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Implementing Green Fitout Projects in LEED Platinum Core and Shell Commercial Science Buildings

October 2025

Learning Objectives

1. Understand the impact of Tenant/Landlord leasing agreements and the tenant demands, priorities, and expectations.
2. Define the elements of a LEED Platinum Core and Shell Buildings, identifying their impact on energy consumption and emissions.
3. Discuss infrastructure trends and opportunities and how they impact “green” fitout strategies.
4. Review and discuss case studies that showcase successful green fit-out projects and identify lessons learned and best practices.

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Buro Happold I2SL Partnership

Buro Happold is a Sponsor of the Labs2Zero program and is engaged in several of the Technical Advisory Committees (TAC) for the Labs2Zero program.

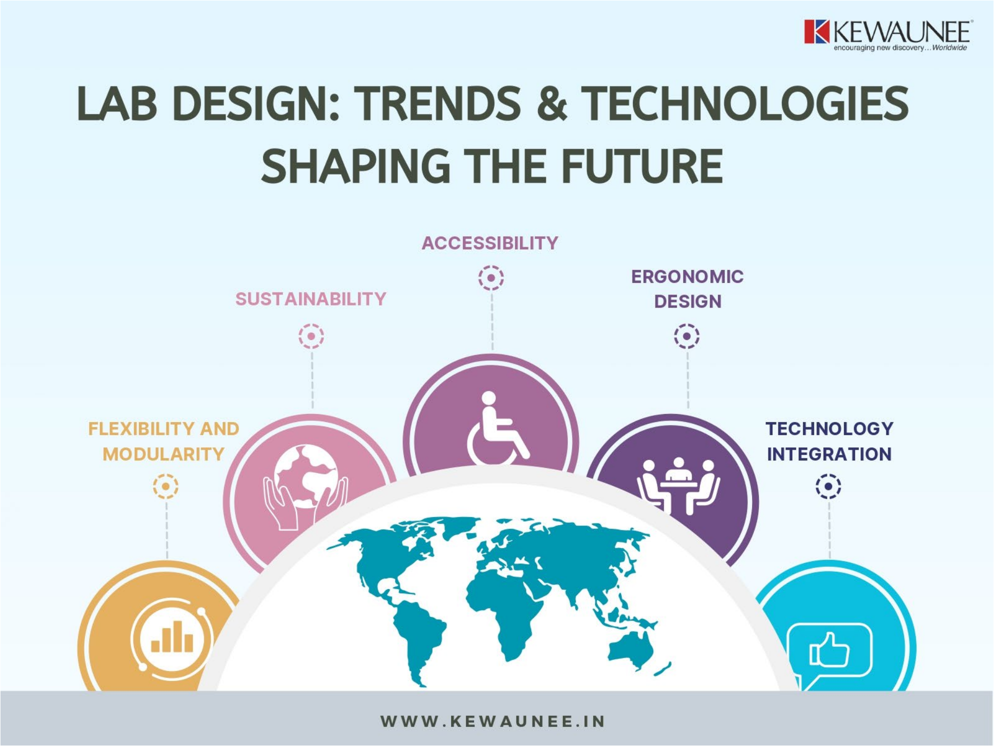
Measures and Impacts TAC Contributions

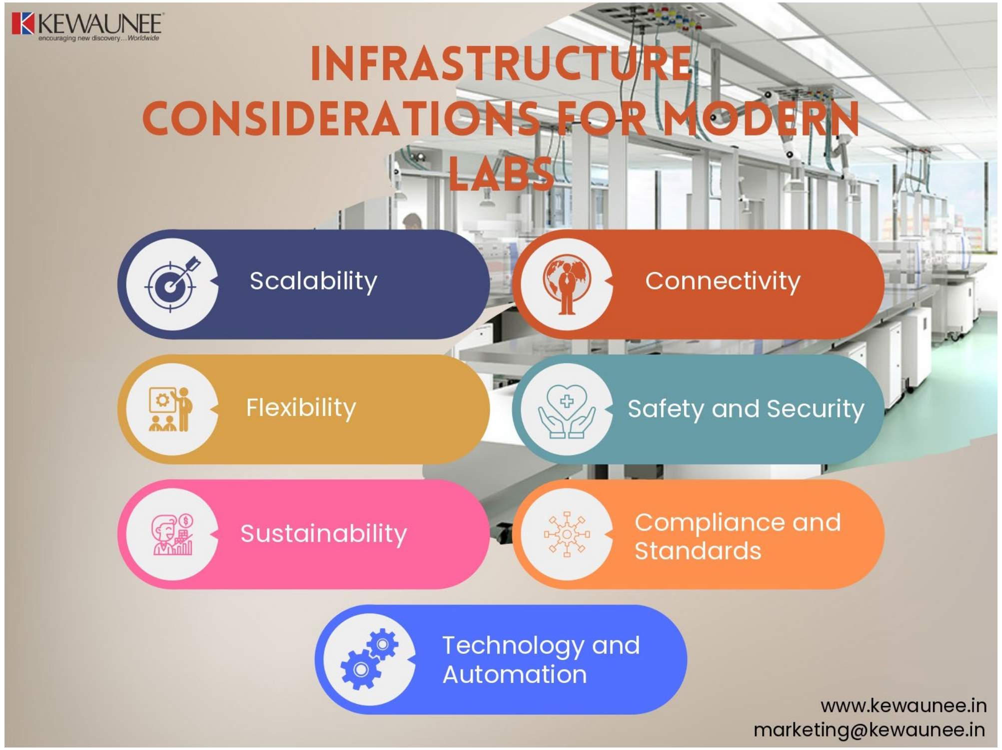
Measure Name
Wind-Responsive Exhaust Fan Control
IEQ Monitoring-Based Control of Exhaust Fans
Convert Staged or CAV Exhaust Fan Controls to VAV Control
Staged Control for Constant Volume Exhaust Fans
Convert CAV HVAC System to VAV
Demand Based Control of Ventilation Using IEQ Sensors
Unoccupied Room Airflow Setback
Decommissioning or Hibernating Unused Hoods
Purchase High Efficiency ULT Freezers
Freezer Challenge -- All Energy Actions
Fume Hood Shut-the-Sash Program
Exhaust-Air to Outside-Air Heat Recovery Systems

Universal Laboratory Trends

- Safe, Healthy and Sustainable Environment
- Talent Recruitment and Retention
- Flexibility and Adaptability: Modular Solutions and Ease of Access to Building Services
- Less Wet Lab, More Computational and Automated Science Space
- Integration of Technology and Data Sciences: AI, Automation and 3D Visualization
- Shared Services, More Amenity Space and Resources Optimize Collaboration and Convergence
- The Convergence of Data Sciences, Healthcare and Life Science Research

Laboratory Infrastructure Trends





Landlord/Tenant Assumptions

GENERAL

- Base Building space/shaft to support (1) 10,000 SF tenant vivarium
- Base Building systems to support 1 tenant/floor on average
- LEED V4 Core and Shell Platinum

HVAC

- 1.5 CFM/SF to lab space
- 0.35 CFM/SF to office space
- 60/40 Lab to Office ratio
- N+1 pumping for all systems
- Manifolded lab exhaust with glycol energy recovery, N+1 exhaust fans
- Tenant SF allowance: space provided in penthouse for dedicated systems

ELEC

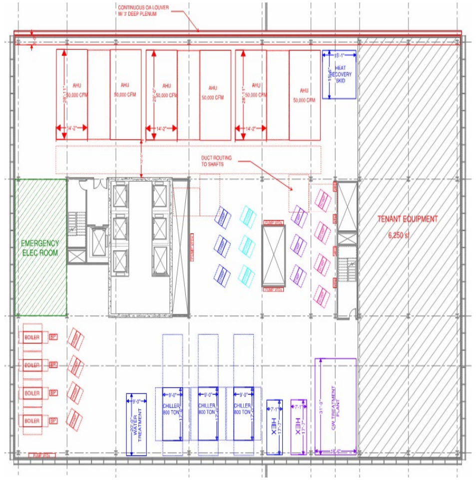
- Electrical service loads for Tenant spaces will be designed as follows:
  - 15 watts/SF for lab
  - 6 watts/SF for office (Tenant loads only)
- Diesel generator for base building life safety and optional standby. Sizing will include 0.2 w/sf for tenant life safety egress lighting
- Any additional office and lab Tenant optional stand-by power service to be provided by the Tenant.

