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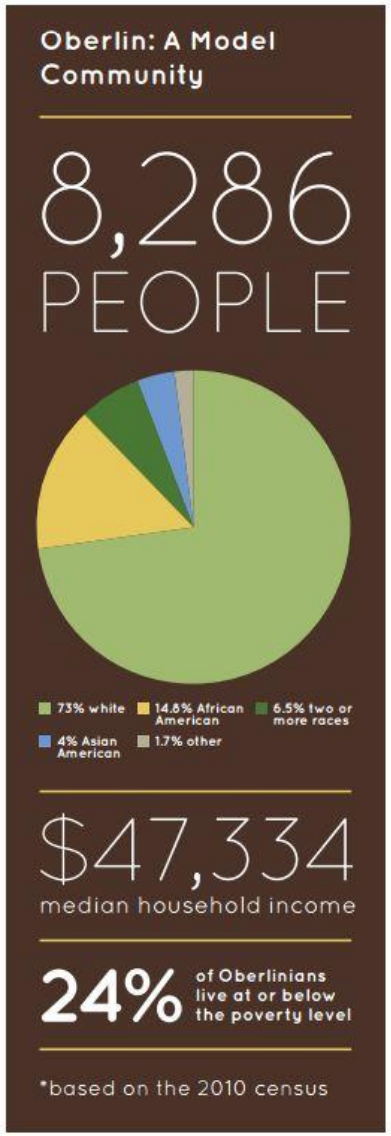
Oberlin College's Path to Carbon Neutrality

February 22, 2016



Demographics

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- Oberlin College: residential liberal arts campus w/ **2,900** students and a central heating plant.
- City of Oberlin: located in Lorain County, 30 miles west of Cleveland.
- City & College were founded at the same time in **1833**.
- Oberlin College is the largest employer in the City.
- 40% of city limits isn't property taxable.
- Oberlin Municipal Light & Power Service .

Sustainability as a Platform

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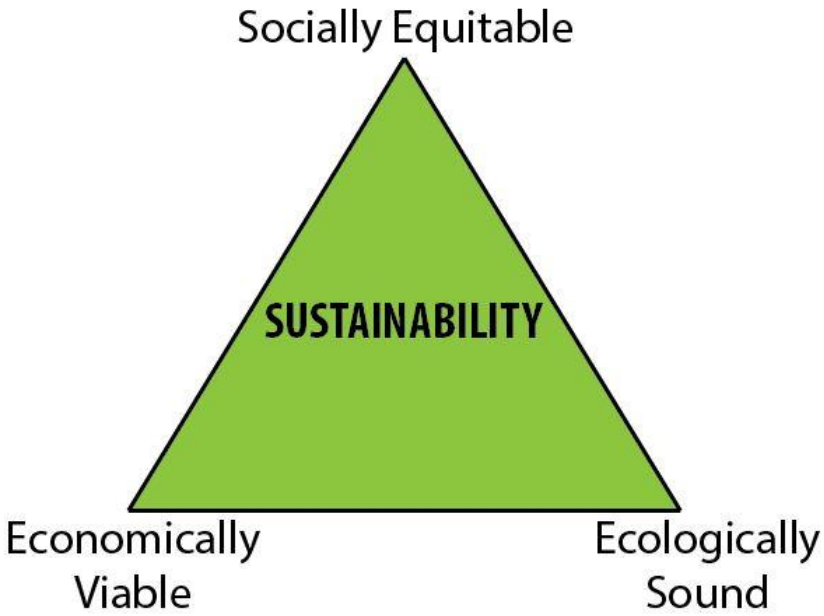
"the ability to meet the needs of the present without compromising the ability of future generations to meet their needs"



Oberlin College

- Long history and tradition of **Sustainability**
- Equity, Ecology, Education

Reflected in:

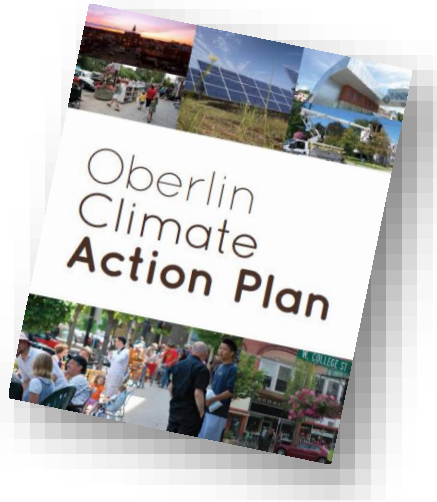
- Comprehensive **Environmental Policy** – 2004
- Key direction of **Strategic Plan**, 2005
- **ACUPCC** charter signatory, 2006
  - **Carbon Neutrality Commitment - 2025**
- Build to at least **LEED Silver** Standard
- Charter **STARS** participant
- Environmental Policy Implementation Plan - 2015

