A Pathway to Attaining Net Zero Through Planning & Predictive Modeling

Objectives

- Current state of health sector pollution and emission and operational and infrastructure related climate vulnerabilities.
- US Health Care Pollution Disease Burden.
- White House/HHS Health Sector Climate Pledge.
- How can AI bridge the gap between data collection and metric standards.

Role of the Healthcare Sector

"If the healthcare sector was a country, it would be the 5th largest greenhouse gas emitter per capita, behind only the United States, China, India, and Russia."

Role of the Healthcare Sector

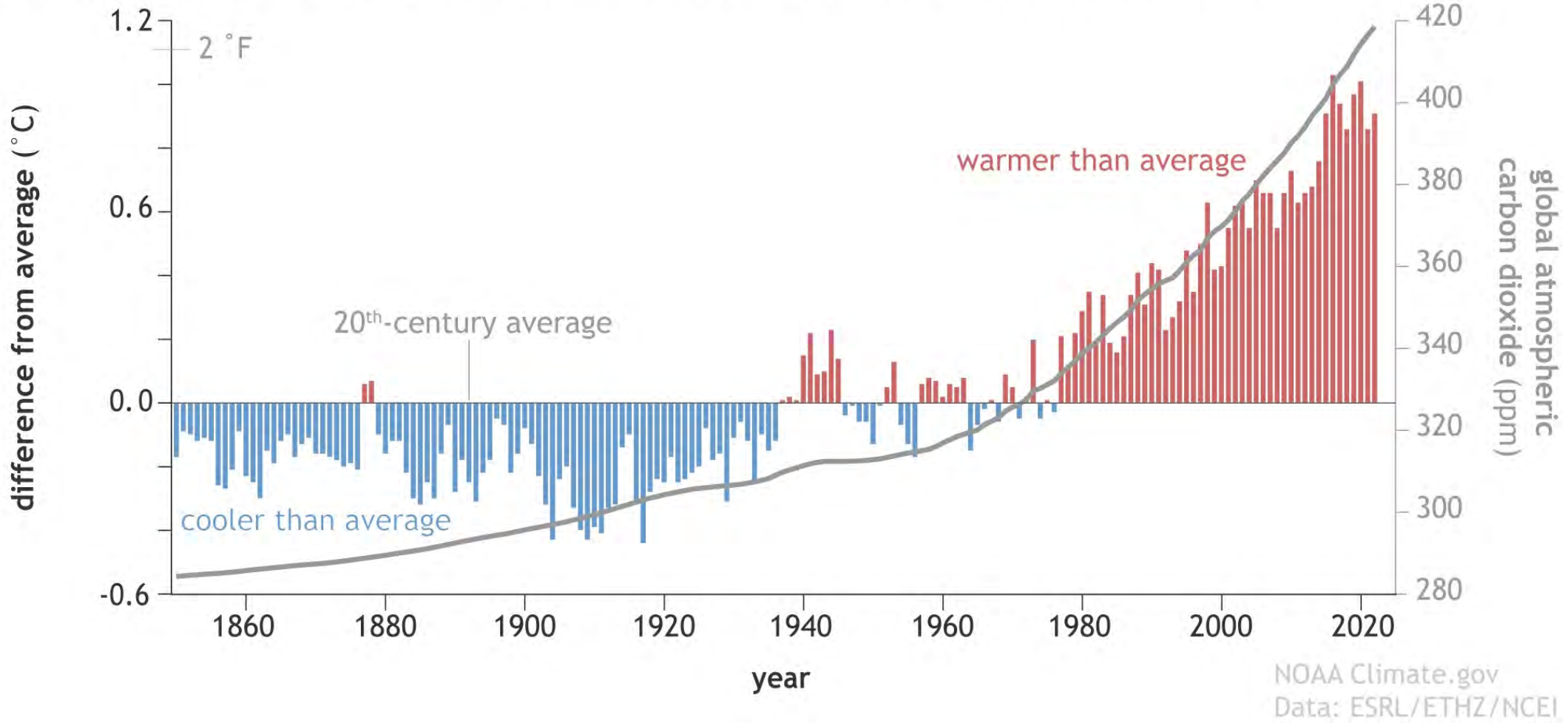
"In the US, the healthcare sector and its supply chain represent 8.5% of domestic emissions. Globally, the healthcare sector contributes 4.6%."

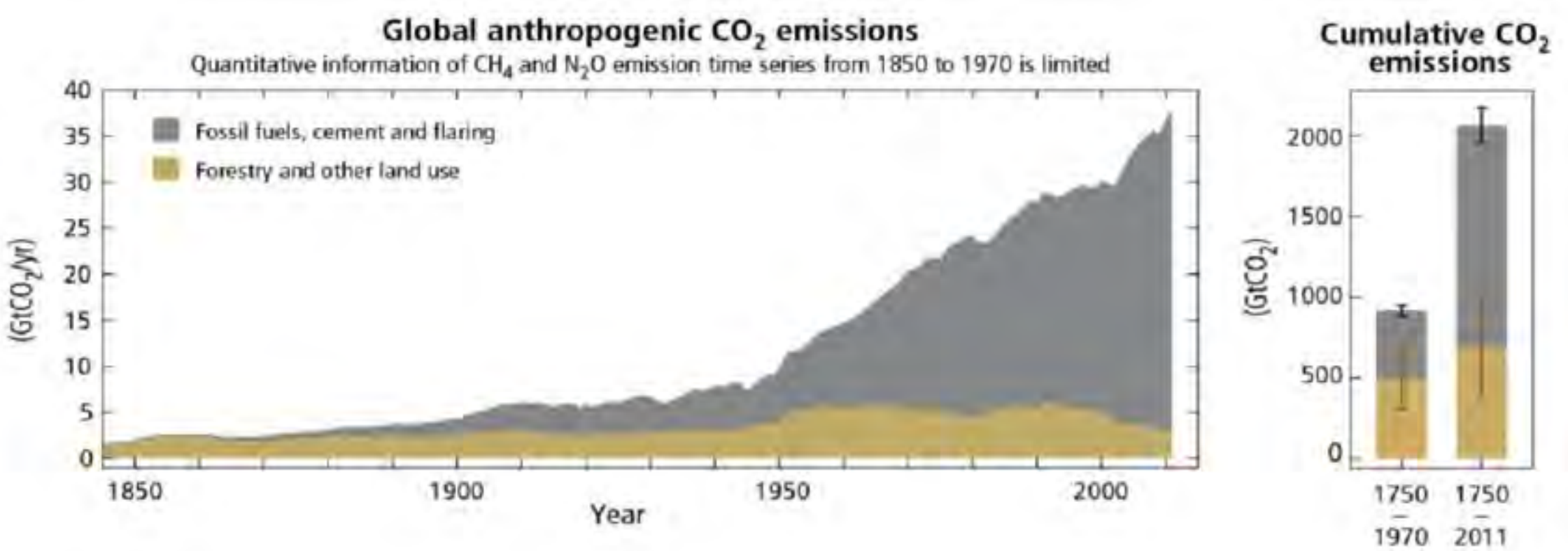
US Healthcare Pollution Disease Burden

"Total disease burden from US healthcare pollution results in the loss of approximately 388,000 DALYs annually.

This is the same magnitude of loss as death from preventable medical errors."

Yearly global surface temperature and atmospheric carbon dioxide (1850-2022)




Global anthropogenic CO_2 emissions
Quantitative information of CH_4 and N_2O emission time series from 1850 to 1970 is limited
Fossil fuels, cement and flaring
Forestry and other land use
$(GtCO_2/yr)$
40
35
30
25
20
15
10
5
0
1850
1900
1950
2000
Year
Cumulative CO_2 emissions
$(GtCO_2)$
2000
1500
1000
500
0
1750 – 1970
1750 – 2011

Global Comparisons

Ranking	EMISSIONS
1	UNITED STATES
2	CHINA
3	EU
4	JAPAN
5	RUSSIA
6	BRAZIL
7	INDIA
8	SOUTH KOREA
9	CANADA
10	AUSTRALIA
11	MEXICO

Global Comparisons

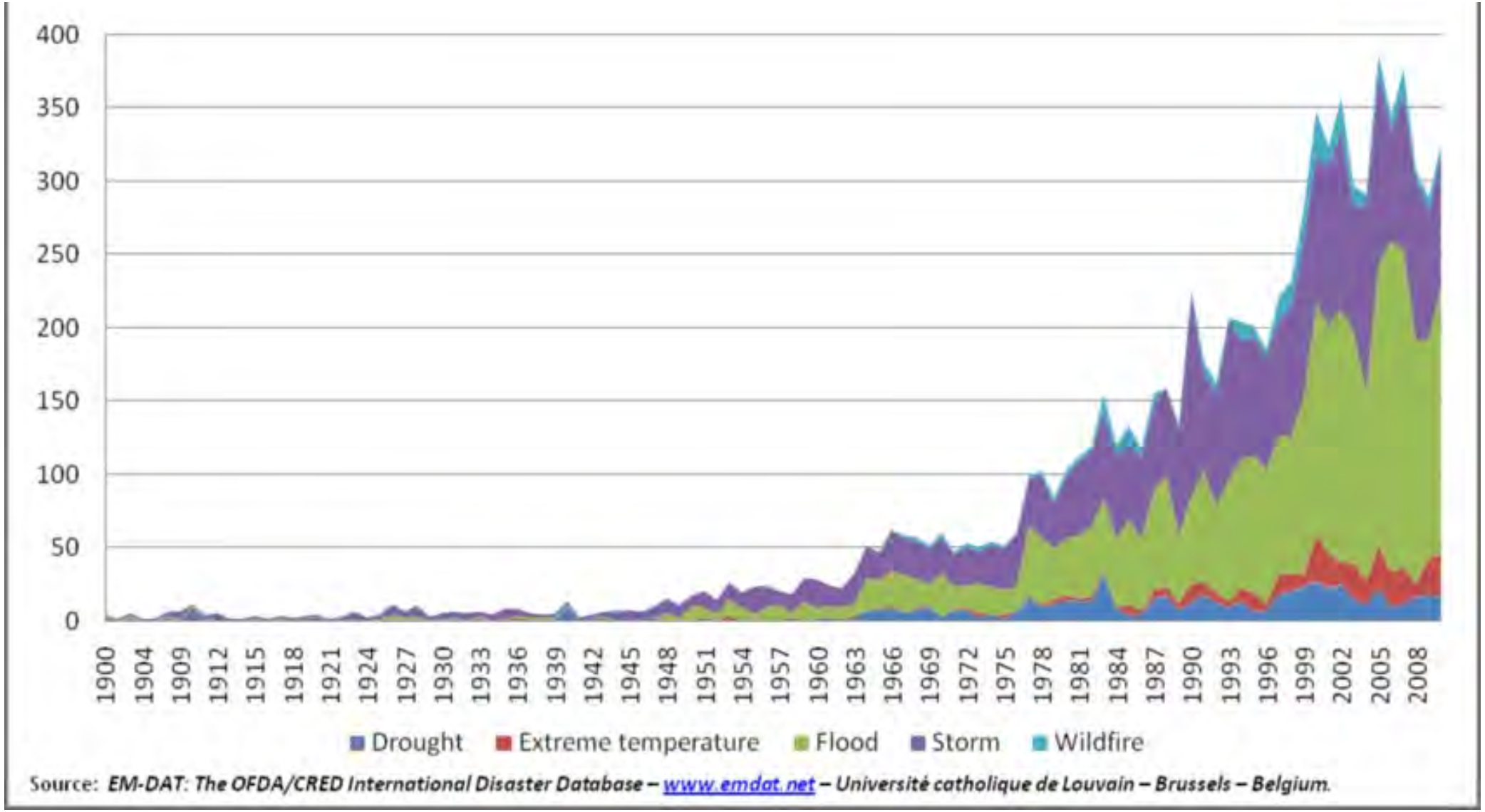
Ranking	EMISSIONS	SPENDING
1	UNITED STATES	UNITED STATES
2	CHINA	SWITZERLAND
3	EU	GERMANY
4	JAPAN	FRANCE
5	RUSSIA	SWEDEN
6	BRAZIL	CANADA
7	INDIA	NORWAY
8	SOUTH KOREA	UK
9	CANADA	NETHERLANDS
10	AUSTRALIA	AUSTRALIA
11	MEXICO	NEW ZEALAND

Global Comparisons

Ranking	EMISSIONS	SPENDING	QUALITY
1	UNITED STATES	UNITED STATES	NORWAY
2	CHINA	SWITZERLAND	NETHERLANDS
3	EU	GERMANY	AUSTRALIA
4	JAPAN	FRANCE	UK
5	RUSSIA	SWEDEN	GERMANY
6	BRAZIL	CANADA	NEW ZEALAND
7	INDIA	NORWAY	SWEDEN
8	SOUTH KOREA	UK	FRANCE
9	CANADA	NETHERLANDS	SWITZERLAND
10	AUSTRALIA	AUSTRALIA	CANADA
11	MEXICO	NEW ZEALAND	UNITED STATES

Increase in Frequency of Extreme Events

"From 1980-2022 there was an average of 8 billion-dollar disasters in the United States annually. In 2022 there were 18, 2021 (20) and 2020 (22). In 2022 weather and climate related disasters cost the United States $165 billion."


