

Roadmap to Net Zero: Decarbonization at Scale



Panel Discussion

Roadmap to Net Zero: Decarbonization at Scale

How to approach building portfolio decarbonization and achieve organizational objectives



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1.0 Learning Units

AIA CEU Learning Objectives

1. Develop knowledge and awareness of Global GHG Emissions and Climate Action Context; Develop an understanding of quantity of carbon emissions by sector, and within buildings
2. Benchmark existing campus conditions. Making carbon visible.
3. Understand the challenges and opportunities of a structured approach to decarbonizing building portfolios:
4. Outline and define the actions that can be taken with a structured approach to decarbonizing building portfolios.

Reflections Over a Long Career...

Energy Savings

Pollution Reduction

More Efficient Technologies and Systems

Sustainability – Green Design Certifications – Product Declarations

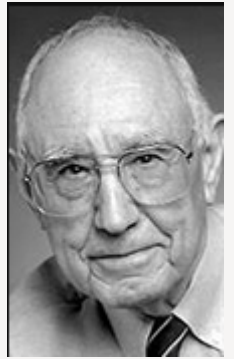
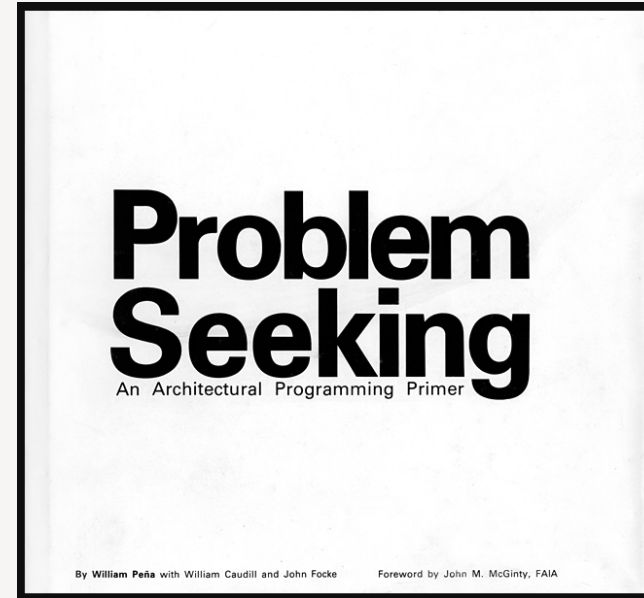
Climate Change, Global Warming

Clean Energy Resources

Net Zero, Carbon Neutrality

Embodied Carbon

Carbon Emissions - Greenhouse Gases - DECARBONIZATION



Willie Pena, FAIA
CRS Architects

Form
Function
Economy
Time
ENERGY!



What is Decarbonization?

Reducing or eliminating carbon emissions before, during, and after construction.

Involves changes in technology, behavior, expectations, and policies.

Mitigates impacts – severe storms, heat waves, sea level rise, healthy planet.

Aligned to Paris Agreement – the planet needs to achieve net zero GHG emissions by 2050.

One of the most **cost-effective** ways to reduce emissions **quickly**.



Why is “Decarbonization” important?

Facility modernization, repurposing, **optimization**, hybridization, downsizing.

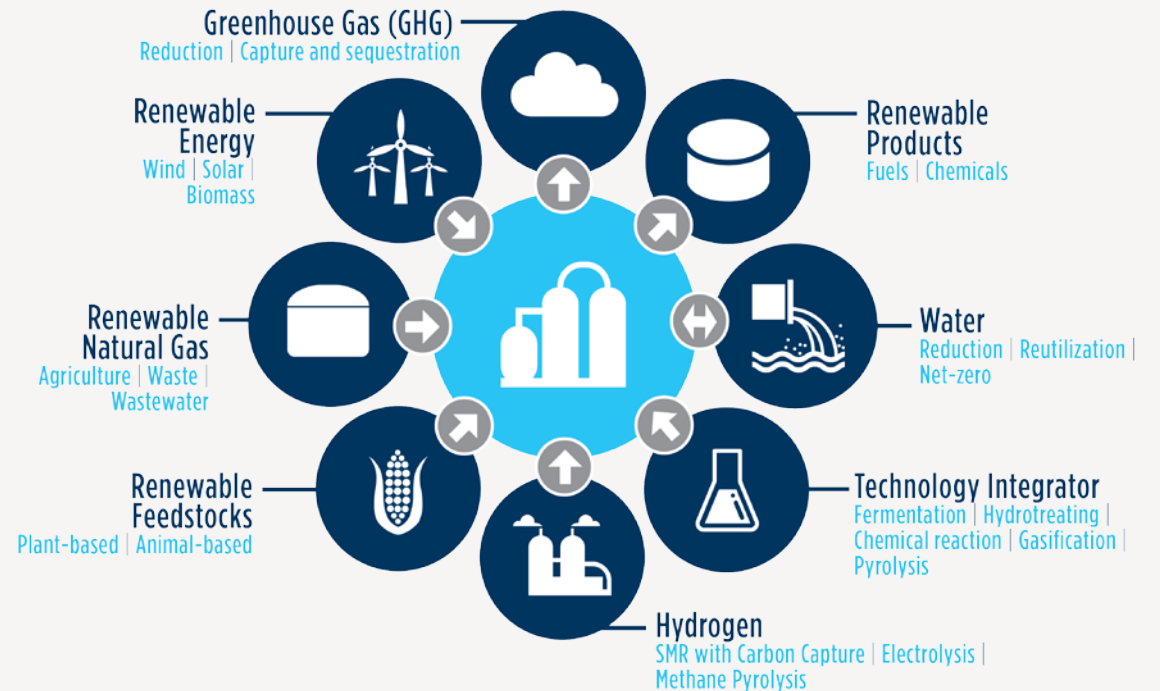
Will become more and **more integral in master planning** processes.

Improves air quality and reduce water pollution.
Healthy classrooms and communities.

Manage the economics - operational efficiencies and renewal costs. **Maximize ROI.**

Likely to become more and more a part of **stakeholder / societal priorities and expectations.**

Sustainable and Low Carbon Initiatives



We are all embarking on decarbonization journeys...

...whether individual, institutional, and/or organizational - if not already engaged.

We'll discuss tools, guideposts, pathways, dashboards, and ideas to consider along the way.

We will also review an imaginary “case study” demonstration for a Florida university campus.



What is a “Decarbonization” Roadmap?

“A decarbonization roadmap identifies cost effective strategies and approaches to achieve net zero greenhouse gas emissions across a portfolio of buildings. A roadmap lays out a vision to transition buildings in their portfolio to be healthy, efficient and carbon neutral. It outlines long term goals, sets interim targets, and explains how they will be achieved.

Getting to net zero over time at the portfolio level requires attention to decisions in individual buildings. Specific events in a building’s lifecycle are seen as opportunities for improvement in a zero over time approach. Having a set of performance goals set in advance allows districts to take advantage of new construction, major modernizations, system retrofits and equipment replacement projects as they occur.

This approach can be customized for organizations of any size, no matter where they are in the process.”

[New Building Institute, “Decarbonization Roadmap Guide for School Building Decision Makers”, April 2022]



Net Zero and Organizational Emissions Sources

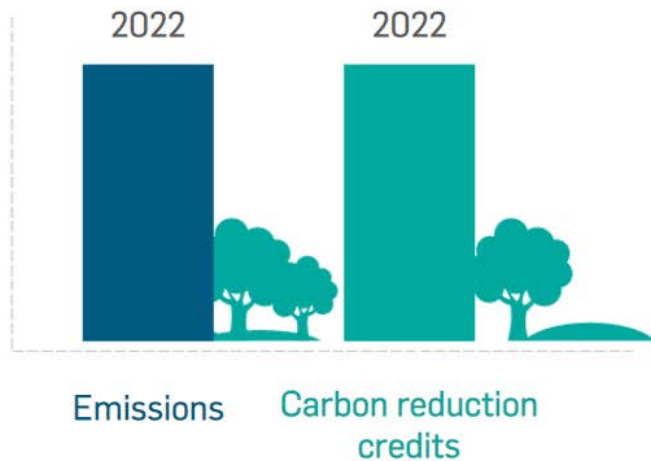


What is Net Zero?



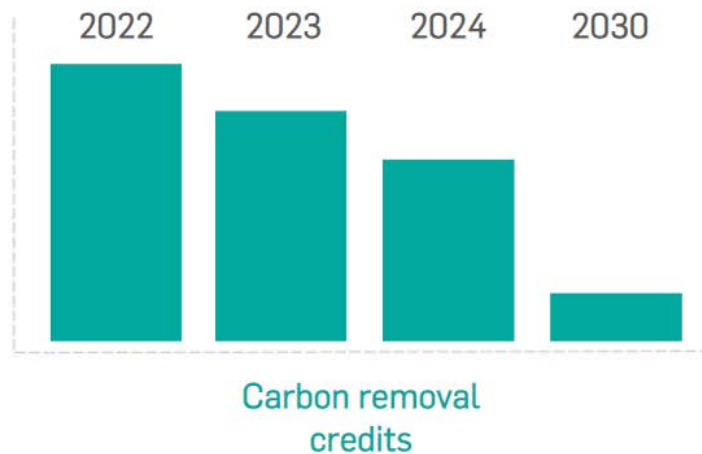
Carbon Neutral

- Requirements are less onerous
- Often seen as a first step



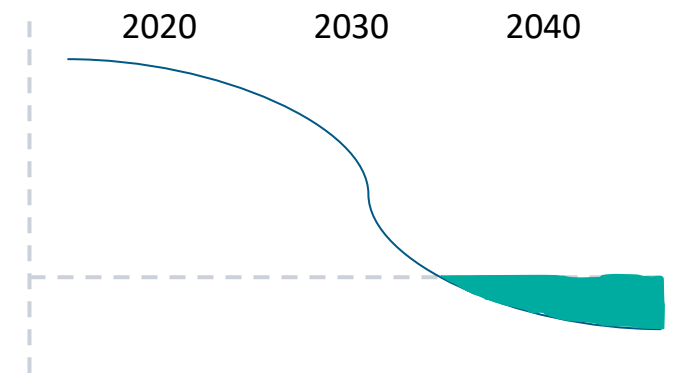
Net Zero

- In line with latest climate science
- Requires all available technologies to be used
- Only truly 'hard-to-decarbonize' emissions may be compensated with carbon offsets



