CY20 SUSTAINABILITY REPORT
Harvard Medical School

HARVARD UNIVERSITY | Sustainability

HARVARD MEDICAL SCHOOL

HARVARD UNIVERSITY SUSTAINABILITY PLAN

- Water Conservation Measures
- Green Lab Certification
- Healthier Building Materials - Countway
- Waste Management

- Healthy and Sustainable Meeting Guide

- Strategic Energy Plan updates
- Energy Conservation Measures
- NRB Solar Array
- BERDO & GHG reporting Analysis

- Countway Community Garden

- Lighting Fairs
- Student Outreach

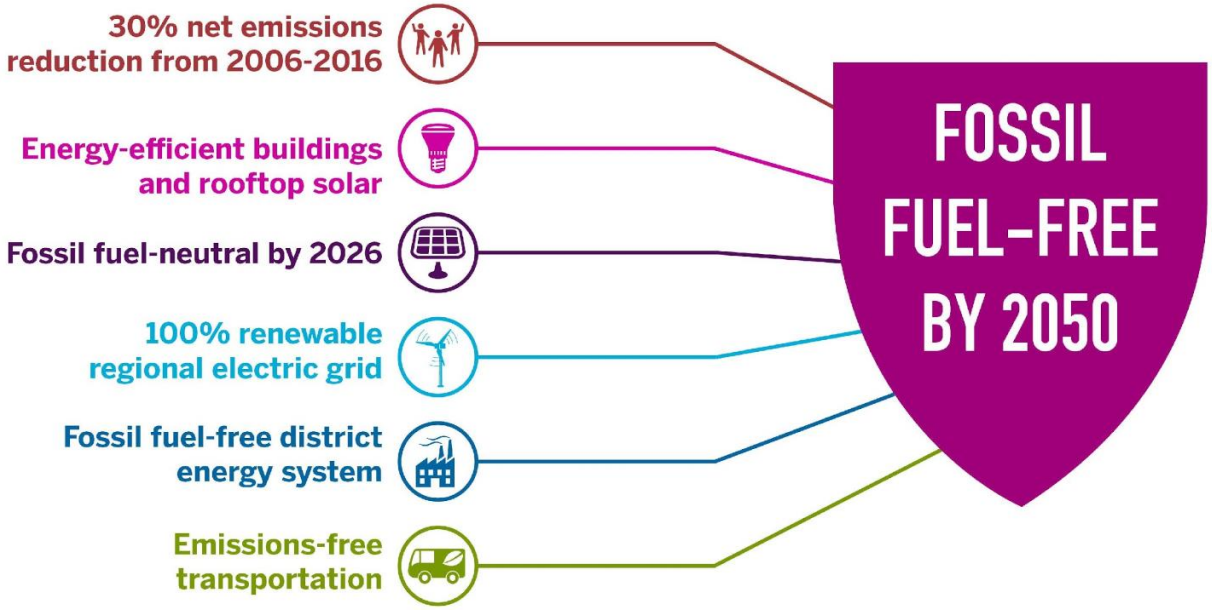
HARVARD'S CLIMATE ACTION PLAN:

