Climate Positive Benefits of Concrete in Design

The Role of ICPs and SRWs

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Who *is* UNILOCK

Segmental Paving Stones & Retaining Walls

New Technologies

FINISHES

Umbriano™ Mottled Finish with ColorFusion™ and EasyClean™

Senzo™ Matte Finish with EasyClean™

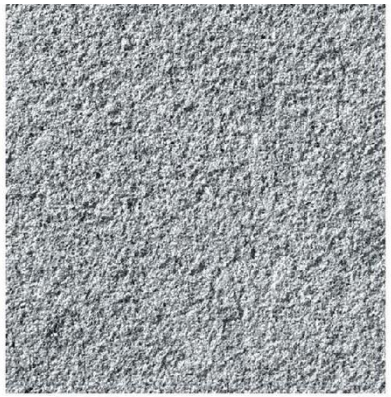
Series™ Exposed Granite Finish

Il Campo® Brushed Finish

Smooth Premier Finish

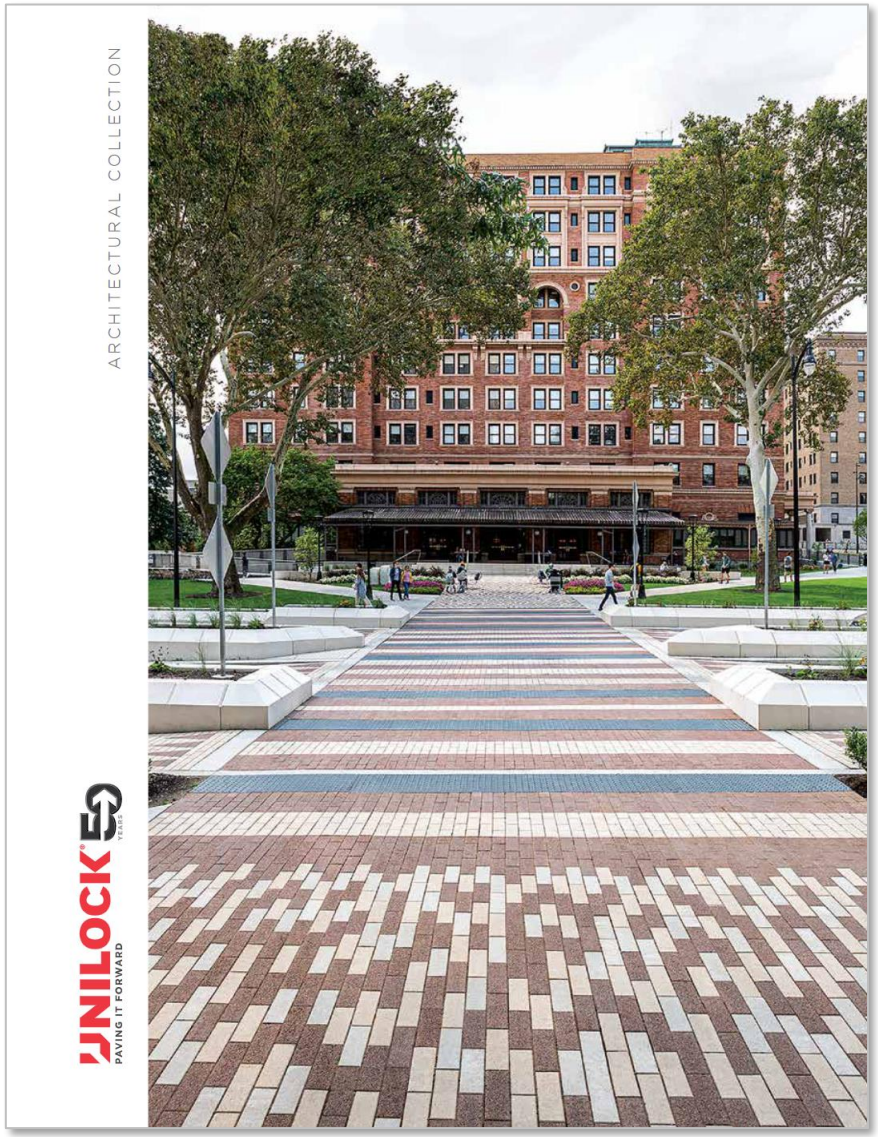
Flagstone Premier Finish

Granito™ Boldly Mottled Finish with EasyClean™



Revela™ Shot-Blast Finish

Unilock Catalogs



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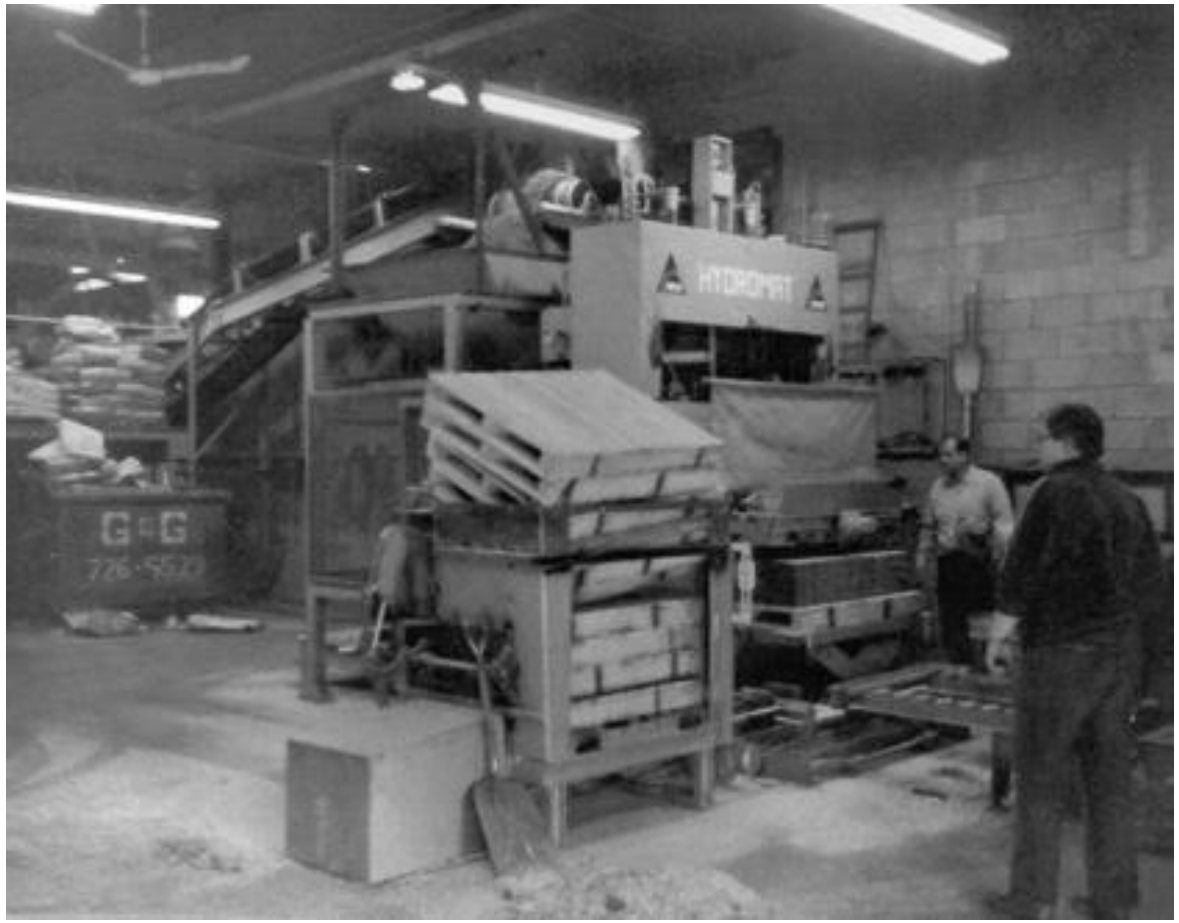
1972



13 LOCATIONS & 18 PLANTS

TORONTO
Barrie, ON
Georgetown, ON
Pickering, ON
Ayr, ON
Gormley, ON

OHIO
Rittman, OH
Columbus, OH
Cincinnati, OH

NEW YORK
Chester, NY
Brewster, NY

VIRGINIA
Fredericksburg, VA

BOSTON
Uxbridge, MA

MICHIGAN
Michigan, MI

CHICAGO
Elkhorn, WI
Aurora, IL
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Learning Objectives

- Describe key gasses that make up our atmosphere
- Identify the key steps in the process of concrete manufacturing to better understand where the carbon hot spots reside and some of the latest innovations in the marketplace.
- Identify tangible types of Climate-Positive Design, in large- and small-scale planning scenarios as well as systems within those design that help to deliver NetZero.

Learning Objectives

- Describe the beneficial environmental impacts of permeable pavers on water quality, groundwater sources and sewer systems and their contribution to the reduction of greenhouse gasses.
- List the benefits of real product case studies that delivered tangible results to the community and the environment.
- Identify scenarios in which ICPs and SRWs can be used in place of poured concrete to reduce the embodied carbon value.

Agenda

1. Greenhouse Gases and Embodied Carbon
2. Concrete and the Environment
3. Climate Positive Design

Greenhouse Gases and Embodied Carbon

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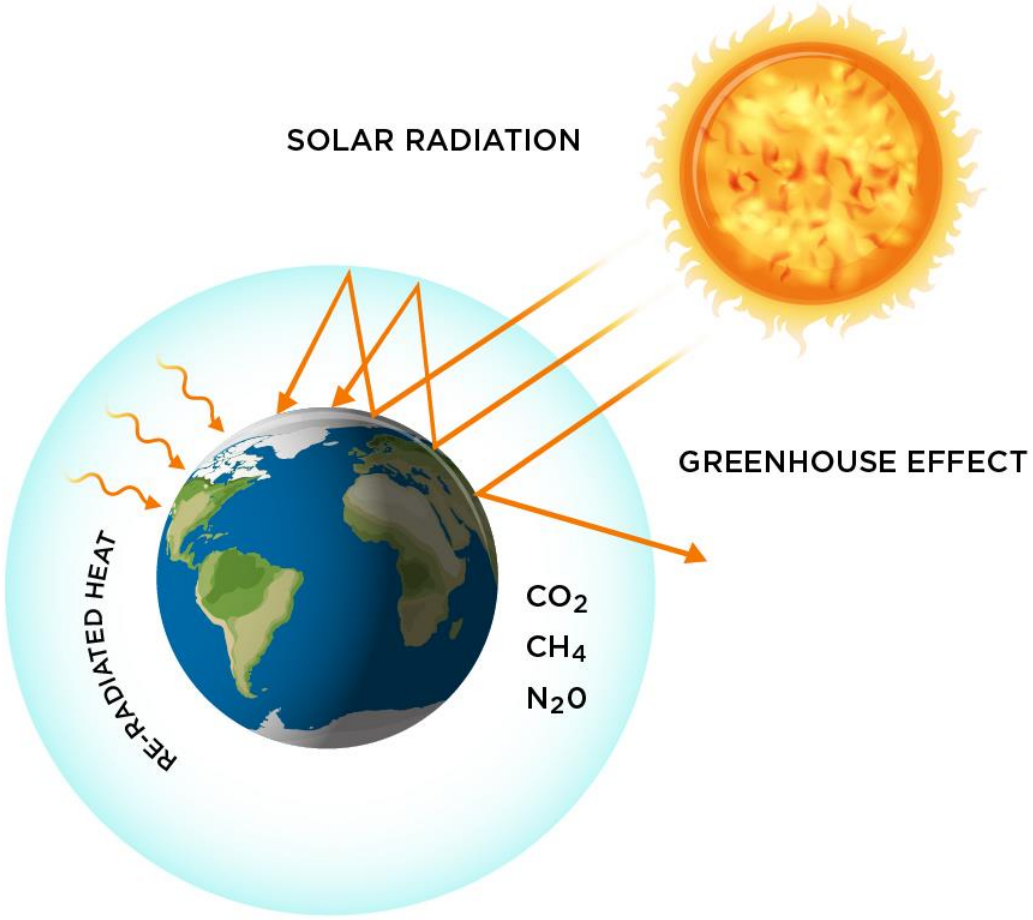
Greenhouse Gases

We need some greenhouse gas

Our greenhouse gases trap heat in the atmosphere and helps to regulate temperature on earth – protective layer

Because we have too much CO2, Methane, Nitrous Oxide, the greenhouse effect is amplified

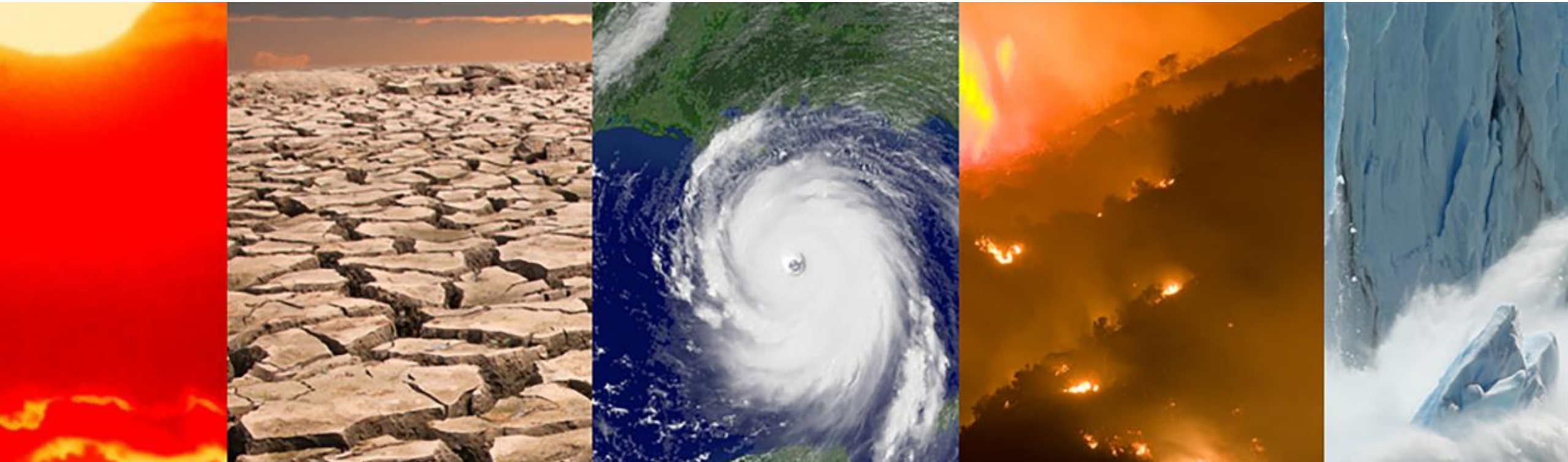


Greenhouse Gases

GHG Imbalance

This industrial age created an imbalance (fossil fuel use, deforestation etc) in the atmosphere, trapping excess heat within the atmosphere and global temperatures to rise

Droughts
Major weather events
Floods
Rising sea levels
Warming waters



Embodied Carbon

Embodied carbon is measured in CO_2-equivalent (CO_2-e) and is a measurement based on the relative impact of a given gas on global warming or its Global Warming Potential (GWP).

