

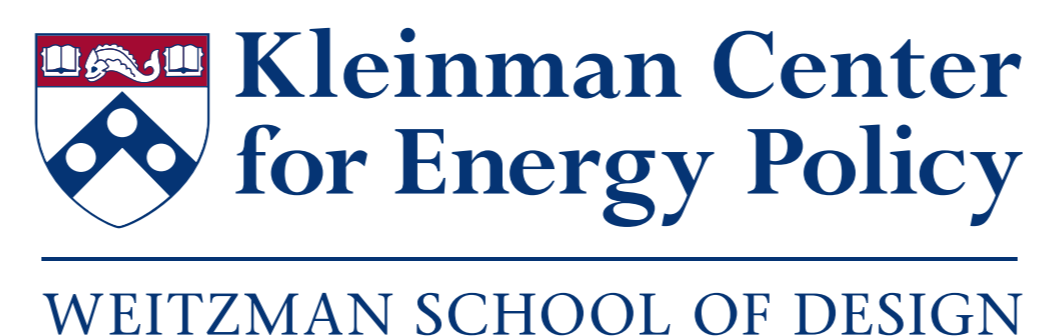
# Decarbonization & Urban Institutions

Julie Newman, MIT

Jessica Prata, Columbia

Nina Morris, Penn

Katherine Leonetti, City of Philadelphia



Sponsored by: Penn Sustainability, Kleinman Center for Energy Policy, Institute for Urban Research, Environmental Innovations Initiative





**Net Zero/ Carbon  
Neutral**

**Fossil-Fuel Free**

**Decarbonization**

## ***Common Terms***

Reduce greenhouse gas emissions to ensure that ongoing emissions are balanced by removals

Eliminate the use of all fossil fuels in campus operations

The process of stopping or reducing CO<sub>2</sub> emissions





Office of Sustainability

# Decarbonizing across Scales



Julie Newman, Ph.D., Director of Sustainability  
Lecturer, Dept. Urban Studies and Planning



# Planning for Today and next 100 yrs @ MIT



**24,000** faculty, researchers,  
staff, students

**450+** labs, departments, centers

**170** buildings, 13 million ft<sup>2</sup>,  
168 acres

**\$3.9B** operating revenues

**1916** Date MIT moved to Cambridge



# City of Cambridge Climate Action Planning & Goals

DRAFT REPORT

## Cambridge Net Zero Action Plan

2021 Update



Date: October 15, 2021

City goal: Carbon neutral by 2050

City progress: As of 2021, the City reduced greenhouse gas emissions (ghg) from municipal operations 38% below 2008 levels

City policy: Climate Protection Plan; Net zero action plan 2022



# MIT Climate Action Planning & Goals

**Fast Forward:  
MIT's Climate Action Plan  
for the Decade**

**A commitment to leadership  
in solving the climate crisis**

**May 2021**



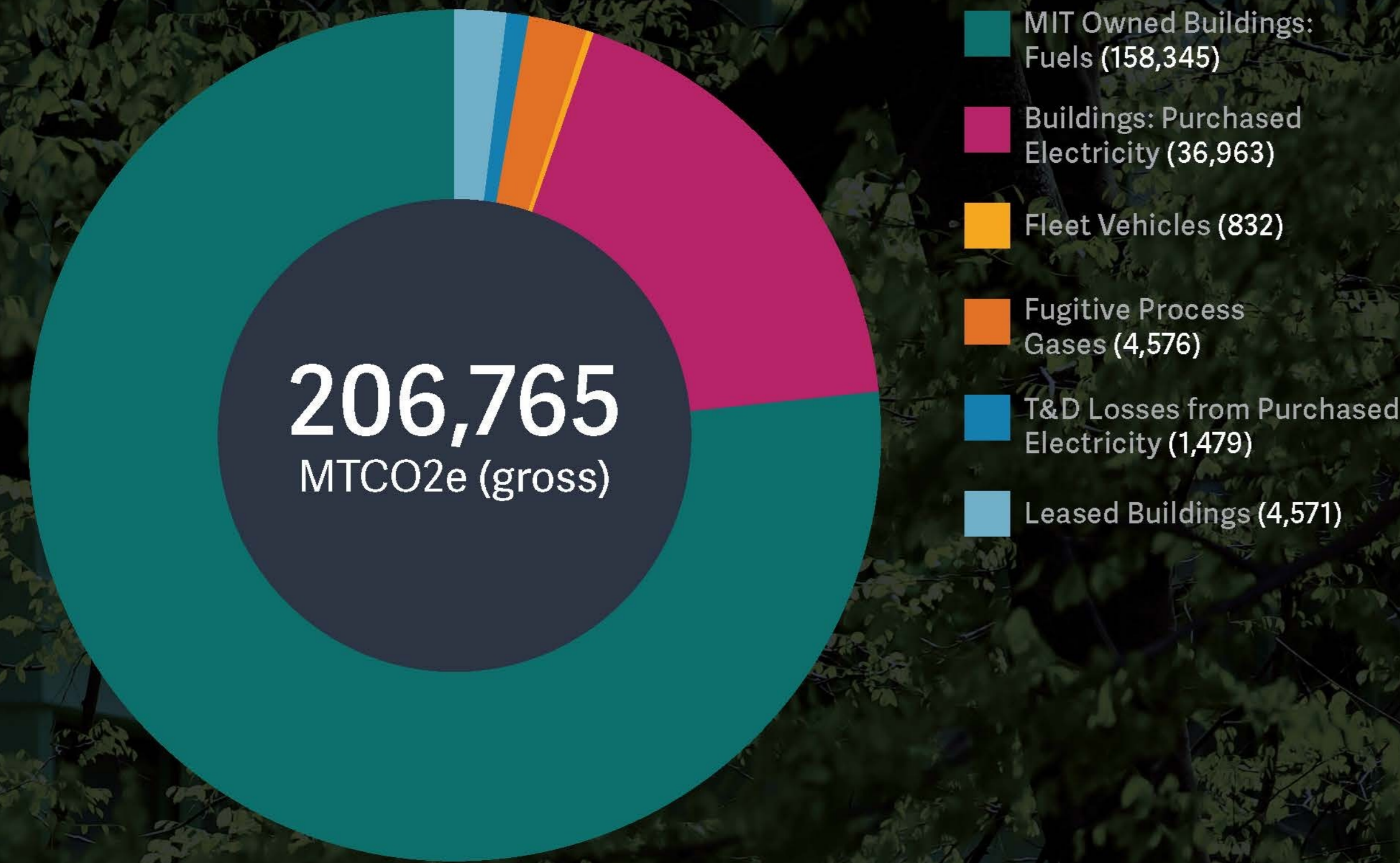
**Long term: Elimination of direct  
emissions from campus by 2050**

