

# Roadmap to Carbon Neutrality Implementing Change in Higher Education

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# Question

If we know we need to reduce carbon AND so many institutions are committed to reductions, why aren't more campuses on their way to carbon neutrality?



# Common Challenges

Deferred  
Maintenance

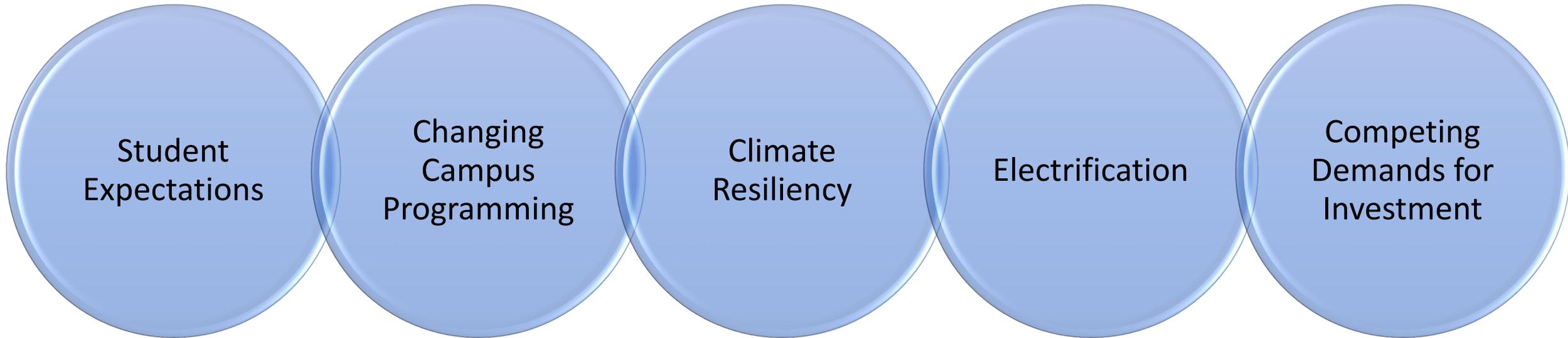
Constrained  
Access to  
Capital

Carbon-  
Intensive Grid

Lack of  
Leadership  
Buy-In

Inconsistent  
Building  
Design and  
Operation  
Specifications

# Common Pressures



What if they just needed a  
little help to move forward?

# Roadmap to Carbon Neutrality

“We created this pilot program to help campus leaders move past the planning phase of carbon neutrality goals and into implementation. If we want to see transformation, we must help our partners move their projects to construction and operation. The right plan is key.”

- Ken Smith, CEO and President

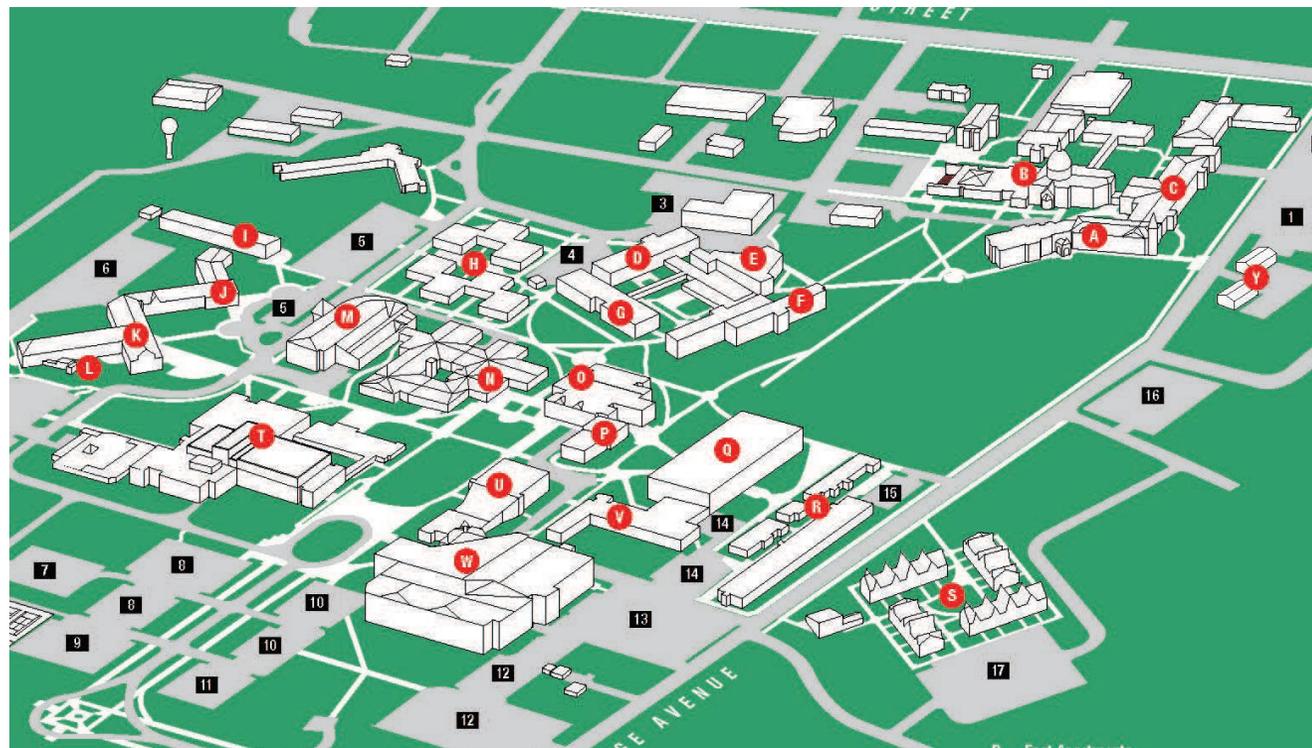
# Shaping the Pilot: Submission Process & Screening

