

College Apartments Electrification

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Project Plan



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■ Introduction

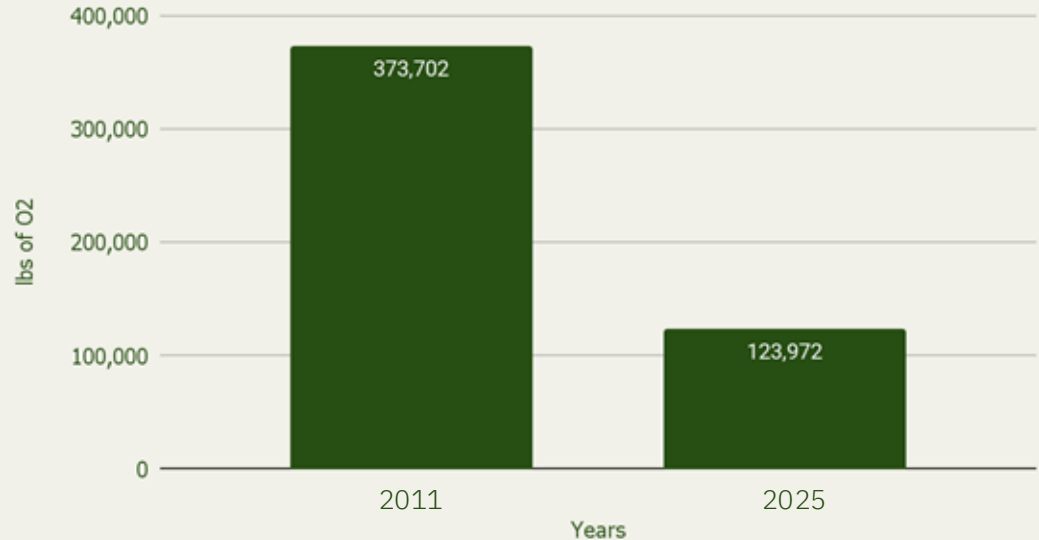
- The College Apartments operate with gas space and water heating
- Luther College goals for 2030 carbon neutrality
- 3 options : 1 long term plan
- Not one right answer, but a game plan
- Smaller suggestions to improve general living
- Important to give these places in detail attention

Past & Current Heating Systems

■ Past

- Fully electric before 2011
- 230,000 kWh per year to operate
- MROW in 2010
 - 16,024 lbs of CO₂/MWh
- MROW in 2025
 - 920 lbs of CO₂/MWh

Annual Carbon Footprint (lbs of CO₂/yr)

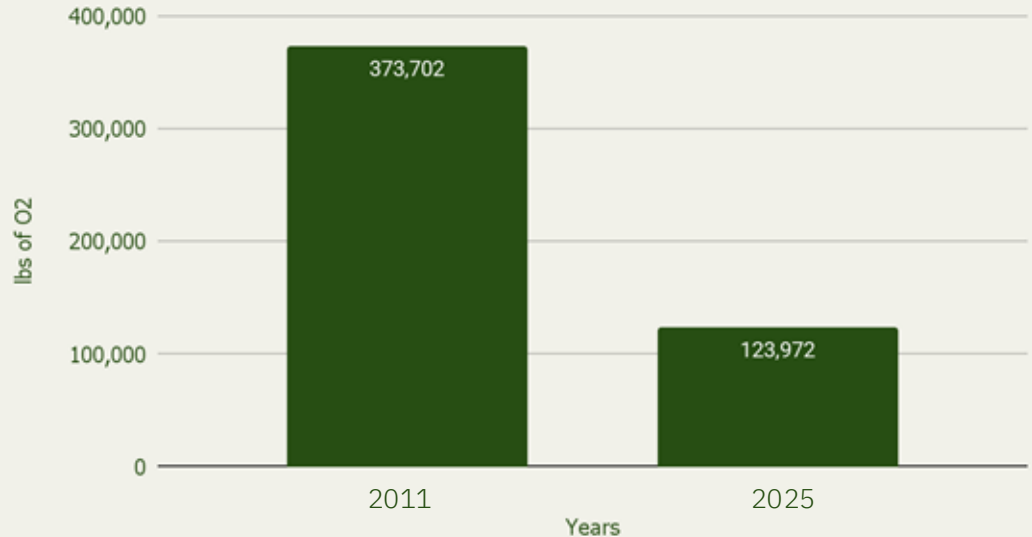


Past & Current Heating Systems

■ Present

- Roughly \$320,000 project to transition to gas water and space heating
- Huge reduction in cost and emissions
- Efficient technology and carbon neutrality goals prompt a transition back to all electric

