The Intersection of Resilience, Low-Embodied Carbon, and LCCA in Materials

GREEN BUILDING INITIATIVE®

National Building Institute of Sciences
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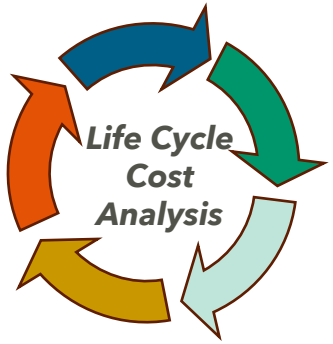
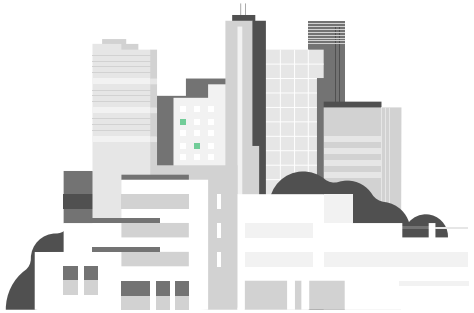
LEARNING OBJECTIVES

Understand the environmental drivers that are reshaping business as usual to focus on specifying low-embodied carbon materials within federal and commercial real estate sectors.



Recognize the different expectations for applying consideration of climate resilience (risk), global warming potential (net zero), and Life Cycle Cost Analysis (LCCA) for each project based on a variety of client objectives.



Recognize that building cost decisions should be made with an understanding of long-term economic and environmental impacts instead of merely upfront costs.

Identify opportunities for each evaluation in materials selection to contribute to ESG reporting, green building certification, and federal compliance.

The Green Building Initiative (GBI) is an international, nonprofit organization whose mission is **to reduce climate impacts by improving the built environment.**

Better buildings, together.

Delivering educational roadmaps through our certification and validation programs.

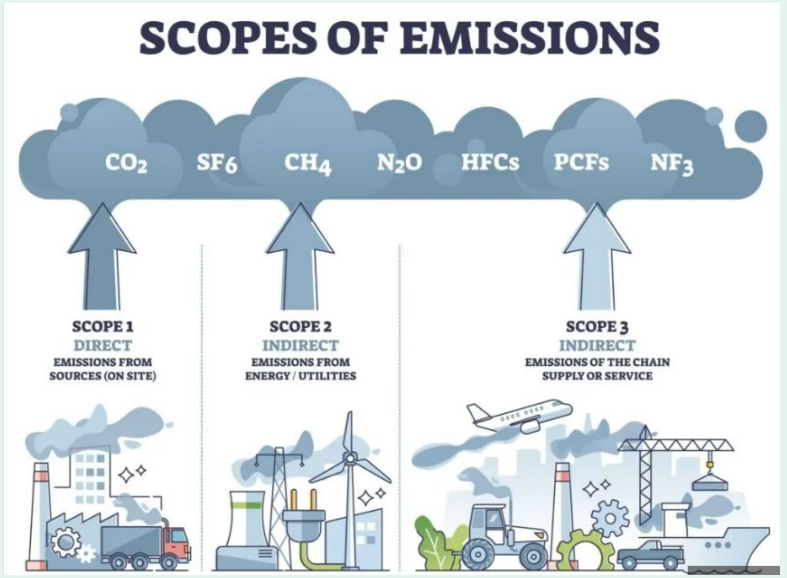
GREEN GLOBES® BUILDING CERTIFICATION

GUIDING PRINCIPLES COMPLIANCE® GREEN BUILDING INITIATIVE®

Sustainable, healthy, and resilient buildings for all.

