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From Coal to Carbon Neutrality

The Sustainable Infrastructure Approach

at Oberlin College

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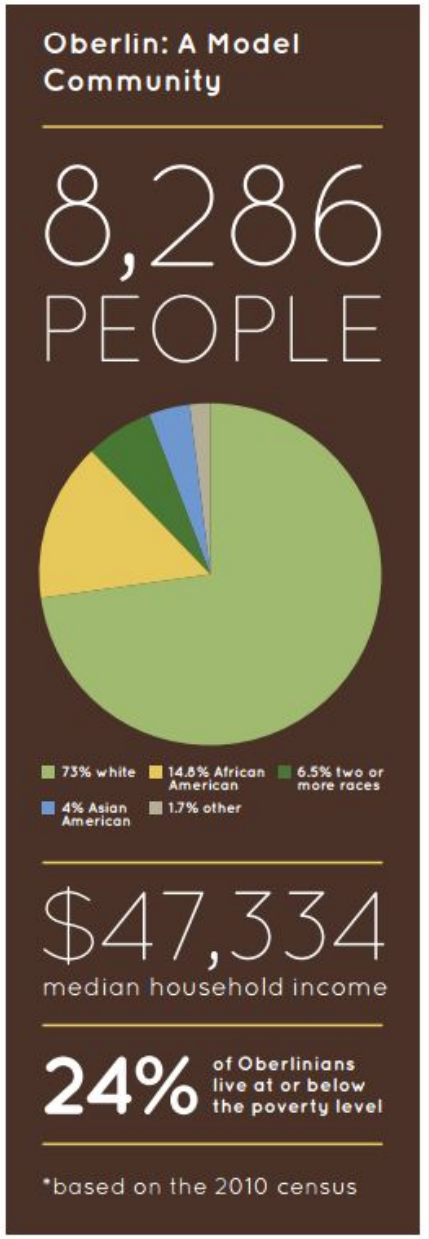
OBERLIN COLLEGE & CONSERVATORY

