



Integrating a Feedback Loop for Sustainability Solutions

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MIT / Office of Sustainability

Guiding questions

How can your research questions and outcomes better inform and be informed by embedded decision-makers and implementers to advance and solve for sustainability?

What methodology can be used that meets the needs of the researchers and implementers?

How might your research de-risk early adoption for campus scale use?

How can MIT be a game changing force for campus sustainability in the 21st century?

MITOS MISSION

We aim to transform MIT
into a powerful model that generates
new and proven ways of responding to the
unprecedented challenges of a changing planet
via operational excellence, education, research
and innovation on our campus.



Office of
Sustainability

AREAS OF RESPONSIBILITY

sustainable campus systems

Reimagining systems on campus and engaging the MIT community to advance the well-being and resilience of people and the environment

urban living laboratory

Infusing living laboratory education and research across campus

leadership & capacity building

Building the internal capacity of the campus community to problem solve, lead, and meet our sustainability objectives.

collaborative partnerships

Harnessing the collective intelligence of communities to solve shared problems



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Sustainability

SCALES OF IMPACT



We start with you to find solutions at the campus level to serve both the institution's needs as well as to incubate new and big ideas.

Seeking solutions to common challenges with the cities of Cambridge, Boston and beyond. We recognize and the deep interconnectivity between our urban campus and the city and seek to operate at both scales

Making structures, processes, and solutions developed at MIT accessible for reapplication and scaling across the globe.



SCALES OF IMPACT



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Our Framework



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HOW WE WORK



MITOS inspires and enables the continuous generation of breakthrough sustainability solutions to transform our campus, city and globe.

By collaborating with our neighbors in Cambridge and Boston and internationally...

we enable the continuous generation of breakthrough sustainability solutions for today and tomorrow.



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What is a living & learning lab for sustainability?

MIT LIVING & LEARNING LAB FOR SUSTAINABILITY

At MIT, the Living & Learning Lab refers to **rigorous campus-based research** with operational & academic partners, sustained data collection/analysis, with measureable and communicable outcomes that seek to:

Innovate

Innovation for Sustainable Cities



Innovation implementation
Research project

Improve

Advancing MIT's Sustainability and Climate Goals

Campus projects
Research project
Competitions

Accelerate

Accelerating Scaleable Solutions and Learning



Course modules
Course focus
Research project



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MIT LIVING& LEARNING LABORATORY: PROGRAM FRAMEWORK

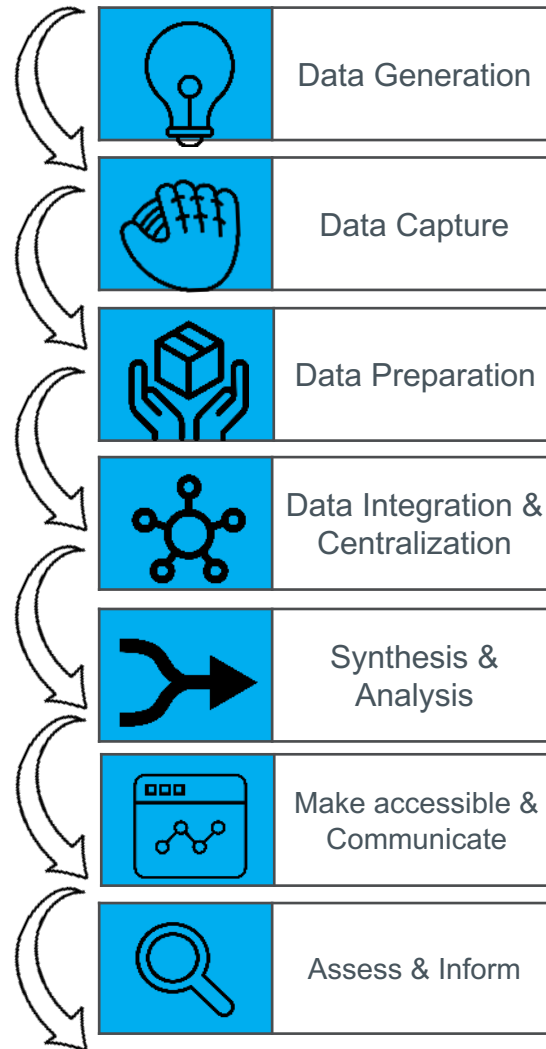
- 1) **Data & Metrics**
- 2) **Framing campus based research**
- 3) **Course driven analysis**
- 4) **Cataloguing & accessing outcomes**