- Committed to carbon neutrality – throughout the organization
- Hurdles that could realistically be overcome by this process
- Committed to providing a partner to coordinate data collection and a cross-functional stakeholder group, representing students, faculty, facilities, and financial management of the institution.



# Campus A: private, rural university

- 3640 undergraduate students
- ~1,300,000 gross square feet
- In October 2015, signed onto the Climate Commitment
- Charter signatory of the original American College & University Presidents' Climate Commitment in 2007

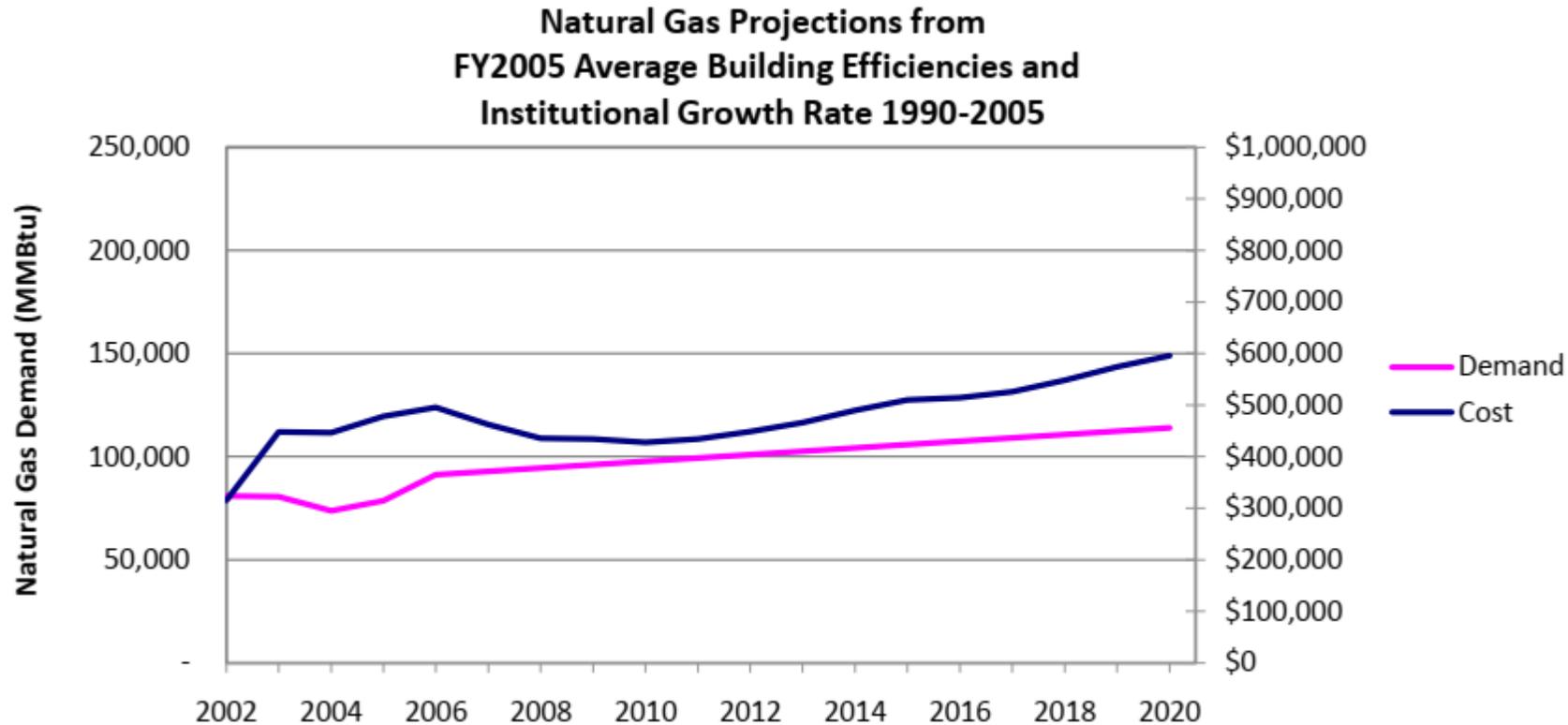


# Campus A : Operations Profile

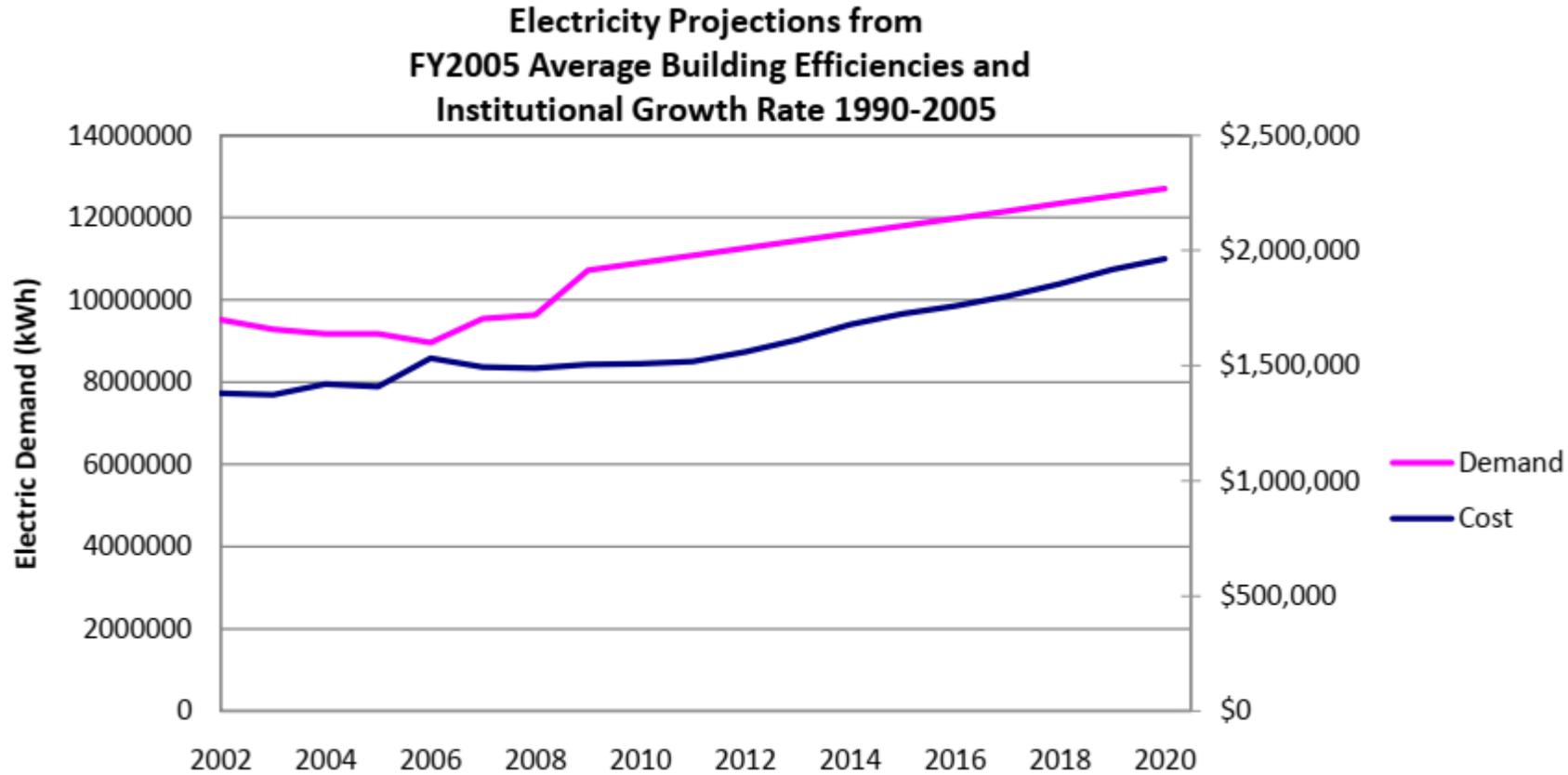
- Annual electric usage  
11,590,000 kilowatt hours
- Annual gas consumption  
749,000 CCFs
- Previous energy efficiency efforts have focused on lighting retrofits and educational programming