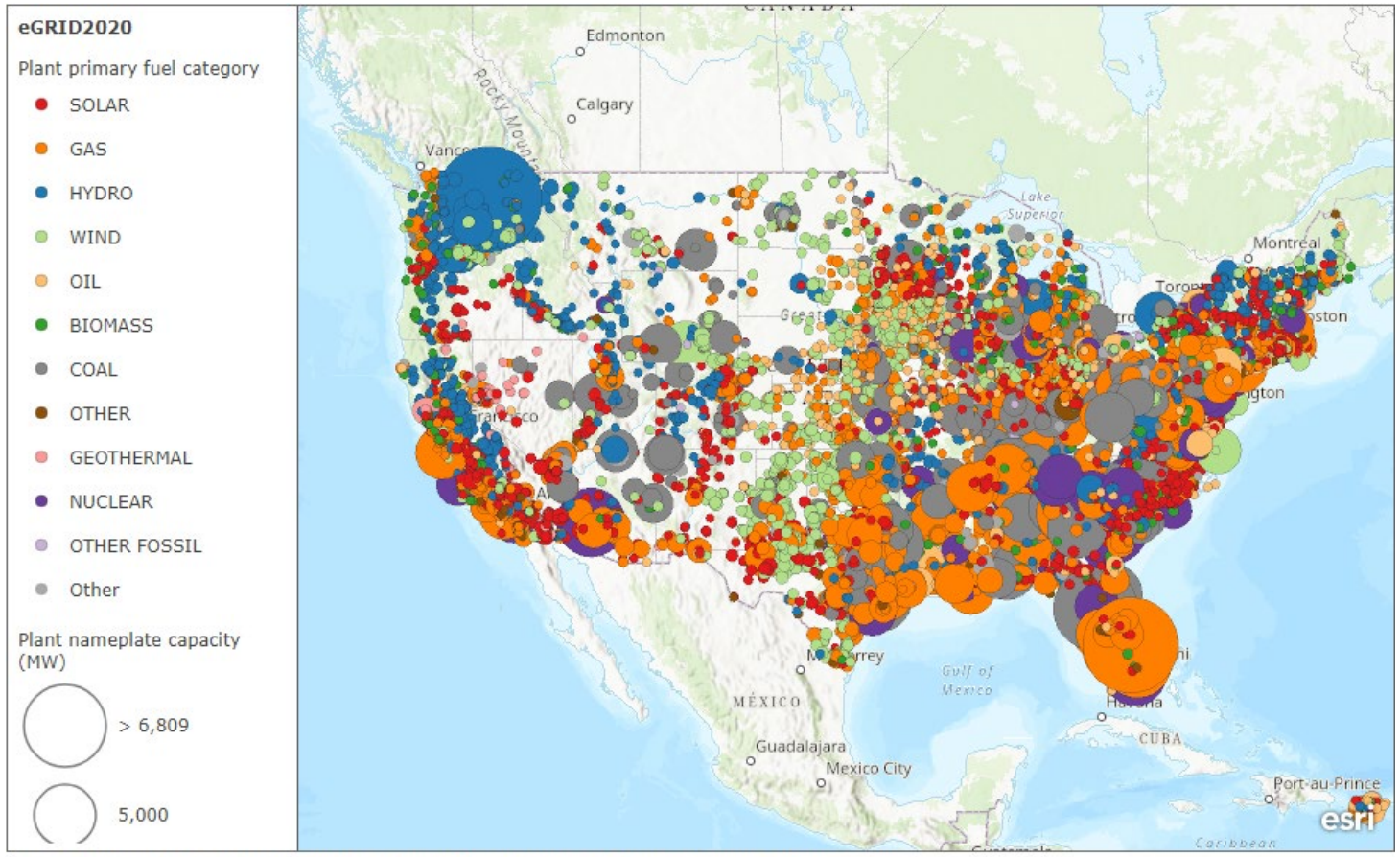
Global Environmental Drivers

Global Focus on Net Zero Carbon Emissions by 2050-2060



Policy & Investors Driving Change in Focus

U.S. ENERGY INFORMATION ADMINISTRATION – ENERGY PLANTS



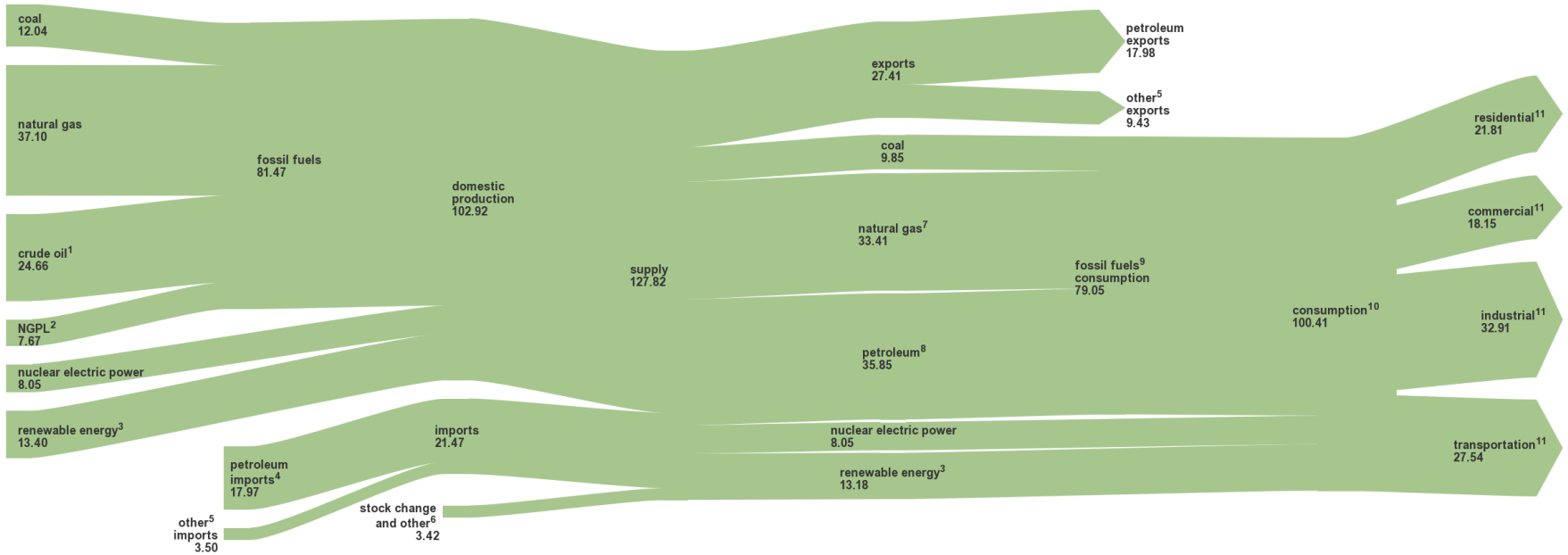
This web map displays the eGRID 2018, 2019, 2020, and 2021 data for power plants across the US.

