Leveraging the campus as a test bed for sustainability: Catalyzing innovation, Imagination, and Impact.





Lecturer, Dept. Urban Studies and Planning

cmpus climite ction



"I've heard an intense desire to see the people of MIT come together, in meaningful ways, to meet all the great challenges of our time. Above all, and most urgently: to marshal a bold, tenacious response to the run-away crisis of climate change."

-Sally Kornbluth, MIT President

A city within a city

Planning for today and next 100 years

168 acres190 buildings

43,000 spaces

13 million square feet

14,508 offices
5,551 labs
1,319 restrooms
528 classrooms

4,657 undergrads
7,201 graduates
1,080 faculty
15,247 staff

40 MW power plant 17 miles of utilities 400 active projects 70,000 work orders / yr.



Strategic sustainability leadership

campus climate action



Strategic Sustainability Leadership

Inquiry & design via burning questions

Work from common scientific models
 Plan across scales
 Foster city-university partnerships
 Lead through collaboration & accountability
 Leverage campus as test bed
 Center equity and justice
 Implement solutions



Inquiry & design via driving questions

What is the organizational structure and behavior that is responsive to, alters, informs, and influences the climate trajectory we are on?



1. Work from common scientific models



Biobieway, 2023, 0, 1–13 https://ini.org/10.125/bioart/Mini.200 Advance access publication dates 0.2023 Special Report

The 2023 state of the climate report: Entering uncharted territory

William I. Riggle, Christopher Wall 😟 Ellian W. Gogg, Johan Rocinteire, Thomas M. Newsone, Reverly E. Law, Luiz Marquez, — Timothy M. Lawton, Chi Ru, Saleenul Han, Leon Simons and Sir David Anthony Ring

2 | BioScienze, 2023, Vol. 0, No. 0



Types 1. Unusual chronic internation in 2022 (the red line, which appears held in print, Sea tor-count in, b), interparatures (y-4), and area borned in Canada §) or presently for sound-which internet integes. These anomalies may be due to both chronic intege and other factors. Sources and solutions all denies should not provided an applemental (b) \$3. Both law commpanies to a clifformit year, with denies gay representing later years.

Energy

(are supplemental file 5) for an accorded discussion). The auddate rate is temperatures a also sharp contributed to by the enset of an 11 Man werm--- maximally occurring gast of the climate system, which could, fixed. be affected by discuss change (Tai et al. 2029) in any case, as Samthi climate system trantitions away from conditions suscission study through the system merallular may become more frequent and could have increasingly catastrophic impacts (2) et al. 2020, Lenson et al. 2024)

Recent trends in planetary vital signs

On the basis of time certis dars, 20 of the 35 wind spins are now showing record anternay (quarks 2 and 5, supplementa, table 50). As we obscribe balow, these data show how the certainsad pursuit, of business as usual has, instituted to uppercodented pressure on the faith system, resulting or many climate-soluted sumables suffaring understatistic lamitory (ligures 1 and 3). It appears the green recovery following COVID-15 that many had hoped for has largely failed to materialize (Zhang et al. 2023). Instead, carbon emissions have continued soaring, and forsil fuels remain dominant, with annual coal consumption reaching a near all-time high of 161.5 ess(culas in 2022 (ligure 2h). Although the consumption of renewable energy (solar and wind) grew a robust. 17% between 2021 and 2022, it remains mughly 15 times lower than local fuel energy consumption (ligure 2h). A major driver of scontinut and energy transfe is Bussia's origoing invasion of Elizable which has accelerated the transition to renewables in Europe but which may also cause some countries to earthh from Russian-supplied gas to coal (Dillelson 2022) Already this conflict has contributed to a massive 107% increase in focal fuel cubsidies from US\$531 billion in 2021 to US\$3052 billion in 2022 because of rising energy prices (figure 2n). Although these subsidies may partially protect consumers from price increases, they are often not. well targeted and help to promote fossil fuel related energy use and profits over low carbox alternatives (Muta and Erdogan 2023).

The Nine Planetary Boundaries



Source: Stockholm Resilience Centre.

Entering uncharted territory: 2023 anomalies across the Earth System compared to 2000-2020.

Source: Bioscience, 2023

MIT Office of Sustainability

10

2. Plan across scales

Scales of Impact





llii T

Planning across scales: Oxford

Oxford University: Net Zero by 2035 City of Oxford: Net Zero Carbon by 2040 England: Net Zero by 2050 Global: Net Zero by 2050

> campus climate action

YOU

3. Foster & strengthen university-city-community partnerships

Climate Community Collaborative





4. Activate the campus as test bed

How do we solve for sustainability at MIT?





