mil thickness

613 g CO2e/sf

Product B



PVC Single-Ply Roofing

60 mil thickness

677 g CO2e/sf

Product C

PVC Single-Ply Roofing

60 mil thickness

725 g CO2e/sf

11.2 tons CO2e

Saved on 100,000 sf roof

Requires **13.4 acres** of US forests
1 year to sequester this much carbon

Sources: Product EPDs and epa.gov Greenhouse Gas Equivalencies Calculator

Embodied Carbon Test Case: Roof Replacement

Equal Product Performance, Significant Environmental Impact

PVC Single-Ply Membrane Roofing

60 mil thickness

613 – 725 g CO2e/sf

11.2 tons CO2e

Saved on 100,000 sf roof

Modified Bitumen Roofing

2-ply SBS

622 – 835 g CO2e/sf

21.3 tons CO2e

Saved on 100,000 sf roof

EPDM Roofing

60 mil thickness

537 - 660 g CO2e/sf

12.3 tons CO2e

Saved on 100,000 sf roof

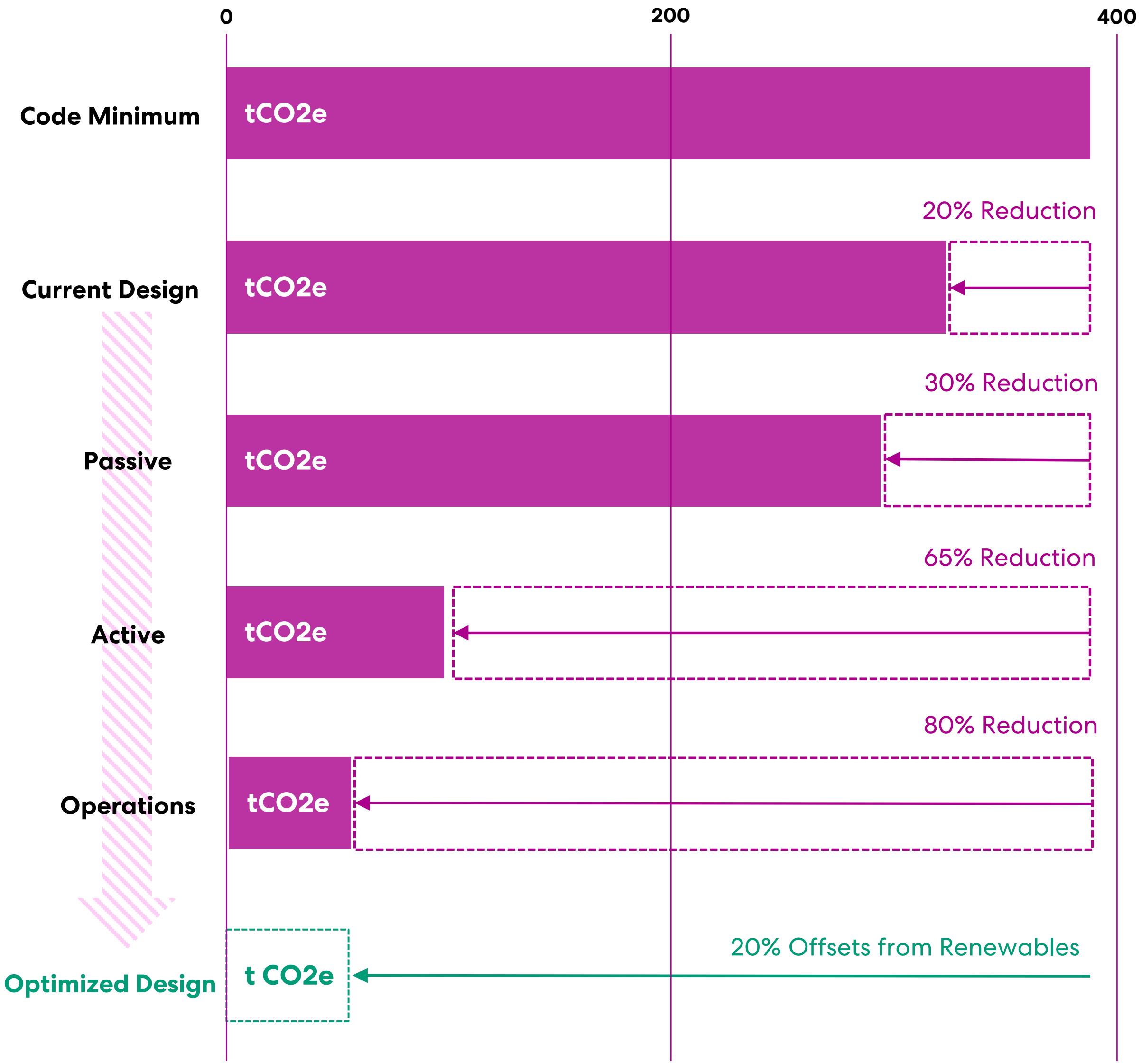
Sources: Product EPDs and epa.gov Greenhouse Gas Equivalencies Calculator