Esri, USGS | Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

U.S. ENERGY INFORMATION ADMINISTRATION – ENERGY FLOW

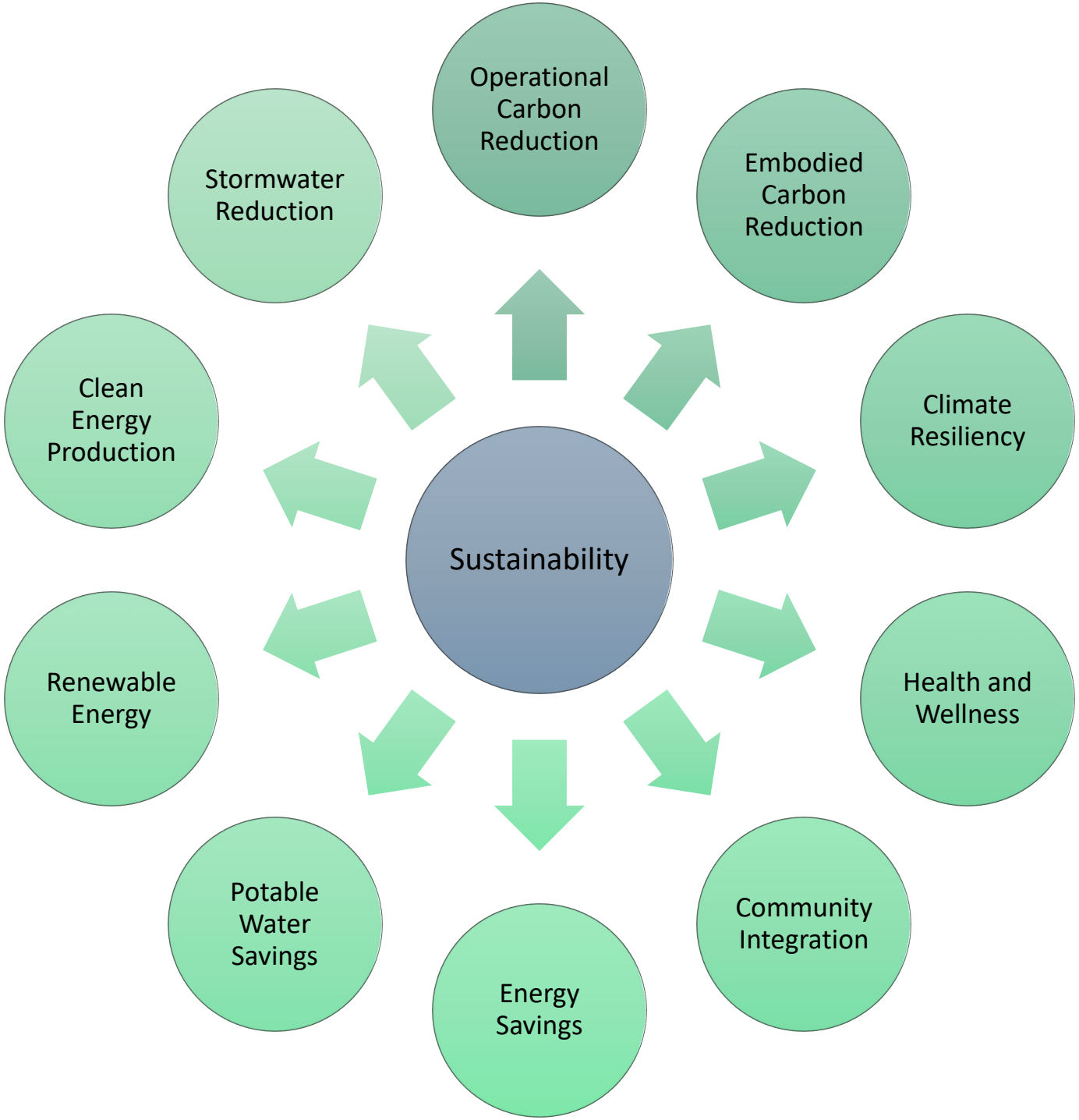
U.S. energy flow, 2022

quadrillion Btu

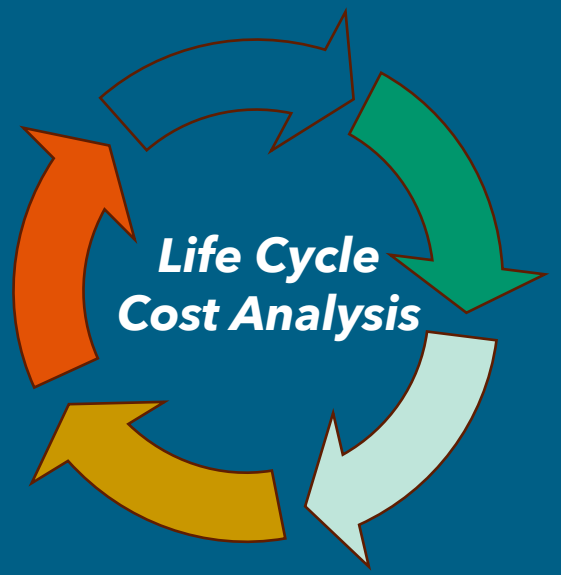


[1] Includes lease condensate. | [2] Natural gas plant liquids. | [3] Conventional hydroelectric power, biomass, geothermal, solar, and wind. | [4] Crude oil and petroleum products. Includes imports into the Strategic Petroleum Reserve. | [5] Natural gas, coal, coal coke, biomass, and electricity. | [6] Adjustments, losses, and unaccounted for. | [7] Natural gas only; excludes supplemental gaseous fuels. | [8] Petroleum products supplied; excludes biofuels. Biofuels are included in "renewable energy." | [9] Includes -0.06 quadrillion Btu of coal coke net imports. | [10] Includes 0.14 quadrillion Btu of electricity net imports. | [11] Total energy consumption, which is the sum of primary energy consumption, electricity sales, and electrical system energy losses. Losses are allocated to the end-use sectors in proportion to each sector's share of total electricity sales. See Note 1, "Electrical System Energy Losses," at the end of U.S. Energy Information Administration (EIA), *Monthly Energy Review* (April 2023), Section 2. See Note 2, "Other Energy Losses," at the end of U.S. Energy Information Administration (EIA), *Monthly Energy Review* (April 2023), Section 2. | Notes: • Data are preliminary. • Values are derived from source data prior to rounding for publication. • Totals may not equal sum of components due to independent rounding.

eia Sources: EIA, *Monthly Energy Review* (April 2023), Tables 1.1, 1.2, 1.3, 1.4a, 1.4b, 1.4c, 2.1a, and 2.1b.


Operational Carbon Reduction
Embodied Carbon Reduction
Climate Resiliency
Health and Wellness
Community Integration
Energy Savings
Potable Water Savings
Renewable Energy
Clean Energy Production
Stormwater Reduction
Sustainability


Energy Model
Life Cycle Cost Analysis
Life Cycle Analysis
Water Reduction Calculations
Daylighting Calculations
Stormwater Calculations
Climate Risk Assessment
Green Building Certification
Health and Wellness Certification
Design Documentation
Tasks



Risk, Net Zero, and LCCA

WHAT IS RESILIENCE?