Could MIT's buildings become just as "smart" as the people who work in them?

CONNECTING THE DOTS:

USING MIT'S CAMPUS AS A "TEST BED" FOR SUSTAINABILITY



campus climate action

If you have a "smart" thermostat in your home, you know how they work to keep your surroundings comfortable and efficient. But what if your house was really big? Say... 13.9 million square feet?

Discover how an Al algorithm pilot is using data from campus spaces to help MIT reduce consumption, increase efficiency, and move closer to decarbonization.







Resilience to extreme weather events

Main St

liver

Ken Stryzpek, Researcher, EAPS



Katya Boukin,'24 PhD student, CEE Incorporating flood-resilient design in all new construction projects Advancing campus flood models Evaluating campus systems and locations most vulnerable to flooding and prioritizing protection measures

> campus climate

CAMBI

Chartes River

Climate Resiliency & Adaptation: Basement Flood Risk Model







campus climate action

5. Lead through collaboration & accountabiilty

Reducing MIT's Climate Impact

Distributed Leadership







TEAM MEMBERS

22

Fast Forward Workstream status update: Climate Mitigation + Resiliency & GHG scope

expansion

General					Program			Traits				
Commitment Name	Status	Recent Accomplishments	Next Steps	Discovery	teplamentation	Deliverable	2022	2023	2024	2025	2026+	
1. Zero Emissions Plan by 2050		AEUALE completed 20 Lavel 1 ASHRAE energy audits and inviewed the Lavel 2 audits for compute wide analysis MEUID analysis with imspect to buildings attached to the CLIP - ongoing Begioning is scient technologies for Decarb Swategies	Workshop for framework for decorbonization Financial modeling for baseline or reference case	0	Θ	Θ					2050>>	
2. Building Efficiency		Bitlig -66 is approx. 90% complete including: Room level ECM implementation on all fours 1-7, epidement restent ECMs (VPDs, favore cols, cross-connect, steam Vapis, etc.), and BMS Transition.	Completion of Bidg, 46: Building lower ECM implementation (path: proteate stat, etc.) targeting and of January wind start of MAX period */76 Construction Phate Eurolog approval E26: Design & construction funding approval	Θ	0	Θ					2030	
3. Resilience & Adaptation Roadmap		Completion of Dest Readmap Collection of 100 new spot deviation data points for Darkfreethymor Coartyact Completion of data realism landscape planning tool	Launch of Stormwater vS.D.model Visualization of campus heat this Techngs	Θ	Θ	Θ						
4, Restrop Soler		Design/Build contract approval W20 roal construction complete Design funding approved	 January: Solenit contracts January: Submit Evensource tetesconnection Agebranet - Well, WHY ESS W20 February - March 2021; Design for 4 soler installations March / Agel 2021; Construction functing requests Winter Tipring 2022; Construction for costing mitaliations Spring / Sommer 2022; PV Installation - W46, ESS, W87 	0	Θ	O					non	
5. Net Zero 2020		Completed regolations and executed contract for 208WW Bowman Wind poject in ND, NT failing 23%, Construction started on 200MW Big Elm solar project.	Coordinated press release and correspondences and an of PPA accomplutioned and heroire poppers - 02 FY24 Initiation of additional PPA project processment process - 03 FY24	0	Θ	0					2020	
6. Al to Reduce Energy Use		Improvements inside to muchine learning platform Pliot testing expanded to additional revens and types of spaces on cause, in collaboration with MIT tabilities and tability remarkement systems wonder	Completion of initial version of machine learning platform Expansion of plot testing on camples	Θ	Θ	Θ					2090	

Fast Forward: Climate Action Plan Winner 2024 Overview January 54, 2004

Category: GHG Scope Expansion

Cat

General				Tatudate							
Commitment Name	Status	Recent Accomplishments	Next Steps	Discovery	Implementation	Deliverable	2022	2023	2024	2025	2026+
7. Travel Offset		Socialized program with Elizabeth Lennox, ADeans, and with AACE Ormate Value catalog live for plat pertoports in Cospa	Communicate program to facility/f in plot areas	0	0	Θ					
8. Add in Scope 3 Emissions		Completed update of business travel dashbood travelyh FY 2003 Established agreement with Audit Division for comulting on data and reporting processes.	Deployment of new back-end data processing systems Socialization of GHS impact hern Centruction, Partilisated Goods + Services, Community	Θ	0	0					
Add in Off Campus Emissions		Completed energy data collection from Bases. Wallacs-Maystacc, Endicot Insure facilities for FY2021 Calculated equivalent GHG emissions for each site	Will publish additional emissions in our FY2023 GHG reporting in Q3 FY24 Will instructionalize data collection and reporting processes in Q2 and Q4 FY24	Θ	0	0					