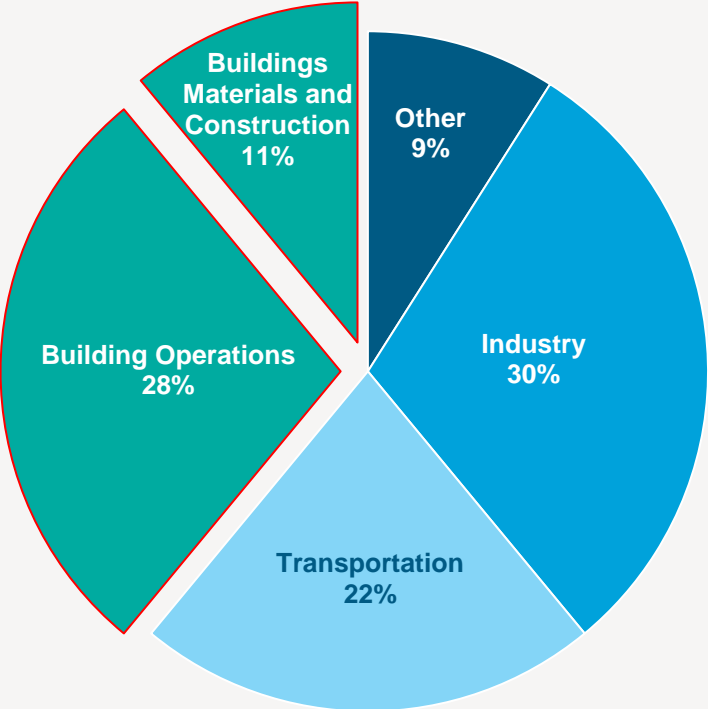
Beyond Net Zero

- 'Climate Positive' or 'Carbon Negative'
- Having a positive impact on the climate
- Abating more carbon that you create

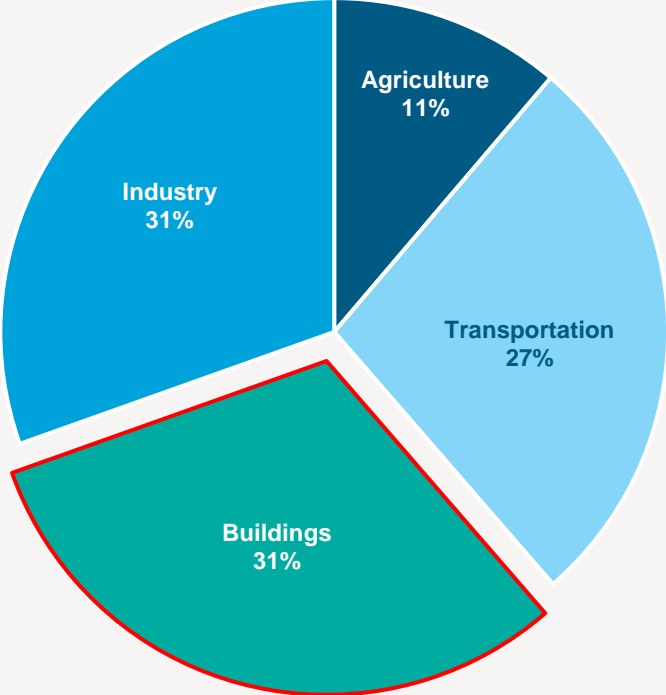


Greenhouse Gas Emissions by Source

Global GHG Emissions by Sector



U.S. GHG Emissions by Economic Sector – Electricity Emissions Distributed



More at the City Level

[Sources of Greenhouse Gas Emissions | US EPA](#)

[Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020 – Main Text \(epa.gov\)](#)



Categorizing Organizational Carbon Emissions

Carbon Footprint: Scope 1, 2 and 3

Scopes 1, 2 and 3 are used to categorize different kinds of emissions that an organization creates in its own operations and wider value chain to enable consistent reporting



Scope 1: Direct emissions issued by an organization
e.g., gas boilers, vehicles, power generation (owned by an organization)



Scope 2: Indirect emissions from purchased energy
e.g., heat or electricity

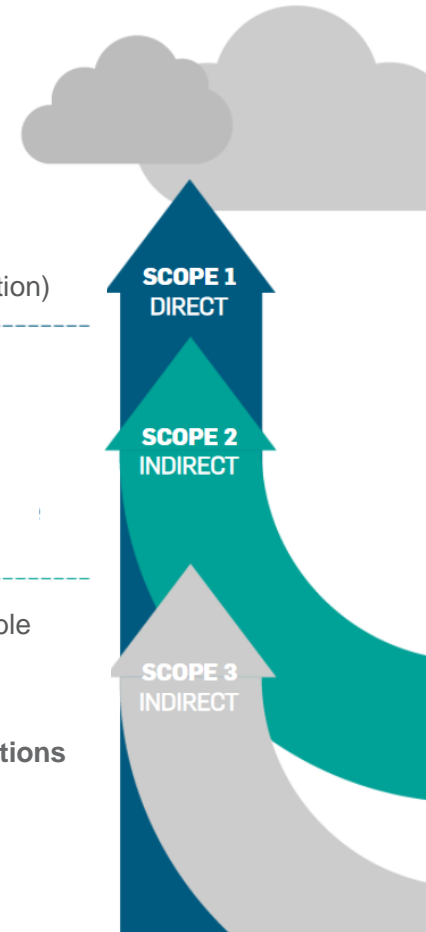
Scope 1 & 2 – mandatory part of reporting for many organizations worldwide and represent systems **'within reasonable control'**



Scope 3: Emissions for which an organization is indirectly responsible
e.g., buying products from suppliers, business travel, and employee commutes



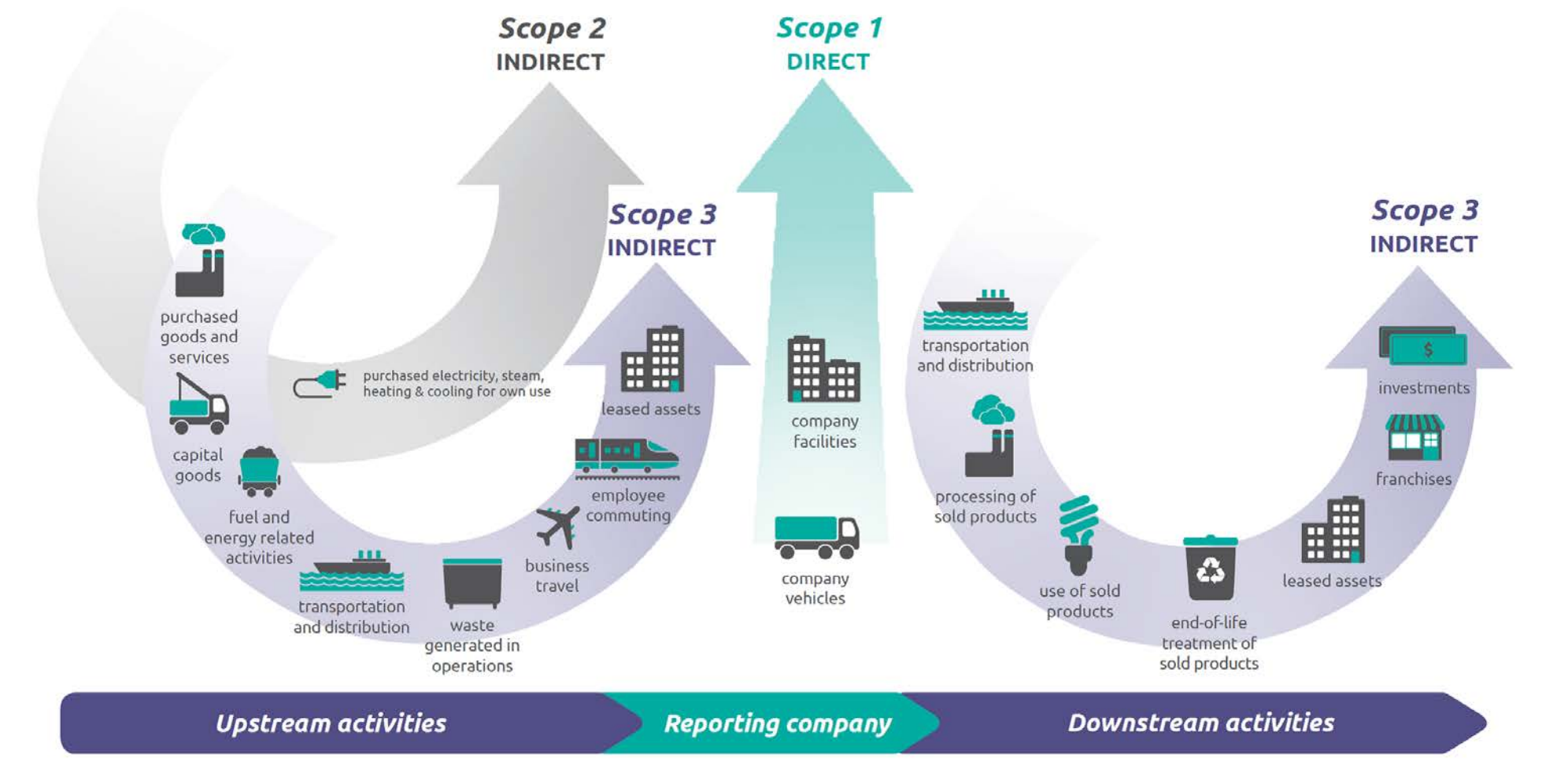
Scope 3 is often the largest and most difficult to tackle (as **organizations have less control** on how these emissions are addressed)