Charting the Path to Net Zero Operational Carbon

1. *High-performance building envelope*
2. *Smart building orientation and massing*
3. *Efficient building systems*
4. *Efficient controls and operations*
5. *Embed Renewables onsite*

Path to Zero Operational Carbon Design

Carbon Reduction Measures, Predicted GWP from Building Operations



Design Features
- Prescriptive Envelope
- Requirements for Electrification of Cooling, Heating, and Domestic Hot Water Systems

Design Features
- Window U-0.35
- Window SHGC 0.40
- Wall R-18
- Roof R-43

1. Passive Strategies
- Window to Wall Ratio 40%
- Window U-0.20 SHGC 0.35
- Wall R-25
- Roof R-55

2. Active Strategies
- Heating and Cooling GeoExchange HP
- Heat Recovery and Economizer
- Electric Tankless DHW

3. Operations Strategies
- Daylight Sensors
- Daylight Controls
- Lighting Schedules
- Energy Saving Lighting and Equipment Power Densities

4. 100% Offset from On-Site Renewable Strategies
- Roof PV
- BIPV
- Parking Lot Canopy Mounted PV

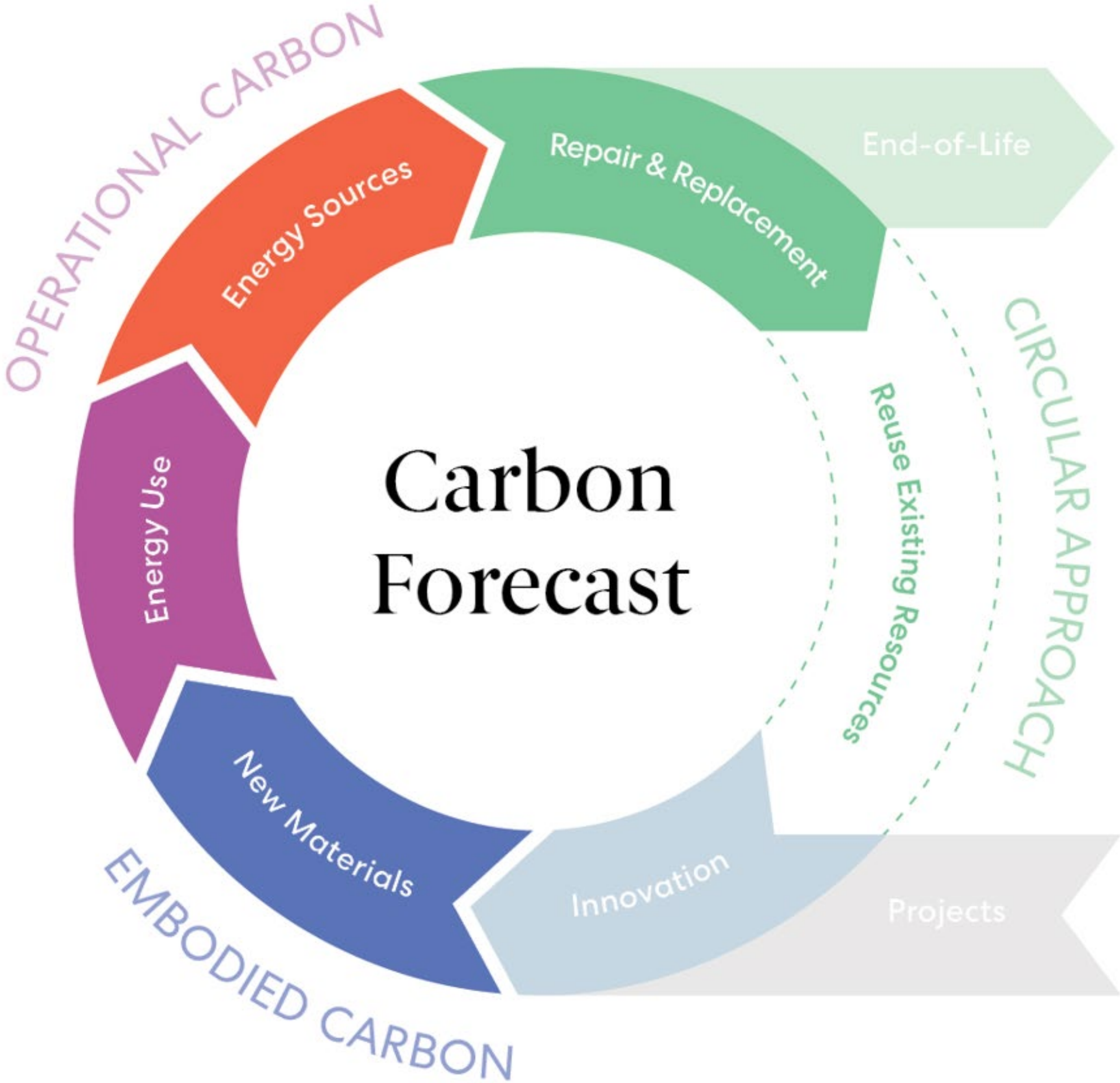
1. **Waste Heat** – 50% energy improvement
2. **PV Array** – Net Zero Energy
3. **Geo-exchange** – Net Positive Energy