MIT LIVING& LEARNING LABORATORY: PROGRAM FRAMEWORK

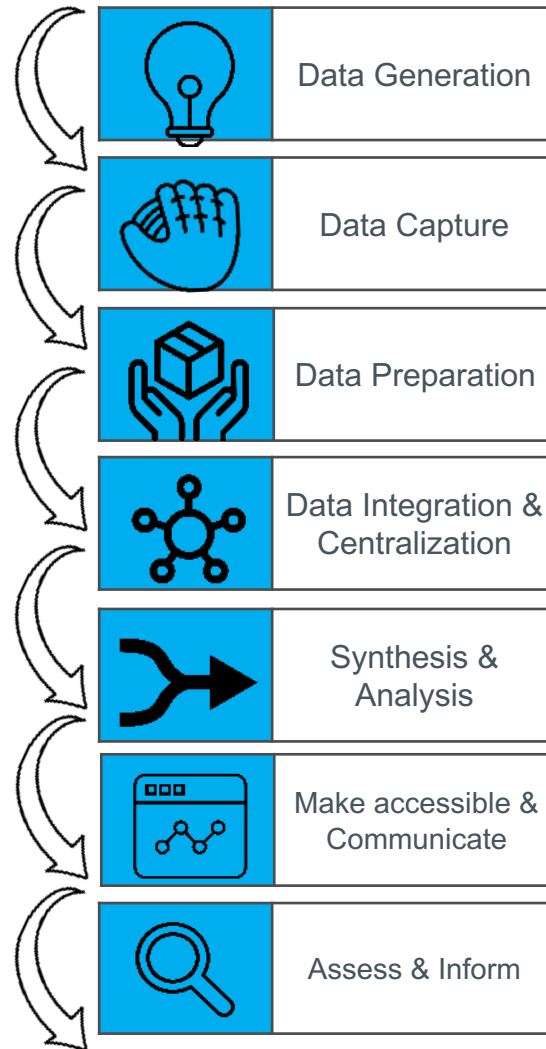
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Data & Metrics

A thriving campus data practice supports the Living Lab model...




...but it is complex and requires interdisciplinary and multi-department collaboration




...and accessible real time data.

[Welcome](#)[About](#)[Energy System Overview](#)[Energy and GHG Campus Totals](#)[Building-Level Metrics](#)[Building-Level Utilities](#)[Pi Metering Data](#)[Data Access](#)[Data Source Details](#)

**Massachusetts
Institute of
Technology**

Energize_MIT(BETA) is an open energy data platform that provides access to information on campus energy usage, greenhouse gas emissions, buildings, and weather. It is intended to serve as an iterative and evolving one-stop-shop for campus energy exploration, analysis, and research. The platform advances the commitment called for in MIT's Plan For Climate Action to establish an energy data resource that supports research, innovation, and intelligent decision-making.

 Help us improve!
Take the quick survey.