Industry Statement on Resilience:

- "we define resilience as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events."
- Preparing to Thrive by NIBS / AIA May 2016

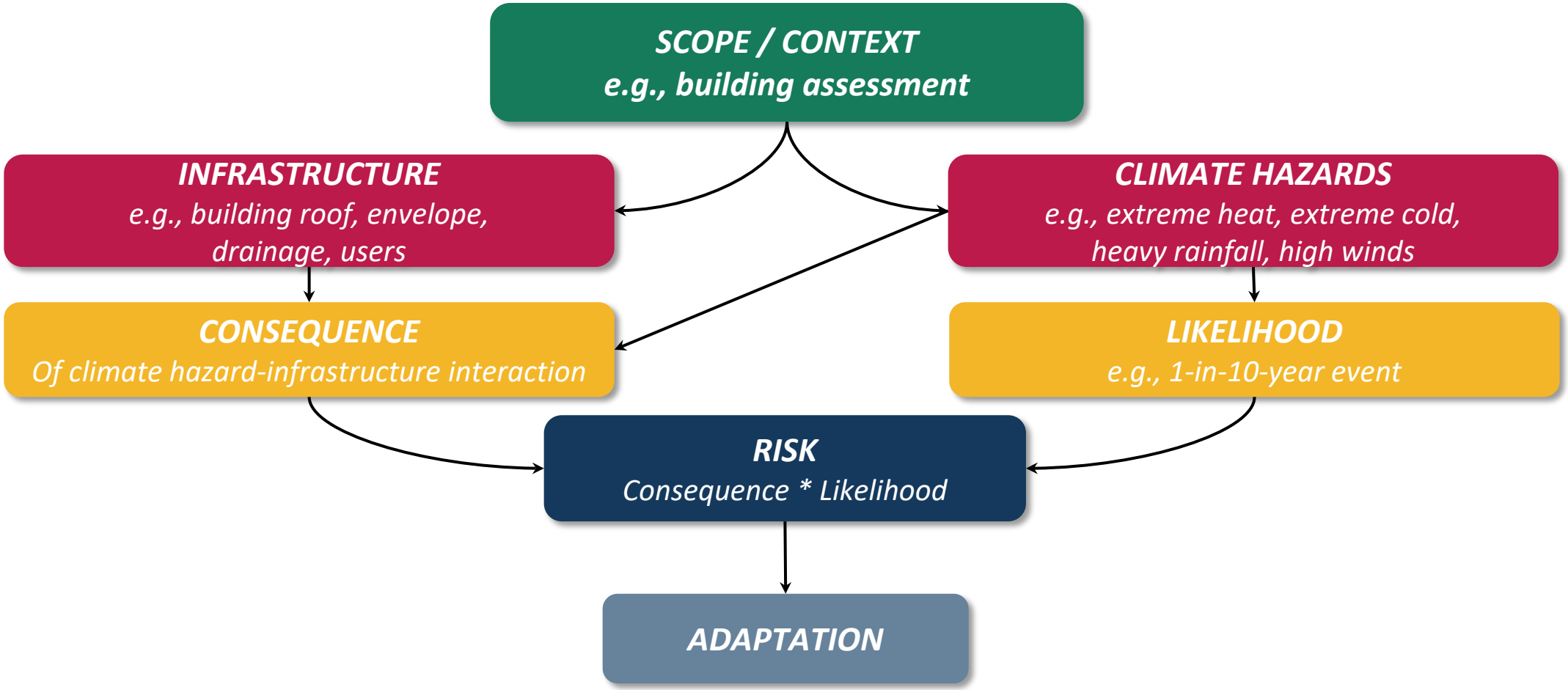
Evaluation of Resilience:

- Risk Analysis
- Life Cycle Cost Analysis
  - US Department of Energy
  - https://www.osti.gov/biblio/1856022