**Near term: Net-zero emissions by 2026**

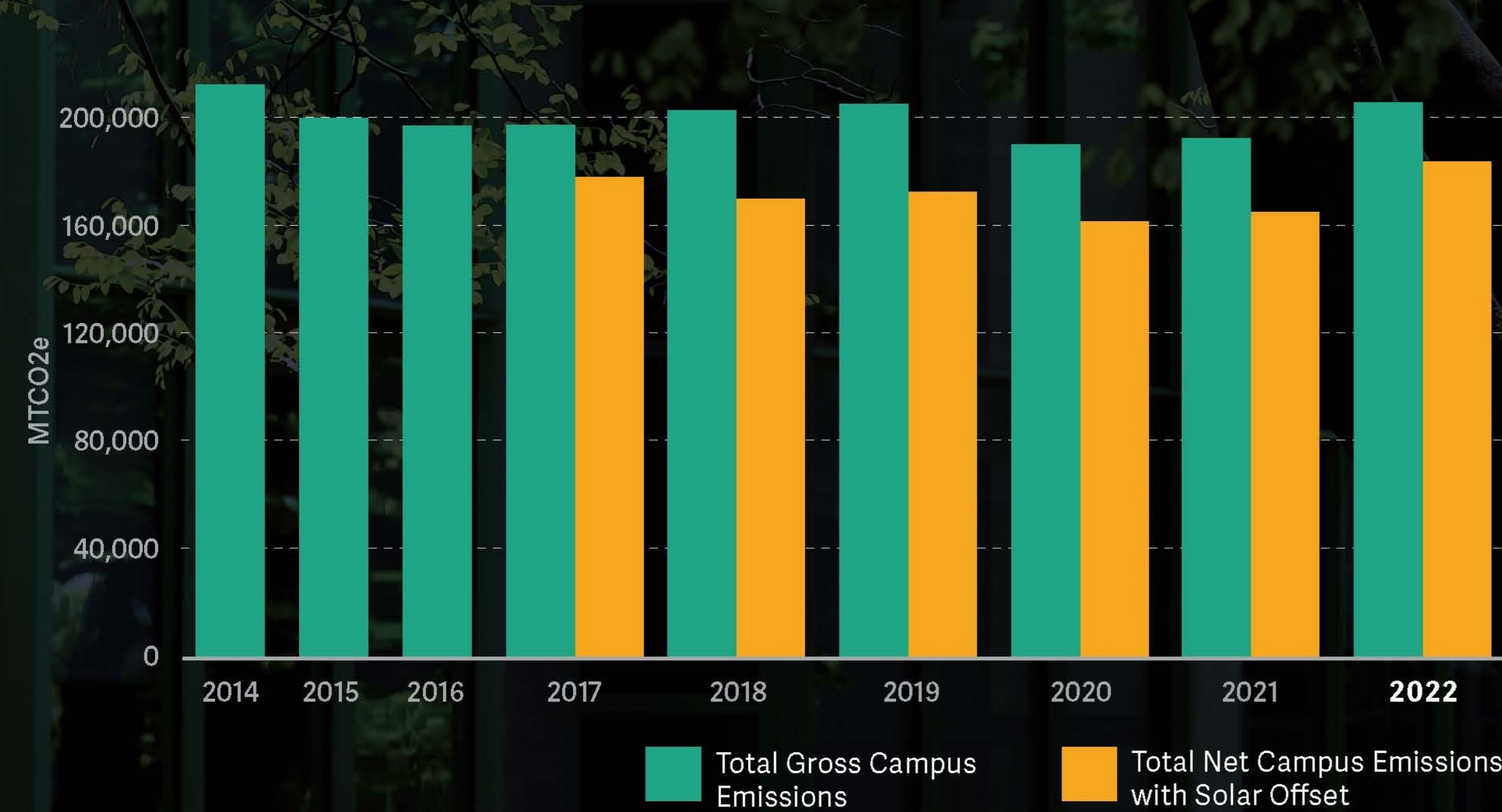
**\*plus 12 other commitments that feed  
into these commitments**



MIT CAMPUS GREENHOUSE GAS EMISSION SOURCES FY22



MIT CAMPUS GREENHOUSE GAS EMISSION



# Campus Carbon Reduction Strategy

- **MIT is dedicated to eliminating campus carbon emissions by 2050...** with a near-term milestone of achieving net-zero campus emissions by 2026.
- **We have reduced emissions by over 20% from a 2014 baseline** (despite significant growth) through investments in campus utility, enabling renewable energy, and energy efficiency.
- **We are accelerating our actions** toward deeper energy reductions in existing buildings, electrifying buildings (Metropolitan Warehouse) and the vehicles we own, increasing rooftop solar, and expanding the number of electric vehicle charging stations for use by our community.
- **We are enabling larger-scale renewable energy projects** (bigger than Summit Farms) with larger partnerships, to accelerate the de-carbonization of regional electricity grids.
- **We are planning for the next energy era on our campus...** evaluating new technologies and strategies for the evolution of our district energy system.