400
350
300
250
200
150
100
50
0
1900
1904
1909
1912
1915
1918
1921
1924
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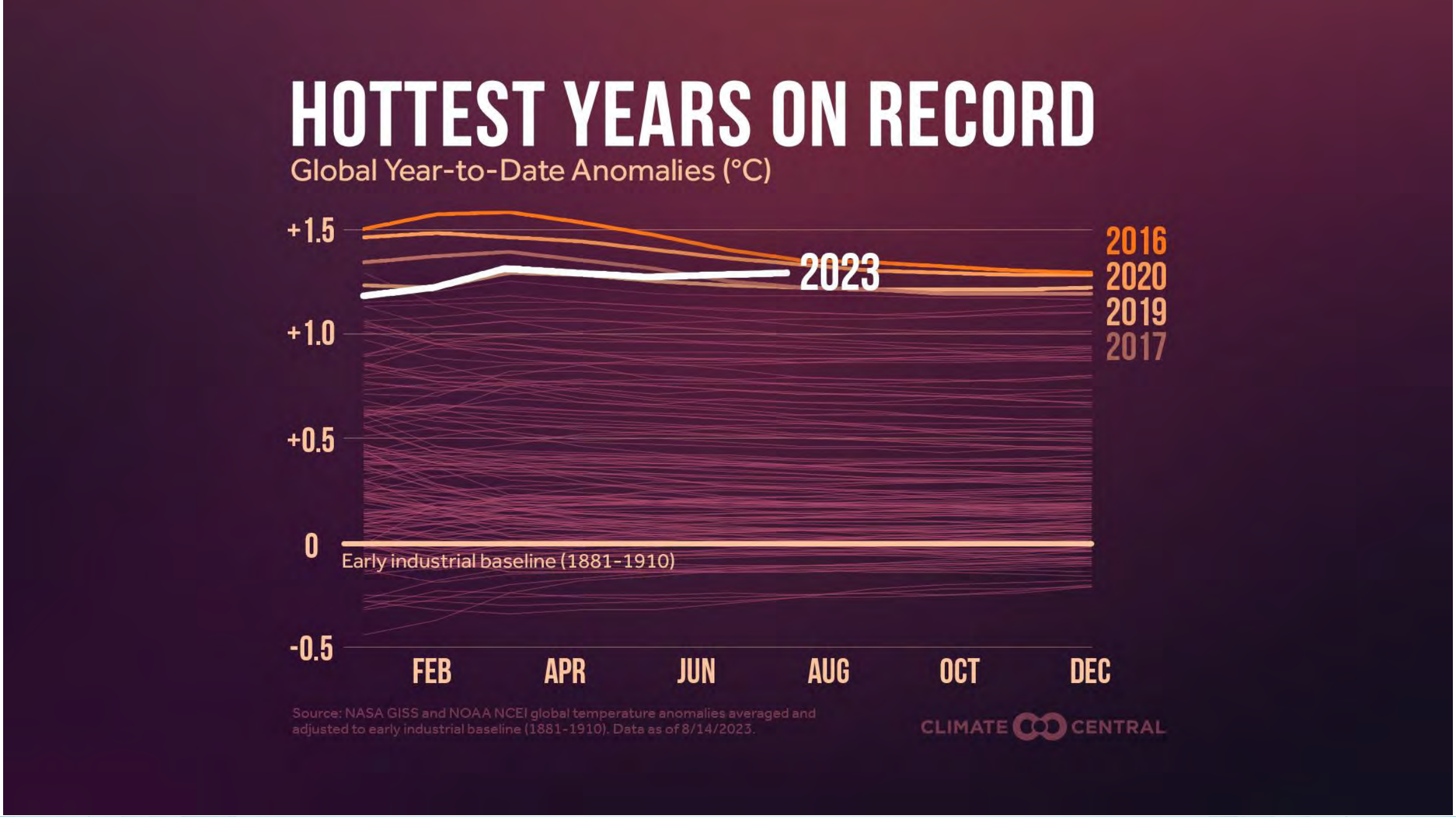
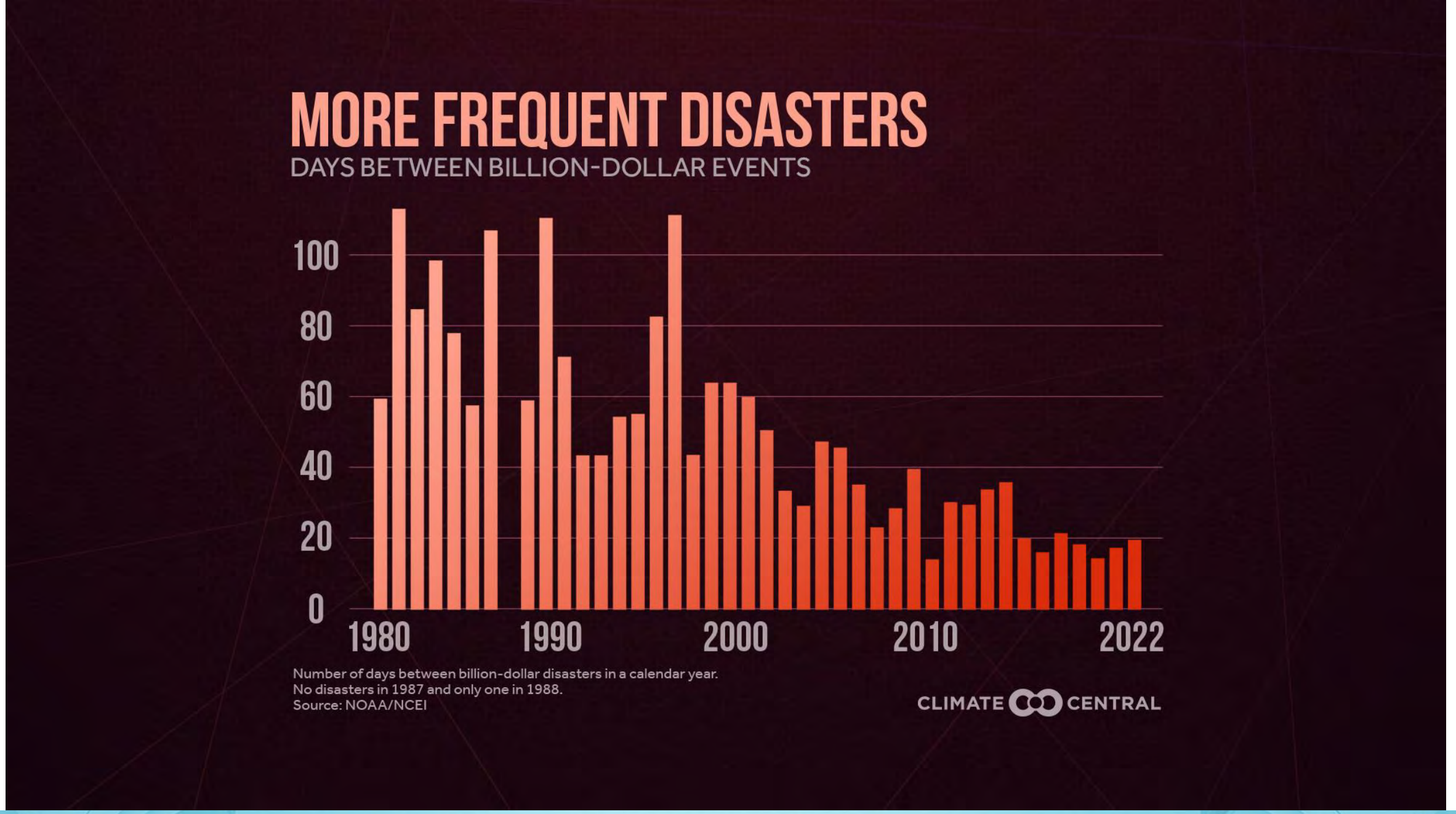
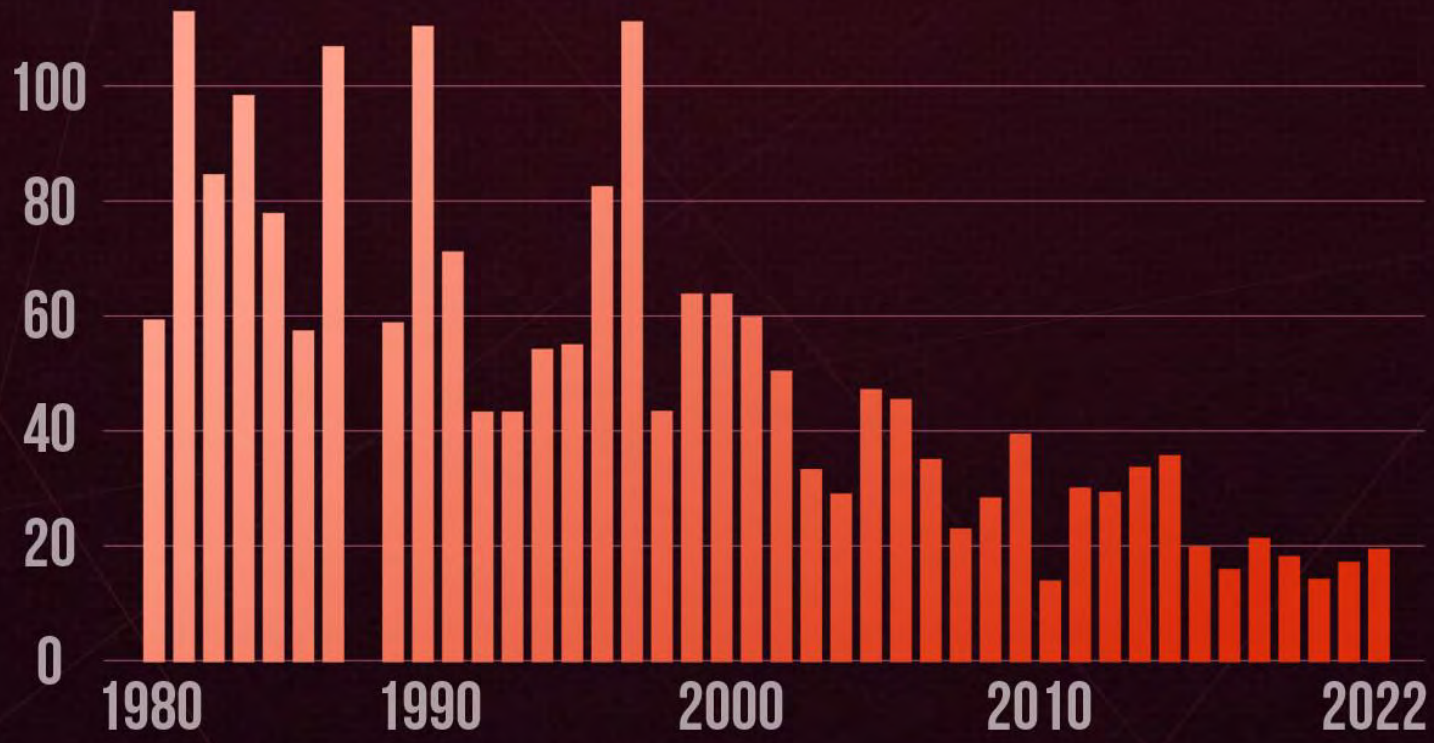
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
Drought
Extreme temperature
Flood
Storm
Wildfire
Source: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.net – Université catholique de Louvain – Brussels – Belgium.


HOTTEST YEARS ON RECORD
Global Year-to-Date Anomalies (°C)
+1.5
+1.0
+0.5
0
-0.5
2023
2016
2020
2019
2017
Early industrial baseline (1881-1910)
FEB
APR
JUN
AUG
OCT
DEC
Source: NASA GISS and NOAA NCEI global temperature anomalies averaged and adjusted to early industrial baseline (1881-1910). Data as of 8/14/2023.
CLIMATE CENTRAL


MORE FREQUENT DISASTERS
DAYS BETWEEN BILLION-DOLLAR EVENTS
100
80
60
40
20
0
1980
1990
2000
2010
2022
Number of days between billion-dollar disasters in a calendar year.
No disasters in 1987 and only one in 1988.
Source: NOAA/NCEI
CLIMATE CENTRAL

MORE FREQUENT DISASTERS

DAYS BETWEEN BILLION-DOLLAR EVENTS

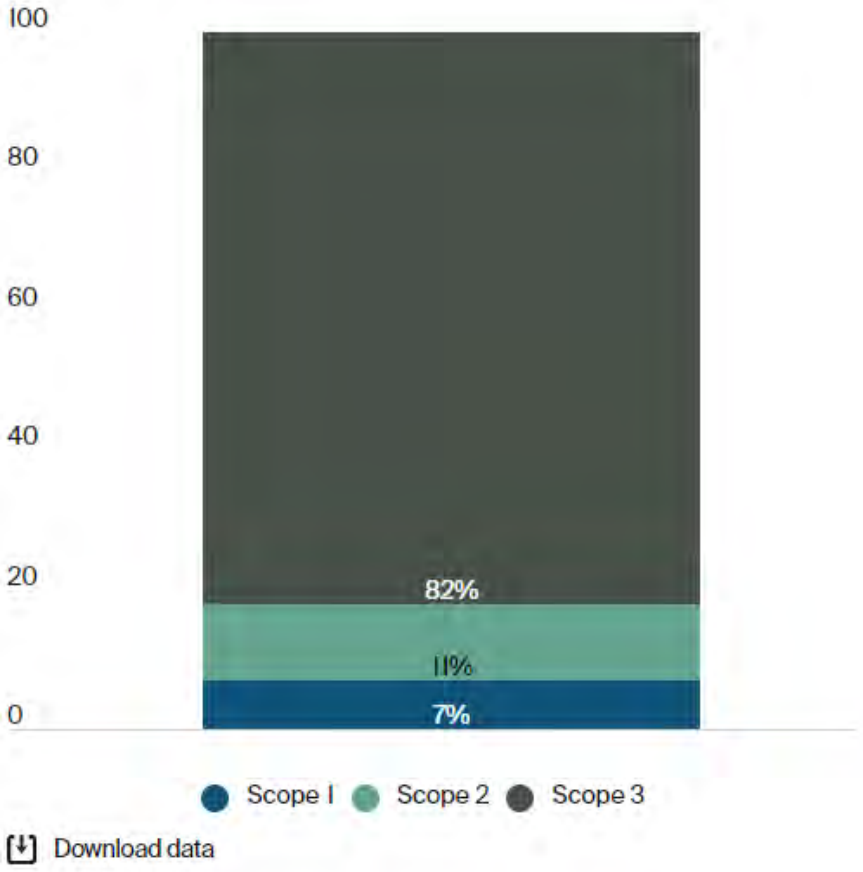


Number of days between billion-dollar disasters in a calendar year.
No disasters in 1987 and only one in 1988.
Source: NOAA/NCEI

CLIMATE CENTRAL

Sources of Greenhouse Gas Emissions in the Healthcare Industry

Greenhouse gas emissions, 2018



Scope 3

All other supply-chain emissions including:

- Water and waste
- Energy
- Transport
- Finance, insurance, administration, and public health
- Testing and research
- Construction
- Other manufacturing
- Information and computer technology, equipment, and services
- Plastics, rubber, textiles, and paper
- Medical supplies
- Medical devices
- Pharmaceuticals and chemicals
- Food
- Other

Scope 2

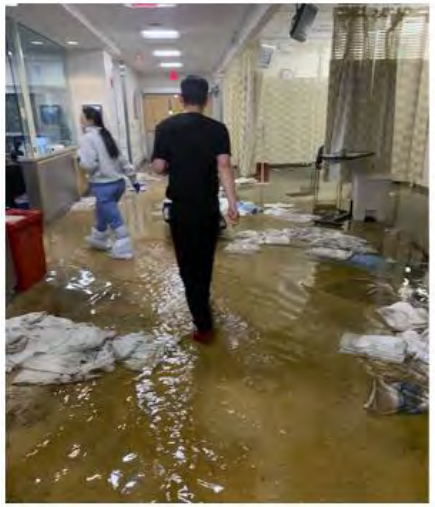
Emissions from direct purchases of energy

Scope 1

Direct emissions from health care facilities

Data: Matthew J. Eckelman et al., "Health Care Pollution and Public Health Damage in the United States: An Update," *Health Affairs* 39, no. 12 (Dec. 2020): 2071–79.