FOSSIL FUEL–FREE BY 2050

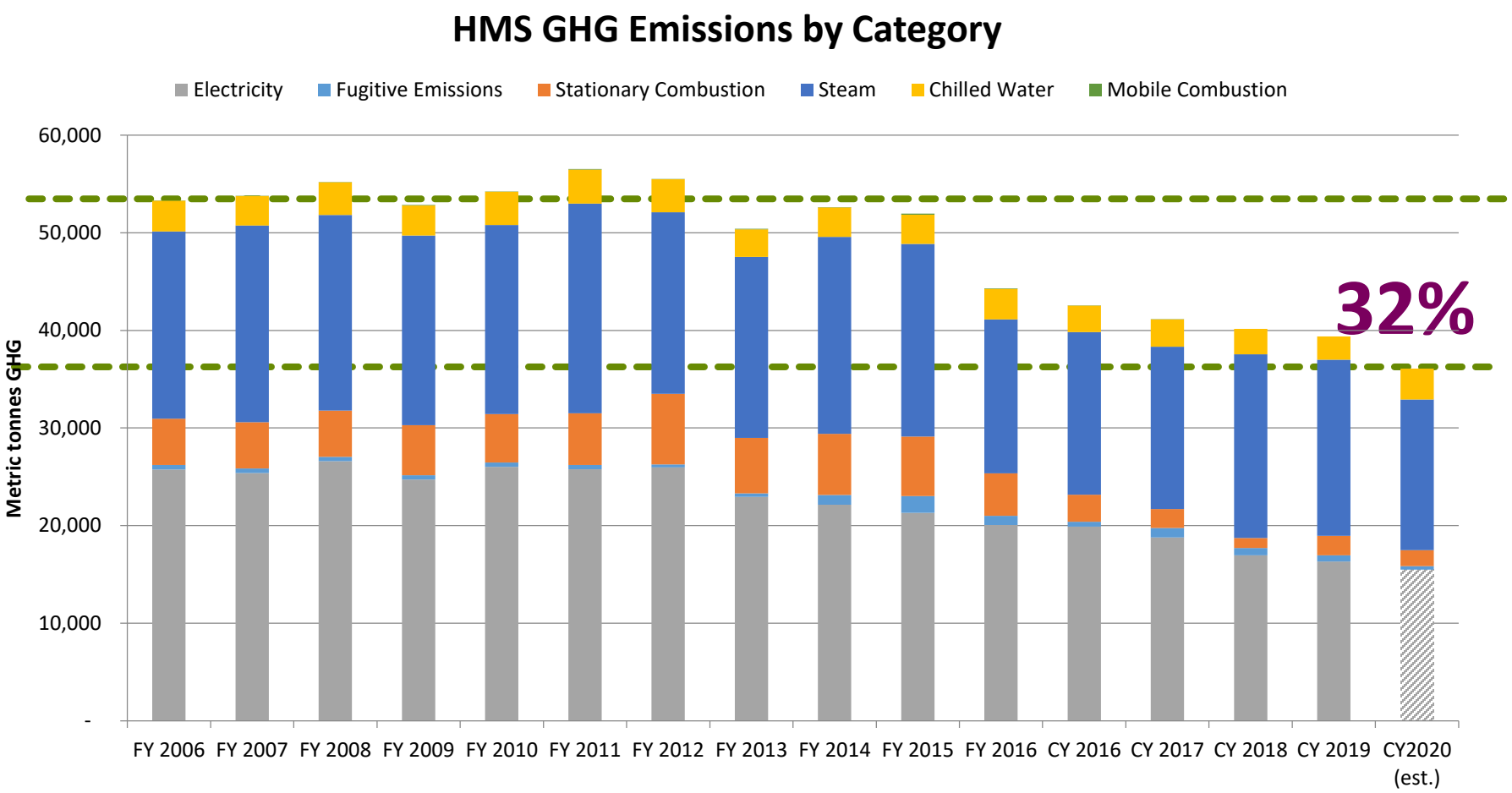
FOSSIL FUEL–NEUTRAL BY 2026

green.harvard.edu/climate

Roadmap to fossil fuel-free



HMS GHG EMISSIONS REDUCTION PROGRESS

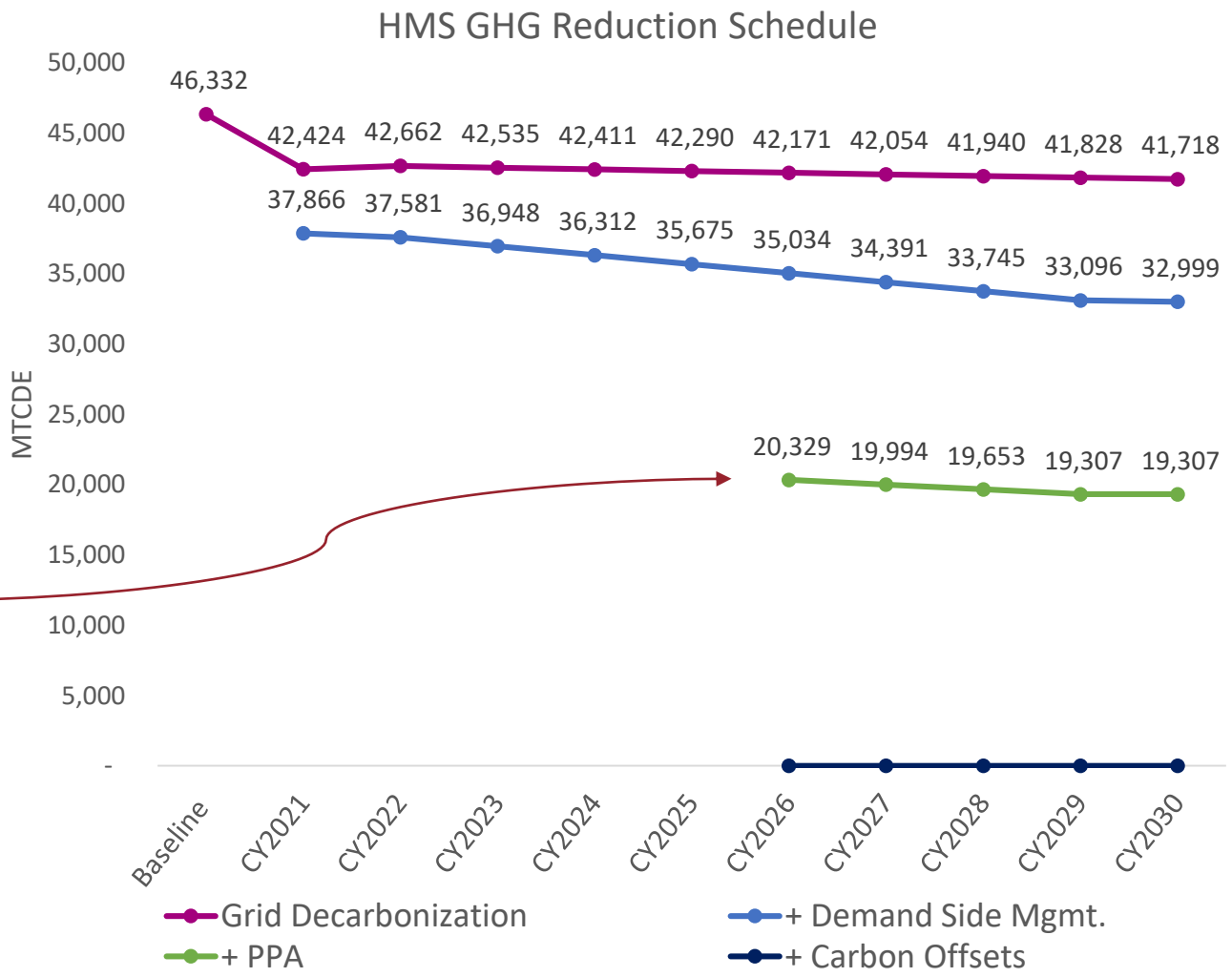


CY2020 emissions data has not be finalized as of this report's publishing, but estimates suggest approximately a 32% reduction from the 2006 baseline in CY2020.

HMS GHG EMISSIONS REDUCTION SCHEDULE

In alignment with Harvard University's 2026 and 2050 goals, HMS projects the following greenhouse gas reduction schedule.

In 2026, the school offsets all electric emissions with RECs, and all of its steam and natural gas emissions with carbon offsets.