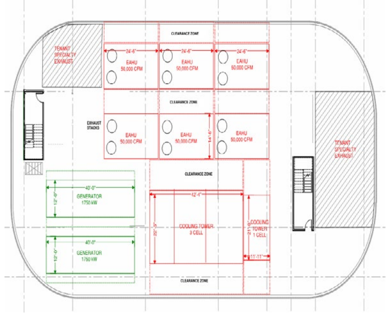
P/FP

- Base Building: 4" lab waste and vent risers to each lab floor. Qty 4 per floor
- Base Building: 4" san waste and vent risers to each lab floor. Qty 4 per floor
- Base Building: Lab waste on L1 by base building
- Base Building: Local hot water heaters to serve core bathrooms, janitor, showers
- Base Building: Tempered water heaters (assumes multi tenant building)
- Base Building: Space for tenant provided equipment in penthouse
- Base Building: Plumbing closet stacked (current and future services)
- Base Building: Building grease interceptors
- Base Building: Accessible shaft space
- Tenant : Non-potable/potable water heaters
- Tenant: Lab gases, air compressor, vacuum system, RO

Flexible Laboratory Considerations

- Building program (office to lab ratio)
- MEP space planning (plant rooms, shafts, roof)
- Access to MEP services
- Future equipment/systems/distribution
- Floor-Floor calibration
- Resiliency
- Modular systems (operations, redundancy)
- Smart building operations

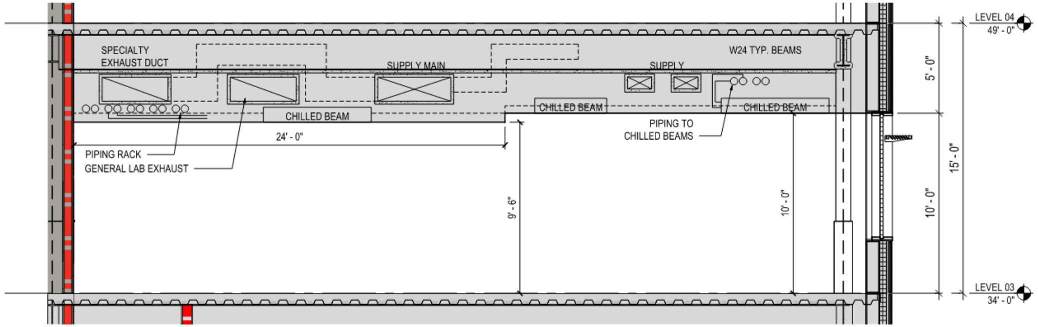




	Clear Height	Plant Area & Distribution	Heating & Cooling Output	Maintenance	Life Span	Sustainability/ Energy Performance	Flexibility	User Controllability	Compatibility with natural ventilation	Compatibility with exposed soffit	Coordiantion with Structure	System Cost	Acoustics	Compliance with Brief	TOTAL SCORE
Chilled Beams (passive or active)	2	2	3	3	3	3	3	3	2	3	3	2	3	3	**38**
Fan Coil Units	2	2	3	2	3	2	3	3	3	2	3	3	1	3	**35**
Chilled Ceiling	3	2	2	3	3	3	2	1	2	3	3	2	3	3	**35**
Chilled Slab	3	2	1	3	3	3	2	1	2	3	2	1	3	3	**32**
All Air - Variable Air Volume	1	1	3	2	3	3	2	2	2	2	1	2	2	3	**29**
DX Split / Variable Refrigerant Flow	2	1	3	1	0	2	2	3	3	2	2	3	1	0	**25**

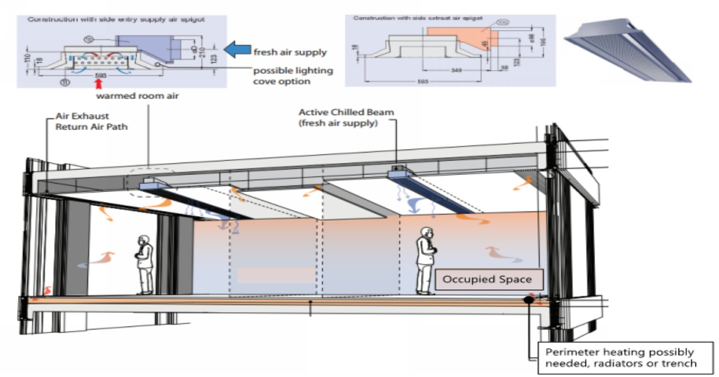
Scoring: Good 3, Fair 2, Poor 1, Not Compliant 0

Lab Flexibility Assumptions



HVAC

- Airside allowances
  - Lab: 1.5 to 2 CFM/SF
  - Office: 0.35 CFM/SF
- Hydronic allowances
  - Tonnage/flow for process cooling
- Modular systems
  - Manifolded equipment (redundancy, optimization of part-load operation)
- Resiliency
  - N+1 for pumping systems
  - N-1 or N+1 for fan systems
- Future needs
  - Indoor/outdoor space for specialty equipment
  - Accessible shafts with allowance for future duct and pipe risers



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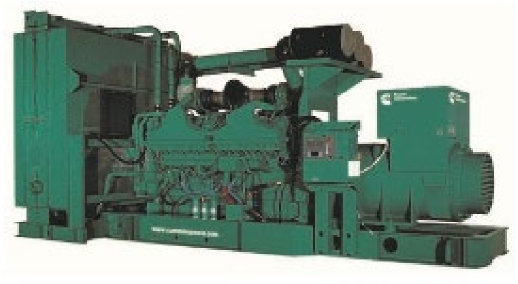
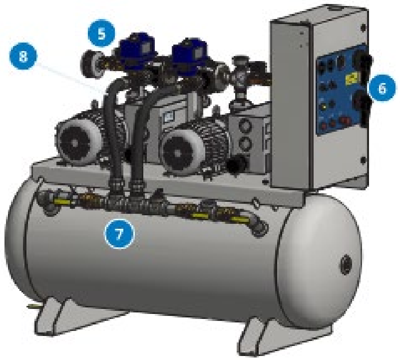
Lab Flexibility Assumptions

ELEC

- Electrical service loads will be designed as follows:
    - 15 to 40 watts/SF for lab/research
    - 6 watts/SF for office/classroom
    - 35 to 100 watts/SF for café/kitchen
- Busduct risers for compact, flexible distribution
- Emergency Power for base building life safety and optional standby.
    - Sizing often includes 0.2 w/sf for life safety egress lighting
    - Any additional office, classroom and lab optional stand-by power service
    - Tie-into emergency system feeders
- Resiliency
    - Generators (fossil fuel)
    - UPS/Battery back-up
    - Fuel Cells



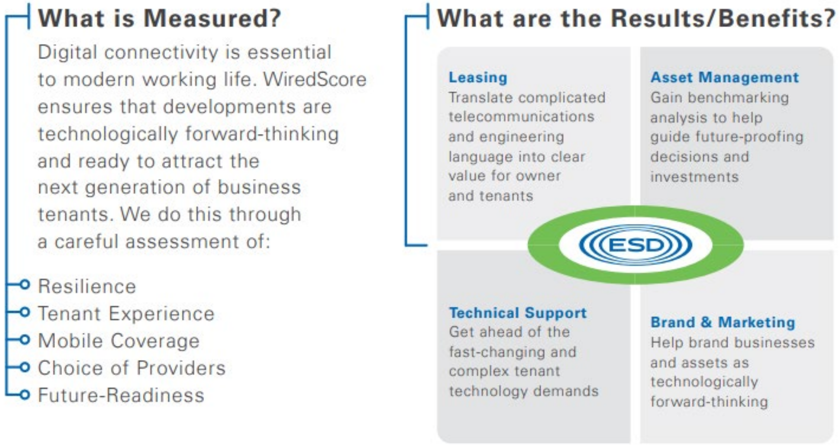
Lab Flexibility Assumptions



<u>Plumbing</u>

- Centralized Equipment
  - PH Neutralization
  - Compressed Air & Vacuum
  - Exterior Tank Farm and any specialty gas manifolds.
  - Process pure water RO System
- Lab waste and vent risers every other column for flexible sink and equipment locations.
- Lab services to overhead grid of ceiling panels with quick connects to allow for flexible lab bench layouts.
- Wet utilities (RO, lab H&CW and tepid water) looped throughout each lab floor for flexible sink and equipment layouts.