EVER-GREEN ENERGY™

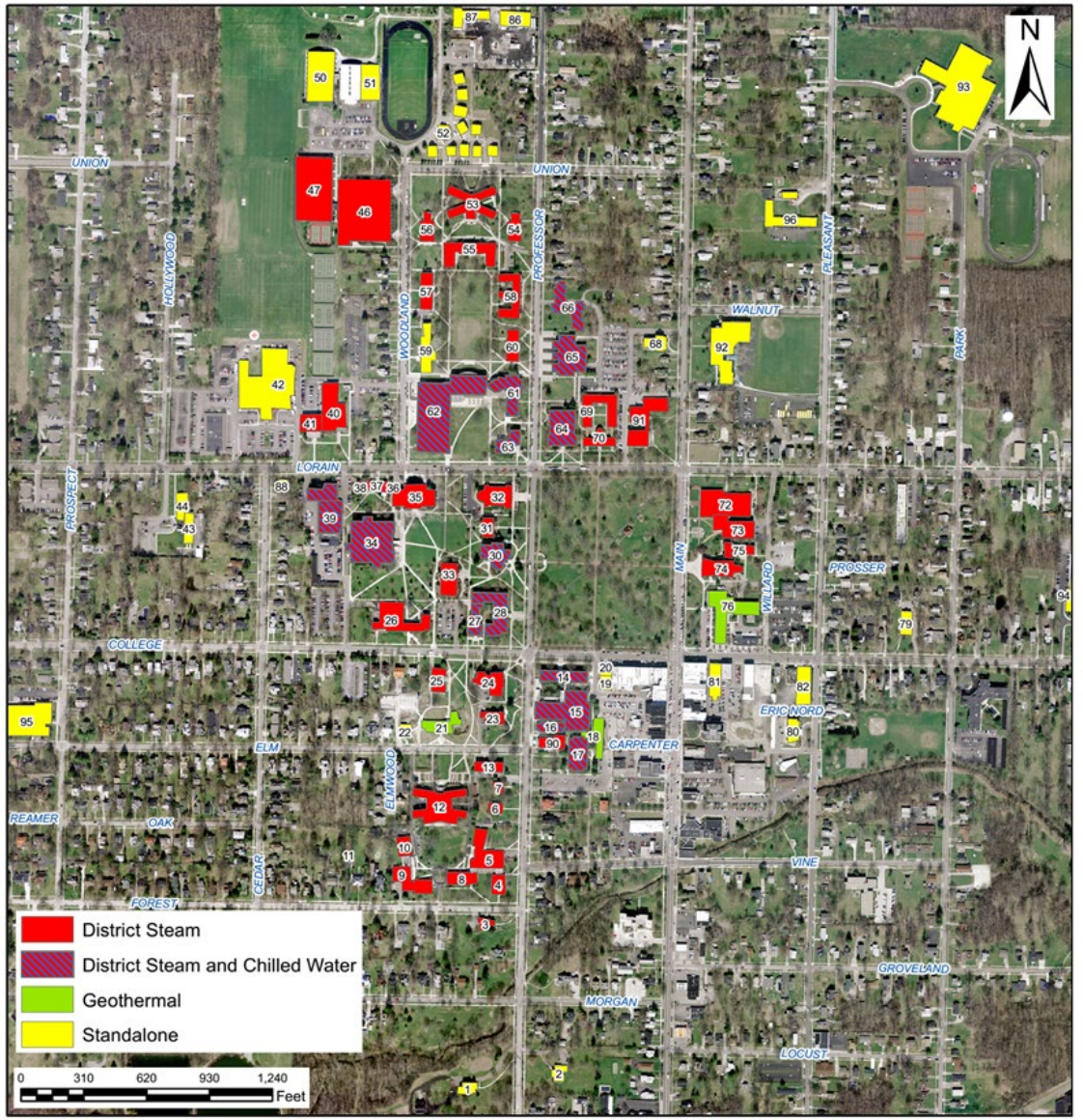
Campus & City Background

- Northeast Ohio, 30 miles west of Cleveland.
- City and college were founded at the same time in 1833.
- Recent leadership changes at city and college.
- Residential liberal arts campus w/ 2,900 students.
- 2,500,000 SF, 85+ buildings.
- Oberlin Municipal Light & Power Service.
- Distributed heating and cooling systems.



Campus Energy Profile

- 56 buildings on central steam
- 15 buildings on central cooling
- Peak plant steam load ~65 MMBtu/hour**
- Peak campus load ~80 MMBtu/hour**
- 2.27 MW PV Solar Array
- ~200kW of PV Roof and Parking lot Canopy Solar Arrays
- 4 geothermal building systems
- Aged system, some parts over 100 years old.
- **2009 PSI study

