

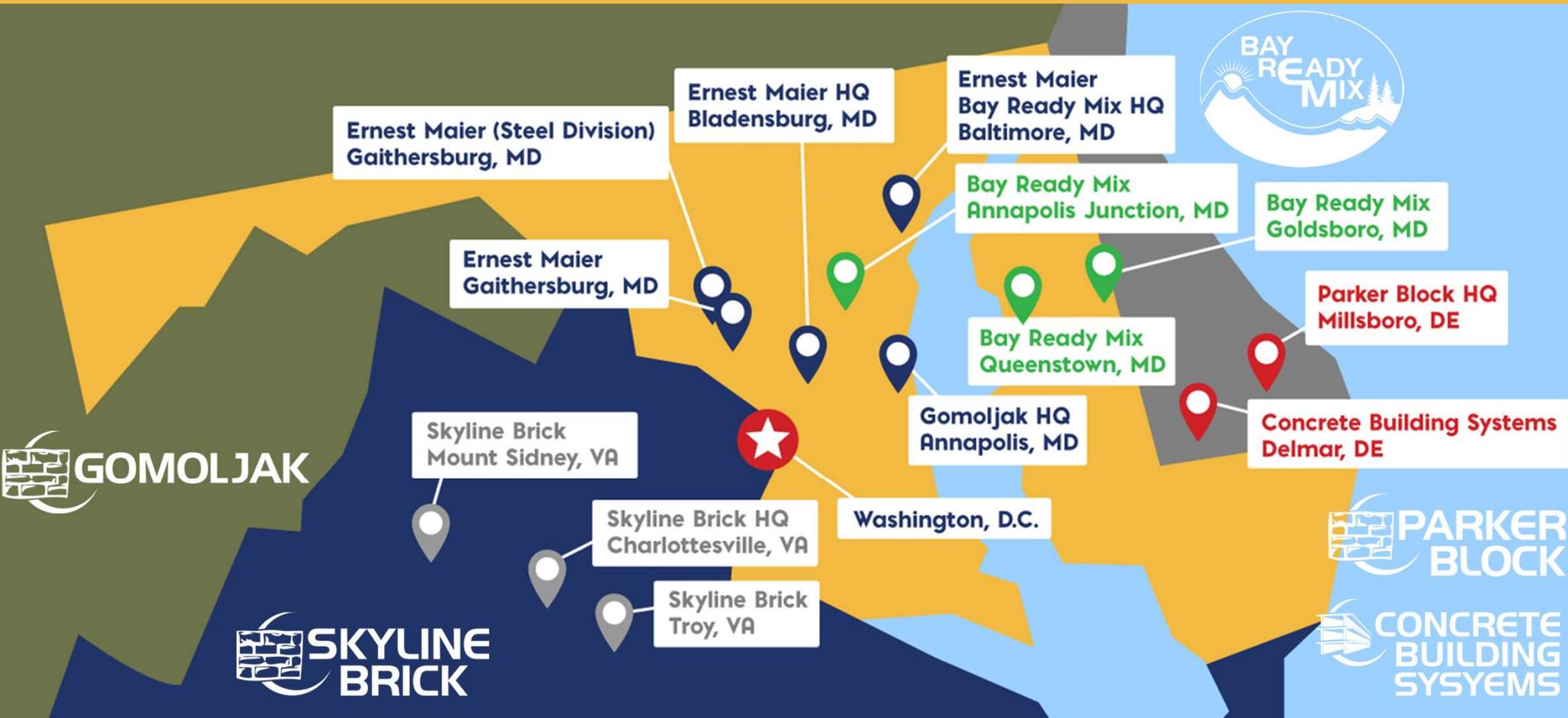
# Climate and Carbon Reduction

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# EST. 1926 ERNEST MAIER

MORE THAN JUST BLOCKS



1.What is Sustainability

2.Statistical Regime Do We Live In: Normal vs. Fat-Tailed

1.Vegas Casino + Craps

2.Real World

3.Odds Build, Leading to Extreme Events

3.Extreme Events

1.Events Nationally

2.Temperature Anomalies

3.CO2 Emissions

4.Stopping CO2 Solves the Problem

#### 4. Construction In the Crosshairs

4. MD rules

5. Lumber Industry Eating Our Lunch

6. Redirect- Sustainability is bigger

#### 5. What About Concrete

4. Long Lasting

5. Resilient

6. Densify Development – but still be livable

7. Lower CO2 Emissions Cement

8. Carbon Diet

9. Freshwater consumption

#### 6. This is the Conversation We've Been Having- Just Need to Reframe



## Least Sustainable Way to Make 1 Cup of Coffee

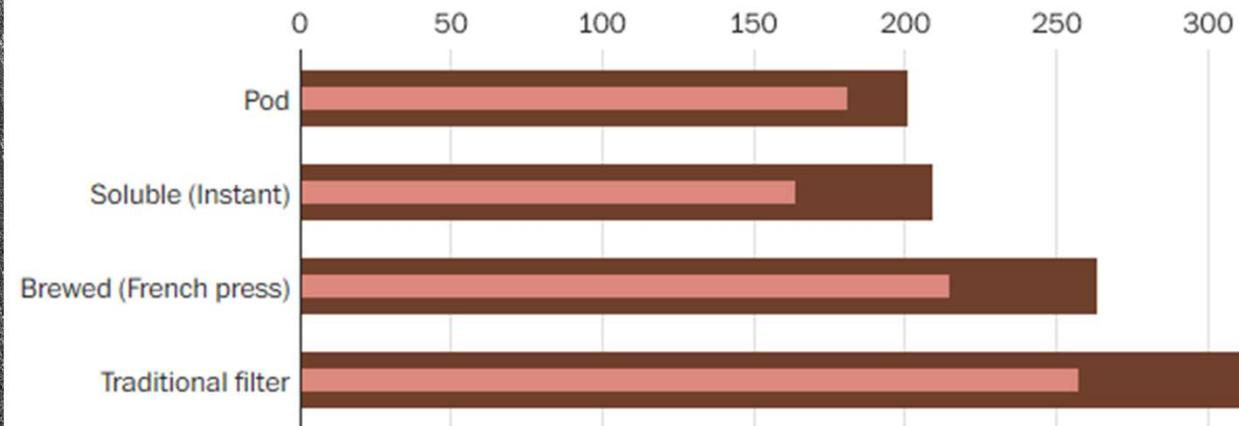
1. Pods (Keurig)
2. Instant
3. French Press
4. Traditional Filter

# Sustainable Coffee

## Total emissions by brewing method based on type of preparation

In grams of CO<sub>2</sub> equivalent per 280 ml of coffee

■ Wasteful ■ Recommended



Note: Data is based on a carbon-intensive electricity scenario

Source: [Luciano Rodrigues Viana/Université du Québec à Chicoutimi \(UQAC\)](#)

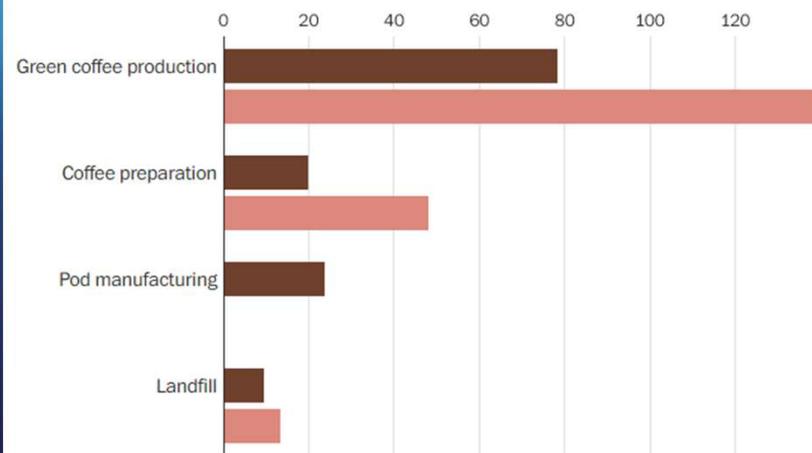
ALLYSON CHIU / THE WASHINGTON POST

# Sustainability: The Unseen

## Comparing emissions from pods and traditional filter brewing

In grams of CO<sub>2</sub> equivalent per 280 ml of coffee

■ Pod ■ Traditional filter



Note: Data is based on a carbon-intensive electricity scenario

Source: Luciano Rodrigues Viana/Université du Québec à Chicoutimi (UQAC)