Annual Carbon Footprint (lbs of CO₂/yr)



Weatherization

■ AC Unit Insulation

- Blower door results:
 - Air flow through uncovered units
 - Less for covered units, but still significant
- Suggestion: Modern covers that will trap heat inside
- Less gas needed to heat
- Keeps students comfortable

■ Example



■ Attic Insulation

- 12in of existing insulation
- Adequate to trap heat



Importance of Electrification

■ Direct Emission & Net-Zero

- Transition to electric systems removes emissions from burning natural gas.
- Electricity can be powered by clean energy like wind and solar, helping reach net-zero goals.
- Electrification reduces reliance on fossil fuels and lowers carbon footprint.

■ Air Quality & Safety

- Electric systems create no indoor pollution from gas stoves, furnaces, or water heaters.
- Cleaner indoor air means fewer health problems like asthma or breathing issues.
- No open flames or gas leaks



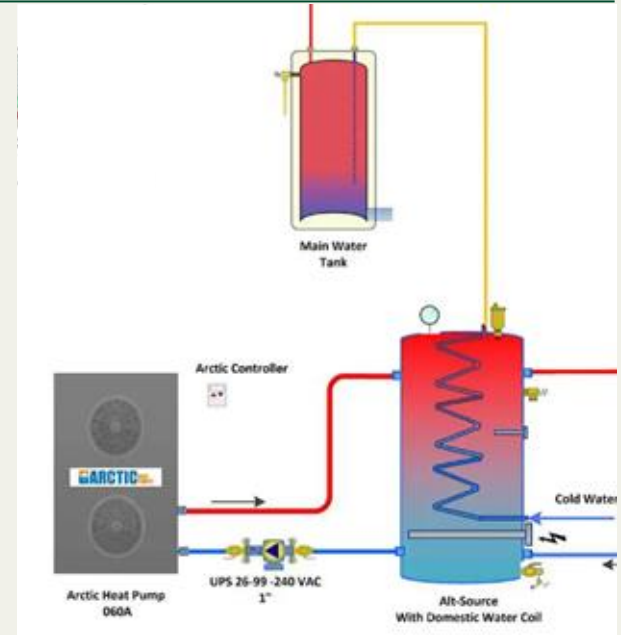
Heat Pump Water & Space Heater

■ How It Works

- Uses electricity to move heat from the ambient air into water or indoor spaces rather than generating heat directly.

■ Benefits & Drawbacks

- Good efficiency(%225)
- High long term cost
- Relies on grid cleanliness for Net-Zero
- High upfront cost ~ \$300,000
- Requires improved baseboard radiators



Arctic Heat Pumps

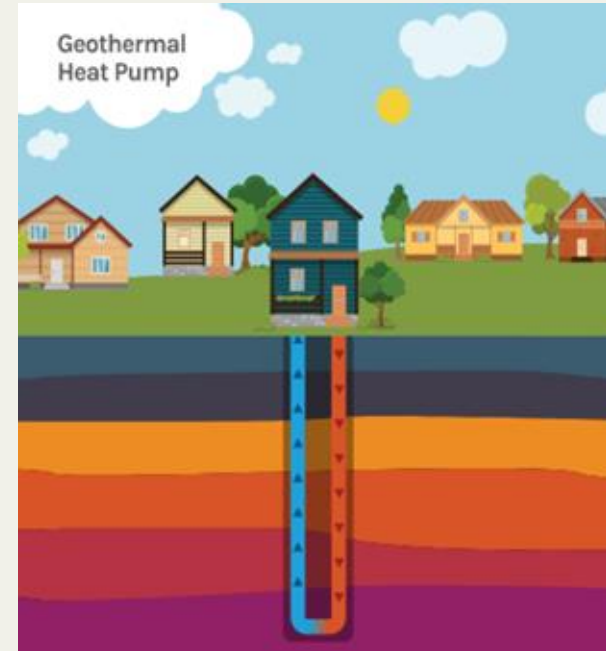
Geothermal Water & Space Heater

■ How It Works

- Geothermal heating uses pipes placed underground to absorb the earth's natural heat. A heat pump inside your house brings that heat up and uses it to warm the air or water for your home.