<u>z</u>mpus limate

ction

Staff / Faculty research teams



Technology	Description (working version)	Faculty / Staff point of				
1 Building Baseline Model	Build an hourly load profile model for MIT campus buildings and apply a series of off-the-shelf retrofits to predict future load profiles for electricity, heating and cooling. The other technology packages will be evaluated based on these evolving load profiles.	contacts Christoph Reinhart / Siobhan Carr/ Steve Lanou/				
2 District Geothermal	A review of how the existing campus district energy system can be electrified and evolve over time to meet evolving load profiles [1].	Pablo Martinez / Carlo Fanone				
3 Avoided Costs	Quantify costs that would occur to MIT from inaction such as a carbon tax or reputational costs.	Siqi Zheng / Steve Lanou				
4 Future grid emissions and capacity; Resiliency	Predict how the New England grid might decarbonize between now and 2050 and what excess capacity the grid might have during key times in the year based on [2].	Andy Sun / Jon Sepich				
5 High resolution building controls (AI)	Survey of next generation sensor, actuator and control technologies for room-level HVAC control. Quantify savings based on [3].	Joe Paradiso / Wade Burner				
6 Energy efficient lab	Identify safe transition pathways to reduce operational energy use in MIT lab based on [3].	Brad Olsen / Jim Doughty				
7 Deep geothermal	In this activity we will investigate the readiness of deep geothermal wells [>5,000ft] for heating and electricity generation based on [2].	Christoph Reinhart / Joe Higgins				
8 Micro-reactors	Evaluate emerging small (5-20MW) nuclear reactor technologies and adoption potential by MIT based on [3]	Jacopo Buongiorno / Janine Helwig				
9 Energy storage including EV and PV	Study potential use of large electric and thermal storage for campus resiliency based on [2].	Jessika Trancik / Randa Ghattas				
10 Local carbon capture	Evaluate various carbon capture opportunities that could be deployed on or near the MIT campus to balance residue on campus emissions.	Betar Galant / Jessica Parks				

6. Center Equity and Justice

Reducing MIT's Own Climate Impacts, Advancing Justice

How can MIT reduce its carbon emissions while promoting equity, benefiting local economies and communities, and improving public health?

- Net-zero by 2026
- Zero direct emissions by 2050
- Zero emissions campus vehicles
- Reduce food, water, & waste impacts

- + Wealth generation opportunities
- + Community climate resilience
- + Workforce dev't
- + Healthy people & ecosystems
- + Food security
- + Environmental justice

campus climate action² 6

Justice

Carbor



7. Implementation

campus climate action

18 Climate and sustainability commitments in action

zctio

r Dreams®

Strategic Sustainability Leadership









Strategic Sustainability Leadership

Inquiry & design via burning questions

Work from common scientific models
 Plan across scales
 Foster city-university partnerships
 Lead through collaboration & accountability
 Leverage campus as test bed
 Center equity and justice
 Implement solutions



© J. Newman PhD, MIT. 2024, do not copy without permission



On the horizon: A call for collaborative climate leadership models

campus climate action

Collaborative disciplinary structures: *Generalists bridging specialists?*

campus climate

action





Collaborative Climate Leadership

ACADEMIC LEADERSHIP ROLE

Research & teaching missions Global scale application, impact and accelerated solution development Research platform oversight

INETGRATOR ROLE

State/Fed liaison on climate Climate regs/IRA funding/higher ed coor Higher education leadership Test bed – campus/community Industry/Campus sustainability liaison Alumni engagement

ADMINISTRATIVE OPERATIONS & INFRASTRUCTURE ROLE

Office of Sustainability Decarbonization of the campus City Compliance EHS/Utilities/Cap. Construction/Facilities/Repair Maintenance/Grounds

> сятриs climяte яction

© J. Newman PhD, MIT. 2024, do not copy without permission