ALLYSON CHIU / THE WASHINGTON POST



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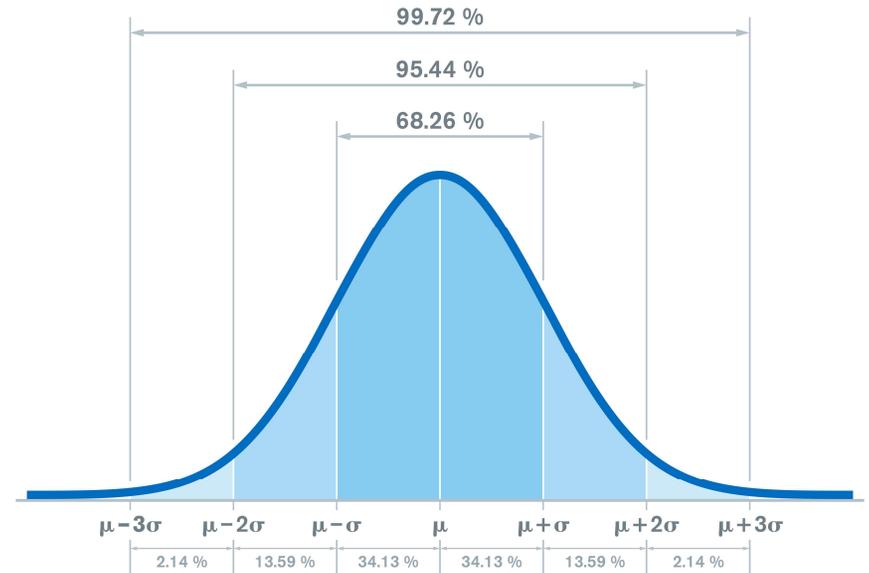
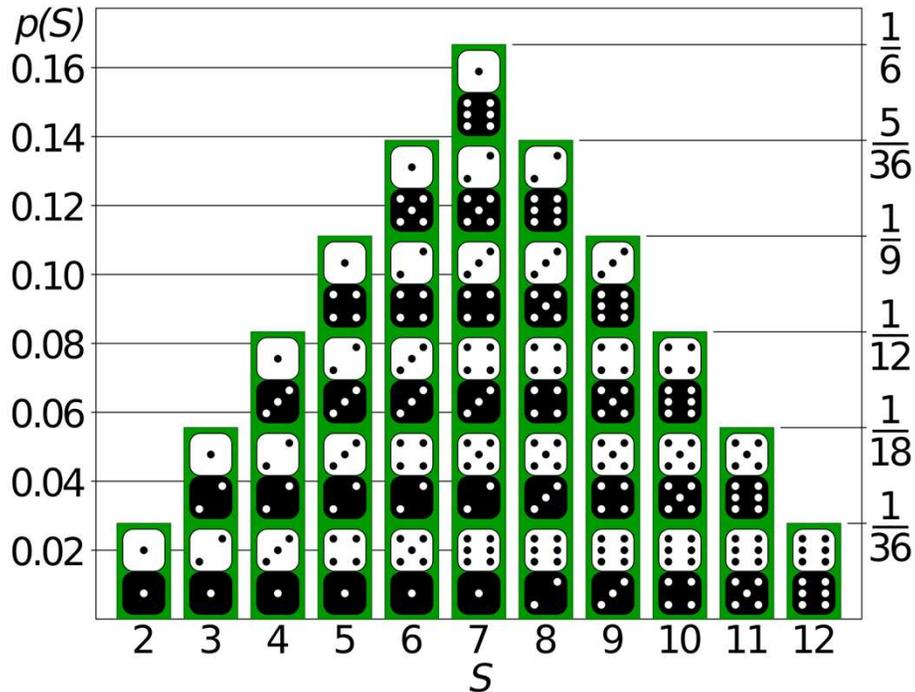
# CRAPS ODDS & HOUSE EDGE

BET	ODDS	HOUSE EDGE
PASS/ COME	1 to 1	1.41%
DON'T PASS/ DON'T COME	1 to 1	1.40%
FIELD 2 OR 12	2 to 1	5.56%
FIELD ALL OTHERS	1 to 1	5.56%
BIG 6 OR 8	1 to 1	9.09%
PLACE 4 OR 10	9 to 5	6.67%
PLACE 5 OR 9	7 to 5	4.00%
PLACE 6 OR 8	6 to 5	3.33%