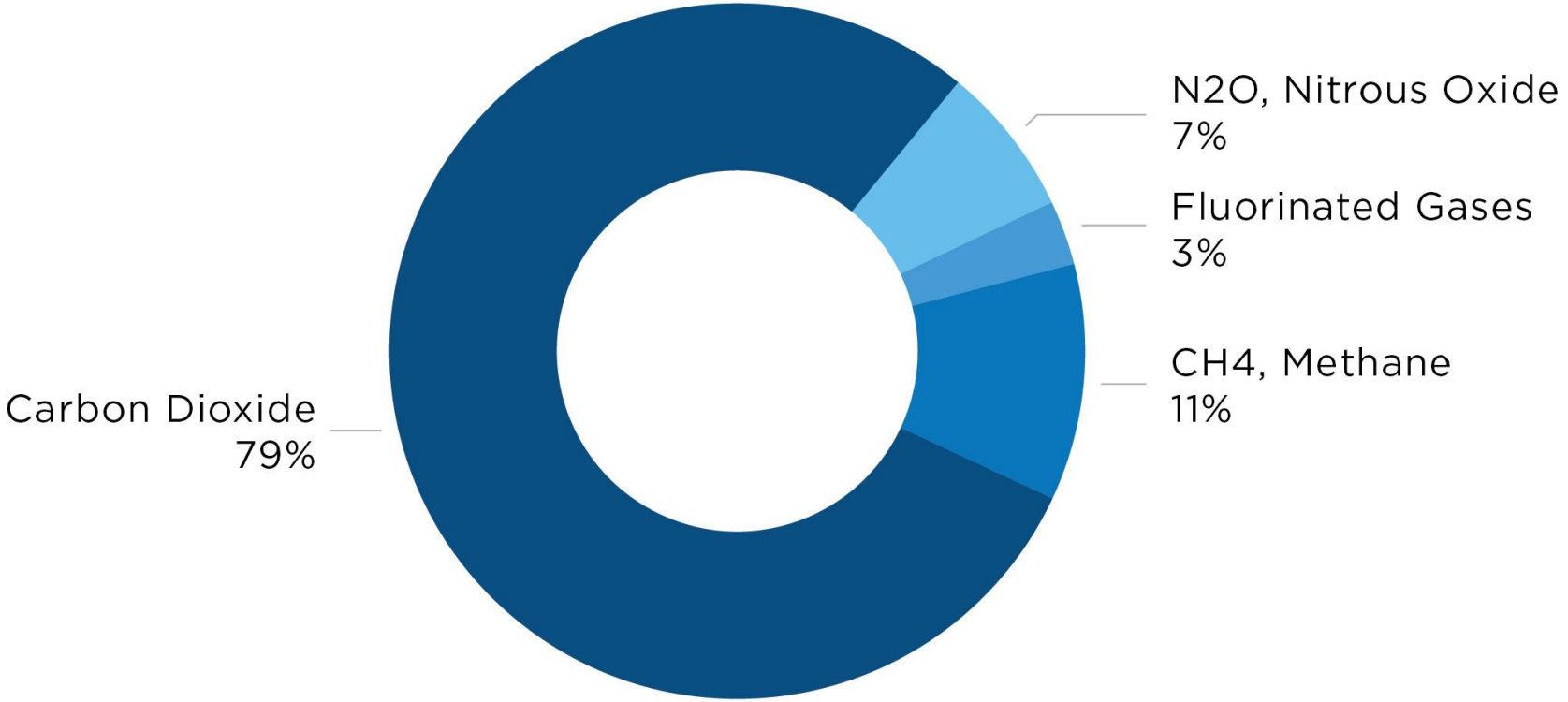
Therefore, embodied carbon and GWP are often used interchangeably.

For structural materials, embodied carbon is linked to the extraction of the raw material, manufacturing, transportation, construction, maintenance during service life, demolition, and end of life.

Other Emission Gases

CO2 is singled out as *the* measurement

There are other human-generated pollutants included in the carbon footprint equation



https://www.epa.gov/ghgemissions/overview-greenhouse-gases

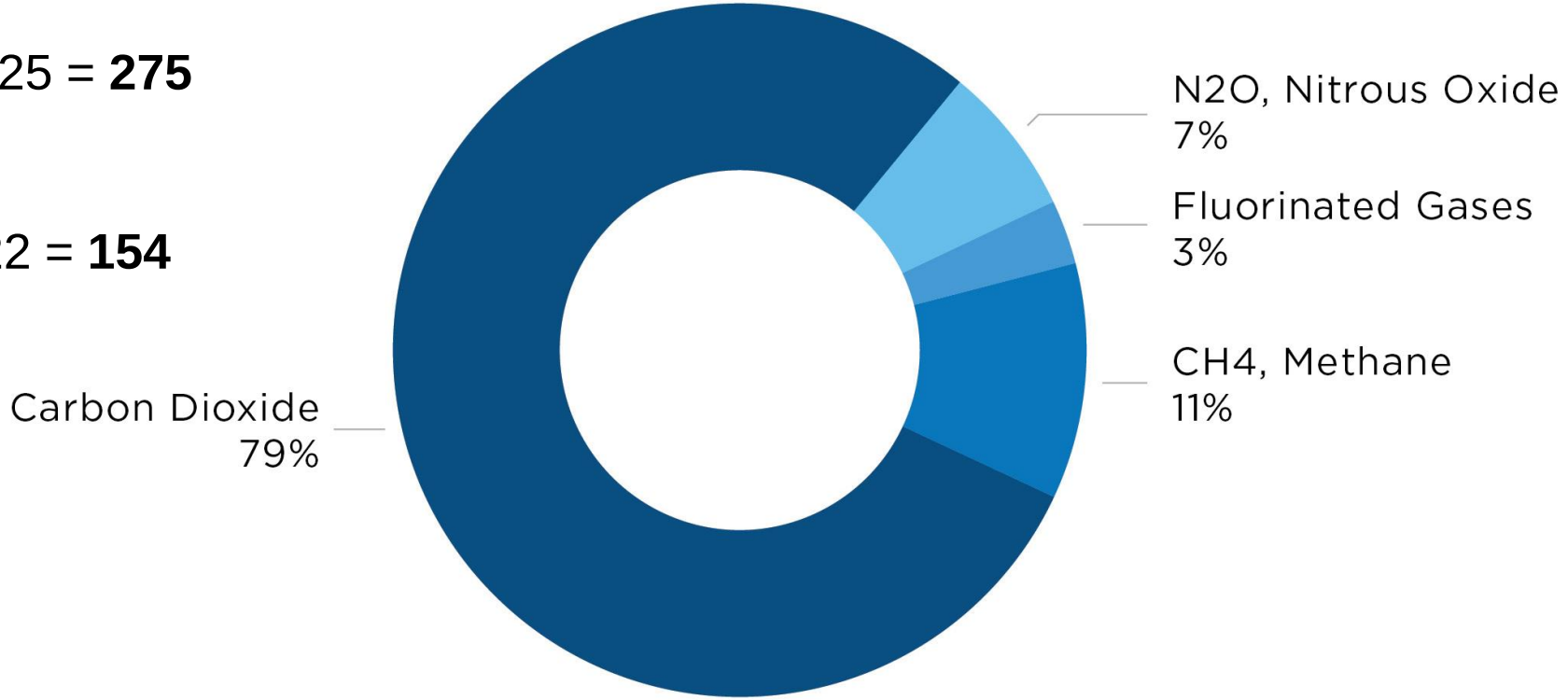
Other Emission Gases

CO_2 is singled out as *the* measurement

Effect value of the gases is much higher

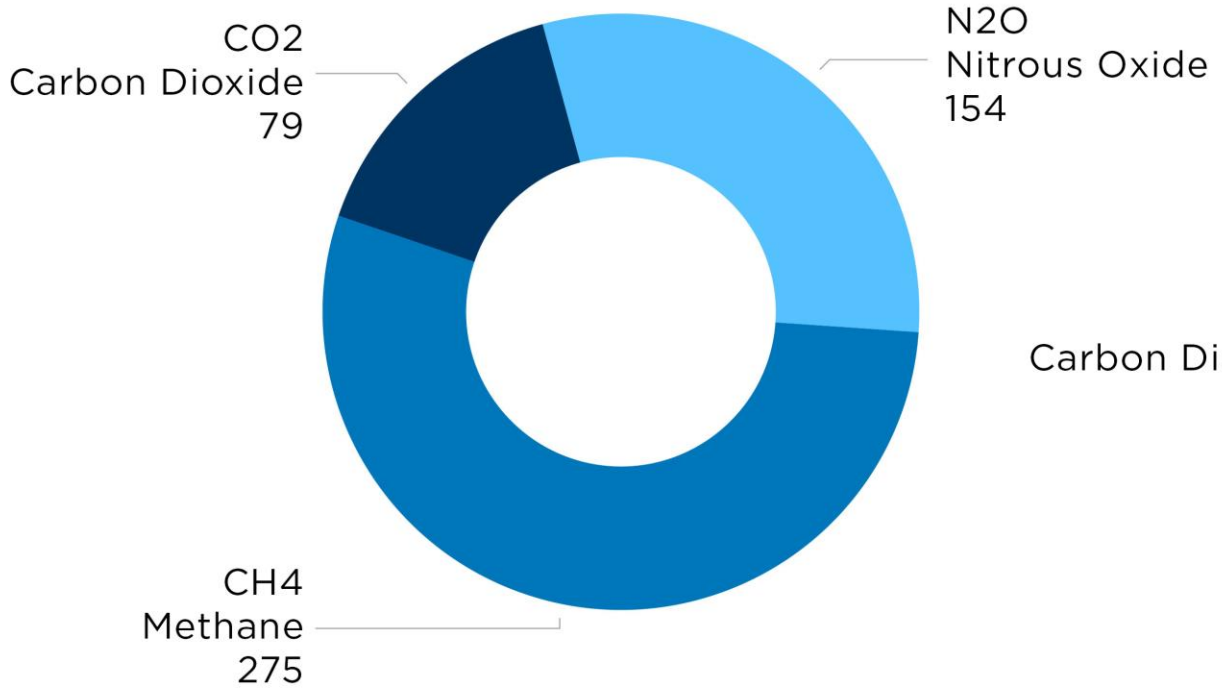
CO_2 79 x 1 = **79** vs **CH_4** 11 x 25 = **275**

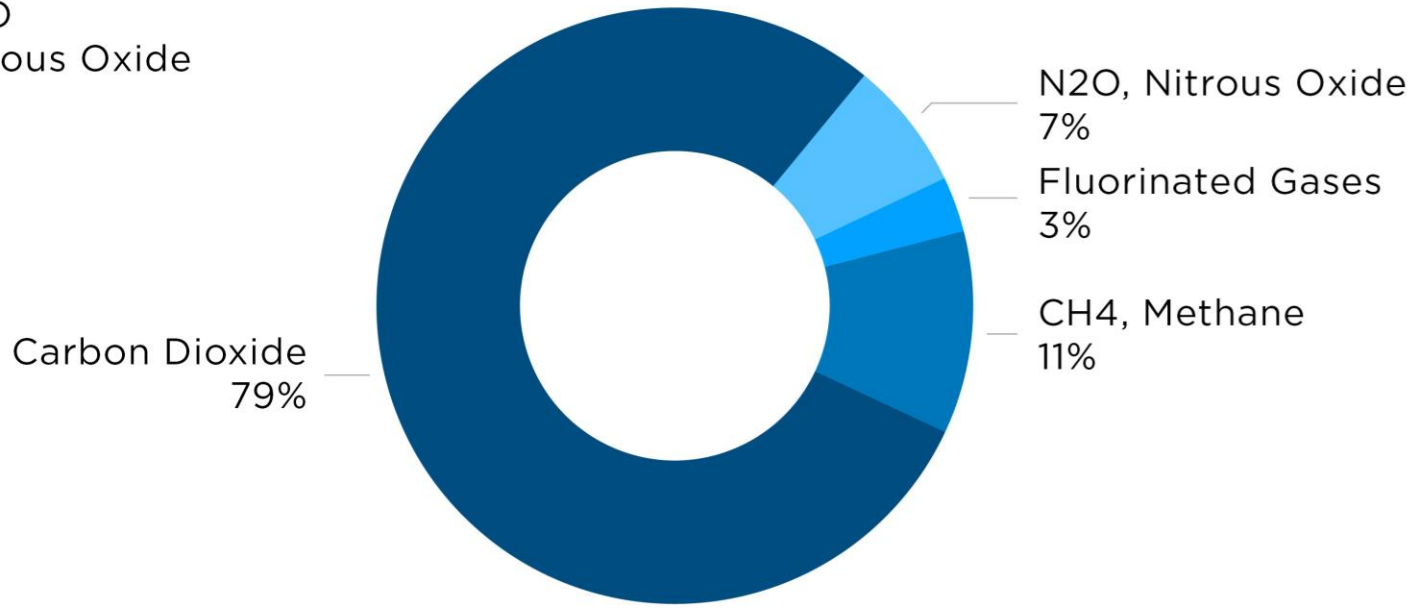
CO_2 79 x 1 = **79** vs **N_2O** 7 x 22 = **154**