Health System Vulnerability



“Humanity must act to prevent this current and rapidly expanding public health crisis.”

International Federation of Healthcare Engineering

"…by 2030 we must reduce our collective carbon footprint by at least 50%...everything new, zero carbon…reducing carbon by 50% in what we are already doing."

ASHRAE

White House/HHS Health Sector Climate Pledge

- In March of 2022, the White House and HHS launched a voluntary commitment to climate resilience and emissions reduction that includes cutting greenhouse gas emissions by 50% by 2030 and achieving net zero emissions by 2050.
- The deadline for signing the agreement was October 2022.
- The pledge was reopened for signatories in March of 2023 and now accepts new signatories on an ongoing basis.
- In addition to hospitals, signatories include health centers, suppliers, insurance companies, group purchasing organizations, pharmaceutical companies, and more.
- Currently, the Pledge lists 116 organizations representing 872 hospitals.
- Combined with the commitment of federal health systems, this represents 15% of US hospitals

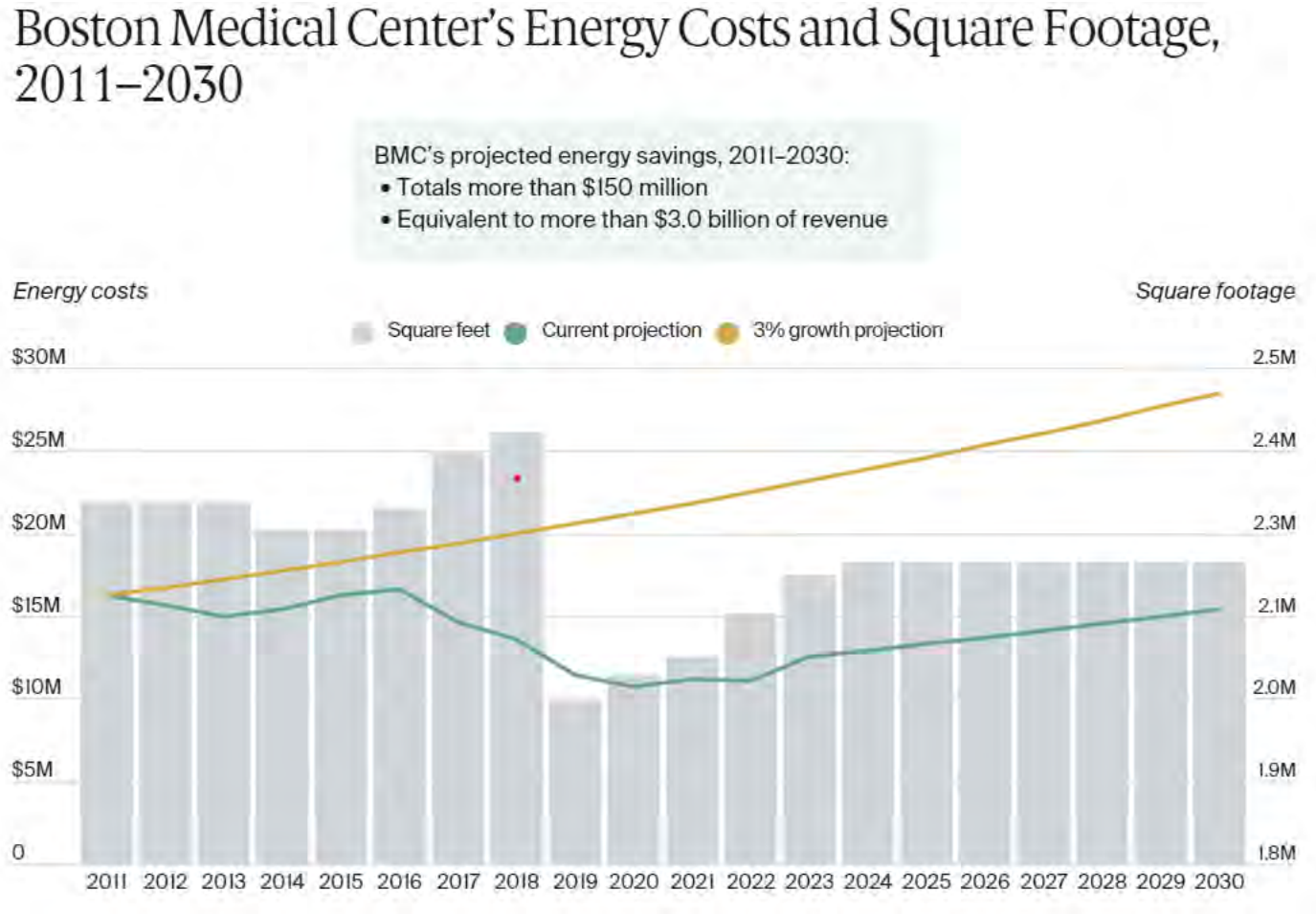
White House/HHS Health Sector Climate Pledge

Specifically, Pledge signers commit to:

1. At minimum, reduce organizational emissions by 50% by 2030 (from a baseline no earlier than 2008) and achieve net-zero by 2050, publicly accounting for progress on this goal every year.
2. Designate an executive-level lead for their work on reducing emissions by 2023 and conduct an inventory of scope 3 (supply chain) emissions by the end of 2024.
3. Develop and release a climate resilience plan for continuous operations by the end of 2023, anticipating the needs of groups in their community that experience disproportionate risk to climate-related harm.

Signatory Success: Boston Medical Center

- Since 2011, BMC has reduced its carbon emissions from energy consumption by 91%.
- Reduced campus square footage by 10% but increased patient volume by 30%.
- Reduced need for ambulance transport around campus ($1.5m savings)
- Combined two cafeterias.
- Underwent over 50 different energy reduction projects.
- Installed cogeneration plant.
- Solar power purchasing.
- Reduced annual operating costs by $40 million.



Signatory Success: Kaiser Permanente

- Third party certified carbon neutral across scope 1 and 2 emissions and some categories of scope 3 emissions (the 1st US healthcare system to achieve this).
- 100 facilities including 31 hospitals host their own on-site solar arrays.
- Between 2014 and 2020 they have seen an 82% reduction in emissions associated with halogenated aesthetic gases.
- 100 megawatt hours of better storage for increased resilience.
- 22 energy star rated medical centers, 195 energy-star rated buildings, Vallejo Medical Center-perfect score.
- 65 LEED certified buildings more than any other health system in the world.

Signatory Success: Kaiser Permanente

- KP Strategies for Impact.

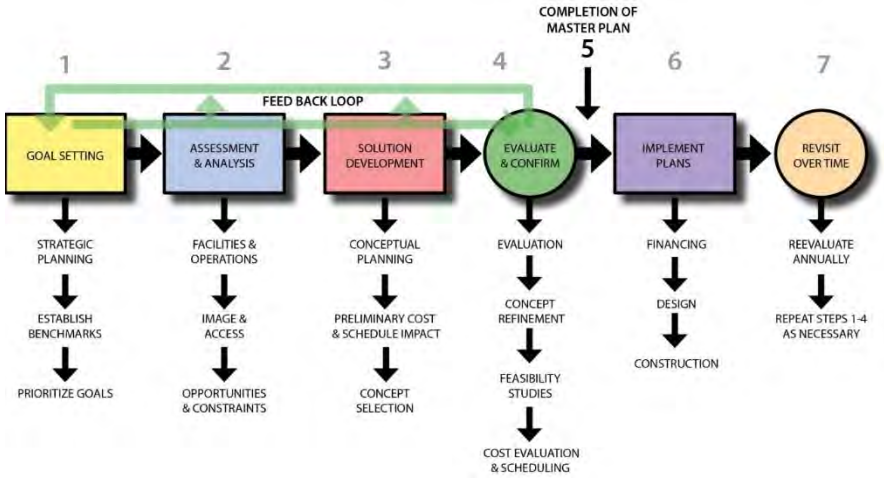
- Measuring what matters (energy analytics to drive conservation and efficiency).
- Employee engagement (enterprise-wide energy management community of practice).
- Accountability (establish targets in design standards and capital investments.
- Smart shifts (equipment efficiency).
- Zeroing in (on most energy intensive facilities.
- Low and zero carbon energy (expand clean and distributed energy to reduce grid dependence).
- Financial stability (optimize energy costs).

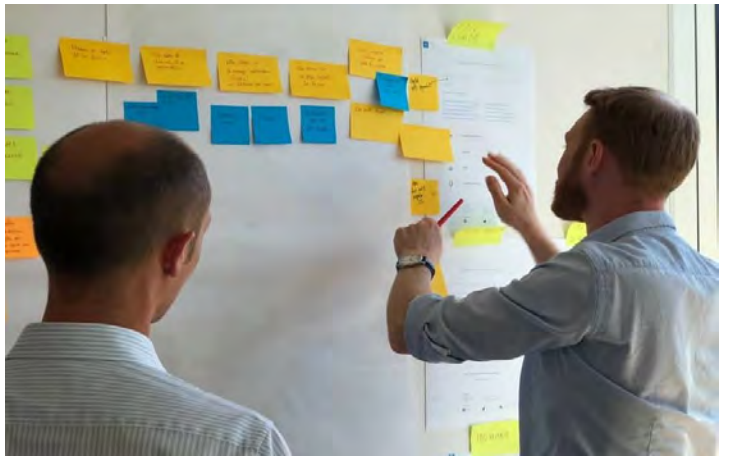
Signatory Success: Mount Sinai

- Have achieved a 30% emissions reduction since 2005.
- Controlled energy use in unoccupied spaces.
- Preventative maintenance on equipment.
- Air and water leak maintenance.
- Cogeneration.
- LEED guidelines for new construction.
- Reducing energy intensity from data centers

Institutional Master Planning Traditional Approach

- Set Goals.
  - Expansion of Clinical Services.
  - Addition of New Technologies & Equipment
  - Decant Services into Community
- Shape Projects.
  - Work with Clients
  - Coordinate with Clinical Vendors
- Evaluate Physical Plant.
  - Available Land for New Buildings
  - Available Space in Existing Buildings
  - Infrastructure Capacity
- Establish Costs.
  - CM Pricing
  - F,F, & E Budget



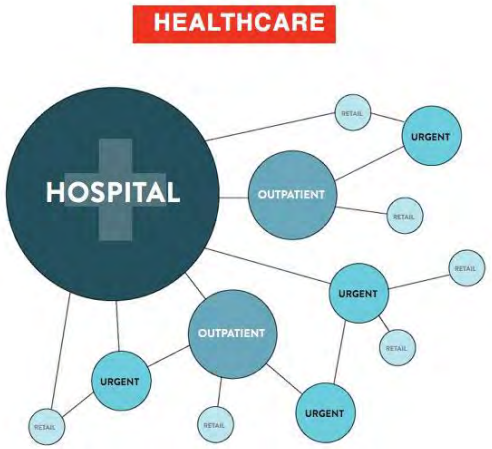


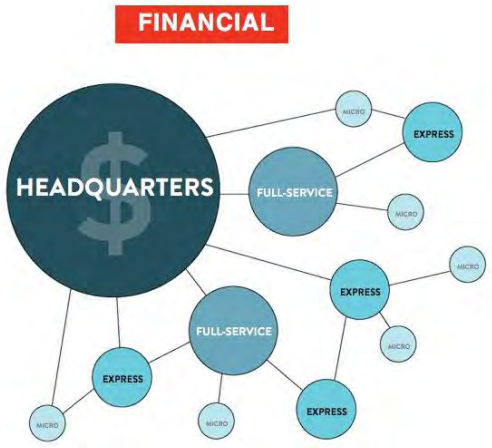
Institutional Master Planning New Approach

- Achieving Net Zero Must be Part of Goal Setting.
- Scope 1.
  - ➢ Program to Update and Retrofit Existing Campus Façade Performance
  - ➢ Program to Update and Retrofit Existing Infrastructure
- Scope 2.
  - ➢ Partnerships with Larger Community Initiatives
  - ➢ Maximizing Energy Provider Offerings
- Scope 3.
  - ➢ Strategy to Use Purchasing Power to Limit Supply Chain Emissions
  - ➢ Leverage Vendor Selection Based Net Zero Compliance Tracking

Identification of Drivers

- Impact on Operational Costs.
  - $3 to $5 Energy Cost Per Square Foot
  - $7,500 to $15,000 Annually Per Patient Bed
- Marketing & Reputation Considerations
  - Philanthropic Efforts
  - Community Partnerships
  - Patient Awareness
- Financial Opportunities.
  - Joint Ventures
  - Vendor Relationships
- Patient Care Trends.
  - More Energy Intensive Equipment
  - Higher Level of Finishes & Amenities





Challenges

- Energy Intensive Uses.
- 24/7/365 Operation.
- 70% of Emissions are Related to Supply Chain.
- Limited Staff to Document Compliance.
- Limited Available Land.
- Limited Options for Maintaining Operation During Renovations.