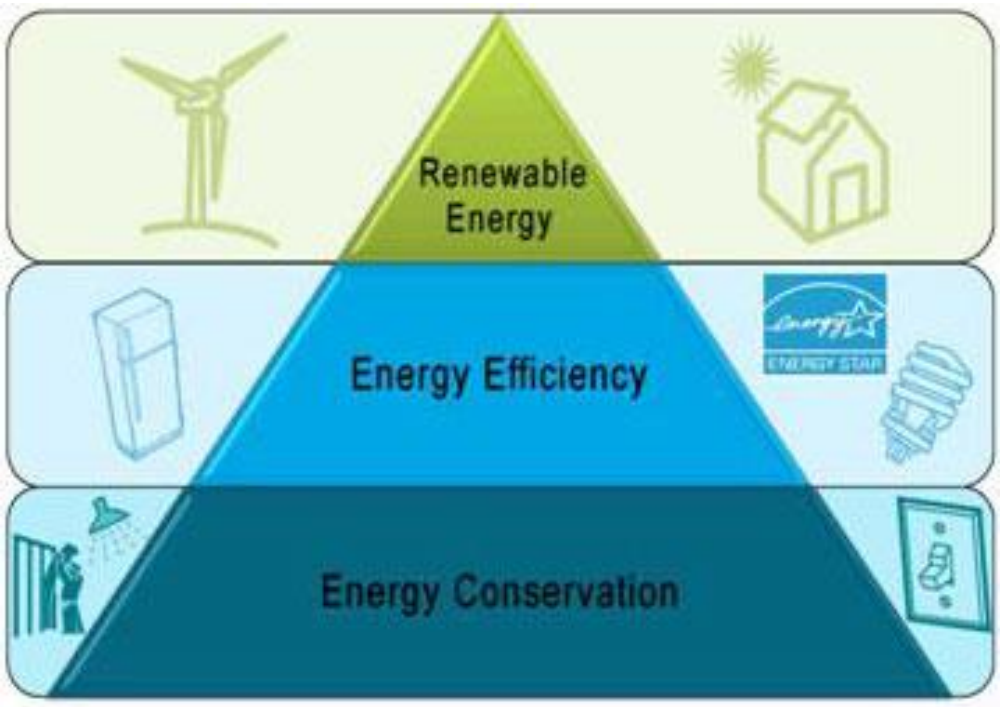
Oberlin College
Office of Environmental Sustainability

Motivations & Priorities

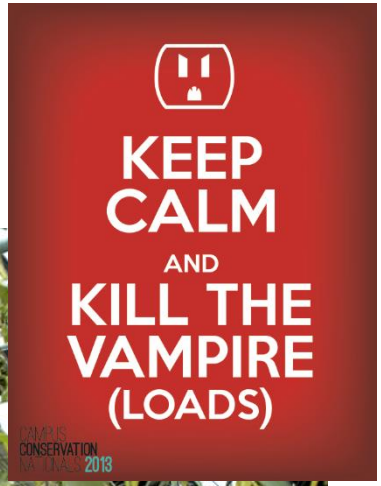
- Carbon Neutral Campus
- Education and scholarship
- Progressive Leader
- Social justice, equity, and inclusion
- Environmental sustainability
- Transformational Change
- Financial Responsibility

