



HARVARD
MEDICAL SCHOOL

CAMPUS PLANNING
AND FACILITIES

CY21 SUSTAINABILITY REPORT

Harvard Medical School



HARVARD
UNIVERSITY

Sustainability



HARVARD UNIVERSITY SUSTAINABILITY PLAN

FISCAL YEAR 2015 – 2020

HMS Campus Planning & Facilities is committed to upholding University-wide sustainability pledges to reduce our environmental footprint, while providing a safe and healthy campus for students and staff and supporting the daily operations of critical research.



HMS is dedicated to assisting in achieving Harvard’s Sustainability and Climate Action Plan commitments, as well as fulfilling the City of Boston’s carbon requirements and regulations.

Harvard University

Read more about Harvard’s shift to fossil fuel-free sources here, [HU Climate Action Plan](#).



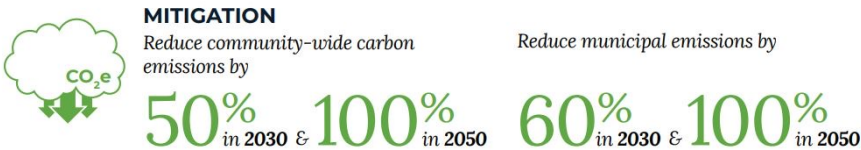
FOSSIL FUEL-FREE BY 2050

FOSSIL FUEL-NEUTRAL BY 2026

green.harvard.edu/climate

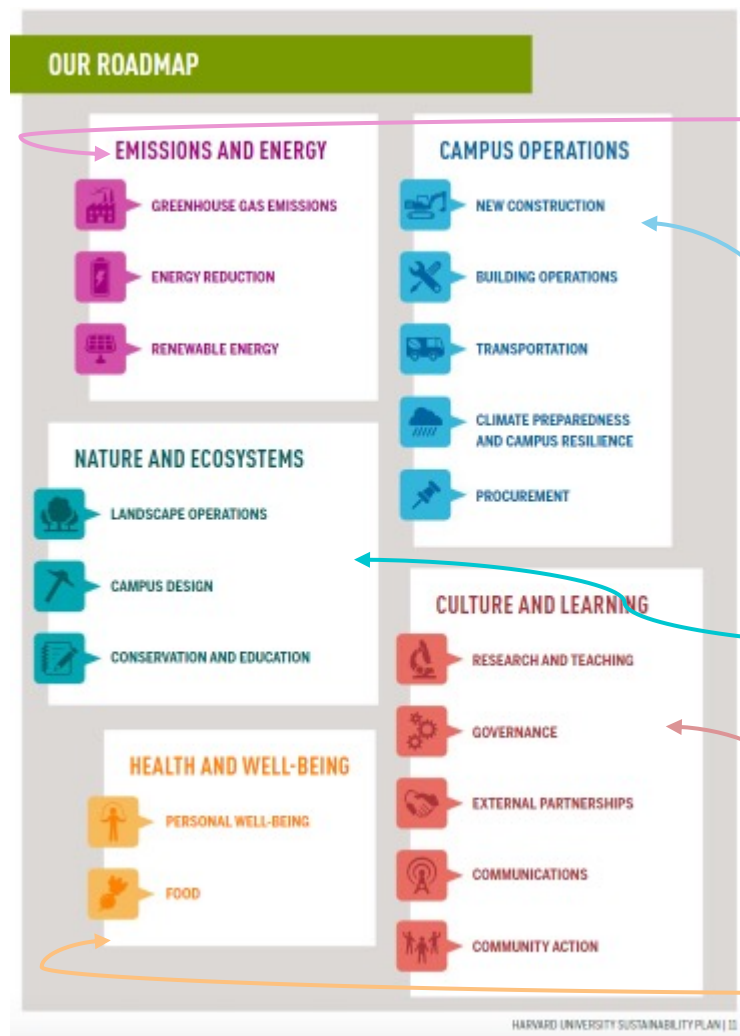
City of Boston

Building Emissions Reduction and Disclosure Ordinance (BERDO)



- Targets buildings as main source of emissions
- Requires annual energy reporting for buildings over 20,000 sq. ft
- Every 5 years, starting in 2025, building owners must meet new carbon emission thresholds
- Requirements increase to zero net emissions in 2050

HMS's sustainability efforts are shaped by the [Harvard University Sustainability Plan](#) and roadmap.



HMS in CY2021:

- GHG Analysis: Past and Projected
- Strategic Energy Plan
- Renewable Energy
- Energy Conservation Measures