Smart Buildings



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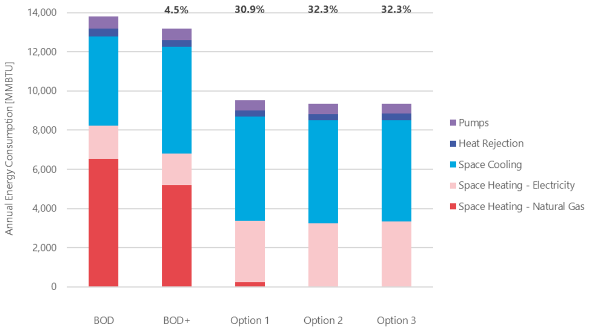
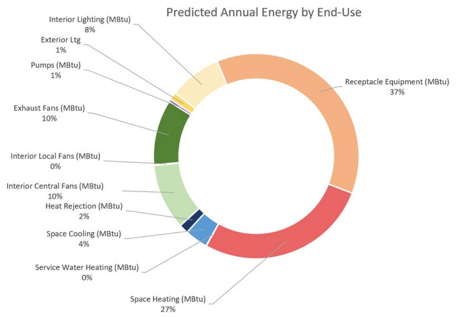
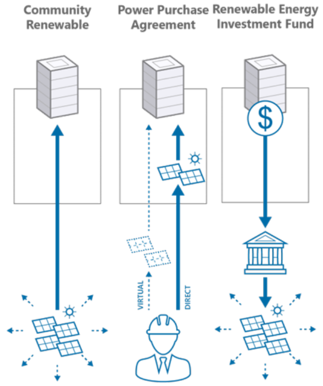
Typical Elements of a LEED Platinum C&S Design



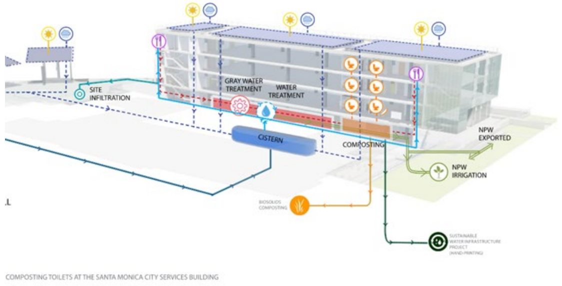
Deep Energy Reductions



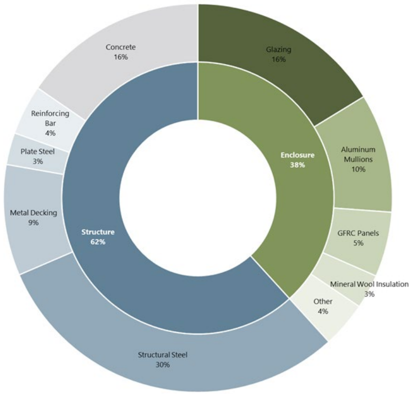
Advanced Energy Metering



Renewable Energy



Water Conservation/Reuse Strategies



Embodied Carbon Reductions

Enhanced Commissioning

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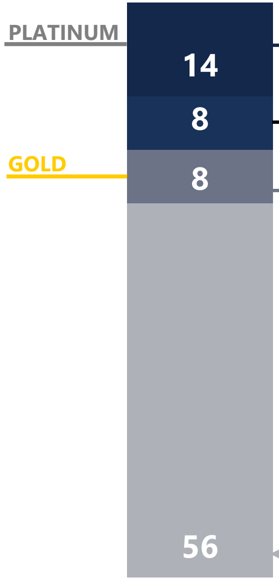
LEED Core & Shell - Sample



Low Hanging Fruit		Moderate Uplift		Significant Uplift	
Credit Description	Points	Credit Description	Points	Credit Description	Points
Electric Vehicles (EV charging stations for 5% of parking capacity)	1	Light Pollution Reduction	1	Rainwater Management (manage 90^{th} percentile of rainfall)	3
Outdoor water use reduction (75% reduction in the annual water use)	1	Enhanced Commissioning (envelope Cx)	2	Outdoor Water Use Reduction (reuse rainwater for irrigation)	1
Indoor Water Use Reduction (utilize 1.0 GPF toilets and 0.35 GPM lav.)	2	Green Power and Carbon Offset (offset 100% of annual energy use)	2	Indoor Water Use Reduction (reuse rainwater for toilet flush)	2
Enhanced IAQ Strategies (include walk-off matt for rooftop/ balcony entries)	1	Sourcing of Raw Materials (achieve the 30% threshold)	1	Cooling Tower Water Use (reuse rainwater and condensate)	1 + 1
Low-Emitting Materials (3^{rd} Point for 4 material categories)	1	Site Development and Restore Habitat (financial contribution = $0.40/ SF of site)	1	Optimize Energy Performance (Additional ECMs/Tenant Measures)	1-3
Construction and Demolition Waste Management	1	Building Life-Cycle Impact Reduction (Conduct LCA)	1	Renewable Energy (1% Cost Offset)	1
Monitoring-based Commissioning	1			Building Life-Cycle Impact Reduction (Achieve a 5% reduction)	1 + 1 RP

56 Points Readily Available to Project

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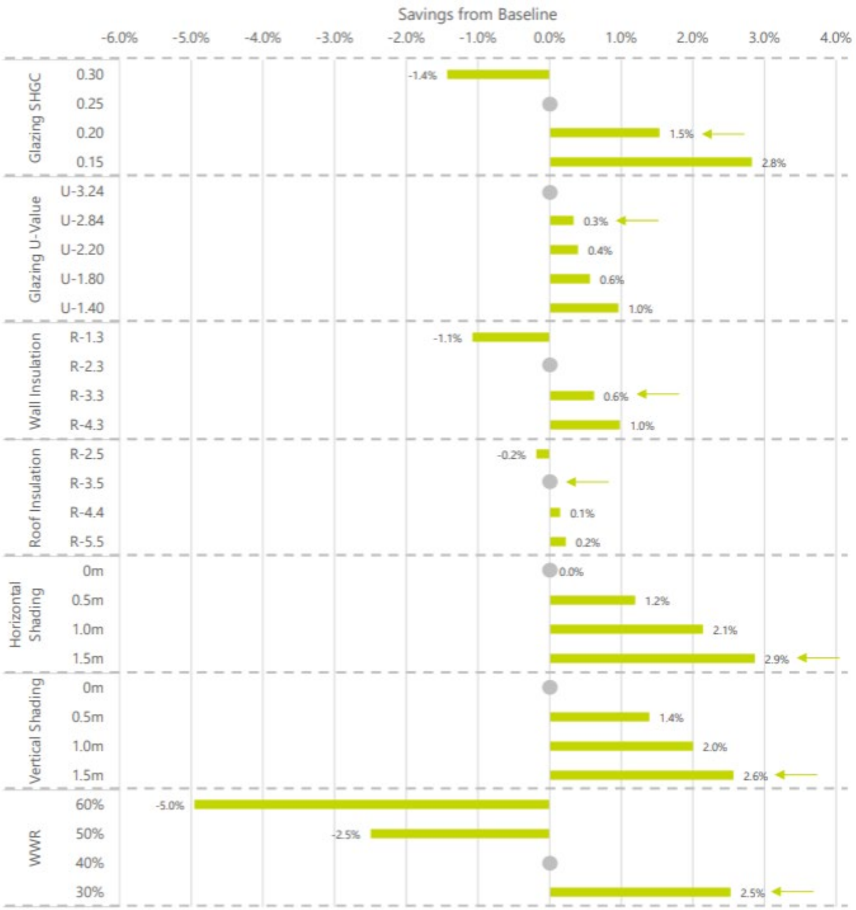
Passive Considerations
Iterative Design Studies