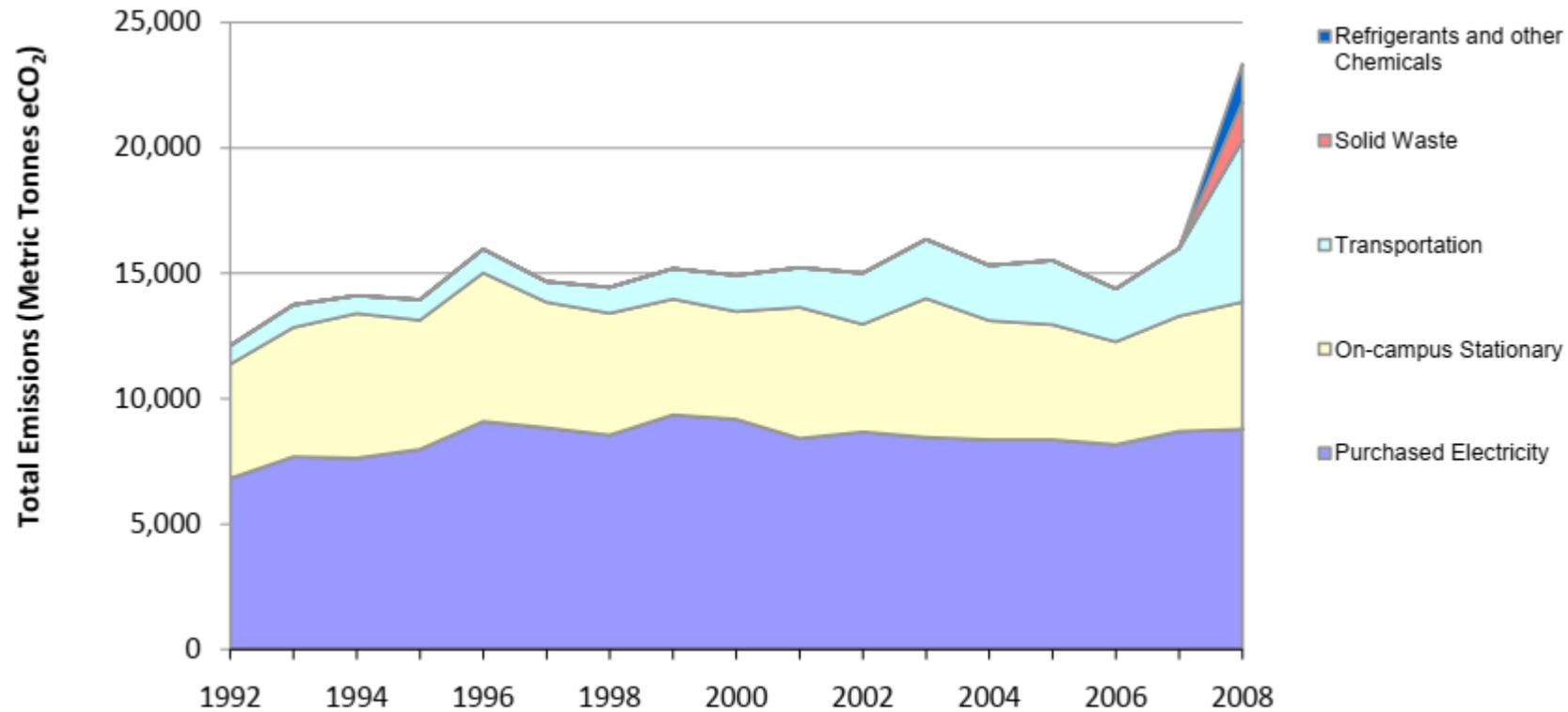
# Campus A : Historic and Projected Gas Usage