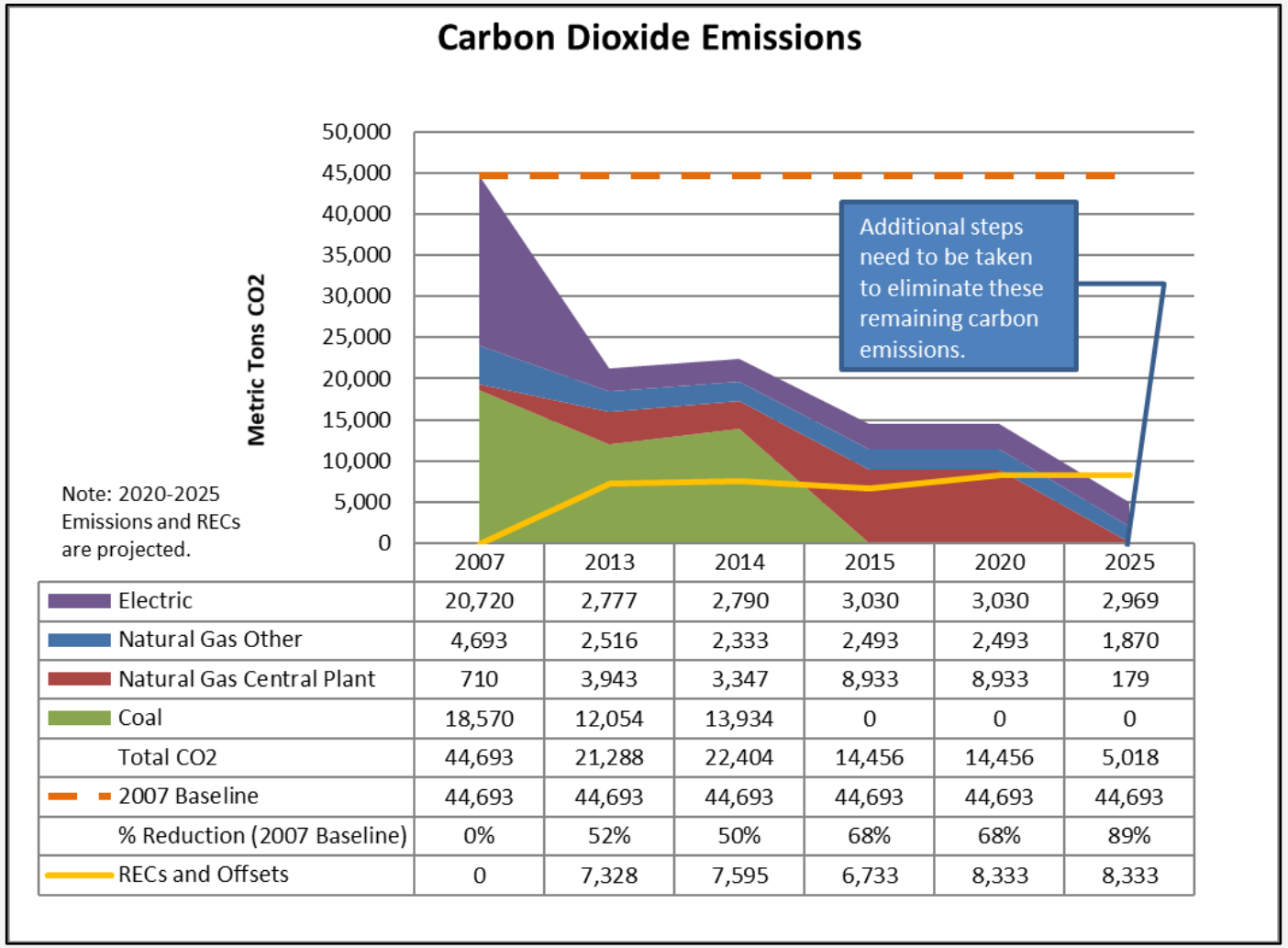


College Commitment & Culture

- **Our Commitments**: Oberlin College has established a very aggressive climate action plan with greenhouse gas reduction targets of 100% by 2025.
- **Our Environmental Policy**: The policy states, “The core mission of Oberlin College is the education of its students. One aspect of such education is the demonstration by its actions of the College's concern for, and protection of, its physical environment.
- ***One Oberlin* Strategic Effort**: Develop a roadmap to financial resiliency.

Carbon Profile

- Electric grid is 86% renewable
- 2.2 MW solar PV array on campus
- Natural gas combustion to heat the campus is the largest carbon emitter
- 2016 Campus Energy and Water Resource Master Plan, Implementation Strategy, and Financial Approach



	2007	2013	2014	2015	2020	2025
Electric	20,720	2,777	2,790	3,030	3,030	2,969
Natural Gas Other	4,693	2,516	2,333	2,493	2,493	1,870
Natural Gas Central Plant	710	3,943	3,347	8,933	8,933	179
Coal	18,570	12,054	13,934	0	0	0
Total CO2	44,693	21,288	22,404	14,456	14,456	5,018
2007 Baseline	44,693	44,693	44,693	44,693	44,693	44,693
% Reduction (2007 Baseline)	0%	52%	50%	68%	68%	89%
RECs and Offsets	0	7,328	7,595	6,733	8,333	8,333

Achieving Carbon Neutrality at Oberlin College

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.
- Helping City of Oberlin low-income residents decrease their energy consumption.
- Providing district energy options to local businesses.

Success in the Political Structures

Intentional Messaging

- Board of Trustee: Sustainable Infrastructure Subcommittee of Capital Planning Committee
- Staff: VP Finance & Administration
- Student: Carbon Neutrality Student Advisory Committee
- City of Oberlin: City's Climate Action Plan administered by Sustainability Coordinator

Project Champions on Every Level

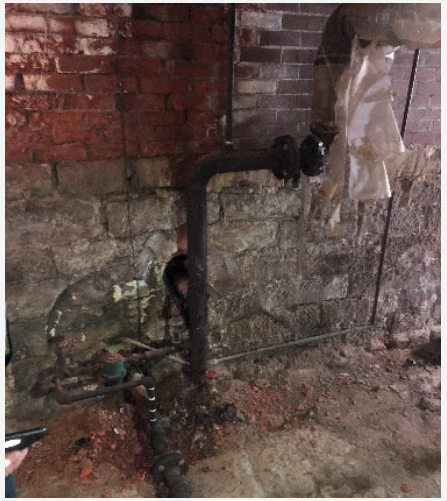
- Holistic Approach
- Carbon Neutrality encompassed within Sustainable Infrastructure Program
- Video Series
- Honesty in existing system condition

New Messaging: Achieving Sustainable Heating Infrastructure

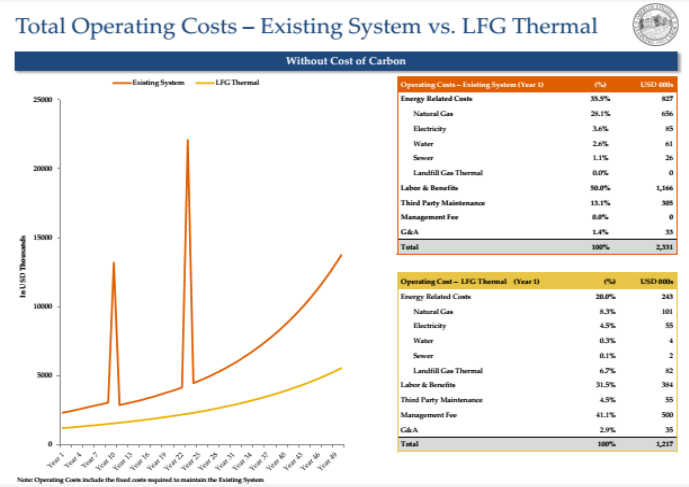
- Existing Steam System
  - Needs approximately $49M in upgrades and repairs
  - Poor operational efficiency due to aged infrastructure
  - Safety & Reliability Issues