# Net-Zero Alignment



YOU

MIT: Net-Zero by 2026/Zero by 2050

Cambridge/Boston: Net-Zero by 2050

Massachusetts: Net-Zero by 2050

Net-Zero by 2050



# Columbia University's Plan 2030: Net Zero by 2050 or Sooner

**PENN ENERGY WEEK**

**Jessica Prata Cianciara  
AVP, Office of Sustainability  
Columbia University**

**March 21, 2023**



# Columbia Portfolios: Morningside /Manhattanville

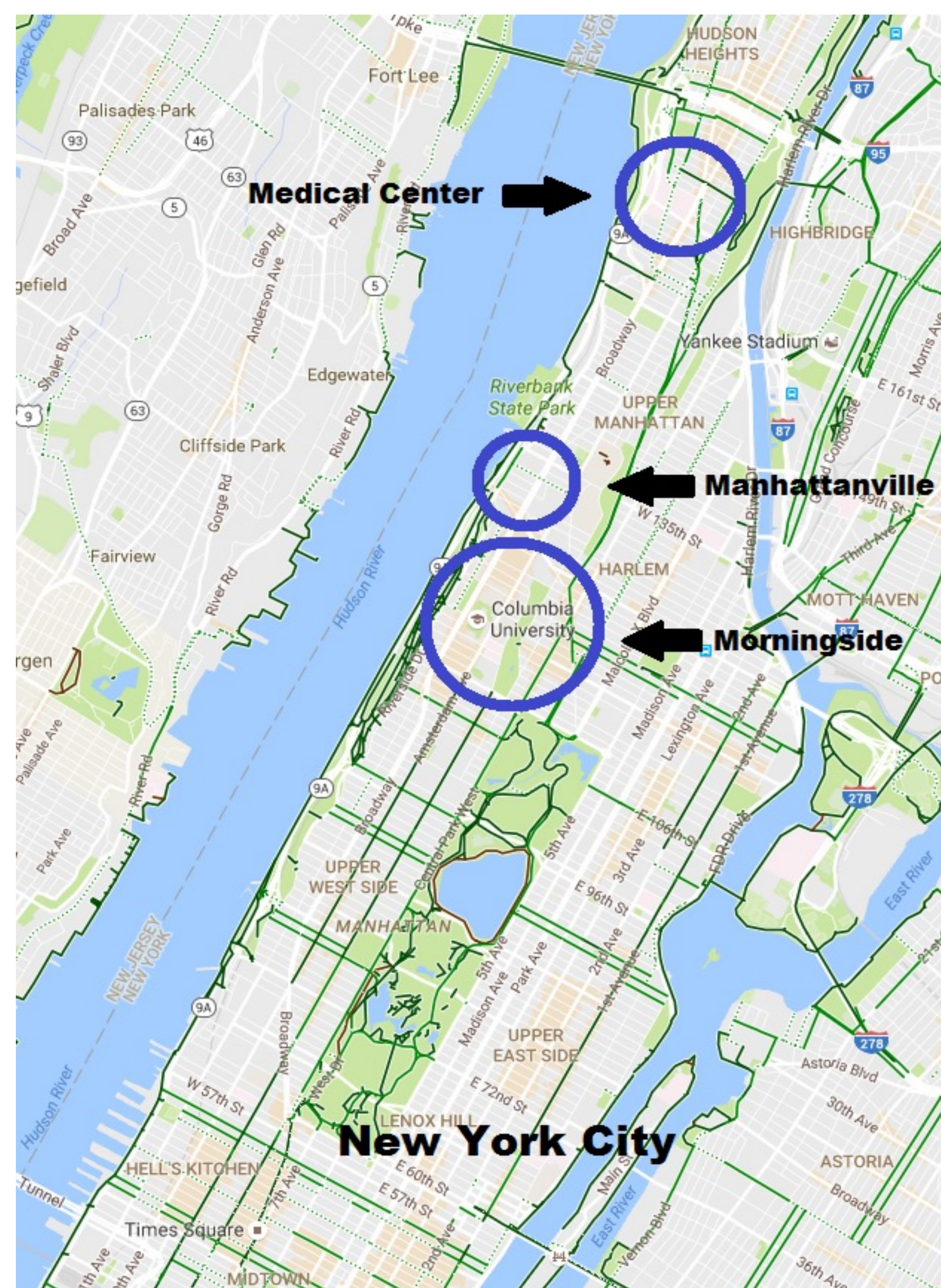
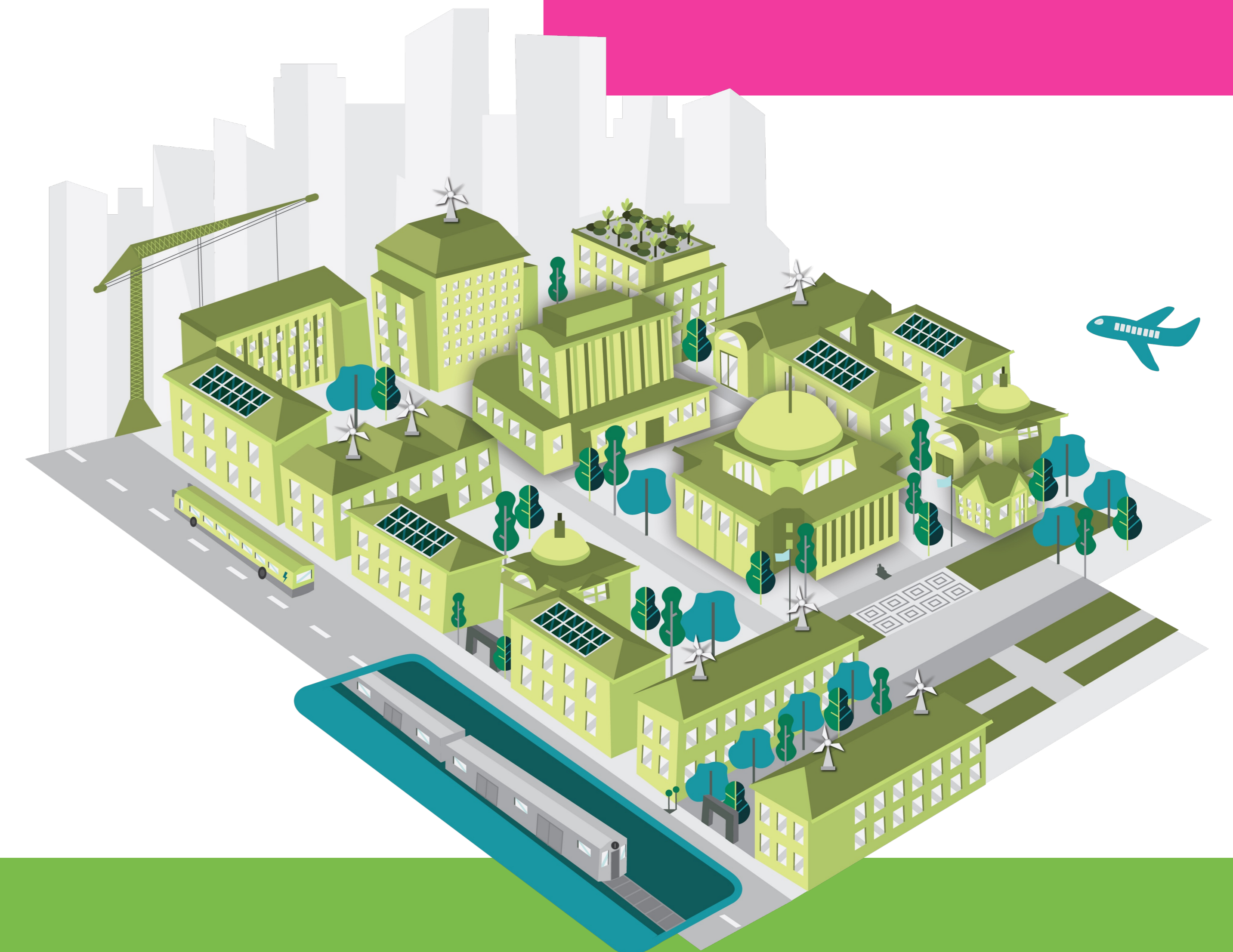
Morningside Central Energy Plant  
65 Buildings + Central Plant  
7.0M sq ft

Manhattanville Central Energy Plant  
6 Buildings + Central Plant  
1.1M sq ft

Standalone Academic  
17 Buildings  
1.1M sq ft

Residential  
149 Buildings  
6.7M sq ft

16 million  
square feet





# City and State Goals

State goal: Net zero by 2050

State policy: Climate Action and Community Protection Act (CLCPA) - 2019

NYC goal: 80% by 2050

City policy: Local Law 97  
Part of the Climate Mobilization Act, part of NYC Green New Deal,





# Plan 2030, University plan towards net zero by 2050: *Commitment Areas*



**Campus Energy**  
Electrify and pursue 100% zero emission electricity



**Sustainable Transportation**  
Reduce emissions from on-campus fleet vehicles, commuters, and business travel.



**Responsible Materials Management**  
Send zero waste to landfill, host sustainable events, ensure retail tenant alignment, and practice sustainable procurement.