Market Sector	Property Type	Source EUI (kBtu/ft2	Site EUI (kBtu/ft2)
Retail	Strip Mall	228.8	103.5
Retail	Enclosed Mall	170.7	65.7
Office	Office	116.4	52.9
Public Service	Courthouse	211.4	101.2
Public Service	Fire/Police Station	124.9	63.5
Food Sales & Service	Bar/Nightclub	297	130.7
Food Sale & Service	Supermarket/Grocery Store	444	196
Lodging/Residential	Multifamily Housing	118.1	59.6
Lodging/Residential	Residence Hall/Dormitory	107.5	57.9
Technology/Science	Laboratory	318.2	115.3
Healthcare	Medical Office	121.7	51.2
Healthcare	Hospital	426.9	234.3
Healthcare	Ambulatory Surgical Center	138.3	62

Enhancing ESG Performance and Reporting

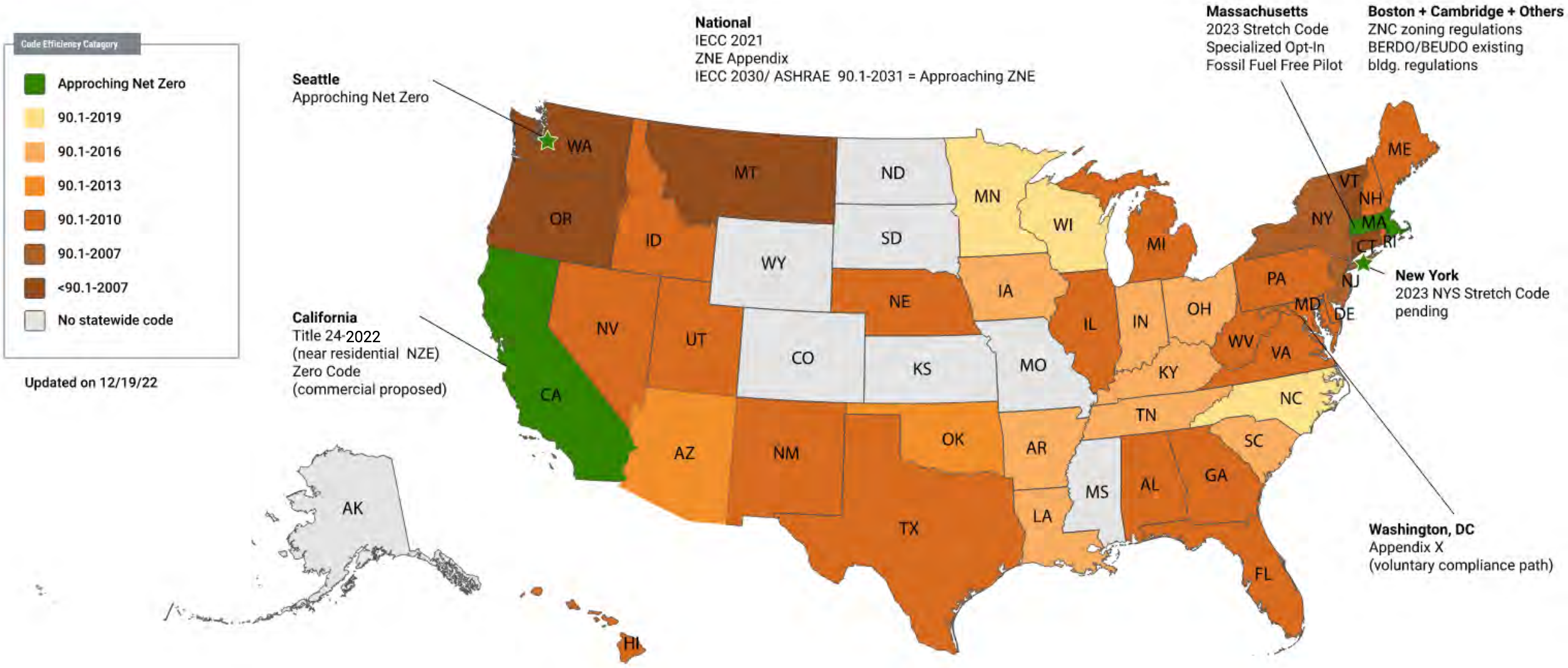
1. **COST SAVINGS:** Through systems energy and optimization, Green LED Interior and Exterior, Lighting, Proactive Infrastructure Maintenance, and Capital Equipment Expenditures one health system has saved over $20 million since 2011.
2. **ENVIRONMENTAL RESPONSIBILTY:** In the activities above the system avoided sending 109 metric tons of CO^2 emissions into our atmosphere, equivalent to the carbon sequestration of 130 acres of US forest
3. **RISK**: Enhanced ESG performance reduces risk. ESG is about managing risk both operationally and reputationally. In healthcare real estate, smart, energy efficient buildings are more resilient to climate shocks and natural disasters.
4. **REGULATIONS:** The regulatory landscape is rapidly evolving. The SEC has proposed mandatory reporting for scope 1 and 2 emissions. Municipal regulations like BERDO have been passed or are under consideration in 16 major cities. These regulations mandate energy and emissions disclosure and reduction.
5. **LABOR:** Companies with higher ESG scores report higher employee satisfaction and better ability to attract young talent in an unprecedently competitive labor market.
6. **CAPITAL:** Companies with higher ESG scores have been shown to have lower cost of capital (-6%)
7. **INNOVATION AND EFFICIENCY:** Studies have shown that as a company's ESG performance increases they experience other operational efficiency improvements enterprise-wide

Opportunity in Greening of the Healthcare Sector

- Increased energy efficiency leads to lower operating costs
- Hospitals are facing staffing crises. Multiple studies suggest the increasing sustainability performance makes it easier to attract and retain staff – especially in the next generation of the work force, Gen Z
- Studies suggest that greener hospitals are associated with better patient outcomes
- Risk mitigation – studies suggest greener hospitals have lower infection transmission
- Community benefits – less negative impact on the environment brings positive community impact