- New Low Temp Hot Water
  - Improves 60 core campus buildings
  - Cost approximately $50M
  - New operational efficiency level at about 85%
  - Estimated 20-30% operational savings or $1.1M
  - Safer, simpler and more efficient to operate
  - Conversion process replaces inoperable and poorly functioning building systems and components
  - Addresses $15M in deferred maintenance

- Sustainable Infrastructure Program Core is Campus Carbon Neutrality



Next step investment occurred!
And support was gained for implementation.



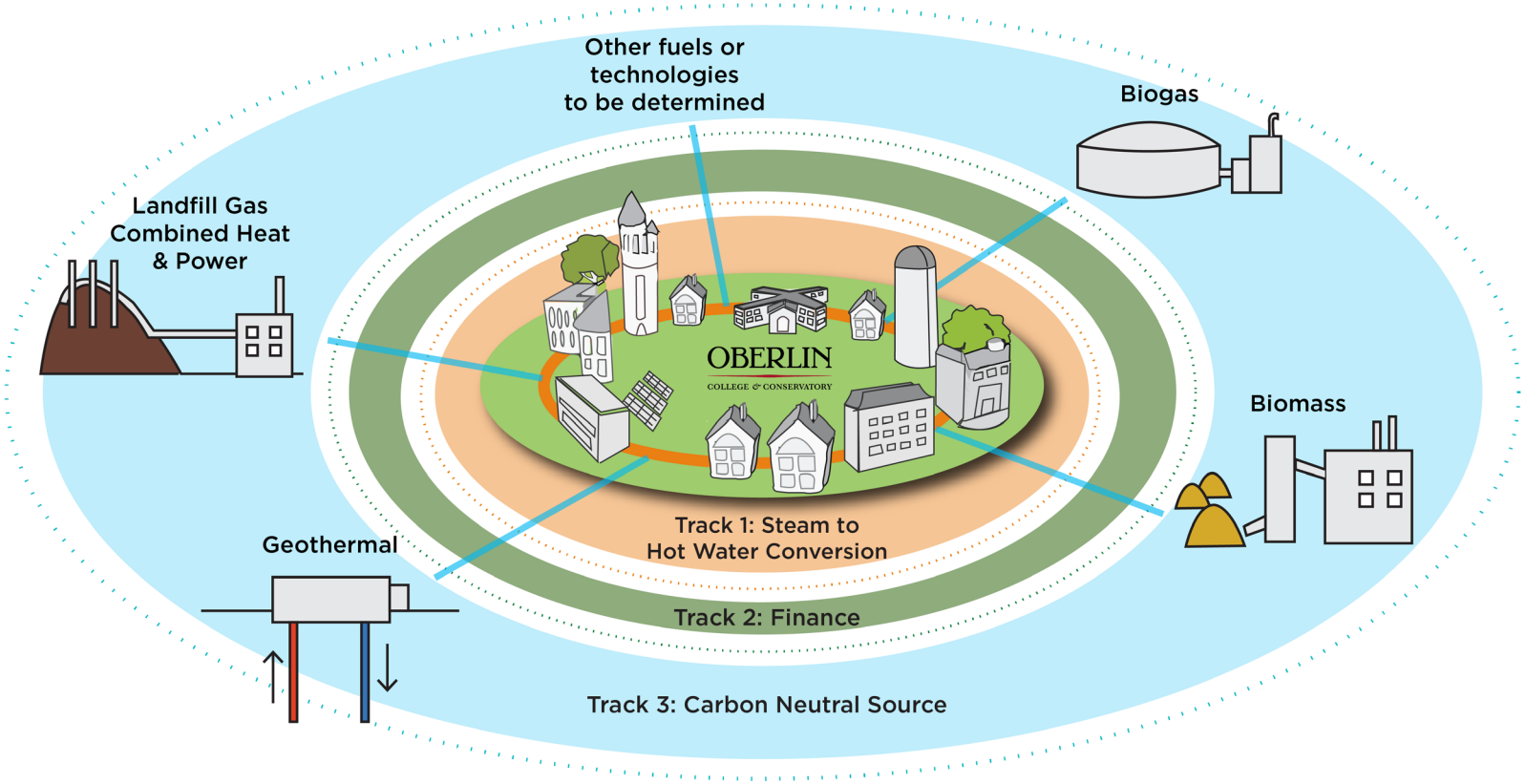
Trustee pro bono work:
Financial Model Review

THE GREEN EDGE FUND

Students offered match funds to refine recommendations and get construction pricing for the steam to hot water campus conversion.