Contact: energize_mit@mit.edu

Data@MIT
powered by DataHub



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Framing Campus Based Research:

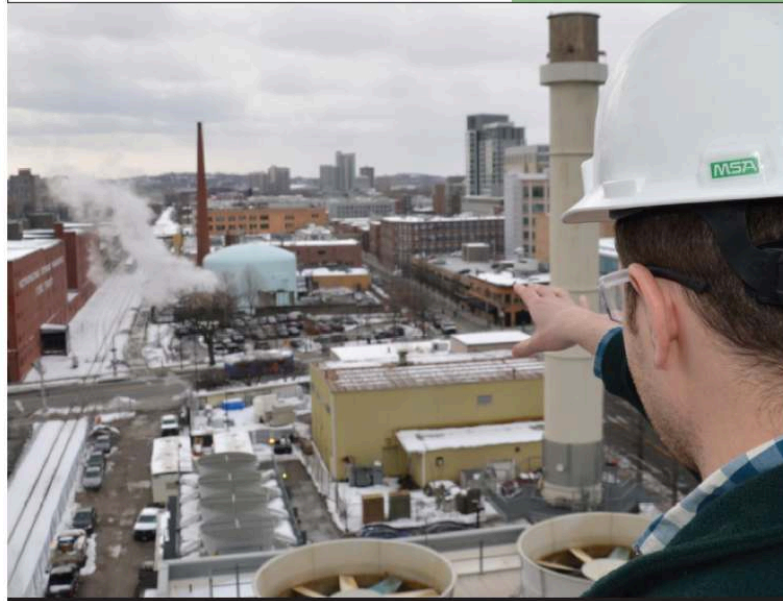
- 1) **Campus to marketplace**
- 2) **Global to Campus**
- 3) **Macro to Micro**

Framing Campus Based Research:

- 1) Campus to marketplace
- 2) Global to Campus
- 3) Macro to Micro

LIVING LAB Learning Adventure
Water Savings in Cooling Towers

FACIL
LOW CARBON CAMPUS



RESEARCH PROBLEM

U.S. power plants use an average of 139 billion gallons of freshwater per day. How can the amount of water required be reduced without sacrificing efficiency?

SOLUTION

Serious water efficiency enhancements, that do not sacrifice fuel efficiency, have to be introduced to power plants in order to meet our growing energy demand.



LIVING LAB Learning Adventure
Waters Savings in Cooling Towers

FACIL
LOW CARBON CAMPUS



Leading Players:

Mahe Damak, Karin Khalil,
Kripa Varanasi

Supporting Players:

Central Utilities Plant
Engineers: Seth Kinderman,
Patrick Karalekas, The Office
of Sustainability

The Story

At the Varanasi Group at MIT, we have developed a technology to reduce water losses due to evaporation in power generation. The process, requires little maintenance, reintroduces water back into the cooling cycle and reduces the water treatment needs of power plants. This technology can work in any type of thermoelectric power plant, including coal, gas, nuclear, concentrated solar, and geothermal.

This team of researchers have won several awards for their work, including second place in the \$100K Pitch competition, the audience choice (3k) at the 100k accelerate competition, and the Clean Energy Prize (50k).

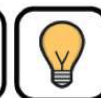
Contact: Mahe Damak @ mdamak@mit.edu, Karin Khalil @ Kkhalil@mit.edu