Hurricane Michael

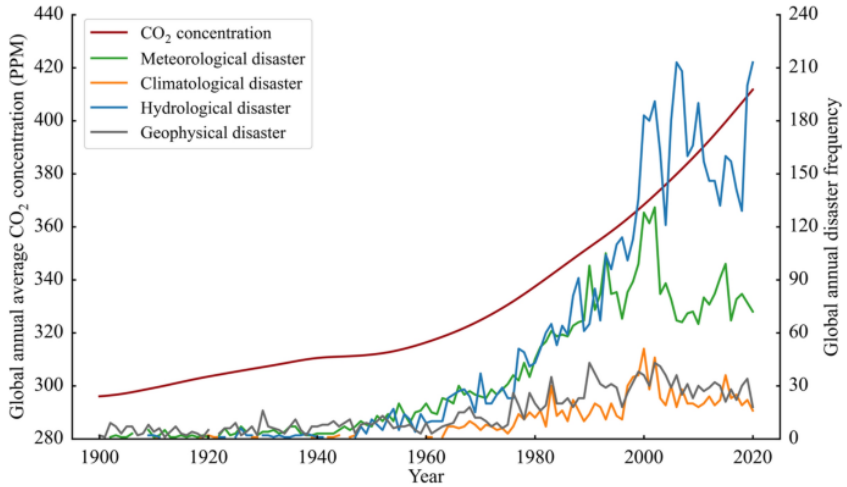
2018

CLIMATE RISK



CLIMATE RESILIENCE

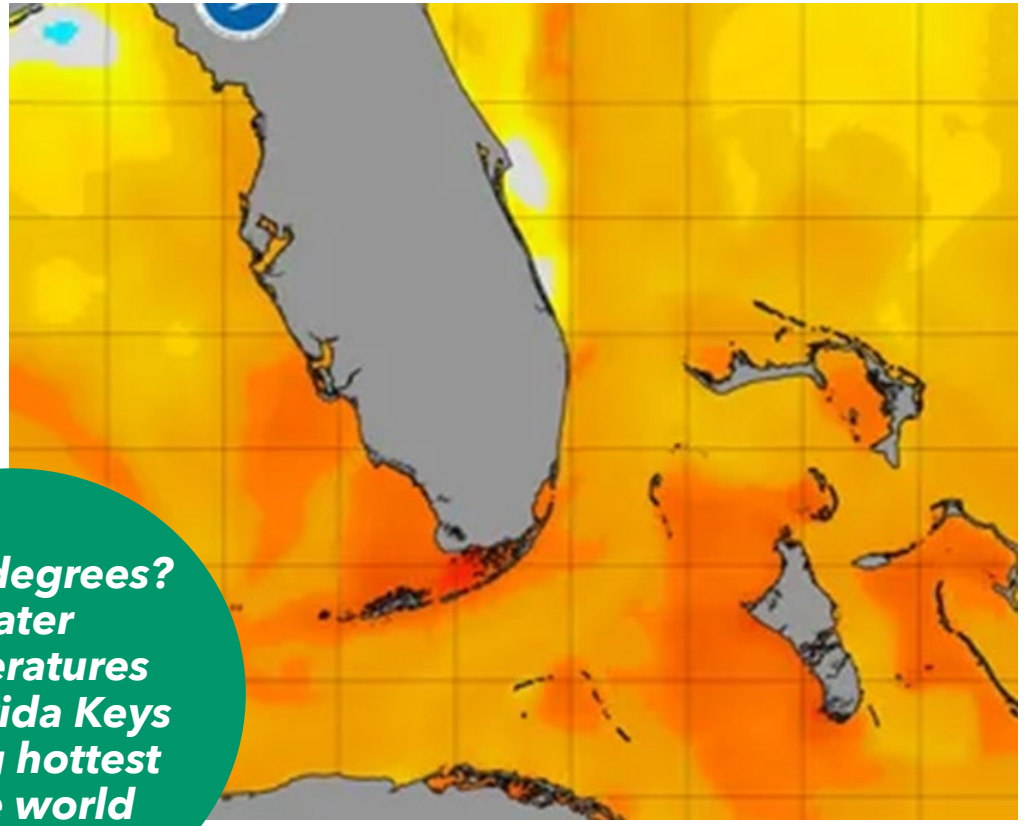
Global Warming Potential



From International Journal of Disaster Risk Science

Paris Accord COP 21

To limit global warming to 1.5°C, greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030



101.1 degrees? Water temperatures off Florida Keys among hottest in the world

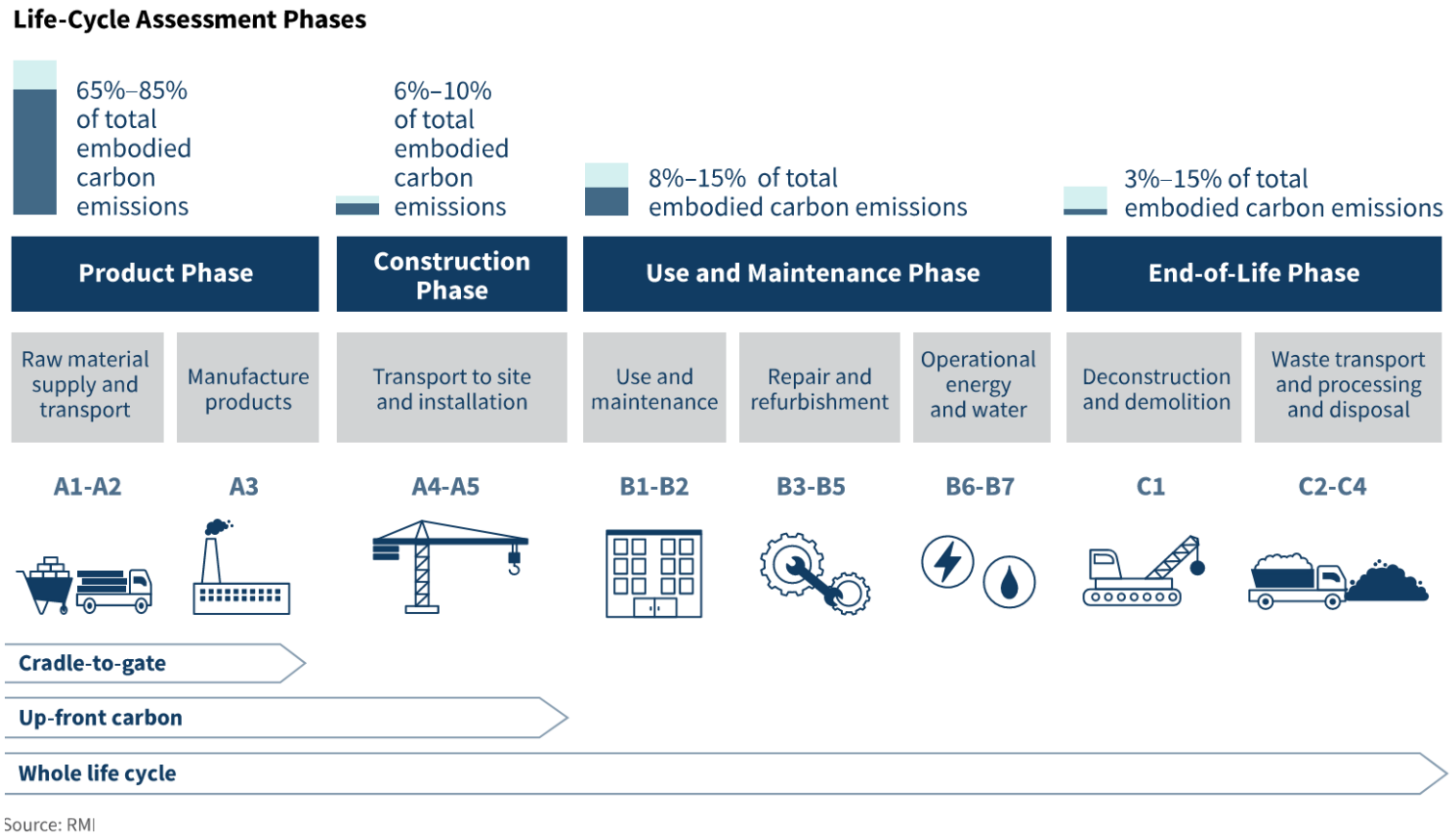
WHAT IS LOW EMBODIED CARBON?

What is Embodied Carbon?

- Millions of tons of carbon emissions released during the lifecycle of building materials
- Account for 11 % of GHG emissions
- Imperative for builders, manufacturers, and policymakers to prioritize this issue to meet climate goals.

Evaluation of Embodied Carbon?