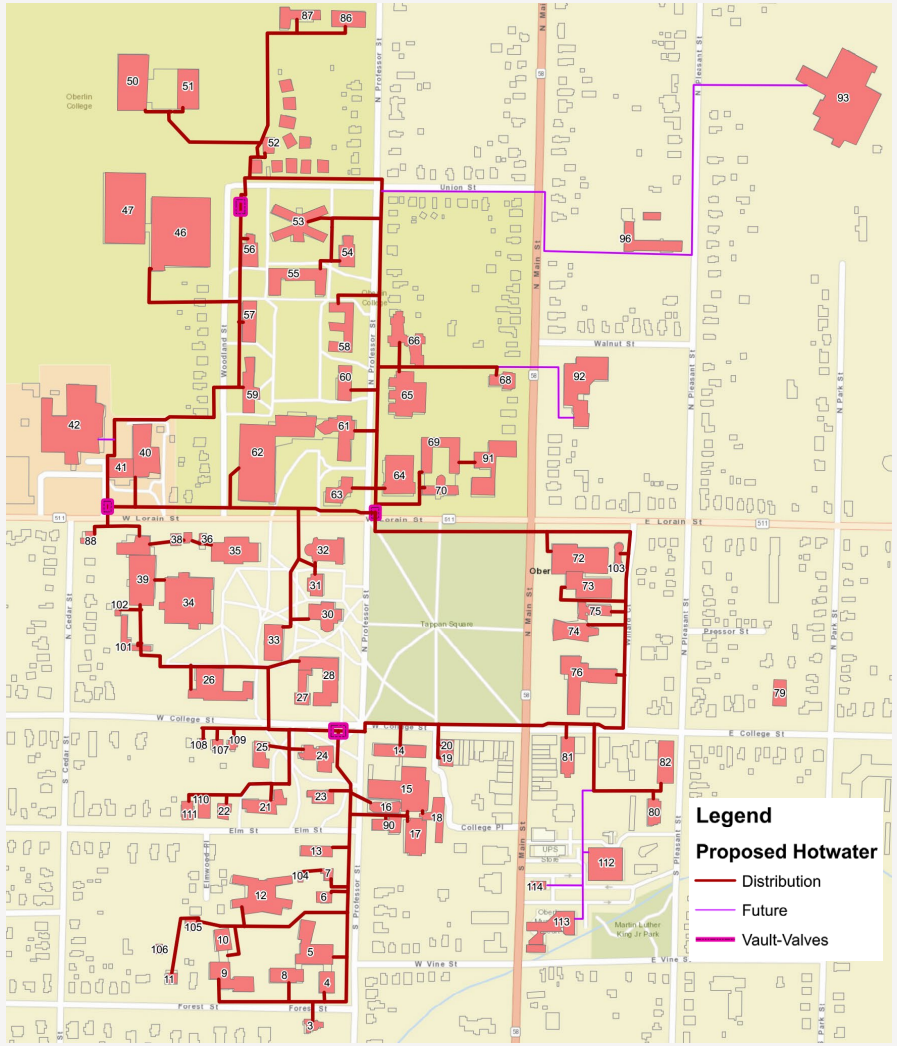
College Administration answered that call for a match; and began dedicating more staff time.

A Call For Action – Three Track Approach



Track 1: Steam to Hot Water Conversion

- 59 buildings converted to hot water
- 16,000 trench feet of pipe
- Direct-buried plastic piping



Track 2: Assess Financing and Organizational Structure Options

Recommended for Further Investigation and Refinement:

- Nonprofit utility model
- For-profit utility with debt and equity investment
- Municipal-owned
- Oberlin College funds with own debt capacity

Track 2: Addressing Sustainable Infrastructure Program Goals & Priorities

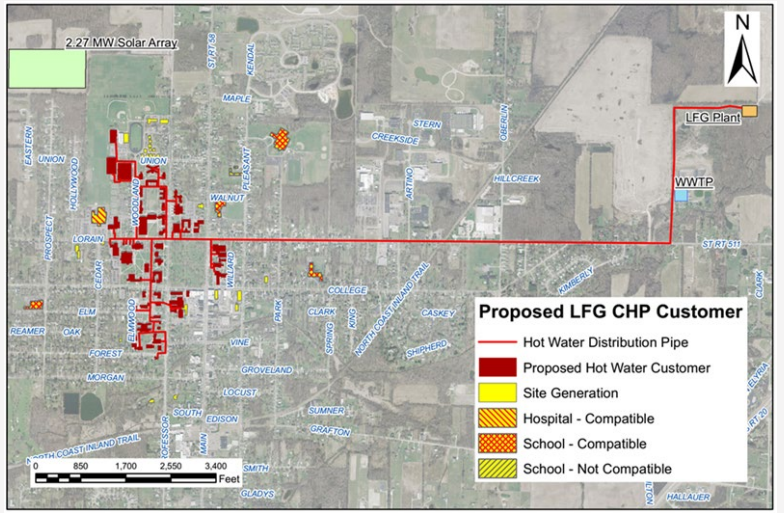
- Operational Cost Savings
- Carbon Reduction
- Resilient and Reliable Systems
- Educational Benefit
- Community Benefit
- Timescale
- Budget Neutral