National Implementation

Net Zero Codes



NET ZERO

ENERGY EFFICIENCY

MINIMIZE FOSSIL FUEL

ON + OFF-SITE RENEWABLE ENERGY

CARBON NEUTRAL

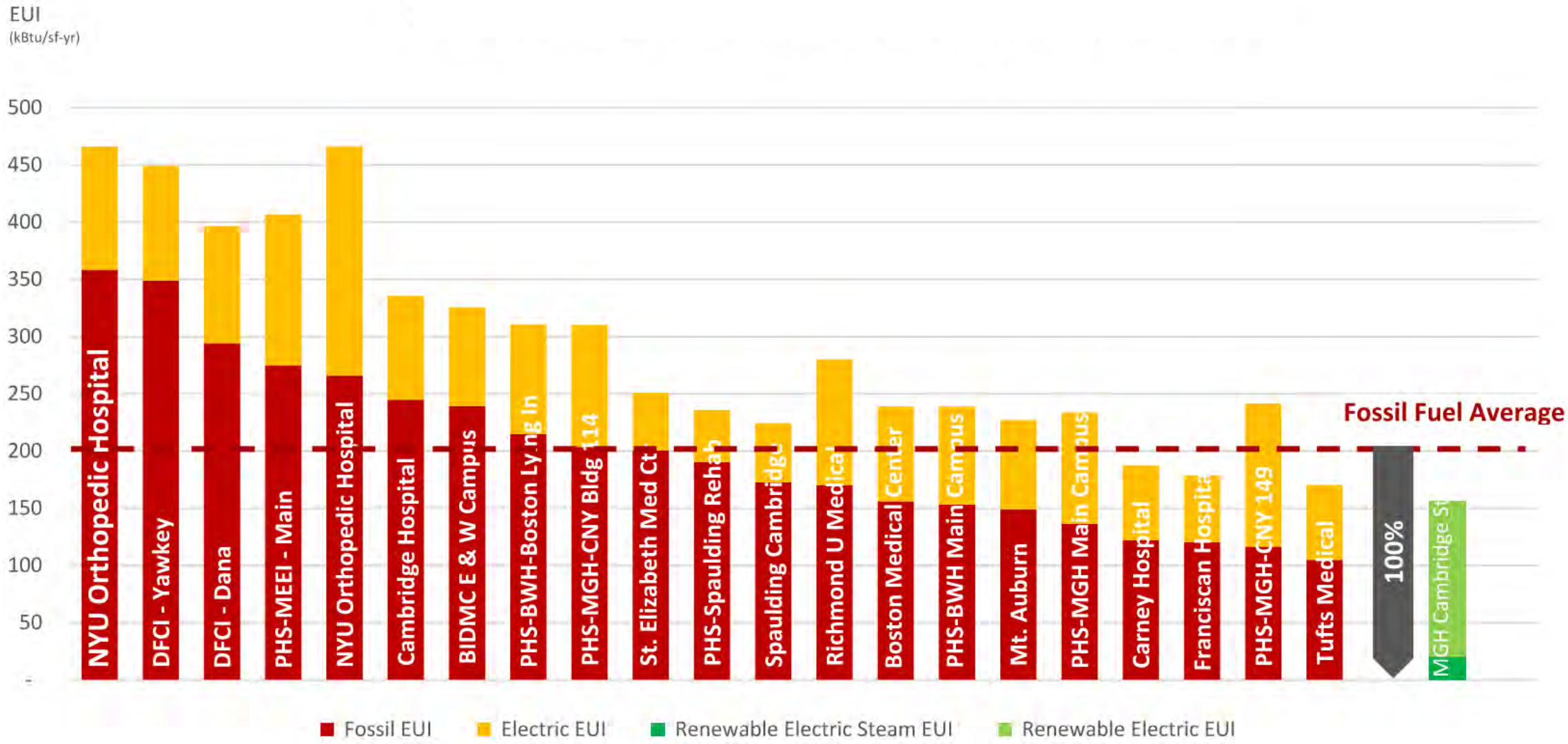
ENERGY EFFICIENCY

MINIMIZE FOSSIL FUEL

ON + OFF-SITE RENEWABLE ENERGY

CARBON NEUTRAL READY

Operational Carbon Impact for Healthcare Projects



Carbon Neutral Hospitals


Mass General Hospital

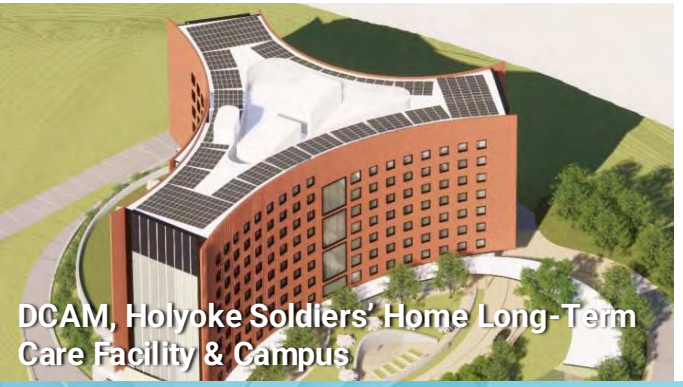

Indiana University Health, Adult Academic Health Center


Nationwide Children's Hospital


Chelsea Soldiers' Home, Community Living Center

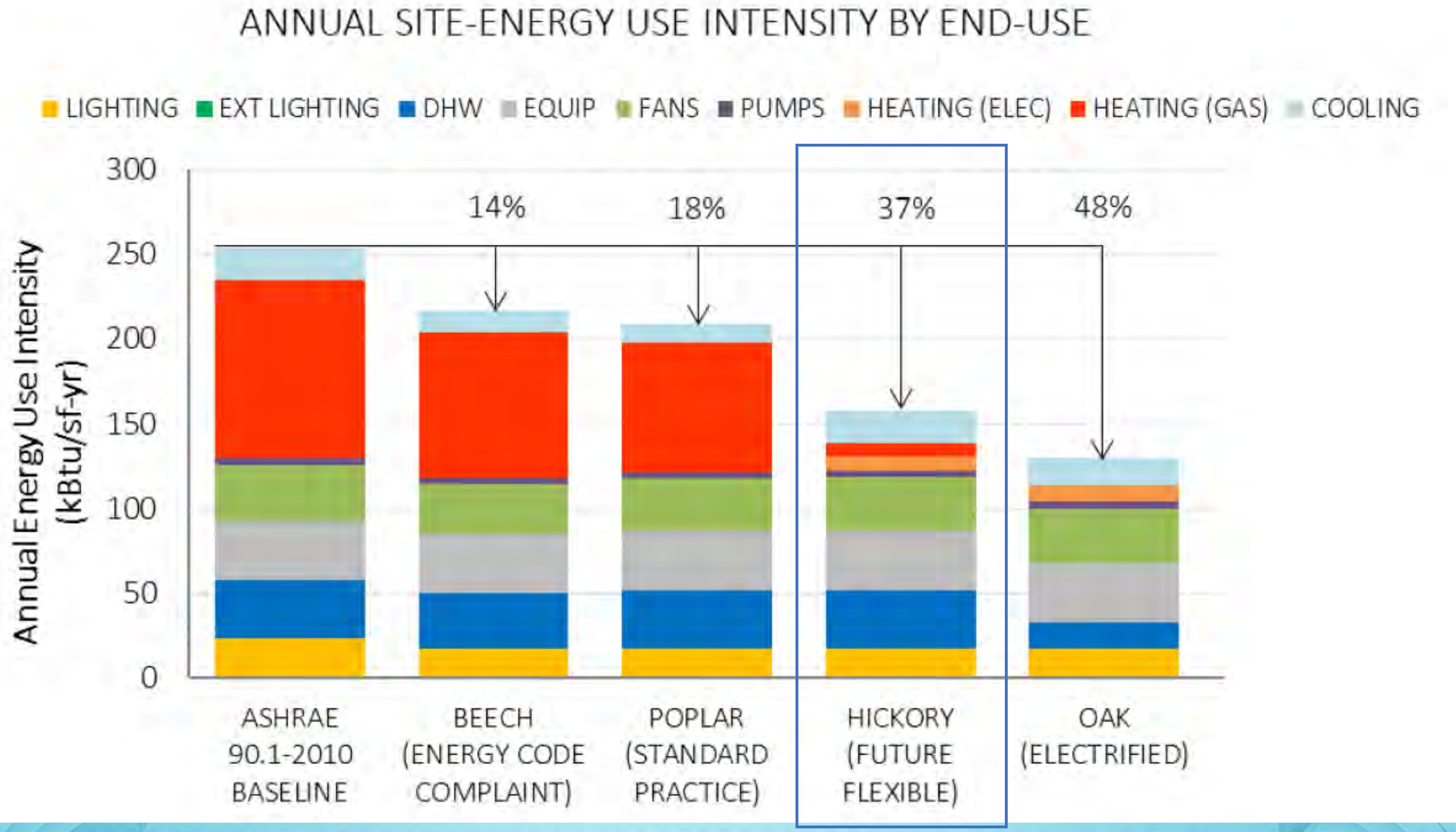

Southampton Hospital Association, Stony Brook Southampton Hospital

Henry Ford Hospital, Phased Hospital Replacement

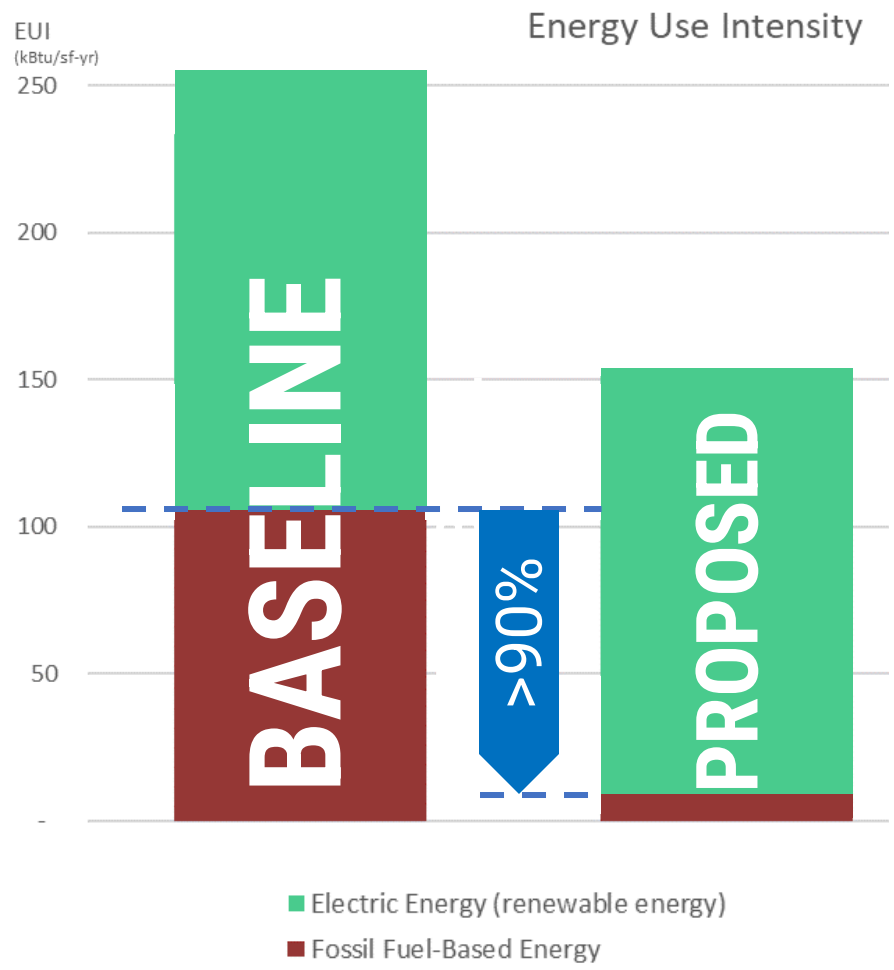

DCAM, Holyoke Soldiers' Home Long-Term Care Facility & Campus


INOVA Health System

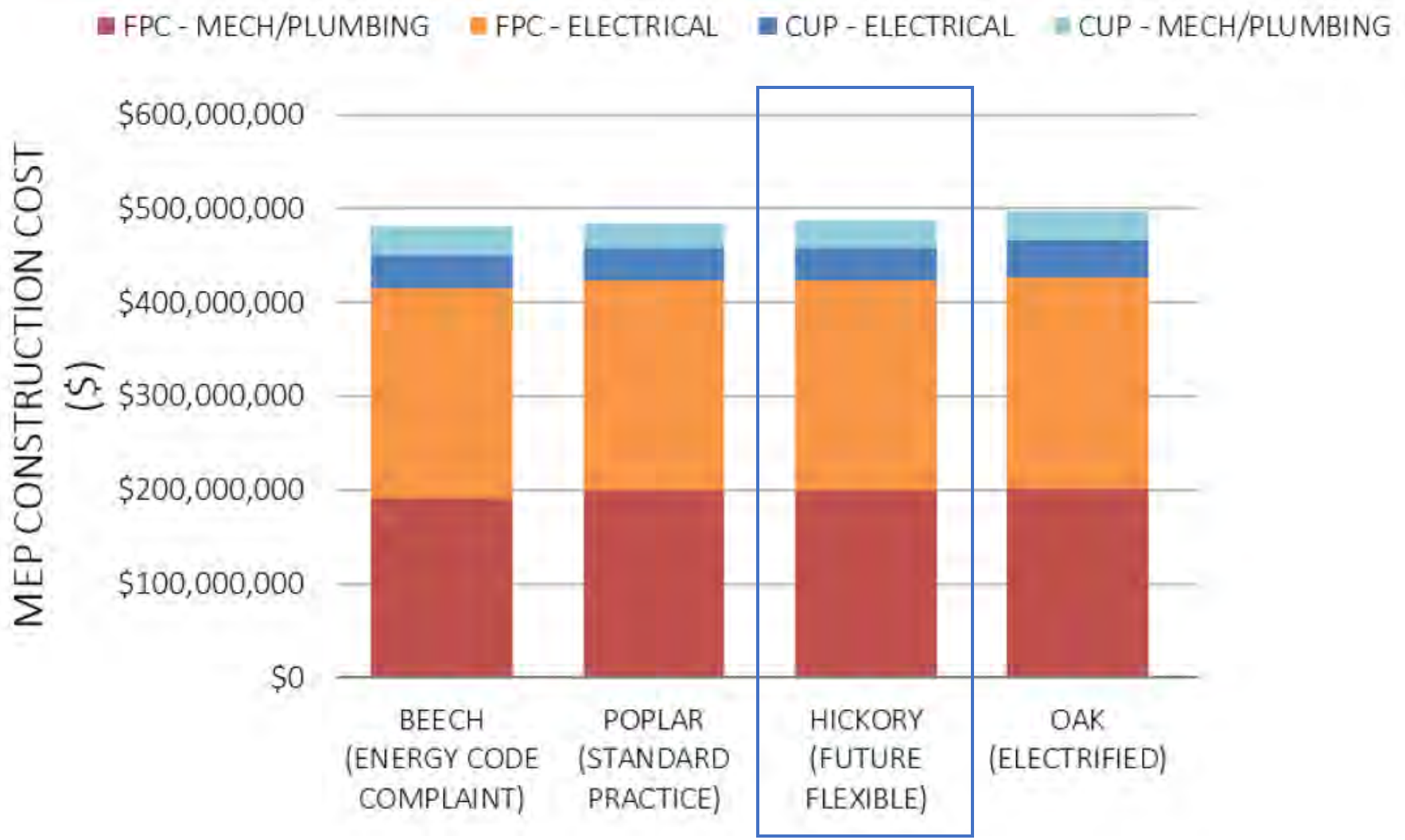
Indiana University Hospital Energy Performance



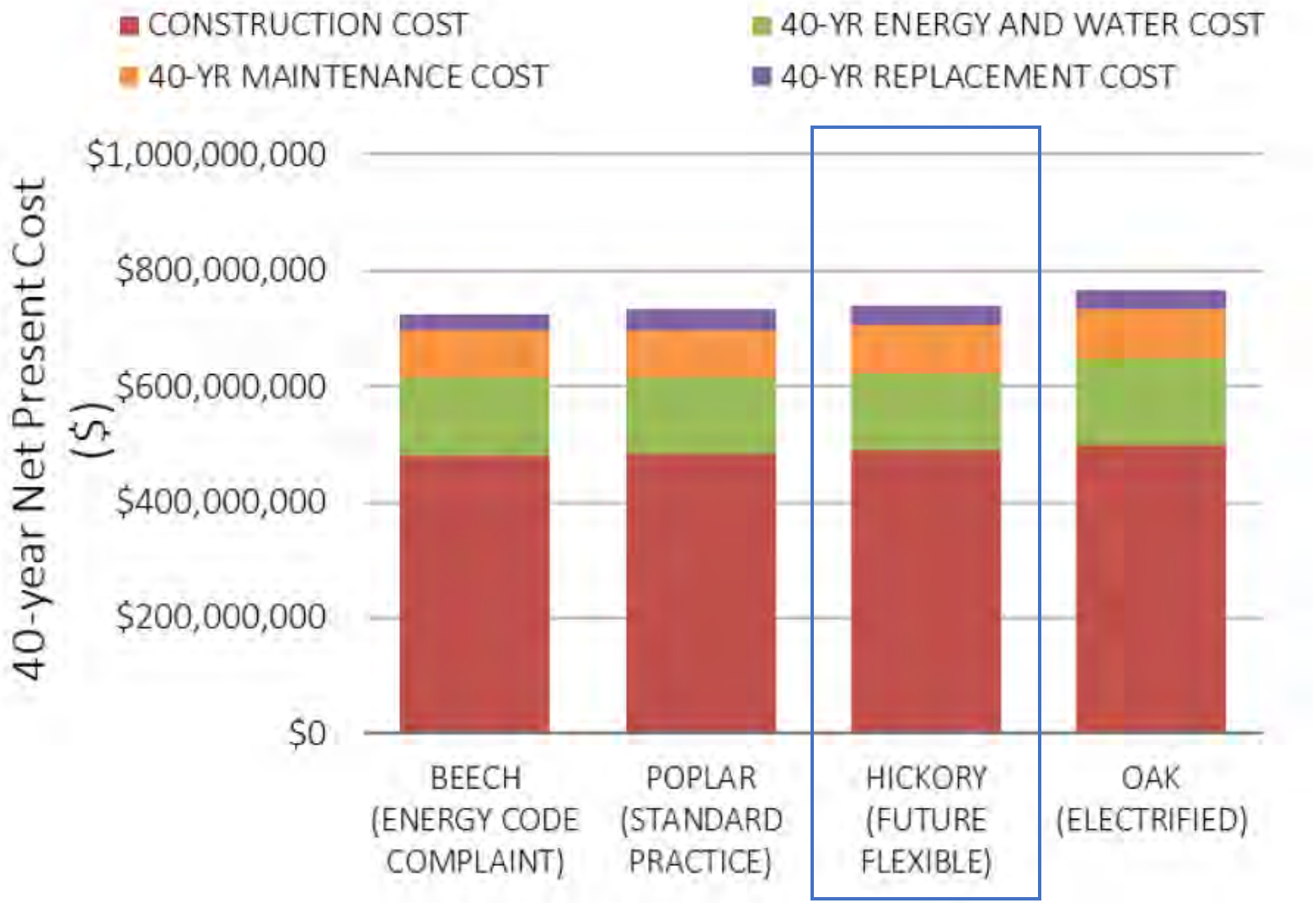
Indiana University Hospital Approaching Fossil Fuel Free



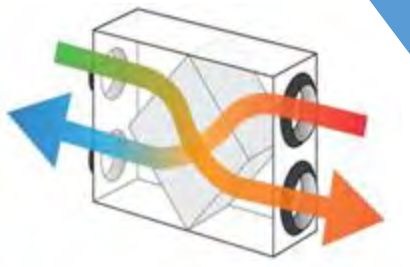
Indiana University Hospital Construction Cost