**Culture Change & Campus as Living Lab**  
Commit to enhance student literacy and access to the campus as a living lab.



**Responsible Design & Construction**  
Ensure the design, construction, and refresh processes at all campuses support the University's long-term goal to both decarbonize and achieve zero waste.

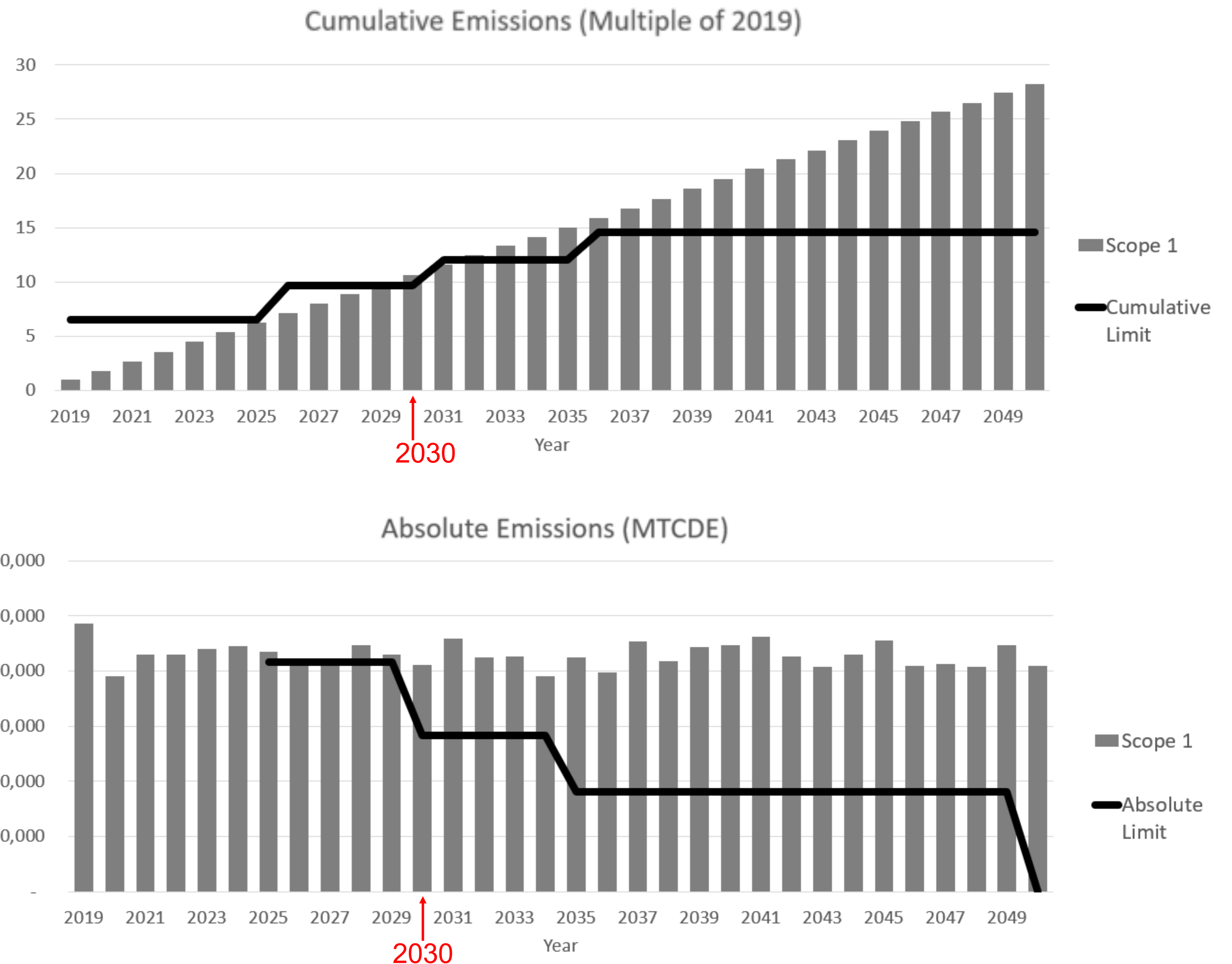


**Water Conservation & Capture**  
Increase efforts toward water conservation, capture, and awareness.



# Plan 2030 sets two types of Science Based Targets (SBTs)

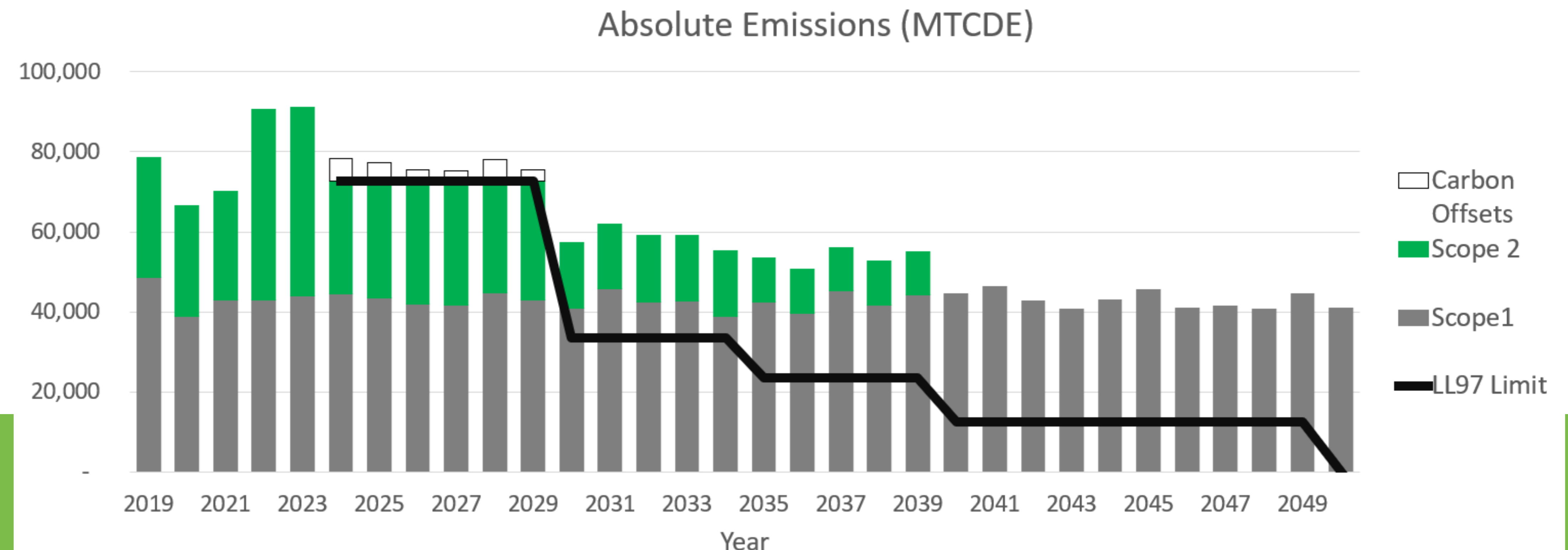
- Business-as-usual emissions, projected through 2050
- Columbia's Sustainability Plan emissions limits are effectively Scope 1 emissions limits
  - The Plan assumes that all Scope 2 emissions will be neutralized using carbon offsets or RECs (not necessarily Tier 4 RECs)
- Beginning in 2030, our emissions will greatly exceed the limit
  - Use the rest of this decade to address near-term exceedances and position ourselves for success in 2030 and beyond





