



Mount Ida Campus Greenhouse Gas, Clean Energy, and Sustainability Planning

Created by the UMass Amherst Clean Energy Corps

Presentation Order:



Introduction:

- Who are we?
 - CEE Interns interested in clean energy, emissions reduction and efficiency





• Project start: Jan 2019

Project Background:

- UMass Amherst purchased Mt. Ida College on May 17, 2018
- "Leading By Example" requires UMass to report and reduce its greenhouse gas emissions
- The UMass Commitment to Sustainability
- Going carbon neutral
- Significant increase to UMass emissions



A	FUE COMMANNA/EALTH OF MASSACHUSETTS	
a 10 a	EVEN ITVE DEPARTMENT	
	STATE HOUSE + BOSTON 02020	
S S S S S S S S S S S S S S S S S S S	(817) 725-4000	
- The second		
DEVAL L PATRICK		
TIMOTHY P. MURBAY	By His Excellency	
	DEVAL L PATRICK	
	GOVERNOR	
	EXECUTIVE ORDER NO. 484	
	FADING BY FYAMPI E-CI FAN ENERGY	
-	AND EFFICIENT BUILDINGS	
WHEREAS	buildings are significant users of energy, water and	
natural resource	s, consuming 39% of U.S. energy, 70% of U.S electricity,	
12% of U.S. pota	able water, and 40% of raw materials globally;	
WHEREAS	5, the Commonwealth of Massachusetts manages over 64	
million square te	et of buildings at hundreds of facilities, which annually	
beating oil and	46 million therms of natural das:	
riearing on, and	to million elemna or natural gas,	
MUEDEAS	P such assersu consumption regults in grouphouse and	
emissions totalin	on more than 1.1 million tons ner year, equivalent to the	
emissions dener	rated by more than 200 000 cars driven for one year:	
3	,,	
WHEREAS	s environmental and health issues related to energy	
consumption, su	ich as global climate change, regional mercury	
contamination, a	ind urban asthma rates are critical issues that need to be	
addressed imme	diately and comprehensively;	
WHEREAS	S state povernment has an obligation to lead by example	
and demonstrate	a that large entities such as state colleges and universities,	
prisons, hospitals	s and others can make significant progress in reducing	
their environmen	tal impacts, thereby providing a model for businesses and	
private citizens;		

AASHE STARS Rating:

- Academics: Curriculum, Research
- Engagement: Campus & Public
- Operations: Air & Climate, Buildings, Energy
- Food & Dining, Grounds, Purchasing,
- Transportation, Waste, Water
- Planning & Administration: Coordination & Planning,
- Diversity & Affordability, Investment & Finance, Wellbeing & Work
- Innovation & Leadership

- Focusing on Aspects of the STARS Rating:
 - Building Operations
 - Emissions
 - Efficiency
 - Green Transportation
 - Sustainability

The Association for the Advancement of Sustainability in Higher Education



Our Goals:

1. Establish foundational energy and GHG emissions reporting data

2. Identify focus areas and provide recommendations for low-cost energy efficiency

3. Model possible deep-energy retrofit applications for high EUI/oil burning buildings

4. Review transportation options and current fleet vehicles and then provide options for increased efficiency

5. Provide an updateable building by building index and interactive GIS map to bring together all the sources of data

6. Identify overall sustainability opportunities through behavioral and operational changes





Energy and Emissions Findings



2018-2019 Energy Use





Yearly Building Energy Use



FY 2018 Mt Ida GHG Inventory:





FY 2018 Mt Ida GHG Inventory:



	Sum CO2e b	y Month										
	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19
Electricity (CO2e)	54.1	55.0	62.4	65.9	57.3	56.6	68.2	58.4	62.0	64.5	60.9	52.6
Natural Gas (CO2e)	21.2	6.8	6.7	14.9	59.9	122.0	151.9	172.6	140.7	110.0	54.6	6.4
Number 2 Oil (CO2e)	3.3	0.0	0.0	2.2	4.9	8.1	13.7	10.2	13.3	12.2	5.6	2.3
Sum CO2e (metric tons)	78.6	61.8	69.1	83.1	122.1	186.7	233.7	241.2	216.0	186.6	121.1	61.3

Analysis Tools: Building Atlas

- All-in-one building by building data organization
- Meter numbers, year built, building aliases, generators, mechanical systems, emissions, issues, etc
- Previous upgrades
- Building recommendations
- Future organization and tracking