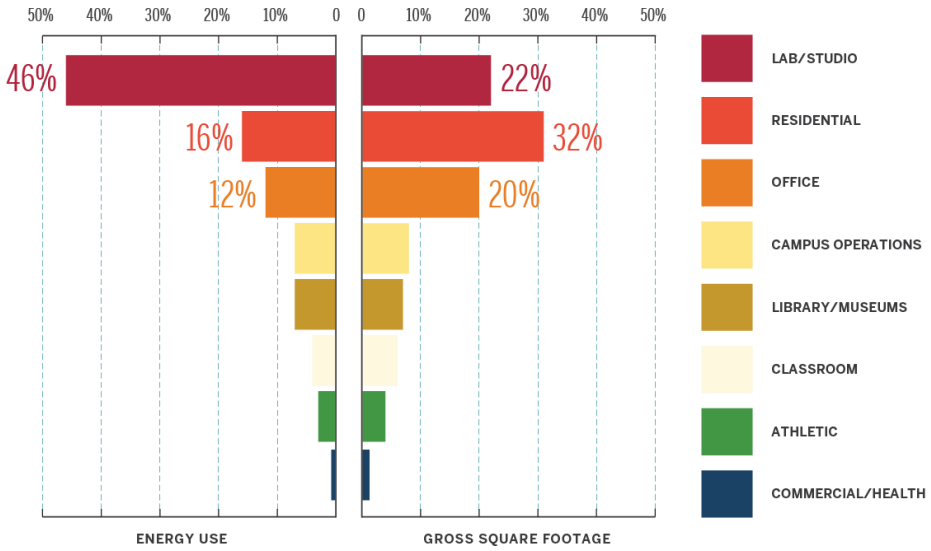


ENERGY CONSERVATION MEASURES AND STRATEGIC ENERGY PROJECTS FOCUS ON LABORATORY ENVIRONMENTS

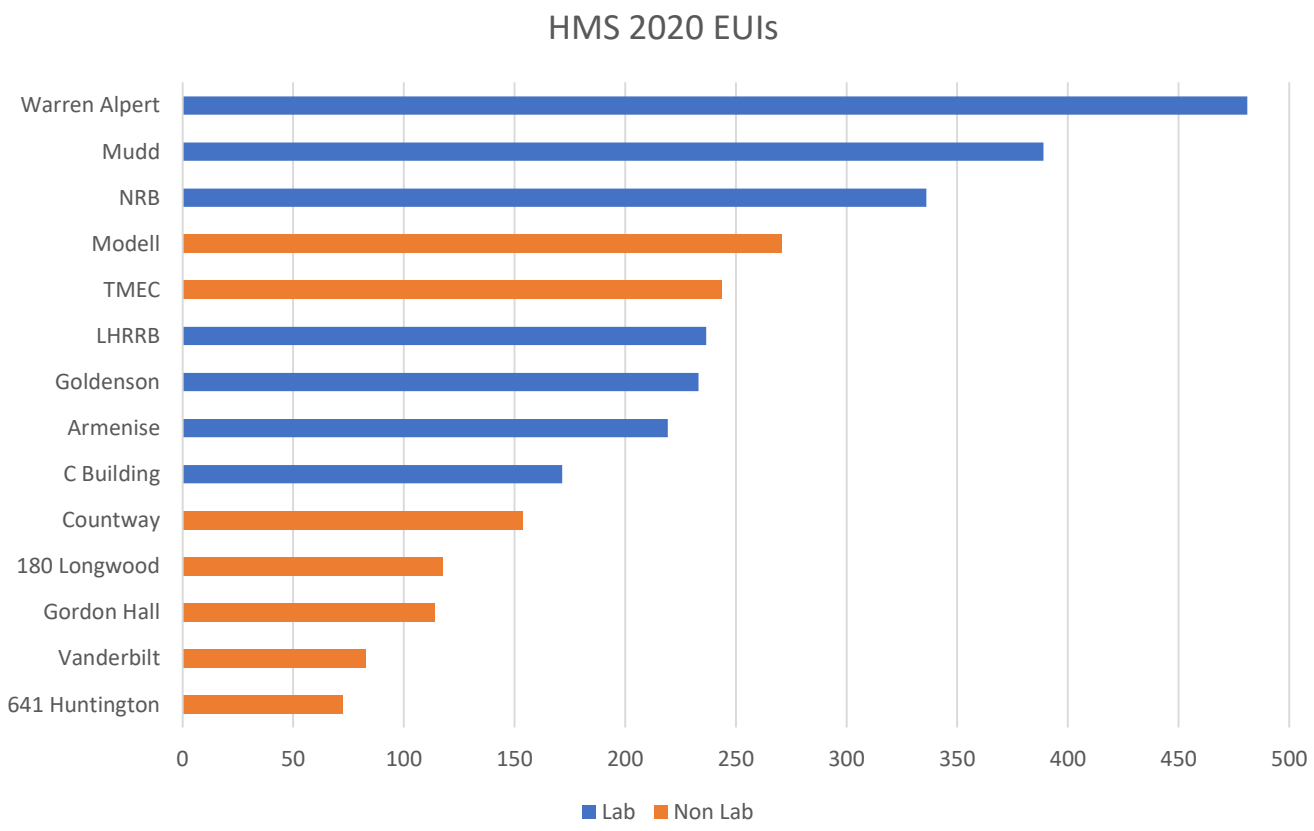
Harvard-wide Lab Impact:

Laboratories at Harvard University consume 46% of energy on campus but represent only 22% of the total square footage, illustrating the unique challenge that research-focused organizations face as they seek to reduce their emissions footprint.

This challenge is especially evident at HMS, where 70% of space belongs to labs. Sustainability and efficiency achievements on campus must keep up with growing research, increased building population density, and the introduction of more delicate, energy intensive equipment.