Energy Strategy Progress





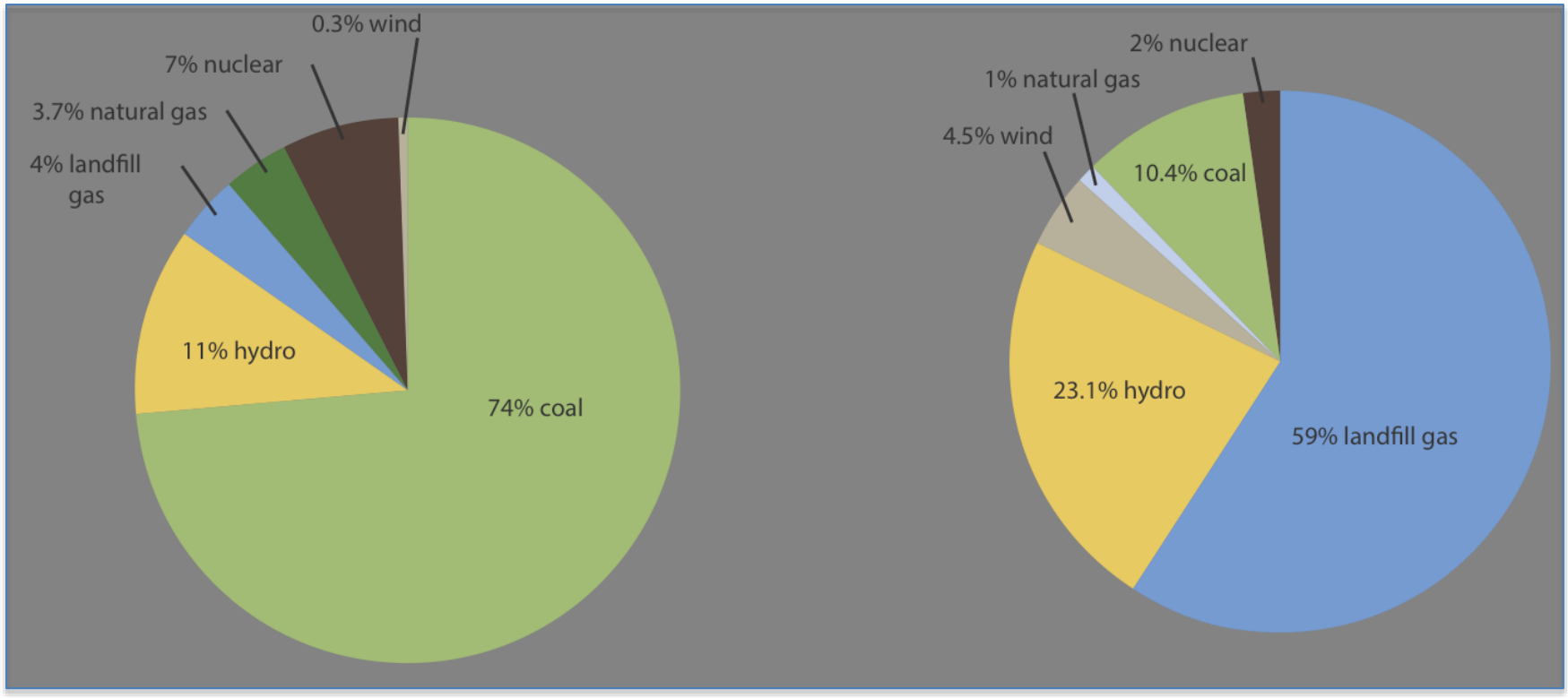
Behavior & Engagement



Environmental Dashboard

Transition to Coal Free Campus Operations

Green Power Purchase



2012

2015

Source: OLMPS

2.2 MW Solar Array

- 2.27 MW (DC)
- ~3,000,000 kWh/yr.
- 10.5 acres of land
- 7722 panels in north-south rows
- Track the sun throughout the day
- Oberlin College property
- PPA with Spear Point & SPG Solar
- Connects to OMLPS grind
- 12% of College's current electricity needs

Strategic Plan Vision for the Master Plan

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Reaffirm and take tangible action toward meeting Oberlin's commitment to environmental sustainability. This includes creating an actionable and financially feasible plan for achieving Oberlin's commitment to carbon neutrality by 2025

Campus Evaluation

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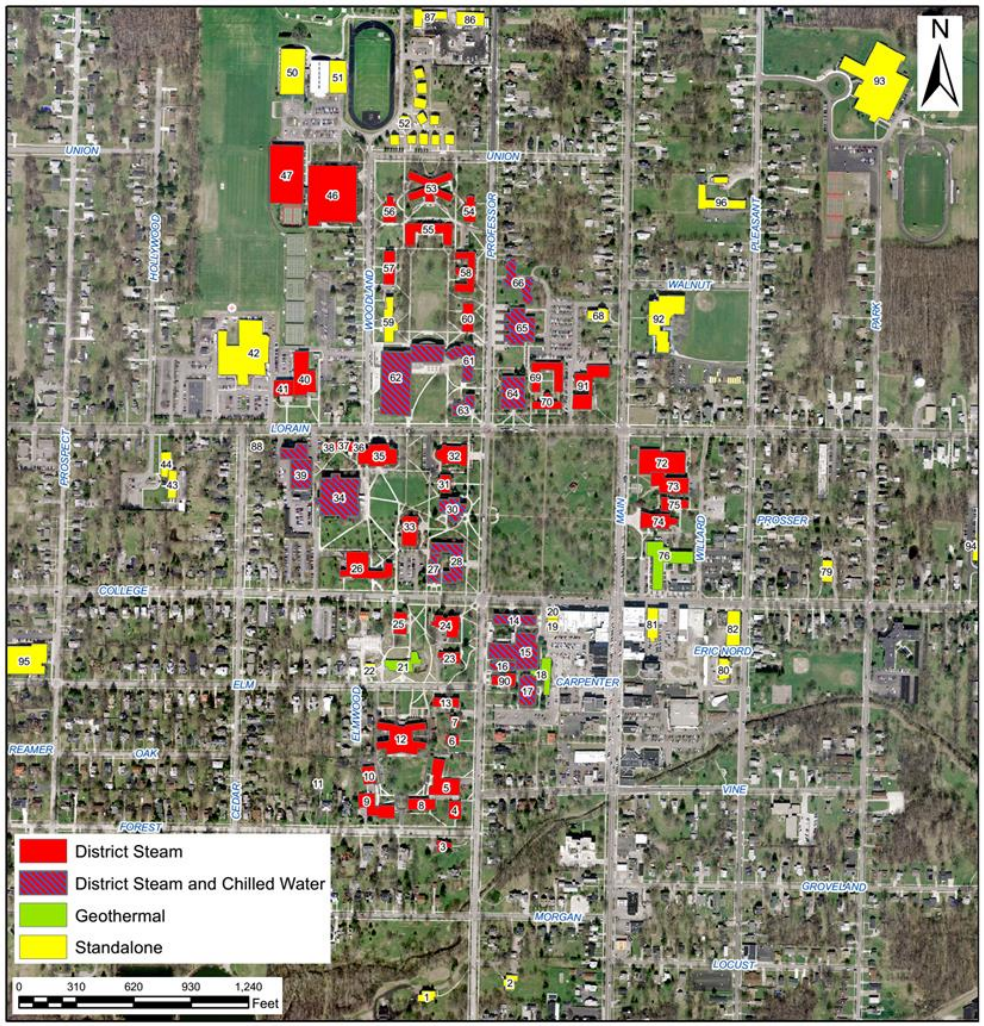
- GIS mapping with Oberlin student interns
- 79 buildings surveyed on and off-campus
- 56 buildings on central steam
- 15 buildings on central cooling
- Peak plant steam load ~65 MMBtu/hour**

**2009 PSI study



Oberlin's Current Energy Profile

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Campus Scope 1 and 2 Carbon Emissions (Metric Tons)		
Source	2007	2015
Thermal production	23,973	11,426
Electricity	20,720	3,030
Total	**44,693**	**14,456**