1 Alumnae (Alumna) Hall + Holbrook Hall			
2 Applied Science Center/NEI Professional Building/School of Applied Sciences/Mortuary + School of De	sign/Chamberlayne (chamberline) Hall		
3 Athletic Center + New Gym			
4 Barone Hall (House)/Guest House/Dean's House	Key:		
5 Boulder Farm/President's House	Green: Building names refer to the exact same building		
6 Brown Hall (Keith Brown Hall) + Shaw Hall (Admissions, Event Center) + Wingate(Windgate) Hall	Blue: Buildings are different sections but connected		
7 Carlson Hall Student Center/Campus Center	*Note: buildings touching often have split data or incomplete data,		
8 Chapman Hall	and may or may not supply eachother with resources (the building		
9 Guard House/Gate House	may not be marked in another group that it recieves a resource		
10 Hallden Hall	(IOH)		
11 Health Center/Health + Counseling Center/Appleton			
12 Health Sciences Building/Academic Technology Center/Community Dental Clinic/Dental Education Cen	ter		
13 Longfellow Hall			
14 Maintenance Shed/Garage/Gar Groom/adis dolupta consequo tem acitemp			
15 Miller Hall			
16 Malloy Hall			
17 New Hall			
18 Pressbox			
19 Ricker Hall			
20 Security/Campus Police/Campus Security/Public Safety			
21 Vet Tech/Center for Veterinary Technology and Science			
22 Wadsworth Library			

Health and Cou	inseling Ce	enter, Appletor									
Ge	neral Informati	on:									
Building Number: Year Building Type: Building Type: Occupied (y/n); Square Footage: Meter Number(s): Fuel Type(s): Generator Boiler Upgrade	764/2: Office Yes Oil No No	L 19 Space, Health + Counseling 30 23751	20	Building and Ene - Building: 2 story, - Heating: an oil-fi - Cooling: window - Water, electrical respectively - controls are loc: - there is no centu - Heating Setpoin - Garage is conve	ergy Planning: ; w/ cedar shingle extr fired steam boiler w AC units (building als il, and nat gas supplied al thermostats ralized computer cont. ts: 70 deg F if occupie rrted to a conference n	erior, wood frame a so has dehumidifier I by city of Newton, rol for heat and AC d, 55 deg F if unocc som	ind asphalt roof (s) Nstar, and Nat Grid upled	Notes: - Moving to - Possible n - Kristen sh - BASEMEN - Mold Prol	where dental clinic was ennovation planned wwed us around T: Oil tank in good conc New water heater Stone Field Foundatis Mice issues Jelems and possible lead	i lition on paint	Q
Appleton Tell 	In the second se										
A 2. Applied S	cience + Design	6. Brown, Shaw, Wingate	7. Carlson Hall,	, Campus Center	8. Chapman Hall	9. Guard Ho	ouse 10. Hallde	n Hall 11. Heal	th Center, Appleton	12. Health Sciences	AcademicTec

Analysis Tools: GIS

- Visualize the key findings of our research
- Establish a malleable tool to be utilized in future campus planning efforts

Identify	□ ×
Identify from: <	Top-most layer>
□-boiler_upgrades □-Carlson Hall	
	\lefter 1
Location: 739,609.	129 2,932,434.765 Feet
Field	Value ^
GlobalID	{3FE4CB2D-B816-4255-8D4F-5D47F5C64F
SHAPE_Length	482.447834
SHAPE_Area	9821.497636
Bldg_Name	Carlson Hall
Matches_GIS_Data	Yes
Bldg_Alias	Campus Center
Year_of_Construction	1992
Renovation	2013
NG_Meter_Groupings	1
Electrical_Meter_Grouping	ngs 1
Oil_Heated	<null></null>
Heat_Pumps	<null></null>
Boiler_Upgrade	Yes
Generator	Yes
Bldg_Type	Dining/Other
Occupied	Yes
	~
<	>
Identified 1 feature	





Building Recommendations



Building Prioritization:



Building Priority:

1. TARGET BUILDINGS

- President's House/Boulder Farm
- Chapman Hall
- Veterinary Technology Center
- 1. Increase Efficiency of Remaining Buildings
- 2. Buildings with No Future Use

Target Buildings: President's House/Boulder Farm

- Heavy oil use, high emissions
- Poor thermal insulation
- Roof needs replacement
- Stormwater management
- Very low baseline of electricity
- Propane used for cooking







President's House: Recommendations

- New well insulated roof
- Insulate and air seal attic, replace Sin pane windows
- Install LEDs and smart plugs
- Replace the boiler with a GSHP



	Estimated <u>Heating Improvements</u> for a Ground Source Heat Pump (COP 4)								
)	Building	Oil Heating Energy Use (kBtu) (2018-2019)	Estimated Operational Savings (kBtu)	CO2e from Oil (metric tons) (2018-2019)	Estimated CO2e from GSHP Electricity (metric tons)	Estimated CO2e Saved (metric tons)	Estimated Percent CO2e Saved for Heating	Estimated Percent CO2e saved for Total Energy	
	Boulder Farm	267,692	200,769	19.94	5.02	14.92	74.8 %	68.8 %	

 Table 4.1: Estimated emissions savings by installing a GSHP to provide all of Boulder Farm's heating load.