Massing and Orientation

Envelope Performance



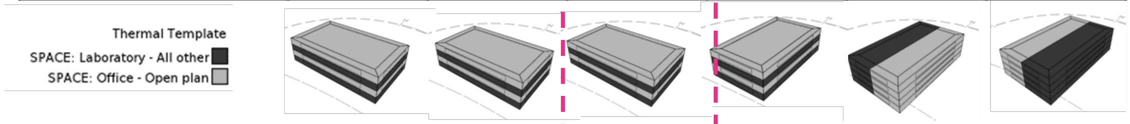
Iterative Design Strategies

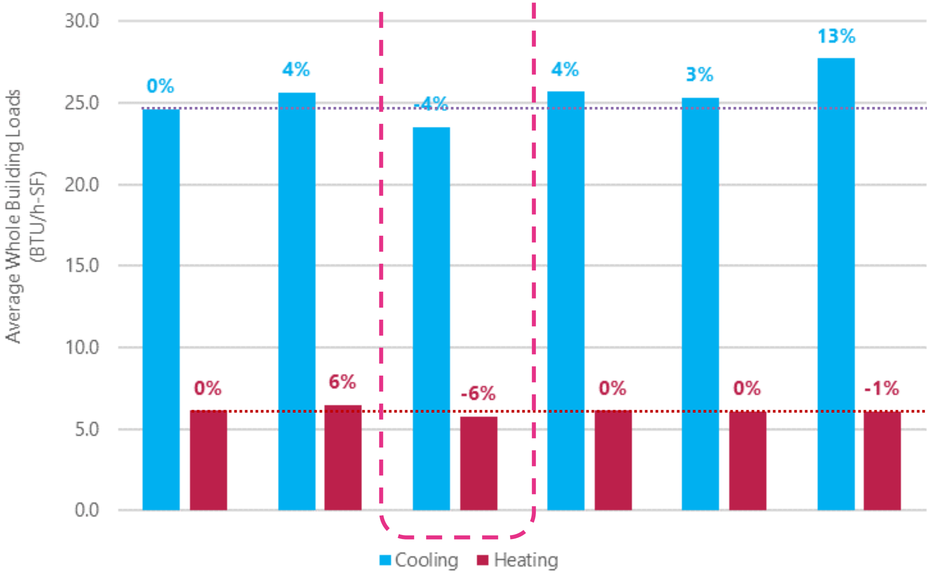
Programming

Reduce Peak Demand and Energy Consumption

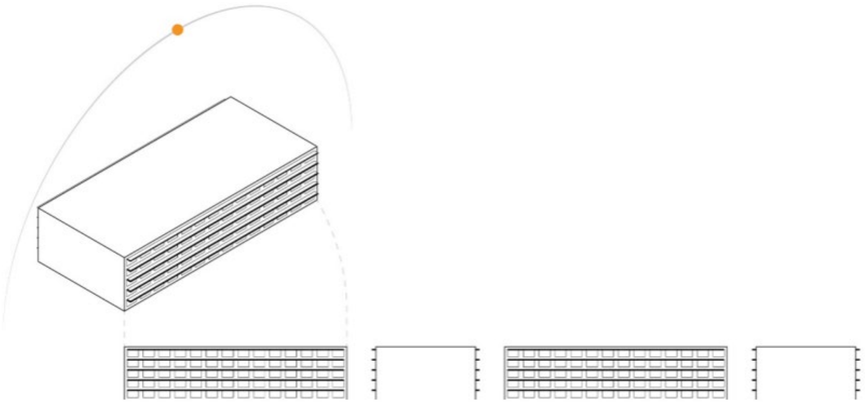
- East-West orientation has a 4% lower peak cooling load compared to North-South orientation
- Reduced WWR reduces peak cooling and peak heating load
- Labs should be evenly distributed throughout floor plate and should not be isolated to the east side of building.

	1	2	3	4	5	6
WWR	40%	50%	30%	40%	40%	40%
Building Orientation	E-W	E-W	E-W	N-S	N-S	N-S
Lab Placement	Floor-by-Floor	Floor-by-Floor	Floor-by-Floor	Floor-by-Floor	Lab on West Side	Lab on East Side

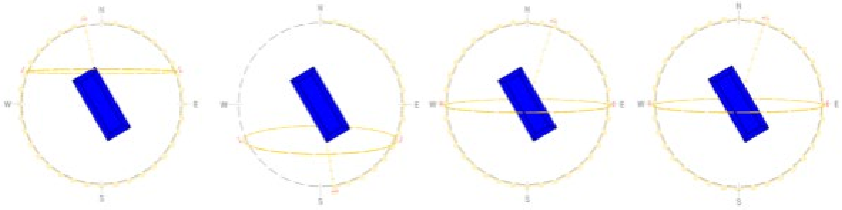


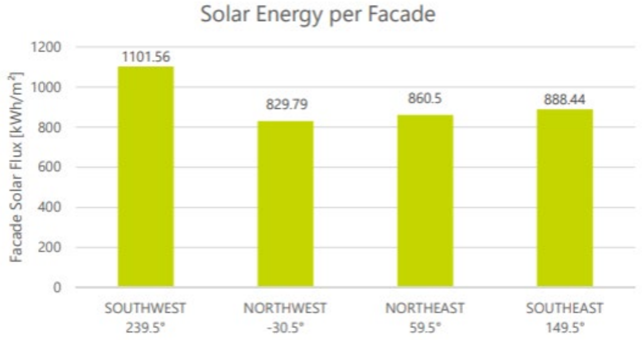


Iterative Design Studies

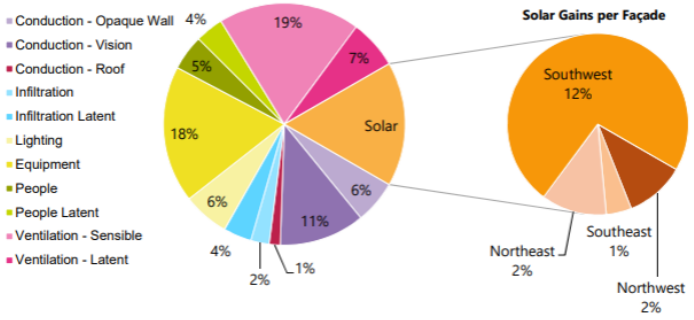


	S	W	N	E
Goals	Minimum glare and heat gain, maximum indirect daylighting	Reduce glazing	Minimum glare and heat gain, maximum indirect daylighting	Reduce glazing
WWR	40-60%	0-10%	40-60%	0-10%
Window U-value	2.8 (0.5)	2.8 (0.5)	2.8 (0.5)	2.8 (0.5)
Wall R-value	2.8 (16)	2.8 (16)	2.8 (16)	2.8 (16)
SHGC	0.25	0.20	0.25	0.20
Fixed Shading	Horizontal	Vertical	Horizontal	Vertical



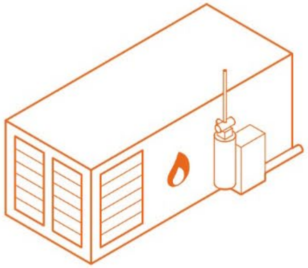


Internal Cooling Gain Breakdown



Redundancy & Resiliency

Many options are available to engineer back-up power to maintain building operations.



Large Generator (fossil/bio fuel)

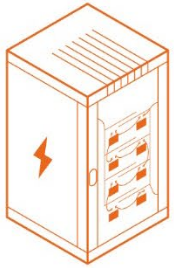
Fossil Fuel

Fossil fuel generators are currently industry standard, and biofuel options are becoming available.

Back-Up Natural Gas Boilers

Fossil Fuel

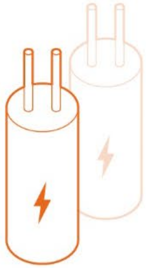
Maintaining gas boilers in a system for back-up only can limit large generator upsizing for electric heating systems.



Batteries (small, large)

Electric

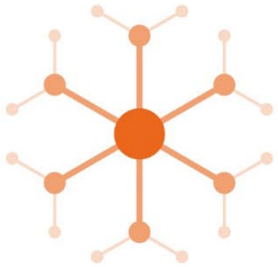
Technological improvements and cost reductions will support the ongoing feasibility of large battery back-up. Reliability must include appropriate time period for backup (e.g. 3 days).



Back-Up Electric Resistance Boilers

Electric

These boilers may be applicable for back-up only in cold climates where air-source heat pumps may be challenged in the coldest temperatures. This would require careful consideration for peak electrical loads.