Baseline Utility Consumption[3]						
Heating System Type	**Area (SF)**	**Natural Gas[1] (MMBtu/yr)**	**Electric (KWH/yr)**	**Water (gals/yr)**	**Sewer[2] (gals/yr)**	**EUI (kBtu/sf)**
Stand alone	272,750	15,032	1,579,348	5,027,971	5,033,058	75
District	2,099,903	188,059	22,723,939	39,734,957	33,336,792	131
Geothermal	130,900	2,148	1,581,873	3,491,086	3,008,301	58
Totals	**2,500,000**	**210,000**	**26,000,000**	**48,000,000**	**41,000,000**	

Notes

1. Includes coal consumption in 2013 and 2014, converted to MMBtu.

2. Sewer utility data shows larger consumption values than water on several buildings.

3. Total of all utilities consumed by buildings classified by heating system type.

Campus Condition Assessment

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- Steam system efficiency reported to be ~42%
- Aging distribution system requires ongoing maintenance
- Thermal metering addition in progress
- Increased decentralization and electrification of the campus energy system

Energy Density and HW Compatibility

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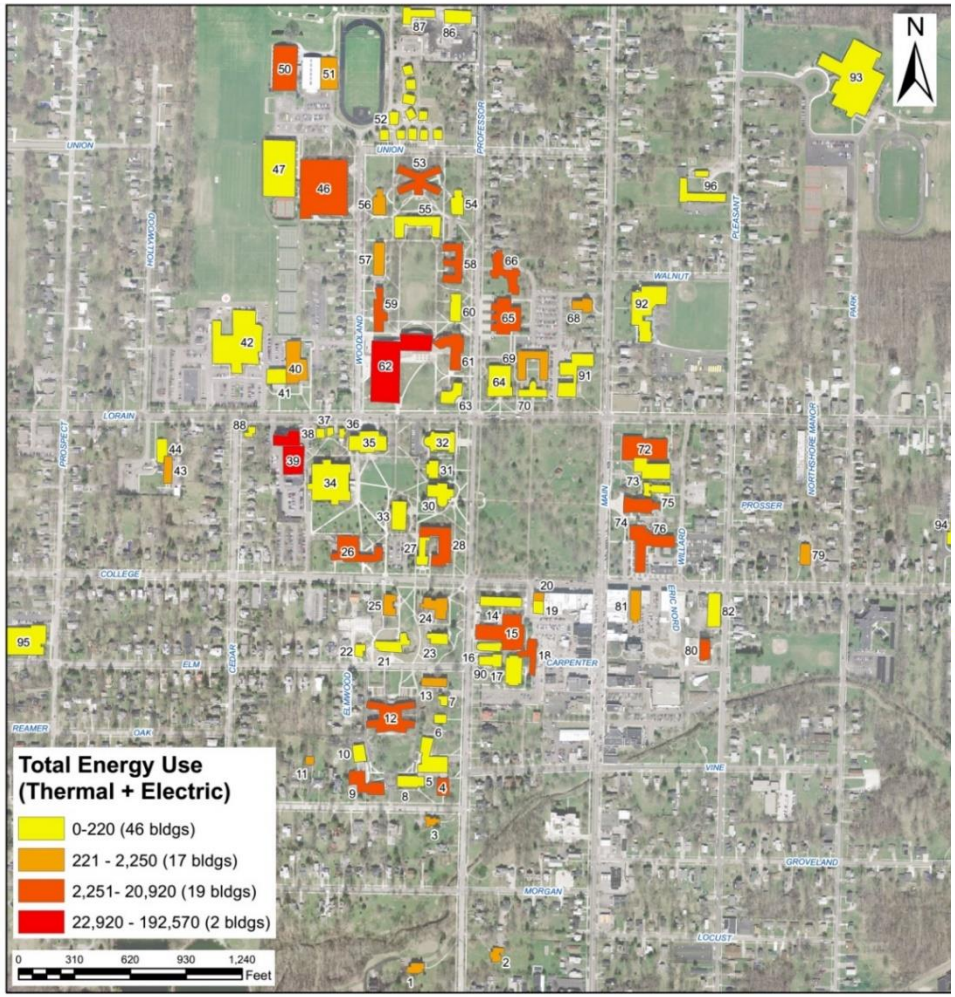