# Campus A : Historic and Projected Electric Usage

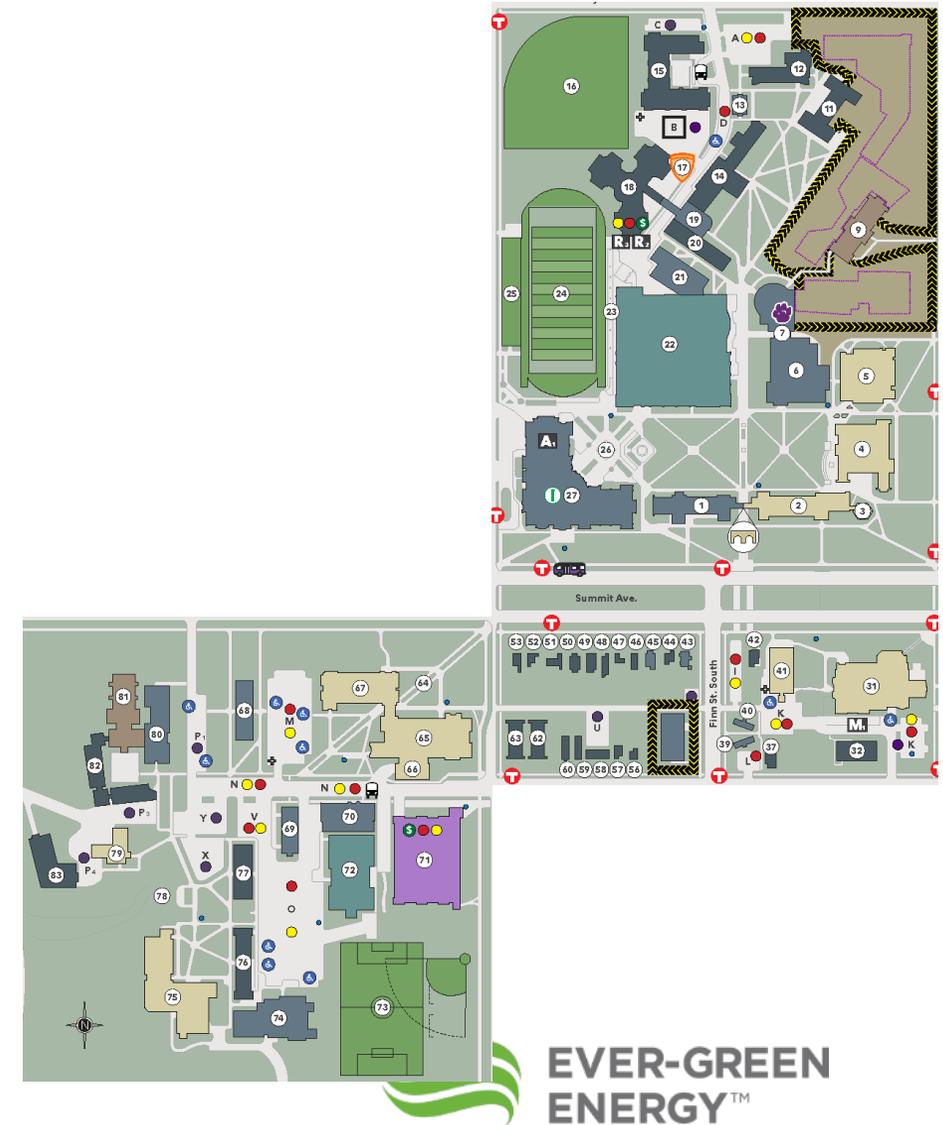


# Campus A : 2008 GHG Inventory



# Campus B: private, urban university

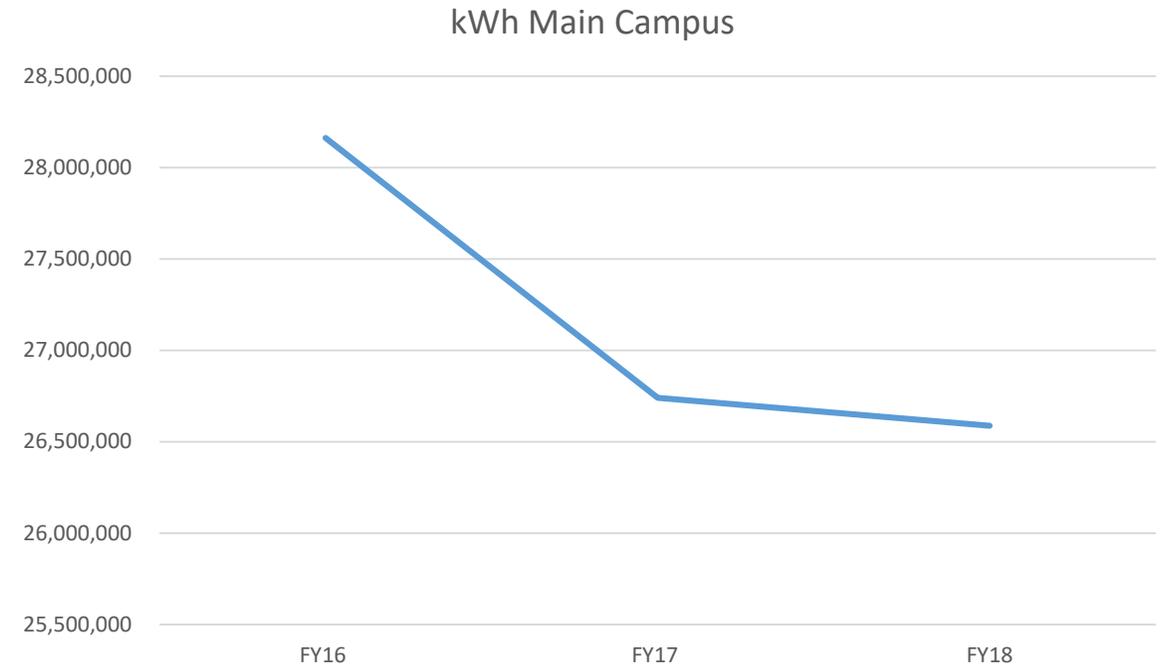
- 84 acres
- 3,191,000 Gross Square Feet
- 10,000 undergraduate and graduate students
- Eight schools and colleges, offering 150+ majors and minors
- Three campuses – Main campus is the focal point for carbon reductions



# Campus B: Operations Profile

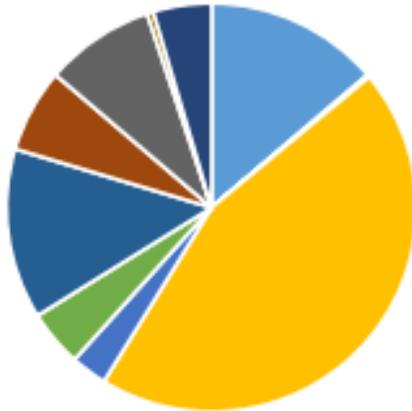
## Utility Consumption for 2018

- Electrical 26,588,058 kWh
- Natural gas – 1,597,1439 Therms
- Fuel Oil – 60,751 Gallons
- Heating Degree Days – 6,283
- Cooling Degree Days - 905



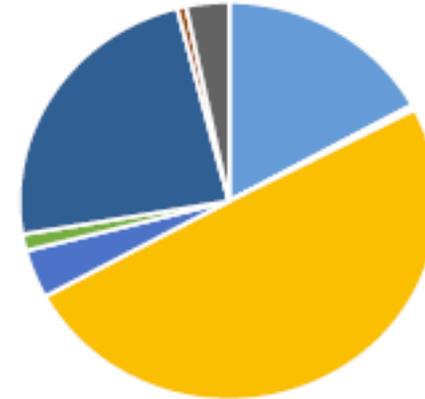
# Campus B: Comparison of 2007 and 2016 Source Emissions

2007 Source Emissions



- On-Campus Stationary
- Direct Transportation
- Agriculture
- Purchased Electricity
- Purchased Steam
- Faculty/Staff Commuting
- Student Commuting
- University Air Travel
- Solid Waste
- Wastewater
- T&D Losses