Maximize Our Chances

# Bell Curve

Normal Distribution





REALITY



Think About a Really Bad Day

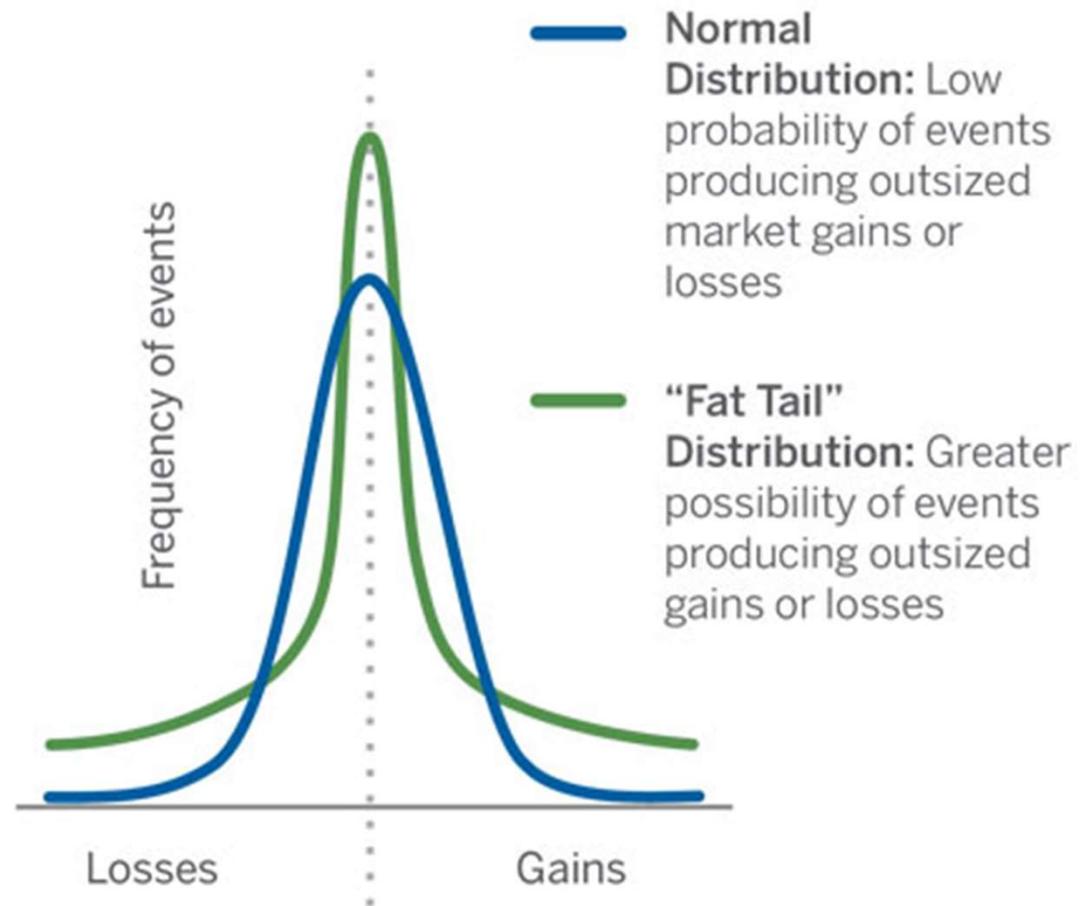
# Cascading Set of Problems

It wasn't just one thing it was a sequence of compounding issues

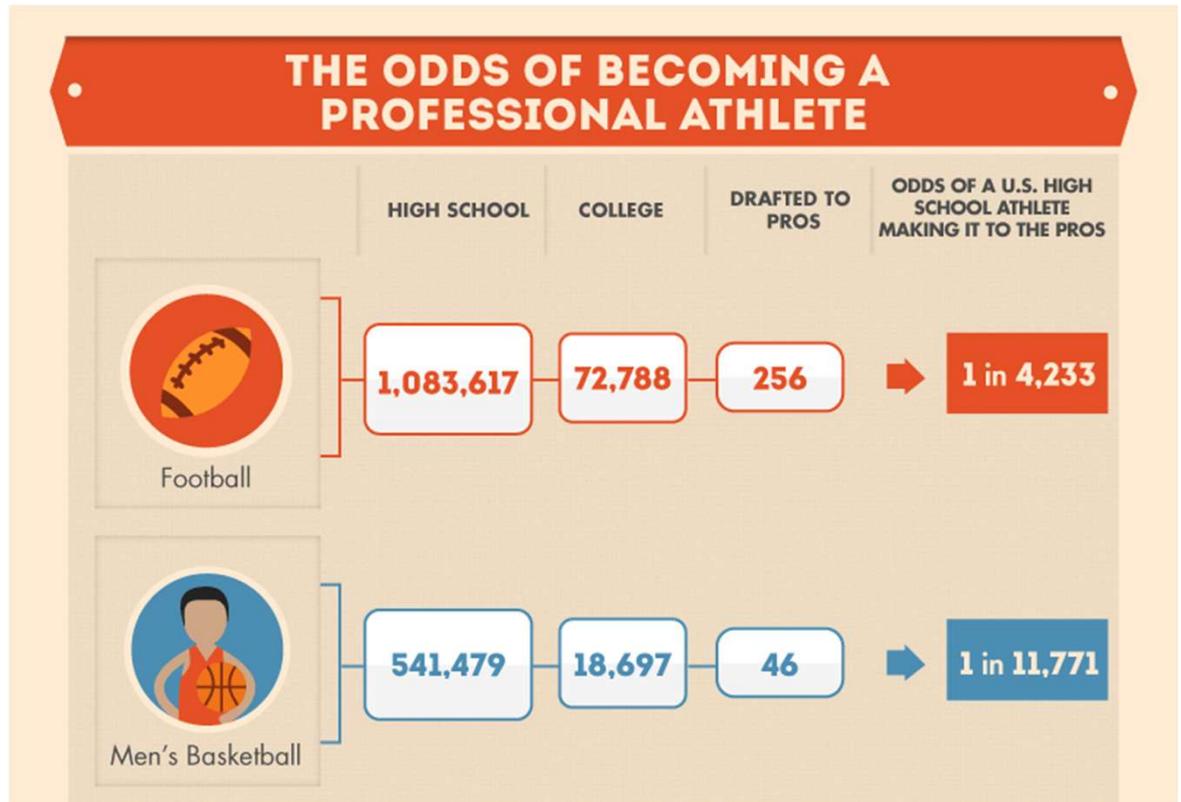


Repeat the exercise for a great day—never just one thing.  
The day builds off itself

# Fat-Tailed Distribution

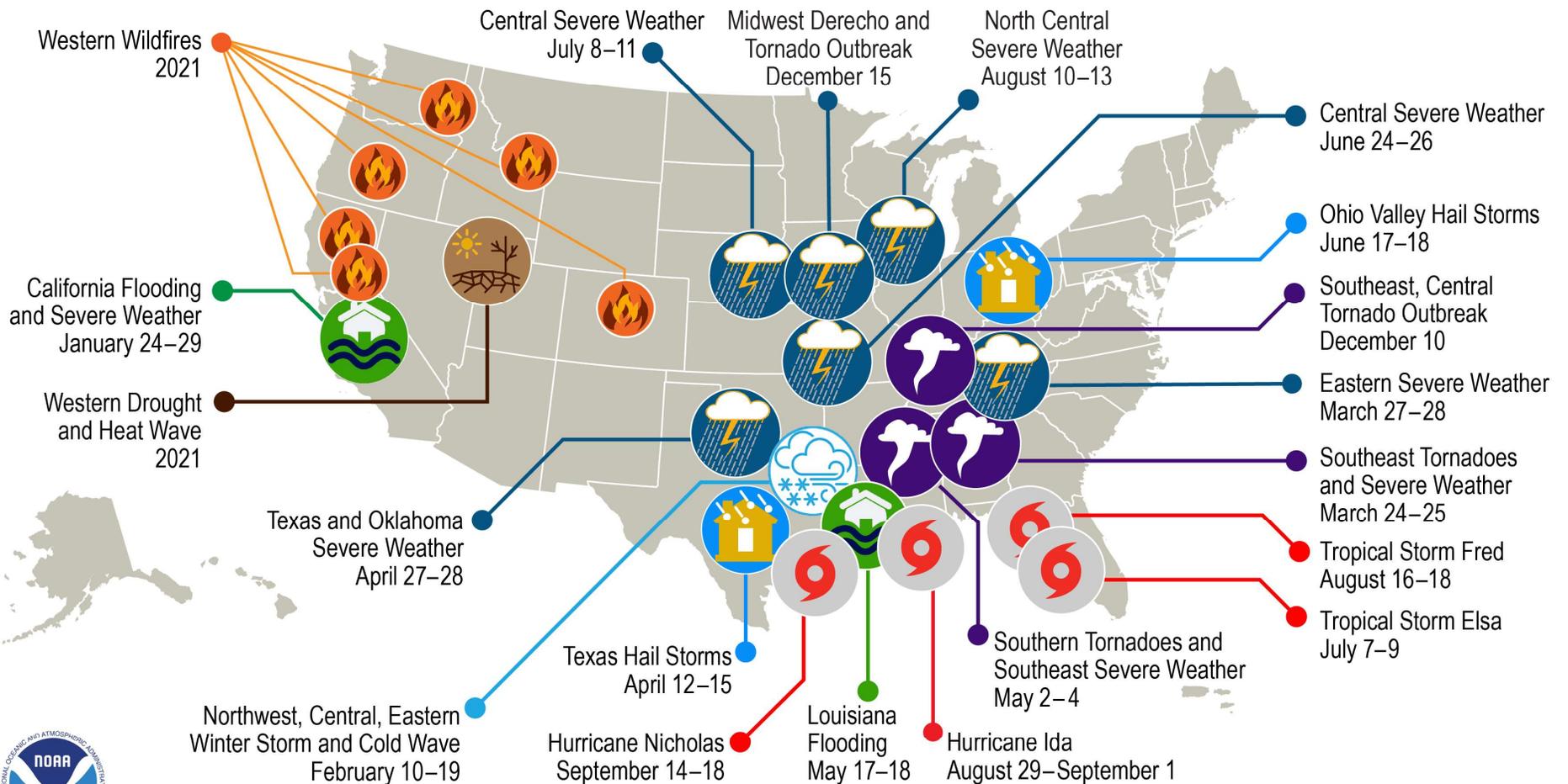


# Odds Build



# U.S. 2021 Billion-Dollar Weather and Climate Disasters

-  Drought/Heat Wave
-  Flooding
-  Hail
-  Hurricane
-  Tornado Outbreak
-  Severe Weather
-  Wildfire
-  Winter Storm/Cold Wave

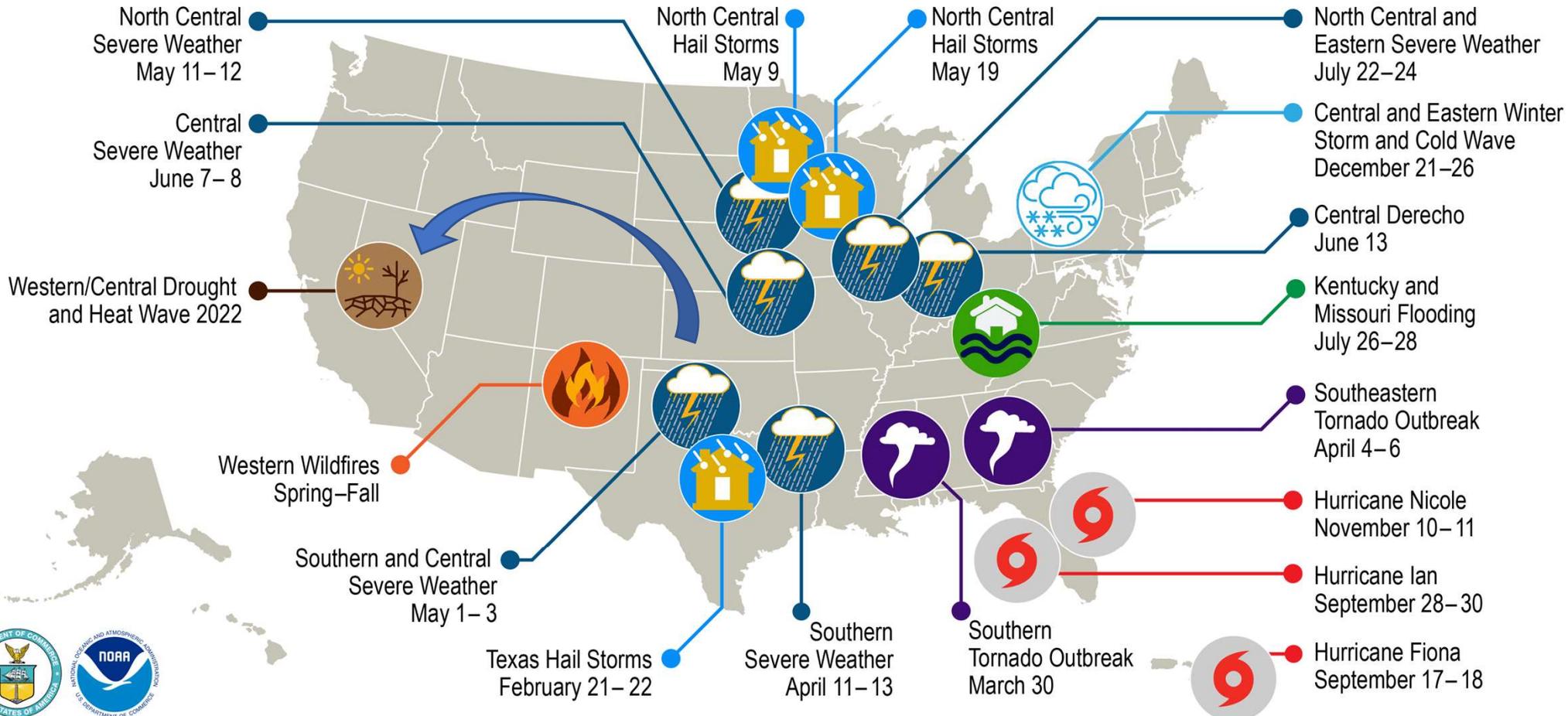


This map denotes the approximate location for each of the 20 separate billion-dollar weather and climate disasters that impacted the United States in 2021