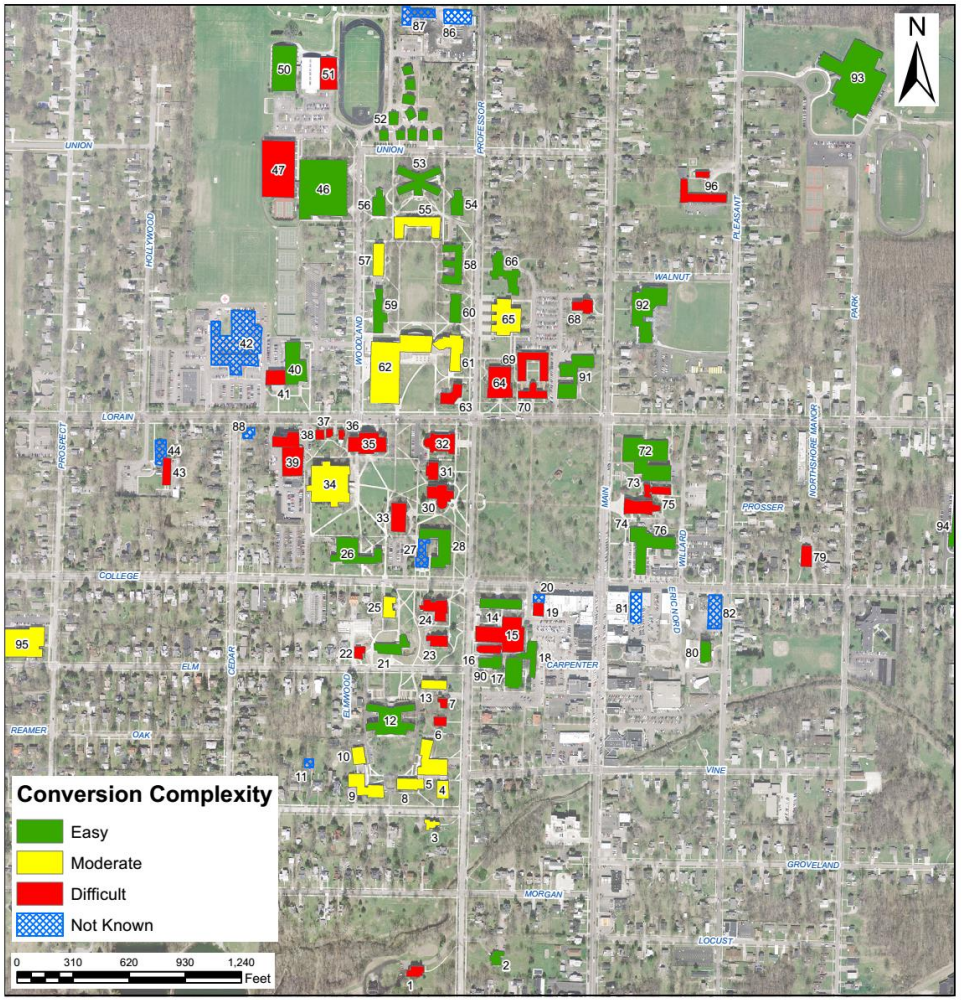

Oberlin's Opportunity

Oberlin has the opportunity to reduce current scope 1 and 2 carbon emissions by 73%, with a 92% reduction from the 2007 baseline.

- Annual water reduction of 7.5 million gallons
- Annual sewer discharge of 5.8 million gallons
- Implementable without capital investment from Oberlin

Primary Recommendations

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- Improve campus efficiency through implementation of energy conservation measures (ECMs)
- Capture waste heat at the Lorain County Landfill electric generation station to heat and cool campus buildings (LFG CHP)
- Multi-faceted education, engagement, and outreach plan
- Initiate Scope 3 carbon and waste planning

Energy Conservation Measures

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Recommended ECMs

ECM Cost Summary				Projected Annual Utility Reductions				
Description	Building Count	Capital Cost	Annual Savings	Natural Gas	Steam	Electric	CO2	Water
	(Each)	(k$)	(k$)	(MMBtu)	(MMBtu)	(MWH)	(tons)	(kgals)
ECM 1 Lighting Vacancy Sensors	60	$843	$213	0	0	2,051	172	0
ECM 2 Commission Existing Lighting Controls	4	$33	$12	0	0	115	10	0
ECM 3 Demand Control Kitchen Ventilation	12	$644	$22	125	1,608	102	133	0
ECM 4 Cooler/Freezer heat recovery	11	$133	$3	45	331	0	23	0
ECM 6 Boiler Stack Economizer	4	$312	$91	17,056	0	0	1,010	0
ECM 7 Low Flow Fixtures	12	$171	$41	276	678	0	66	1,709
ECM 9A Mudd Replace HVAC with VAV with Economizer and DCV	1	$733	$120	0	2,305	653	223	0
ECM 10 Double pane glass	31	$8,117	$459	620	23,486	1,490	1,876	0
ECM 12 Replace Multizones units with Vav AHU and DOAS with energy recovery	1	$405	$35	0	450	204	50	0
ECM 13 Complete Kahn Solar Array with hybrid PV-Thermal panel	1	$163	$5	0	238	28	20	0
ECM 14 Science Center Heat Recovery	1	$858	$89	0	12,045	54	884	0
ECM 15 Ground Floor OA with Energy Recovery	1	$54	$7	0	528	10	39	0
Totals		**$12,465**	**$1,096**	**18,121**	**41,669**	**4,705**	**4,506**	**1,709**
Simple Payback	**11**	**years**						