https://www.epa.gov/ghgemissions/overview-greenhouse-gases

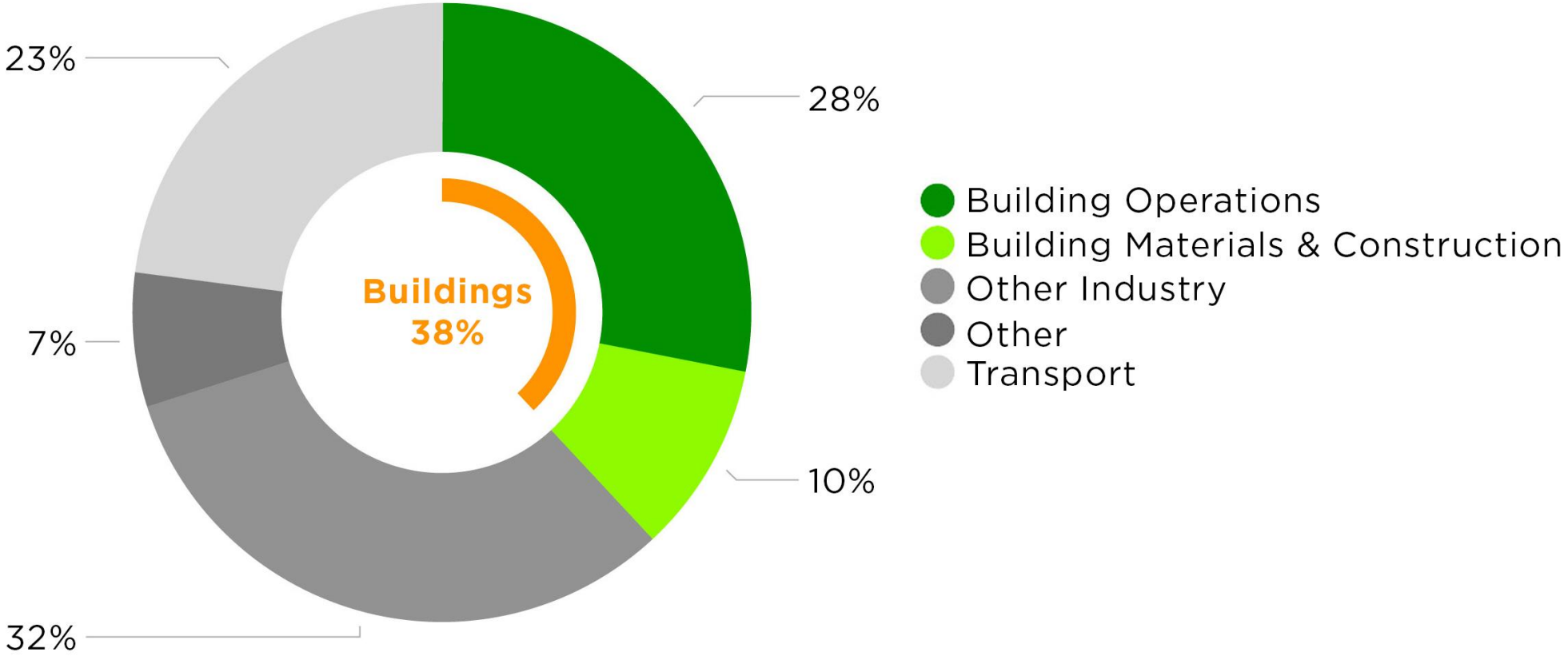
Greenhouse Gases





Impact of other gasses outweigh CO_2

Embodied Carbon



Source: "Net-zero Buildings: Where Do We Stand?" *World Business Council for Sustainable Development*. https://www.wbcsd.org/contentwbc/download/12446/185553/1. Accessed 13 Sept. 2021.

Concrete and the Environment

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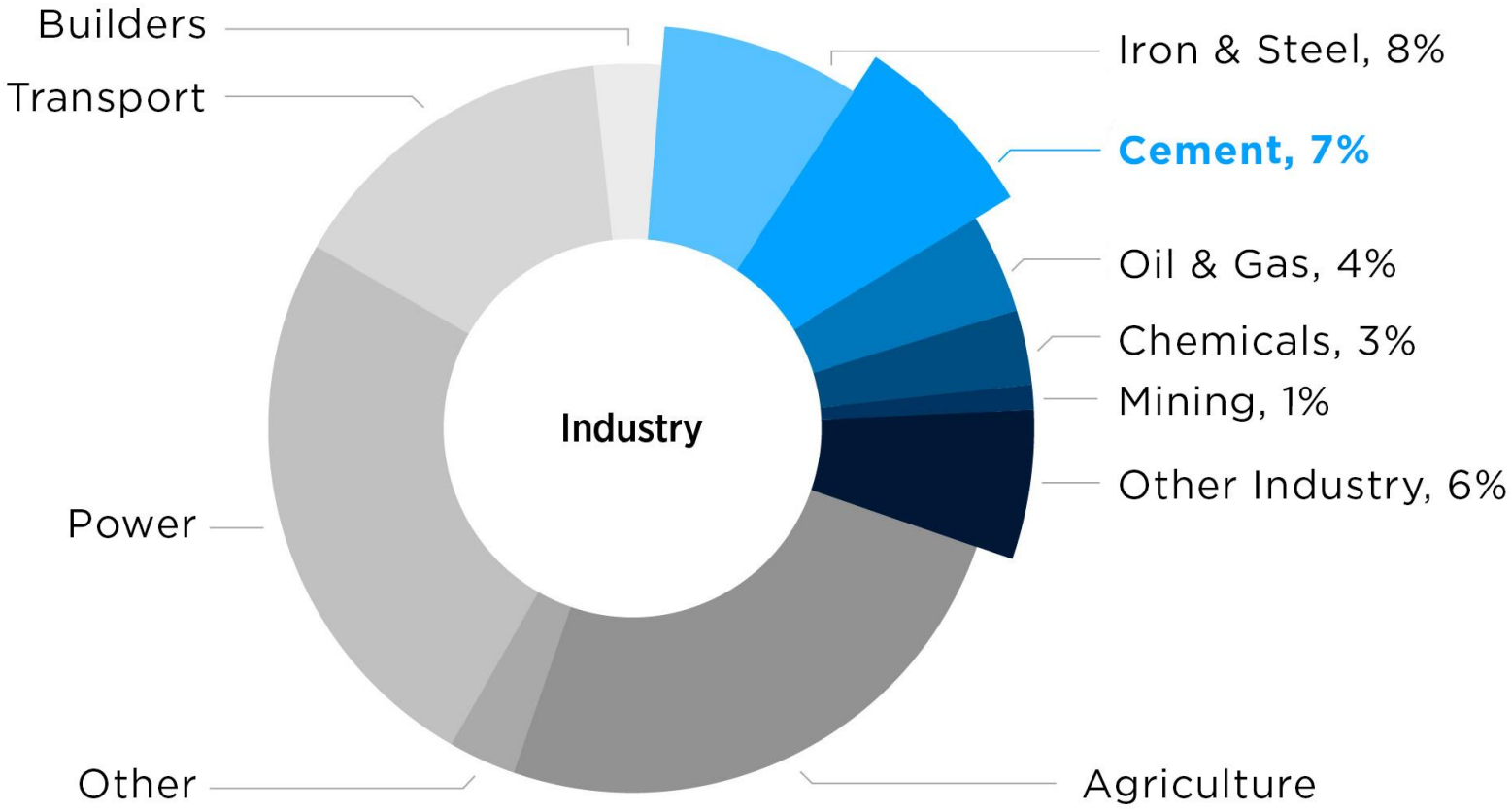
Concrete and the Environment

7% of Total Global Emissions comes from Cement

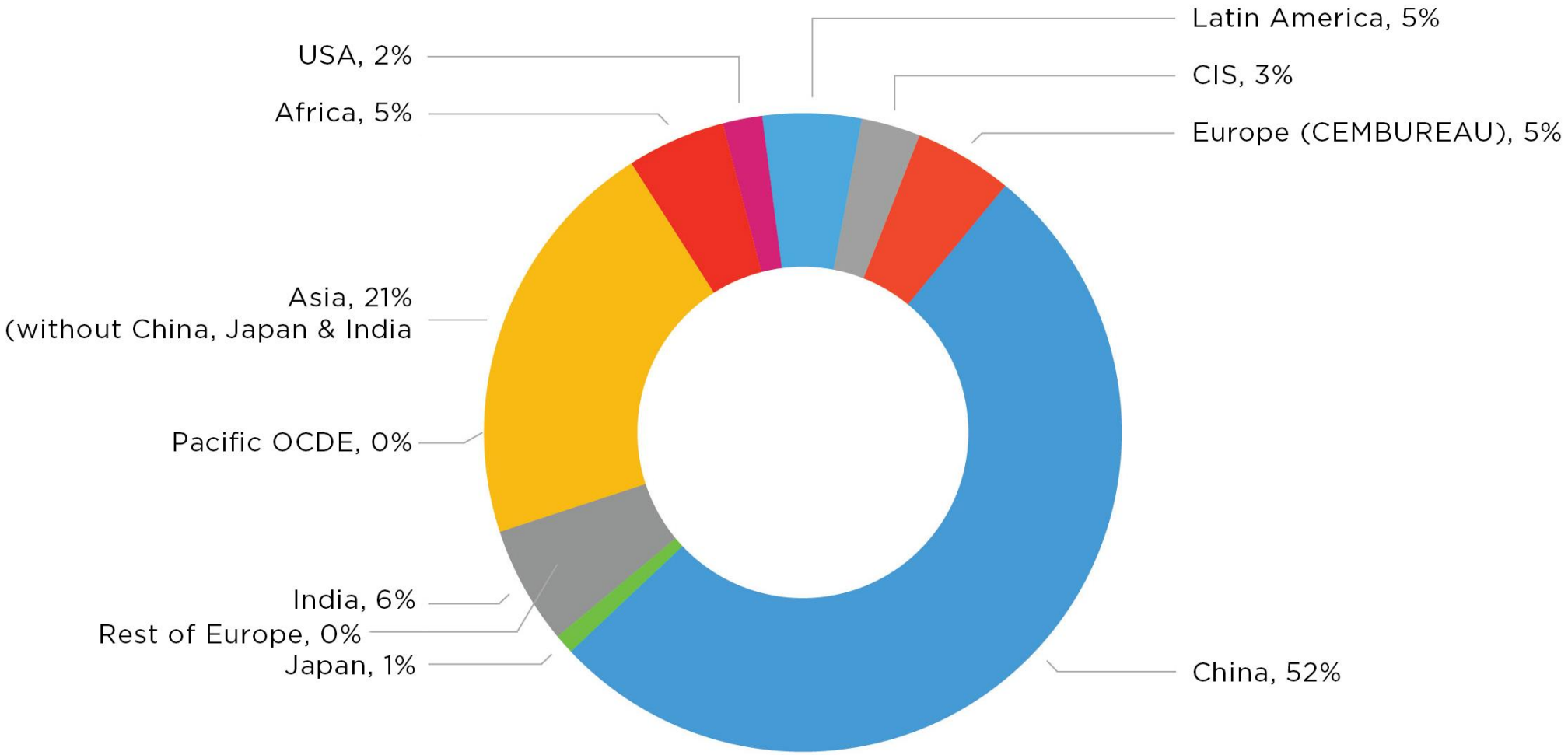
Cement Production's Share of Global CO_2 Emissions % in 2017

The share of global carbon dioxide emissions by sector. Cement production, part of the industrial sector, contributed 7% in 2017. Unless steps to decarbonize are taken, this number is likely to increase as demand for concrete continues to grow.