Track 3: Decarbonization Alternatives

1. Business as Usual steam system with natural gas combustion
    a. Convert campus to hot water (180°F) with natural gas combustion
    b. Convert campus to low temperature hot water (140°F) with natural gas combustion
2. Aquifer Thermal Energy Storage, a type of geothermal
3. Biofuel, such as biodiesel
4. Biogas, such as methane from the landfill
5. Biomass, such as wood chips
6. Traditional geothermal with a well field
7. Variable Refrigerant Flow
8. Landfill gas combined heat and power
9. Solar PV with electric resistance heat and thermal storage
10. Wind with electric resistance heat and thermal storage

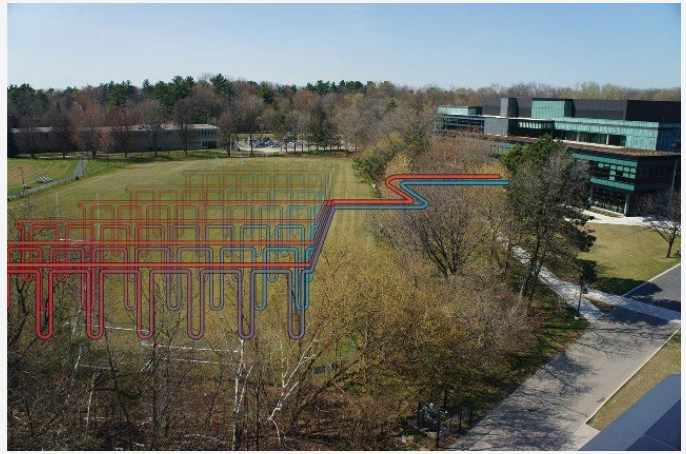
Cost-Competitive Decarbonization Strategies

1. Landfill Gas Combined Heat & Power
   - **Pros:** Lowest cost, Leverages existing energy source, Eliminates combustion on campus
   - **Cons:** 2 miles from campus, Dependent upon EDL business plan
   - **Risks:** EDL PPA, Landfill permit, Changing RIN market
2. Biomass
   - **Pros:** Local fuel source, Job creation
   - **Cons:** Solid fuel combustion on campus, Increased truck transportation, Labor intensive
   - **Risks:** Abundancy of fuel supply, Potential volatile fuel cost