Landfill Gas Combined Heat and Power

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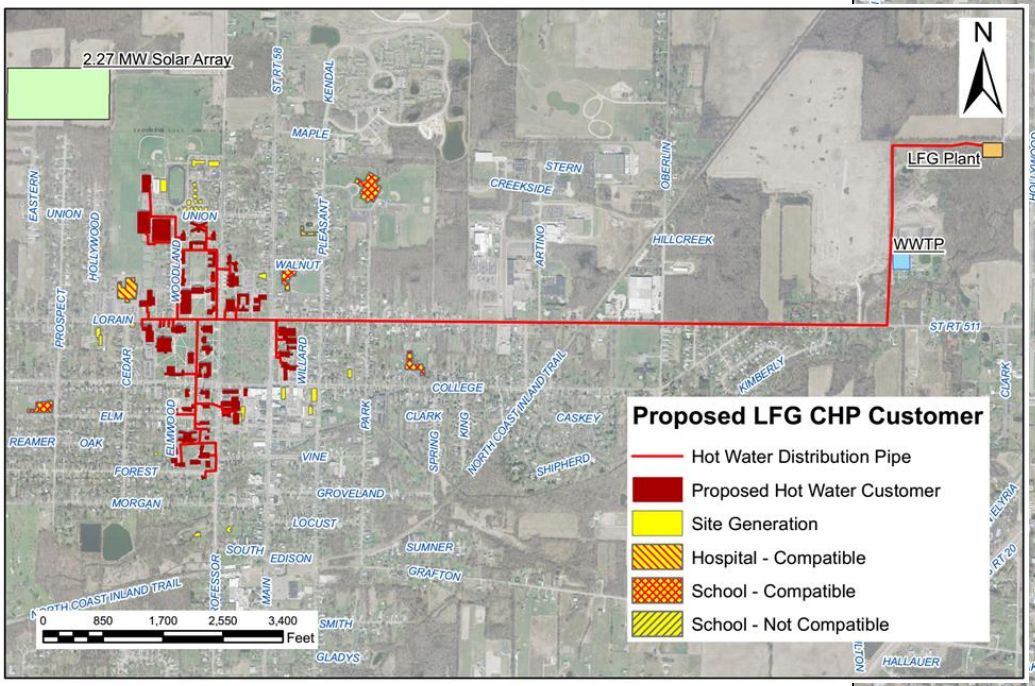