# U.S. 2022 Billion-Dollar Weather and Climate Disasters

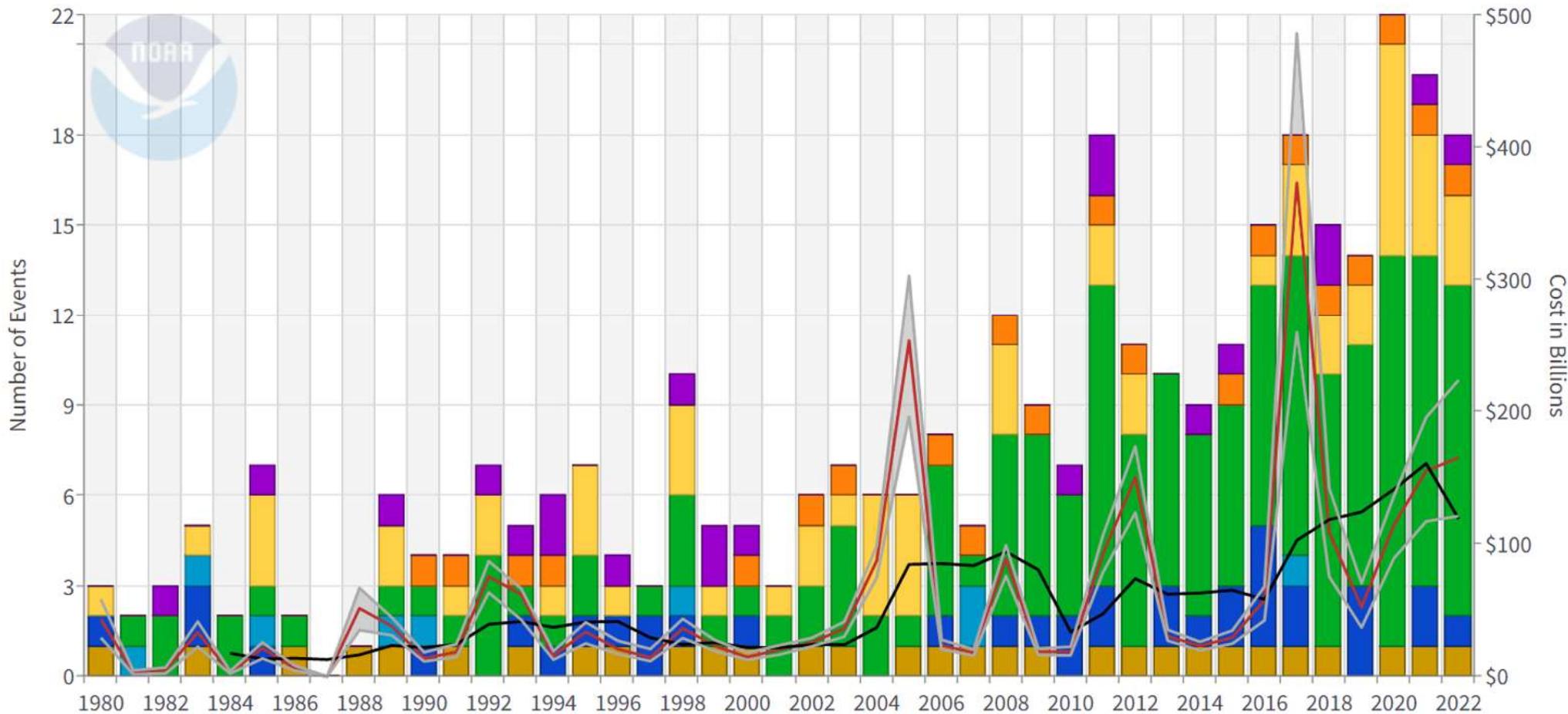
-  Drought/Heat Wave
-  Flooding
-  Hail
-  Hurricane
-  Severe Weather
-  Tornado Outbreak
-  Wildfire
-  Winter Storm/Cold Wave



This map denotes the approximate location for each of the **18 separate billion-dollar weather and climate disasters that impacted the United States in 2022.**

## United States Billion-Dollar Disaster Events 1980-2022 (CPI-Adjusted)

- Drought Count
- Flooding Count
- Freeze Count
- Severe Storm Count
- Tropical Cyclone Count
- Wildfire Count
- Winter Storm Count
- Combined Disaster Cost
- Costs 95% CI
- 5-Year Avg Costs