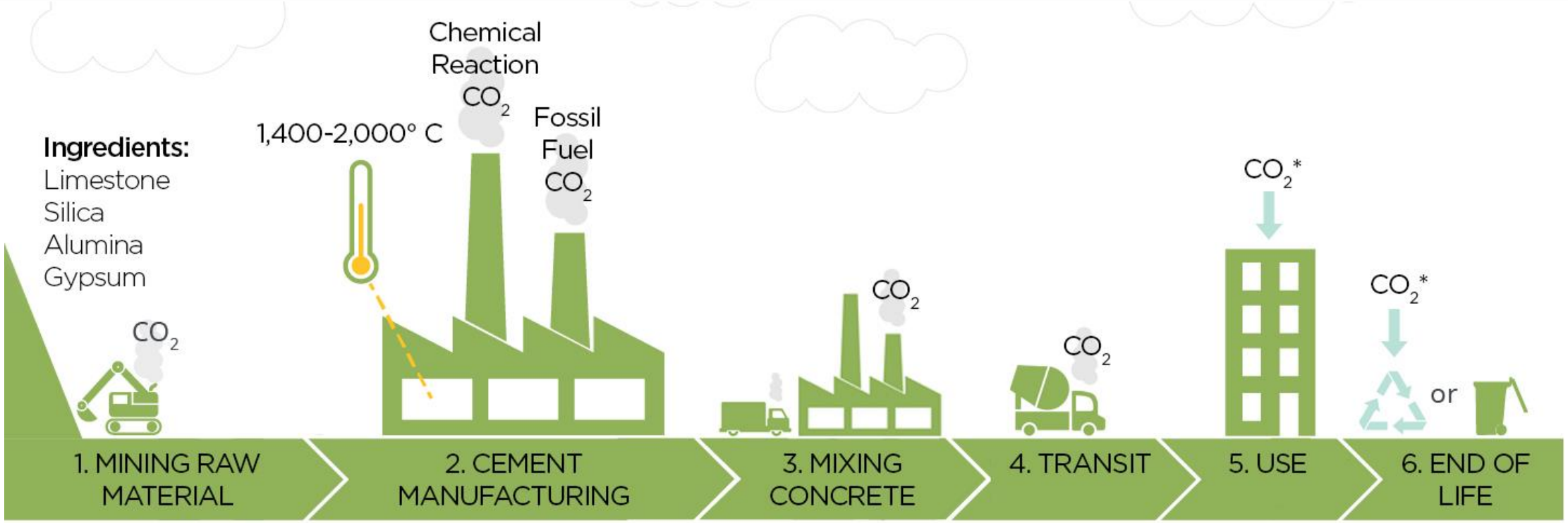


Concrete and the Environment

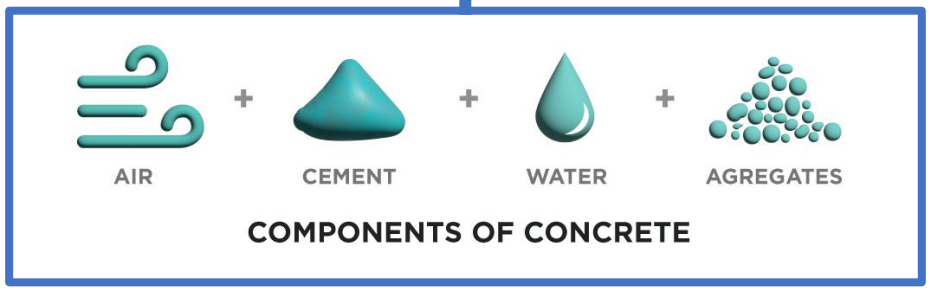
World Cement Production (2016)



Concrete and the Environment



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 CO_2

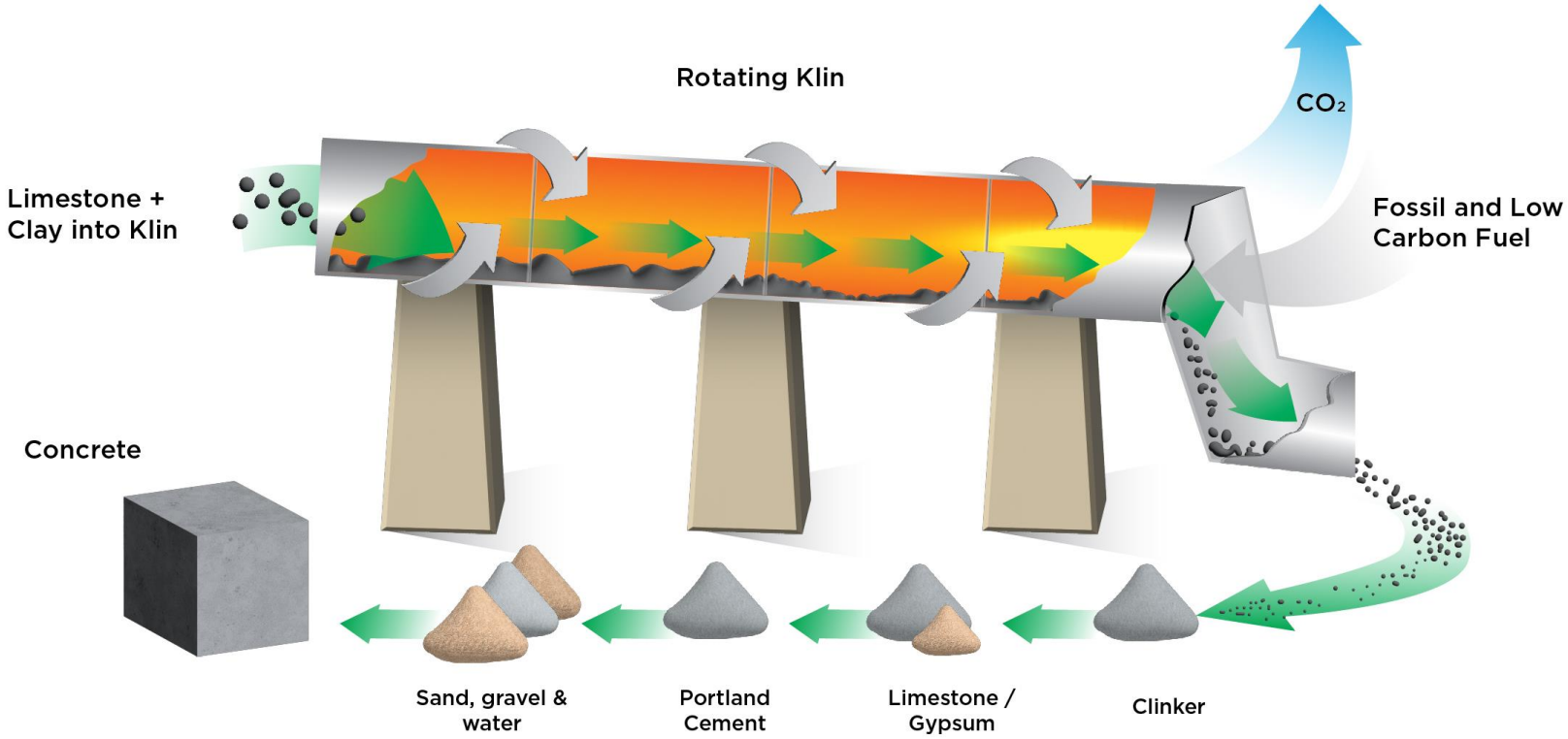


Cement, Concrete and CO_2

CO2 Emissions from a Cement plant are divided into two sources

Combustion – 40%

Calcination – 60%



https://www.cement.org/docs/default-source/th-paving-pdfs/sustainability/carbon-foot-print.pdf

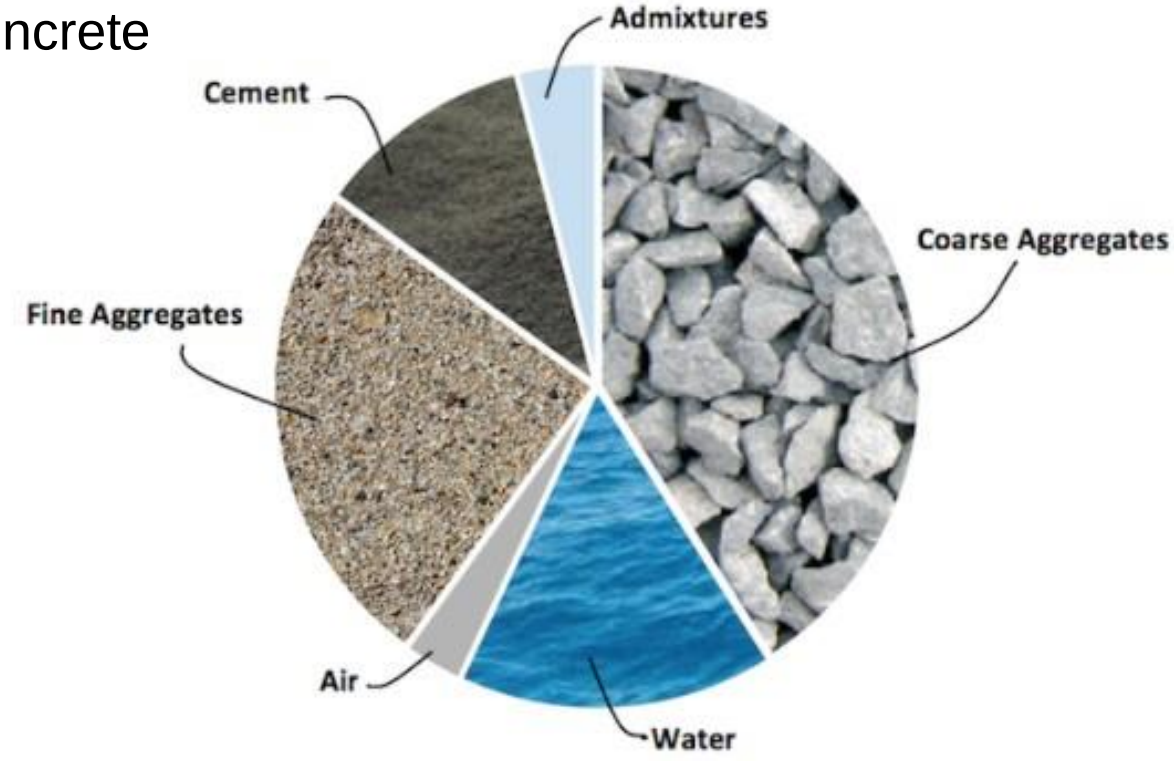
85% of Concrete is not Cement

CO2 Emissions from a Cement vs Concrete

0.9 pounds of CO2 emitted for every pound of cement

Cement is only one part of the ingredient mix for concrete

1 m3 concrete = +- 450 kg of CO_2



https://www.cement.org/docs/default-source/th-paving-pdfs/sustainability/carbon-foot-print.pdf

Concrete Today

Today's Concrete recipe is different

- Replaces a portion of cement with Supplementary Cementitious Materials (SCM)
  - FlyAsh
  - Slag
  - Silica Fume
  - Calcium Carbonate
  - Natural Pozzolans

Many are recycled or by-product materials

https://www.nahb.org/-/media/NAHB/nahb-community/docs/councils/bsc/supplementary-cementitious-materials.pdf

Concrete Today

Latest Innovations

Geopolymers – reacting aluminate and silicate minerals

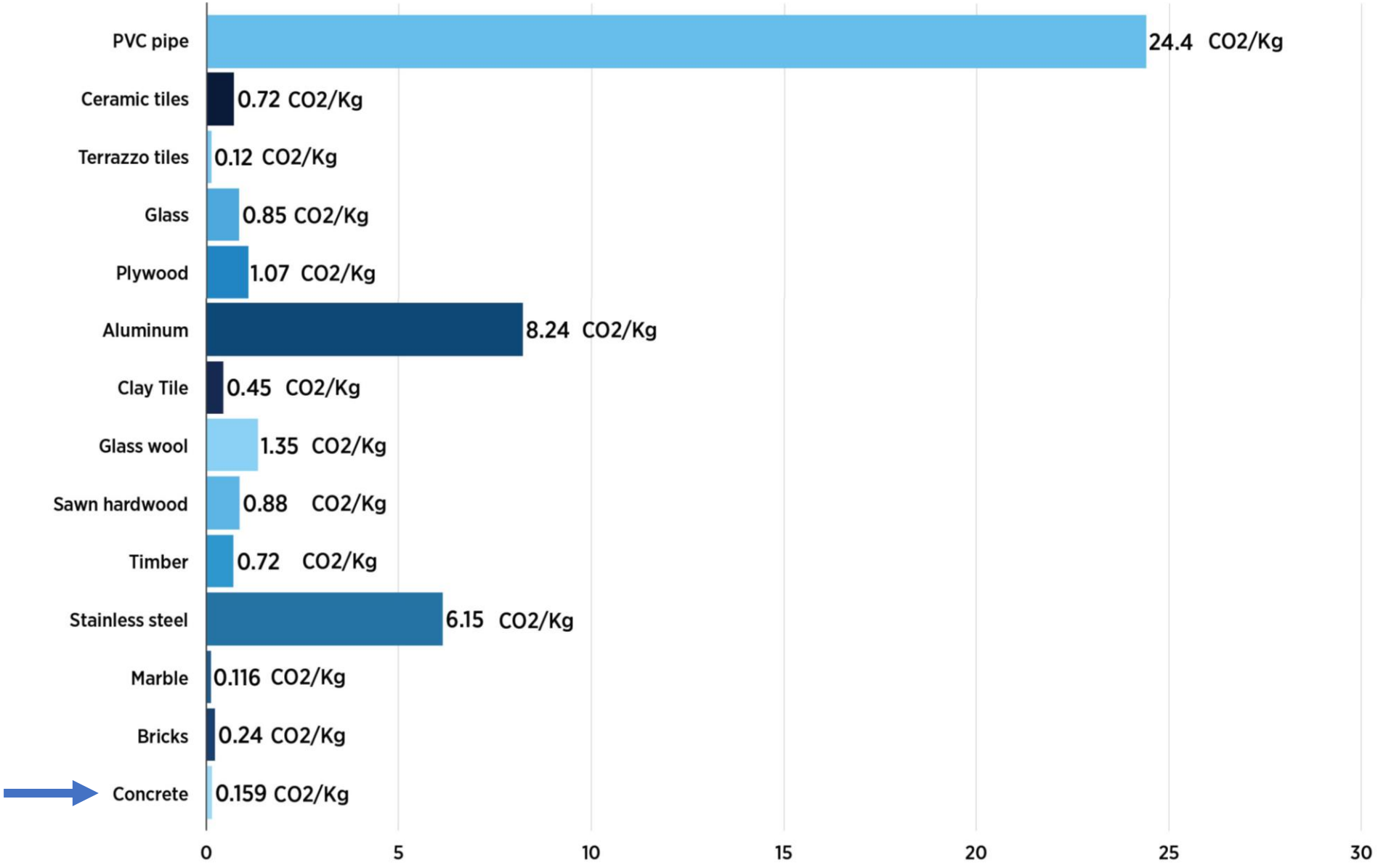
Pozzolans – fly ash, volcanic ash, glass, rice husk