- Water Consumption
- Waste Management

- Countway Community Garden

- Eco-Opportunity

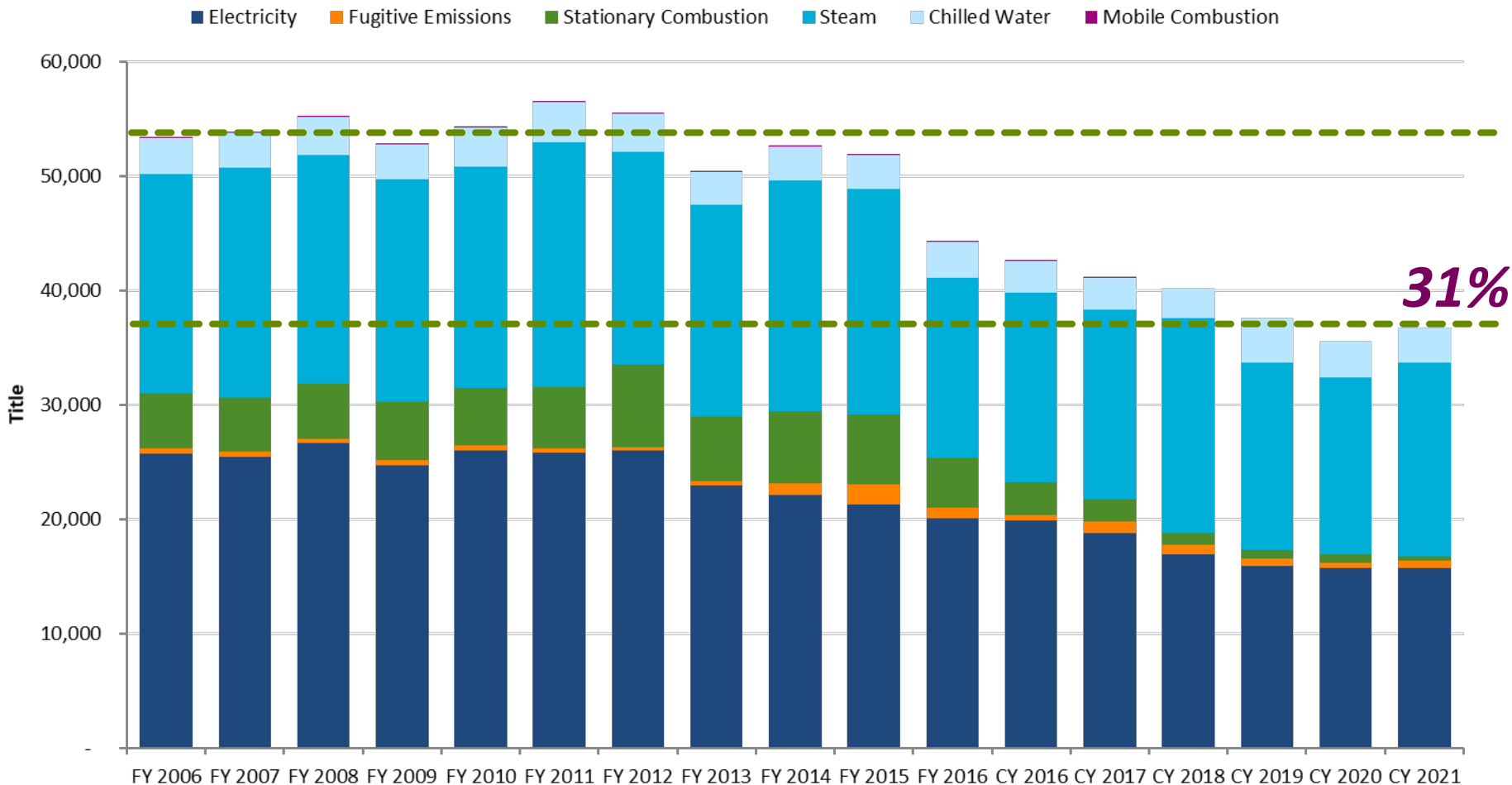
- HU OFS Guides

EMISSIONS AND ENERGY

HMS Progress



Annual HMS-HSDM GHG Emissions by Category



CY2020 and CY2021 emissions data has not be finalized as of this report's publishing, but drafted versions estimate that CY2021's total MTCDE emissions for HMS/HSDM are a 31% reduction from the FY2006 baseline. Note: starting in CY21, Facilities is using a new methodology for calculating its overall emissions.

EMISSIONS AND ENERGY

HMS Commitment to Decarbonization

HMS believes that pro-active facilities management plays a critical role in achieving net zero emissions, improving energy efficiency, and reducing local impacts of the School on the community. To plot the way forward to decarbonization, the Facilities department has initiated two major planning processes:

- Strategic Energy Plan
- Decarbonization Plan

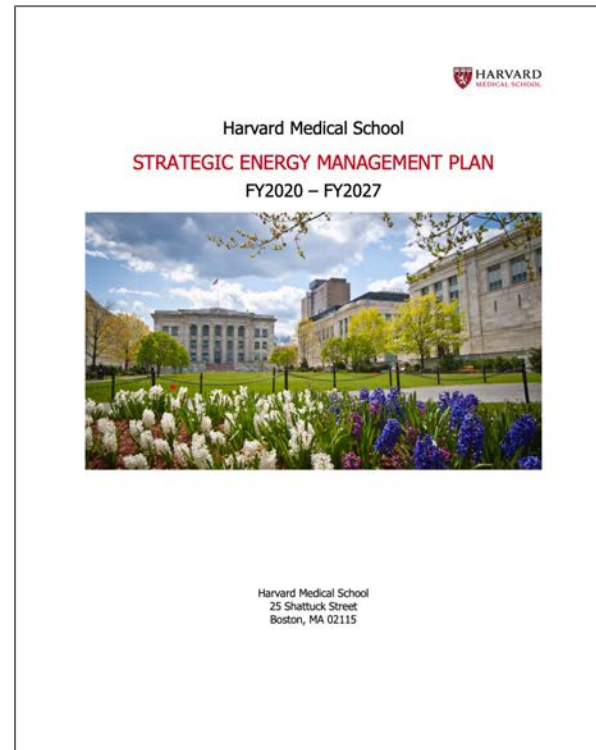


EMISSIONS AND ENERGY

Strategic Energy Management Plan

Focus Areas

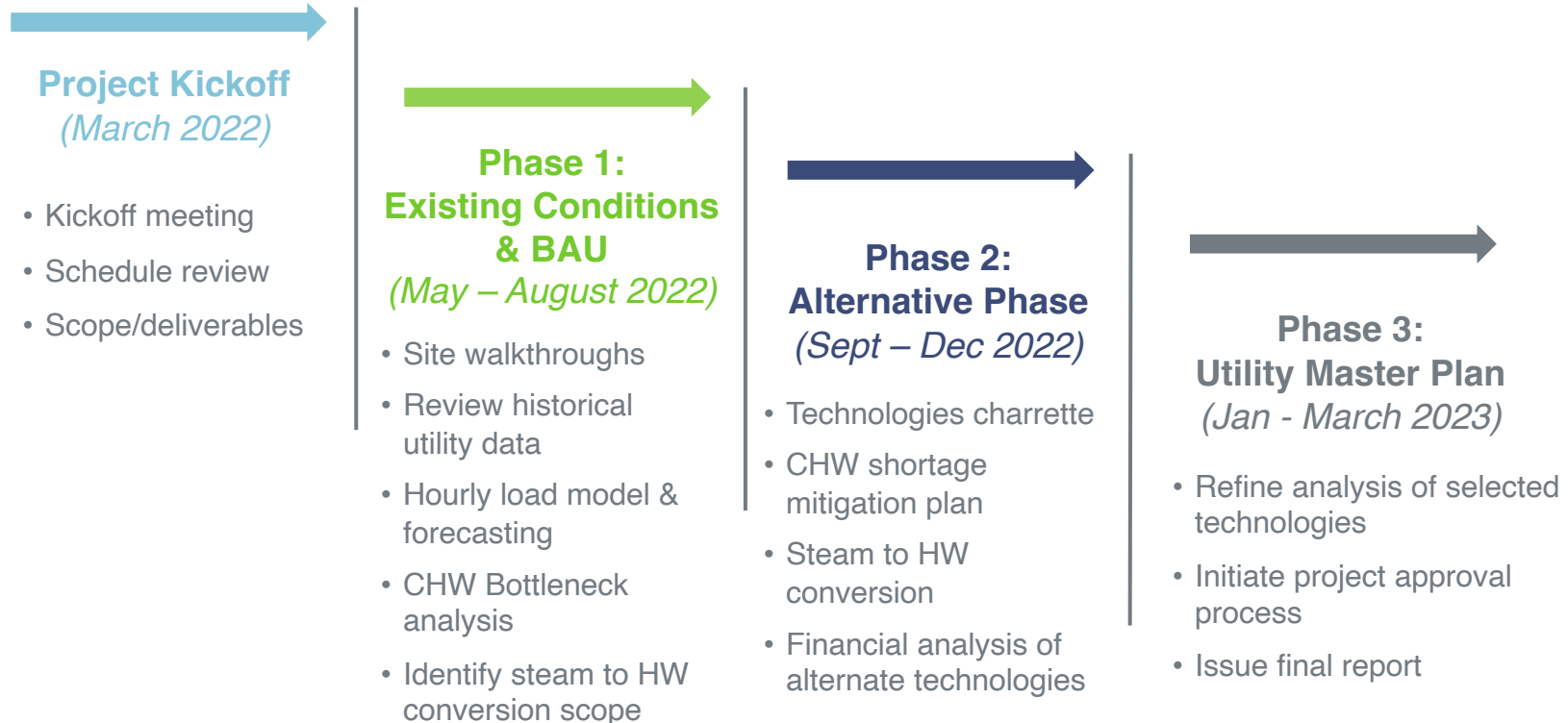
- Ensuring competitive procurement of energy resources
- Reduction of energy consumption
- Improvement of energy data sourcing and analytics
- Championing energy and sustainability outreach
- Guaranteeing continuity and reliability of utility service
- **Utility Master Plan**