Adapted from the Greenhouse Gas Protocol



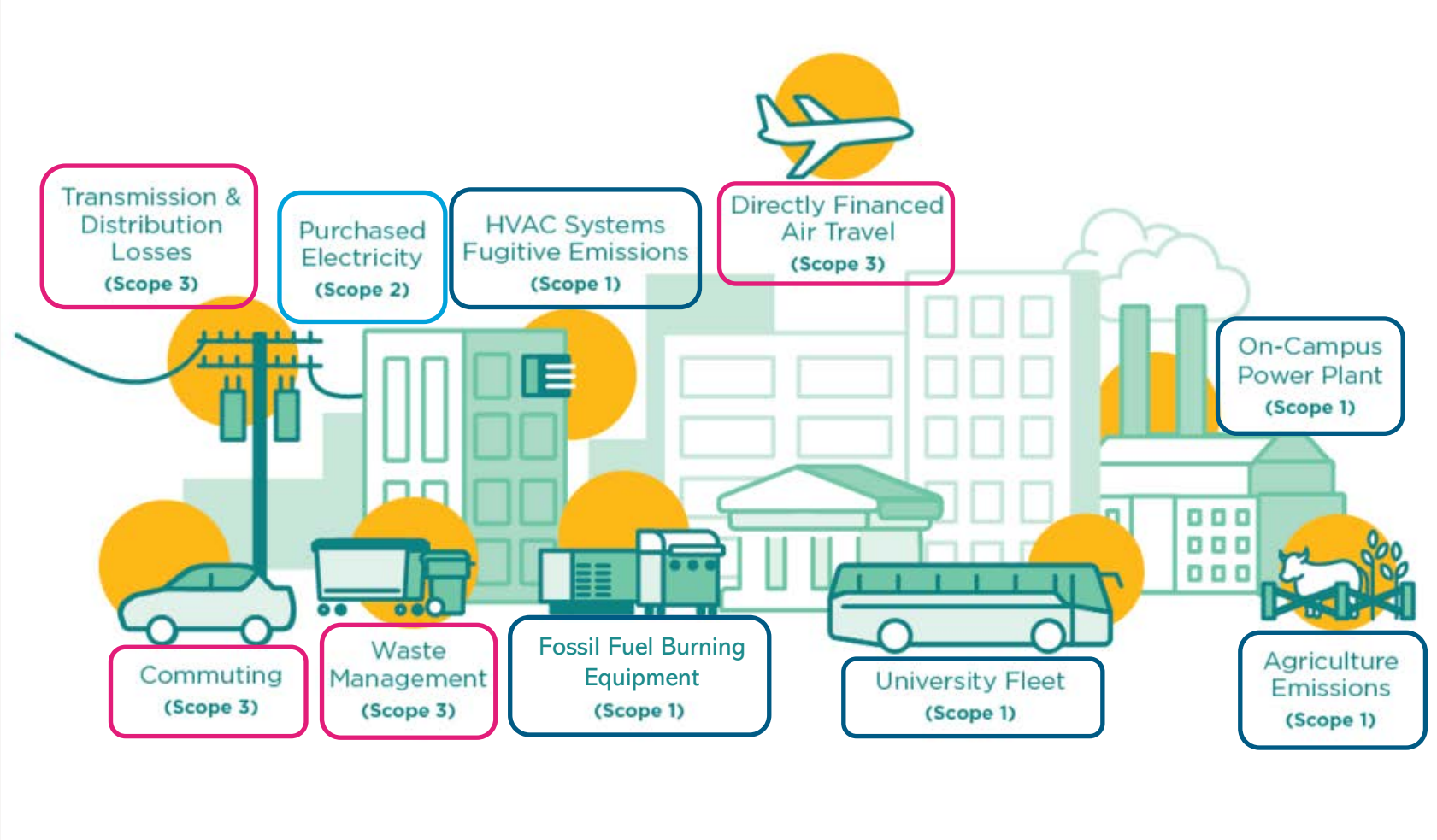
Examples of Emissions by Scope



Source: WRI/WBCSD Corporate Value Chain (Scope 3) Accounting and Reporting Standard (PDF), page 5.



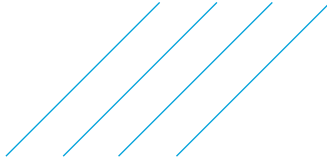
Example of Education Emissions by Scope



HIGHER EDUCATION INSTITUTIONS:

- SCOPE 1: 10-40%**
- SCOPE 2: 5-10%**
- SCOPE 3: 60-80%**

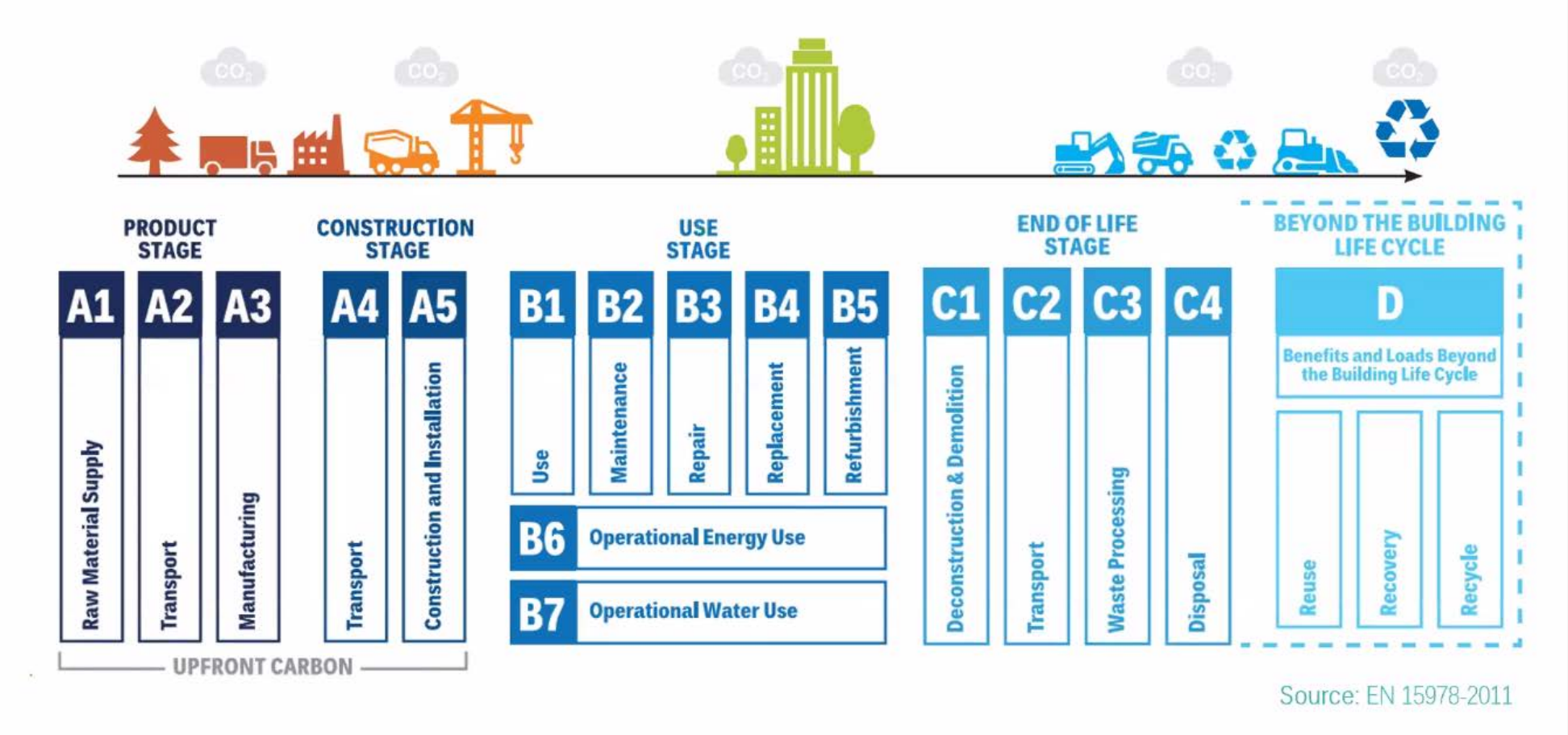
Source: [Why Your College Hasn't Achieved Carbon Neutrality \(Yet\)](#) - The Association for the Advancement of Sustainability in Higher Education (aashe.org).



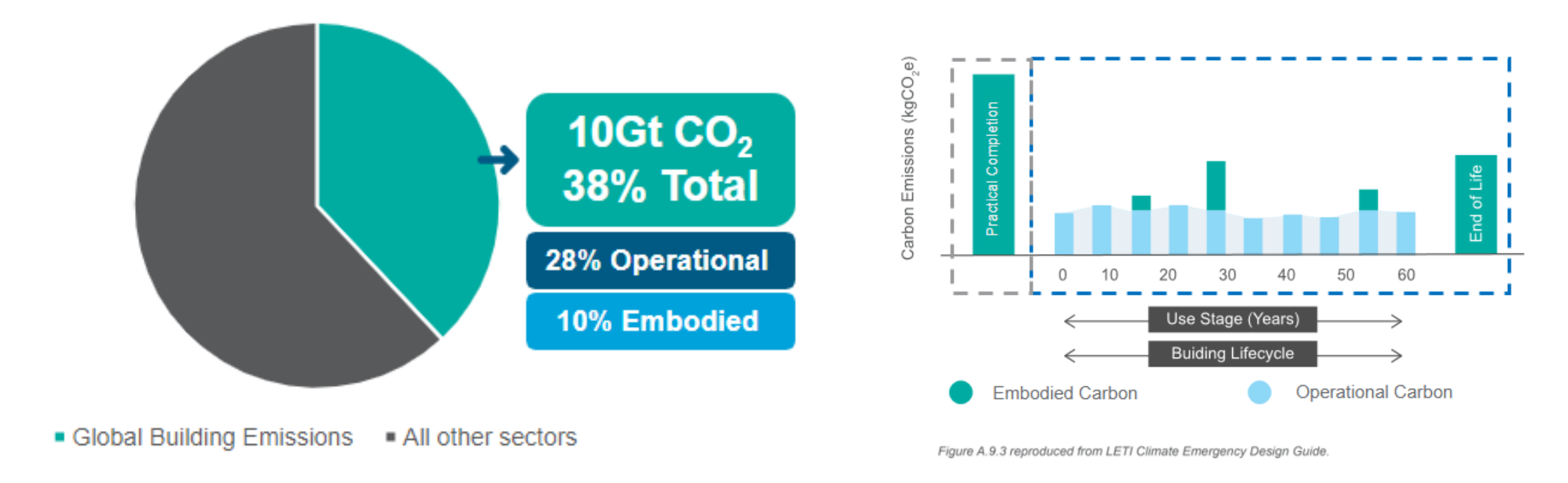
Building Source GHG Emissions



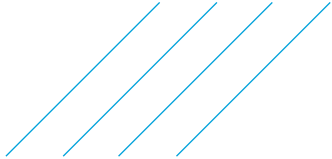
Whole Life Carbon = Embodied Carbon + Operational Carbon



Whole Life Carbon = Embodied Carbon + Operational Carbon



80% of Buildings Standing in 2050 already exist today



Major Climate Impacts on Building Owners, Operators, and Users

1. Direct Impacts

- Asset Damage
- Reduced Asset Lifespan
- Power Outages & Closures

2. Indirect Operational Impacts

- Supply Chain Disruptions
- Transportation System Disruptions

3. User & Operator Impacts

- Acute and Chronic Health Impacts
- Migration and Displacement
- Physical & Mental Stress
- Reduced Productivity

4. Regulatory Impacts

- Financial & Operational risks associated with direct and transitional risk



Opportunities

Achieve
Objectives

Cost Effective
Decarbonization

Retrofit in Line with
Existing Building
Asset Lifecycles

Reduce
Operational Costs
by Optimization

Compliance with
Emerging Codes &
Regulations

Appease
Stakeholder
Expectations



Challenges

Carbon Visibility

Incomplete Data

What intervention options are there?