Calcined Clay – Metakaolin – naturally occurring and by-product

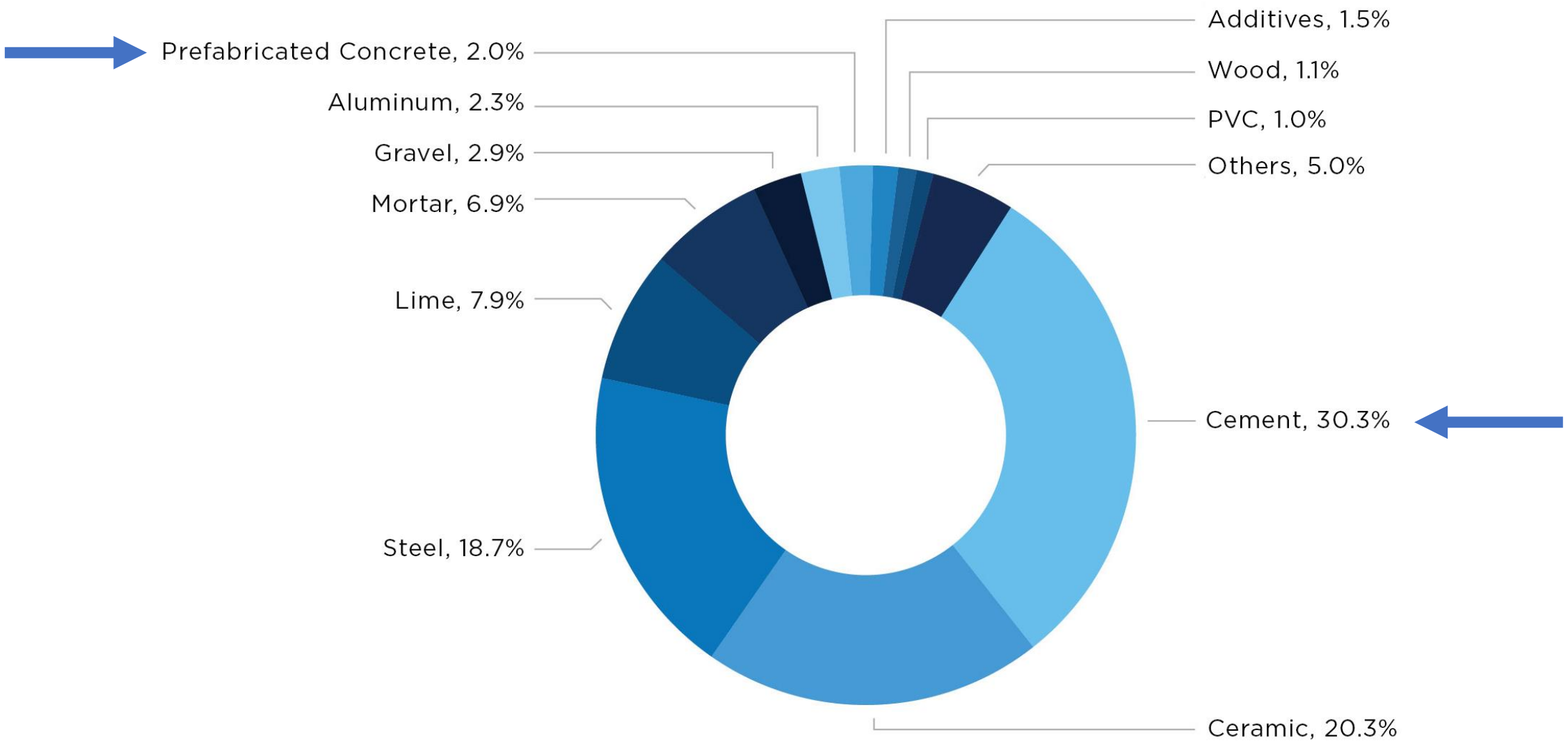
Bio-concrete – naturally occurring microalgae or natural materials/bi

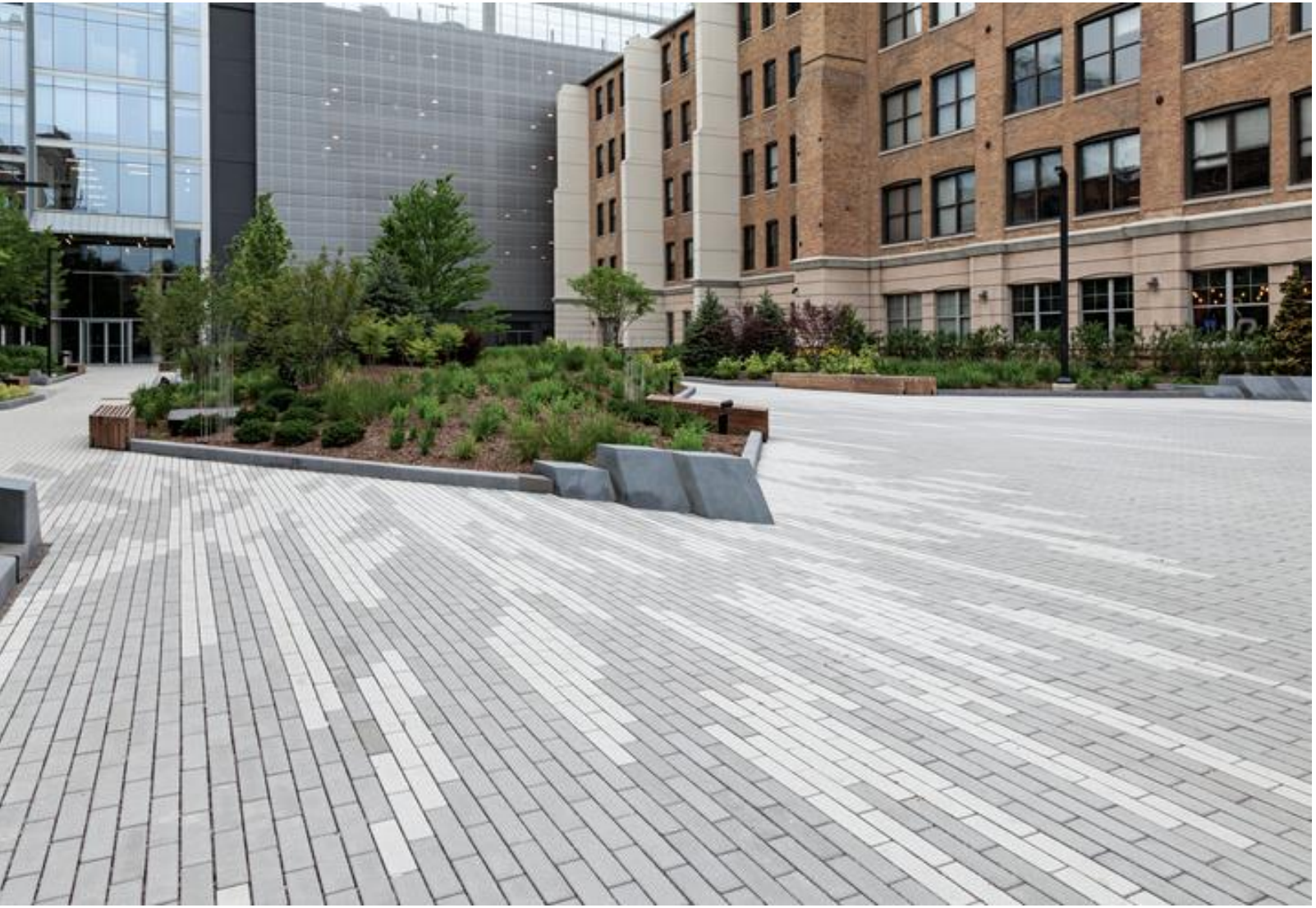
Capturing Carbon in the mix, from industrial processes

Carbon Footprint of Construction Materials



Carbon Emissions Percentage of Building Materials





Climate Positive Design

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ASLA – Climate Action Commitment

Architecture 2030

Challenged design professional to meet targets

Pamela Conrad: Today “landscape architects are likely emitting more greenhouse gas emission than they are sequestering, it’s time for a radical change in the field of landscape architecture.”

https://dirt.asla.org/2022/02/05/landscape-architects-design-with-carbon/

Climate Positive Design

Creating walkable communities

Climate Positive Design

Creating walkable communities

Increase the walkability score

Transportation makes up 29% of emissions – 58% is from light duty vehicles

Creates value for local economies

Healthier for your body and your wallet

Mixed-use Developments – homes, groceries, business, high end and affordable

Create Infrastructure

- Transit – safe, clean, reliable
- Biking – safety and connectivity
- Pedestrian – improving, increasing walkways, reducing vehicular traffic

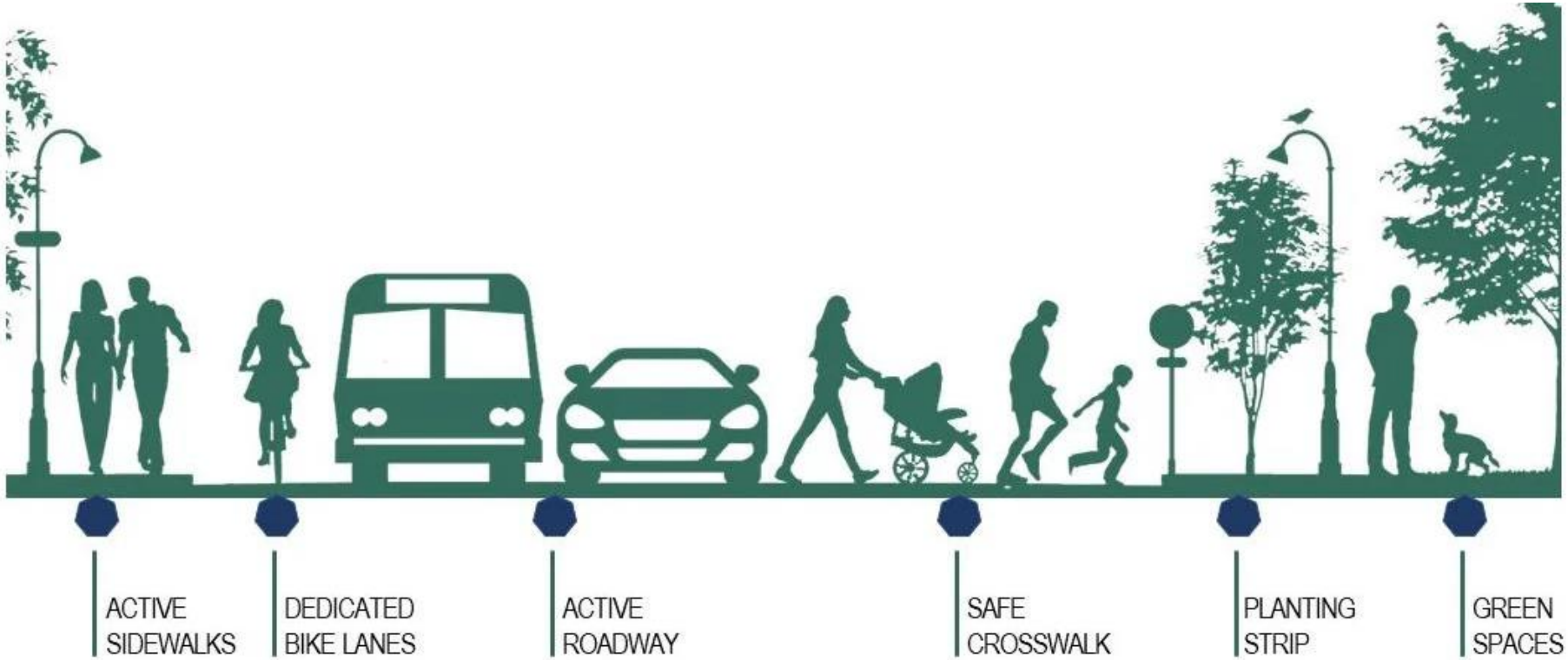
https://www.climaterealityproject.org/blog/walkable-cities-can-benefit-environment-economy-and-your-health

KPMG
pwc

PORTAGE PARKWAY
BUS TERMINAL PRECINCT
APPLEMILL ROAD
NEW PARK PLACE
CENTRAL PARK
KPMG BLOCK
APPLEWOOD ROAD
HIGHWAY 7
EDGELEY BLVD.
MILLWAY AVE.
JANE STREET

Climate Positive Design

Complete Streets



https://nacto.org/wp-content/uploads/2012/06/National-Complete-Streets-Coalition-No-Date.pdf

Climate Positive Design

Complete Streets

Promote mobility, community and environment

Narrowing of traffic lanes, swapping vehicular lane for bike lanes, increasing walkways

Reducing non permeable surfaces and stormwater quality and quantity, polluted runoff, heat island effect

Landscaping – bioswales, planters, rain gardens, street trees – sequester carbon

https://nacto.org/wp-content/uploads/2012/06/National-Complete-Streets-Coalition-No-Date.pdf

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Permeable Paving System Contribution