- GSHPs have a higher avg COP vs ASHPs
- Unaffected by weather
- Greater temperature control
- Integrative, non-intrusive design
- Chimney stove insert

Target Buildings: Chapman Hall

- Small residents hall with no AC
- Only baseboard heating
- Model for conventional building





Chapman Hall: Recommendations

• Install ASHPs

• Air seal and insulate

• LEDs and controls



Target Buildings: Veterinary Technology Center

- Largest energy user on campus
- Lab-type construction and high glazing
- High ventilation requirements



Vet Tech + Gen GHG Inventory 2018-2019 25.00 20.00 Metric Tons CO2e 15.00 10.00 5.00 0.00 101128 134-18 131-19 111-18 118-18 ep 18 oct-18 NON'IS Dec'IS cebr19 Nar.19 Natural Gas - CO2e Electricity - CO2e

Veterinary Technology Center: Recommendations

Energy Recovery Ventilation:





Target Buildings: Air Source Heat Pumps

Electrifying with ASHPs:

- Estimated avg COP of 2.9 vs .91 efficiency
- Replacing heating systems and adding cooling capability
- Fuel switching to electricity

• Similar emission but potential to be green

Potential Carbon Saving Benefits of Air-Source Heat Pumps						
Building	2018/19 Total Energy Use from Electricity + NG or Oil (kBtu)	Estimated Total Energy Use from ASHPs and Electricity (kBtu)	2018/19 CO2e (metric tons)	Estimated ASHP CO2e (metric tons)	Estimated CO2e Saved (metric tons)	Estimated Percent CO2e Saved
President's	291,924	115,908	21.8	8.7	13.1	60%
Chapman	411,434	190,831	23.5	14.3	9.2	39%
Vet Tech	3,269,692	1,996,968	202.8	149.7	53.1	26%

General Buildings: Recommendations

- Improve Efficiency Through Temperature
 Control
 - Schedules based on occupancy
 - Set Points for Occupied Buildings:
 - 68 °F to 72 °F for heating, 68 °F to 70 °F for cooling
 - Comfort
- Condemn Oil buildings and Malloy
- Renewable Energy
- BMS: sensors and controls

Yelow cell = enter your own data Green cell = result (do not change the value) White cell = calculated value (do not change the value)	
Global formula : E = A * r * H * PR E = Energy (kWh)	1084133 kWh/an
A = Total solar panel Area (m²)	6600 m²
r = solar panel yield (%)	15%
H = Annual average irradiation on tilted panels (shadings not included)*	1461 kWh/m².an
PR = Performance ratio, coefficient for losses (range between 0.9 and 0.5, default value = 0.75)	0.75
Total power of the system	990.0 kWp
Losses details (depend of site, technology, and sizing of the system)	201
Inverter losses (6% to 15 %) Température losses (5% to 15%)	8%
- DC cables losses (1 to 3 %)	2%
- AC cables losses (1 to 3 %)	2%
- Shadings 0 % to 40% (depends of site)	3%
 Losses weak irradiation 3% yo 7% 	3%
 Losses due to dust, snow (2%) 	2%

General Buildings: Recommendations Cont.

- **Building Metering**
- Electrification: Consider ASHP
 - 100% switch saves ~27% 0 emissions

4

Future Building Standards Commitment

On-Site

Envelope

High Performance

1 Unit



Campus Sustainability Recommendations

Environmental Sustainability:



Environmental Sustainability:

- Rare Species Habitat and Vernal Pools
- Uncovered Road Salt
 - Harm native species (ex. spotted salamander which use vernal pools as their only breeding ground), kill trees, change stream chemistry, and more
- ClogBusters
 - "Stormwater picks up potential pollutants that may include sediment, nutrients, bacteria, pesticides, metals, and petroleum by-products" -U.S. Geological Survey



Natural Heritage & Endangered Species Program (NHESP)

Environmental Sustainability:

- Inefficient and environmentally harmful outdoor light fixtures
 across campus
- Poorly sited solar compactors
- Lack of composting







Transportation:

- Highlight existing student commuting trends
- Explore opportunities for campus transportation systems
- Investigate the potential for electrification of the campus fleet







Working with Newton:



"The Cit, and the second secon

- Ann Berwick, Director of Sustainability for the City of Newton



- 40% of large commercial buildings in Newton are used for academic purposes
- Green Ribbon Commission
- Align emissions reduction and clean energy goals
 - On-site renewables
 - EV transit
 - High Efficiency Buildings
- Integrate sustainable actions with Newton's goals and ongoing projects
 - e.g. Limebike bike share



Action Items:

- Increase Building Efficiency
- Operational/Behavioral Modifications and Retrofits
- Implement Campus-wide Sustainability Measures
- Transform Mt. Ida's Transportation Sector





- Set future campus specific emissions goals
- Develop detailed HVAC schedules
- Investigate more renewable options
- Retrofit cost analyses
- Further develop transportation plan
- Investigate energy storage

Thank You!