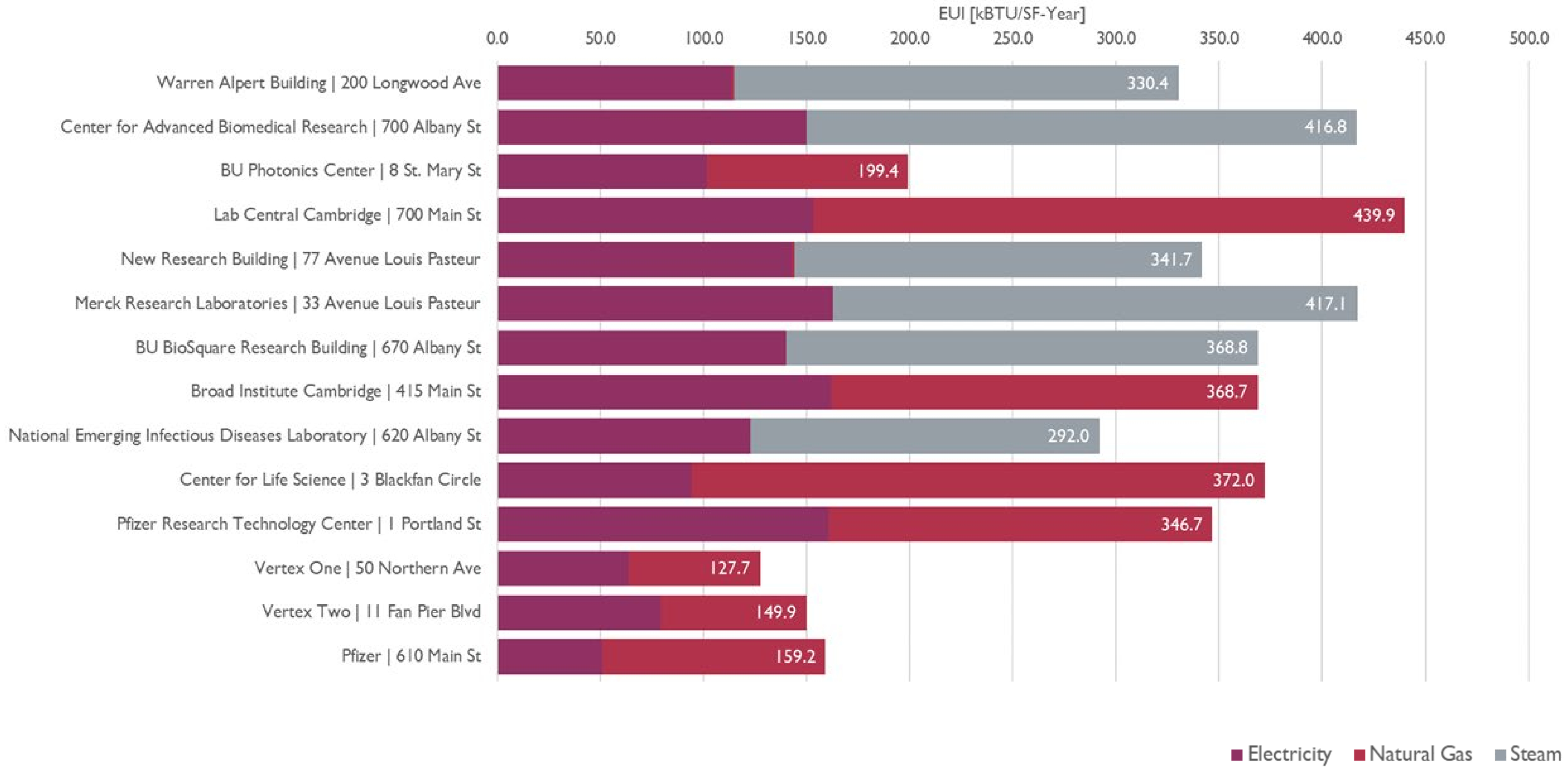
Microgrids

Various

Deployed at building or district scale, dynamic controls can island their energy supply in the event of a power disruption.

Benchmarking – Boston Area Labs

Energy Use Intensity



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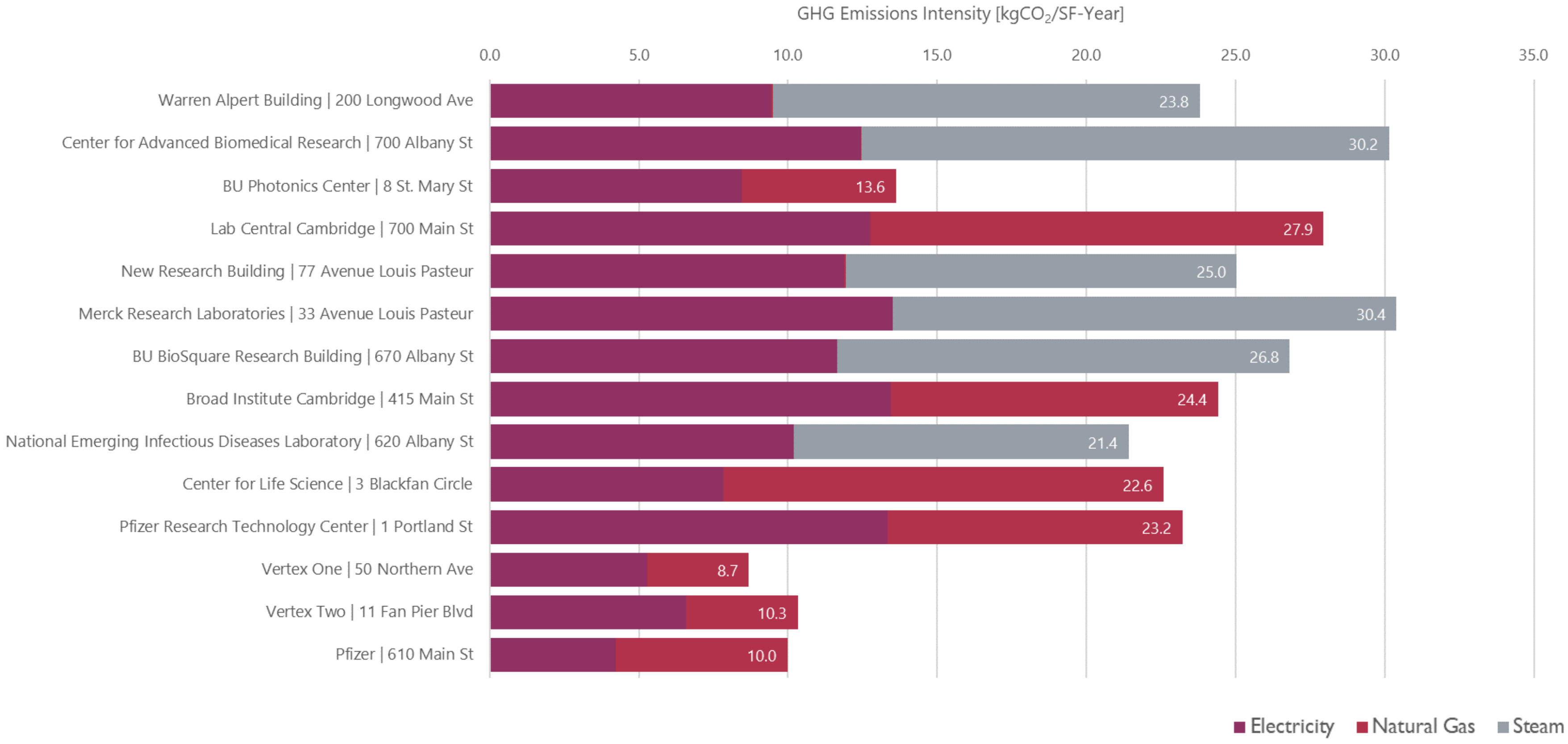
Benchmarking – Boston Area Labs

Operational Greenhouse Gas Emissions Intensity



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Grid Carbon Factors: MA

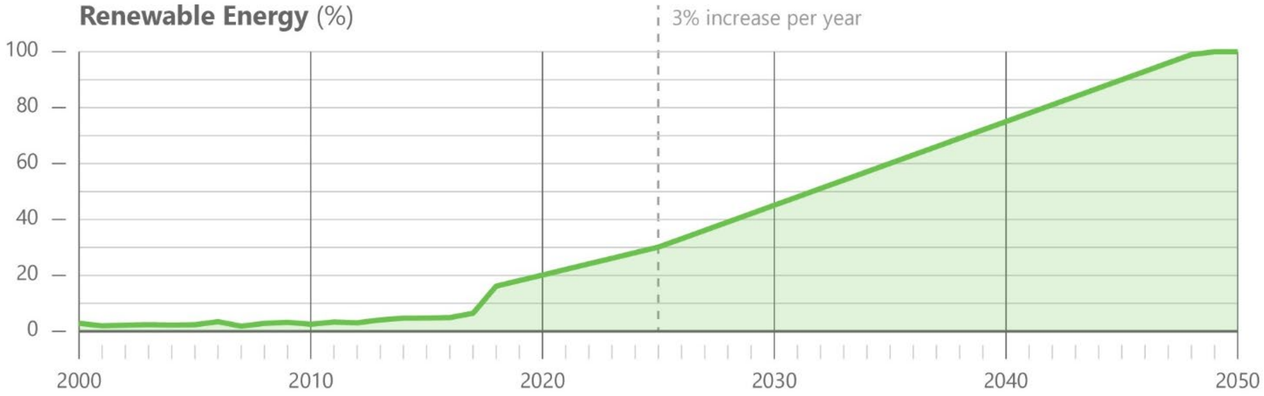
State Policy Example: Massachusetts

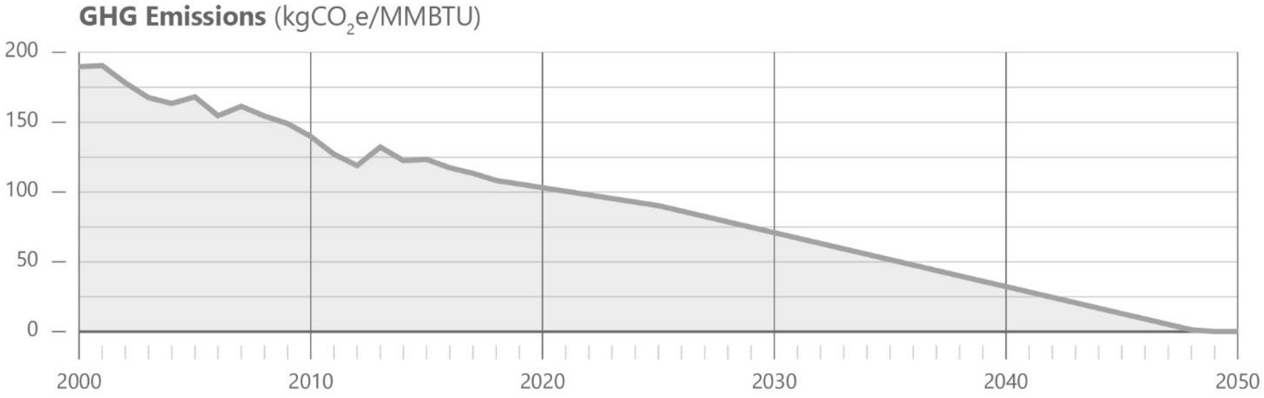
The 2021 Massachusetts Climate Bill increases the year-over-year proportion of renewables engaged on the grid from 2% to 3% starting in 2025.