Part of a Green Infrastructure system

Stormwater management – detention and volume control

Improve water quality

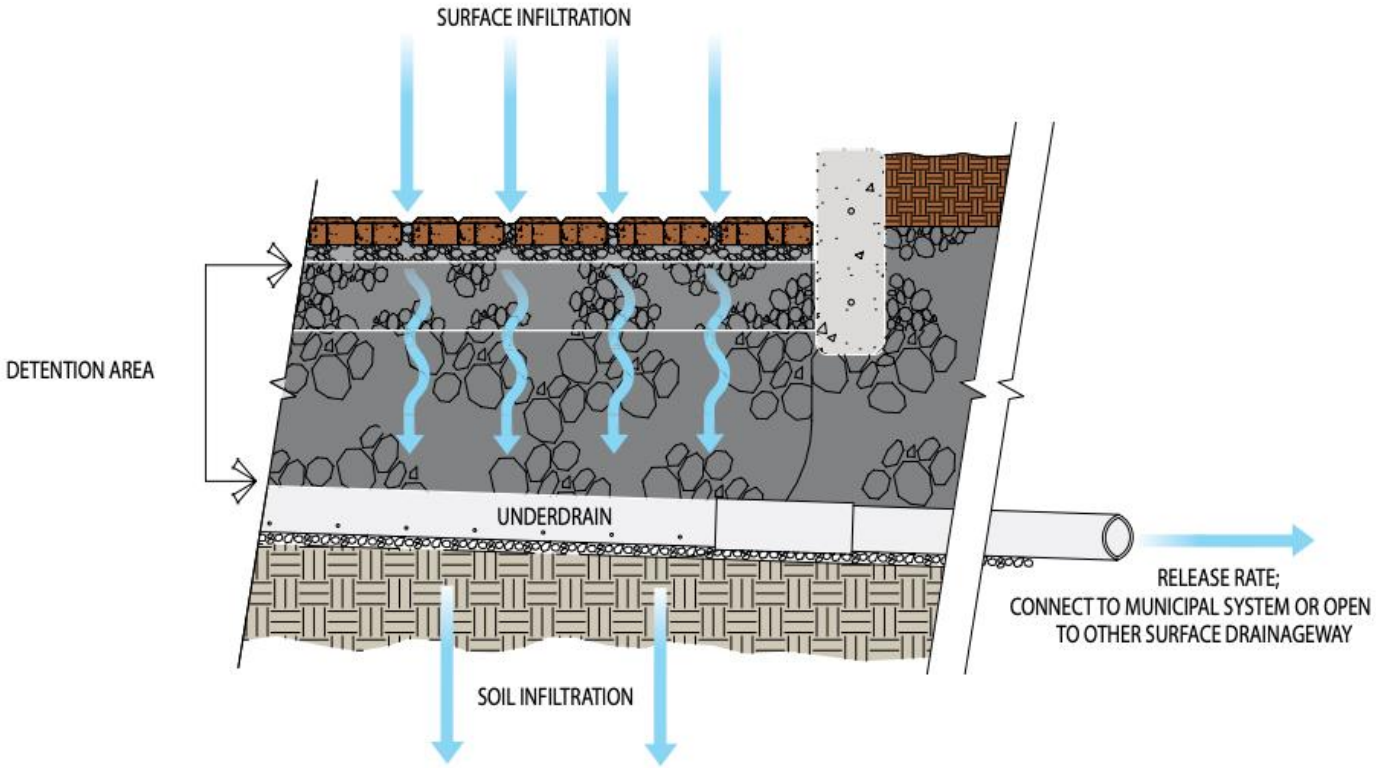
Reduce flooding

Decrease heating of local waterways

Highly aesthetic

Long term durability

Easy to maintenance



Climate Positive Design

Permeable Paving System Contribution

GHG emissions reduced 78-95% (vs conventional drainage systems)

GHG emissions reduced 46% (vs conventional asphalt pavement systems)

Life Cycle Costs of permeable pavements is 30% lower as compared to conventional pavements

Maintenance costs were lower

https://www.sciencedirect.com/science/article/abs/pii/S0921344920302718

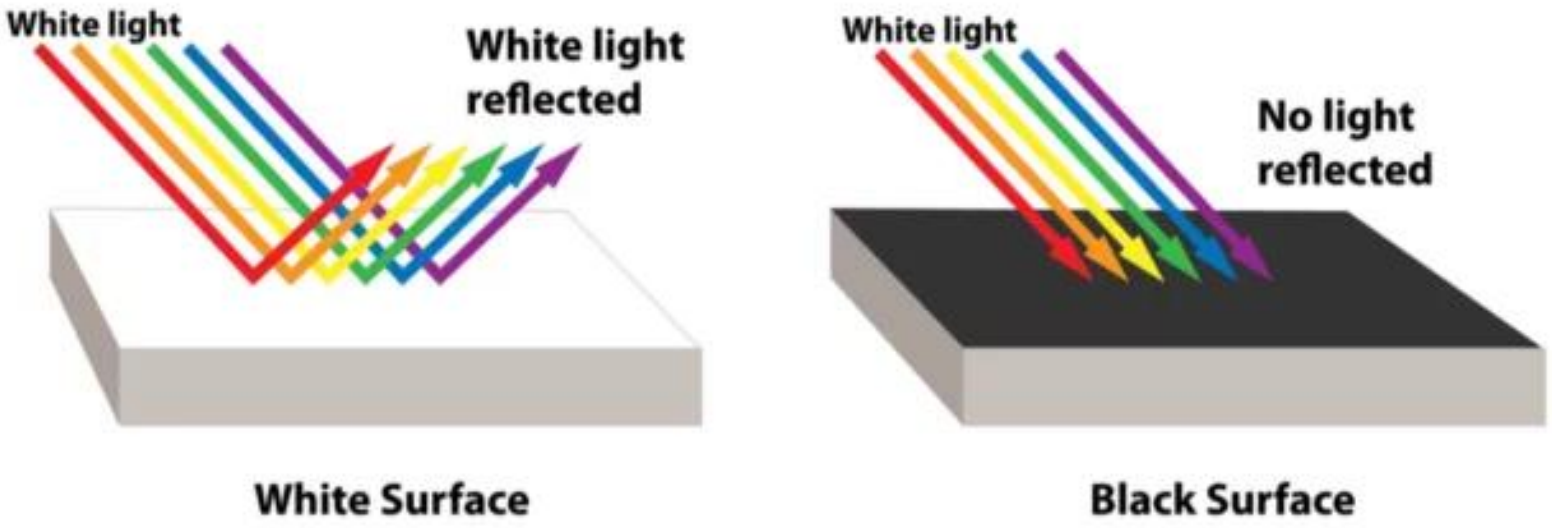
Climate Positive Design

Permeable Paving System Contribution

Highly aesthetic

Climate Positive Design

High Solar Reflectance to reduce Heat Island Effect



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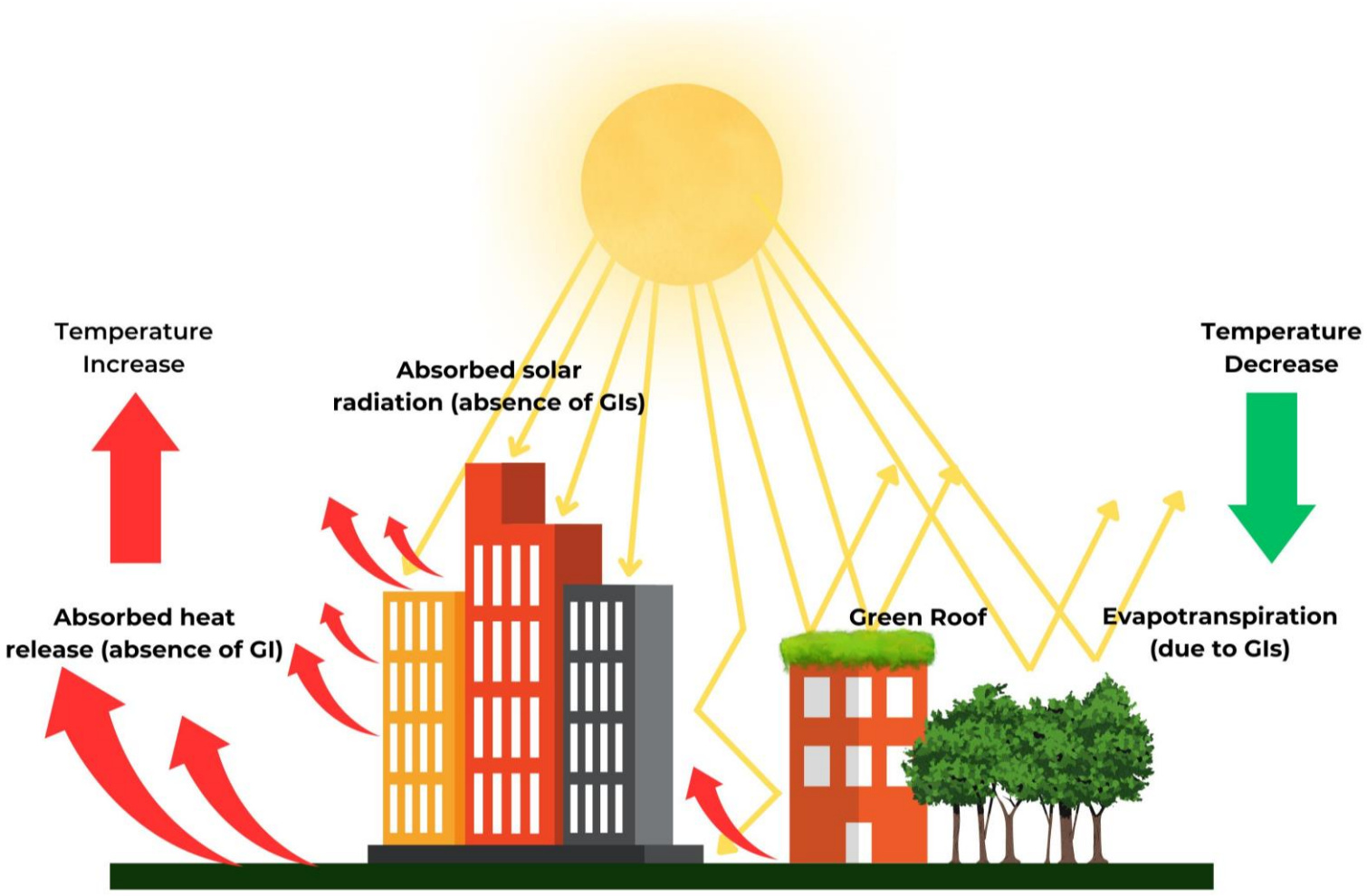
High Solar Reflectance to reduce Heat Island Effect



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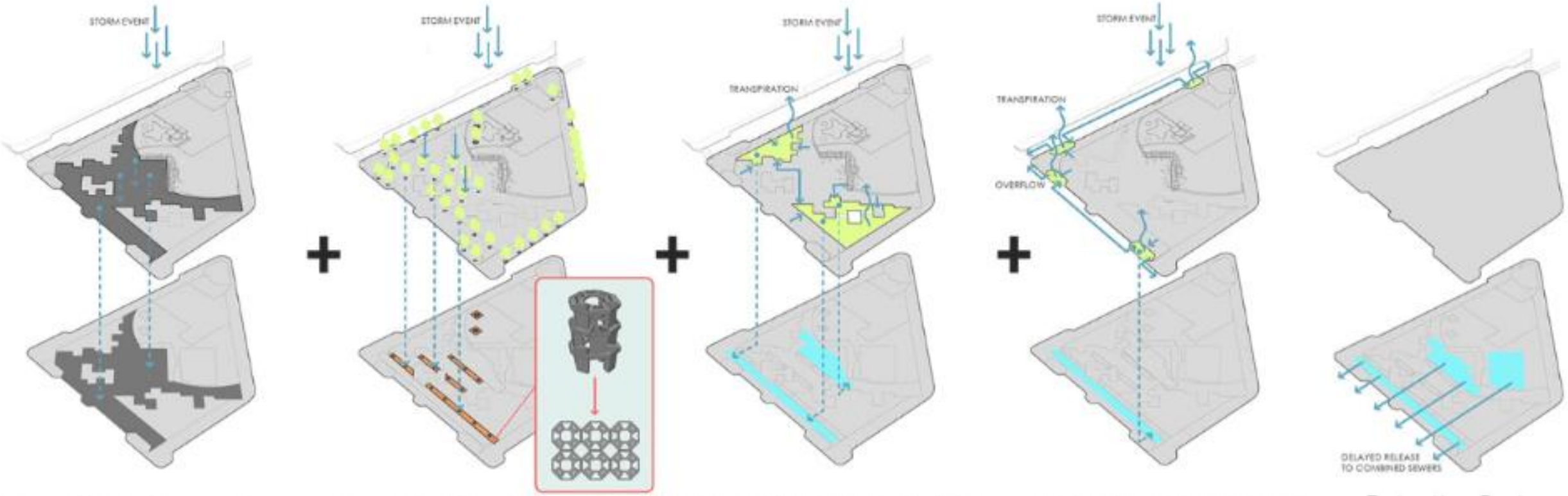
High Solar Reflectance to reduce Heat Island Effect

Swatch	Solar Reflectance	SRI*
	0.64	77
	0.57	68
	0.52	61
	0.49	57
	0.46	53
	0.46	53
	0.46	53
	0.46	53
	0.45	52
	0.46	50
	0.44	50
	0.44	50
	0.42	48
	0.42	48

Swatch	Solar Reflectance	SRI*
	0.41	46
	0.41	46
	0.40	45
	0.39	44
	0.39	44
	0.40	44
	0.38	42
	0.37	41
	0.37	41
	0.35	38
	0.35	38
	0.35	36
	0.33	36
	0.32	34

LOADING 2
651 OBSERVER HWY
INTREPID GYM



Open-Jointed Pavers Over Gravel Filter Stormwater

Tree Cells Allow Aerated Soil to Collect Water

Rain Gardens Channel Water to Detention Basins

Street Bioswales Channel Water to Detention Basins

Detention Basins Delay Release to Combined Sewer

Climate Positive Design

Ramp up nature-based carbon sequestration/carbon sinks

Increase plantings on site

The right soil base for capturing

Increase variety of species on site

- Including variety of root range, type and depth adds positive impact
- More native and resilient plants

Increase coastal wetlands- mangroves, tidal marshes, seagrass

Bamboo can store carbon for thousands of years

Green roofs

https://dirt.asla.org/2022/02/05/landscape-architects-design-with-carbon/

Climate Positive Design

Understand material options

Recycled or reuse materials where possible - recycled steel - recycled plastics

Natural elements – if wood, use reclaimed or sustainably harvested

Reduce materials – get creative with designs.