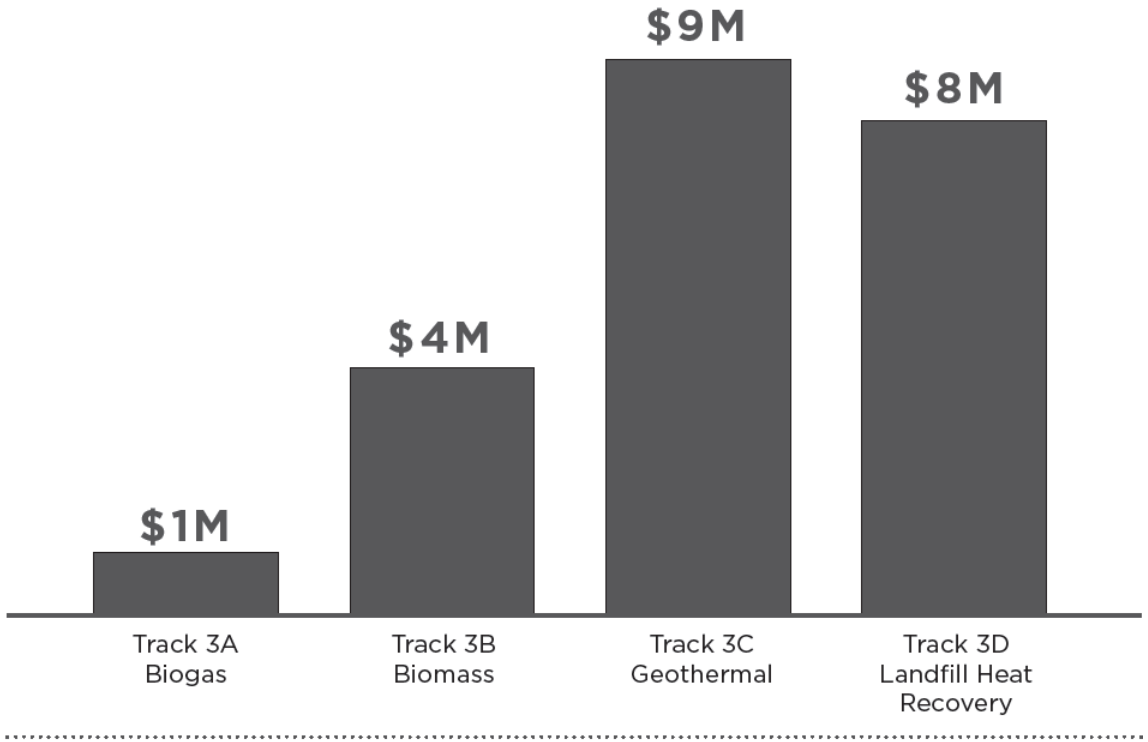


Cost-Competitive Decarbonization Strategies

3. Biogas
   - **Pros:** Leverages existing fuel source
   - **Cons:** 2 miles from campus, Dependent upon EDL business plan
   - **Risks:** EDL PPA, Landfill permit, Changing RIN market
4. Geothermal
   - **Pros:** Primarily controlled by Oberlin, Local to the campus, Eliminates combustion on campus, Already deployed at Oberlin, Adds cooling to all buildings
   - **Cons:** More complex mechanical systems, Some geothermal challenges on campus now
   - **Risks:** Land availability,