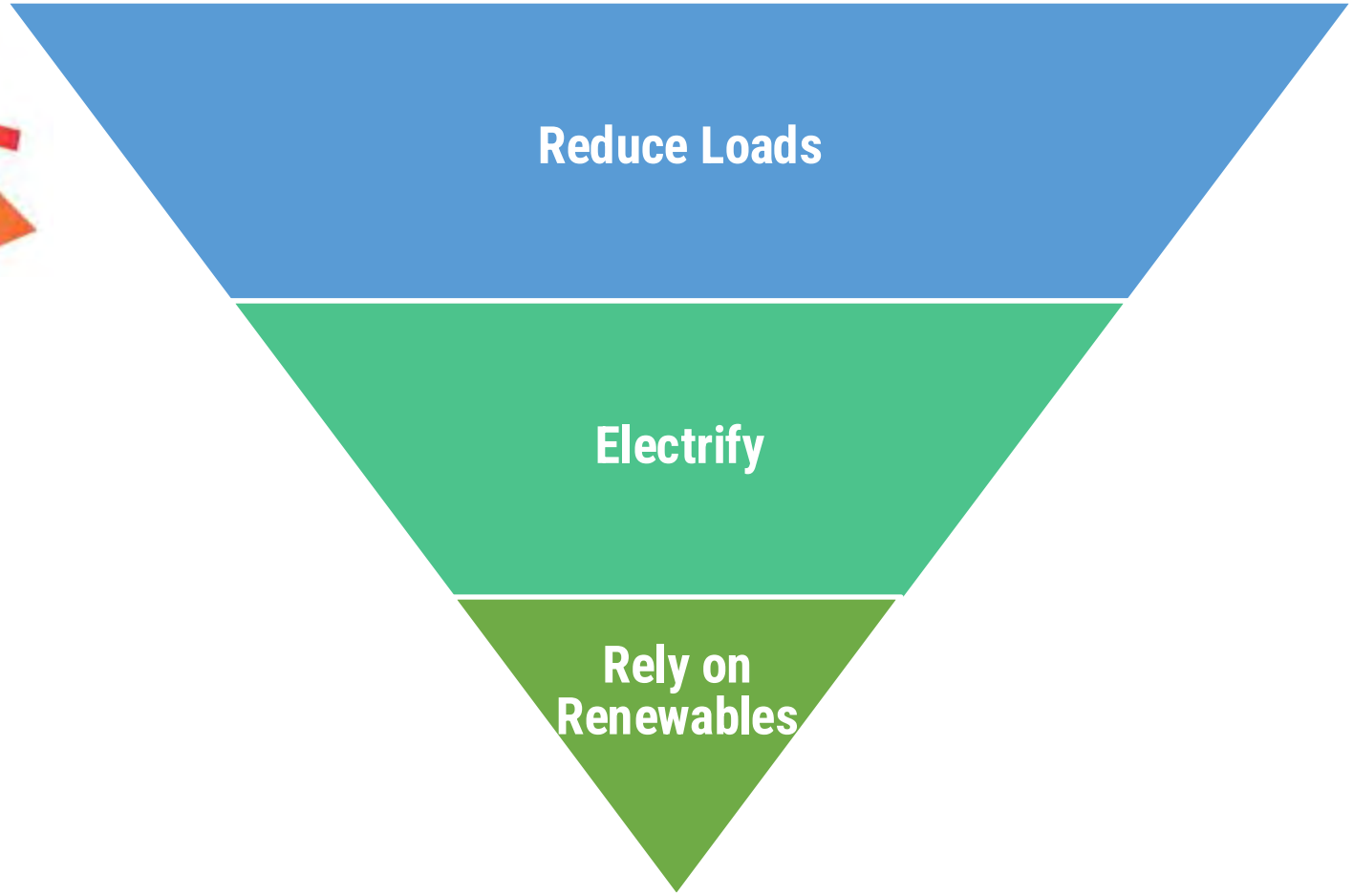


Indiana University Hospital Life Cycle Cost

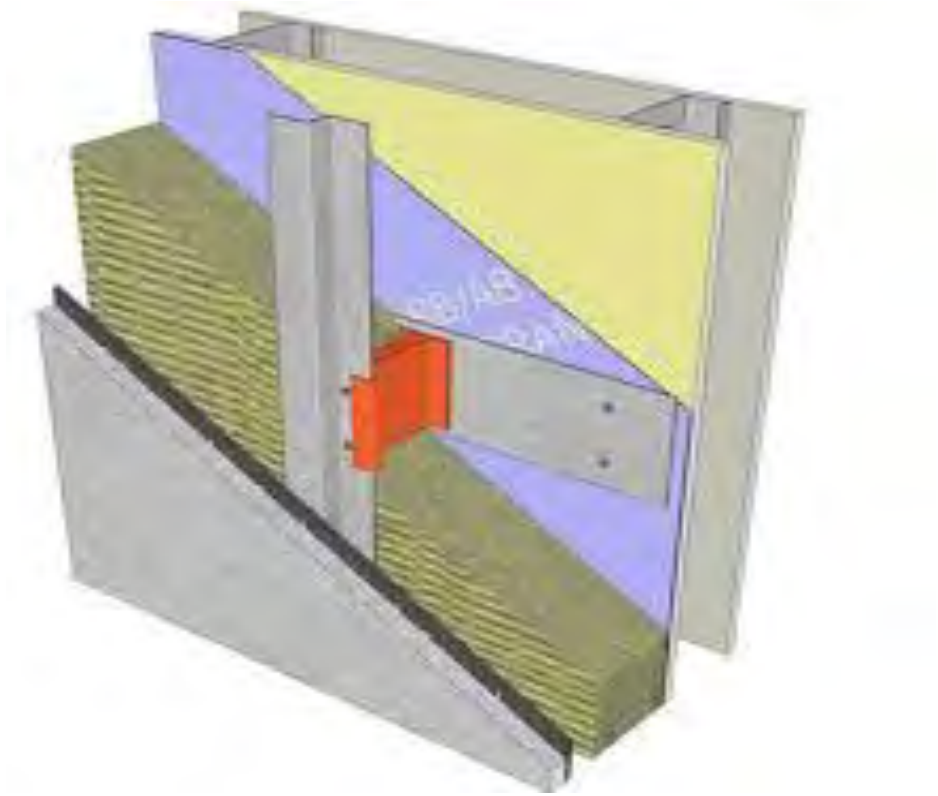


Cost-Effective Path to Carbon Neutral

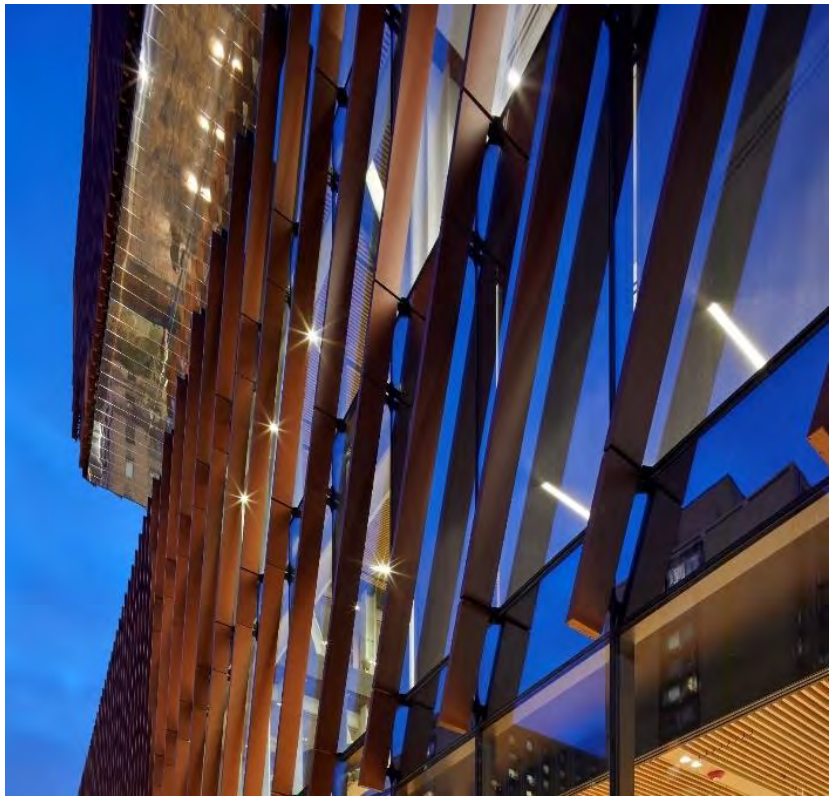




Ultra-Efficient Systems

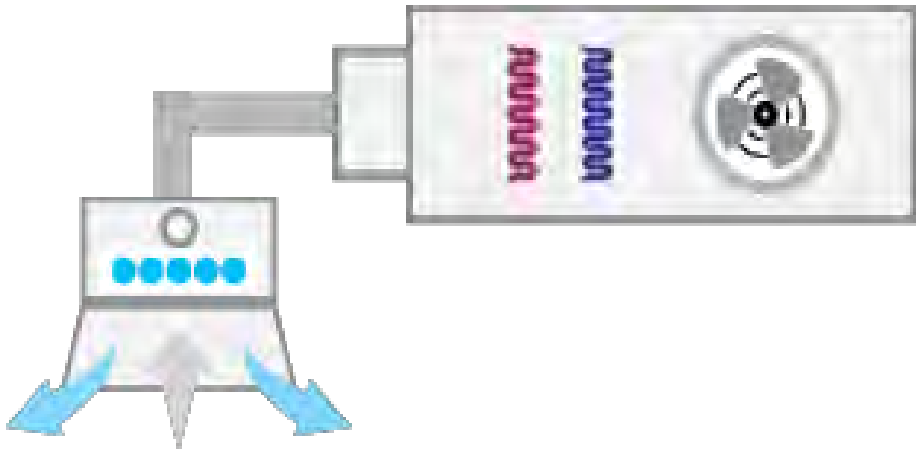


Thermal Break + Insulated Envelope

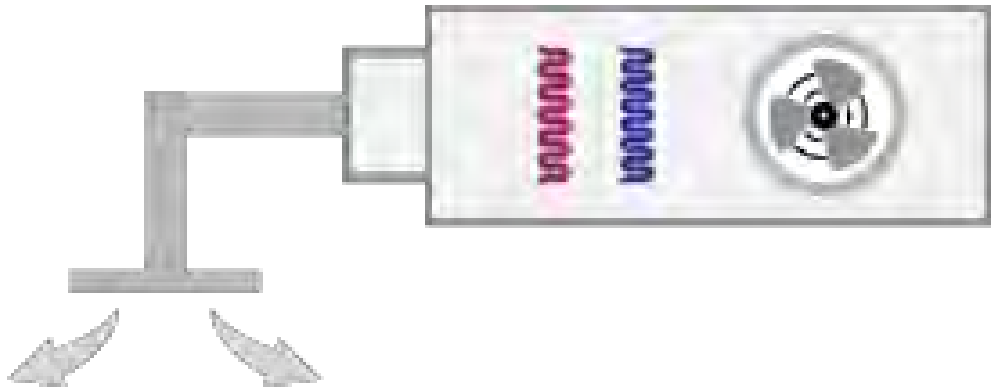


High Performance Glazing

Ultra-Efficient Systems-Hydronic



Active
Chilled Beams



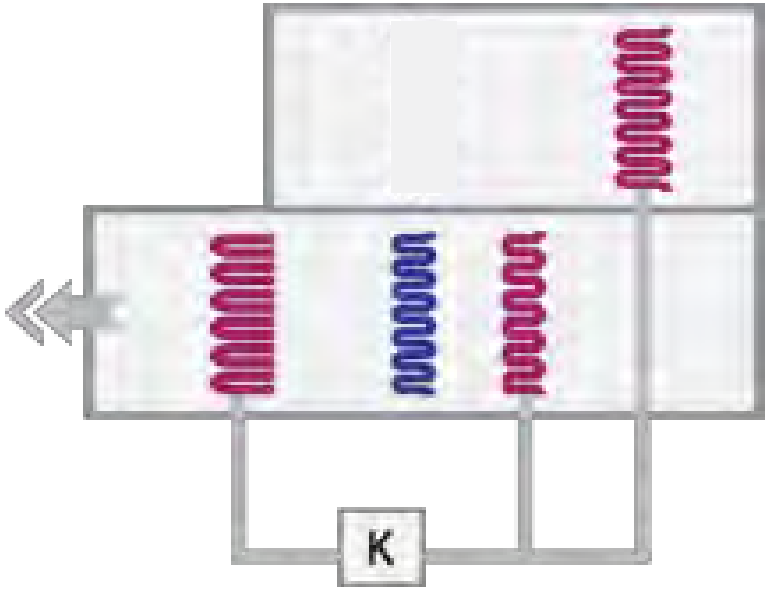
Standard
Fan Coil Units

Ultra-Efficient Systems

Typical Buildings
& Dry Labs

Airside
Energy Recovery

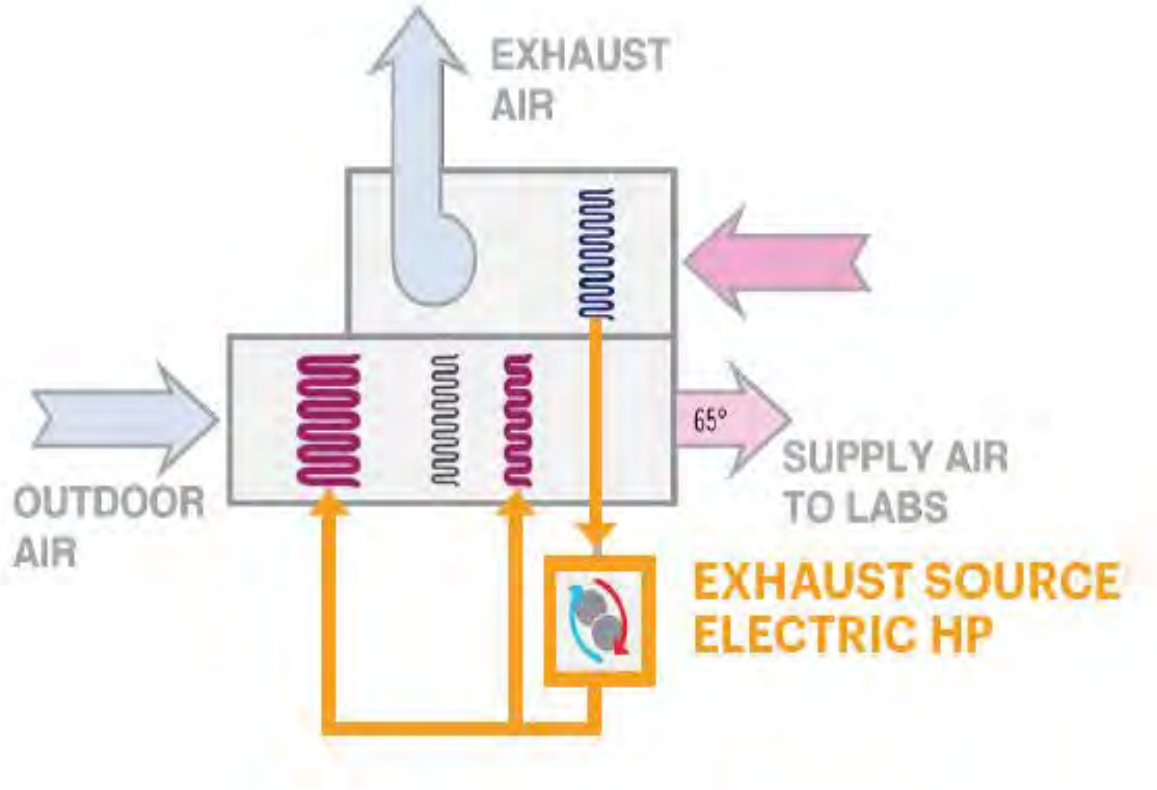
Vivarium / Wet Labs



Hydronic
Energy Recovery

How to Electrify

AIR-SOURCE



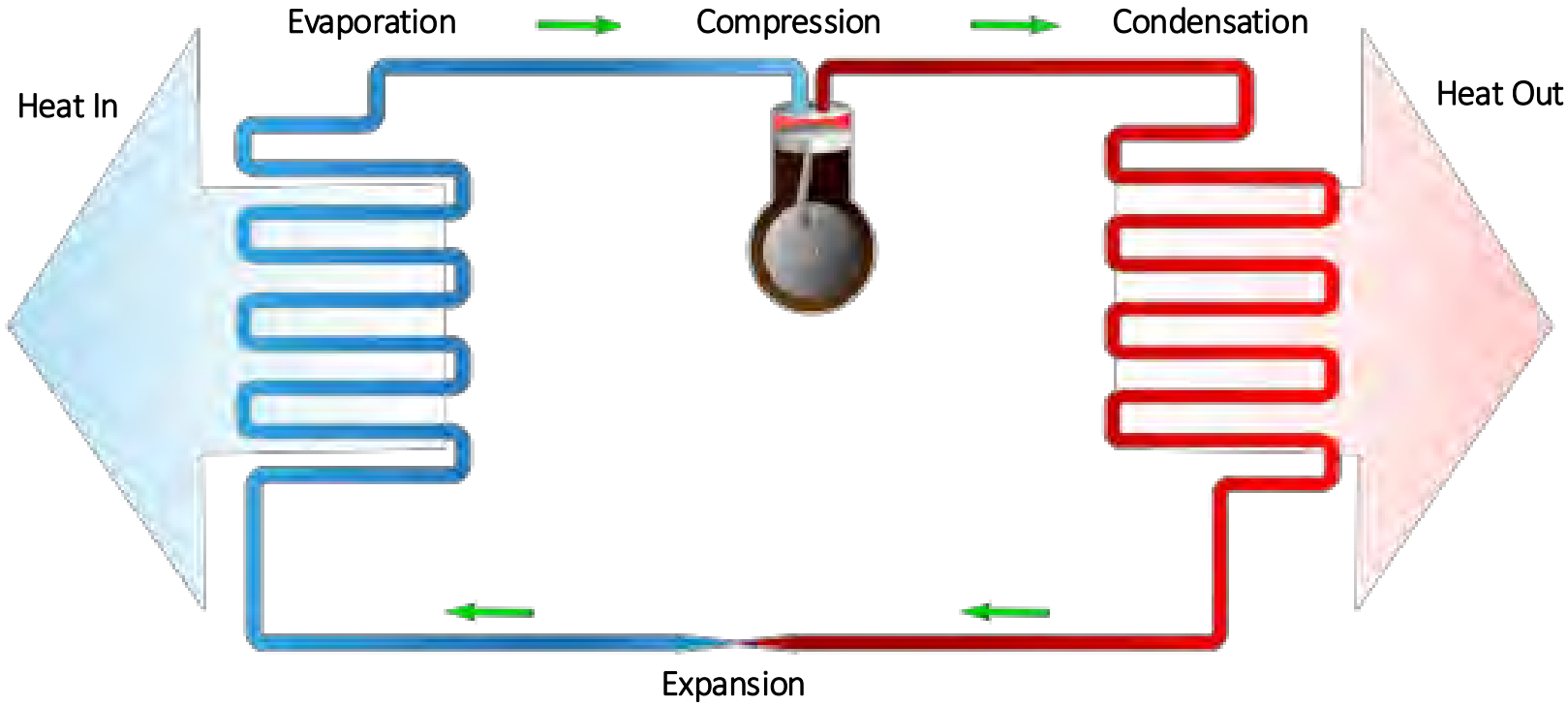
EXHAUST-SOURCE

Why Electric Heat Pumps?

Electric Input 1x → Heat Output 1x

Why Electric Heat Pumps?

Electric Input 1x → Heat Output 3x or More



Operational Heating & Cooling Demand

Hospital Size:
400,000 sf

Cooling Demand:
1,800 Tons

Heating Demand:
18,000 mbh

Chillers x2
Cooling Only

600
Tons
Each

100%
(N+1)