Therefore:

- The GHG Emissions associated with the grid, in accordance with the Clean Energy Standard, are reduced each year.
- Ultimately, this policy results in a 100% clean grid by 2050.

Many of the following slides study all-electric feasibility in Boston, MA to illustrate implementation in a cold climate.





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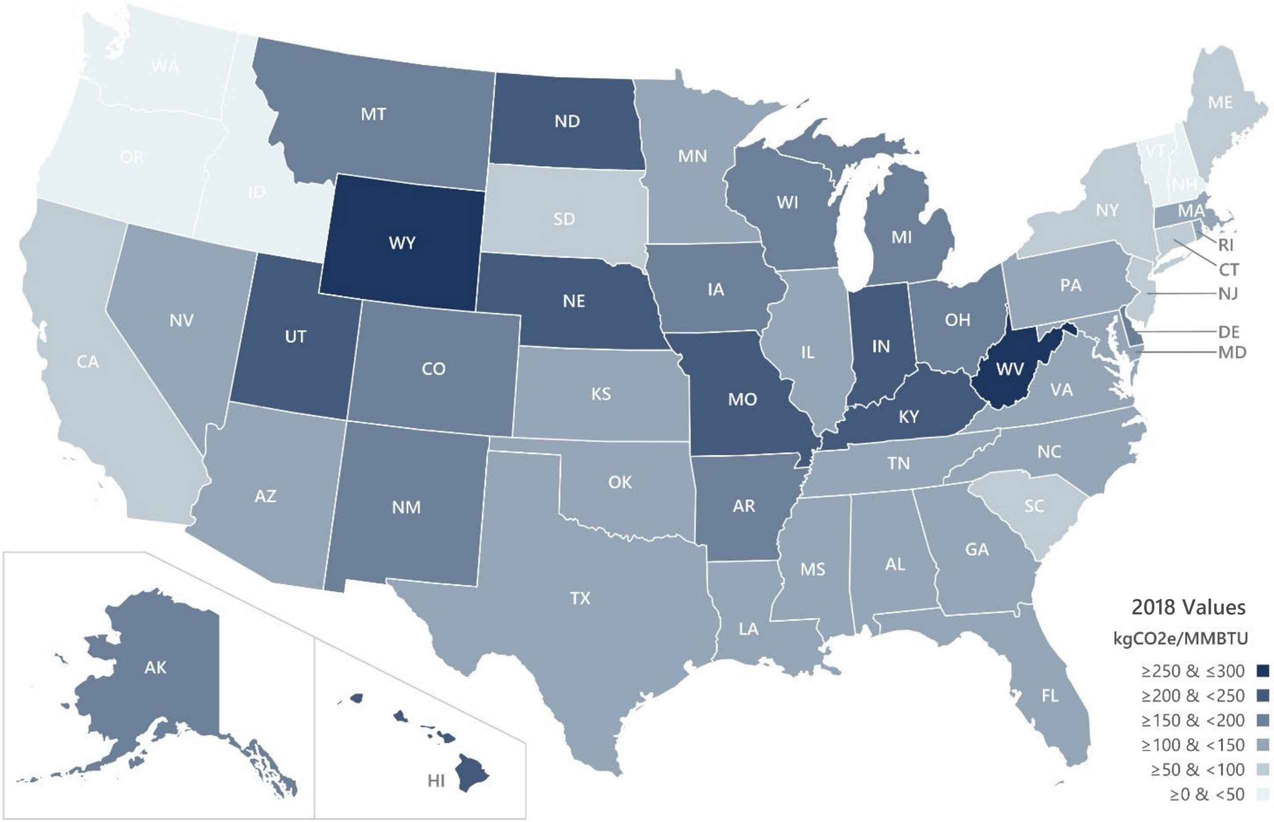
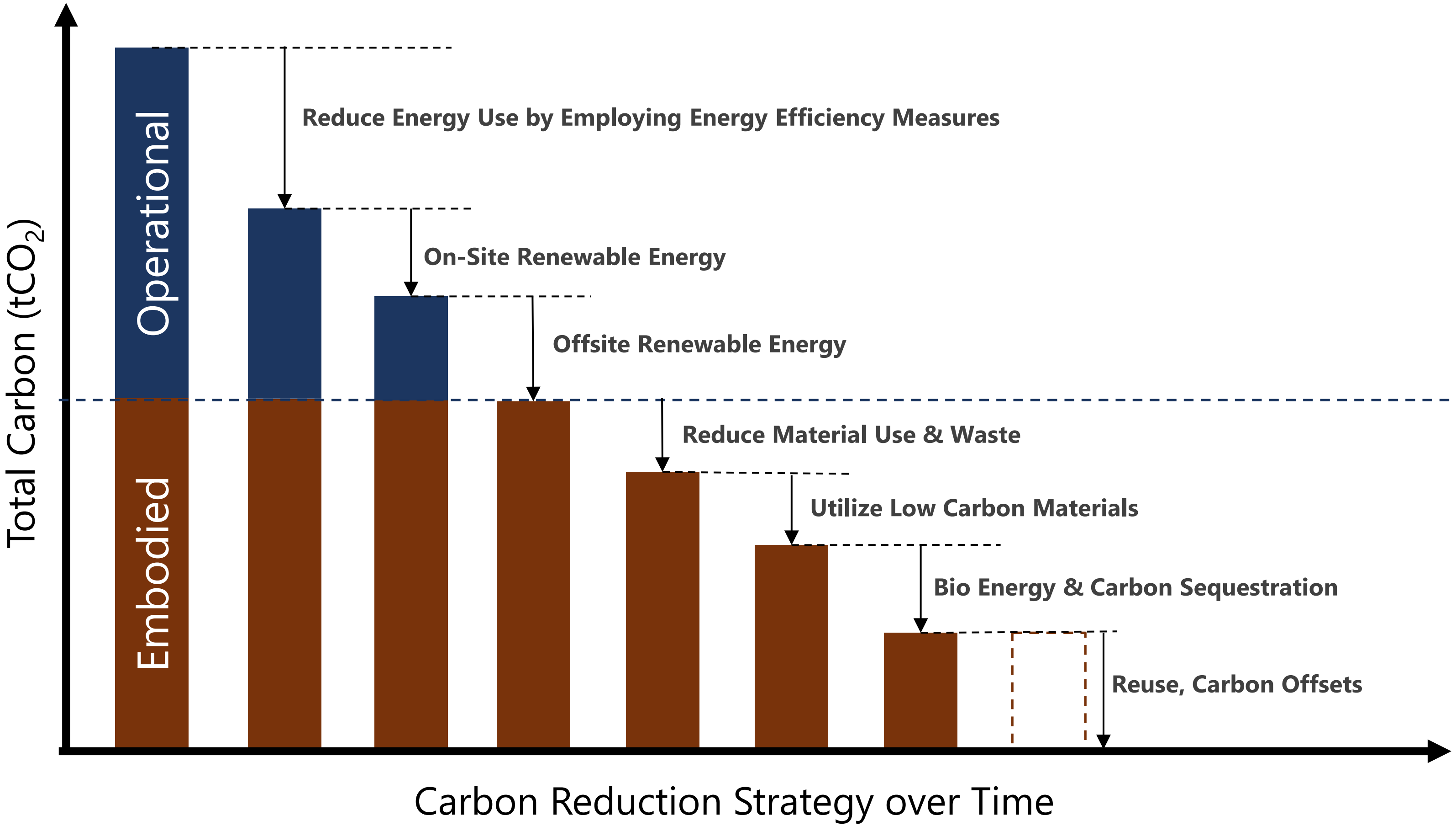
Grid Carbon Factors: USA

There is currently a wide range of carbon factors across the US.