EMISSIONS AND ENERGY

Utility Master Plan

The Utility Master Plan is an implementable, comprehensive planning tool for HMS's energy consumption and sourcing which will help to move the campus towards Fossil Fuel Neutrality by 2026, and fossil fuel free by 2050.

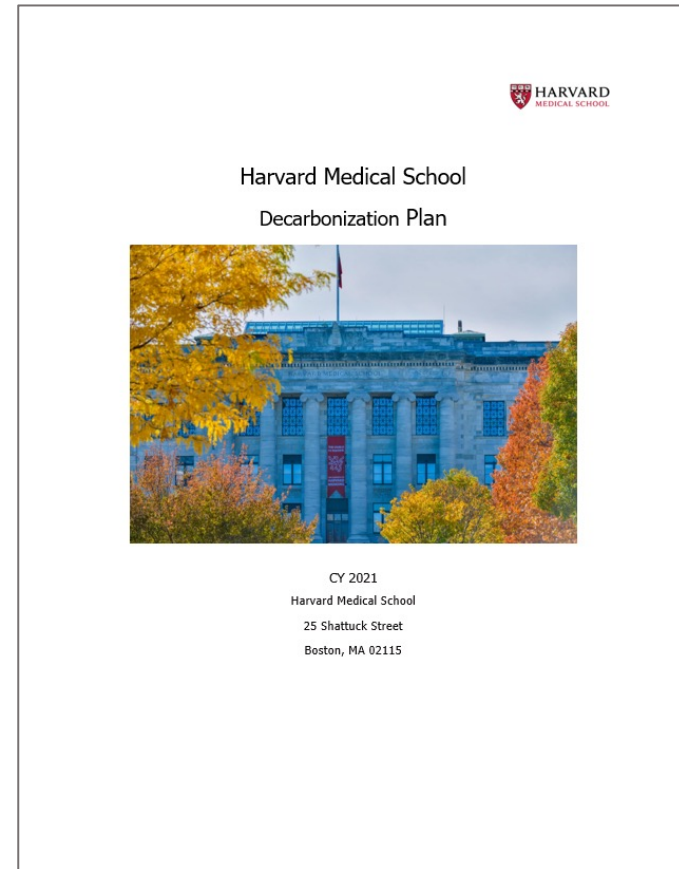


EMISSIONS AND ENERGY

Decarbonization Plan

Focus Areas

- Guaranteeing carbon emissions compliance and reporting with:
 - City of Boston BERDO regulation
 - Harvard University objectives
- Description of progress and changing requirements
- Cost projections for renewable energy certificates and carbon offsets
- Emissions factors
- “Grid Greening” anticipated in Massachusetts



EMISSIONS AND ENERGY

Reducing Emissions Further

How will HMS achieve its emission compliance?

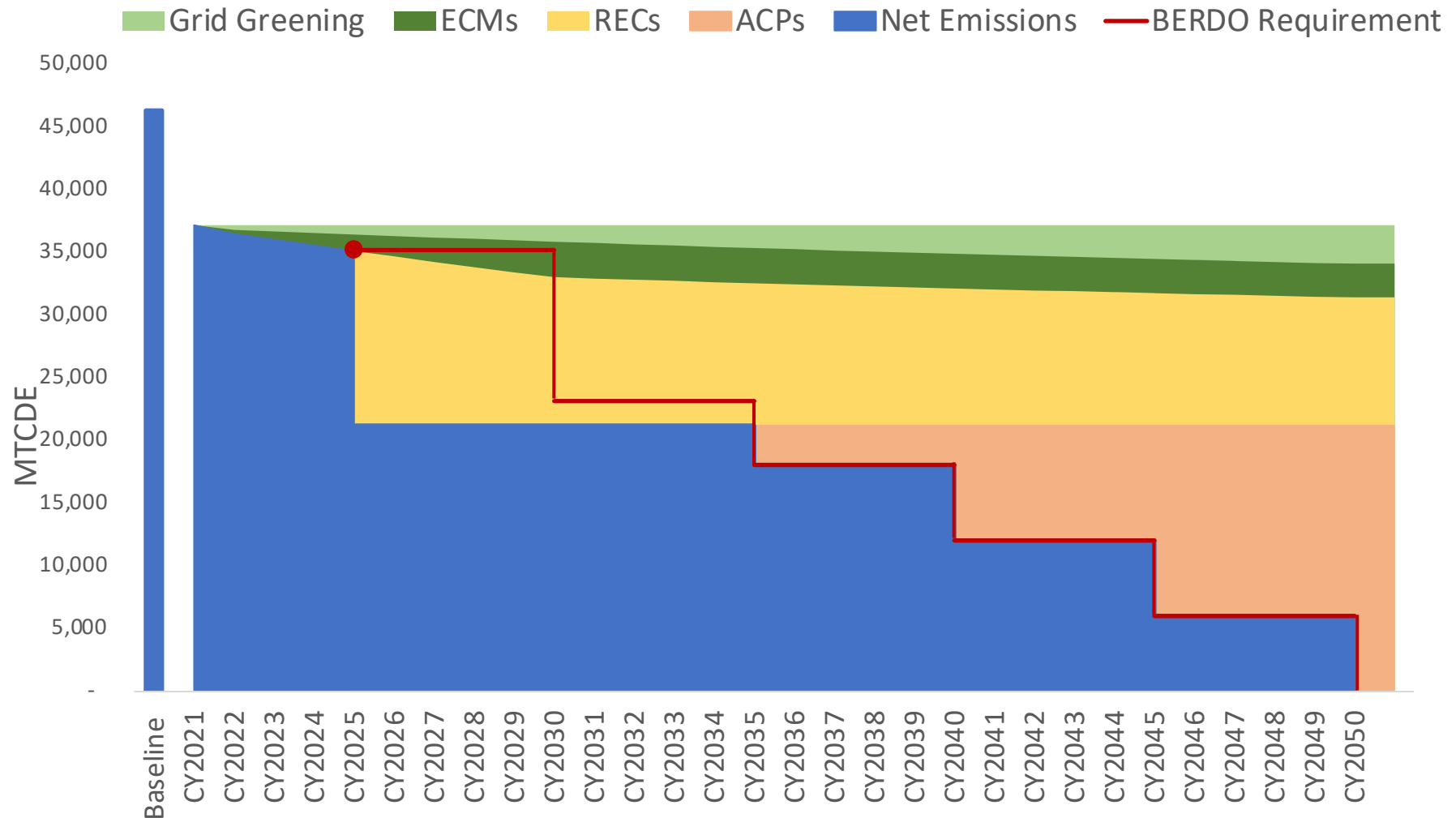
1. Reduction of GHG emissions due to the “Greening” of the grid
2. Improvements in building and utility distribution energy efficiency
3. Implementation of technological advances
4. Electrification of heating hot water and steam utilities
5. Purchase of Renewable Energy Credits (RECs) to offset electricity emissions:
 - Purchase MA Class I Renewable Energy Certificates (RECs)
 - Enter into a PPA agreement for Renewable energy (additionality requirement needs to be met)
6. Purchase of Carbon Offsets to net out the remaining amount of GHG emissions