Optimizing Delivery Approach

Developing Robust Investment Cases

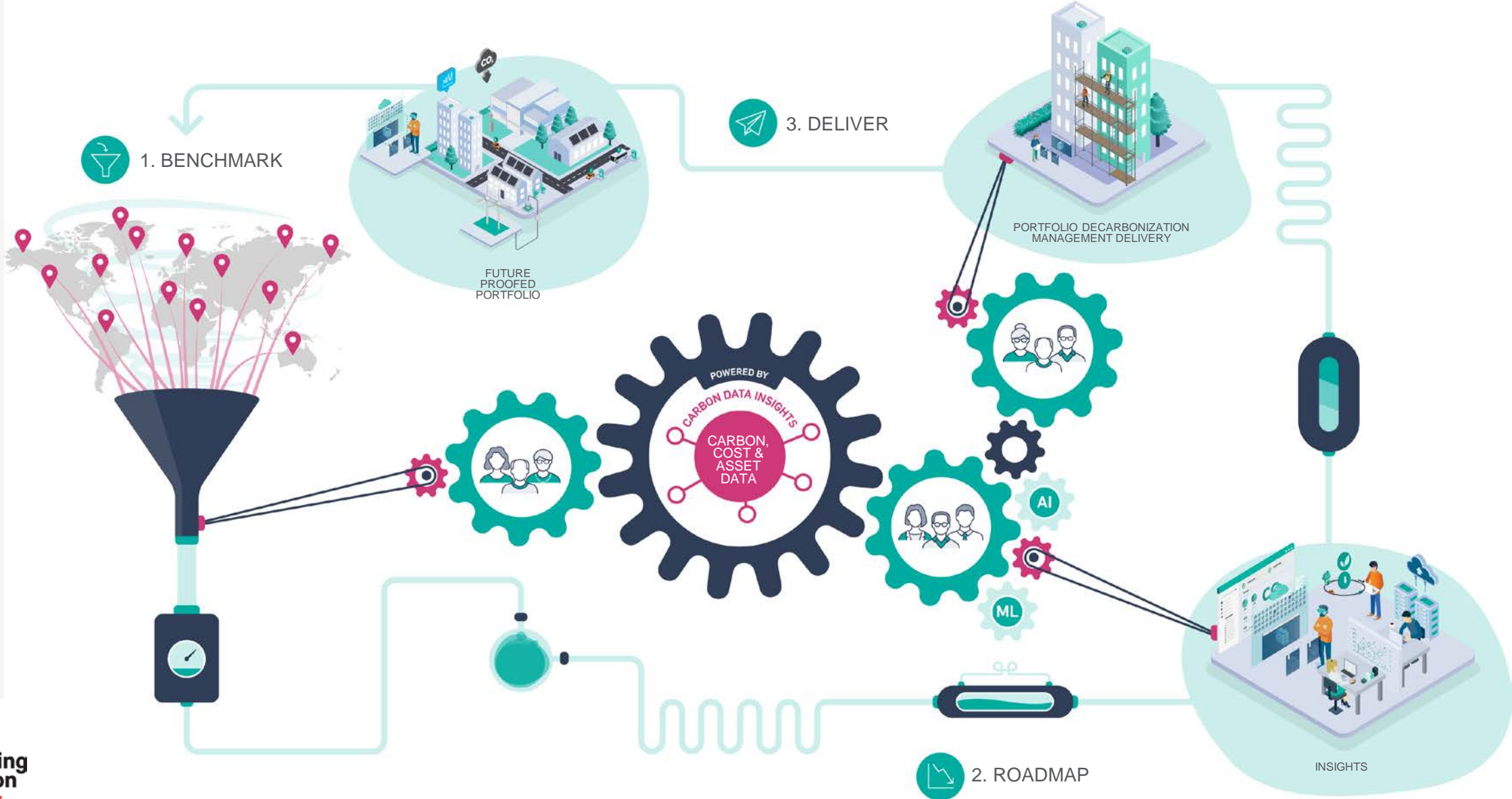
Performance Tracking & Reporting



Approach to Decarbonization at Scale



An Approach to Portfolio Decarbonization



Key benefits throughout the process

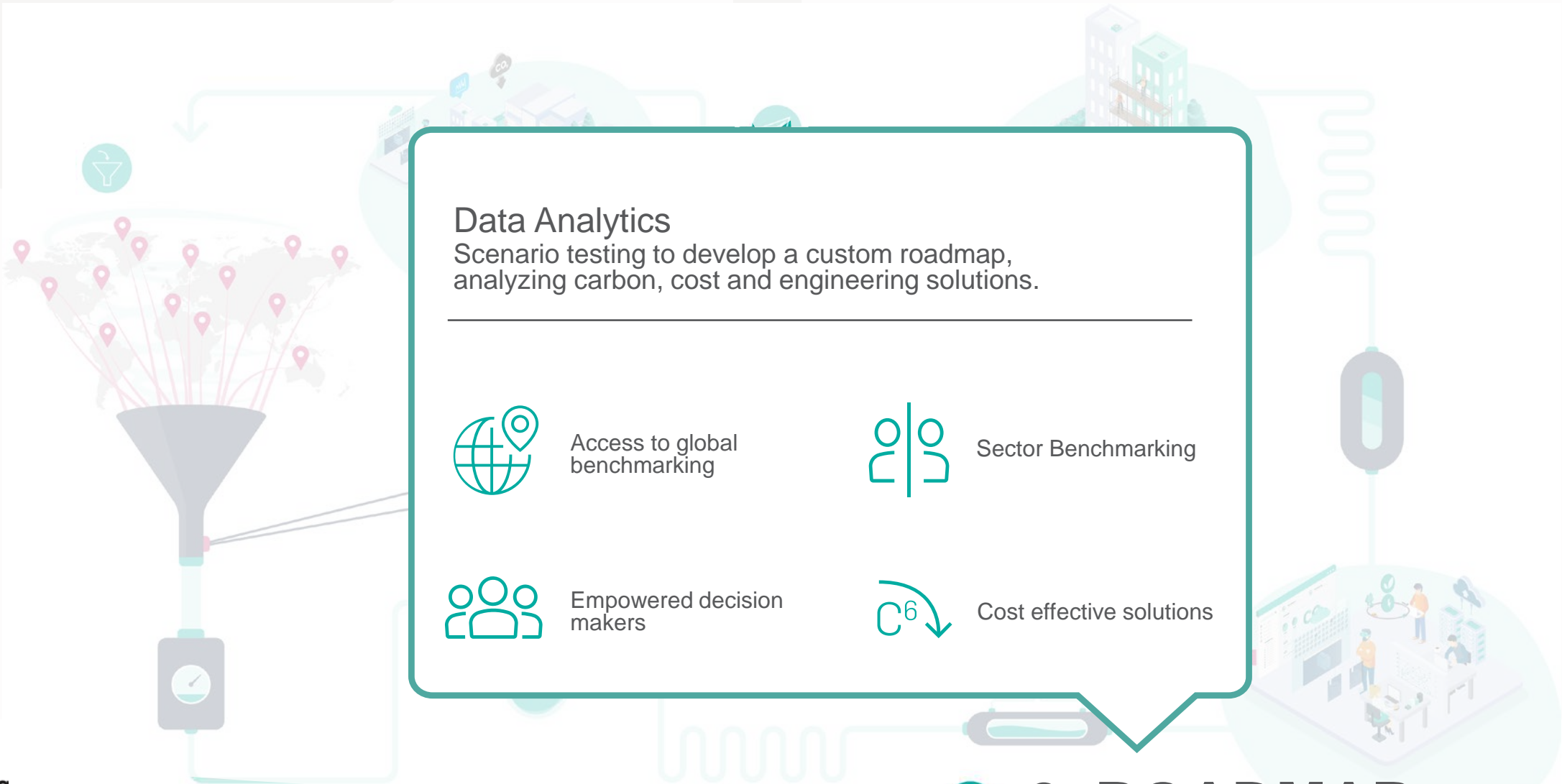
1. BENCHMARK

Data Capture and Management
Capture data to enable clients to understand their portfolio.