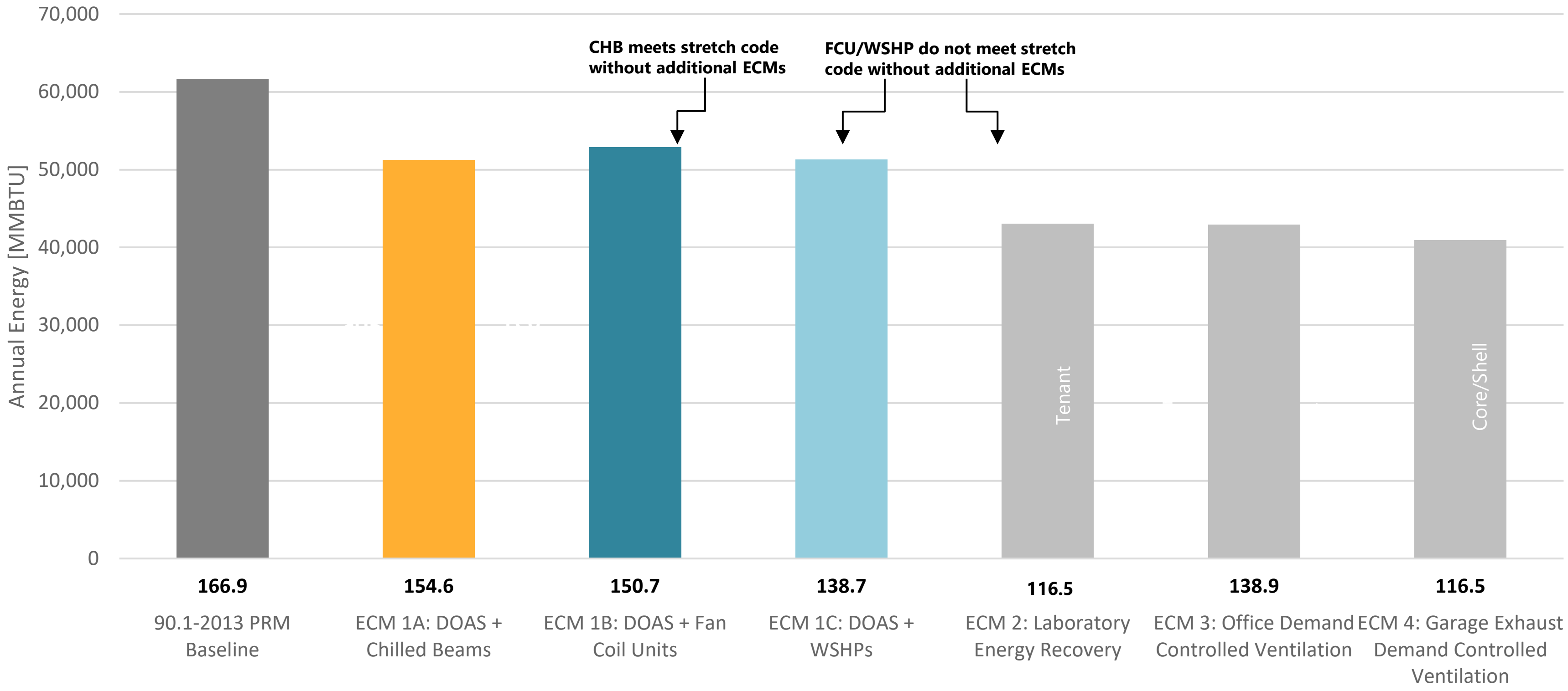
- All projects must evaluate current carbon factors for all fuel sources based on location.
- If the local grid is not yet renewable enough, then identify renewable power procurement opportunities and all-electric preparedness.
- The next slide indicates how this might affect a near-term versus long-term approach.



Whole-Building Carbon Reduction



HVAC System Fit-out Options and ECM’s



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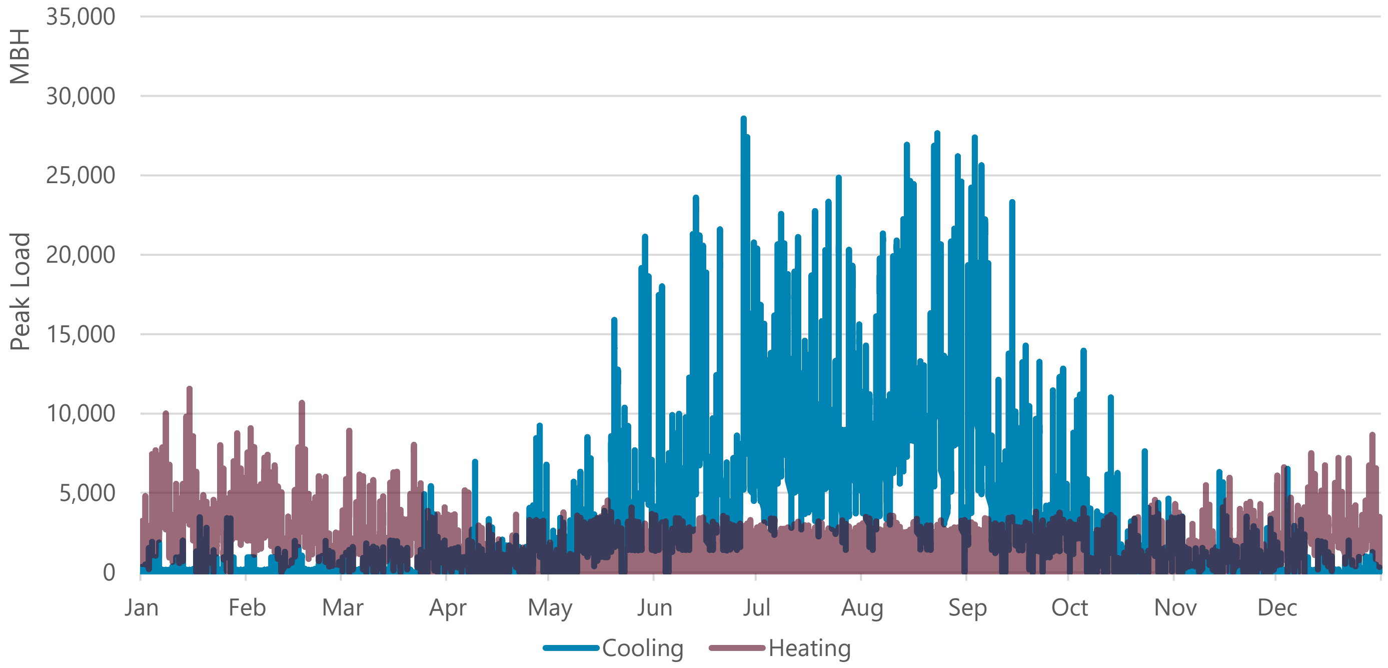
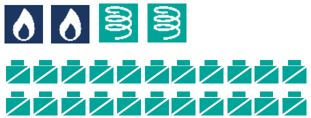
Waterside Heat Recovery

- Waterside heat recovery can meet nearly all of the summer reheat load



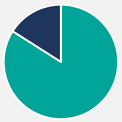
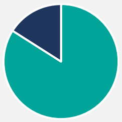
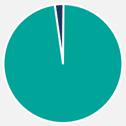
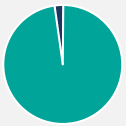
HVAC System Options

	BOD	BOD+	Option 1	Option 2	Option 3
SYSTEM OUTLINE	• Centrifugal Chillers • Condensing boilers • Glycol energy recovery for all spaces • Free Cooling Heat Exchanger	• Remove free cooling heat exchanger • Add Heat Recovery Chillers	• Remove one gas boiler • Remove free cooling heat exchanger • Add Heat Recovery Chillers • Add air source heat pumps	• Remove one gas boiler • Remove free cooling heat exchanger • Additional air source heat pumps • Add Heat Recovery Chillers	• Remove two gas boilers • Remove free cooling heat exchanger • Add two electric boilers • Add Heat Recovery Chillers • Air source heat pumps • 4th Transformer Needed
% All-Electric	0%	Peak: N/A* Hours: 71.8% Energy: 49.2%	Peak: 25.0% Hours: 95.5% Energy: 87.5%	Peak: 50.0% Hours: 99.9% Energy: 99.2%	Peak: 100.0% Hours: 100.0% Energy: 100.0%
ENERGY RECOVERY	• All Spaces: Glycol	• All Spaces: Glycol	• All Spaces: Glycol	• All Spaces: Glycol	• All Spaces: Glycol
CHILLED WATER					
HEATING HOT WATER					
BACK UP EQUIPMENT					

*Heat Recovery Chiller primarily supports cooling season simultaneous heating, and therefore typically is less beneficial in heating season, and thus is not applicable to peak heat load.