EMISSIONS AND ENERGY

Reducing Emissions Further



In alignment with HU's 2026 and 2050 goals, as well as City of Boston regulations, HMS projects the following greenhouse gas reduction schedule for the School:



EMISSIONS AND ENERGY

Focus on laboratory environments

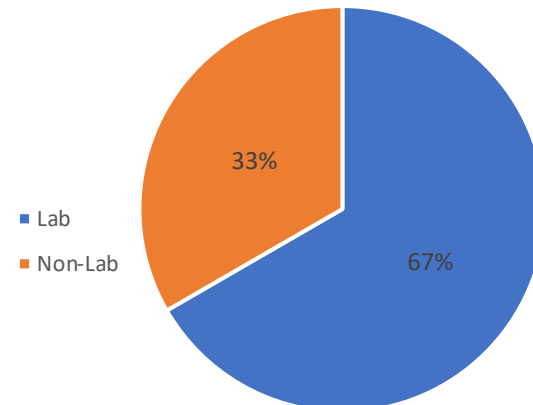


Laboratories at Harvard University consume 46% of energy on campus but represent only 22% of the total square footage, illustrating the unique challenge that research-focused organizations face as they seek to reduce their emissions footprint.

This challenge is especially evident at HMS, where nearly 67% of space belongs to labs, which are responsible for 80% of the campus's total annual energy consumption. Sustainability and efficiency achievements on campus must keep up with the expansion of research, increased building population density, and the continued introduction of delicate, energy intensive equipment.



HMS Square Footage



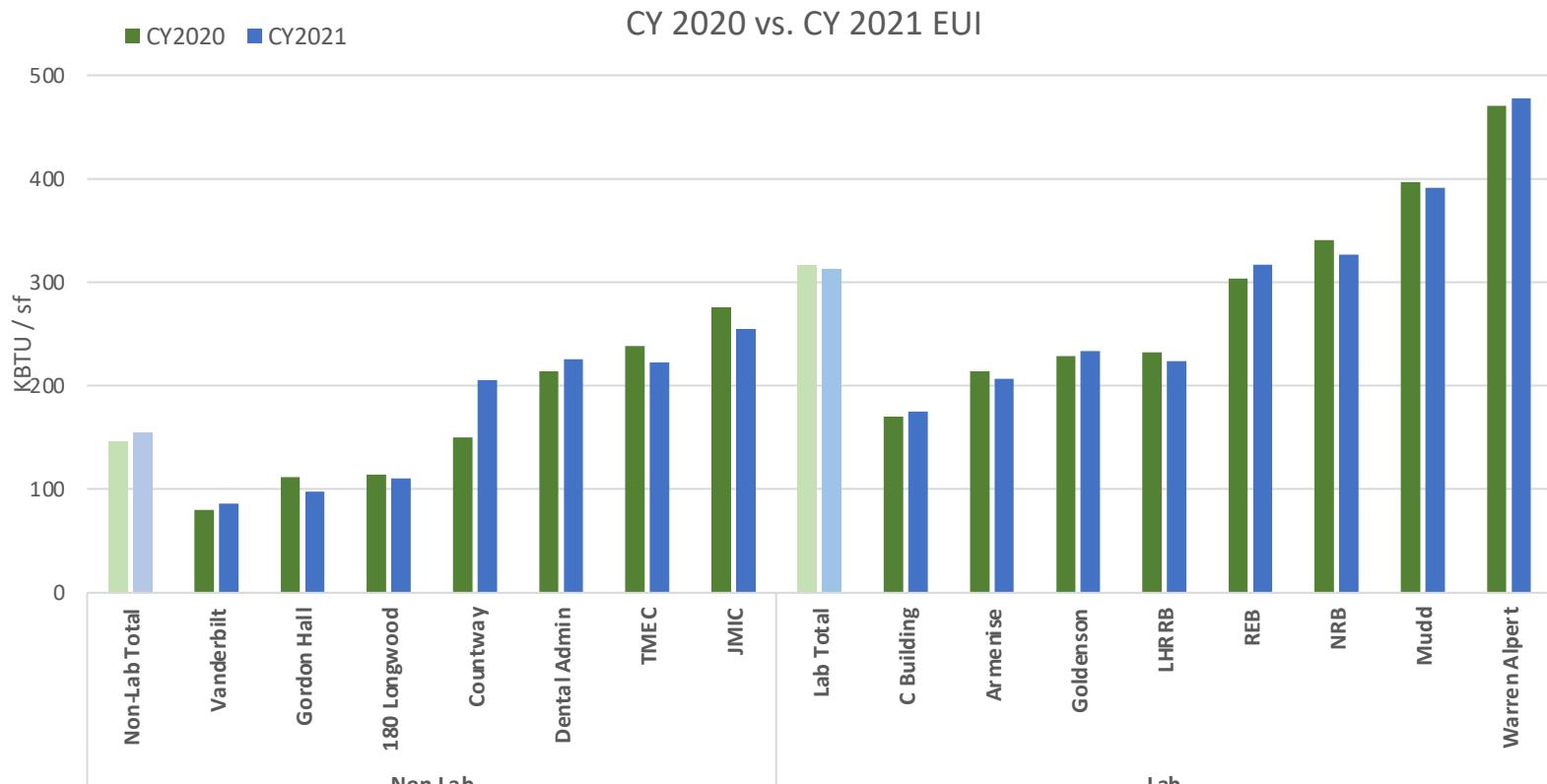
EMISSIONS AND ENERGY

Focus on laboratory environments



Which buildings are most intensive?