# New York City Local Law 97 Aligns with Plan 2030 SBTs

- **Local Law 97 mandates that buildings 25,000sq-ft and larger cannot emit greenhouse gas emissions at levels higher than the limits set by the law**
  - The law takes effect in 2024 and emissions limits are defined in the law for various building types
  - 162 CUFO Morningside / Manhattanville buildings are covered by the Law
  - The limits become more stringent over time: After 2024, the next set of limits take effect in 2030 and by 2050 the emissions limit for all building types is 0
- **Buildings are fined \$268 per ton for CO2 emissions which exceeds the annual limit. The Law allows some Market based Emissions Mitigation**
  - From 2024-2029: The law allows the purchase of carbon offsets to reduce building emissions for up to 10% of the emissions limit
  - Purchase of Tier 4 Rec's
- **The law is evolving**





# Sample Mitigation Roadmap to Net Zero Emissions

Hypothetical Trajectory & Mitigation Strategies  
to Meet Campus Energy Science-Based Targets, Net Zero in 2050

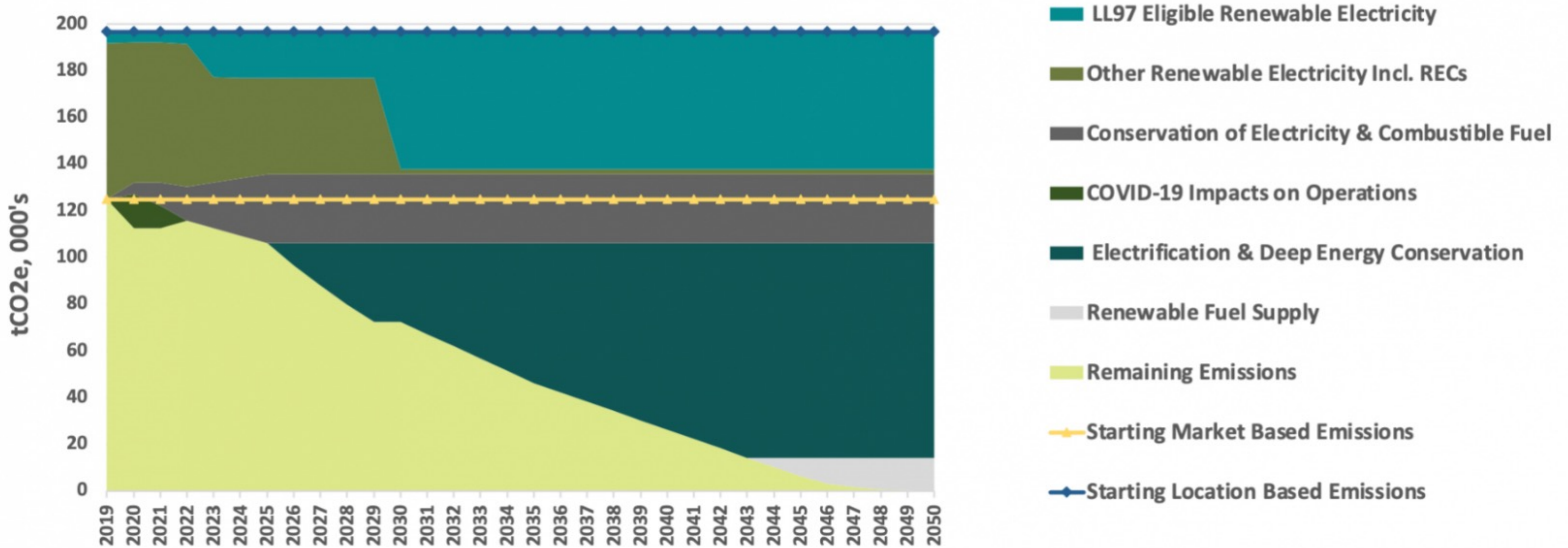


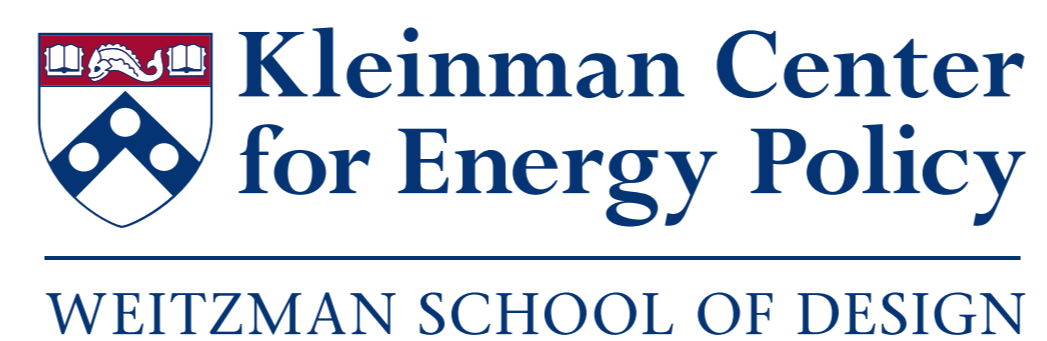
Image Description: Hypothetical application of general mitigation measures to follow the sample trajectory and meet Columbia's science-based targets.