2016 Source Emissions



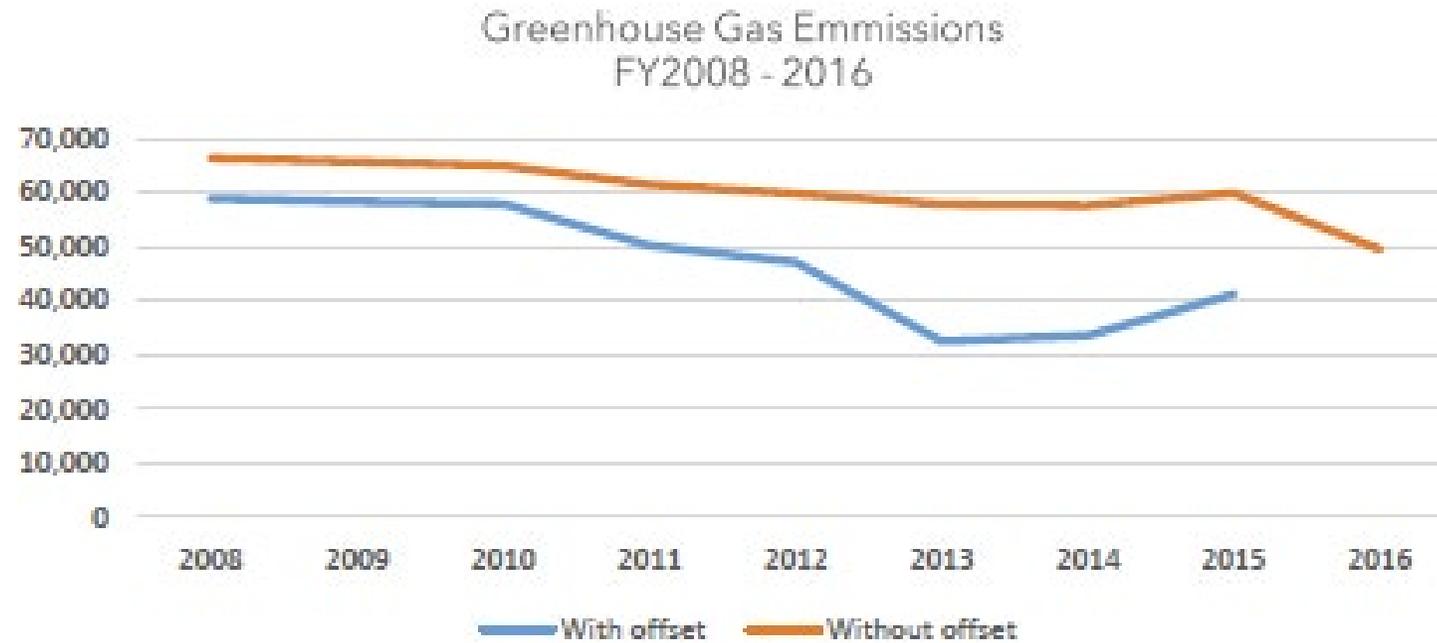
- Stationary Sources
- Direct Transportation
- Refrigerants
- Purchased Electricity
- Purchased Steam
- Commuting
- Air Travel
- Wastewater
- T&D Losses

# Campus B: Greenhouse Gas Emissions FY 2008-2016

Greenhouse Gas Emissions FY 2008 - 2016

Year	Stationary Source Emissions (tonnes CO <sub>2</sub> )	Purchased Electricity Emissions (tonnes CO <sub>2</sub> )	Total University Emissions (tonnes CO <sub>2</sub> )	Total University Emissions with Renewable Energy Offsets (tonnes CO <sub>2</sub> )
2008	10,488	29,731	66,415	58,919
2009	9,506	29,107	65,802	58,399
2010	9,115	26,533	64,978	57,976
2011	11,236	28,433	67,474	56,248
2012	8,165	28,024	59,852	47,176
2013	10,234	23,310	57,872	32,557
2014	12,161	21,788	57,657	33,580
2015	10,180	25,936	59,918	41,249
2016	8,421	24,636	49,594	NA

# Campus B: Recent GHG Reductions



# Campus B: Initial Findings

- Campus has been focused on efficiency efforts to optimize overall savings, as well as carbon savings.
- Reduced carbon by nearly 20% since 2007 (baseline tracking year)
- Microgrid under development 2016
- Electric utility will achieve 80% carbon-free threshold by 2030 and 100% carbon-free electricity by 2050
- Additional combustion strategies are limited to RNG



*Rhombus Energy provided two UPC-30/60 kW bi-directional inverters to the project. They come equipped with two 30-kW DC input ports and one 60-kW AC output port.*