■ Benefits & Drawbacks

- High efficiency (%400)
- Clean & renewable energy
- High upfront costs ~ \$800,000
- Improves Air quality
- Requires improved baseboard radiators



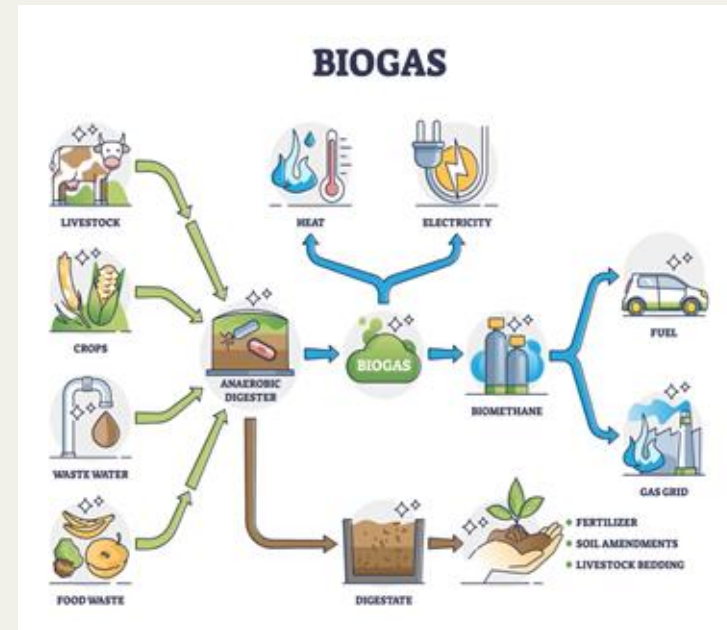
Biogas: Black Hills Green Forward

■ How It Works

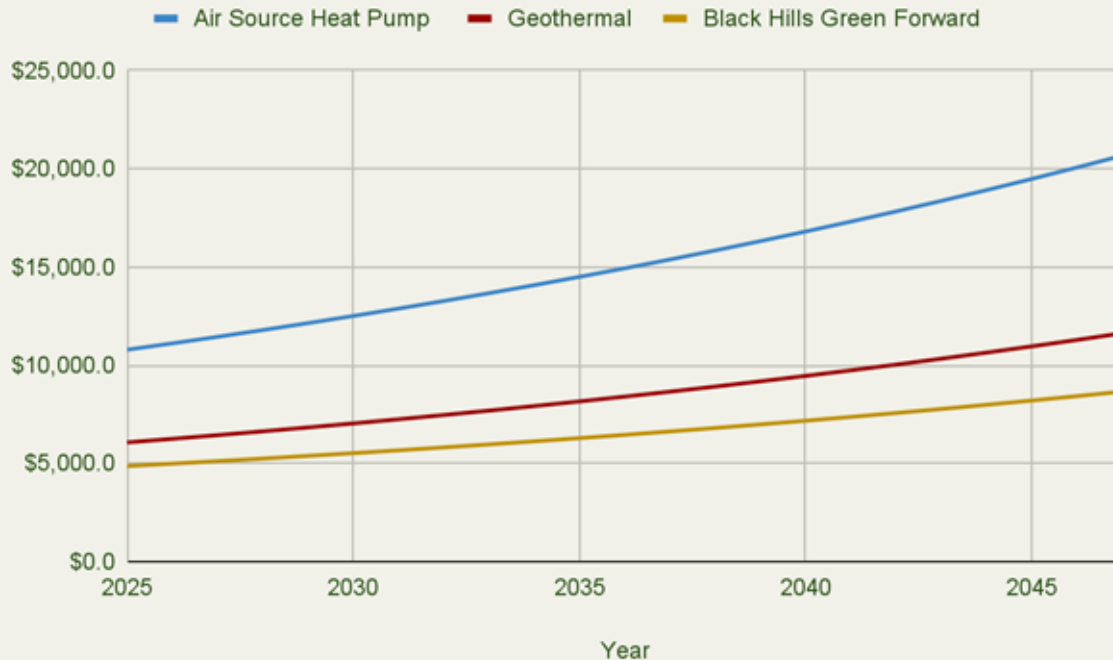
- Biogas is a renewable fuel, produced by the natural, oxygen-free decomposition of organic matter like manure, food waste, and sewage through **anaerobic digestion**
- Black Hills has 2035 net zero goals but they are being met by offsets, not 100% biogas production