- Life Cycle Assessments
- Environmental Product Declarations



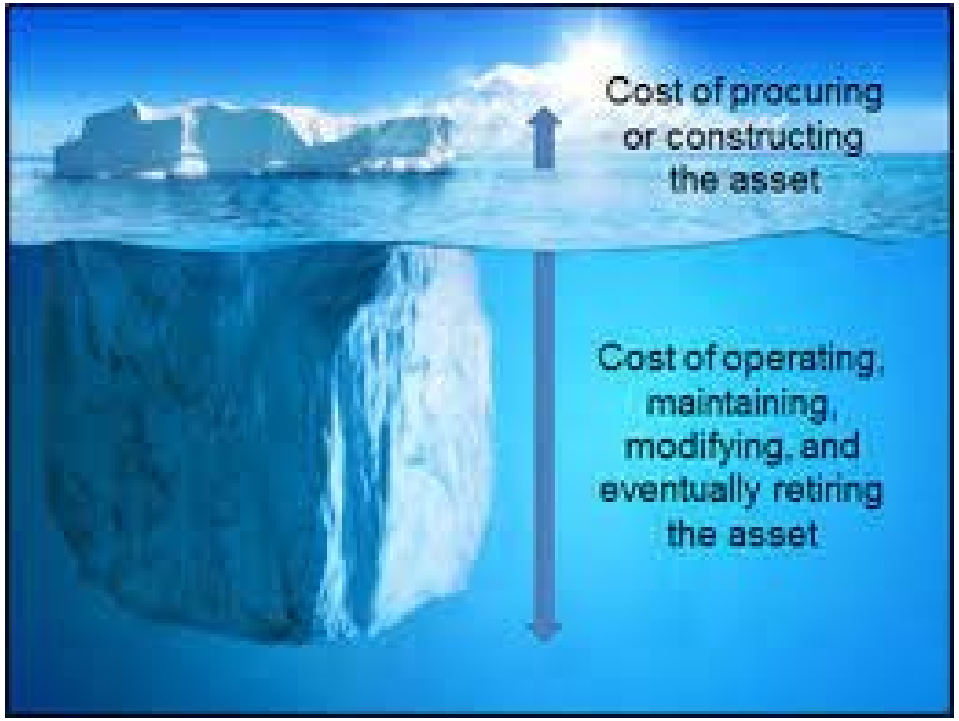
LIFE CYCLE COST ANALYSIS (LCCA)

What is LCCA?

- Method for assessing the total cost of facility ownership. It takes into account all costs of acquiring, owning, and disposing of a building or building system

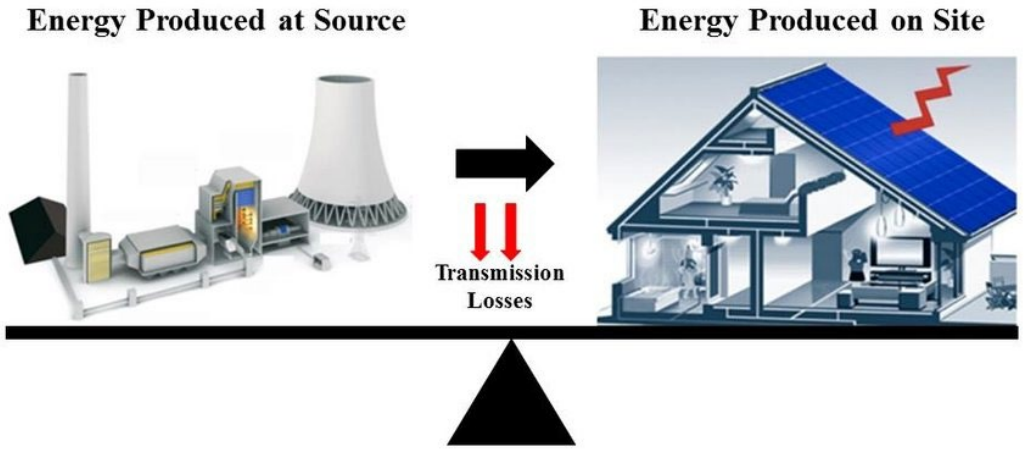
Evaluation of LCCA?

- NIST BLCC5 program
  - https://www.nist.gov/services-resources/software/building-life-cycle-cost-programs
- Effective tool for evaluating options to determine most cost effective.