HMS's buildings, split between lab buildings and non-labs, and their Energy Use Intensities (EUI), in CY2021. EUI is a measurement of a building's annual energy consumption relative to its square footage, and allows for comparison between buildings. Buildings most impacted by the pandemic were non-lab buildings, in CY20.



EMISSIONS AND ENERGY

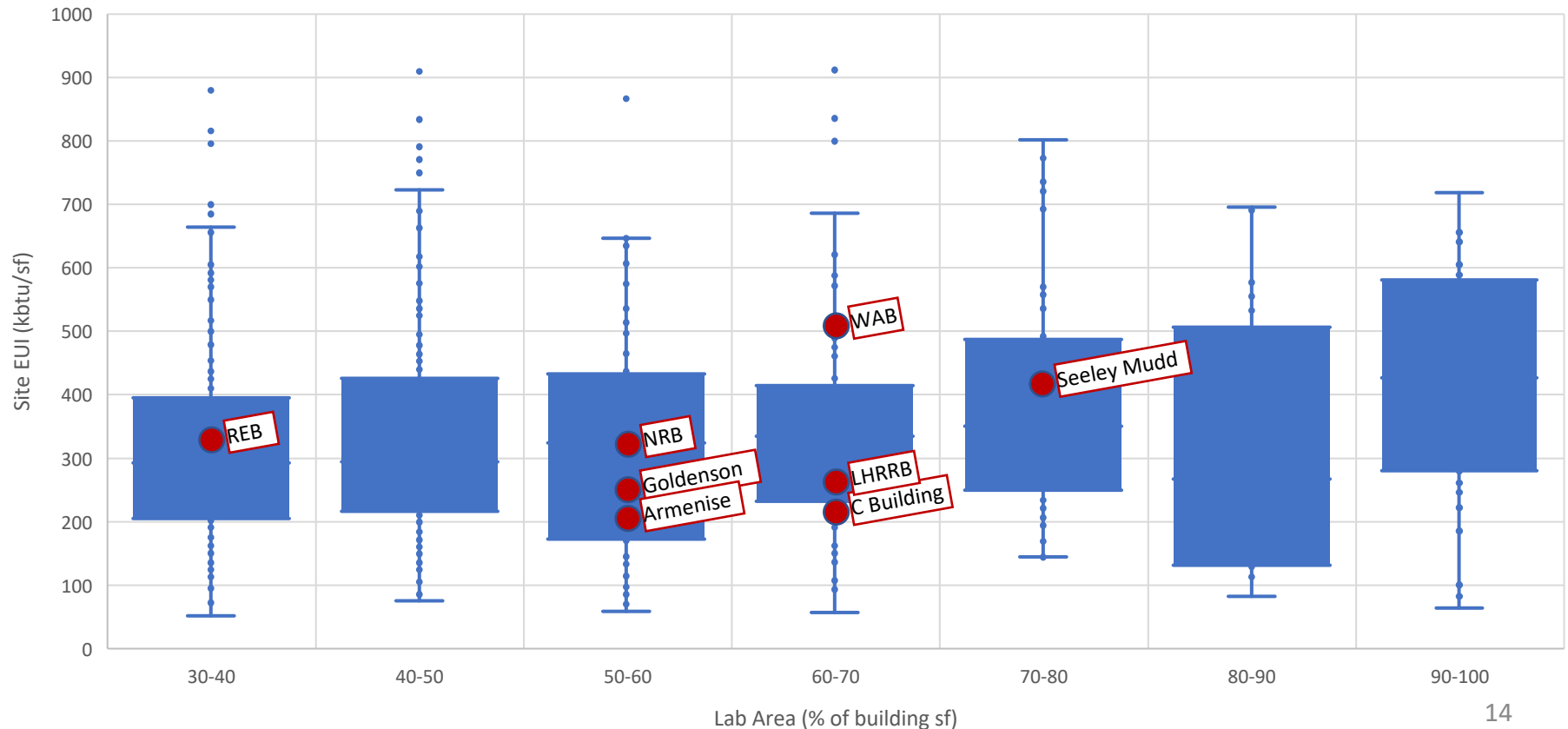
Focus on laboratory environments



How does HMS compare to its peers?

This chart shows HMS's lab buildings placed in a data set from the International Institute for Sustainable Laboratories (I2SL), which maps buildings by the proportion of square footage dedicated to labs versus their CY21 EUI.

Site EUI(kBtu/sf/yr): HMS with Peer Institutions

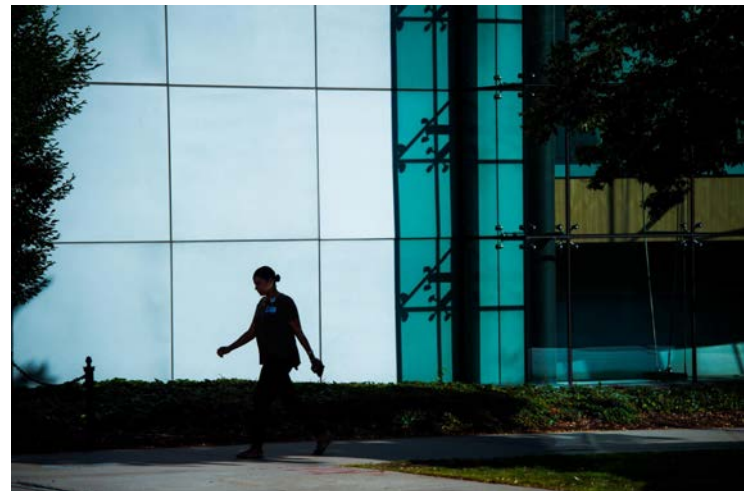


EMISSIONS AND ENERGY

CY21 ECMs and Strategic Energy Projects

CY 21 Projects

- Clockworks Analytics Fault Detection Software
- Energy Retrofits and Retro-commissioning Projects
- NRB Heat Recovery System Improvements
- Compressed Air Energy Audit Phase 1 & Long Range Plan
- Compressed air leak detection and repairs
- Thermal Imaging of Building Exteriors
- Ultra-Low Temperature Freezer Preventive Maintenance Program
- NRB power factor improvement project
- Lighting LED Upgrade projects