-  Up to date and organized data
-  Actively seek continuous improvement
-  Reputational benefits
-  Increased market value
-  Data led decisions to reduce risk
-  Quality and security assurance






Key benefits throughout the process



Key benefits throughout the process

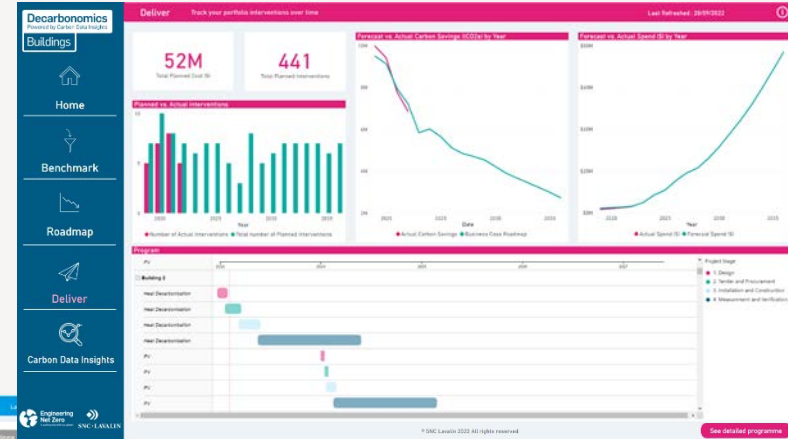
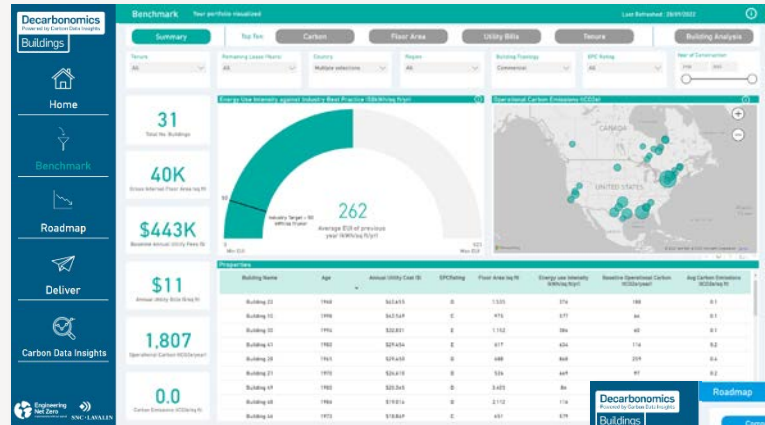
3. DELIVER

Delivery Management
Deliver interventions effectively over the lifetime of a portfolio.

-  Decarbonized and resilient portfolio (solution)
-  Cost effective and deliverable decarbonization plan
-  Quality control in construction
-  Reduced performance gap
-  Improved productivity
-  Healthier & resilient portfolios
-  Whole life asset management to remove performance gaps

PORTFOLIO DECARBONIZATION
MANAGEMENT DELIVERY

Case Study Demonstration – a Florida University Campus*



* Data used to generate the following demonstration slides were collected from publicly available information coupled with Atkins database of cost, carbon, and asset information. These have not been developed in collaboration with any institution.





Home



Benchmark



Roadmap



Deliver



Carbon Data Insights

Benchmark

Your portfolio visualized

We capture, structure, and manage your portfolio data to gain a deeper understanding of your properties, benchmark current performance and create a framework to maximize the value of your data.

Roadmap

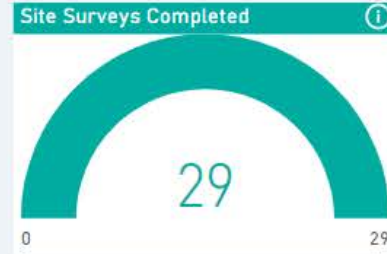
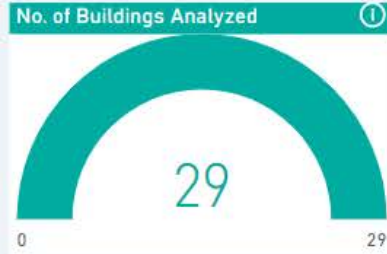
Your decarbonization scenarios

We analyze carbon, cost and engineering solutions to create enterprise level digital twins and use scenario testing augmented by Artificial Intelligence and Machine Learning to create bespoke roadmaps, for the most cost-effective and pragmatic implementation.

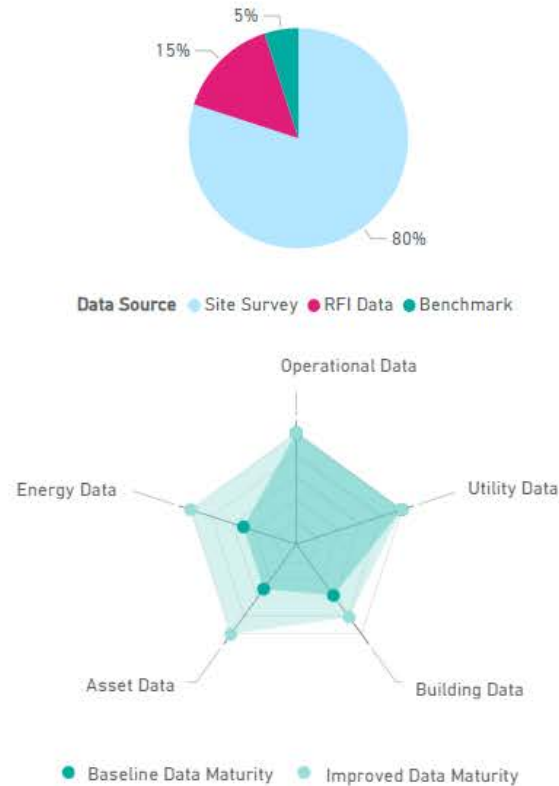
Deliver

Track your portfolio interventions over time

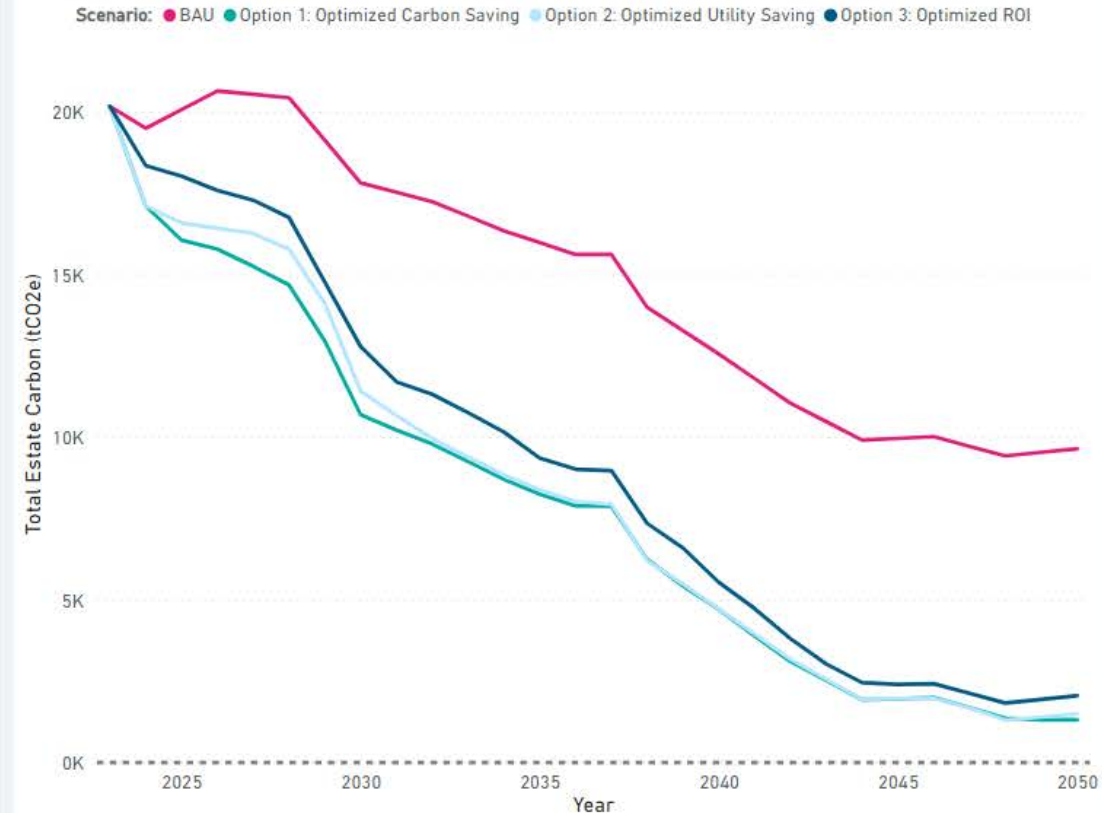
We ensure quantifiable decarbonization interventions are delivered throughout the life cycle of your assets, providing real time views of your performance against plan.



Data Accuracy



Net Zero Pathway Summary



Go to Portal



Home



Benchmark



Roadmap



Deliver



Carbon Data Insights

Summary

Top Ten:

Carbon

Floor Area

Utility Bills

Tenure

Building Analysis

Tenure

All

Building Name

All

Country

All

Region

All

Building Typology

All

Year of Construction

1980

2014

29

Total No. Buildings

3M

Gross Internal Floor Area (sq ft)

\$6.6M

Baseline Annual Utility Bills (\$)

\$2

Annual Utility Bills (\$/sq ft)

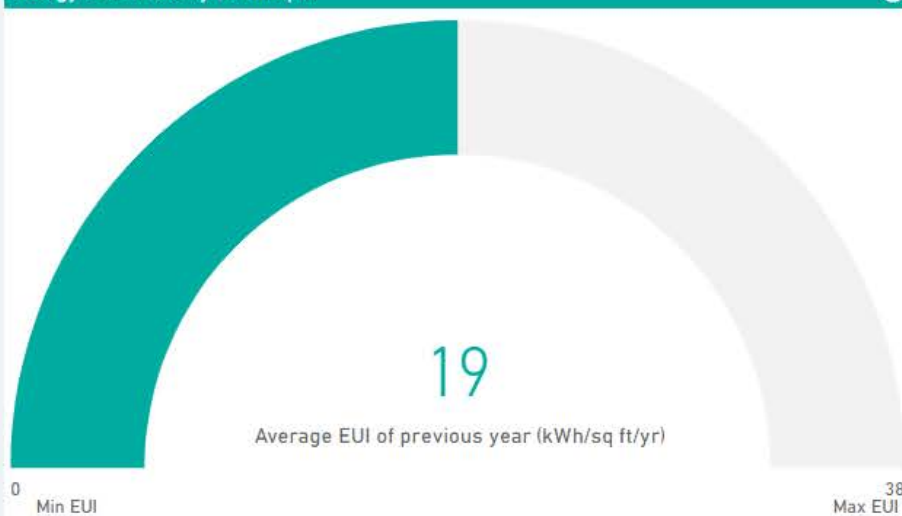
20,170

Baseline Carbon (tCO2e/yr)