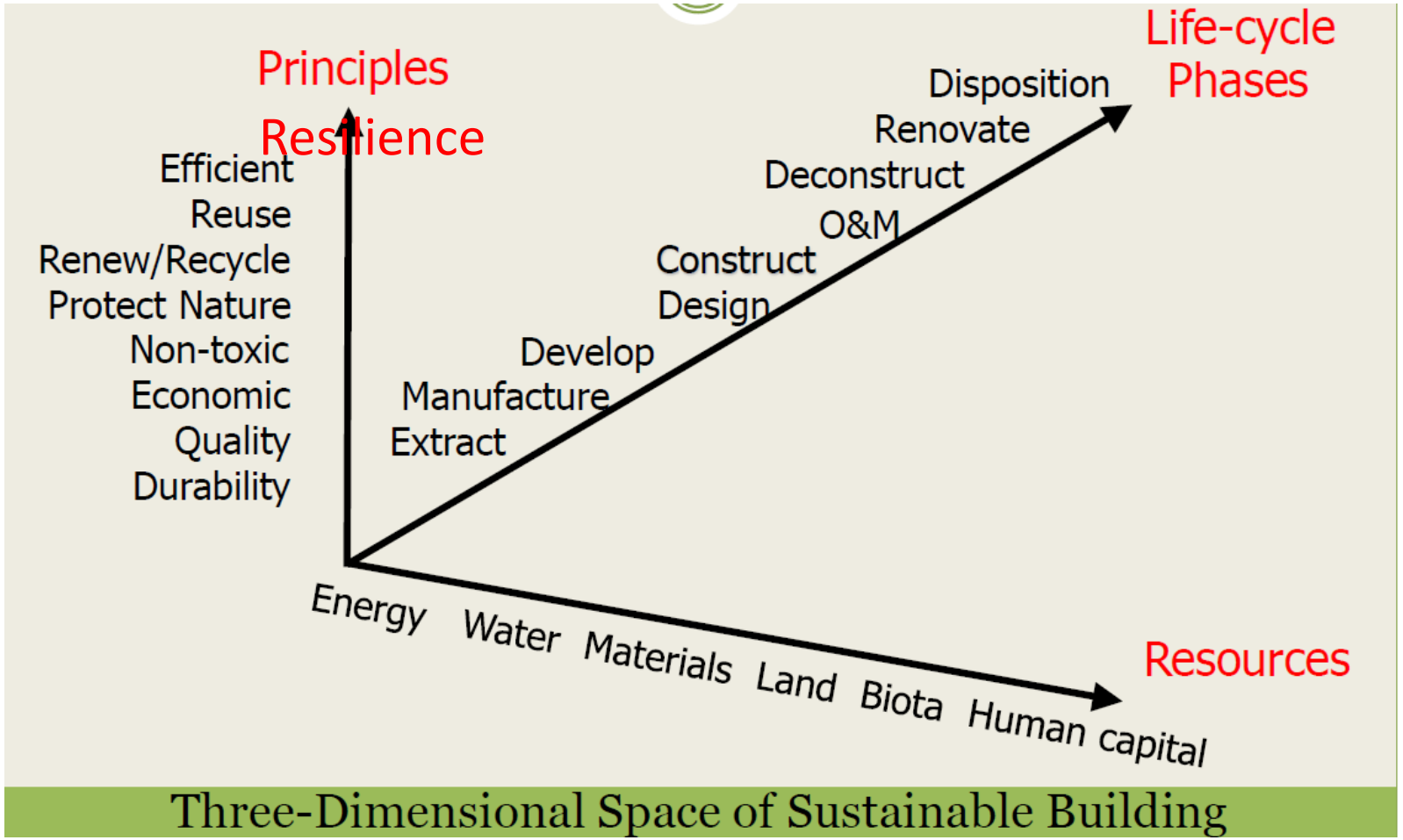


WHAT IS NET ZERO?

- Balance between resources used and resources produced
  - Energy, Water, Waste
  - Fuels
    - Greenhouse Gases
    - Offsets
- US Goal to achieve net-zero green house gases by 2050
  - Net Zero emission buildings by 2045, with 50% reduction by 2032
  - Executive Order 14057
- How is it evaluated?
  - Calculate carbon footprint
  - Source or Site



HOW DO THESE INTERACT?



Three-Dimensional Space of Sustainable Building

Long-term Economic and Environmental Impacts

- 100 percent carbon pollution-free electricity on a net annual basis by 2030, including 50 percent 24/7 carbon pollution-free electricity, as defined in section 603(a) of this order;
- 100 percent zero-emission vehicle acquisitions by 2035, including 100 percent zero-emission light-duty vehicle acquisitions by 2027;
- a net-zero emissions building portfolio by 2045, including a 50 percent emissions reduction by 2032;
- a 65 percent reduction in scope 1 and 2 greenhouse gas emissions, as defined by the Federal Greenhouse Gas Accounting and Reporting Guidance, from Federal operations by 2030 from 2008 levels;
- net-zero emissions from Federal procurement, including a Buy Clean policy to promote use of construction materials with lower embodied emissions;
- climate resilient infrastructure and operations; and
- a climate- and sustainability-focused Federal workforce.

USG: EO-14057

GC: GREENING GOVERNMENT STRATEGY

State & Local Buy Clean Programs Emerging

- State projects
- Cost exceeds $500K
- Jan. 1, 2024

•Asphalt and asphalt mixtures
•Cement and concrete mixtures
•Glass
•Post-tension steel
•Reinforcing steel
•Structural steel
•Wood structural elements

Climate Policy in California

Senate Bill 261

- As of 2026, companies with annual revenues of $500 MM+ that do business in California will now be required to issue a biennial climate-related financial risk report.
- The reports must be prepared in accordance with the Task Force on Climate Related Financial Disclosures (TCFD) reporting framework
- Failure to report will be subject to a fine of up to $50,000 per year

Climate Policy in California

Senate Bill 253

- SB 253, also known as the “Climate Corporate Data Accountability Act” applies to companies that do business in California and have total annual revenues in excess of $1 Billion
- Beginning in January 2026, reporting entities must annually publicly disclose their ***scope 1 and scope 2*** GHG emissions for the prior fiscal year
- Beginning in 2027, reporting entities will also be required to annually disclose their ***scope 3*** emissions for the prior fiscal year

What is ESG?

ENVIRONMENTAL

Sustainability

Reduce energy and carbon emissions toward net zero

Increase water efficiency

Enhance sites and protect habitats

Choose low impact materials

Address climate resilience

Improve IEQ, health, and wellness

Minimize and work toward zero waste

Implement ESG policies

SOCIAL

Responsibility

Cultivate diversity, equity, and inclusion

Support openness, consensus, stakeholder engagement, and due process

Invest in community access, improvement, and engagement

Promote and assess health, safety, and satisfaction

Evaluate supplier impact on human rights, labor standards, and working conditions

Forge partnerships for societal benefit

GOVERNANCE

Transparency

Emphasize ethical behaviors

Implement conflict of interest policies and ensure compliance

Ensure stakeholder rights

Assess climate risk

Protect data and privacy

Disclose compensation strategies

Create accountability for public commitments

Provide transparent reporting

- Quarterly/Annual Financial Reporting
- Sustainability Statements
- Corporate Social Responsibility Report
- Sustainability Report
- Materiality Assessment Report

- ESG Report

Evaluation in Materials Selection

Assessing Resiliency, LCCA, and Material Selection

Government Projects use Guiding Principles to assess compliance with UFC standards

Resiliency

- UFC 1-200-02, Paragraph 2-2.1: Integrated Design
- UFC 1-200-02, Paragraph 2-7 Address Climate Change Risk
- GPC Section 1.b Integrated Design
- GPC section 6: Assess and Consider Climate Change Risks

LCCA

- UFC 1-200-02, Paragraph 1-7 Life Cycle Cost Analysis (LCCA)
- UFC 1-200-02, Paragraph 2-3.2: On-Site Renewable Energy
- GPC Section i.a LCCA Format
- GPC Section 2.b Renewable and Clean Energy

Material Selection

- UFC 1-200-02, Paragraph 2-6.1.1 Recycled Content
- UFC 1-200-02, Paragraph 2-6.1.2 Biologically-Based Products
- UFC 1-200-02, Paragraph 2-6.1.3 Ozone Depleting Compounds
- UFC 1-200-02, Paragraph 2-6.2.2 Waste Diversion
- GPC Section 5: Reduce Environmental Impact of Materials

