



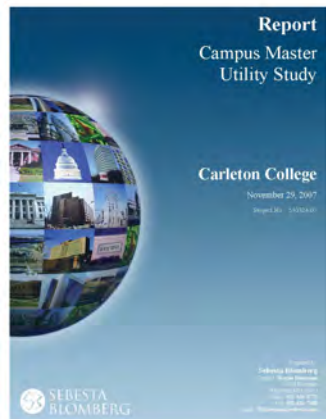
Carleton College Utility Master Plan

Martha M. Larson, CEM
Manager of Campus Energy & Sustainability

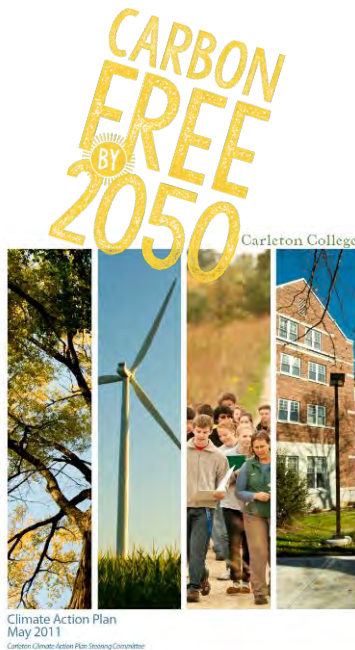
June 15, 2018



Carleton's utility plan is part of a 10-year planning progression.



Campus Master
Utility Study
2007



Climate Action Plan
2011



Strategic Plan
2012



Facilities Master Plan
2014



Utility Master Plan
2017

The charge.

Key objectives:

1. Replace the **aging and outdated** central plant facilities, campus steam distribution network and controls
2. Provide for **future loads** as envisioned in the Facility Master Plan
3. Reduce our **operating costs and carbon emissions** significantly and permanently

Little campus on the prairie.





First building constructed in the 1910 campus master plan



We are now planning for the *next* 100 years.



Expanding the steam tunnels



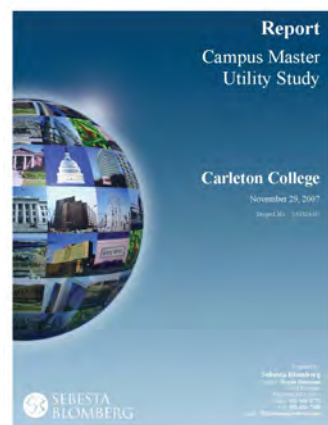
Installing a wind turbine (2011)

We are always asking:

- How much should we invest now to save long term?
- What technology investments will serve us well into the future?

Build off of existing plans.

How can we incorporate the goals of prior strategic plans into the utility planning process?



Campus Master Utility Study
2007



Climate Action Plan
2011



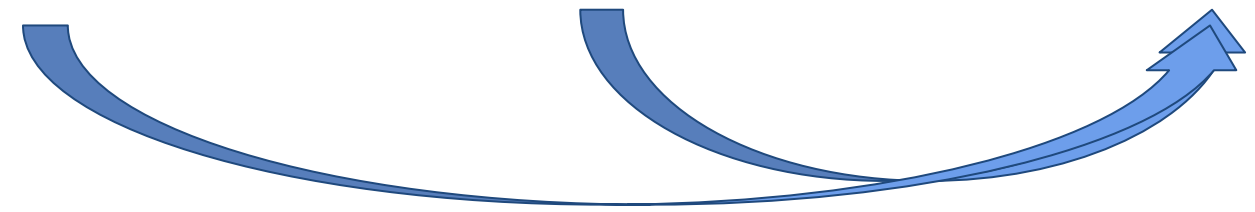
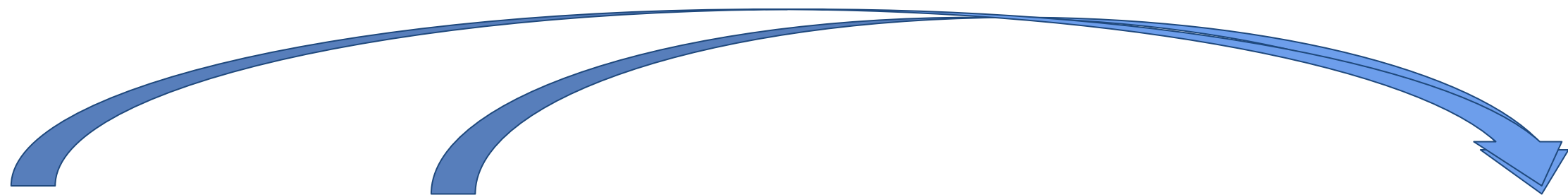
Strategic Plan
2012