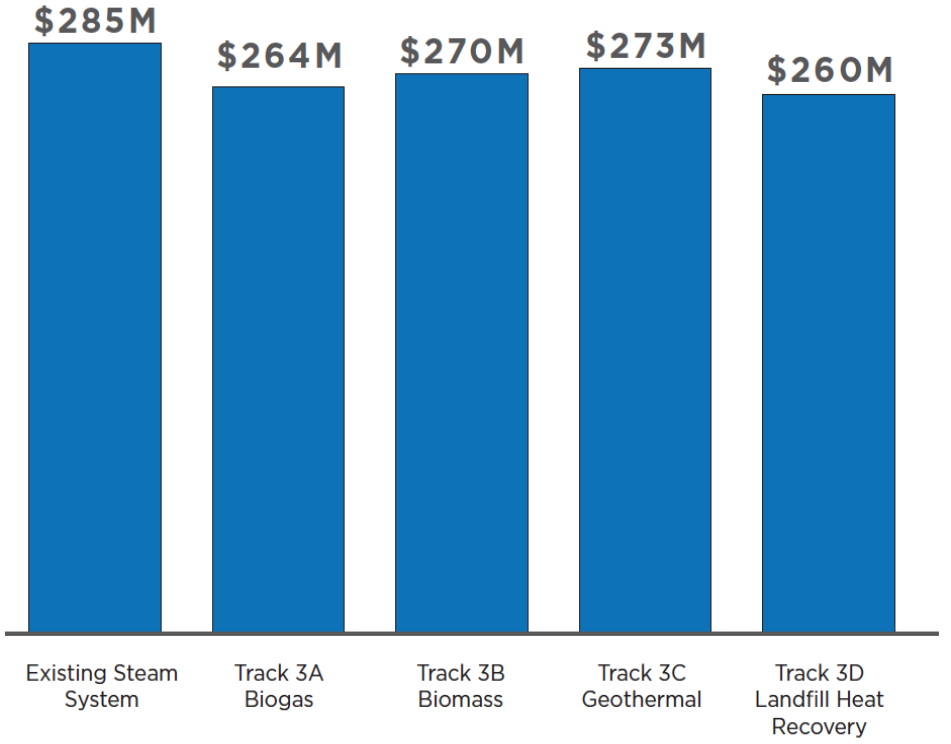
Capital Cost



Baseline: Track 1 - Steam to Hot Water Conversion

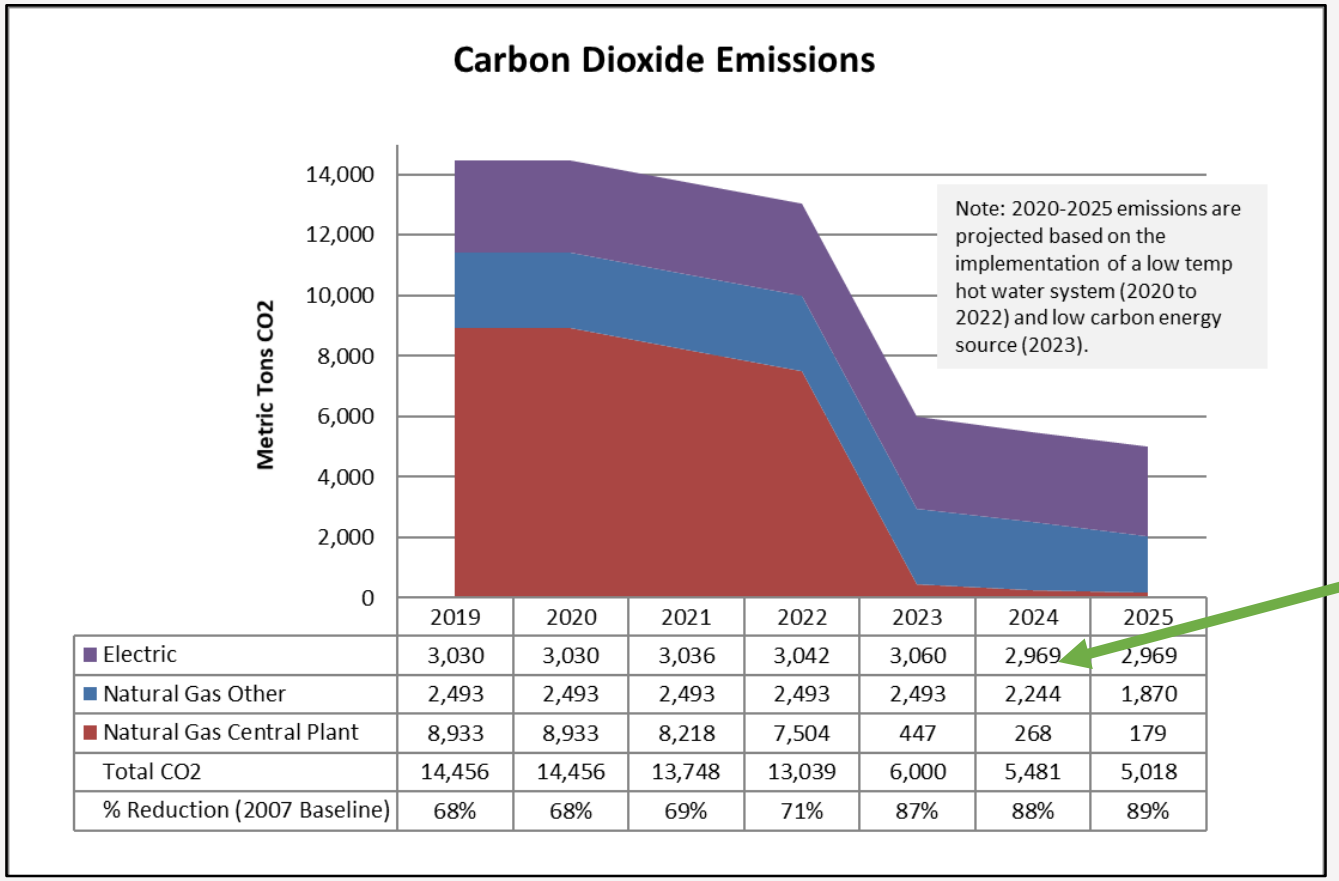
$50M

30-Year Lifecycle Costs*



*With $35 per ton cost of carbon

Achieving Sustainable Infrastructure and Carbon Neutrality at Oberlin



	2019	2020	2021	2022	2023	2024	2025
Electric	3,030	3,030	3,036	3,042	3,060	2,969	2,969
Natural Gas Other	2,493	2,493	2,493	2,493	2,493	2,244	1,870
Natural Gas Central Plant	8,933	8,933	8,218	7,504	447	268	179
Total CO2	14,456	14,456	13,748	13,039	6,000	5,481	5,018
% Reduction (2007 Baseline)	68%	68%	69%	71%	87%	88%	89%

This solution eliminates 89% of Oberlin College's emissions, from the 2007 baseline. Additional strategies will be required to get the rest of the way there

Nonprofit Utility Model

- Community asset
- Serving churches, city buildings, hospital, library, schools, and private buildings
- Governance by system customers, with the college taking a key role
- Off balance sheet transaction
- Cost-based rates

Nonprofit Utility Model

- Enables achievement of sustainable, carbon-free heating infrastructure
- Maintains alignment with Oberlin's mission
- Managing to mission rather than the contract
- No impact to college debt capacity
- Flexibility to integrate additional utility programs as campus needs change
- Flexibility to adapt as technologies and markets change

Outreach and Engagement

- Project Internships – GIS, project management, utility planning
- Student and Community Forums – to learn more about utility system advancement
- Ongoing Utility System Interns
- Curriculum Integration and Learning Experience Enrichment
- Integration with other campus and community programs

Moving Toward Implementation

1. Board direction to proceed with planning in December 2019
2. Financing and organizational planning Q1 2020
3. Energy service agreements (ESA) and financing Q2/Q3 2020
4. Design and construction planning Q3 2020 – Q2 2021
5. Campus hot water conversion construction commencement Q2 2021
6. Vetting of energy supply alternatives ongoing with selection in late 2020/early 2021