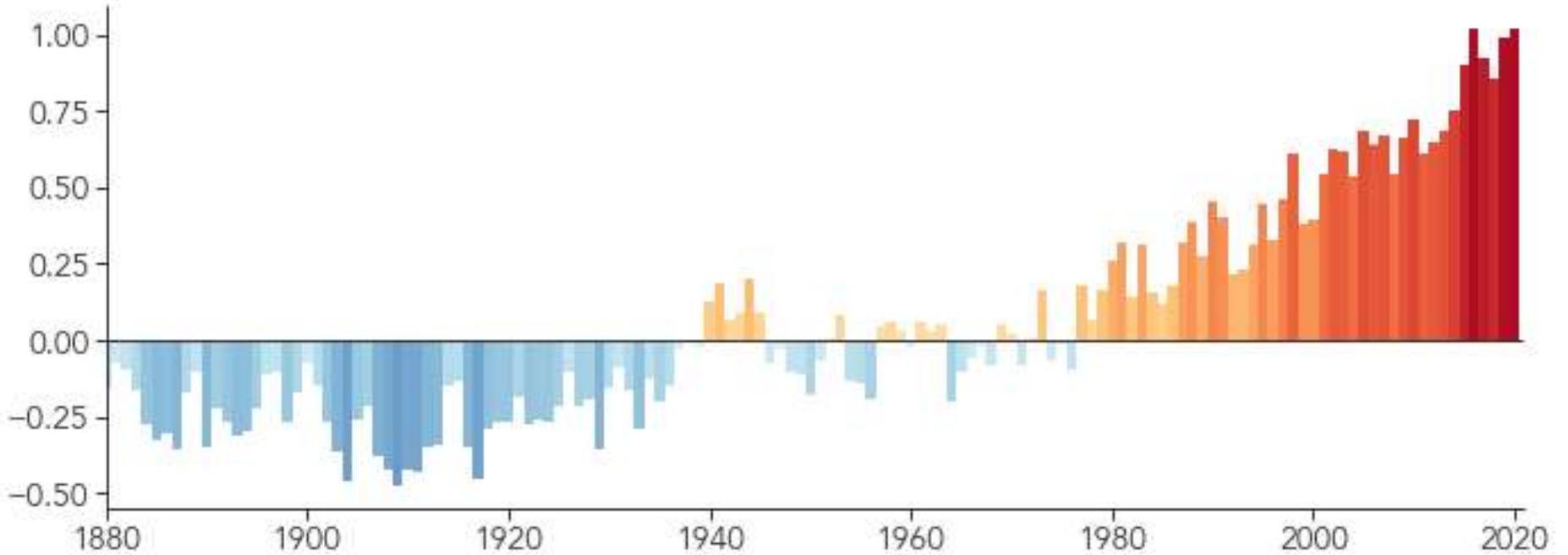
Updated: January 10, 2023

Powered by ZingChart

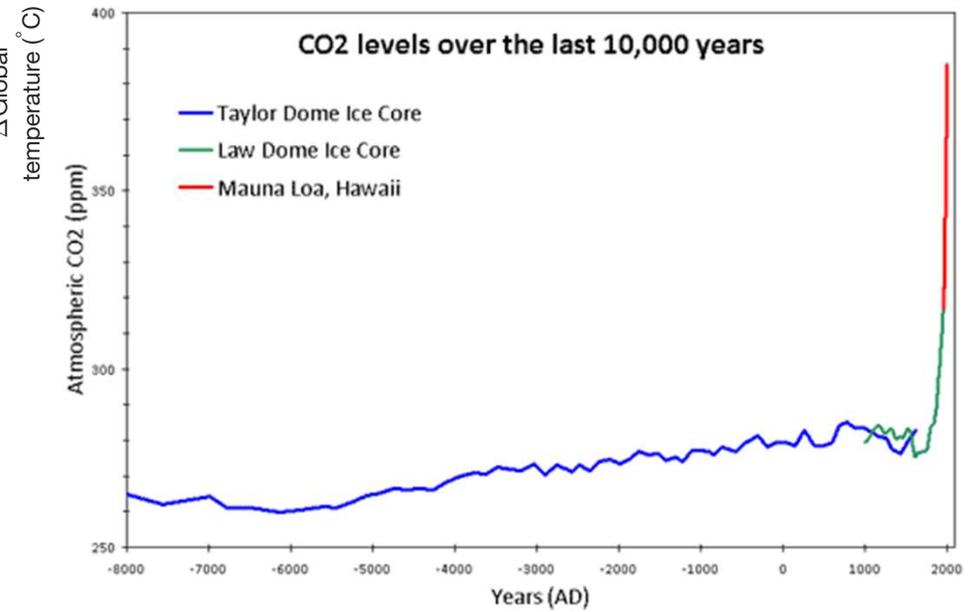
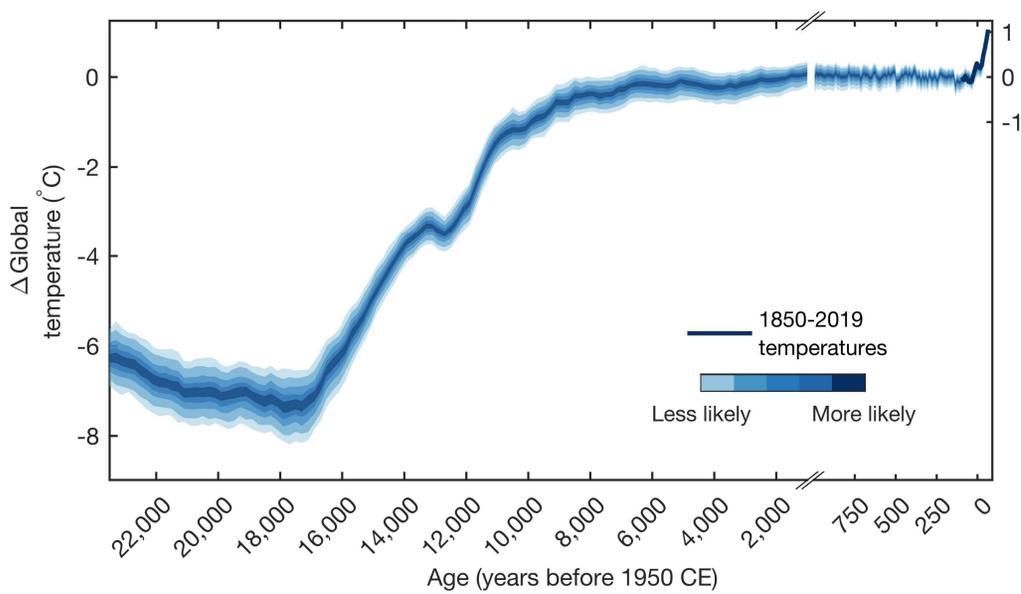
# Might Be A Trend

## 2020 in Statistical Tie for Warmest Year on Record

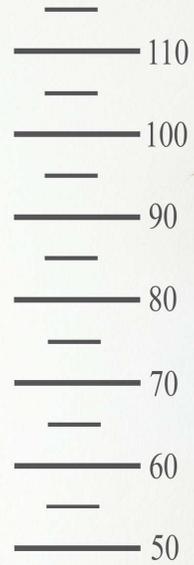
Global Temperature Anomaly (°C compared to the 1951-1980 average)



# Definitely an Anomaly



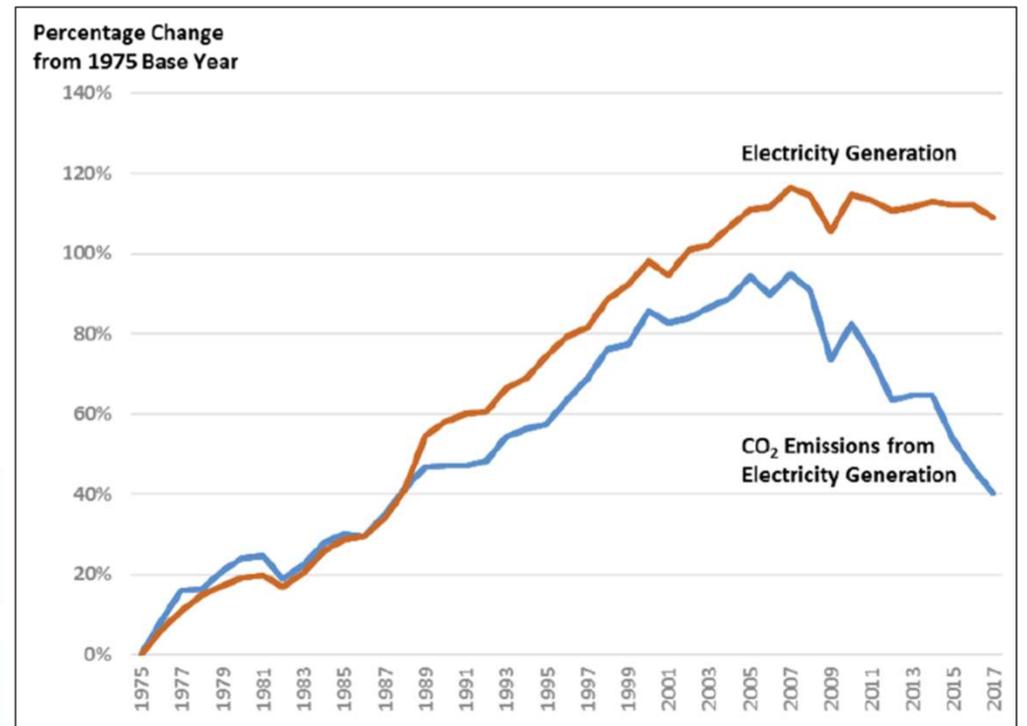
you are what  
you MEASURE



# Sustainability Priority List

## Go for the Big Polluters

### 1. The Grid



Source: Prepared by CRS; data from EIA, *Monthly Energy Review*, net electricity generation from Table 7.2 and emissions from Table 12.6, <http://www.eia.gov/totalenergy/data/monthly/>.

## Sustainability Priority List

### Go for the Big Polluters

1. The Grid
2. Transportation

## EU approves effective ban on new combustion engine cars from 2035

NATIONAL

California will ban sales of new gasoline-powered cars by 2035

Updated August 25, 2022 · 4:58 PM ET

New York begins implementation of 2035 ban on new gas-powered cars and trucks, following California lead

21 June 2022

First flight in history with 100% sustainable aviation fuel on a regional commercial aircraft

Published Sept. 30, 2022

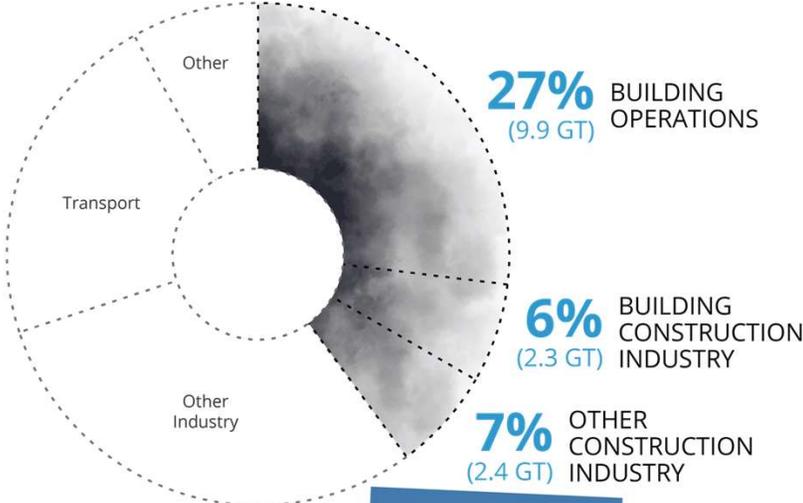


# Sustainability Priority List

## Go for the Big Polluters

- 1. The Grid
- 2. Transportation
- 3. Construction

Annual Global CO<sub>2</sub> Emissions



© Architecture 2030. All Rights Reserved. Data Source: IEA (2022), Buildings, IEA, Paris

*Building Construction Industry and Other Construction Industry represent emissions from concrete, steel, and aluminum for buildings and infrastructure respectively.*



## Maryland Legislature Enacts Most Ambitious 2031 Emissions Reductions Target, With Special Focus on Buildings

On April 8, the Climate Solutions Now Act, [SB 528](#), became law. The bill, sponsored by Senator Paul Pinsky, set the nation's leading interim goal of a 60% reduction below 2006 emissions by 2031, with a requirement to reach net-zero by 2045. To accomplish this, the bill:





# LUMBER INDUSTRY

# Multifamily



WOOD

CONCRETE

Mass Timber: 80 M Street (Washington, DC)



# Trees Eat CO<sub>2</sub>

Growing a tree takes water, sunlight, and air (CO<sub>2</sub>)

## The Full Story

- Old growth forests better at carbon sequestration
- Old growth trees make better lumber
- Trees need clean water
- Forest management and deforestation need to be considered