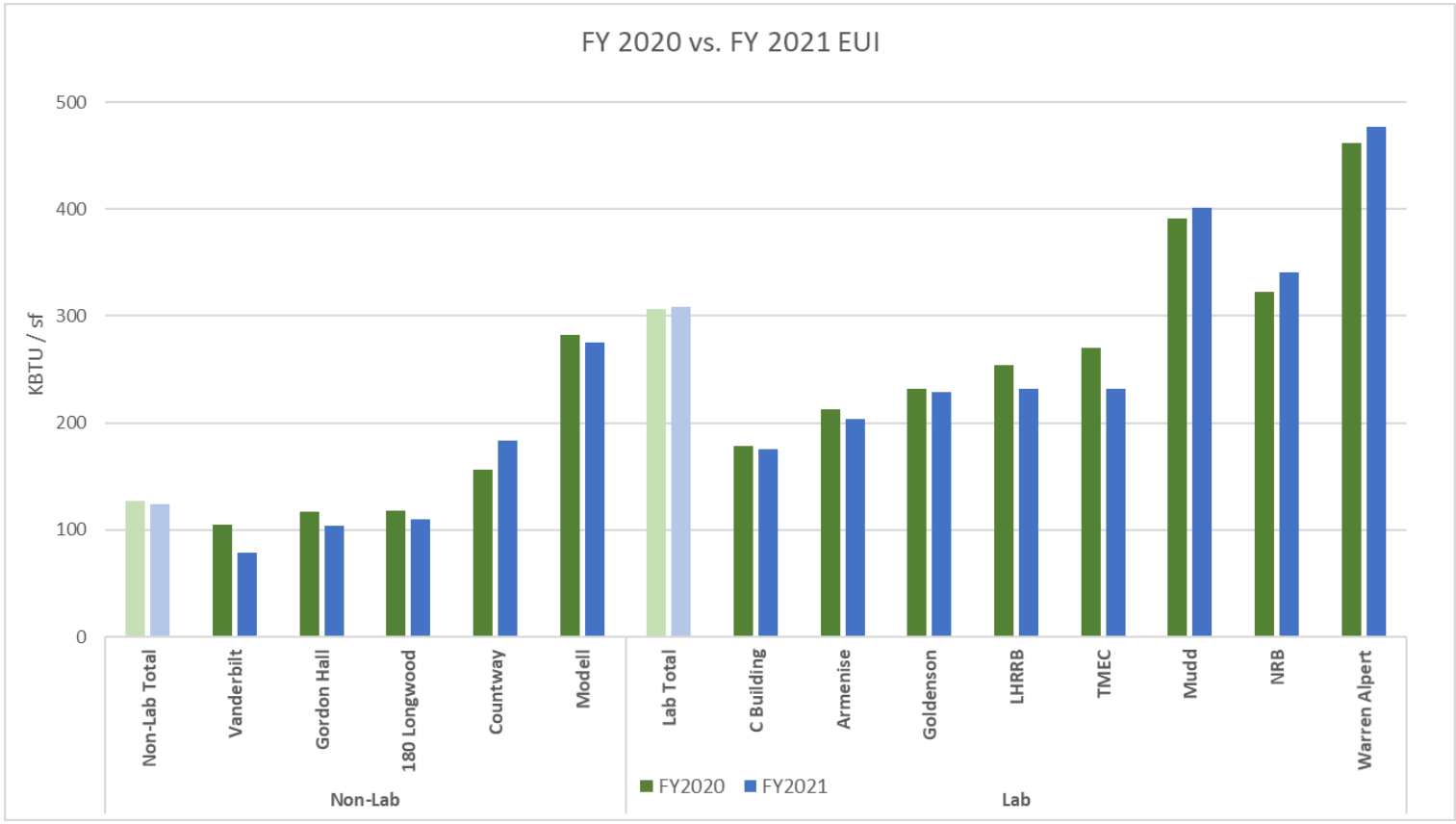


ENERGY CONSERVATION MEASURES AND STRATEGIC ENERGY PROJECTS FOCUS ON LABORATORY ENVIRONMENTS



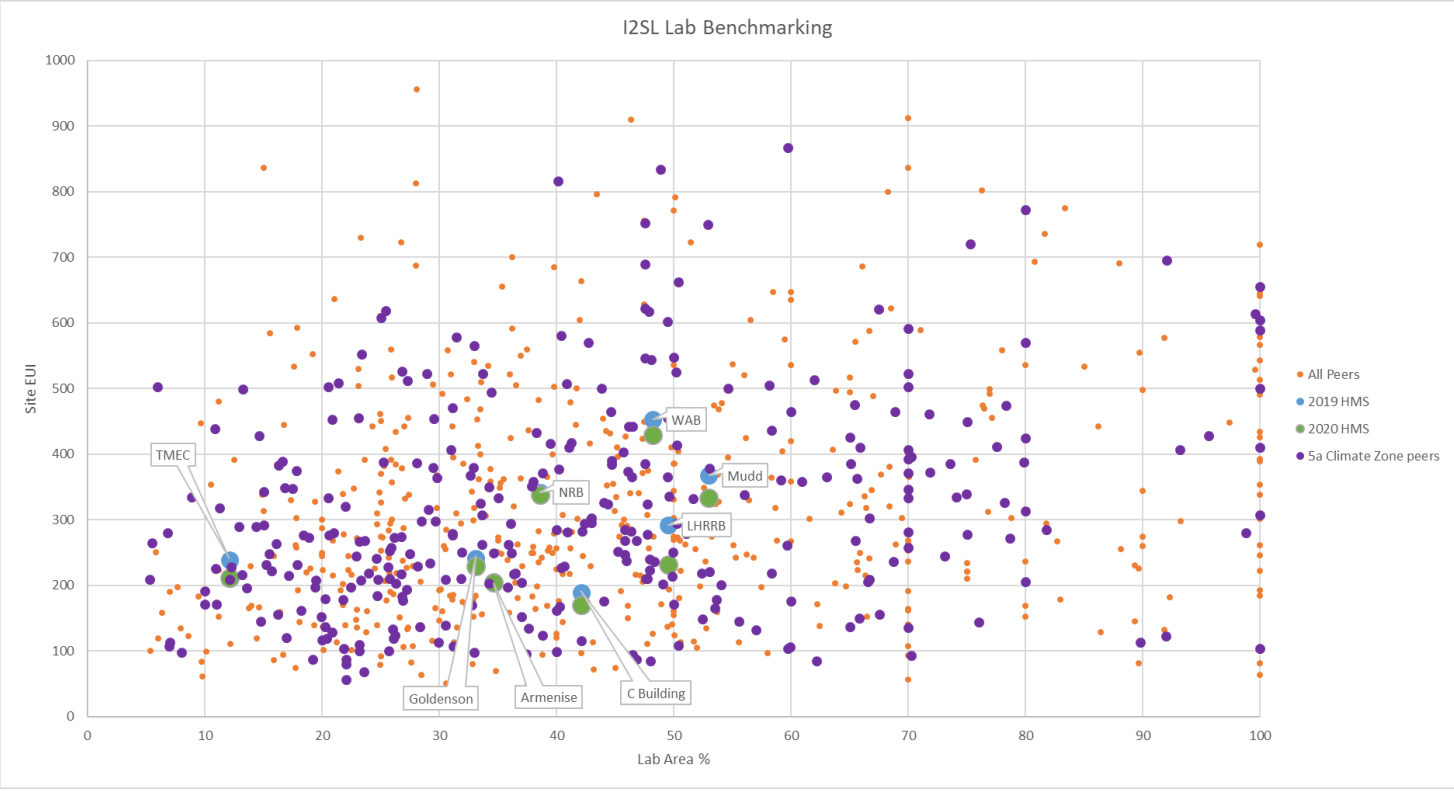
This shows HMS's buildings, split between lab buildings and non-labs, and their Energy Use Intensities (EUI), in CY2020. EUI is a measurement of a building's annual energy consumption relative to its square footage, and allows for comparison between buildings.

ENERGY CONSERVATION MEASURES AND STRATEGIC ENERGY PROJECTS FOCUS ON LABORATORY ENVIRONMENTS



This shows HMS's buildings, split between lab buildings and non-labs, between FY20 and FY21. The lighter bars, for "Non-Lab Total" and "Lab Total" represent the EUI for the building category as a whole, using total energy consumption and total area.

ENERGY CONSERVATION MEASURES AND STRATEGIC ENERGY PROJECTS FOCUS ON LABORATORY ENVIRONMENTS



This chart shows HMS's lab buildings within a data set from the International Institute for Sustainable Laboratories, where buildings are ranked by the percentage of the building's lab area versus their EUI. HMS is well aligned with its peers in this respect.

HMS FACILITIES COMMITMENT TO SUSTAINABILITY

HMS facilities is committed to providing a safe and healthy campus to support daily operations of critical research and to the wider community. Simultaneously, facilities focuses on reducing operating costs and shrinking the impacts of operations on the environment.

To better align with HU's overarching sustainability goals, HMS Campus Planning and Facilities has updated its Strategic Energy Plan, building on 2016-2020 plan.

HMS FACILITIES IS FINALIZING ITS UPDATED STRATEGIC ENERGY PLAN

The new Energy Plan's focus areas include:

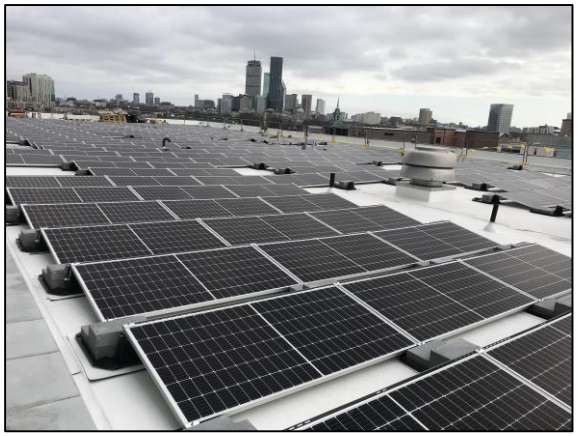
- Ensuring Competitive Procurement of Energy Resources
- Reduction of Energy Consumption
- Improvement of Energy Data Sourcing and Analytics
- Championing Energy and Sustainability Outreach
- Ensuring Continuity of Utility Service
- Ensuring Carbon Emission Performance Compliance and Reporting with:
  - Boston BERDO regulation
  - Harvard University goals

ECMs AND STRATEGIC ENERGY PROJECTS

- NRB Solar PV System
- Clockworks Analytics Fault Detection Software
- Energy Retrofits and Retro-commissioning Projects
- GreenerU Investment Grade Audits (IGAs)
- WAB LED Lighting & Controls Upgrades
- NRB Tower & Parking Garage LED Lighting & Controls Upgrades
- Campus Wide Heat Recovery Coil Cleaning
- C Building Heat Recovery System Recommissioning
- Goldenson Ventilation Optimization Study
- NRB CoolTrol Installations Round 2

ECMs AND STRATEGIC ENERGY PROJECTS

NRB SOLAR PV SYSTEM

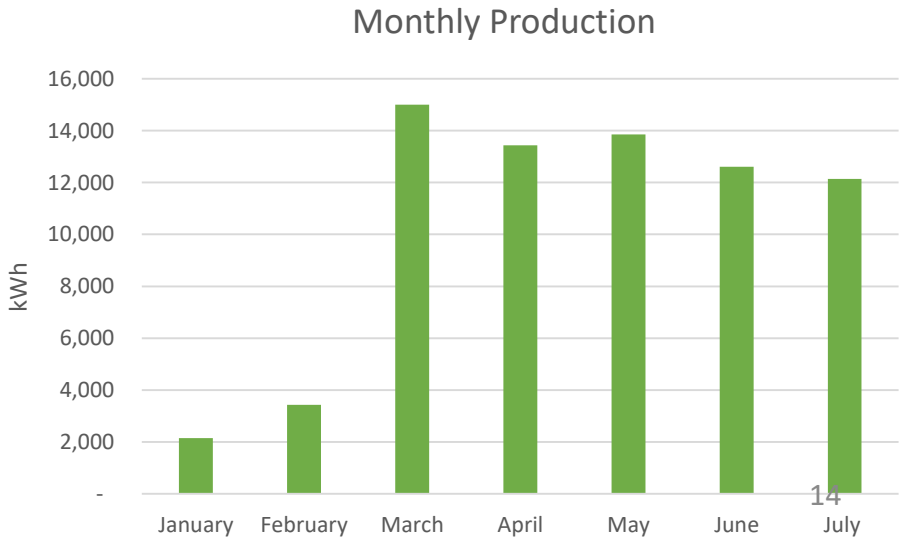


Building Use: Research Lab

380 solar panels interconnect January 2021 on two adjacent sections of the roof in New Research Building. The power output from the system is directed to the building's main switchgear and supplements the power provided by Eversource.