EMISSIONS AND ENERGY

ECMs and Strategic Energy Projects



Clockworks 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 2021, HMS resolved 13 major issues identified by Clockworks, including simultaneous heating and cooling, sensor failures, fixing pneumatic controls and other issues which helped to achieve significant energy savings and reduce greenhouse gas emissions by about 284 MTCDE



EMISSIONS AND ENERGY

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 improve the longevity of mechanical and electrical equipment, lowering operational expenses. The following projects were implemented in CY21:

- Improve air handling units' operation and reduce simultaneous heating and cooling by replacing valves, dampers and actuators
 - NRB AHUs 7 & 12 chilled water valve replacements
 - TMEC AC-1 pneumatic to DDC upgrades
- Compressed air leak detection survey & repairs across entire campus
- Commissioning NRB's compressed air system
- Re-programming for optimization of mechanical heating, ventilation, and air conditioning equipment



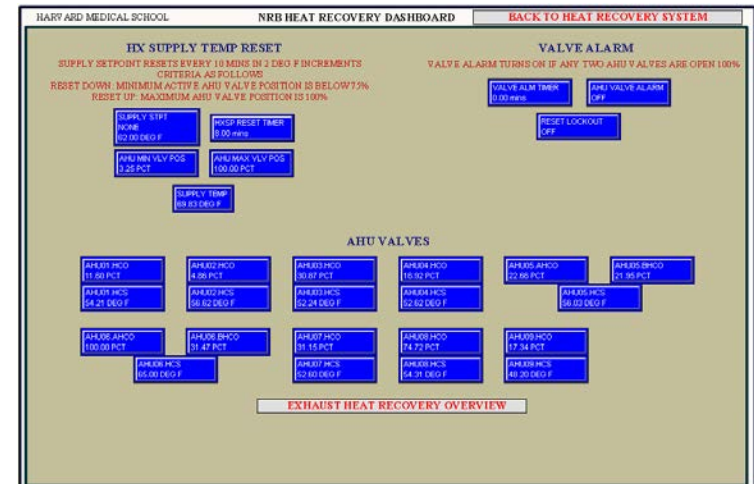
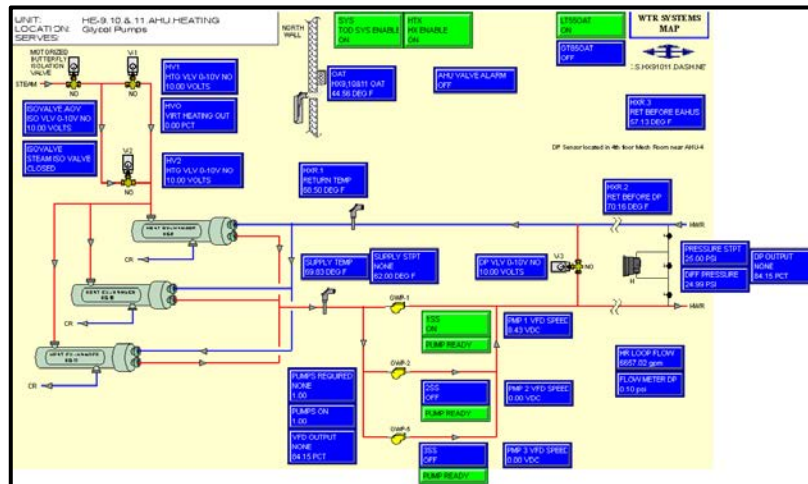
EMISSIONS AND ENERGY

ECMs and Strategic Energy Projects

Energy Retrofits and Retro-Commissioning Projects

In 2021, Facilities implemented improvements to NRB's heat recovery system which included:

- Repair/replacement of outdated and obsolete automation equipment
- Installation of new pressure and temperature sensors for improved visibility
- Creation of new program for calculating the quantities of recovered heat
- Helped to generate steam and chilled water savings by optimizing the heat recovery process and providing better process control and visibility



EMISSIONS AND ENERGY

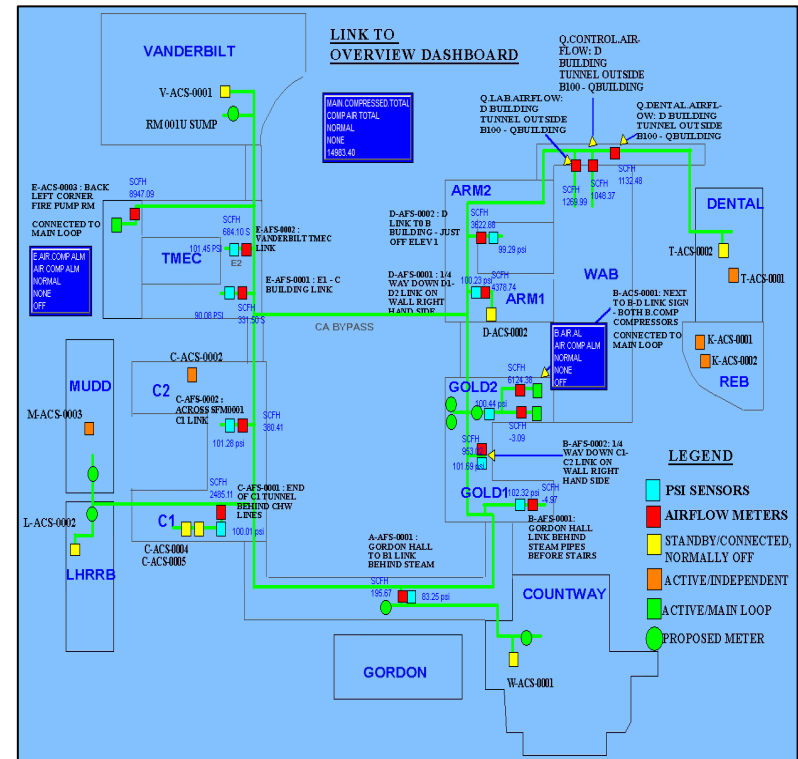
ECMs and Strategic Energy Projects

Compressed Air Repairs & Long Range Plan

HMS is working on improving energy efficiency and reducing operation and maintenance cost of its central compressed air system.

Phase 1 focused on understanding building consumption and the detection and repair of leaks.

Subsequent phases, to be completed in CY22 and CY23, will focus on campus-wide replacement of all pneumatic devices with DDCs with a final goal of decentralizing this utility as a whole.