## UN Definition of Sustainability

meeting the needs of the present  
without compromising the ability of  
future generations to meet their own  
needs

**NOTHING ABOUT CO<sub>2</sub>**



# Elements of Sustainability

- Longer Lasting
- Denser Development
- Resiliency
- Fire Safety
- Energy Efficiency
- Better Concrete
- Water
- Adaptation



# Concrete Lasts

- Roman Concrete has lasted 2,000+ years



# Reinforced Concrete: Steel Corrodes



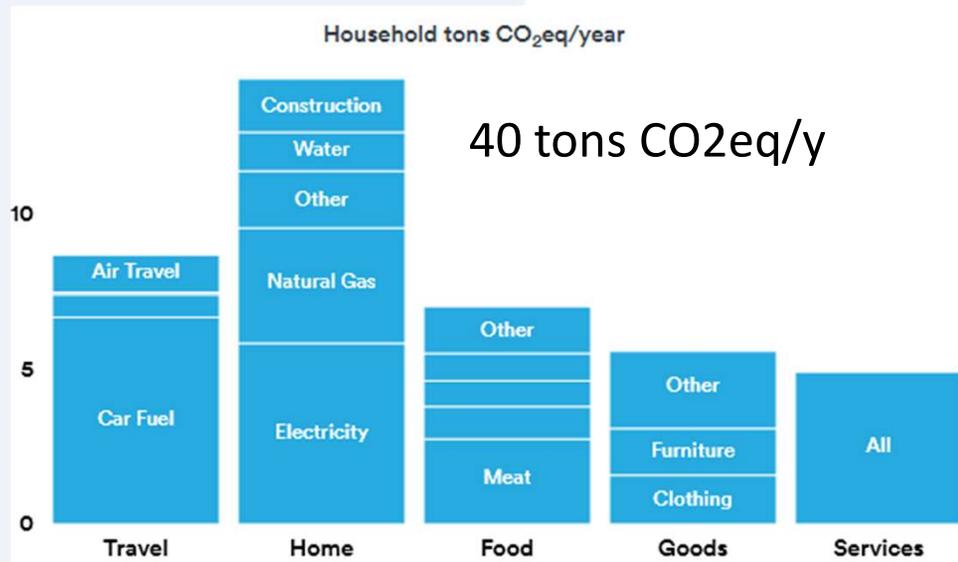
# Reinforced Concrete: Rethinking Steel

- Steel is doing concrete no favors
- Ways to address
  - Fibers
  - Corrosion Inhibitors
  - Cleaner Mix Water
  - Fiberglass Rebar
  - Seal the concrete

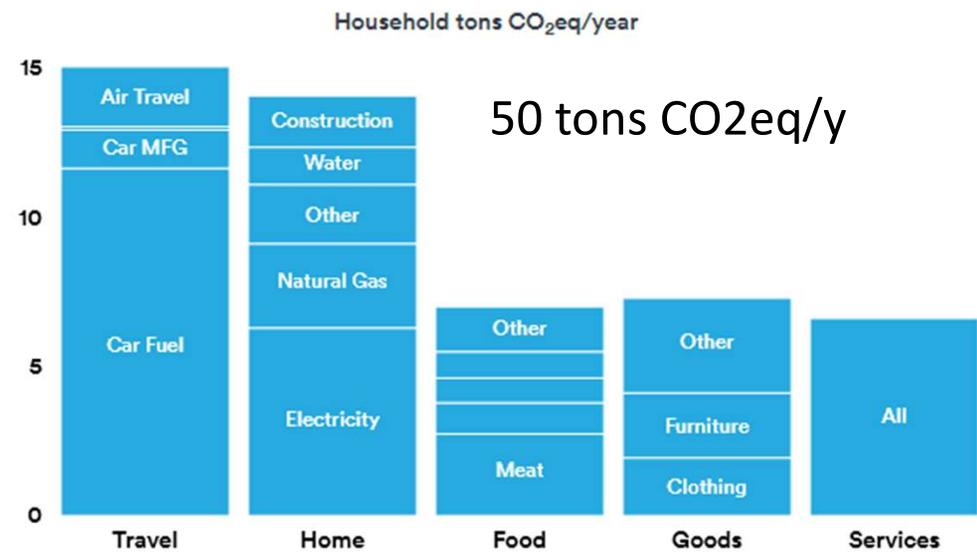


# Densify

## Baltimore, MD



## Frederick, MD



# Climate Crisis Averted: We All Move to Baltimore





# Densify

- Sound Transmission
- Vertical Buildings
- Safe in a Fire



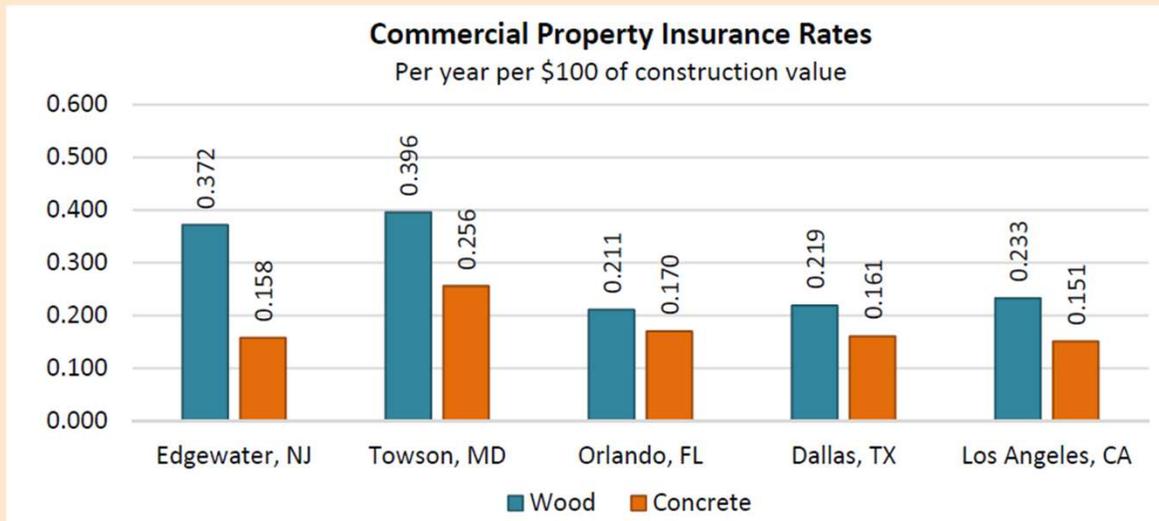
Hurricane Michael (2018)

# Concrete=Resilient

“At every point, from pilings to the roof and everything in between, when it came time to make a decision about what level of material or what to use, we didn’t pay attention to code,” said Lebron Lackey, sharing the story of the project with CNN. “We went above and beyond code, and we asked the question: ‘What would survive the big one?’ And we consistently tried to build it for that.”

**Walls were made of poured reinforced concrete.**

# Insurance Loves Concrete



Premiums are based on risk. Concrete has lower risk than frame housing

Brick homes cost 6% less to insure, on average. Homes made of fire-resistant materials save 12%, on average.



# Fire Safety

- Lumber Industry replaces gypsum board after fire, but before hose test
- Never seen a fire department do that

# Concrete Pavement



**Fuel Efficiency**  
(+4%-8%)



**Durability (40+ years)**



**Safety**



**Recycled Material**



**Affordability from Optimized Engineering**



**Heat Island**



**Maintenance/Repair Work**

**The road to better paving starts with concrete.**

From conserving energy to saving time and money, concrete brings long lasting strength, safety, and affordability to a broad expanse of paving projects. And it's a lot more versatile than many people realize. Let's go for a drive and see why concrete is the world's most popular construction material.

**Safety**  
Concrete's rigid surface provides greater skid resistance for safer driving in inclement weather. And its bright, reflective nature makes roads and parking lots safer at night.

**Fuel Efficiency**  
Research shows that concrete pavement can reduce fuel consumption by 3-17%, resulting in significant cost savings and reduction in CO2 emissions.

**Durability**  
Concrete pavement can take many years of punishment with fewer repairs and less maintenance. Concrete resists fuels, oils, solvents, and extreme temperatures, and supports heavier axle loads.

**Affordability**  
An investment in concrete saves money.

**PAVE AHEAD**  
DURABLE. SUSTAINABLE. CONCRETE.

**Cradle-to-Grave/Rock-to-Rock!**

A full life cycle assessment (LCA) must consider a material's environmental impact from cradle-to-grave. Concrete is comprised of large and small aggregate and Portland cement, which itself is ground natural aggregate. Once it has reached the end of its service life, concrete can be crushed, to be used as a natural aggregate replacement for virgin aggregate material as either subbase material, or even in new concrete mixes.

Cradle-to-Grave equals Rock-to-Rock. Sustainability in its simplest form!