Production January 2021-July 2021:

- ~73.6 MWh generated
- ~115,712 lbs avoided CO_2 Emissions

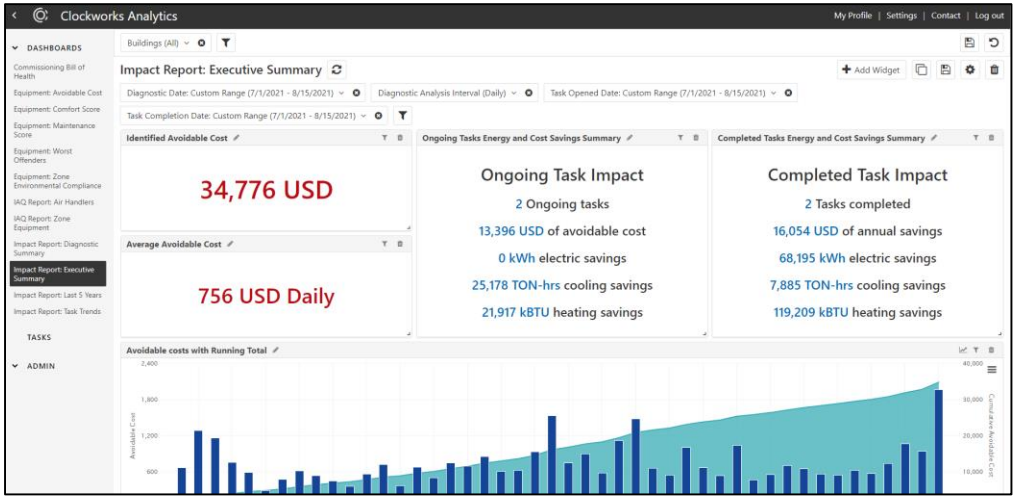


ECMs AND STRATEGIC ENERGY PROJECTS

CLOCKWORK ANALYTICS FAULT DETECTION SOFTWARE

Clockworks Analytics software is designed to perform continuous fault detection on all mechanical/HVAC equipment by pulling trends from points found on the Building Automation System (BAS). The platform has been fully deployed and is currently used to check operation of major and critical equipment such as air handling units, chillers, boilers, pumps, fan coil units, exhaust fans, terminal units, etc.

- In 2020, HMS resolved 14 major issues identified by Clockworks, including simultaneous heating and cooling, sensor failures, fixing pneumatic controls and other issues which realized $68,119 of savings.



ECMs AND STRATEGIC ENERGY PROJECTS

ENERGY RETROFITS AND RETRO-COMMISSIONING PROJECTS

Implementing energy retrofit projects not only results in the reduction of energy cost and emissions, but also helps Facilities to improve the longevity of mechanical and electrical equipment, lowering operational expenses. The following projects were implemented in CY 20:

- Repair and replacement of inoperable and leaking valves, dampers, and actuators
- Compressed air leak detection survey & repairs
- Programming optimization for mechanical heating, ventilation, and air conditioning equipment
- Commissioning of compressed air system in NRB

GREENER U

INVESTMENT GRADE AUDITS (IGA)

In 2020, HMS Facilities contracted with GreenerU, an energy consulting firm, to develop a comprehensive energy conservation program for the campus. Three investment grade audits (IGA) targeting lighting and mechanical systems were initiated, scheduled to be completed in 2020/2021. Projects will include:

- IGA 1 – Campus Lighting Audits
  - WAB and NRB Tower & Garage in bid
- IGA 2 – Ventilation Optimization & Heat Recovery Systems
  - Heat recovery from an exhaust fan in Goldenson basement
  - Heat recovery from a cage wash fan in WAB
- IGA 3 – Variable Frequency Drives (VFDs) for Hydronic Systems
  - Pumps and fans over 5 horsepower for potential VFD installation

ECMs AND STRATEGIC ENERGY PROJECTS

WARREN ALPERT LED LIGHTING & CONTROLS UPGRADES

Building Use: Research, Lecture Room, Office

Purpose – LED lighting fixtures and controls consume far less energy per unit of light, allowing for enhanced lighting and reduced electricity consumption.

Outcome – Proposal to upgrade 755 lighting fixtures, reducing the building's electricity consumption by **approximately 160,000 kWh/yr or ~$39,000/yr.**

This is equivalent to about **113 metric tons of CO2.**

The project is in the final phases of approval and construction will start in FY22.

ECMs AND STRATEGIC ENERGY PROJECTS

NRB TOWER & PARKING GARAGE LED LIGHTING & CONTROLS UPGRADES

Building Use: Research, Lecture Room, Office, & Parking Garage

Purpose – LED lighting fixtures and controls consume far less energy per unit of light, allowing for enhanced lighting and reduced electricity consumption.

Outcome – Proposal to upgrade 2,715 lighting fixtures, reducing the building's electricity consumption by **approximately 608,000 kWh/yr or ~$153,000/yr.**

This is equivalent to about **431 metric tons of CO2.**

The project is in the final phases of approval and construction will start in FY22.

ECMs AND STRATEGIC ENERGY PROJECTS

CAMPUS WIDE HEAT RECOVERY COIL CLEANING

This project included a deep cleaning of 44 coils on air handling units, makeup air units, and exhaust fans across the campus.

Resulted in:

- A decrease in pressure drop across coils, helping to conserve fan energy.
- Increased heat transfer efficiency, helping to conserve energy of steam
- Installation of access doors for future maintenance.

This project will save approximately $78,000/yr in avoided energy costs.

ECMs AND STRATEGIC ENERGY PROJECTS

C BUILDING HEAT RECOVERY SYSTEM RECOMMISSIONING AUDIT

Building Use: Research Lab

This audit evaluated C Building's heat recovery system, including piping, insulation, connected coils, and pumps.

The resulting scope of work will replace insulation, upgrade controls and monitoring, and re-balance the system.

This project is slated for construction in FY22 as part of a larger air handling unit replacement project in C Building.

ECMS AND STRATEGIC ENERGY PROJECTS

GOLDENSON VENTILATION OPTIMIZATION STUDY

Building Use: Research, Lecture Room, Office

Purpose – This study evaluated the building's ventilation system on the subject of ventilation optimization.

Outcome – The building's ventilation levels were found to be in compliance with the standards and some energy conservation opportunities were identified including the installation of air-side heat recovery system.