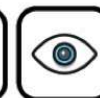
Award



Exhibit



Invention



Public

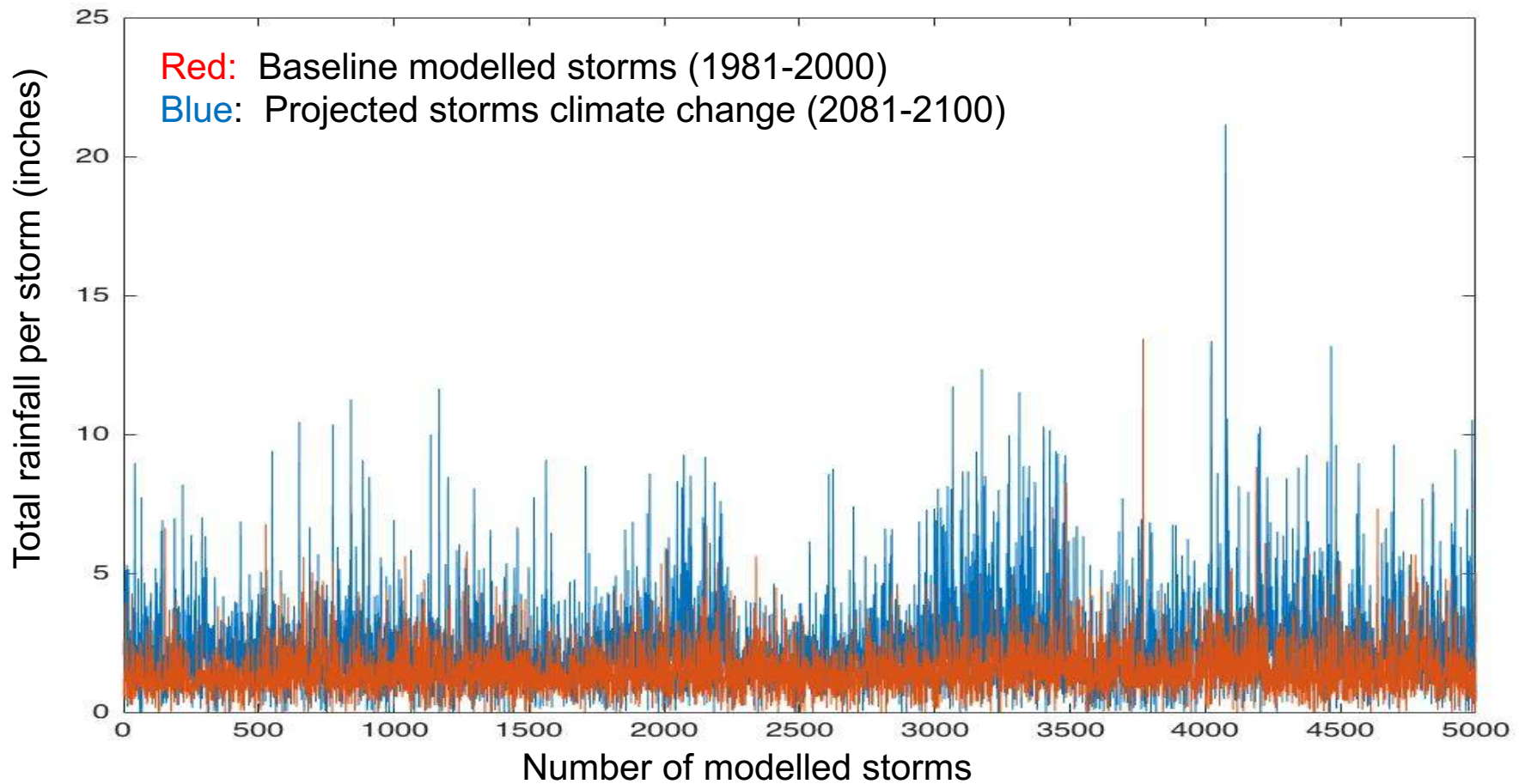


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Framing Campus Based Research:

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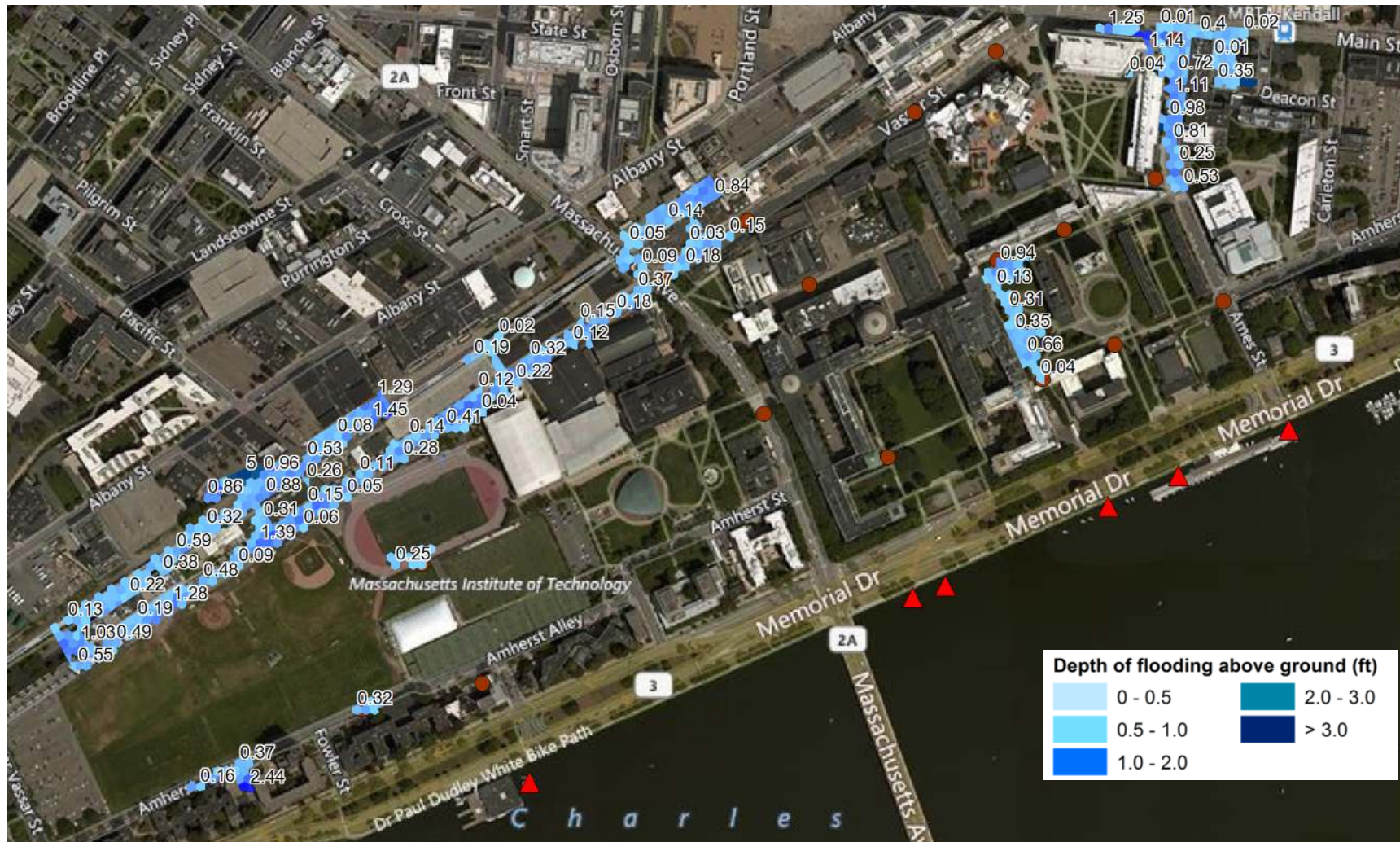
Modelling of Future Cambridge Precipitation Totals (24 hour storms)



Source: Dr. Ken Strzepek (preliminary findings, 2017)

Precipitation Scenario

1% probability TODAY of 8.9" rain in 24 hrs ... there is more modeling work to do.



Flood risks - lowest campus elevations along Vassar, Albany and Main St.

Framing Campus Based Research:

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EXCEPTIONAL CARE. WITHOUT EXCEPTION.