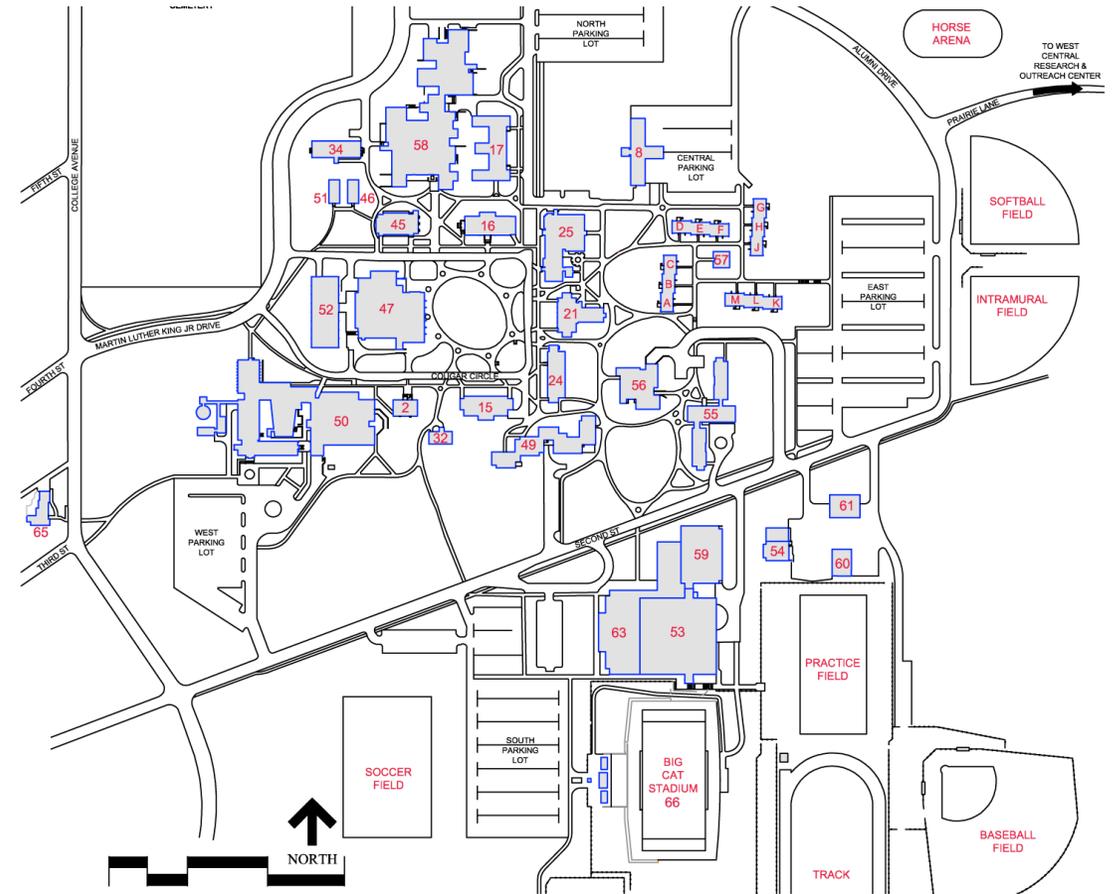
# Campus B: Initial Findings Cont.

- Offsets are a lower priority strategy for the campus, but could include gas/thermal offsets
- Steam conversion is a low priority, limiting additional low-temperature strategies in near-term
- Significant Scope 3 carbon challenges related to travel and commuting that the leadership would like to address



# Campus C: public, rural university

- Carbon neutrality commitment - 2020
- 1600 students
- 165 acres
- 993,000 Gross Square Feet
- One of the first public colleges to generate on-site renewable power from wind and corn stover (biomass gasification)
- Integration of solar thermal and PV



# Campus C: Operations Profile

- Steam Produced – 113,000 MMBtu (Peak 21.8 MMBtu/hr)
- Gas Consumed – 124,000 Therms
- Electricity Consumed – 8,627 MWhr (Peak 1.7 MW)
- Cooling
  - No individual cooling metering
  - Campus has three chillers:
    - Chiller 1 (Electric): 400 actual tons max @ 232 kW
    - Chiller 2 (Electric): 600 actual tons max @ 346 kW
    - Chiller 3 (Steam): 617 tons
  - Campus demands around 550-600 tons of cooling on average on a typical summer day

# Campus C: Operations Profile Cont.

- ▶ Roughly 70% renewable electricity
  - ▶ 60% of campus electricity from 2 wind turbines
  - ▶ Utility is 30% renewable
  - ▶ 240 kW of solar PV
- ▶ Campus electrical demand ranges from 1000 – 1650 kW
- ▶ Peak steam demand is 23,000 #/hr