**Questions about concrete paving?**  
Visit [paveahead.com](http://paveahead.com)  
Or call us at 833-465-1192

**Economically Green**  
With its extensive service life, concrete pavement eliminates the constant maintenance, the additional CO2 emissions, and other toxins associated with resurfacing and reconstruction operations, making it both financially and environmentally friendly.

**Resilience**  
Concrete pavement retains its structural integrity and performance, even when inundated by floods. In many cases, concrete roads can be returned to pre-flood service levels immediately after the water recedes.

**Carbon Sequestration**  
Through a process called carbonation, concrete pavements sequester carbon dioxide from the atmosphere over their service life, reducing nearby pollution levels. A study by MIT found that concrete's carbon uptake can offset 5% of the CO2 emissions generated from cement used in U.S. pavements.

**Lighting**  
The increased reflectivity of a concrete pavement allows for more efficient lighting with 1/3 fewer light fixtures. The light-colored surface pairs perfectly with LED and other high-efficiency lights.

**Durability**  
No other paving material matches concrete's ability to withstand heavy day-to-day traffic and extreme weather while providing a service life of 40 years or more.

**Sustainable Materials**  
Concrete mixtures maximize strength through optimized aggregate proportions and incorporate materials like Portland limestone cement, supplementary cementitious materials, and recycled materials which reduce concrete's carbon footprint by up to 25%.

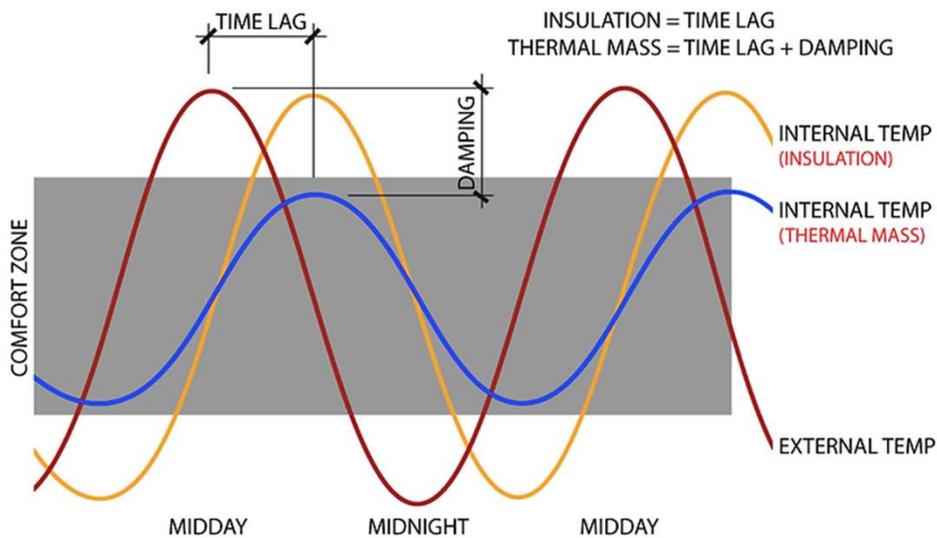
**Heat Island**  
Concrete's natural lighter color absorbs less heat and can assist in lowering ambient air temperature by as much as 7 to 10 degrees.

**Fuel Efficiency**  
Research at MIT shows that concrete pavement can reduce fuel consumption by 4 to 8%, significantly lowering CO2 emissions and user costs.

**PAVE AHEAD**  
DURABLE. SUSTAINABLE. CONCRETE.

# Concrete Has Mass

Mass walls require less insulation



Excerpt from ASHRAE Standard 90.1-2007 TABLE 5.5-5:  
Building Envelope Requirements for Climate Zone 5 (A, B, C)\*

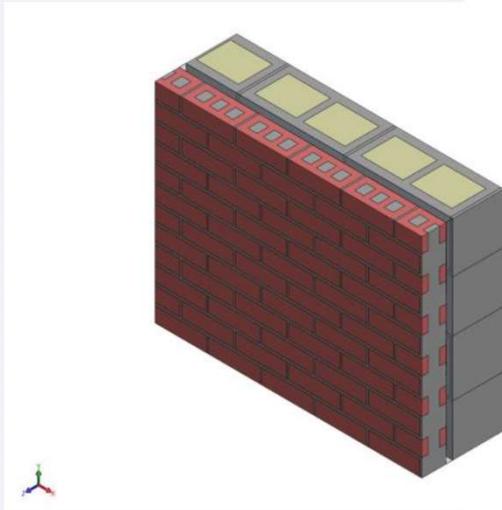
Opaque Elements	Nonresidential	
	Assembly Maximum	Insulation Min. R-Value
Walls, Above-Grade		
Mass	U-0.090	R-11.4 c.i.
Metal Building	U-0.113	R-13.0
Steel-Framed	U-0.064	R-13.0 + R-7.5 c.i.
Wood-Framed and Other	U-0.064	R-13.0 + R-3.8 c.i.

\*The following definitions apply; c.i. = continuous insulation (see Section 3.2), NR = no (insulation) req

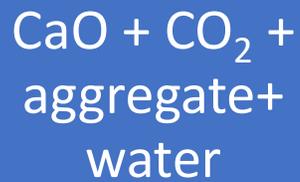
\*\* Notable exception applies; please reference the standard for additional information.

# Energy Efficiency + Insulation

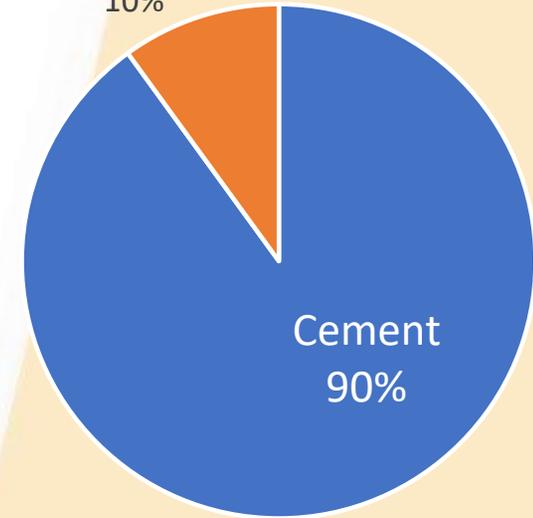
- Better sealing at corners, joints, windows, doorframes
- ICF Walls
- Insulated Masonry



# CO<sub>2</sub> and Concrete

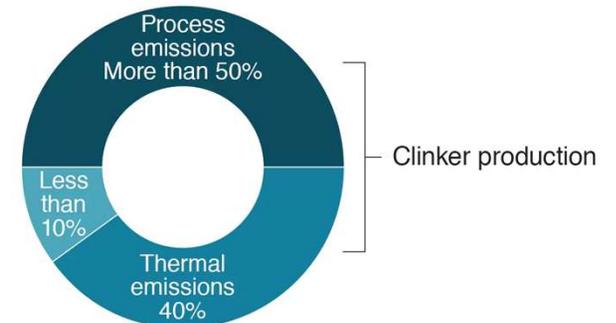


Aggregates/Other  
10%



The production of “clinker” accounts for most of the CO<sub>2</sub> emissions of cement production