# Decarbonization at Penn & Philadelphia

**Nina Morris, Sustainability Director**  
**University of Pennsylvania, Office of**  
**Sustainability**







# GREENWORKS

A VISION FOR A SUSTAINABLE PHILADELPHIA

CITY OF PHILADELPHIA  
OFFICE OF SUSTAINABILITY

MAYOR JIM KENNEY

# Philadelphia, PA

- **City Goal: Net Zero by 2050**
- **City Progress: 44% GHG reduction**
- **City Policy: Commercial Buildings must be high performance, or complete tune ups**







# University of Pennsylvania

- **28,000 Students**
- **299 acres in West Philadelphia**
- **180+ Buildings from 1873-2023**
- **~690 Labs in 1.2 million sq. ft.**
- **28% Green Space on Campus**



# Climate and Sustainability Action Plan 3.0

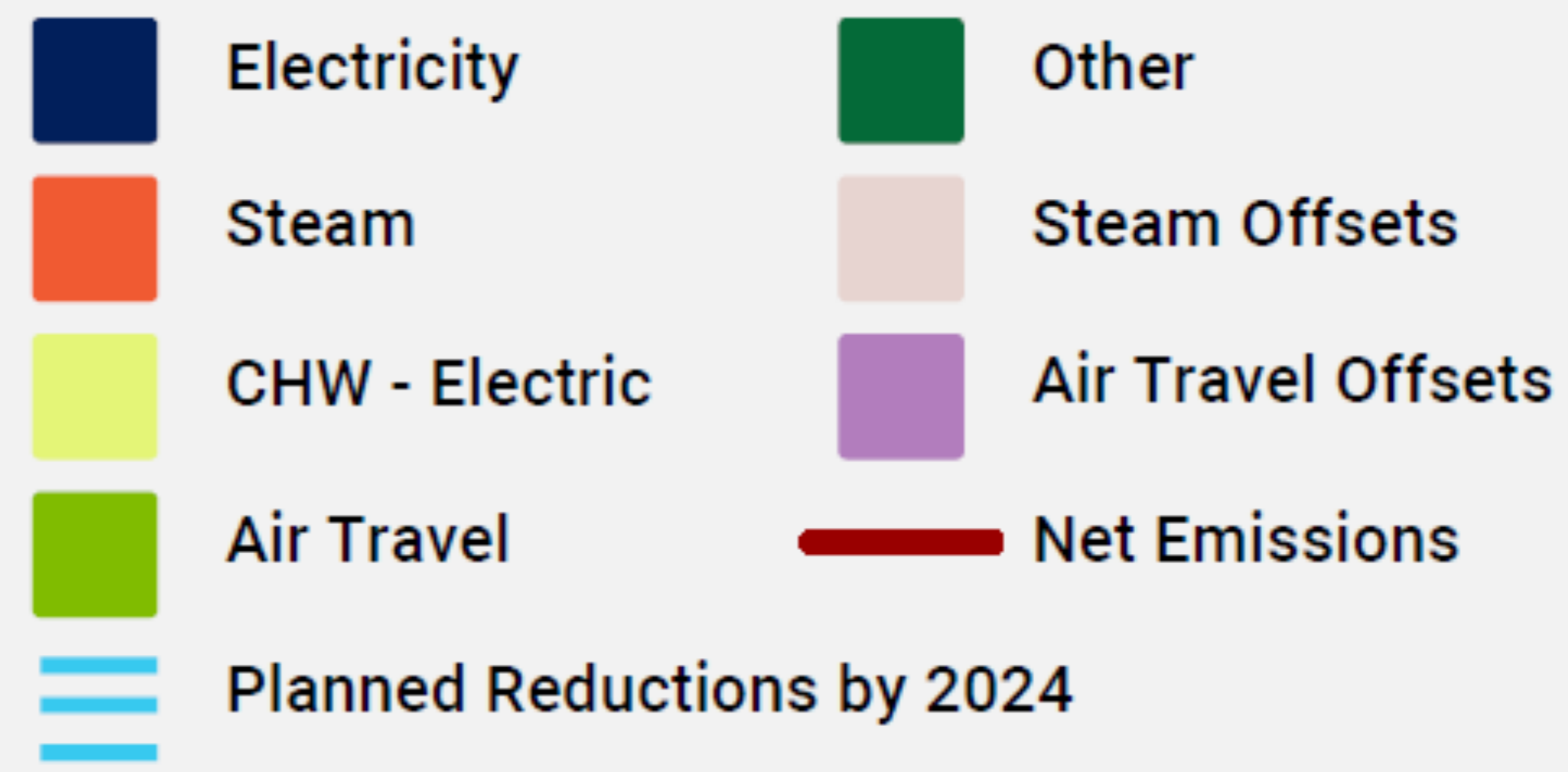
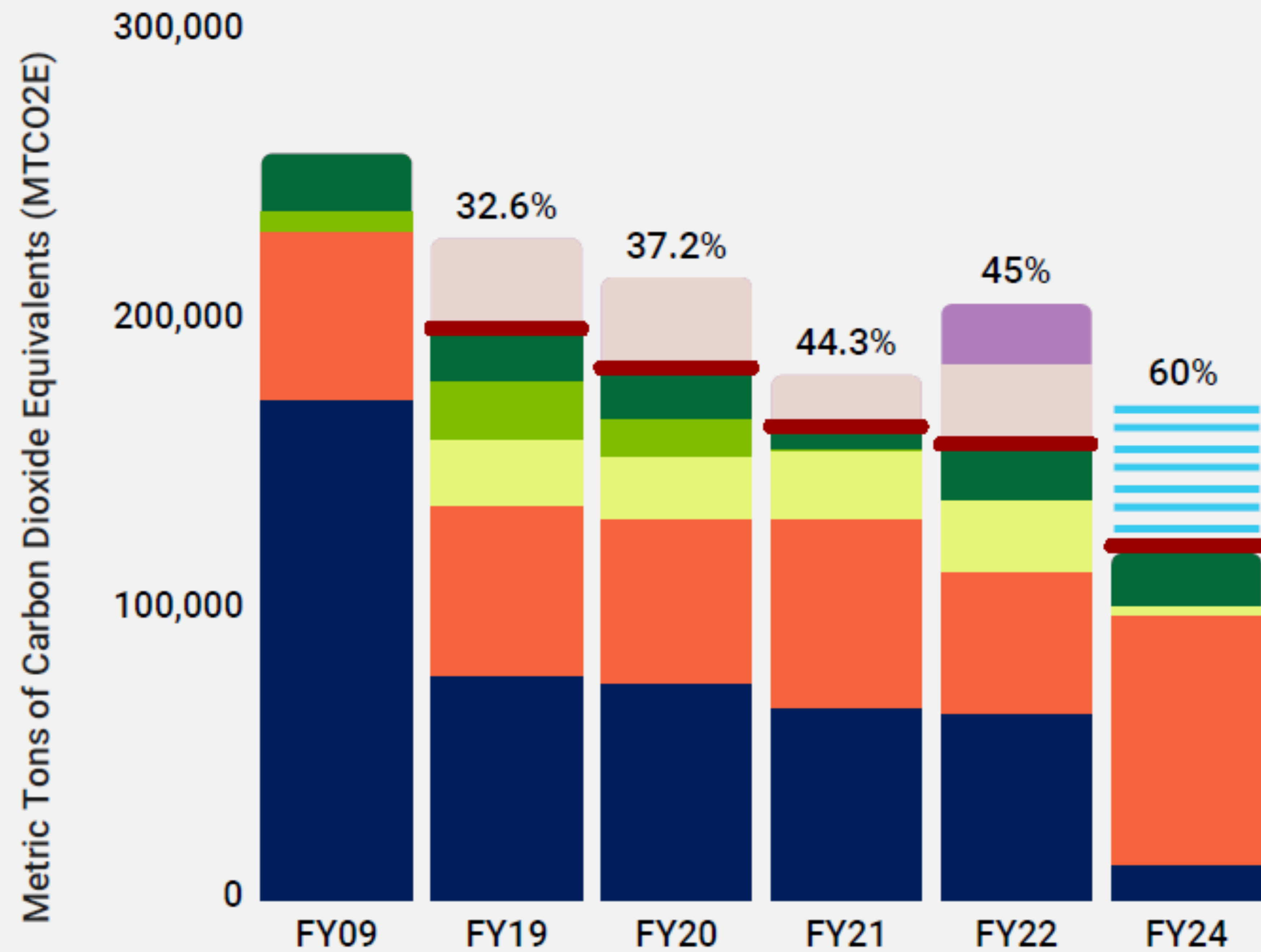
Progress and highlighted achievements towards the 100+ tactics identified in CSAP 3.0 across the 7 initiative areas