Design for deconstruction

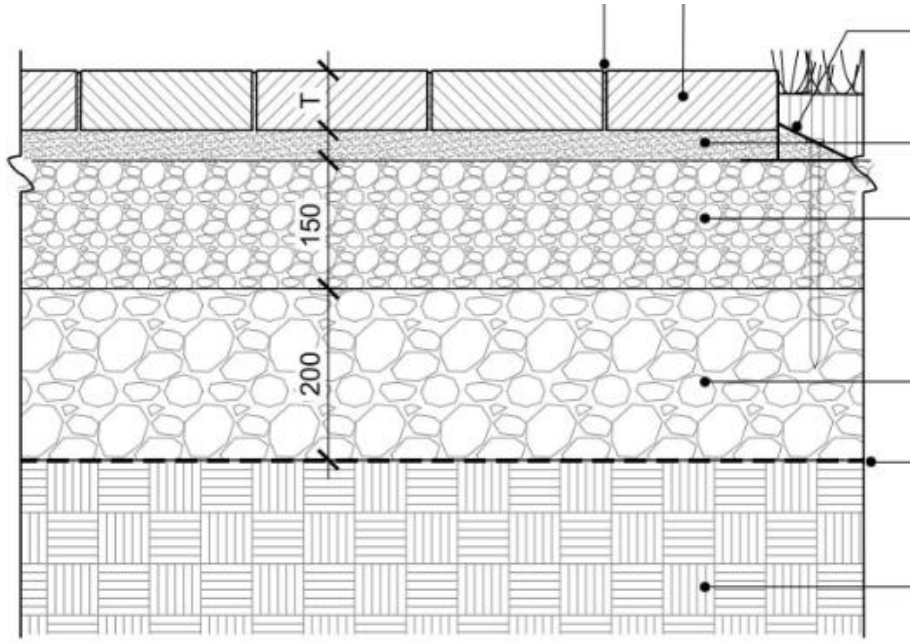
Optimize specification & mix design (i.e concrete)

- use performance based specification
- use concrete that replaces a portion of the Portland cement with SCMs
- explore alternatives to poured in place

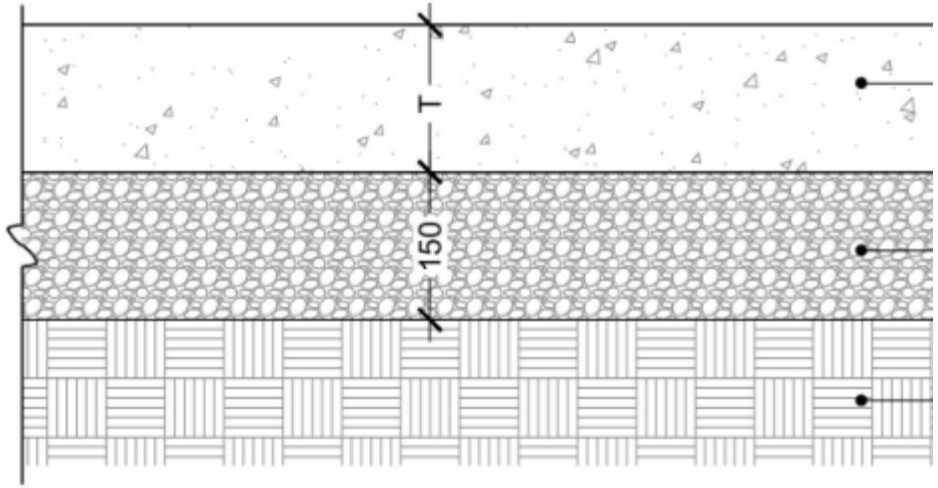
Source local materials

https://worldlandscapearchitect.com/landscape-architects-leading-the-charge-for-climate-action/?v=3e8d115eb4b3#.Y_UaZy2cZ4k

Climate Positive Design



T= 60MM.: PEDEDSTRIAN DUTY



NOTES:
1. CONCRETE THICKNESS (T):
   1.1. 150MM: PEDESTRIAN STANDARD DUTY
   1.2. 180MM: VEHICULAR HEAVY DUTY

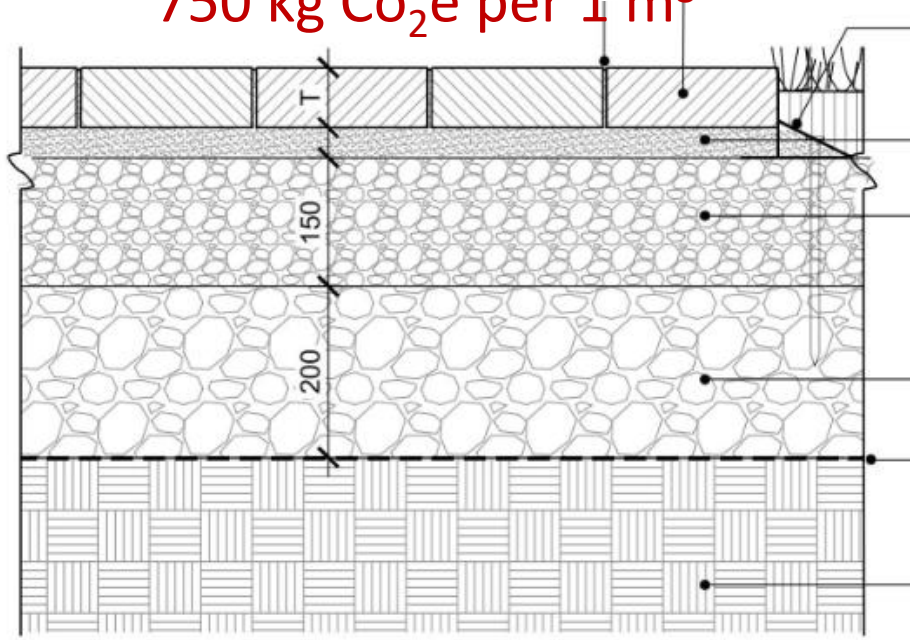
Using Pavers vs Poured in Place

Pedestrian = 60mm vs 150 mm = 60% concrete mass savings

Vehicular = 100mm vs 180mm = 45% concrete mass savings

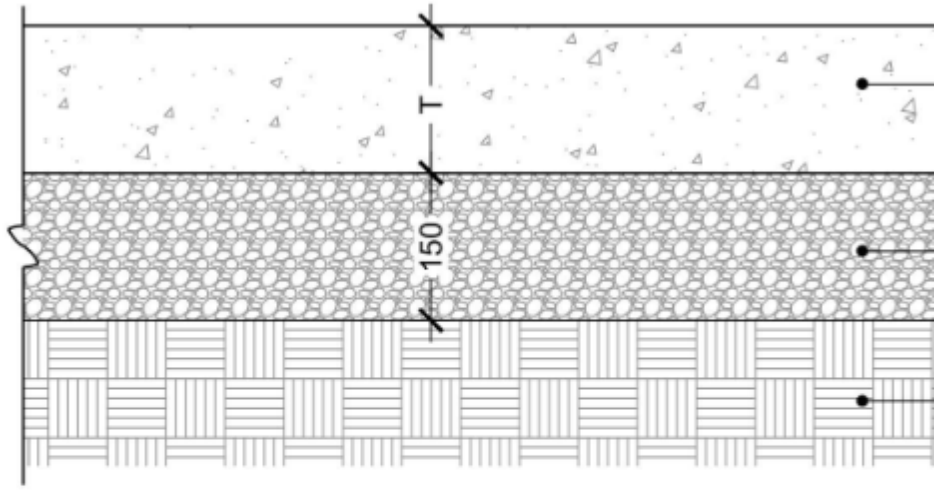
Climate Positive Design

750 kg Co_2e per 1 m^3



T= 60MM.: PEDEDSTRIAN DUTY

400 kg Co_2e per 1 m^3 – 5800 psi



NOTES:
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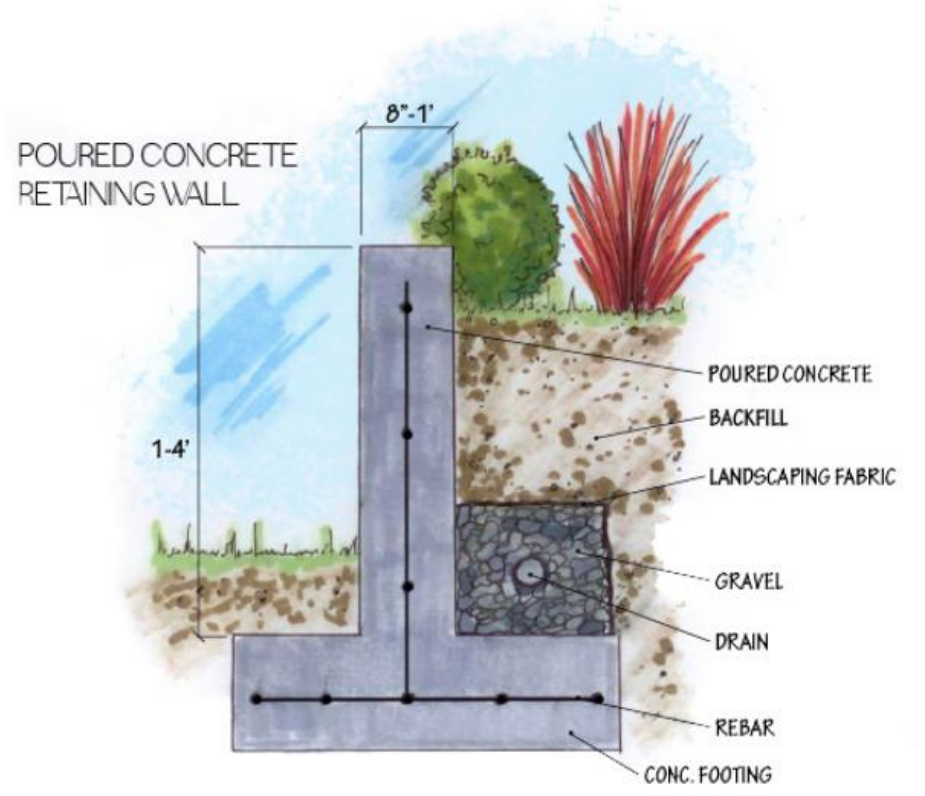
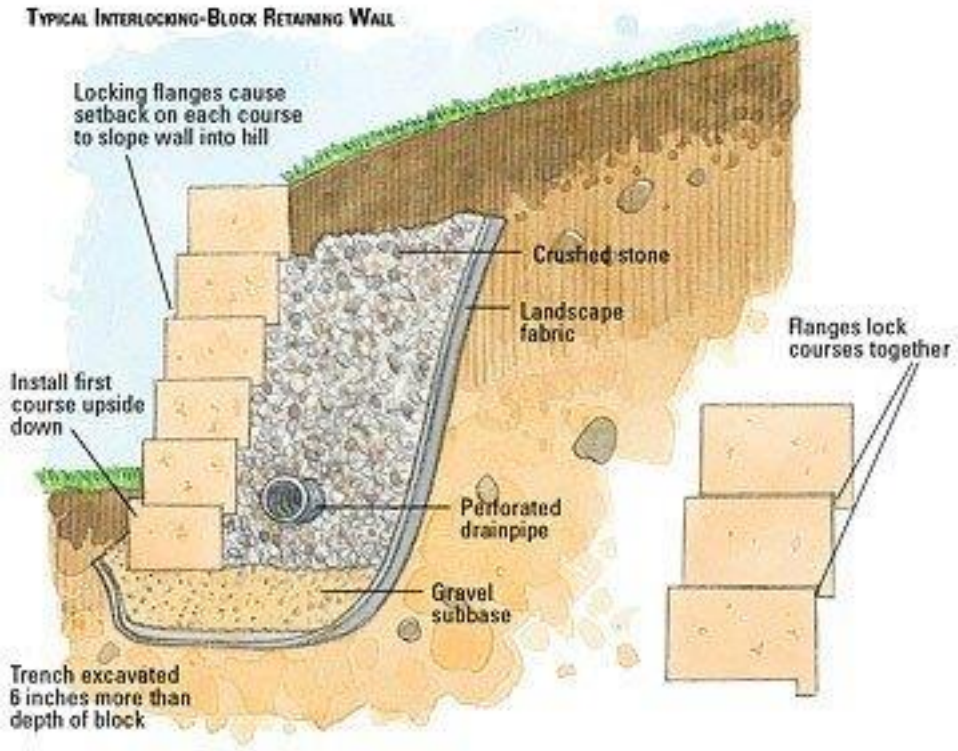
   1.2. 180MM: VEHICULAR HEAVY DUTY

Using Pavers vs Poured in Place

Pedestrian = 60mm vs 150 mm = 60% concrete mass savings = 300 kg C02e = 25% less

Climate Positive Design





Retaining Walls

Design dependent - similar volume of material or a great reduction in material for SRW

Metals / Rebar not required – significant CO2 impact

Segmental blocks walls easily be reused and reconfigured

Climate Positive Design

Engineered Walls

Site by site evaluation

- Ground conditions on site
- Geometric limitation (allowable space)
- Aesthetic finish

Material savings (cost)

Excavation savings (labor and material)

Reduced wastage

Locally sourced

Tools

Environmental Product Declaration

Industry-wide EPDs

Product-specific EPDs

Supply chain-specific EPDs

Facility-specific EPDs

ENVIRONMENTAL PRODUCT DECLARATION

DRYCAST PAVER PRODUCT

UNILOCK

Since 1972, when Unilock brought the first paver to North America, we have consistently strived to raise the bar. Today we offer unmatched variety of paver, slab and wall styles. It takes more than bringing new products to market to make a great company. It also requires providing excellent support, and fostering business practices that are inclusive, equitable, sustainable and grounded in corporate integrity. As we pave the way forward, this remains at the core of our company culture.

CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

Concrete interlocking paving units, slabs and segmental retaining walls units are used as hardscapes in the creation of outdoor environments, both commercially and residentially. Being very durable and resistant, these materials have a long lifecycle, low maintenance costs, contribute to Low Impact Development, carbon sequestration, LEED and Green building initiatives.