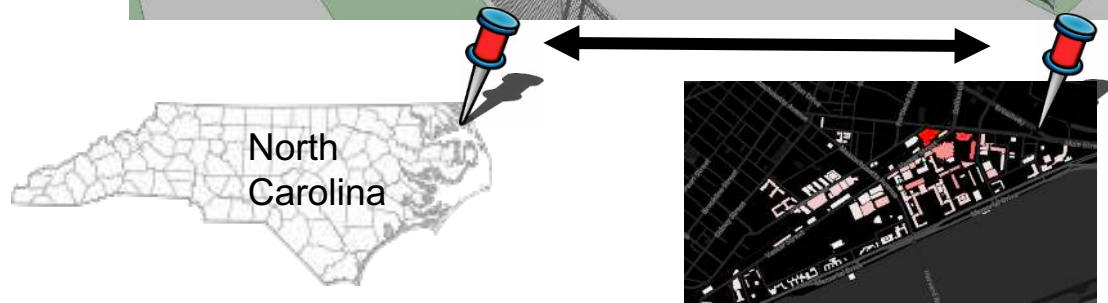
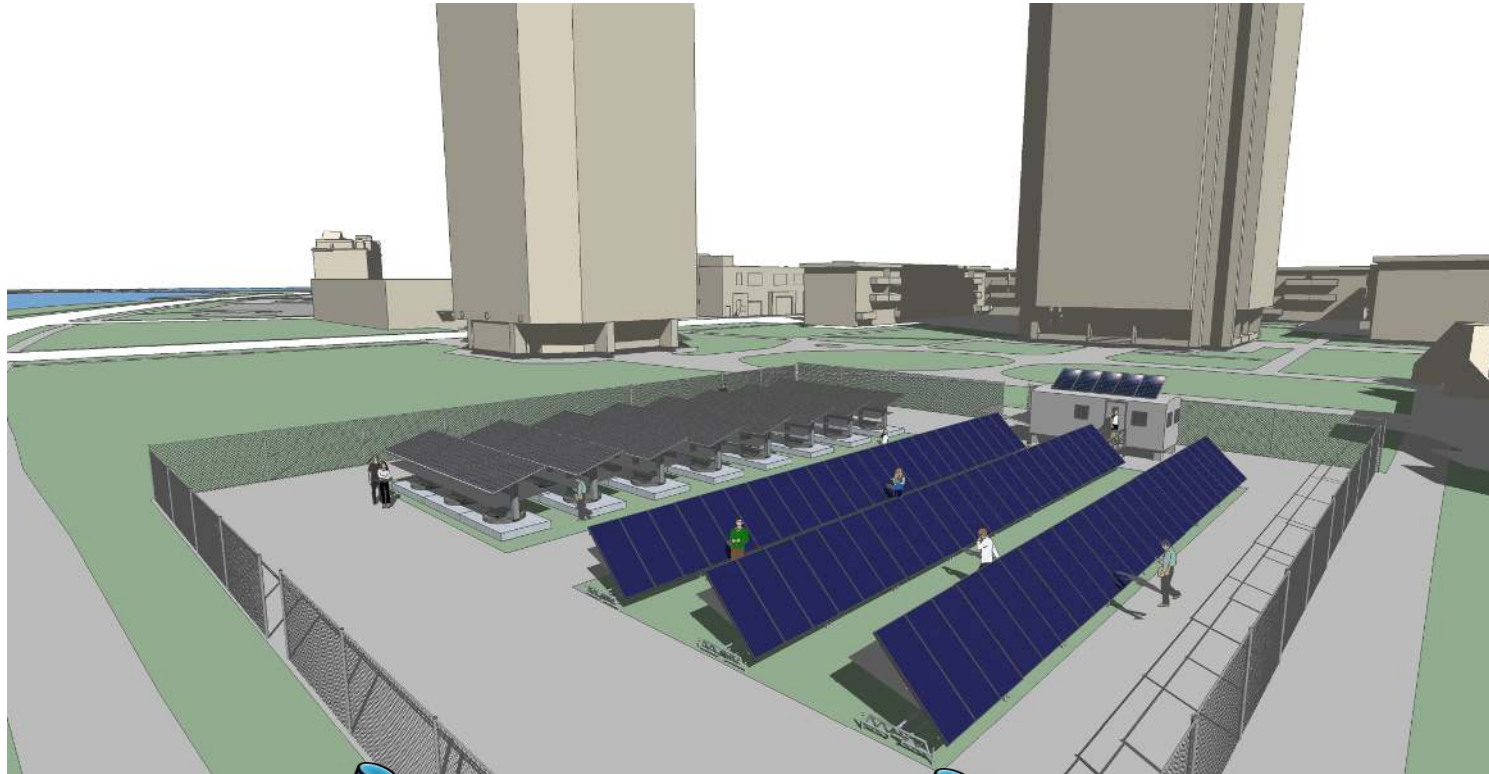