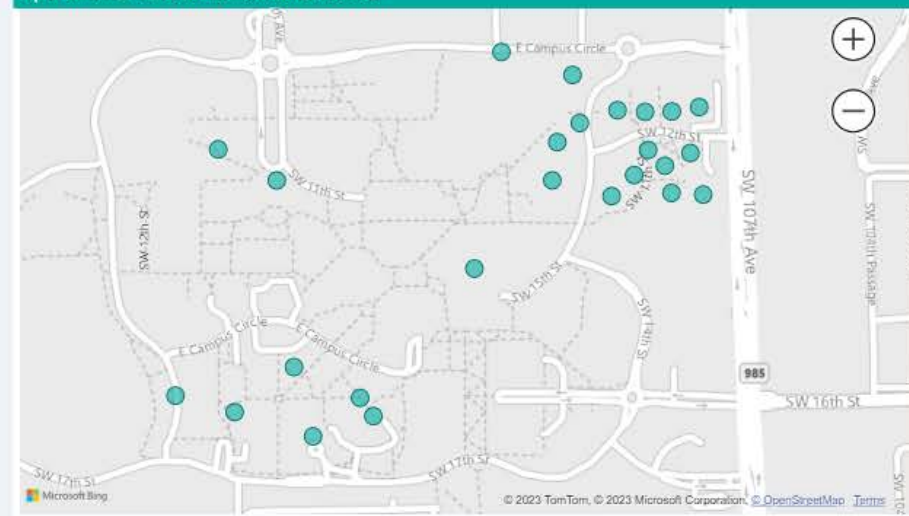
0.007

Carbon Emissions (tCO2e/sq ft)

Energy Use Intensity (kWh/sq ft)



Operational Carbon Emissions (tCO2e)



Properties

Building Name	Year of Construction	Floor Area (sq ft)	Annual Utility Bill (\$)	Annual Energy Consumption (kWh)	Energy Use Intensity (kWh/sq ft)	Baseline Operational Carbon (tCO2e/year)	Carbon Emissions (tCO2e/sq ft)	Annual Utility Bills (\$/sq ft)
College of Engineering & Computing	1996	479,212	\$1,318,233.0	12,080,582	25	4,506	0.009	\$3
Parkview Hall (PVH)	2013	300,000	\$746,694.0	4,666,837	16	1,741	0.006	\$2
Gregory B. Wolfe Univ. Ctr (WUC)	1980	153,420	\$477,596.0	4,376,795	29	1,633	0.011	\$3
Academic Health Center 4 (AHC4)	2013	136,076	\$427,395.0	3,916,743	29	1,461	0.011	\$3
Academic Health Center 2 (AHC2)	2005	119,899	\$380,482.0	3,486,824	29	1,301	0.011	\$3
Academic Health Center 1 (AHC1)	2002	117,862	\$366,050.0	3,354,566	28	1,251	0.011	\$3
Mgmt And New Growth Opportunities (MANGO)	2014	113,051	\$354,598.0	3,249,611	29	1,212	0.011	\$3
Academic Health Center 3 (AHC3)	2009	114,929	\$316,151.0	2,897,276	25	1,081	0.009	\$3

Comparison

Optimize for:

Carbon Savings

Utility Savings

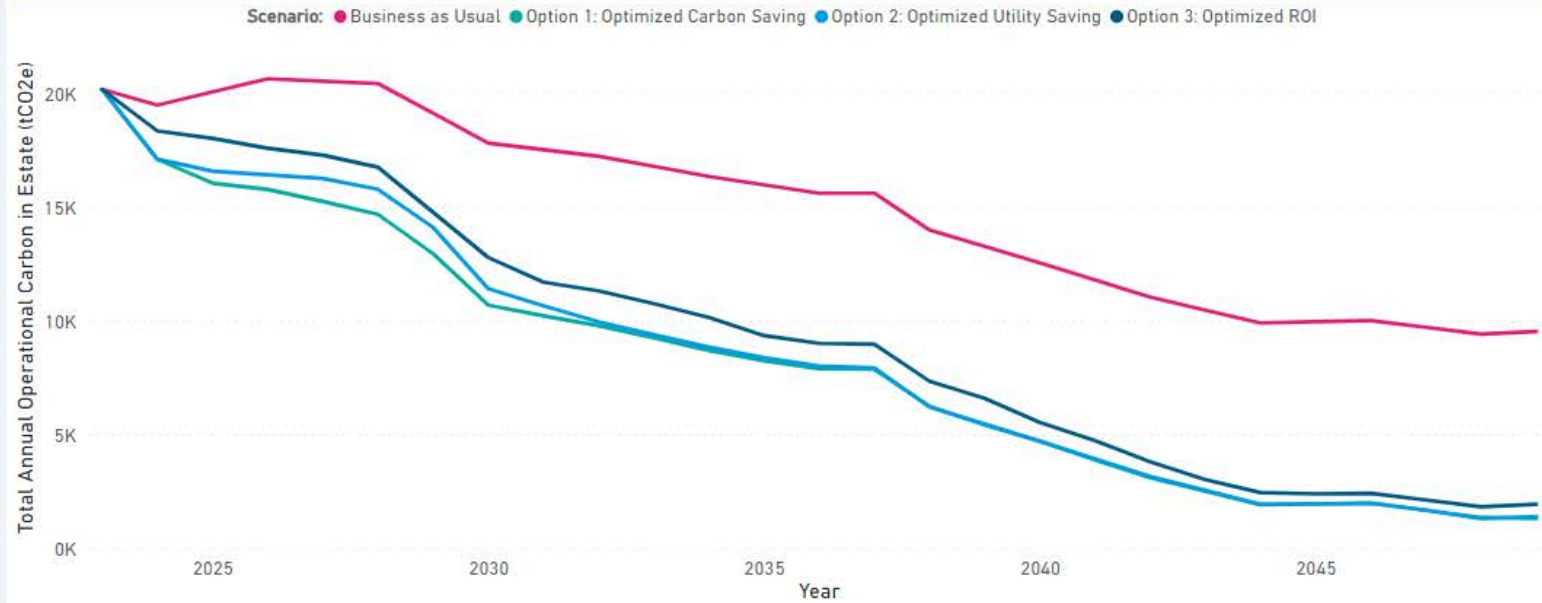
Return on Investments

Interventions

Net Zero Target Year

All

Net Zero Pathway Summary



Capital Costs (\$)

\$241,279,724

Optimized Carbon Saving

\$241,286,896

Optimized Utility Saving

\$239,750,784

Optimized ROI

Utility Savings (\$)

\$5,189,958

Optimized Carbon Saving

\$4,894,040

Optimized Utility Saving

\$5,208,011

Optimized ROI

Operational Carbon Saving (tCO2e)

8,504

Optimized Carbon Saving

8,305

Optimized Utility Saving

7,860

Optimized ROI

Residual Carbon (tCO2e)