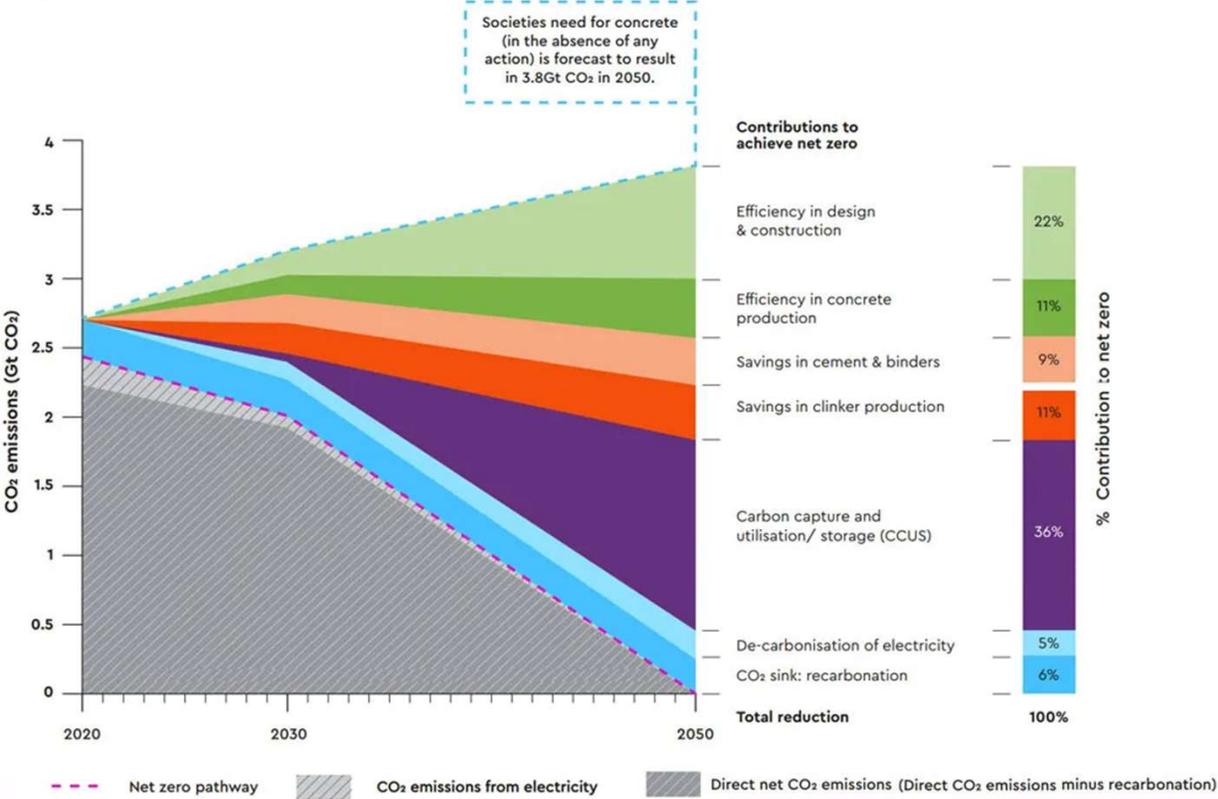
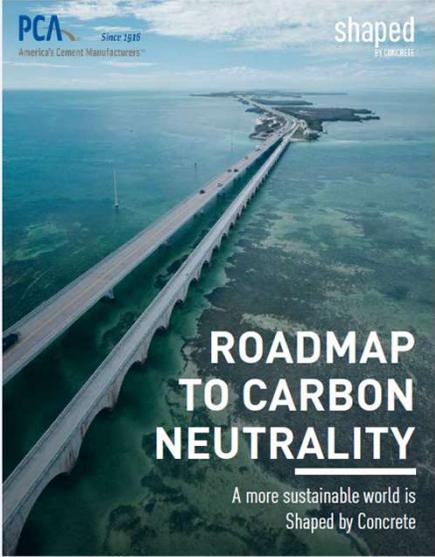
- Quarrying & transport
- Grinding & preparation of raw materials
- Cooling, grinding, mixing



Source: Chatham House

BBC

# Cement Producers: Carbon Neutral by 2050



# Lower CO<sub>2</sub> Concrete Starts w/ Less Cement

- Cement is the most expensive part of a mix— we've been minimizing forever
- SCMs- fly ash, pozzolans, etc.
- Carbon curing (e.g., CarbonCure, CarbonBuilt)
- Optimize mix design

# What is an EPD

- Type I- Self certified
- Type II- Industry Average, Independently Verified
- Type III- Product Specific, Independently Verified

Summary of Environmental Product Declaration		Environmental Impacts 			
<b>Central Concrete</b>		<b>Impact name</b>	<b>Unit</b>	<b>Impact per m3</b>	<b>Impact per cyd</b>
Mix	340PG9Q1	Total primary energy consumption	MJ	2,491	1,906
San Jose Service Area		Concrete water use (batch)	m3	6.66E-2	5.10E-2
EF V2 Gen Use P4000 3" Line 50% SCM		Concrete water use (wash)	m3	8.56E-3	6.55E-3
<b>Performance Metrics</b> 		Global warming potential	kg CO2-eq	271	207
28-day compressive strength	4,000 psi	Ozone depletion	kg CFC-11-eq	5.40E-6	4.14E-6
Slump	4.0 in	Acidification	kg SO2-eq	2.26	1.73
		Eutrophication	kg N-eq	1.31E-1	1.00E-1
		Photochemical ozone creation	kg O3-eq	46.6	35.7

# Carbon Diet

- Not only what, but how much
- Owners are buying concrete, they are buying a building
  - We need to sell them the concrete + insulation + waterproofing +++++
- Conversations with engineers, owners, GC's, subs
  - We have the technical knowledge



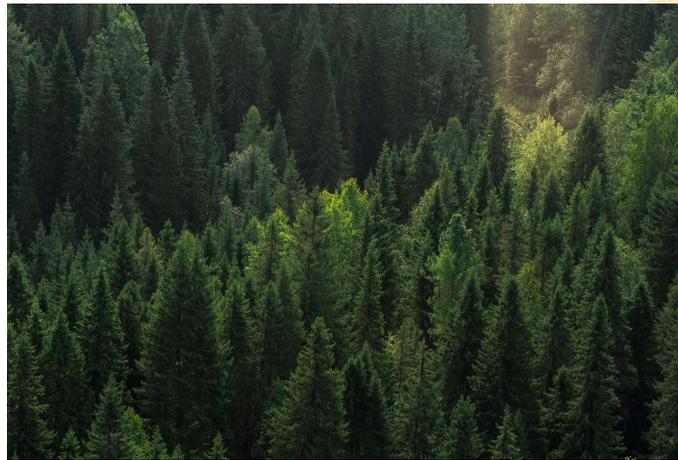
# Cradle-to-???

- Not just manufacturing
- Building's Use
- Concrete is recyclable
- Damage and Rehab

Product / Manufacture Stage [A1-A3]			Construction Process Stage [A4-A5]		Use [B1-B7]							End-of-Life Stage [C1-C4]				Benefits & Loads Beyond [D]
					Building Fabric				Operation of the Building							
Raw Material Extract / Process / Supply	Transport	Manufacture	Transport to the Site	Assembly / Install in the building	Use / Application of Installed Products	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction / Demolition	Transport to Waste Process	Reuse-Recovery-Recycle	Disposal	Reuse-Recovery-Recycle Potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Cradle-to-Gate			Gate-to-Grave													
Cradle-to-Grave																
Cradle-to-Cradle																
System Boundaries																

# Trees- The Goldilocks of Water

Water



# Biodiversity

- Preserving Nature and The Natural Environment
- Keeping Nature Wild
- Maintaining Natural Ecosystems
- Avoiding Human Interaction/Intervention
  
- More Intensive Manufacturing is Better, Relative to Large Area Activities





## Adaptation

- Pipes + Stormwater Infrastructure
- Seawalls
- Permeable Pavement

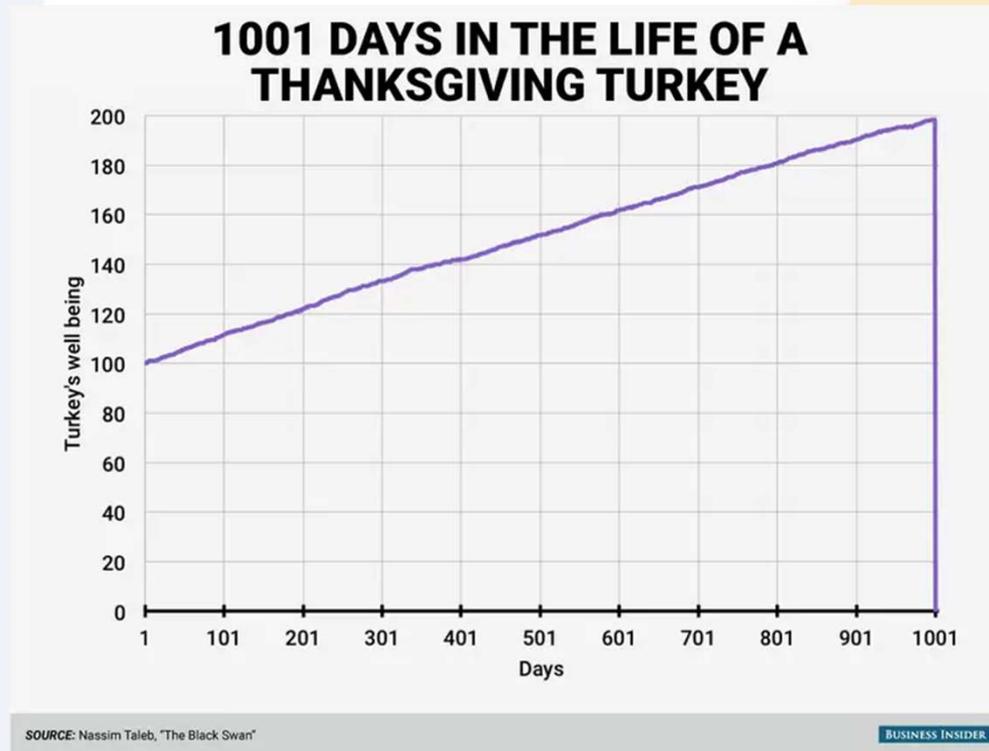
## Same Package, Different Bow

- Opportunity here in how we pitch concrete
  - Aligning goals of concrete with green
  - Speak green to look green to get green
- The Full Story of Sustainability
  - Longer Lasting
  - Denser Development
  - Resiliency
  - Fire Safety
  - Concrete Roads
  - Energy Efficiency
  - CO<sub>2</sub> Emissions
  - Water





# Everything Is Fine, Until It Isn't





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