Greenhouse Gases

Designing for Zero Carbon Summary

Choose products with recycled or carbon friendly content

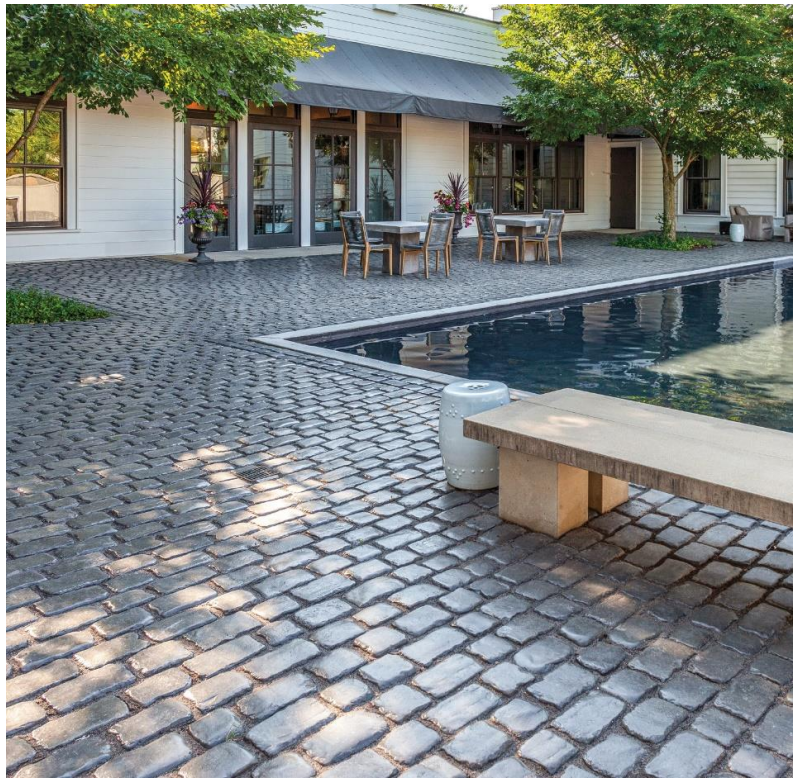
Use materials that are on site

Choose low maintenance products

Weigh the offsets of the product or systems benefit

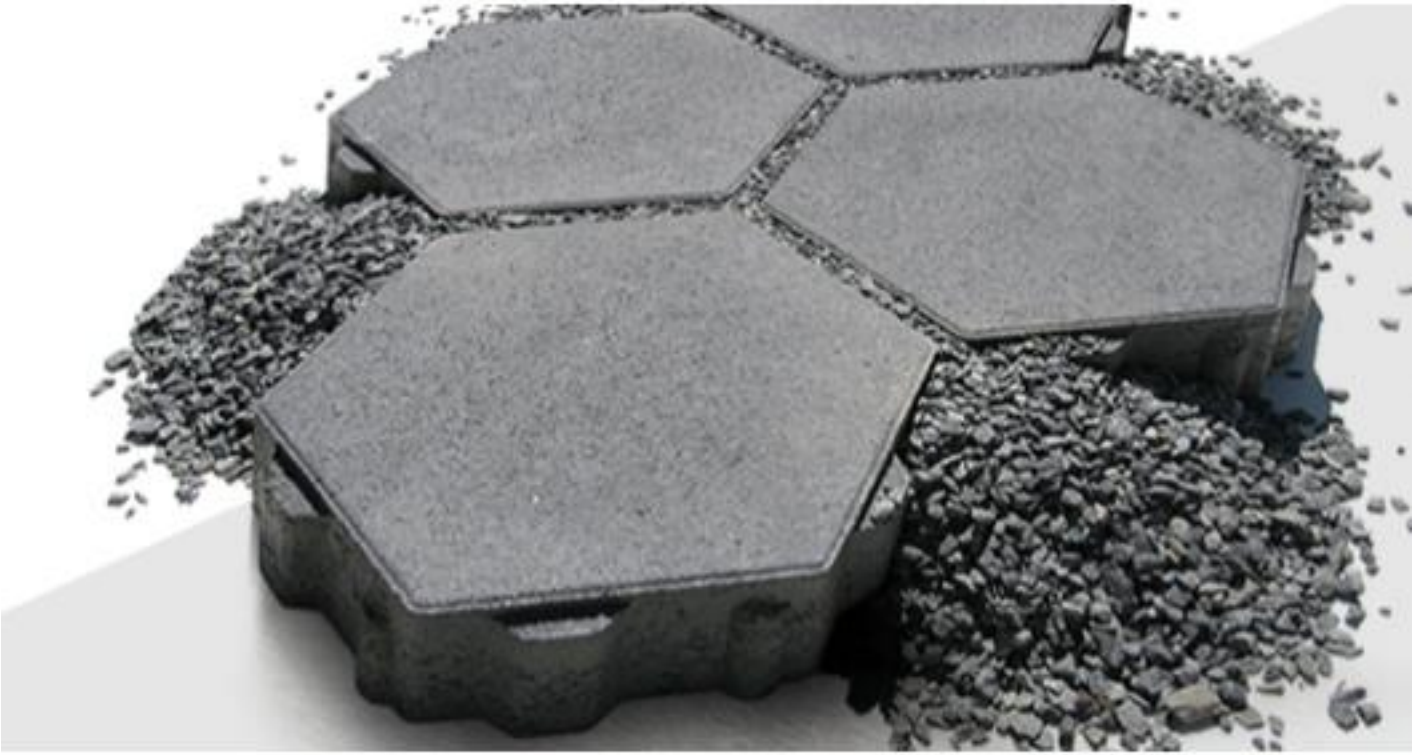
Design wholistically positive projects that will deliver a net zero carbon value over prescribed period of time

THANK YOU!



The completes the accredited portion of this presentation.

Recycled Content



Navy Pier, Chicago IL

Project Goals:

- ✓ 30% Recycled content (Copper Slag)
- ✓ Source regionally manufactured pavers
- ✓ Source regionally extracted aggregates for the pavers
- ✓ Use pavers with a high SRI value

Result:

Unilock was able to help James Corner Field Operations meet their goals and Navy Pier was awarded Sustainable (SITES) Gold Certification.

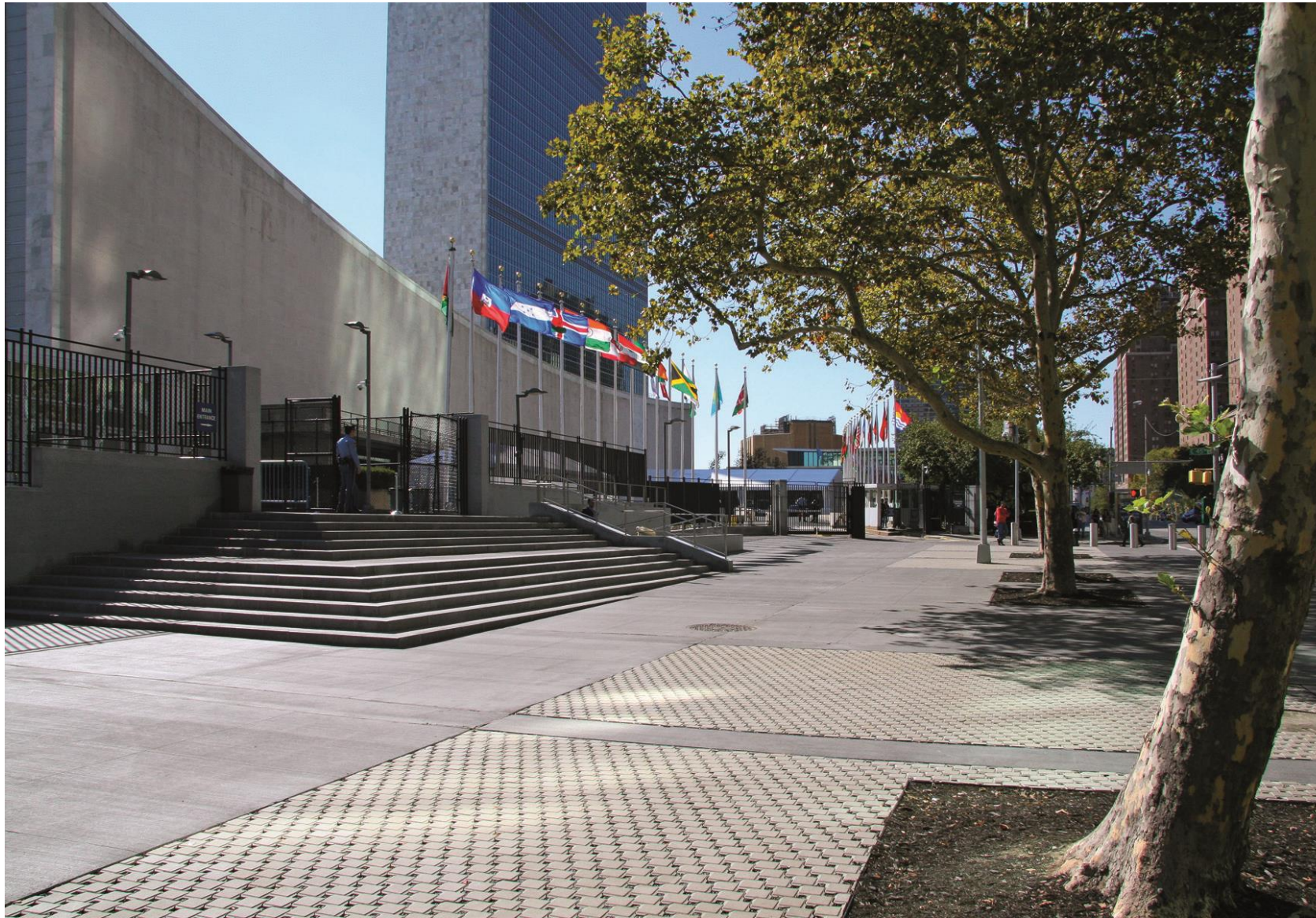
United Nation Secretariat Building, Manhattan NY

Project Goals:

- ✓ Replace 60 yr old single pane windows with efficient double glazed panels
- ✓ Recycle windows being removed – ground in to pozzolan
- ✓ 20% cement replacement
- ✓ Source regionally manufactured pavers
- ✓ Source regionally extracted aggregates for the pavers

Supplementary Cementitious Materials (SCM) can be by-products of other materials

- Fly Ash (Class C or F)
- Ground Granulated Blast Furnace Slag
- Silica Fume
- Natural Pozzolans
- Recycled glass and more



Unilock Journey to Carbon Neutrality

A little history

Unilock introduced paving stones to North America in 1972

a new alternate to asphalt and poured concrete

1990’s we introduced the permeable paver system to North America

1990’s we also started to supplement cement content in our mix with slag

Today we **replace up to 55% cement** content with alternate SCM’s which are recycled or by-product materials

Product EPDs are now available.

Unilock Group of Companies

All concrete waste from our facilities is recycled

Adding / using Electric Vehicles and Forklifts

Installed Solar Panels

Some of our packaging/labels are made of recycled material

Working to quantify our current Carbon Footprint to make further improvements

EPDs

Environmental Product Declaration

Unilock Journey to Carbon Neutrality

EcoTerra™

PAVING A GREENER WAY

Unilock Journey to Carbon Neutrality

EcoTerra Face-Mix

Cement is replaced in the top 15% of the product

Reducing cement by 15% results almost a 15% reduction in CO_2

Unilock Journey to Carbon Neutrality

NEW Technology

100% Cement-free Facemix

- High Compressive Strength >12,000 psi
- Low Absorption
- Efflorescence free
- Brighter Colors
- Water Repellant
- Dirt won’t penetrate
- More Durable

Up to **15% Embodied Carbon Reduction**

Unilock Journey to Carbon Neutral

4 x 12” 7cm Promenade Plank EcoTerra

Light Opal Blend – Shot Blast

Light Steel Grey – Shot Blast

A GREENER WAY

19

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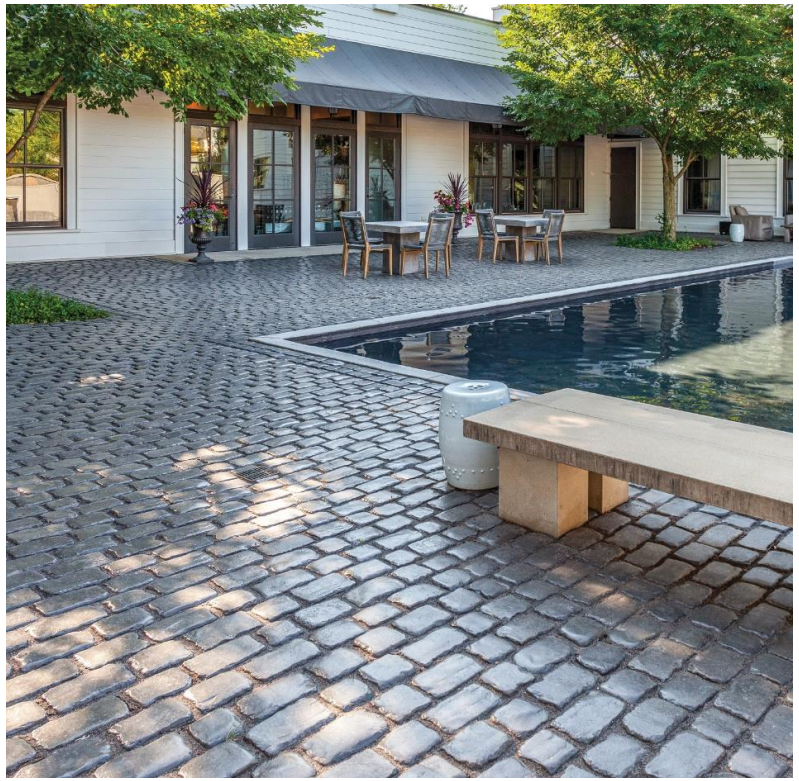
ECOTERRA
THE SUSTAINABLE CONCRETE STONE.

THANK YOU!