Academics	 <b>94%</b>	<ul style="list-style-type: none"> <li>• The Environmental Innovations Initiative was founded in 2019</li> <li>• All 12 Schools published Academic Climate Commitments</li> </ul>
Utilities and Operations	 <b>92%</b>	<ul style="list-style-type: none"> <li>• <b>Reduced GHG emissions by 45% from 2009 baseline</b></li> <li>• Construction underway on two solar energy facilities in Central PA. Penn will purchase all electricity production - equal to approximately 70% of the electricity demand of University and Health System</li> </ul>
Physical Environment	 <b>100%</b>	<ul style="list-style-type: none"> <li>• Launched and initiated the Ecological Landscape Stewardship Plan (ELSP) to improve landscape ecology practices - over 70% of action items are in progress or completed</li> <li>• Bird-friendly guidelines created to minimize bird strikes on campus</li> </ul>
Waste	 <b>70%</b>	<ul style="list-style-type: none"> <li>• Signed on to City of Philadelphia's Zero Waste Partnership program</li> <li>• Expanded recycling collection to include flexible plastics in single-stream recycling</li> </ul>
Procurement	 <b>100%</b>	<ul style="list-style-type: none"> <li>• 62% of food purchases by Bon Appetit are sustainably or ethically produced, as determined by AASHE</li> <li>• Enacted a Travel Sustainability Policy and process to track, fund, and offset the carbon emissions from all Penn-related air travel - 4,336 MTCDE of air travel emissions were offset in FY22</li> </ul>
Transportation	 <b>100%</b>	<ul style="list-style-type: none"> <li>• Published a Low-Emission Vehicle Guide to support vehicle purchasers in transition to electric vehicles</li> <li>• Penn Transit added 4 electric passenger vans to fleet</li> </ul>
Outreach & Engagement	 <b>87%</b>	<ul style="list-style-type: none"> <li>• Climate Week and Earth Week established as major annual event series</li> <li>• Green labs conducted a ULT Freezer Inventory to assess energy saving opportunities in labs</li> </ul>