Chillers x2
Heat Recovery

7,200 MBH
Each

Up to 80%
of Demand

Gas Fired Boilers
80% Reduction

Air Cooled Heat Pump
100% Carbon Reduction

100% of Demand
(N+1)

Power Increase:
Only 20%

Fossil Fuel Bach-Up is OK

Standby Generator

Back-Up Boilers

Major Components of the E in ESG

MANAGEMENT

- Climate strategy
- Low carbon strategy
- Environmental policy and management
- Environmental reporting

Our ESG Program focus = Operations we can control

CO_2 CH_4 N_2O HFCs PFCs NF_3 SF_6

SCOPE 1

- Onsite energy
- Fleet vehicles
- Waste anesthetic gas
- Refrigerants

SCOPE 2

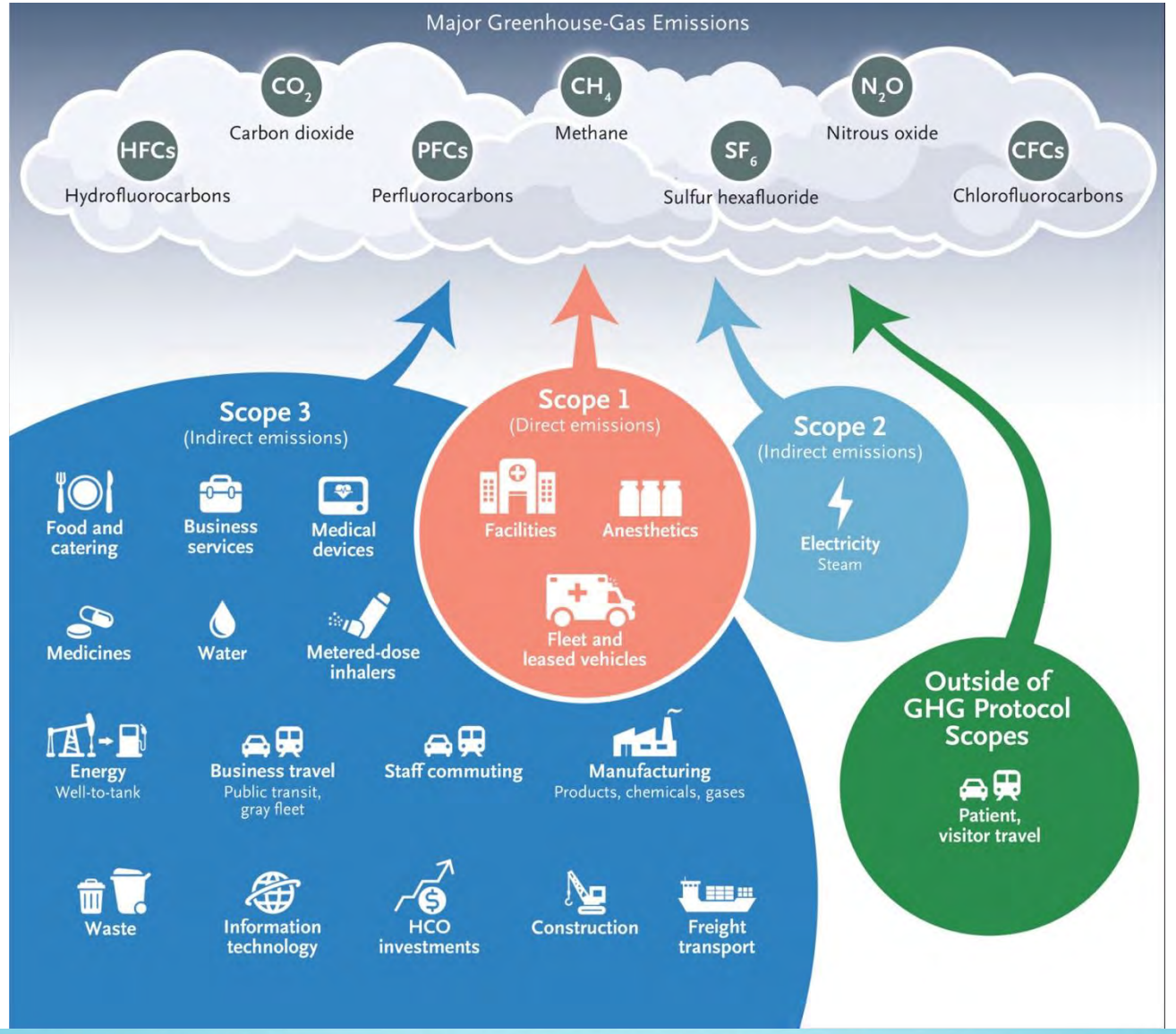
- Purchased electricity
- Purchased gas

SCOPE 3

- Business travel
- Medical devices and equipment
- Employee commute
- Pharmaceuticals
- Waste disposal
- Meat procurement
- Other*

Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF_3), and sulphur hexafluoride (SF_6)

Major Components of the E in ESG



Healthcare Orgs have an Opportunity to Make a Huge Impact

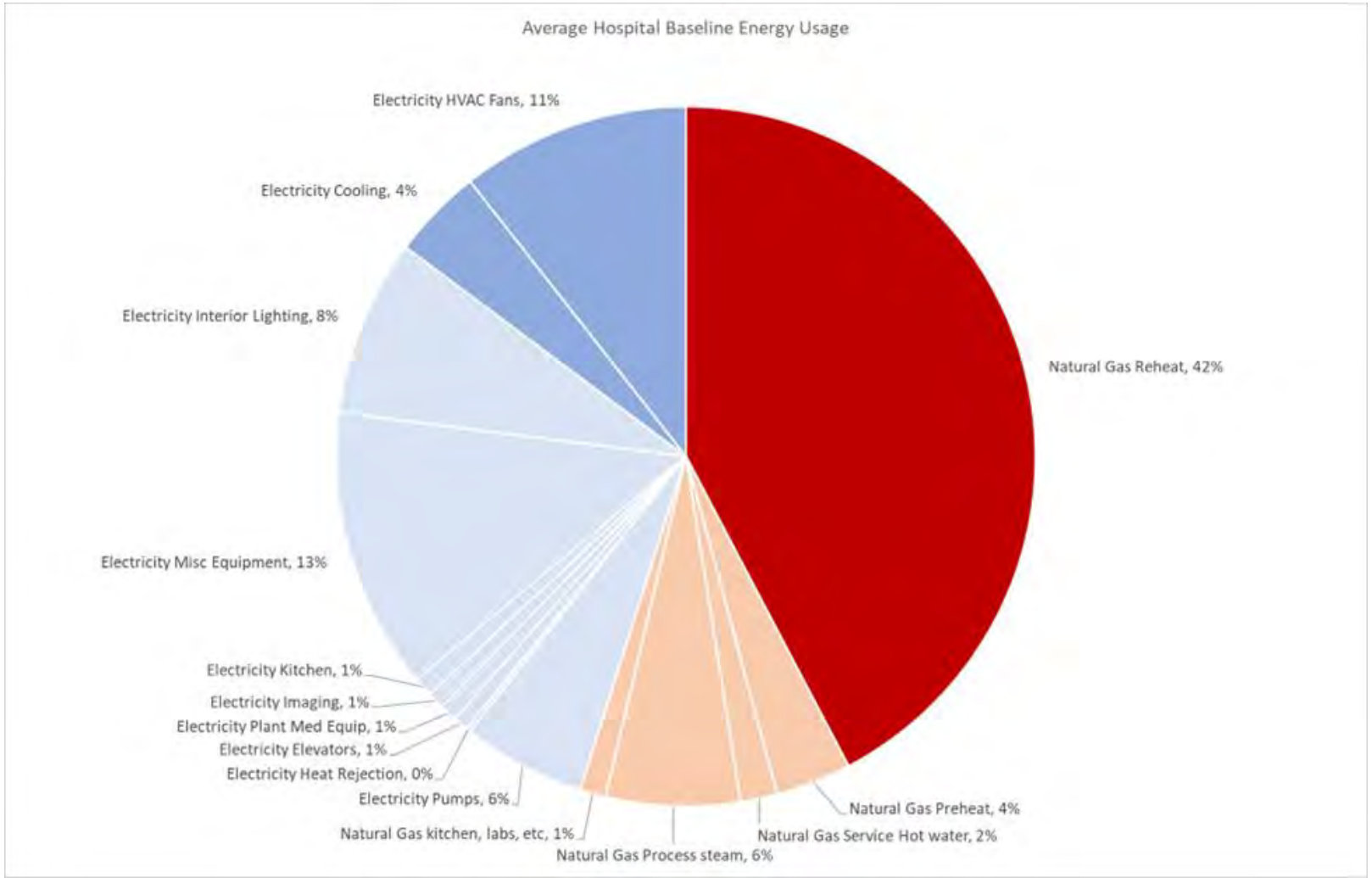
The Role of Facility Manager in Reducing Emissions