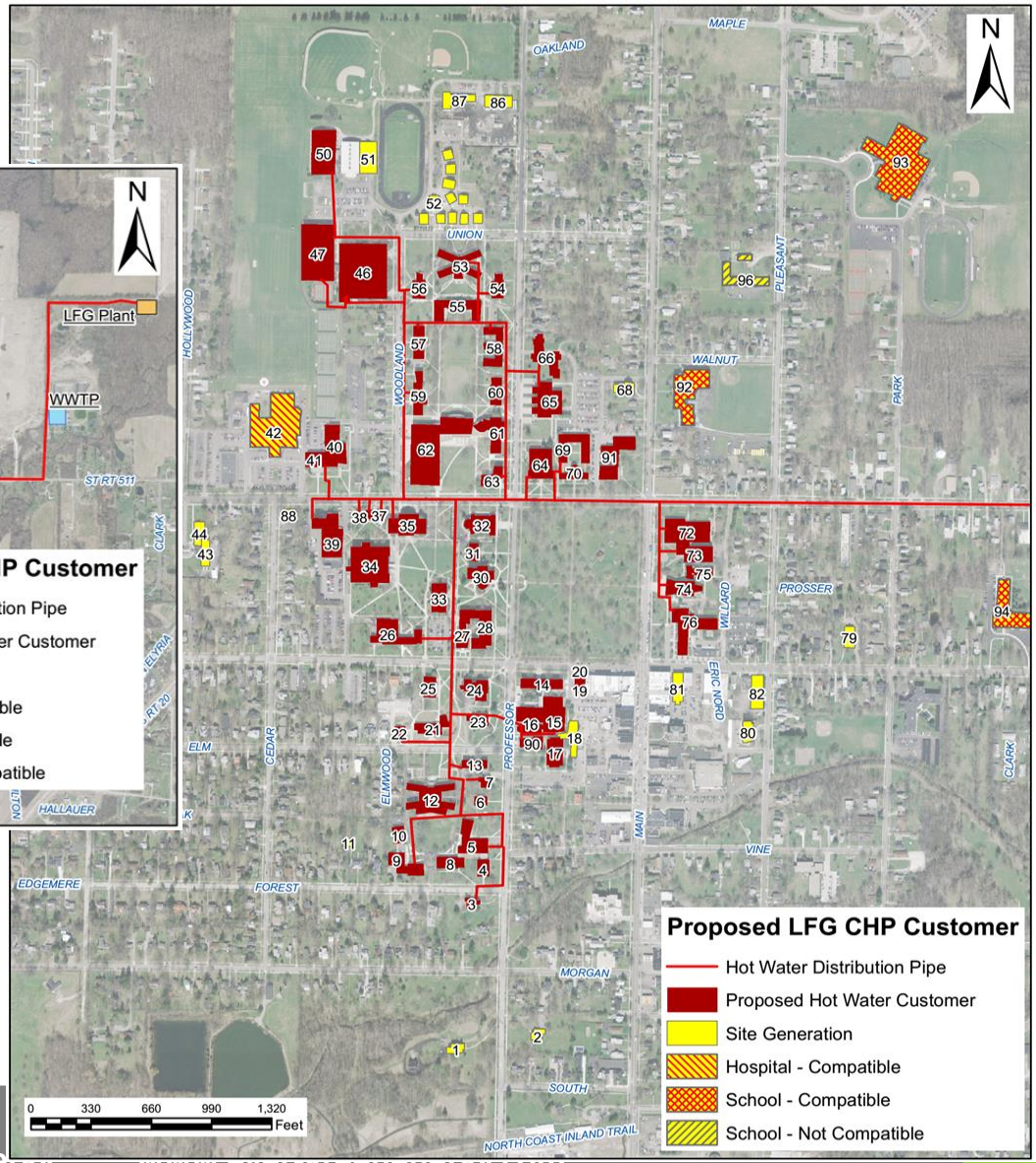

District Energy System Advancement

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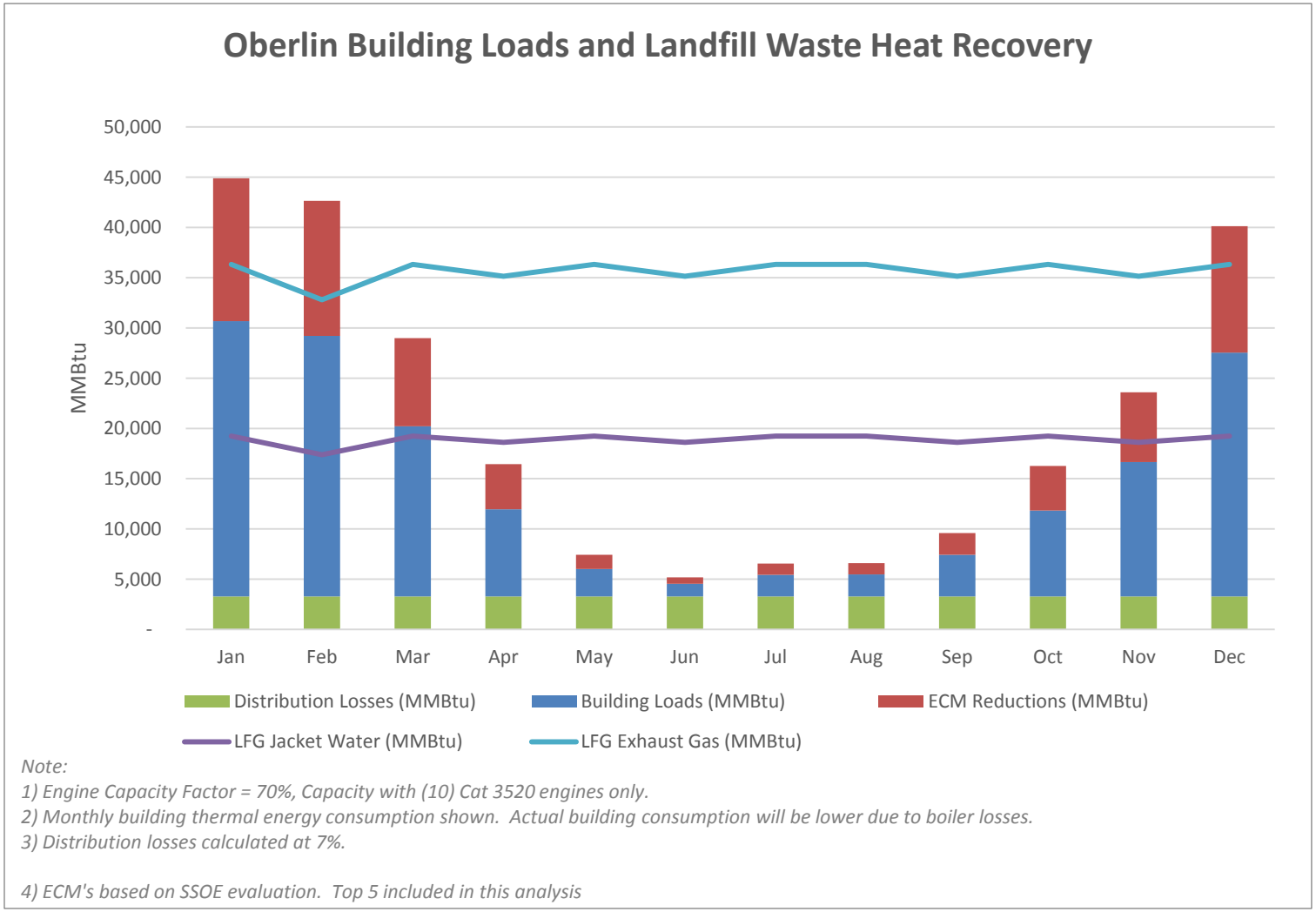

Note:

1) Engine Capacity Factor = 70%, Capacity with (10) Cat 3520 engines only.

2) Monthly building thermal energy consumption shown. Actual building consumption will be lower due to boiler losses.

3) Distribution losses calculated at 7%.