These opportunities will be further investigated in FY22.

ECMS AND STRATEGIC ENERGY PROJECTS

NRB COOLTROL INSTALLATIONS ROUND 2

Six cold rooms in NRB were retrofitted with the CoolTrol temperature and evaporator fan control technology. In addition, 29 shaded-pole evaporator motors were replaced with high-efficiency EC motors and dewpoint-based pulse controls were installed for anti-sweat cooler/freezer door heaters.

This project is estimated to save approximately 145,000 kWh/yr or $23,000/yr.

WATER CONSERVATION

Quench Valve Project

Location: Campus-wide

Purpose – Quench valves are used in sterilization and cage washing machines to reduce the temperature of hot effluent water and condensate.

Outcome – 31 quench values on 75 units of sterilization equipment found to be leaking and in need of repair have been replaced or repaired. HMS Facilities expects substantial water and steam savings due to the project completion.

WATER CONSERVATION

Water Savers Project

Location: NRB

Purpose – To reduce the consumption of potable water by sterilization equipment. Each sterilizer uses about 111,750 gallons/week per sterilizer.

Projected Outcome - Getinge proposed adding water saver kits to 22 autoclaves in NRB. With a water saver kit installed, water consumption is expected to drop ~92%, to 8,550 gallons/per week per sterilizer.

With water costs at ~$21/kGal, cost savings are expected to be ~$112,695 per year.

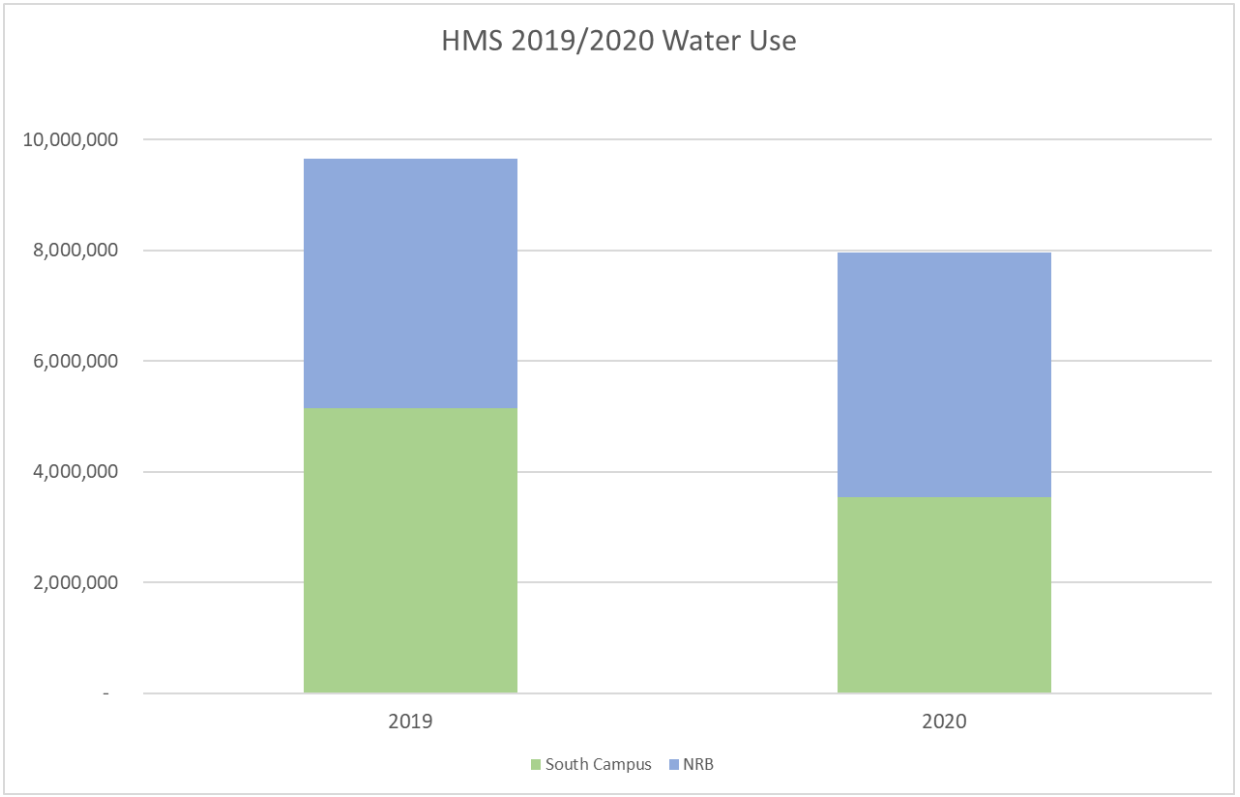
Installation of the kits is planned to start in FY22.

WATER CONSERVATION

Pandemic Impacts on Water Use

HMS saw a ~18% reduction in total water usage between CY2019 and CY2020.

Some reductions are expected to continue into CY2021. Maintaining the decreases will greatly depend on campus re-occupancy.



WATER CONSERVATION

IRRIGATION

- Irrigation controllers updated to Rain Bird IQ4 modular multi-site controllers for improved control and increased water savings

- HMS is exploring installation of moisture meters to better understand moisture content and to only irrigate zones based on specific demand

Green Lab Certification Program

Labs are the most energy intensive spaces at HMS, so conserving resources and efficient consumption habits are of key importance in these areas.

To further these practices, the HMS Green Lab Certification Program recognizes and encourages labs engaging in sustainable practice.

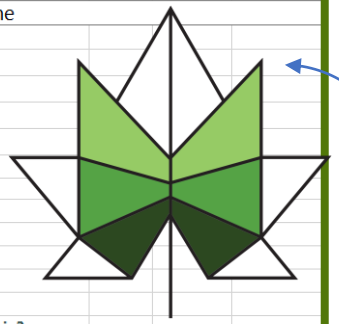
Lab	Certification Level	Points Achieved / Points Available
ICCB-L	Leaf 4	89/97
Zhang Lab	Leaf 4	70/101
HiTS LSP	Leaf 3	79/103

Three labs completed certifications in CY2020 prior to the pandemic. Post-pandemic, HMS is working to bolster the program and encourage these practices in a wider array of labs.

Green Lab Program - Progress Dashboard

Lab Name	Yor Lab Name
Current Level	76
Available Points	100
N/A Points	0
Total Points	100

Leaf Level	Points
Leaf One	55
Leaf Two	65
Leaf Three	75
Leaf Four	85



What categories are you strongest/weakest in?

Category	Total Points Achieved	Points Available	N/A Points	Total Points	Progress
Universal Practices	**18**	**27**	**0**	**27**	67%
Save Energy	**24**	**29**	**0**	**29**	83%
Reduce Energy Consumption	10	13	0	**13**	77%
Maximize Efficiency	14	16	0	**16**	88%
Conserve Resources	**34**	**44**	**0**	**44**	77%
Operate Efficiently	13	16	0	**16**	81%
Purchase Sustainably	6	10	0	**10**	60%
Reduce Waste	15	18	0	**18**	83%
Total	**76**	**100**	**0**	**100**	76%

Example summary of a lab's certification process.
Lab members complete the program's self-assessment guide, and earn points to achieve one of four levels of certification. They may track their progress, earn points for improving in certain areas, and attempt certification at a higher level.