Scopes 1-2 Reduce Loads in Existing Infrastructure

- Improving **energy efficiency** is an easy and cost-effective way to decarbonize the healthcare sector
- Most hospitals that will exist in 2050 are already built
- The majority of these were not built with energy intensity in mind
- The Commercial Building Energy Consumption Survey (CBECS) estimates we have about 2.2 billion sqft of inpatient healthcare in the United States and another 1.7 billion sqft of outpatient care
- According to CBECS, hospitals are the second most energy intensive building type in the United States
- Energy and carbon retrofits are essential to reducing overall carbon emissions of the healthcare sector

The Role of Facility Manager in Reducing Emissions

Scopes 1-2 Reduce Loads in Existing Infrastructure



Reducing Load

BMS Building Automation Systems & Retrocommissioning of Controls

- You can't manage what you can't measure! Many older hospital campuses within the region built over 50 years ago.
- Antiquated Controls – DDC & Pneumatic need to be brought up to today's standards with IoT technology to effectively manage hospital space around the clock … *and the spaces that are operated during usual business hours.*
- Retro-commissioning is not a "one-time" improvement.
- Update systems' sequence of operations to include setbacks & integrate BAS metadata with BIM
- **Buildings that perform retro-commissioning can cut their electricity and natural gas use by up to 30% each!**

Scope 1 and 2 Improvements to Building Envelope

- Hospital energy efficiency is largely driven by high internal heat gains due to equipment loads, high air change rates, and around the clock use.
- Assess your envelope regularly… Inspect sealants, caulking, and insulation.
- Select materials for your envelope with high R-values and thermal breaks.. and seal the gaps & cracks.
- Antiquated glazing should be replaced with high R-value, dynamic glazing

Scope 1 and 2 Load and Energy Sensor Modeling

- Hospital BAS systems have limited measuring capability
- Installing non-intrusive load monitoring & energy sensors will complement BAS information for a better understanding of energy use and reduce costly assessments!
- BAS + sensors + BIM = Digital Twin

Scope 3 Environmental Product Declarations

- Specifying materials that have environmental product declarations (EPD's) allow hospitals to measure embodied carbon that contributes to Scope 3 reporting
- EPD's improve tracking against carbon budgets
- Don't reinvent the wheel – just add a spoke! Submittal processes that include EPD's will be converted to metadata in BIM allowing for real time carbon calculations
- BAS + sensors + BIM + EPD's = The future of scope 3 reporting!

You Can’t Manage if you Can’t Measure…

PURCHASED UTILITIES

CO2 source data

District energy, such as steam for heating, will also typically emit CO2 at its generation source

Operational SOPs

EQUIPMENT

IoT & sensor (equipment & occupancy) data

Contracts, Equipment Planning, SLA's and Performance Goals

WATER

Heating and cooling water is a major energy source on-site

MATERIALS & SUPPLIES

Commuter transportation and supply chain emissions

Sustainably sourced supply chain

ENERGY

Meet energy, water, and sustainability goals

Energy Cost Guarantees & Earn utility rebates

Energy Efficiency Tax Deduction

EQUIPMENT

Extend equipment life

Proactive & Predictive maintenance

Equipment Performance Guarantees

REPORTING

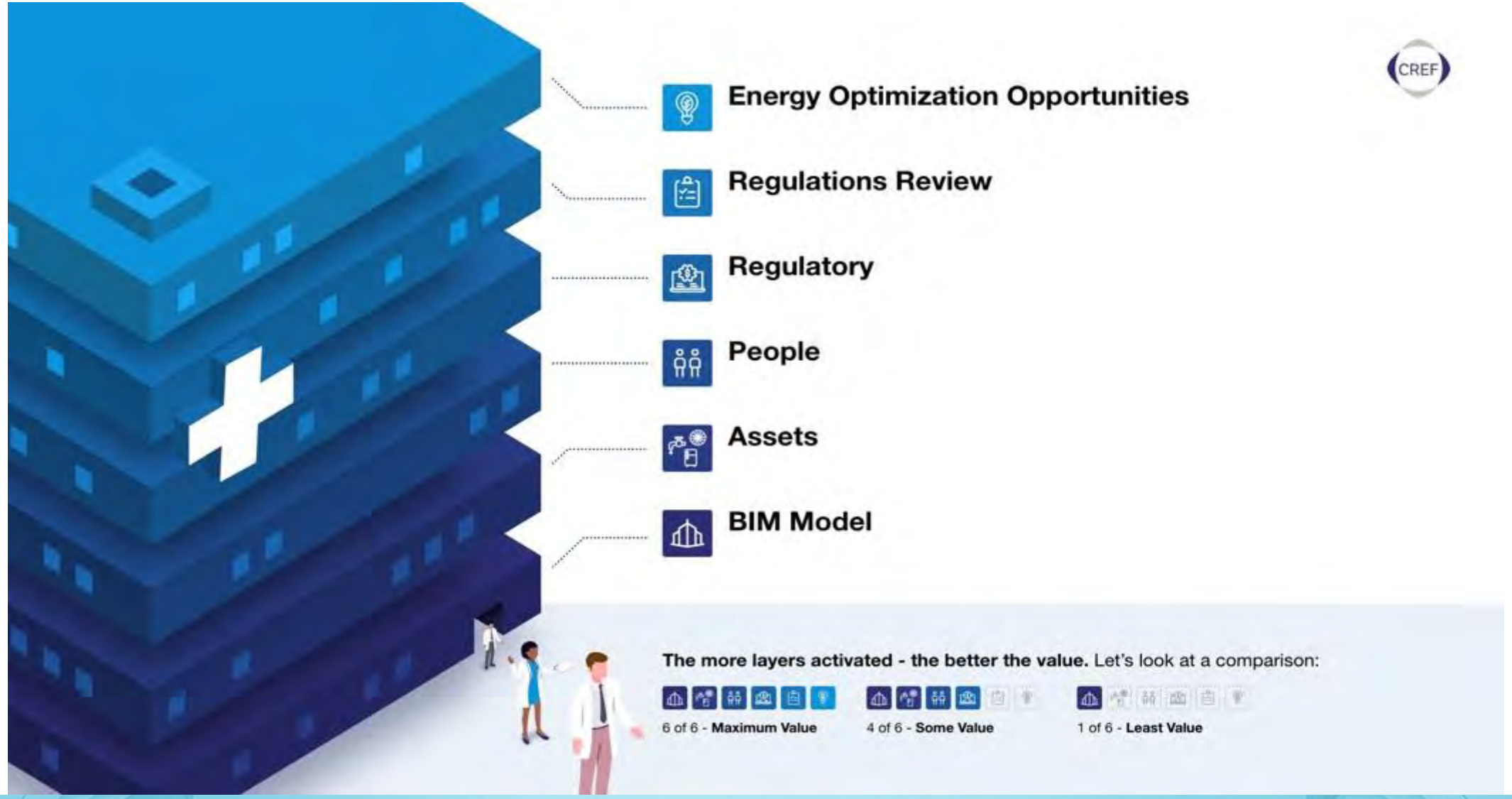
Enable Owner / Tenant ESG Goals progress monitoring

In-depth visibility into equipment health (steam, chiller)

Energy & emissions real time monitoring

Historical data from first day of connection

Platforms Can Help You Build For the Future



Hospitals Must Have a Platform to Monitor Progress

Program		Metric			Impact		
Element	Intention	Energy Intensity	Energy Costs	Carbon Emissions	Environment (Planet)	Society (People)	Governance (Return)
Energy Procurement	Lock in utility contracts for low carbon electricity (and gas) at favorable terms based on futures analysis	⟷	↓	↓	✓	✓	✓
Performance Optimization	Continuous commissioning to align facility operations by tuning up existing equipment, setting appropriate equipment schedules, and identifying corrective maintenance needs	↓	↓	↓	✓	✓	✓
Infrastructure Maintenance Program	Protect investments by preserving gains and avoiding backsliding through smart work order systems, standardized training, and smart sensors	⟷	⟷	⟷	✓	✓	✓
Portfolio BAS Command Center	Leverage portfolio through information sourced from sensors, asset tagging, and electronic logs; merged with digital twins, analytics, and AI; yields predictive analytics to inform strategic planning and investment and avoid costs	↓	↓	↓	✓	✓	✓
Strategic Infrastructure Investments	Cost-effective replacement of conventional equipment or substitution with low carbon technologies via low interest loans and/or leases	↓	↓	↓	✓	✓	✓
Carbon Offset Procurement	Purchase qualified renewable energy credits or offsets as needed	⟷	⟷	↓	✓	✓	✓

Real Impacts

- Performance Optimization & Reduced Energy Consumption Provided $23.1 in Steward Savings.

Overview

We understand how Operators and Asset Owners can capitalize on ESG initiatives. CREF helped Medical Properties Trust **avoid the emission of Greenhouse Gases** across their hospital portfolio.

Results

As a result, **Steward avoided the release of 18,013 metric tons of CO2**. This is the equivalent to:

- Taking 2,338 cars off the road for one year
- Energy used in 2,170 homes for one year
- Revenue from 2,444 inpatient days per month

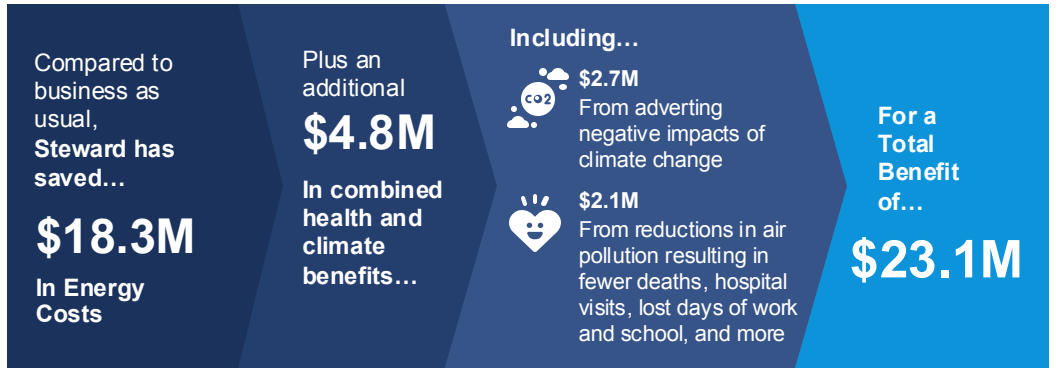
This equates to a total of **$191,612 in energy cost savings per month,** or **$2.4M per year** on average, for a total increase of **$57M in topline revenue.**

Testimonial

Jason Frey
Director of Asset Management & Underwriting
Medical Properties Trust (MPT)

By investing in various building improvements and green initiatives throughout our hospital portfolio, CREF has helped us achieve significant annual cost savings – lighting, ventilation, plumbing, retro commissioning, solar, etc. – millions of dollars we're reinvesting; while at the same time offsetting the impact carbon emissions have on the communities we serve.

Value



HEALTHY BUILDINGS FOR HEALTH

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

Steward

HEALTHFX HEALTH CO-BENEFITS OF GREEN BUILDINGS

Operators Must Navigate a Complex Regulatory Environment

Facilities need a platform to manage and adapt to the evolving regulatory landscape

Health Care Without Harm

For: Investors
Financial impact reporting

SUSTAINABILITY ACCOUNTING STANDARDS BOARD
SASB

July 2020: Announce Collaboration

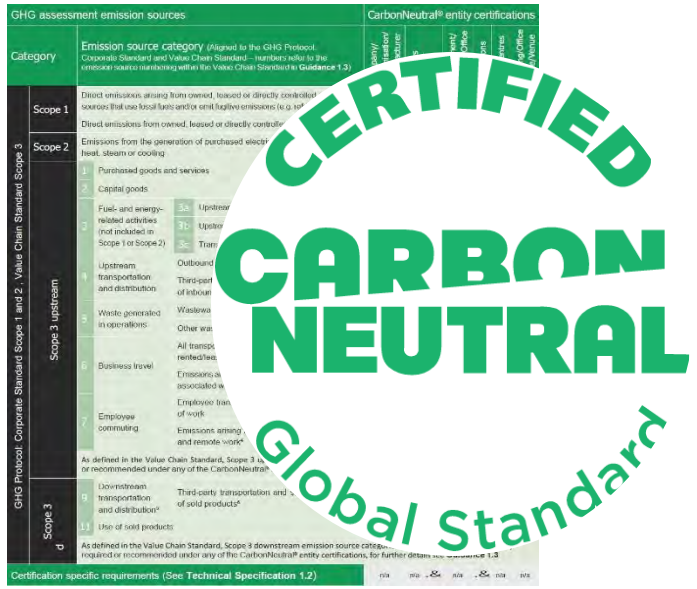
- Quantifies and reports the outward ESG impacts and risks of an organization's performance across 77 different industry standards

For: Operators
Climate Impact Reporting

GRI Empowering Sustainable Decisions

- **Disclosure frameworks** provide a set of principles-based guidance for how information is structured and prepared, and which broad topics are covered.
- **Disclosure standards**, like SASB Standards, provide specific, replicable, and detailed requirements for what should be reported for each topic. In other words, standards make frameworks actionable by providing comparable, consistent, reliable information.

For: Operators
Greenhouse Gas Reporting



- Framework for transparent GHG reporting; ongoing monitoring
- Certification when "Neutral"

Climate Mitigation & Adaptive Survey

CREF

Global Corporate Real Estate & Facilities

CUBE 3

architecture | interiors | planning

BR+A