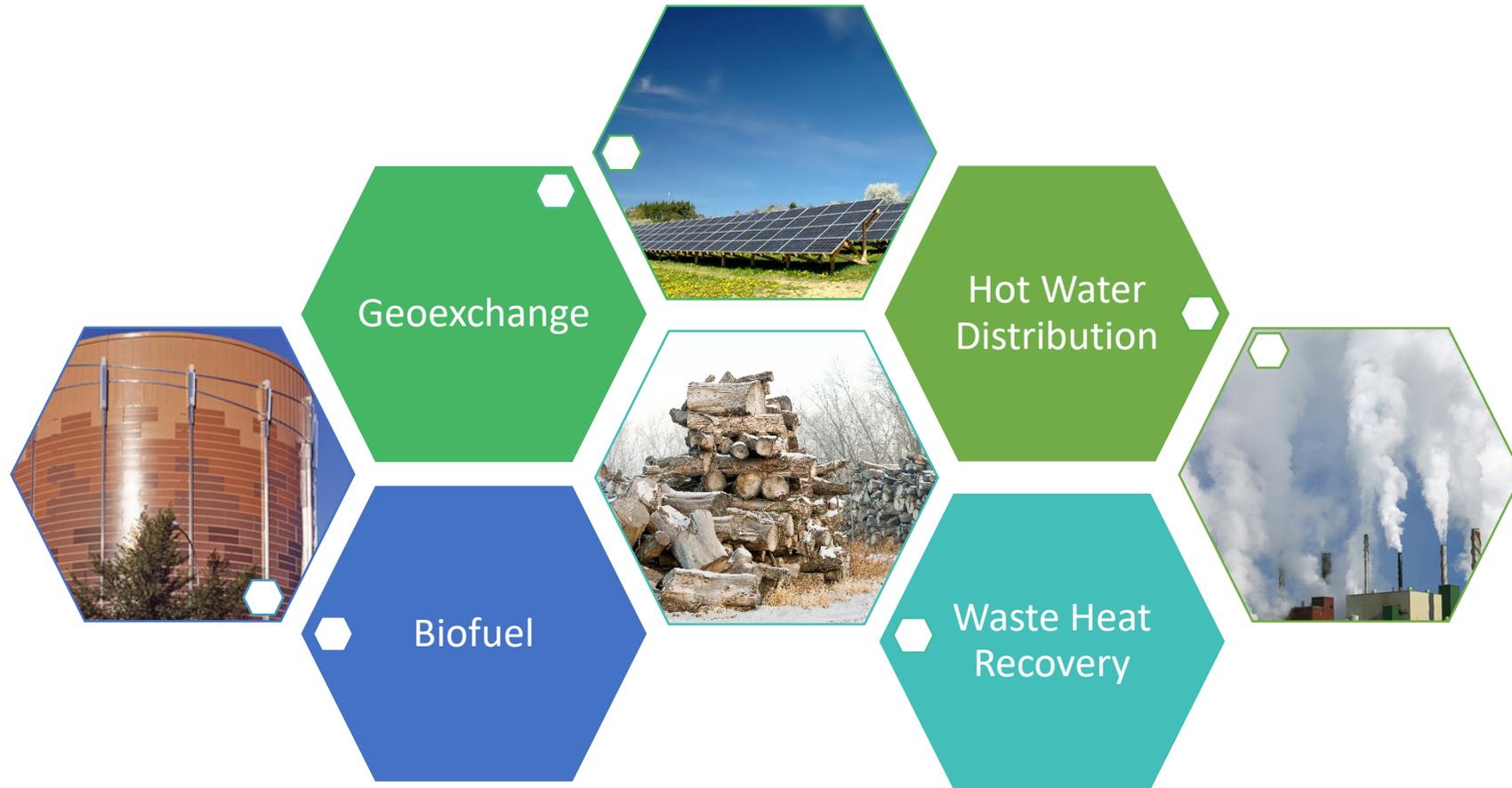


# Campus C: Path Forward

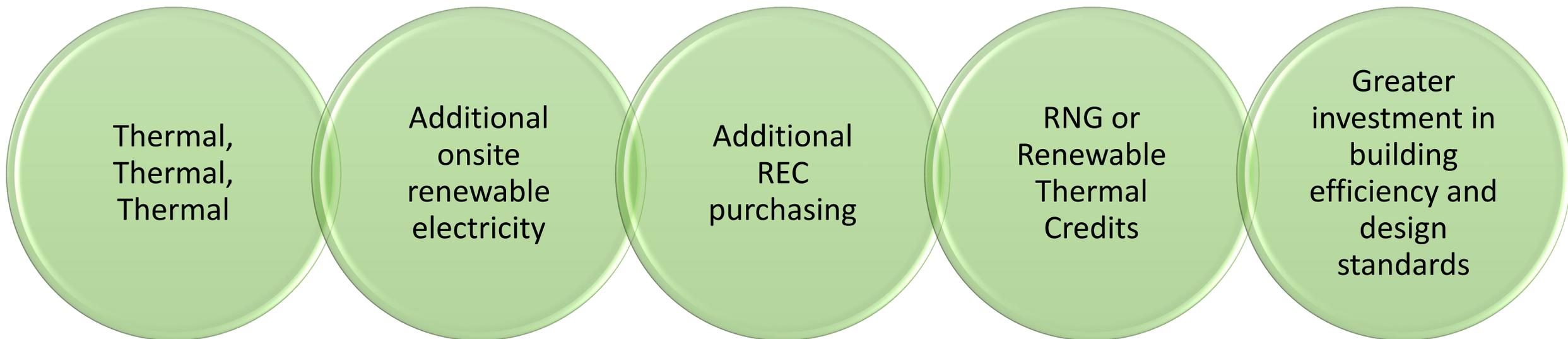
- Steam to low-temperature hot water system transformation – 140 degree supply
- Three primary renewable source opportunities:
  - Heat capture from a local ethanol plant
  - Extended biomass program to include local woody biomass and additional agricultural residues (tree waste and ag waste)
  - Geothermal



# Sources and Technologies Examined



# Common Opportunities



# Common Lessons

All teams  
need to  
buy-in

No silver  
bullets

Ok to go  
slow first to  
eventually  
get further,  
faster

Still lots of  
low-  
hanging  
fruit

Stakeholder  
education

Data is Not  
Readily  
Available or  
Always  
Current



# Questions?

# Thank You

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