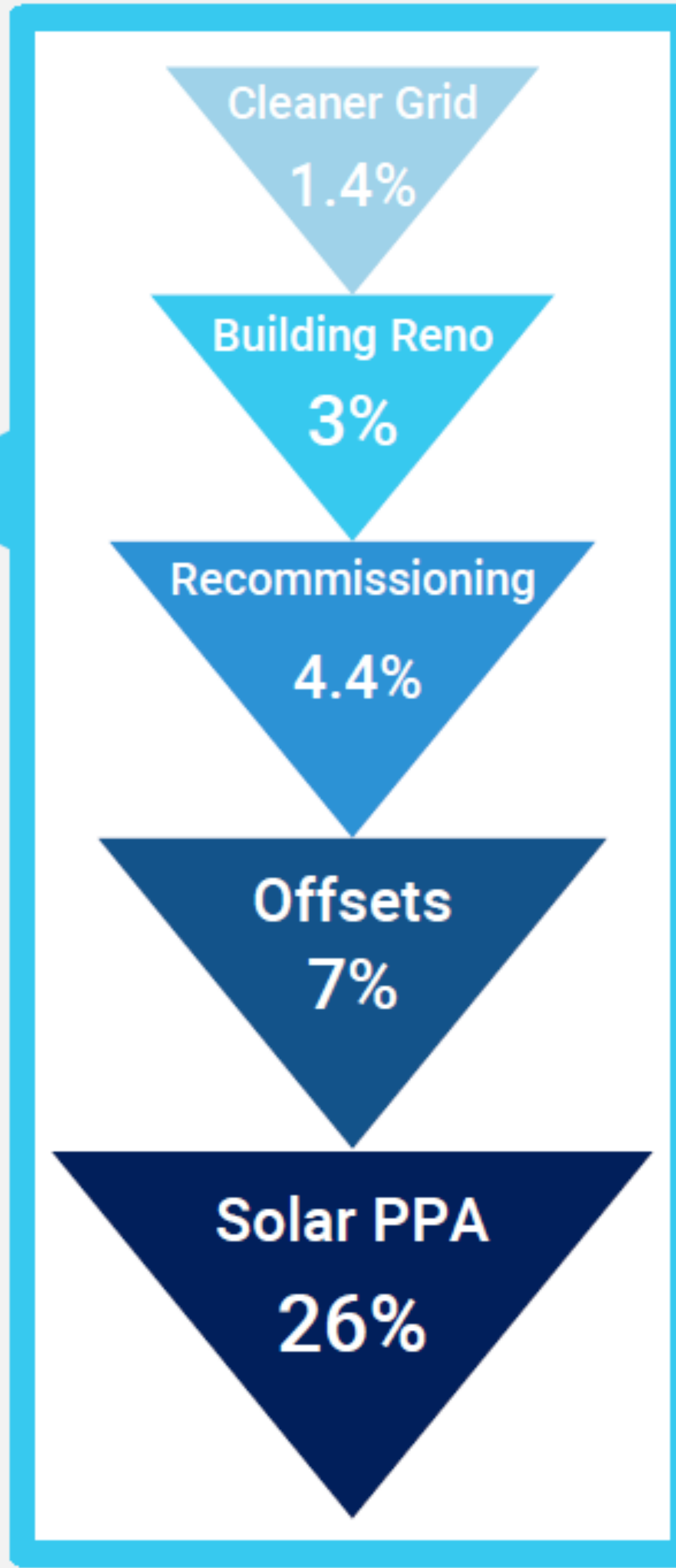


# Penn Climate Goal: Carbon Neutral by 2042

Total carbon emissions **reduced by 45% in FY22** compared to FY09 baseline



## Planned Reductions by 2024





# Appendix Slides



# Reducing MIT's Climate Impact: 14 Campus Commitments

A. Climate Footprint Working Group 2050

B. Net-Zero 2026

C. Net-Zero Direct Emissions 2050

D. Climate Resiliency & Adaptation

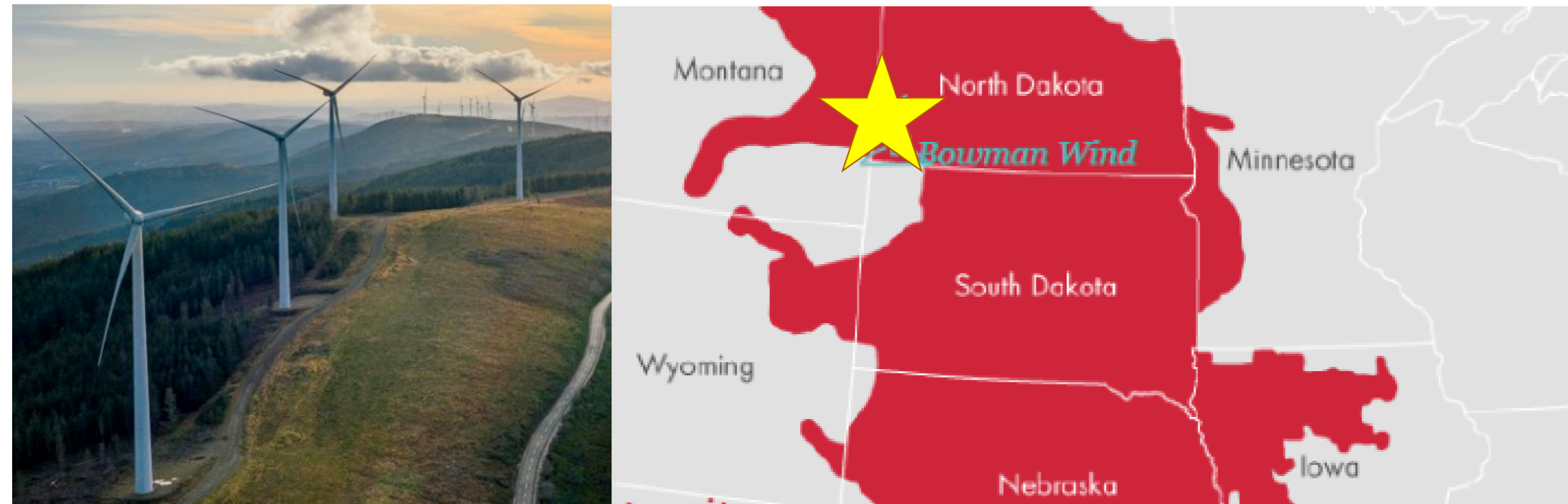
E. Campus as Test Bed

1. Net-Zero by 2026
2. Zero by 2050
3. Increase the capacity of solar energy installations on campus by a minimum of 400% (from 100kw to 500kw) by 2026
4. Employ artificial intelligence to reduce on-campus energy consumption
5. Develop a Climate Adaptation and Resiliency Roadmap
6. Develop and publish in 2022 a carbon offset strategy for MIT-sponsored travel
7. All future MIT fleet purchases of light-duty vehicles will be zero emission, subject only to availability.
8. Convert shuttle bus vehicles to zero-emission buses by 2026.
9. Increase campus car-charging stations by a minimum of 200% (from 120 to 360) by 2026.
10. Expand MIT greenhouse gas portfolio accounting to include priority Scope 3 emissions (e.g., sponsored MIT travel, commuting) by 2023
11. Expand greenhouse gas portfolio accounting to include off-campus locations—such as Bates Research and Engineering Center, Haystack Observatory, and Endicott House facilities—by 2026
12. All DLCs will prepare and implement their own carbon footprint reduction and sustainability plans FY23
13. Establish and publish in 2022 a quantitative set of food, water, and waste systems impact goals that inform and advance MIT's commitment to climate
14. Establish a Carbon Footprint Working Group



# Getting to net-zero by 2026

## **BOWMAN WIND** project in North Dakota



- Operational in calendar year 2025
- Generates 875,000 megawatt hours of power per year
- MIT to contract for 21% of the power generated or 185,000 megawatt hours per year
- 40% contribution to MIT 2026 net-zero target
- Annual gross liability (nominal) of approximately \$7 million, with estimated net cost of \$4 million (see exhibit on slide 5)
- Cambridge emissions penalty avoidance estimated at \$20 million per year effective 2030

## **BIG ELM SOLAR** project in Texas



- Operational in calendar year 2024
- Generates 515,000 megawatt hours of power per year
- MIT to contract for 15% of the power generated or 77,000 megawatt hours per year
- 15% contribution to MIT 2026 net-zero target
- Annual gross liability (nominal) of approximately \$4 million, with estimated annual net cost of \$1.5 million (see exhibit on slide 7)
- Cambridge emissions penalty avoidance estimated at \$10 million per year effective 2030
- MITIMCo also to contract for 15% of the power generated to apply to directly-owned commercial real estate investment portfolio.



# A goal of eliminating direct emissions by 2050

... depends on a decarbonized electrical grid, with adequate capacity, and advances in carbon-reducing technologies

- **Continuing to expand the scope of our carbon reduction tasks on campus** beyond the work we've been doing to date, from energy retrofits to our electric vehicle infrastructure, to increasing our rooftop solar installations.
- **Planning for the next energy era on our campus** – actively collaborating with faculty, students, industry experts, peer institutions, and the Cities of Cambridge and Boston. Together, we are evaluating various strategies, scenarios, policies, opportunities, constraints and technologies to get us to our 2050 goal.
- **Evaluating new technologies and strategies** for the next generation of our district energy system, including:
  - electrification of heating: electric steam boilers, industrial-scale heat pumps
  - energy storage, micro-reactors, and geothermal exchange
  - bio-based renewable fuels, green hydrogen produced from renewable energy
- **Taking steps to articulate 'what it will take'** while taking into account the technical and operational resiliency considerations needed to evolve our district energy system
  - the new-energy era blueprint for our campus.