Assessing Resiliency, LCCA, and Material Selection

Non-Federal Government Projects use Green Globes to assess compliance with ANSI standards

Resiliency

- 1.1.1 Performance & Green Design Goals
- 1.1.2 Integrated Design Process
- 1.1.3 Site and Building Resilience
- 5.3.1 Occupant Exposure Screening Report

LCCA

- 1.3.1 LCCA or Building Service Life Plan
- 5.1.1.1 Whole Building Life Cycle Assessment
- 5.2.1 Product Life Cycle

Material Selection

- 5.4.1 Product Sustainable Materials Attributes
- 5.7.1 Off-Site Fabrication for Construction Optimization
- 5.5.1 Structural Systems and Non-Structural/ Interior Elements

Green Globes and Low Embodied Carbon

Green Globes for New Construction 2021 & 2023

- Points are awarded based on a Sustainable Materials Index that includes third-party sustainable forestry certification content.

Green Globes for New Construction 2023

- Points are awarded when least 9% reduction is demonstrated for GWP when using a life cycle assessment, ASTM E2921-16a, or an embodied carbon tool such as EC3. The objective of this criteria is to determine global warming potential comparisons between the building and the proposed design.

Green Globes for Existing Buildings 2023

- Points are awarded for product materials that include third-party sustainable forestry certification, categorized as Responsible or Certified Sources in accordance with ASTM D7612.

10. MATERIALS (150 points)

10.1 WHOLE BUILDING LIFE CYCLE ASSESSMENT (26 POINTS)

10.1.1 WHOLE BUILDING LIFE CYCLE ASSESSMENT

10.1.1.1 The project team evaluates a minimum of two different building designs using ASTM E2921-16a and the following assessment protocol to select the building with the lower environmental impact.

Assessment protocol:

The life cycle assessment reports the following life cycle impact indicators:

- *Global warming potential (GWP)*/climate change*;*
- Acidification potential;
- Eutrophication potential;
- *Ozone depletion potential (ODP);* and
- Smog potential.

The proposed final design of the building with the lower anticipated environmental impact achieves the following performance targets compared to the reference design:

- A minimum 5% reduction each, for at least three impact indicators, one of which is *global warming potential*; and
- No other impact indicator exceeds the reference design by more than 5%.

Operating energy consumption and MEP systems can be included
A registered design professional verifies structural material quantities, with the exception of *existing buildings*.

GREEN GLOBES EB 2023 & ESG + Climate Risk & Resilience

- 5% of total Green Globes points can be earned for Resilience
- Buildings earn points for environmental goals including CO_2e, reduction of waste, water, and energy, i.e.
  - Leases include monitoring of goals
- Earn points for DEI, CSR, and ESG policies/reports

1.3.2 SOCIAL & GOVERNANCE	
1.3.2.1 Ownership/stakeholders engage in social and governance best practices.	1 point
1.3.2.2 The organization issues a CSR (Corporate Social Responsibility) or ESG (Environmental, Social, Governance) report on an annual or regular basis.	1 point
1.3.2.3 The CSR or ESG report is publicly available.	1 point
1.3.2.4 The report aligns with an industry standard for disclosures and includes a materiality and climate *risk* or *resilience* assessment.	1 point

1.2.1 *RISK ASSESSMENT* & FACILITY ADAPTATION	
1.2.1.1 A multi-hazard *risk assessment* has been completed for the building and location that includes as a minimum the following *risks* or hazards as applicable: **1.2.1.1.1** Floods (coastal storm surge, tidal, pluvial/*stormwater*, or fluvial/riverine) **1.2.1.1.2** Seismic events (earthquake, vulcanism, and/or resulting tsunami) **1.2.1.1.3** Landslides and avalanches **1.2.1.1.4** Severe weather (wind, tornado, hail, lighting, snow, ice-storm, drought, or severe heat or cold) **1.2.1.1.5** Wildfires **1.2.1.1.6** Man-made *risks* (explosion, terrorist act, or poison release) **1.2.1.1.7** Health issues (e.g., pandemic, or sanitation issue in the aftermath of a disaster) **1.2.1.1.8** Infrastructure disruptions (loss of energy, water, sanitation, transportation, or communications service) **1.2.1.1.9** Changes to geology and/or groundwater conditions that affect or disrupt infrastructure and/or facility function	3 points
1.2.1.2 A *risk assessment* has been completed for 1.2.1.1 for each associated *risk* or hazard.	Maximum = 4 points • One point is earned for in 1.2.1.1 for a maximu
1.2.1.3 The assessment evaluates building functional requirements and prioritizes accordingly for future facility resiliency modifications.	3 points

Bringing Green Globes Net Zero Carbon to our Growing Client Base

GBI's Green Globes® Clients Across Industry

IDS center
amazon
Northwood Ravin
Community Health System
Equinix
GLEACHERCENTER Executive Conferences & Events
UPS
Majestic Realty
Fairfield Residential
VA U.S. Department of Veterans Affairs
MG Properties
333 Twin Dolphin Drive
Capstone Real Estate Investments, LLC
Northwestern Mutual
UFHealth
LaSalle Investment Management
INAP
entergy
CyrusOne
Digital Realty
Aligned Adaptive Data Centers
Equinix
neustar
Capital One
Presidium
GAIA Real Estate
Crow Holdings
Olympus Property
Kaufman Development Group
Metropolitan Development Group
Becovic
Woodridge Capital
Newmark Knight Frank
Berkadia
Arrimus Capital
EY
Avenue5 Residential
Sunroad Enterprises
Cushman & Wakefield
ColRich Generations of Excellence
Kromer Investments Inc.
CBRE
Greystar The Global Leader in Rental Housing
Toll Brothers Apartments Living
JLL
W3 Luxury Living
LivCor
Stoneweg
Fairfield Residential
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GREEN GLOBES® HEALTH & WELLNESS DISTINCTION

NEW CONSTRUCTION
SUSTAINABLE INTERIORS
CORE & SHELL
EXISTING BUILDINGS

GREEN GLOBES® NET ZERO ENERGY

GREEN GLOBES® NET ZERO CARBON

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Q+A

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