1,312

Optimized Carbon Saving

1,395

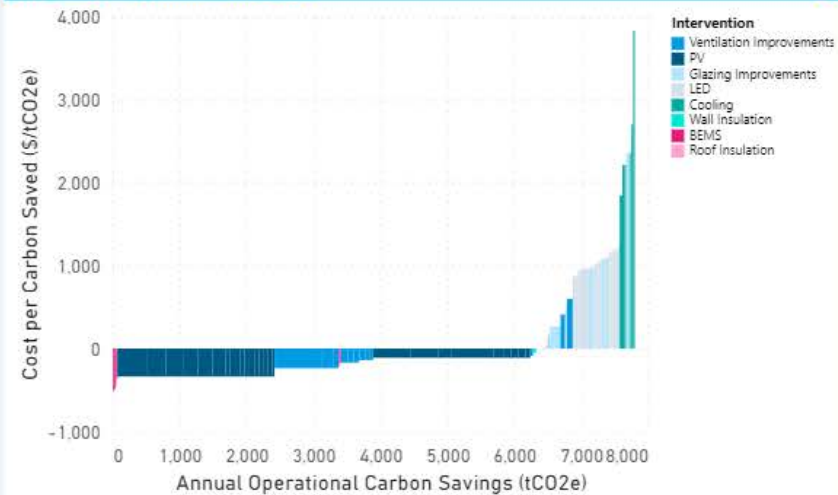
Optimized Utility Saving

2,050

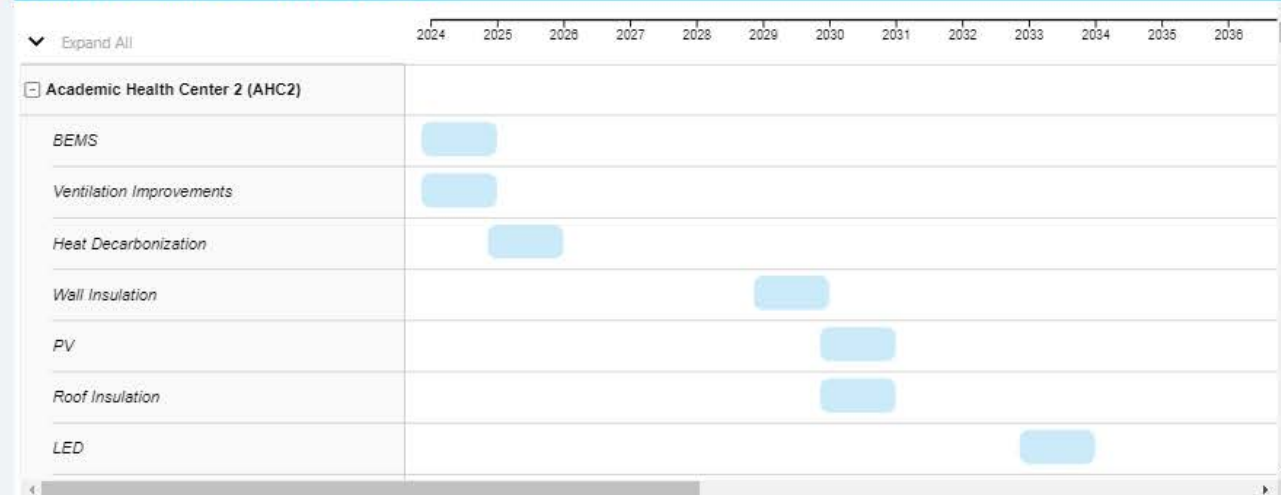
Optimized ROI

See All Programs

Marginal Abatement Cost Curve



Option 1: Optimized Carbon Savings Scenario



Home



Benchmark



Roadmap

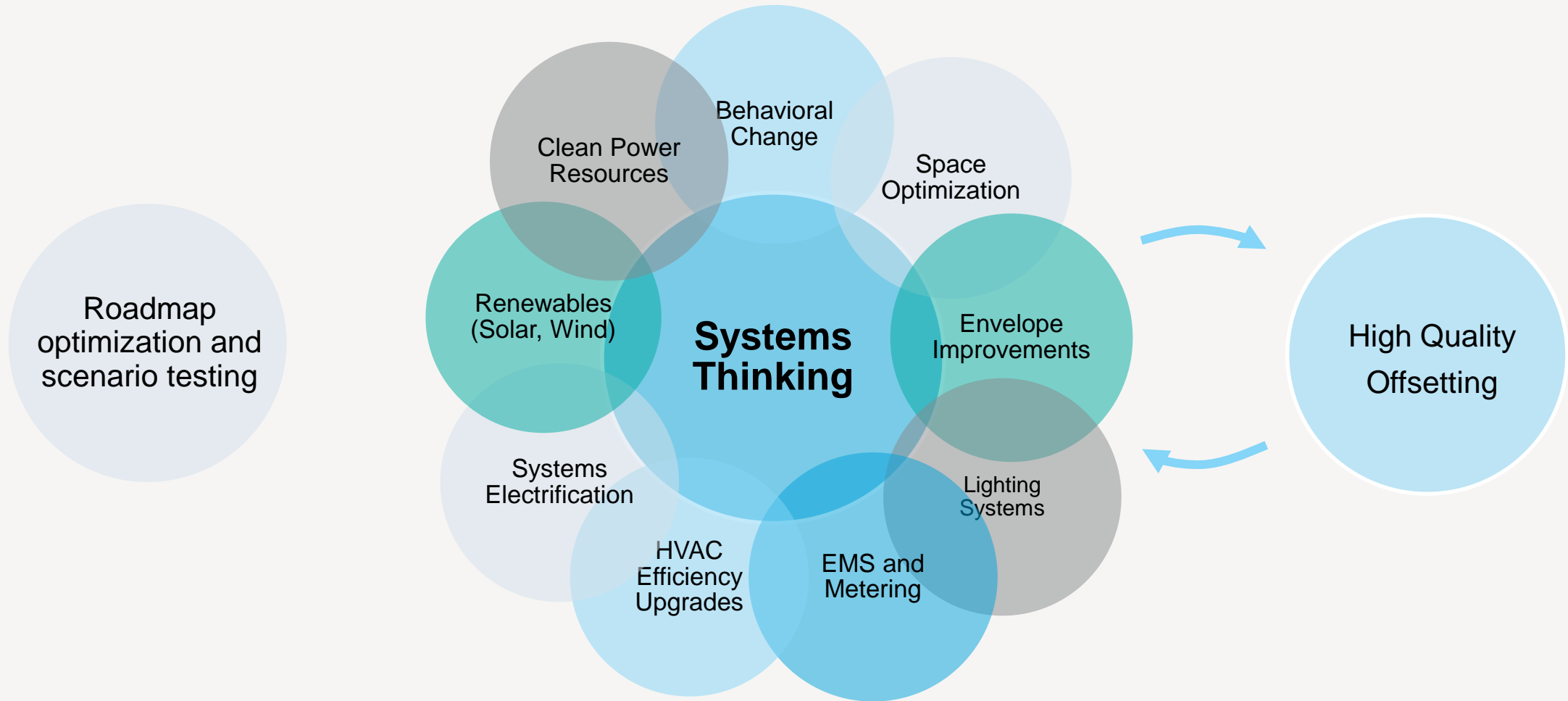


Deliver



Carbon Data Insights

Interventions





Home



Benchmark



Roadmap



Deliver



Carbon Data Insights

Back to Roadmap

Building Name

All

Intervention

PVs

GO

Capital Cost (\$)

Building Name	BEMS	Cooling	Glazing Improvements	Heat Decarbonization	LED	PV	Roof Insulation	Ventilation Improvements	Wall Insulation	Total
Academic Health Center 1 (AHC1)	\$991,718	\$3,919,668	\$3,874,549	\$1,850,138	\$1,129,936	\$524,902	\$57,063	\$200,730	\$94,709	\$12,643,414
Academic Health Center 2 (AHC2)	\$0	\$4,107,034	\$3,423,875	\$1,190,778	\$1,773,770	\$337,808	\$36,774	\$204,199	\$114,158	\$11,188,396
Academic Health Center 3 (AHC3)	\$967,040	\$3,710,803		\$1,520,849	\$1,487,714	\$592,037		\$195,735		\$8,474,178
Academic Health Center 4 (AHC4)	\$1,179,325	\$4,800,997	\$25,720,210	\$1,828,632	\$2,073,483	\$799,597	\$79,508	\$231,750	\$341,800	\$37,055,302
Total	\$7,309,112	\$71,255,708	\$80,280,626	\$28,367,750	\$25,840,256	\$19,759,887	\$1,408,440	\$3,624,576	\$1,904,429	\$239,750,784

Operational Cost Savings (\$)

Building Name	BEMS	Cooling	Glazing Improvements	Heat Decarbonization	LED	PV	Roof Insulation	Ventilation Improvements	Wall Insulation	Total
Academic Health Center 1 (AHC1)	\$76,241	\$947	\$27,450	(\$2,016)	\$10,817	\$33,903	\$1,624	\$19,178	\$1,917	\$170,060
Academic Health Center 2 (AHC2)	\$62,960	\$18,720	\$26,483	\$5,230	\$13,961	\$21,819	\$1,140	\$52,582	\$2,522	\$205,418
Academic Health Center 3 (AHC3)	\$71,734	\$12,109		\$2,802	\$12,959	\$38,240		\$23,214		\$161,057
Academic Health Center 4 (AHC4)	\$90,708	\$11,362	\$115,222	\$932	\$18,467	\$51,646	\$638	\$27,485	\$2,402	\$318,861
Total	\$1,169,540	\$191,657	\$919,480	\$31,749	\$248,238	\$1,998,333	\$26,482	\$566,758	\$55,772	\$5,208,011

Operational Carbon Savings (tCO2e)

Building Name	BEMS	Cooling	Glazing Improvements	Heat Decarbonization	LED	PV	Roof Insulation	Ventilation Improvements	Wall Insulation	Total
Academic Health Center 1 (AHC1)	14.58	1.37	39.64	-2.22	26.12	111.76	5.36	63.30	6.33	266.25
Academic Health Center 2 (AHC2)	0.00	24.82	45.23	17.26	30.45	71.92	3.77	173.57	8.33	375.35
Academic Health Center 3 (AHC3)	7.28	18.98		-15.99	28.26	121.77		76.63		236.93
Academic Health Center 4 (AHC4)	17.43	13.75	98.08	2.87	38.05	144.36	2.11	90.73	7.92	415.29
Total	72.93	203.02	963.34	-22.92	464.85	4,263.67	76.10	1,682.70	156.01	7,859.71

Annual Energy Saving (kWh)

Building Name	BEMS	Cooling	Glazing Improvements	Heat Decarbonization	LED	PV	Roof Insulation	Ventilation Improvements	Wall Insulation	Total
Academic Health Center 1 (AHC1)	44,267	5,573	161,465	-10,853	80,601	292,863	14,878	170,631	17,565	776,991
Academic Health Center 2 (AHC2)	0	106,906	165,267	46,534	98,057	188,476	10,449	467,838	23,115	1,106,641
Academic Health Center 3 (AHC3)	44,226	73,362		16,024	91,017	320,700		206,541		751,871
Academic Health Center 4 (AHC4)	53,790	62,998	180,090	7,585	125,925	408,269	5,846	244,545	20,746	1,109,794
Total	270,316	834,200	3,208,798	566,991	1,536,501	12,618,064	265,443	4,768,544	570,475	24,639,332



Home



Benchmark



Roadmap



Deliver



Carbon Data Insights

Back to Roadmap

Building Name

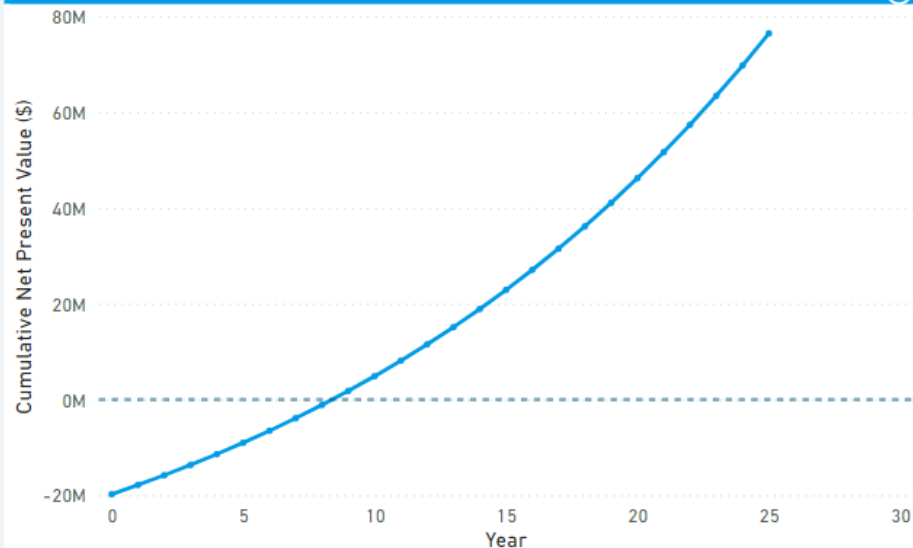
All

Intervention

PVs

GO

Estate-wide Average NPV curve



4K

Annual Operational Carbon Saving (tCO2e)

147.0

Average Annual Operational Carbon Saving per Building (tCO2e)

-244

Average Cost per Carbon Saved (\$/tCO2e)

0.008

Carbon Reduction (%)

\$2M

Annual Operational Cost Saving (\$)

\$69K

Average Annual Operational Cost Saving per Building (\$)