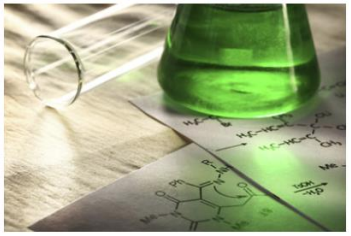
green.harvard.edu/greenlabcert

Lab Product Sustainability and Transparency

HMS continues to collaborate across Harvard and lead a Longwood-based group to advance lab product transparency and reporting related to sustainability and health, such as the ACT Label from MyGreenLabs.

CONSUMABLES

CHEMICALS & REAGENTS



EQUIPMENT

ACT.

Accountability, Consistency, Transparency.

The Environmental Impact Factor Label

Product Name

Manufacturing Location

Manufacturing	
Manufacturing Impact Reduction	6
Renewable Energy Use	No
Responsible Chemical Management	10
Shipping Impact	7
Product Content	5.3
Packaging Content	5.4
User Impact	
Energy Consumption	5
Water Consumption	N/A
Lifetime Rating	2
End of Life	
Packaging	5.2
Product	8
Environmental Impact Factor	53.9
Label Valid Through	September 2019

My Green Lab mygreenlab.org

**Energy and water consumption reported as daily values, all other values on a scale of 1-10: 1 indicates the least environmental impact and 10 indicates the greatest.

HEALTHIER BUILDING MATERIALS ACADEMY PILOT: HMS COUNTWAY LIBRARY

Using an integrated design process with an initial sustainability kick-off and goal setting, the project accomplished:

- Healthy materials used for renovation with focus on carpet, furniture, window shades, wall base
- Designed to LEED Gold CI-V4 standards
- Designed to Harvard Green Building Standards, including enhanced systems commissioning
- Reduction in emissions through LED lighting, lighting controls, daylight optimization, automated shades throughout

- Prioritizes high levels of Occupant comfort
- Water reductions through low-flow fixtures and water efficient planting

WASTE DISPOSAL

Regular Waste

- Composting
  - Collected throughout campus including directly from cafeteria
- Single Stream Recycling
- Municipal Solid Waste

Campus Regular Waste	Compost (Ton)	Single Stream Recycling (Ton)	Municipal Solid Waste (Ton)
CY2020	70.5	251.5	767.1
FY19	*157.5*	*312.1*	*983.1*

HMS disposed of ~20% less recycling and municipal waste, and ~55% less compost in CY20 than in FY19. Closures in TMEC and in the cafeterias due to the pandemic are the largest contributors to these changes.

Bio-waste

- Cannot be disposed of through regular channels
- Regulated Medical Waste

CY2020 Bio-Waste	Regulated Medical Waste (lb)	Sharps
TMEC	57,406	-
WAB	58,936	499
NRB	133,654	85

CAMPUS OPERATIONS

WASTE REDUCTION & DIVERSION: COMPOST EXPANSION & TIP-BOX RECYCLING PILOT

- HMS Custodial expanded the campus composting program to include bathrooms.

- A pilot program to collect clean tip-boxes from labs began in Genetics. It was expanded to the full campus in August 2020.

GreenLabs RECYCLING
Sustaining science through recycling

CAMPUS OPERATIONS

TIP-BOX RECYCLING PILOT

- Polypropylene plastic
- Boxes are granulated and re-used at local manufacturers
- A pilot program to collect clean tip-boxes from labs began December 2019 in NRB
- Pilot expanded to full campus in August 2020

GreenLabs RECYCLING

Performance in FY21:

South Campus	6,419 lbs
NRB	10,017 lbs
Total Collected	16,436 lbs

HMS collected a total of about 7.5 metric tons of tip boxes in FY21.

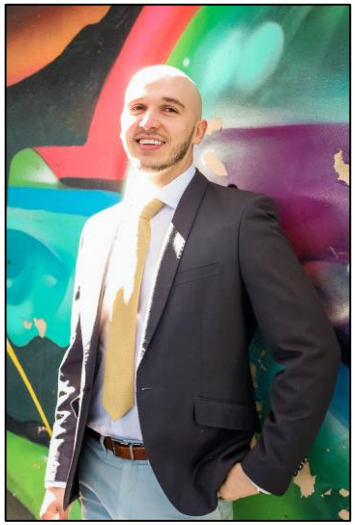
LANDSCAPING: FERTILIZER

- Facilities collaboration with Harvard Office for Sustainability on developing site maintenance standards regarding landscaping needs
  - Recycling all mow clippings using “X Blade Adapters” to reduce the amount of granular fertilizer applied seasonally
  - Soil testing to determine each year’s site maintenance plan
  - Operate as Zone 2: eliminating turf products detrimental to bee and aquatic invertebrates

STRENGTHENING ENERGY MANAGEMENT TEAM

HMS Facilities hired two full time employees for the energy office in July 2020.

Stan Karachev
Energy Performance Analyst



Stan is a BMET Wentworth graduate with 8 years of experience in energy consulting, project management and commissioning.

Outside of work, Stan is involved in Boston's art communities, specifically in dance. As a street style dancer, he’s an active supporter, contributor and leader through performances, teaching classes, battles, and organizing events.

Colette Baker
Energy Billing Analyst

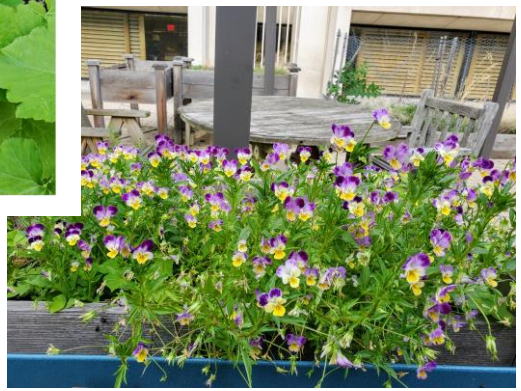
Colette comes to HMS with years of experience in energy data analysis from both utility and governmental perspectives. She graduated from the economics and environmental analysis and policy programs at Boston University.

In her spare time, Colette enjoys hiking, kayaking, and biking her way through New England.

COUNTWAY COMMUNITY GARDEN

The garden was closed for the 2020 growing season due to COVID-19 precautions, but reopened for the 2021 growing season and now has a full team of gardeners using the available raised beds.

Harvard Longwood Campus members can now host events in the garden. To submit an event request visit countway.info/garden or contact countwaycommunitygarden@hms.harvard.edu.