EMISSIONS AND ENERGY

ECMs and Strategic Energy Projects



Thermal Imaging of Building Facades

During the winter months, Facilities conducted thermal imaging of building facades and exterior doors to highlight thermal leakage areas otherwise difficult to detect or diagnose with the naked eye. Once identified, adding weather-stripping and aligning exterior doors for a tighter seal is a simple but effective measure to keep heat in. Below are thermal images taken during the study – darker areas indicate where cold air is getting in through these doors.



EMISSIONS AND ENERGY

ECMs and Strategic Energy Projects

Ultra-Low Temperature Freezer PM Program

This preventive maintenance (PM) program serviced 270 -80C freezers across the campus. This service includes cleaning, inspection and testing of the condenser, filter, gaskets, compressors, motors and alarm operations. Regular service and cleaning of ULTs allows the appliance to operate at maximum efficiency which saves energy, as well as reduces the risk of failure and potential loss of research.

# of Freezers Serviced, by Department	
Systems Bio	29
Cell Bio	50
BCMP	42
NeuroBio	30
LSP	9
MicroBio	37
Genetics	59
ImmunoBio	14
Sum	270



Thinking of holding a cleanout or buying a new ULT? Check out the OFS Guides to: [Annual Freezer Cleanout](#) or [ULT Purchasing Guide](#).

EMISSIONS AND ENERGY

Lighting Projects



NRB Capacitor Bank Replacement

NRB's capacitor bank was replaced for a better power-factor resulting in electrical cost savings. Higher power factors indicate that grid incoming power is being used more effectively in the building.



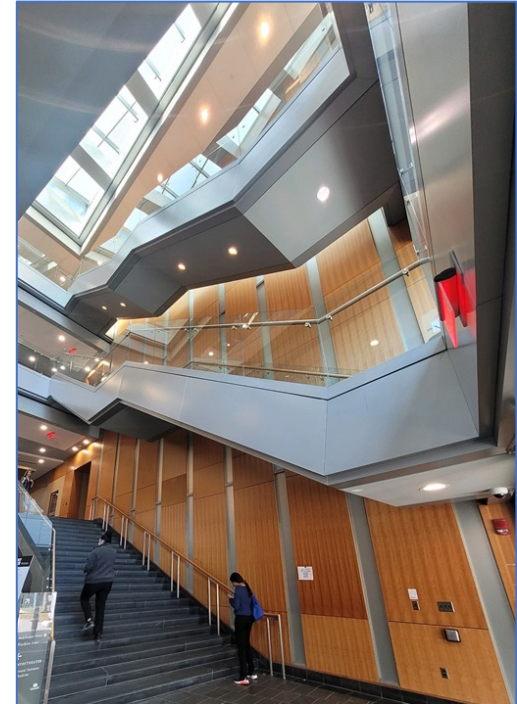
EMISSIONS AND ENERGY

Lighting Projects

GreenerU

At the end of 2020, HMS Facilities developed a comprehensive energy conservation program for the campus including campus-wide LED lighting upgrade projects. In 2021, the following upgrades have been completed:

- NRB: 8,348 fixtures and fluorescent lamps replaced with LEDs
- Vanderbilt:
 - Corridors: 48 new LED lights in corridors and ensured occupancy sensors operate correctly
 - Athletic Courts: 20 new LED fixtures and 10 new occupancy sensors
- This resulted in annual emission reduction of about 872 MTCDE



EMISSIONS AND ENERGY

Renewable Energy Generation

NRB Solar PV System

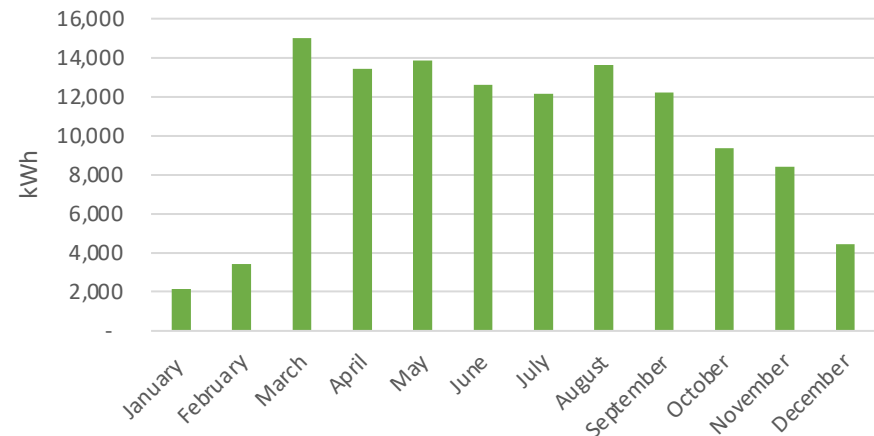
380 solar panels were interconnected in January 2021 on two adjacent sections of the roof of the New Research Building. The power output from the system is directed to the building's main switchgear and supplements power provided by Eversource.

Production Stats CY2021:

- ~121 MWh generated
- ~35 MTCDE of avoided CO₂ Emissions



NRB Solar Production (CY2021)