4) ECM's based on SSOE evaluation. Top 5 included in this analysis

Projected Scope 1 & 2 Carbon Reductions

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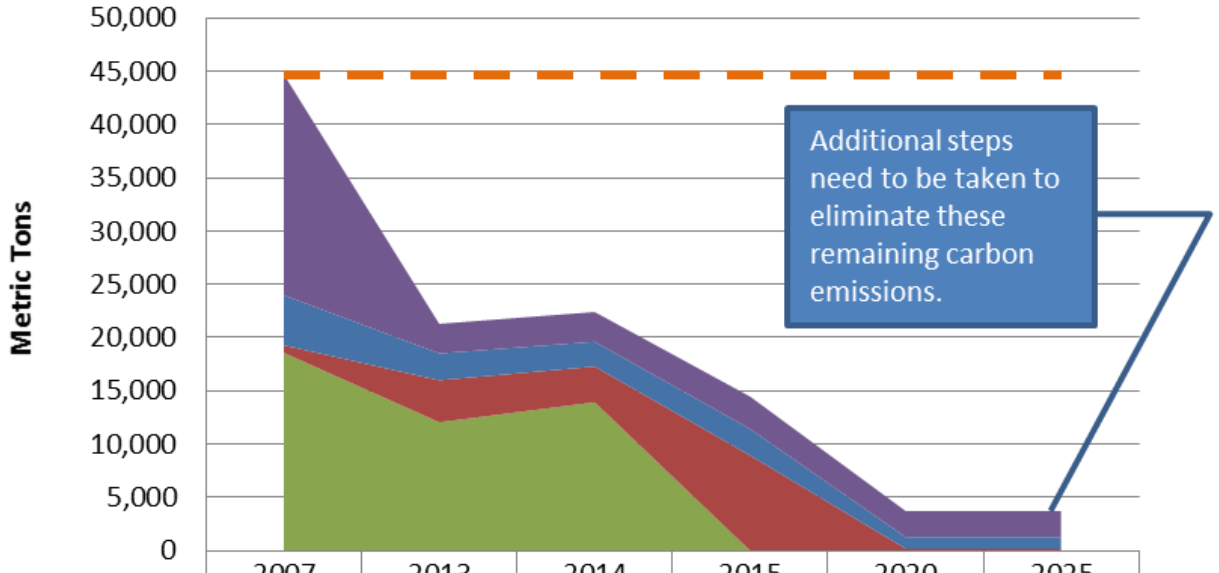
Carbon Dioxide Emissions

(As Metric Tons CO2)



	2007	2013	2014	2015	2020	2025
Electric	20,720	2,777	2,790	3,030	2,450	2,450
Natural Gas Other	4,693	2,516	2,333	2,493	1,082	1,082
Natural Gas Central Plant	710	3,943	3,347	8,933	191	191
Coal	18,570	12,054	13,934	0	0	0
Total CO2	44,693	21,288	22,404	14,456	3,724	3,724
2007 Baseline	44,693	44,693	44,693	44,693	44,693	44,693
% Reduction (2007 Baseline)	0%	52%	50%	68%	92%	92%

Financial Analysis

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Project Cost Summary - All Campus Utilities				
		2015 Baseline	2015 Baseline + ECMs	Alt 1- LFG CHP + ECMs
COST SUMMARY	Net present value w/out social cost of carbon (25-year) (k$)	$109,472	$103,273	$121,370
	Net present value w/out social cost of carbon (50-year) (k$)	$158,305	$144,106	$159,965
	Net present value with social cost of carbon (25-year) (k$)	$136,769	$120,206	$128,645
	Net present value with social cost of carbon (50-year) (k$)	$196,832	$168,005	$167,961

Financial Analysis

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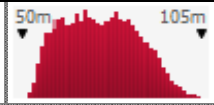
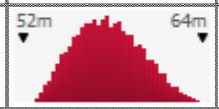
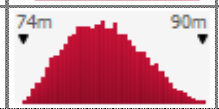
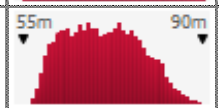
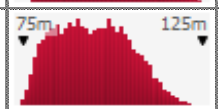
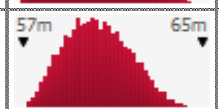
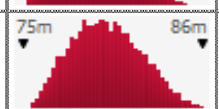
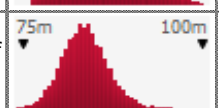
Name	Graph	5%	95%
25-Year NPV baseline with cost of carbon		$58,833,940	$91,844,020
50-Year NPV baseline with cost of carbon		$82,804,140	$129,625,200
25-Year NPV baseline without cost of carbon		$54,659,250	$61,214,860
50-Year NPV baseline without cost of carbon		$76,751,300	$86,508,380
25-Year NPV baseline+ ECMs with cost of carbon		$61,083,690	$81,869,230
50-Year NPV baseline+ ECMs with cost of carbon		$81,094,970	$110,576,000
25-Year NPV baseline+ ECMs without cost of carbon		$58,439,970	$62,620,300
50-Year NPV baseline+ ECMs without cost of carbon		$77,264,480	$83,484,170
25-Year NPV LFG CHP with cost of carbon		$79,643,920	$88,914,700
50-Year NPV LFG CHP with cost of carbon		$94,400,300	$105,112,600
25-Year NPV LFG CHP without cost of carbon		$78,213,220	$86,407,220
50-Year NPV LFG CHP without cost of carbon		$92,507,970	$101,317,100

Student Engagement

- Student Advisory Group
  - Kickoff in May
  - Ongoing meetings through summer
  - Check-ins throughout preliminary findings and report drafting
- Student and Community Forum in September
- Ongoing engagement and updates

Campus and Community Engagement

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- Board of Trustees Carbon Neutrality Subcommittee
- Committee on Environmental Sustainability (CES)
- Facilities Operations
- Oberlin Office of Environmental Sustainability
- Oberlin Faculty
- Finance and Administration
- Capital Planning
- Construction Office
- Grounds Services
- Financial Planning
- The Oberlin Project
- OMLPS
- Oberlin Public Schools
- Oberlin Dept. of Public Works
- Oberlin Planning and Zoning
- Public Library
- Oberlin Community Services
- Mercy Allen Hospital

Future Student and Community Engagement

- Student advisory group provided preliminary ideas on engagement for 2016-17 efforts, including:
  - OES newsletter
  - Engagement with on-campus student groups
  - Leveraging new student orientation
  - Ongoing open forums
- Continuation of an internship program
- Supporting curriculum and student programming development
- Oberlin Community Services collaboration
- Community benefits agreement
- Community engagement forum

Recommended Next Steps

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