60 Megawatts
650 Acres
255,000 Panels



North
Carolina

Proposed: MIT Solar Test Bed



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Course development

MIT OFFICE OF SUSTAINABILITY



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Sustainability

Spring 2018: Solving for Carbon Neutrality at MIT



Cataloging & accessing outcomes

MIT SUSTAINABILITY DATADRIVE

DataDrive provides access to quantitative information on campus sustainability operations at MIT. It is an evolving one-stop-shop supporting sustainability data access, informed decision-making, and living laboratory research.

VISUALIZATIONS

Flip through curated data visualizations on topics like campus greenhouse gas emissions, building energy use, waste, and mobility.

DATA LIBRARY

Find campus sustainability datasets to use MIT as a test bed for analysis and innovation

LIVING LAB LIBRARY

Discover past and present living laboratory projects to learn and find inspiration

PARTNERS

managed by **The Office of Sustainability**

powered by **DataHub**



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FILTER LABS

[CLEAR ALL](#)

INITIATIVE TYPES



- ☐ Low Carbon Campus
- ☐ Resilient Ecosystems
- ☐ Material Lifecycles
- ☐ Healthy People
- ☐ Thriving Networks

SUSTAINABILITY TOPICS



[mit](#) [cambridge](#) [skin](#) [energy](#) [music](#)
[tactile composition](#) [campus](#) [city](#) [data](#)
[touch](#) [body](#) [project](#) [fume hoods](#)
[time](#) [biodiesel](#) [research](#) [lab](#) [water](#)
[system](#) [sustainability](#)

OUTCOMES



- ☐ Avoided GHG
- ☐ Award
- ☐ Behavior Change
- ☐ Book
- ☐ Community Resource

Bubble size determined by outcome score

CUSTOMIZE



What are Living Labs?

At MIT a Living Lab refers to rigorous, campus-based research. All living labs include specific attributes such as diverse operational and academic partners, sustained data collection, formal and informal learning activities and measurable outcomes.

FILTER LABS

[CLEAR ALL](#)

Bars size determined by outcome score

CUSTOMIZE

INITIATIVE TYPES



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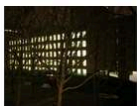











OUTCOMES



- ☐ Avoided GHG
- ☐ Award
- ☐ Behavior Change
- ☐ Book
- ☐ Community Resource

ESTABLISHED



LAB	OUTCOMES	OUTCOME SCORE	EST.	DURATION
 Chemical Fume Hoods Building 18		100 <div><div></div></div>	2008	 4yr completed
 Bates Wind Turbine		100 <div><div></div></div>	2006	 9yr completed
 Glove Recycling		86 <div><div></div></div>	2016	 1yr ongoing
 Solar Farm (Off Campus)		82 <div><div></div></div>	2016	 1yr ongoing
 Biodiesel Fuel Processor		82 <div><div></div></div>	2005	 7yr completed
 Energy Efficiency in Building 18		76 <div><div></div></div>	2006	 2yr completed
 ClimateX Hive Project		74 <div><div></div></div>	2016	 1yr ongoing
 OpenAg		70 <div><div></div></div>	2012	 5yr ongoing
 Real Time Energy Monitoring		68 <div><div></div></div>	2017	 8mo ongoing