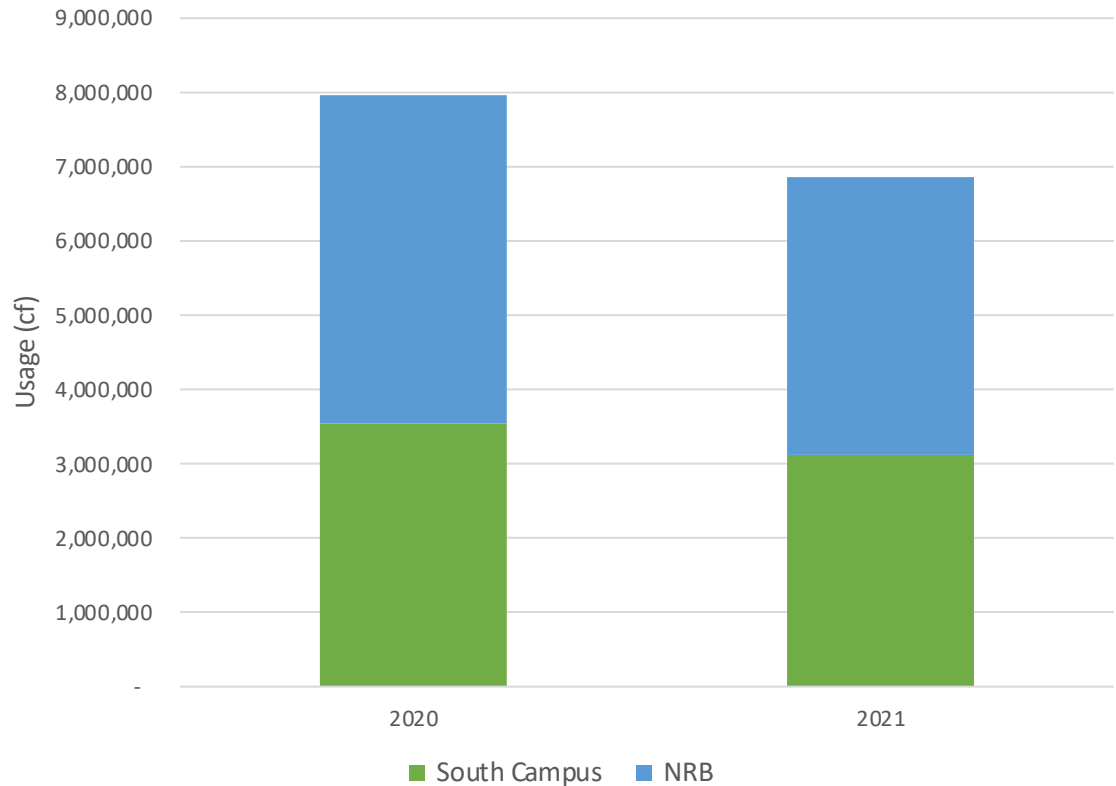
CAMPUS OPERATIONS

Water Conservation

HMS's water conservation projects have generated a ~13% reduction in total water usage between CY20 and CY2021.

This included improvements to NRB's cooling tower system, campus irrigation controller system, as well as replacements of leaking quenching valves on th sterilizers and autoclaves

2020-2021 HMS Water Consumption



CAMPUS OPERATIONS

Waste Disposal

Regular Waste

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 were the largest contributors to these changes.

Now, after campus reopening, CY21 disposal has increased again, but has not returned to pre-pandemic levels.

Campus Regular Waste (Tons)	Compost	Single Stream Recycling	Municipal Solid Waste
FY2019	157.5	312.1	983.1
CY2020	70.5	251.5	767.1
CY2021	90.1	233.7	819.3



CAMPUS OPERATIONS

Waste Disposal

Bio-waste

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



Please visit [HU Environmental Health & Safety](#) for more information on proper management of laboratory wastes.

	CY2020	CY2021
Bio-Waste (tons)		
South Campus	58.17	63.79
NRB	66.83	79.56
Total	125.00	143.35

CAMPUS OPERATIONS

Waste Disposal

Pipette Tip Box Recycling

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

CY21 Totals (lbs)	
South Campus	10,738
NRB	12,301
Total	23,039



HMS recycled 10.45 metric tons of tip boxes in CY21!

ACCEPTED ITEMS

MOST BRANDS OF
PIPETTE TIP BOXES,
WAFERS, AND LIDS

CONICAL TUBE
RACKS ONLY

MEDIA BOTTLES
(TRIPLE RINSED AND
DRIED)

CLEAN #1 AND #5 LAB
PLASTICS

**GreenLabs
RECYCLING**

NOT ACCEPTED

ANYTHING THAT
CONTACTED A
BIOHAZARD

PIPETTE TIPS

GLOVES

PACKAGING
MATERIALS

WELL PLATES

EPPENDORF
WORKING BOX

#6 MEDIA
BOTTLES

#2, 3, 4, 6 OR 7
PLASTIC

NATURE AND ECOSYSTEMS



Countway Community Garden



Countway Plot
Managed by Countway Cares

CULTURE AND LEARNING

Eco-Opportunity

EcoOpportunity

- Open to all students and staff
- Gather to discuss sustainability priorities and projects on campus and beyond
- Brainstorm new campaigns
- Connect with other sustainability advocates from all across the HLC campus!

ECO OPPORTUNITY

Get involved in sustainability on campus!



Contact:

ecoop@hsph.Harvard.edu

sustainability@hms.Harvard.edu

HEALTH AND WELL-BEING

Harvard Sustainability & Health Resources

Harvard Sustainable Meeting and Event Guide

TOP 10 TIPS FOR BETTER MEETINGS

FROM THE HARVARD SUSTAINABLE MEETING AND EVENT GUIDE

The Harvard Sustainable Meeting and Event Guide was created to support a culture of health and wellness in meetings and conferences across the University. Start with these 10 tips to help employees, students, and visitors eat well and be active while reducing their environmental impact.

FOOD AND BEVERAGES

Always ask caterers to label common allergens, such as nuts and shellfish.

- Make pitchers of tap water the featured beverage. Add fruit to some pitchers for a flavor-infused option.
- Opt for plant-based proteins for the main dish, like beans, lentils, or tofu.
- Offer fruits and/or vegetables every time food is served.
- Always serve whole grains instead of refined grains (like brown rice in place of white rice).
- When offering snacks, serve whole or cut fruit, vegetables and hummus, or unsalted nuts.
- Coffee and tea make for a satisfying end to a meal. If dessert is necessary, opt for a combination of dark chocolate, fresh fruit, and unsalted nuts.

WASTE REDUCTION

- Ask your caterer to use reusable, recyclable, or compostable serving items.
- Make sure your meeting room has a "waste station" with clearly-marked recycling, compost, and trash bins.

MOVEMENT

- Periodically break up sitting time with standing, walking, or light stretching.
- Inform attendees of which stairwells, elevators, and restrooms they may use, including any on other floors.

CHECK OUT THE FULL GUIDE AT GREEN.HARVARD.EDU/EVENTGUIDE

Become a Green Office



Harvard Green Office Program
Office for Sustainability
www.green.harvard.edu

Lighting Comparison

	Incandescent	LED
Life span (hours)	1,000	25,000
Lumens/Watt	15	80
Energy use (kWh/year)	100	20
Annual operating cost	\$100	\$20

Power Management

For Windows

1. Stop
2. Cut

Suggest to

* You can manually or Hibernation

Add

- You can
- Screen off
- Save

HELP KEEP OUR BUILDING GREEN.

DID YOU REMEMBER TO SHUT DOWN YOUR COMPUTER & TURN OFF YOUR POWER STRIP?

LAST ONE LEAVING YOUR FLOOR?

PLEASE TURN OFF PRINTERS, COPIERS, FAXES, & OTHER ELECTRONICS.

 **GREEN**
is the new Green



Connect & Learn More

Ruben Avagyan

Energy Manager

Ruben_Avagyan@hms.Harvard.edu
617-432-7997

- 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

Stan Karachev

Energy Performance Analyst

Stanislav_karachev@hms.Harvard.edu
617-432-0018

- 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

Colette Baker

Energy Billing Analyst

Colette_baker@hms.Harvard.edu
617-432-0169

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