HARVARD SUSTAINABLE MEETING AND EVENT GUIDE

This guide was developed as a quick reference resource for event and meeting planners to improve the sustainability of their events

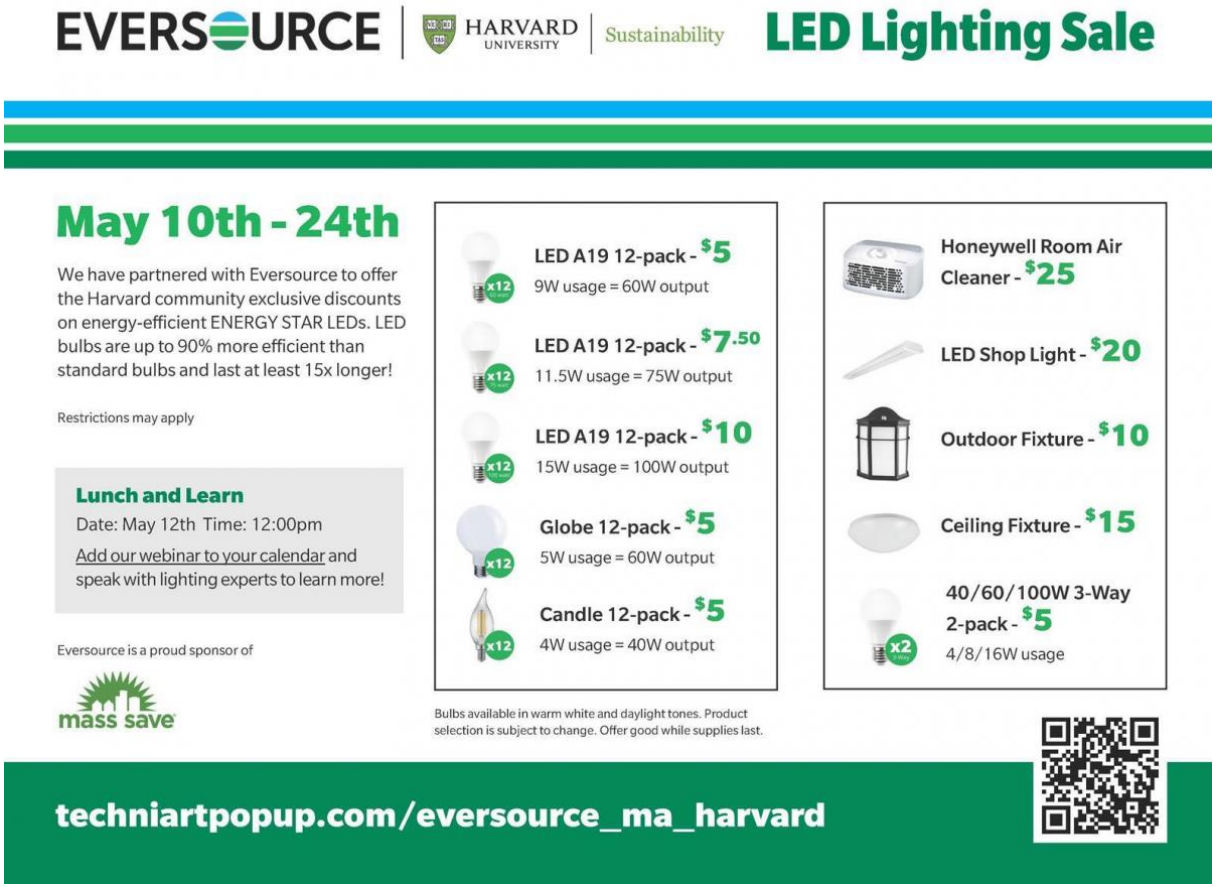
https://green.harvard.edu/campaign/sustainable-meeting-and-event-guide

LONGWOOD LIGHTING FAIRS

HMS: 11 attendees
HSDM: 5
HSPH: 6

Total 22 attendees
292 LEDs purchased

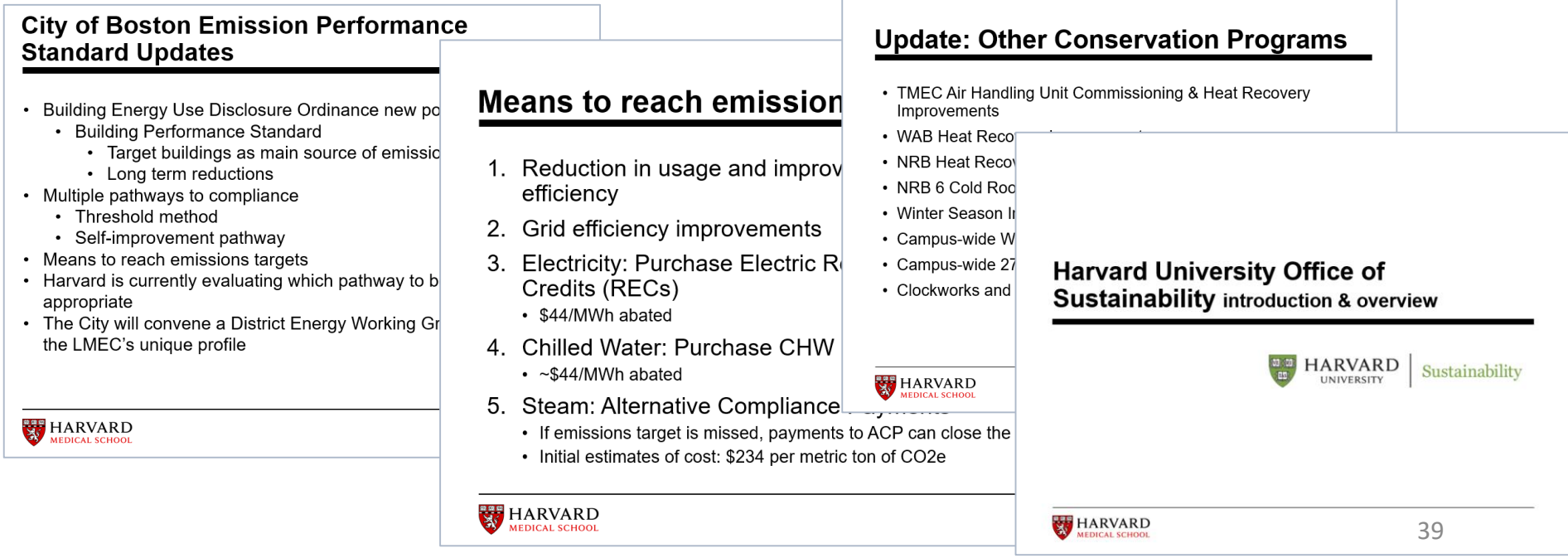
*If all the bulbs are installed at home, the expected annual electricity cost savings are ~**$3,192**. The emissions equivalent is removing approximately **2.4 cars** from the road.*



CULTURE AND LEARNING

STUDENT OUTREACH

- Collaboration and discussion with Students for Environmental Awareness in Medicine (SEAM)
- Quarterly meeting and forum for staff and students to discuss daily operations, energy sourcing, sustainability projects, waste disposal, and Boston's regulatory requirements.



ORIGINAL CONTENT and SOCIAL ENGAGEMENT @HARVARDCHANSPH

HARVARD MEDICAL SCHOOL

Connect & Learn More

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- Utility Supply/Delivery Contracts
- Energy & Water Reduction Targets and Load Growth Planning
- Demand Response and Load Shed Program
- GHG Reduction Strategy
- Budgeting and Forecasting
- Energy Prediction Modeling
- Continuity of Utility Service
- Critical Equipment PMs
- Utility Infrastructure Resiliency

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- Asset Management
- Critical Equipment PMs
- Proactive PM of Building Assets
- ECM implementation
- Mechanical equipment retrofits
- Retro & Continuous Commissioning
- Fault Identification and Diagnoses via Clockworks Analytics Software
- Data Analysis

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- Utility Supply/Delivery Billing and Energy Data Analysis
- Metering Issues and Upgrades
- Energy Budgeting and Forecasting
- Energy Benchmarking, Dashboards, and KPIs
- Green Labs
- GHG Emissions Analysis
- HU Energy/GHG Emission Data Compliance
- City of Boston BERDO Data Compliance