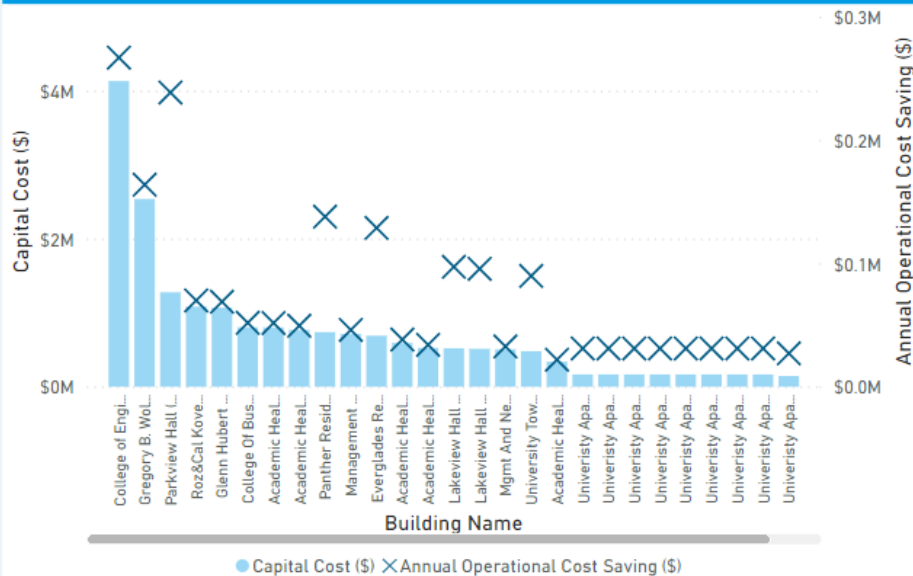
\$20M

Capital Cost (\$)

\$681K

Average Capital Cost per Building (\$)

Cost Comparison



Costs and Carbon Savings

Building Name	Capital Cost (\$)	Annual Operational Energy Savings (kWh)	Annual Operational Cost Savings (\$)	Annual Operational Carbon Savings (tCO2e)	Chosen Intervention
College of Engineering & Computing	\$4,130,171	1,523,470	\$266,768	353.75	PV
Parkview Hall (PVH)	\$1,276,167	1,212,049	\$238,507	392.82	PV
Gregory B. Wolfe Univ. Ctr (WUC)	\$2,536,083	1,084,465	\$163,806	320.46	PV
Panther Residence Hall (PH)	\$737,862	743,467	\$137,901	262.89	PV
Everglades Residence Hall (EH)	\$688,990	715,051	\$128,767	270.15	PV
Lakeview Hall North (LVN)	\$519,867	572,388	\$97,160	218.42	PV
Lakeview Hall South (LVS)	\$511,440	563,110	\$95,584	214.88	PV
University Towers (UT)	\$480,364	528,894	\$89,777	201.83	PV
Roz&Cal Kovens Conference Ctr. (KCC)	\$1,082,055	520,775	\$69,890	168.78	PV
Glenn Hubert Library (HL)	\$1,066,390	513,236	\$68,878	166.34	PV
College Of Business Complex (CBC)	\$803,004	410,009	\$51,866	144.98	PV
Academic Health Center 4 (AHC4)	\$799,597	408,269	\$51,646	144.36	PV
Academic Health Center 5 (AHC5)	\$765,523	390,871	\$49,445	138.21	PV
Total	\$19,759,887	12,618,064	\$1,998,333	4,263.67	



Home



Benchmark



Roadmap



Deliver



Carbon Data Insights

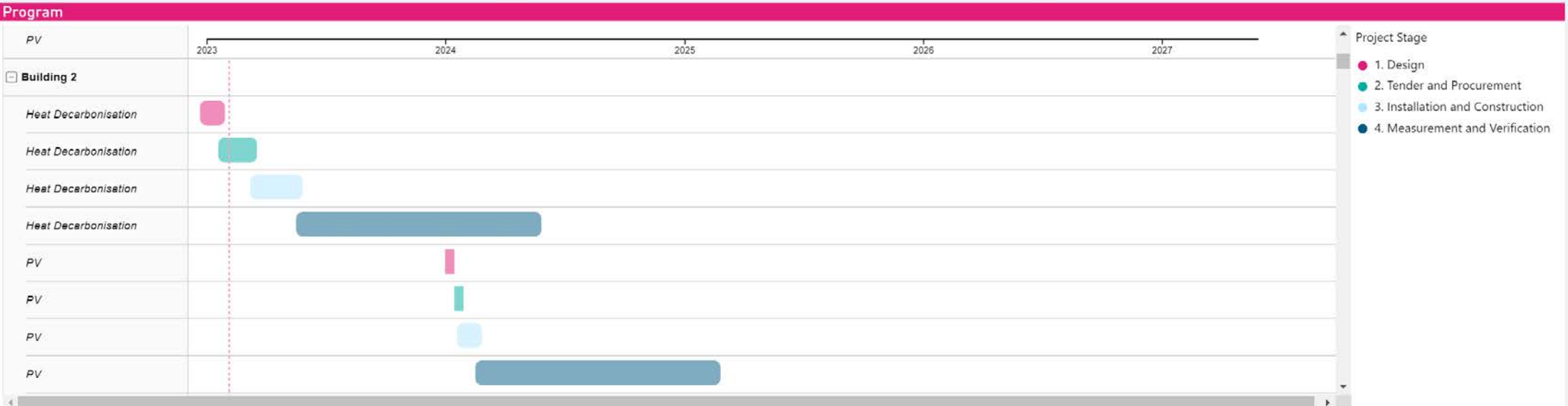
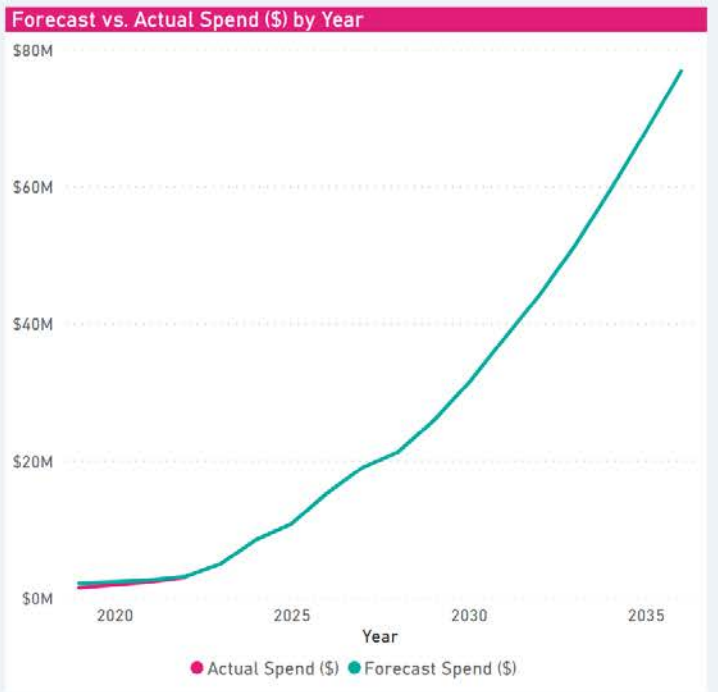
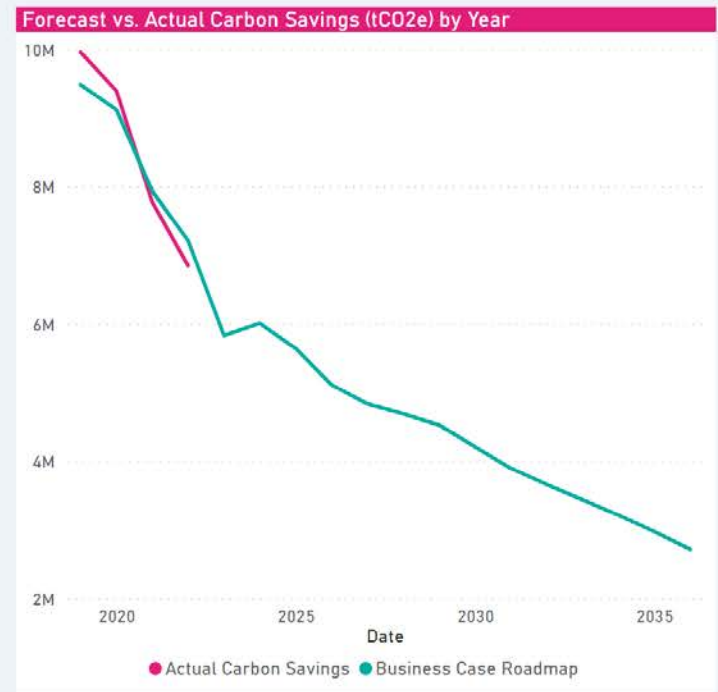
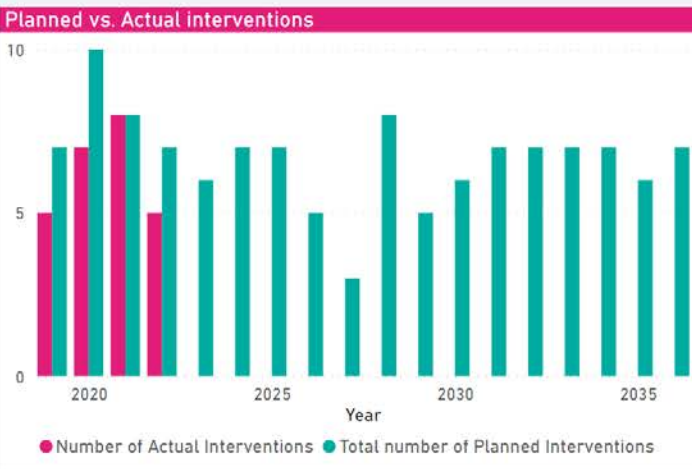


52M

Total Planned Cost (\$)

441

Total Planned Interventions



Campus Visualizer

ATKINS
Member of the SNC-Lavatin Group

UNIVERSITY OF PLYMOUTH

PLYMOUTH UNIVERSITY

Data Selection Menu

Select data type
OFFICES EDUCATION COMPARE

Hide utility areas **ON**

Select Faculty
All Faculties

Select Department
All Departments

Select Floor
All Floors

Select date
Monday 21st

Select time
9:00

Key (Utilisation 0-100%)
0% 100%

Cameras

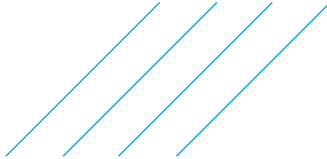
Settings

Tools

NAVIGATION

1 OVERVIEW 2 BABBAGE 3 BRUNEL LABS 4 CAPERA COTTAGE 5 DAVY 6 ENDSLEIGH PLACE 7 FITZROY BUILDING

QUIT HELP



Thank You. Questions?



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