Phillips Academy Andover, Snyder Center

Carbon Forecasting

A Path to Net Zero Carbon Buildings

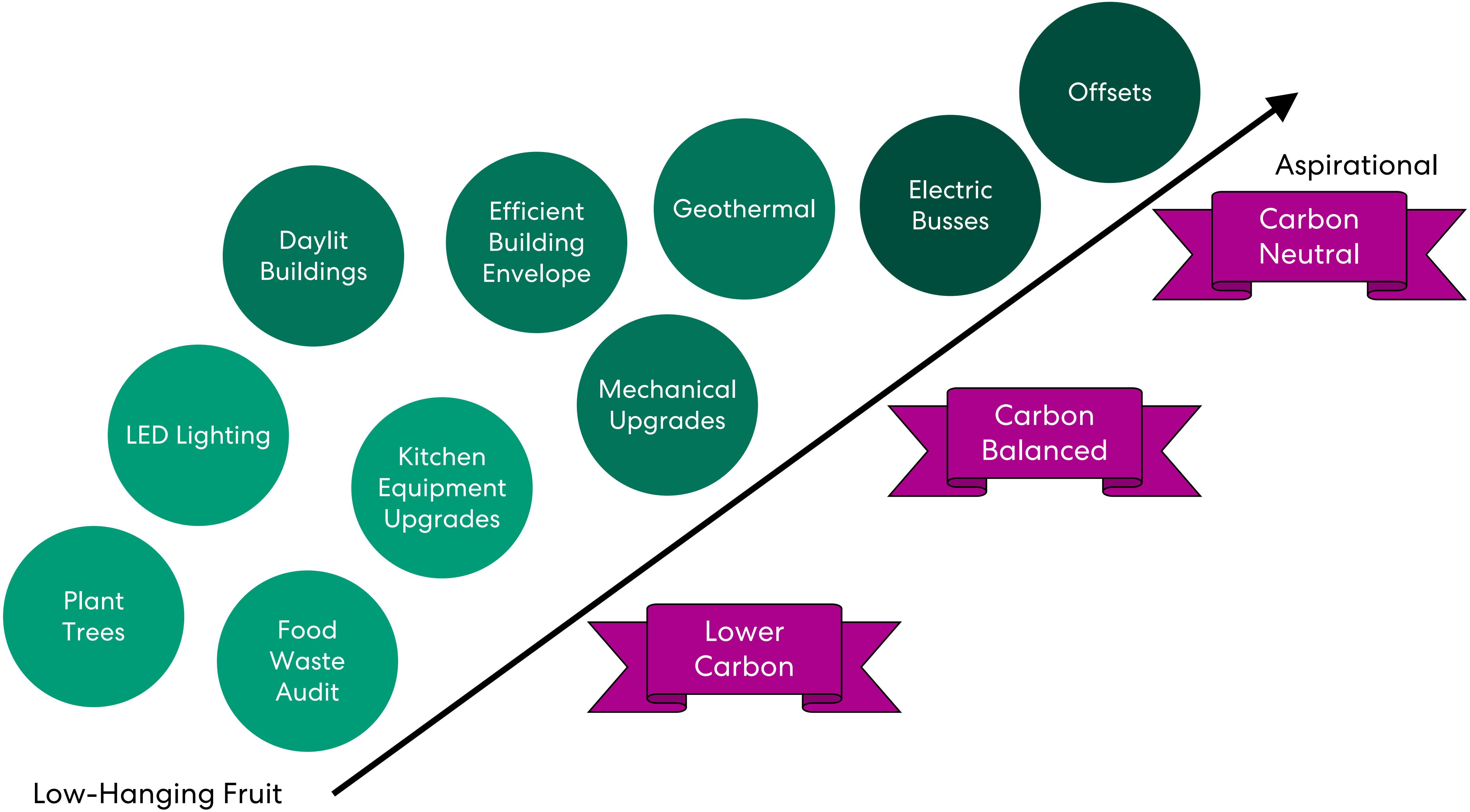
1. Innovation in design of high-efficiency buildings
2. Source materials with lower embodied carbon
3. Reduce energy use in manufacturing, construction, and operations
4. Utilize sustainable energy sources
5. Extend longevity through operations and maintenance
6. Thoughtful reuse of existing resources



Call to Action

“Do what you can,
with what you have,
where you are.”

- Theodore Roosevelt


Offsets
Aspirational
Daylit Buildings
Efficient Building Envelope
Geothermal
Electric Busses
Carbon Neutral
LED Lighting
Mechanical Upgrades
Kitchen Equipment Upgrades
Carbon Balanced
Plant Trees
Food Waste Audit
Lower Carbon
Low-Hanging Fruit

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