Results
Summary

Electricity
Natural Gas

	BOD	BOD+	Option 1	Option 2	Option 3
Electricity & Gas					
EUI	104.3	1.4% savings 102.8	9.9% savings 94.0	10.4% savings 93.5	10.4% savings 93.5
Energy Cost	-	1.1% increase	1.7% increase	1.6% increase	1.7% increase
Operational Carbon [present-day] [2050]	-	0.2% savings 19% savings	4.5% savings 90% savings	4.7% savings 93% savings	5.4% savings 100% savings
Space Planning	No additional equipment	No additional equipment	2 Banks of (6) ASHPs on Roof	2 Banks of (11) ASHPs on Roof	2 Banks of (11) ASHP on Roof; Elec Resist Boilers

What does it look like to deliver a sustainable fit-out, when lab buildings are increasingly having greater demands?

Ventilation and HVAC

- Demand Controlled Ventilation & Laboratory Ventilation Risk Assessment
- Optimized Lab Exhaust
- Waterside and Airside Energy Recovery on fit-out equipment
- Waste Heat Recovery (from Servers, chillers, etc.)
- Decouple Ventilation from Heating and Cooling

Laboratory Ventilation Risk Assessment

The LVRA is a focused risk assessment

- First of a two-part building assessment process
- Surveys of lab environments and associated exposure control devices
  - "Below-the-ceiling" study
- Relative risk is determined using weighted algorithm method that establishes a control band representing a range of hazard emission scenarios
- Control banding techniques correlate with risk band values with minimum operating specifications

Risk Control Band	Description
0	Negligible
1	Low
2	Moderate
3	High
4	Special (Extreme)

- Address protective capabilities for the labs
- Development of room-based airflow specifications
- Harmonization with EHS standards
- Addressing the elements of "ventilation effectiveness" (VEFF)
- Creation of ECD inventories, risk matrices for future reference and updates
- Opportunities for sustainable initiatives
- Smart Labs onboarding

BURO HAPPOLD

What does it look like to deliver a sustainable fit-out, when lab buildings are increasingly having greater demands?

Smart Building Controls and Technology

- Building Automation Systems
- Smart Lighting
- Airflow Sensors
- Smart Energy and Water Use Monitoring

Our Clients

BioMed Realty

brandywine REALTY TRUST

ALEXANDRIA

Cleveland Clinic

charles river

Massachusetts Institute of Technology

NOVARTIS

ADA Forsyth

DRAPER

MITIMCo

WakeMed

HARVARD UNIVERSITY

Case Studies

400 Summer Street
Boston, MA

- **LEED Platinum**
- Triple-Pane Glazing
- High performance energy recovery equipment

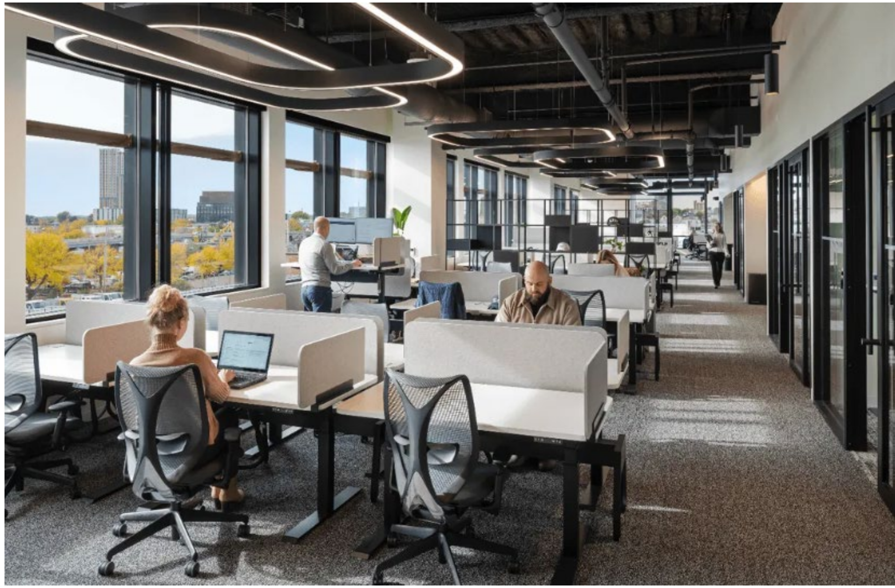
100 Chestnut Street
Somerville, MA

- **LEED Platinum**
- Triple-Pane Glazing
- All-Electric Ready with large heat pump equipment
- High performance energy recovery equipment

Complex Systems with High Expectations

A design that is committed to accommodate world class research space within the LEED platinum building while not sacrificing the intended high-performance operation of the buildings MEP systems.

At the CRADL Vivarium fit-out, the team integrated the vivarium exhaust into the building heat recovery system, which helped to balance the OA/EA loads and maximize energy recovery effectiveness.



cradl

BURO HAPPOLD

High Power Needs without Sacrificing Operation

Account for diversities of power and air within automation lab without sacrificing intended user operation

XtalPi's use of intelligent, state-of-the-art laboratory infrastructure is designed to not only boost research efficiency but also enhance safety through high automation and digitization.

XtalPi

BURO HAPPOLD

Flexible Solutions for Optimal Efficiency

Flexibility is the backbone of sustainable lab fit outs, because the greenest space is the one that adapts, not rebuilds.

The *Hatch.Bio Labs* suites are designed with flexibility at their core, with spaces that adapt to evolving scientific needs. Modular infrastructure and scalable layouts allow for quick reconfiguration, minimizing downtime and costly renovations. From custom exhaust systems to robotics-ready flooring, every element supports tailored fit outs without compromising speed or safety.

Hatch.Bio
LABS

BURO HAPPOLD

Productivity Enhanced through Indoor Environmental Quality

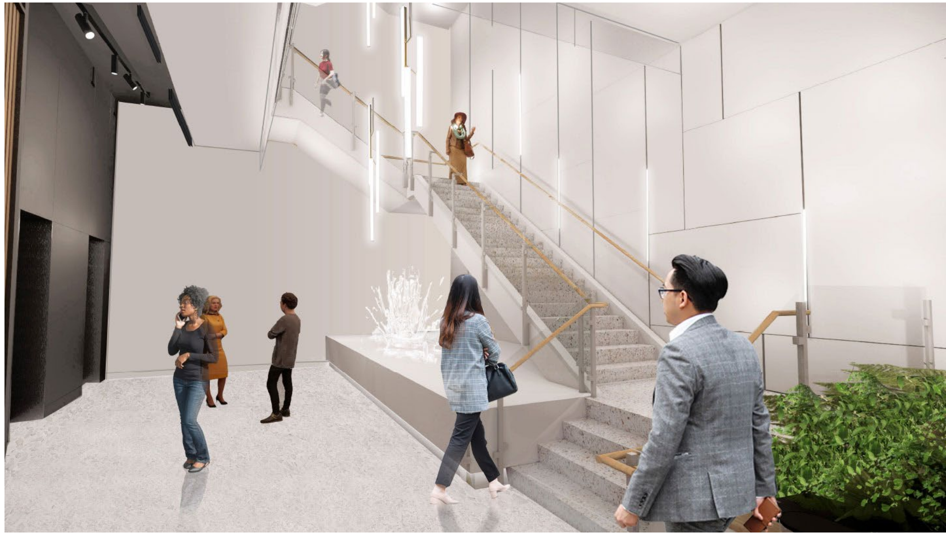
Prioritizing daylight, health, and wellbeing transforms sterile spaces into thriving ecosystems for science and scientists alike.

ADA Forsyth is a top-tier NIH-funded research institute focused on exploring the connections between oral health and overall well-being.

In their new Massachusetts lab, abundant daylight and outdoor views elevate the daily experience for scientists, which is complemented by maintaining precise indoor air conditions through the building management system.

ADA Forsyth®

BURO HAPPOLD



A Fit-Out Alignment to Corporate Sustainability

When a high-performance core and shell meets a smart fit-out strategy and a bold sustainability policy, the result isn't just a building, it's a mission-ready ecosystem for innovation and impact.

- Establish business commitment
- Operating in a safe and environmentally responsible manner
  - Lifecycle impact reduction of products
  - Measure and report environmental impact
  - Laboratory waste diversion
  - My Green Lab certification

ultragenyx

BURO HAPPOLD

Our corporate responsibility program

At Ultragenyx, our corporate responsibility strategy helps us identify, manage and communicate on topics relevant to our business and stakeholders and is structured around six key pillars:

- **Innovation**
- **Patients**
- **People**
- **Communities**
- **Planet**
- **Governance**

By focusing on these pillars, we strive to make a meaningful difference in the lives of those affected by rare and ultra-rare diseases.

Innovation | Patients | People | Communities | **Planet** | Governance

Commitment

We are committed to implementing an environmental strategy that helps to minimize our environmental footprint across our business.

Aspiration

To conduct business in an environmentally responsible manner and strive to continuously improve our performance to benefit our employees, patient and physician communities, the localities where we work, and the environment.

BURO HAPPOLD

Implementing Green Fitout Projects in LEED Platinum Core and Shell Commercial Science Buildings

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