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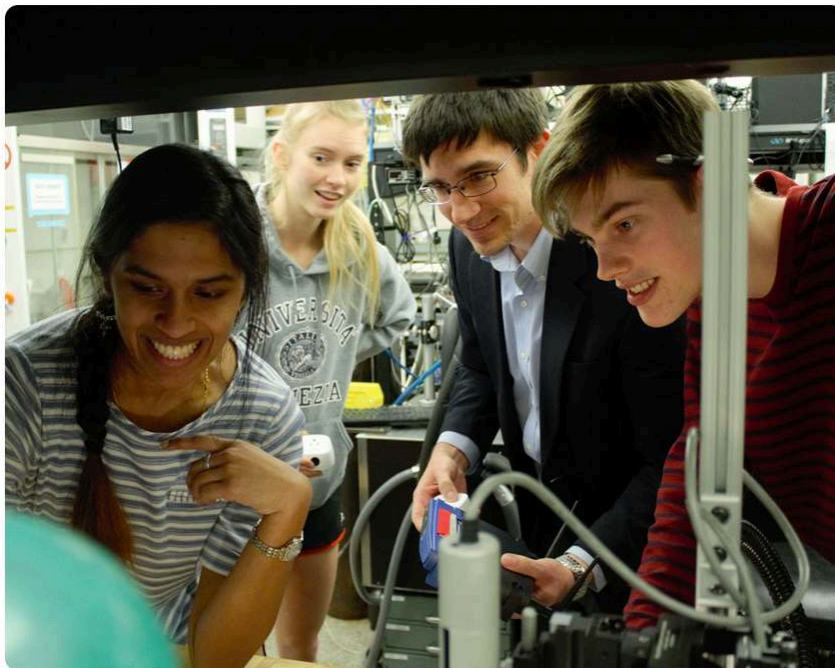
Real Time Energy Monitoring

VIEW DOCUMENT

SAVE AS .PDF

RESEARCH PROBLEM

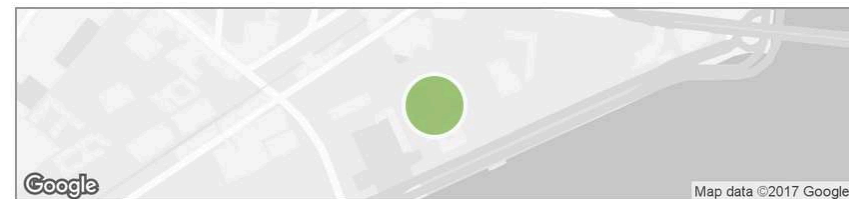
How can research labs maximize the two pillars of sustainability: renewable energy and energy efficiency?



THE STORY

In an effort to monitor lab-wide energy consumption, the researchers in the Wang Lab deployed a network of wireless energy monitors called Wemos that plug in-line with lab devices and broadcast power use data to a computer which is recording and processing data. Devices that do not plug in to walls, such as

[Show more](#)



PLAYERS

Daniel Preston, Ariel S. Anders, Evelyn N. Wang

OUTCOME SCORE

68

high outcome score

OUTCOMES



behavior change, award, exhibit presentation, internship, public presentation, money, invention, feasibility pilot, new technology

DURATION



8mo ongoing



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MIT LIVING& LEARNING LABORATORY: PROGRAM FRAMEWORK

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Our Framework



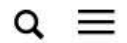
SCALES OF IMPACT



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Resource Library

Living Labs

Data & Metrics

Certifications

News

Events

About Us

GIVE

Low-Carbon
Campus

Resilient
Ecosystems

Material
Lifecycles

Healthy
People

Thriving
Networks

START

STUDY

SOLVE

Solving global sustainability issues at a local level

By utilizing the campus as a testbed and incubator, we aim to transform MIT into a powerful model that generates new and proven ways of responding to the challenges of our changing planet.

<https://sustainability.mit.edu/>

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