■ Benefits & Drawbacks

- Secondary emissions
- Cleaner than Natural Gas
- Renewable energy source
- Uses the current gas delivery system
- The leftover material becomes fertilizer
- Least cost in 10 years



Total Cost in 20 Years Comparison



■ Data & Disclaimers

Heat Pump

● \$350,074

Geothermal

● \$196,916

Green Forward

● \$150,974

- Excludes upfront cost
- Assumes 3% cost increase in gas and electricity price

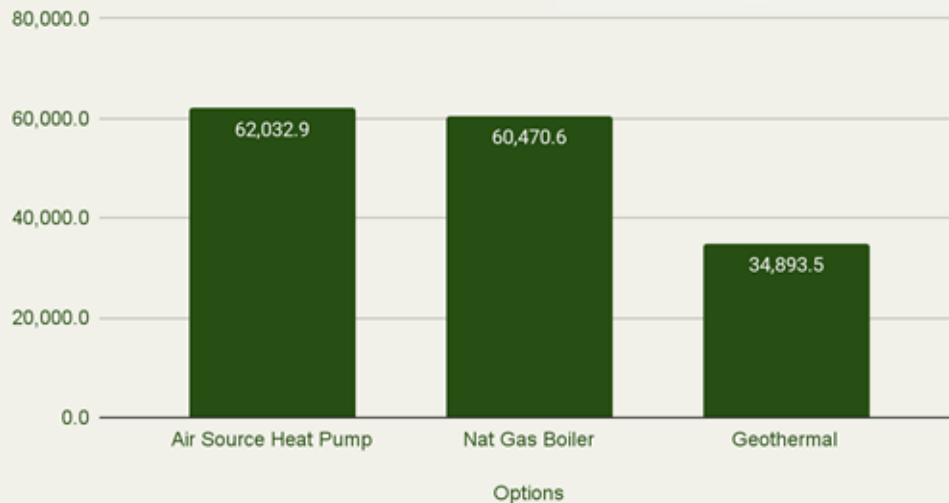
Carbon Footprint

■ Long Term Impact

- Electrification lowers carbon emissions every year, not just short-term.
- Systems like heat pumps become cleaner over time as the grid adds more wind and solar.
- Switching from natural gas to electric reduces lifetime CO₂ from heating.
- Geothermal and efficient heat pumps give the biggest long-term carbon savings.
- Lower carbon footprint also means lower climate impact for future generations.



Carbon Emissions (lbs of CO₂) 2025



Long Term Plans

Now: Pay Biofuel Premium

- Contact Black Hills to get College Apartments zoned and build payment plan
- Instal AC weatherizers

Implement Metering and Solar

- Take donor money to support the meter combining
- Take donor money to set up solar panels

Set Aside Savings

- Encourage savings to be set aside and put toward net-zero goals
- Specifically for College Apartments

Use Money For Ground Source Heat Pump

- Put in a geothermal system that heats space and water
- Replace baseboard radiators

Zero Emission Housing

- No direct emissions and most energy made on site
- Honestly on its way to Net-Zero

Conclusion



■ Past and Current Systems

2011-2025

■ Solutions

Weatherization, heat pump and space heater,
Geothermal, Biogas

■ Impact on the Future

20 year comparison, carbon footprint, long term
plans.