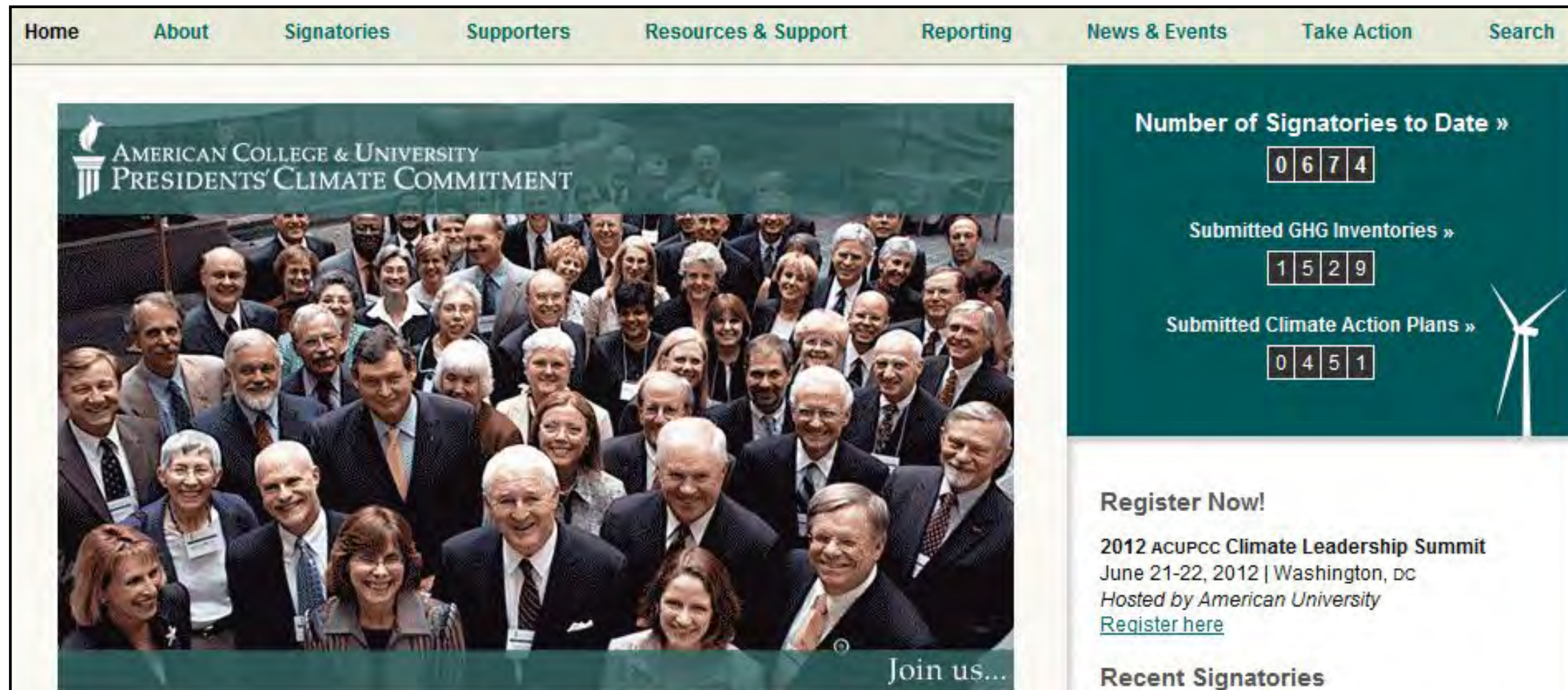
Facilities Master Plan
2014



Utility Master Plan
2017



American College & University Presidents' Climate Commitment



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AMERICAN COLLEGE & UNIVERSITY
PRESIDENTS' CLIMATE COMMITMENT

Join us...

Number of Signatories to Date »
0674

Submitted GHG Inventories »
1529

Submitted Climate Action Plans »
0451

Register Now!

2012 ACUPCC Climate Leadership Summit
June 21-22, 2012 | Washington, DC
Hosted by American University
[Register here](#)

Recent Signatories

“We believe colleges and universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality.” - ACUPCC Excerpt

Carleton signed in 2007

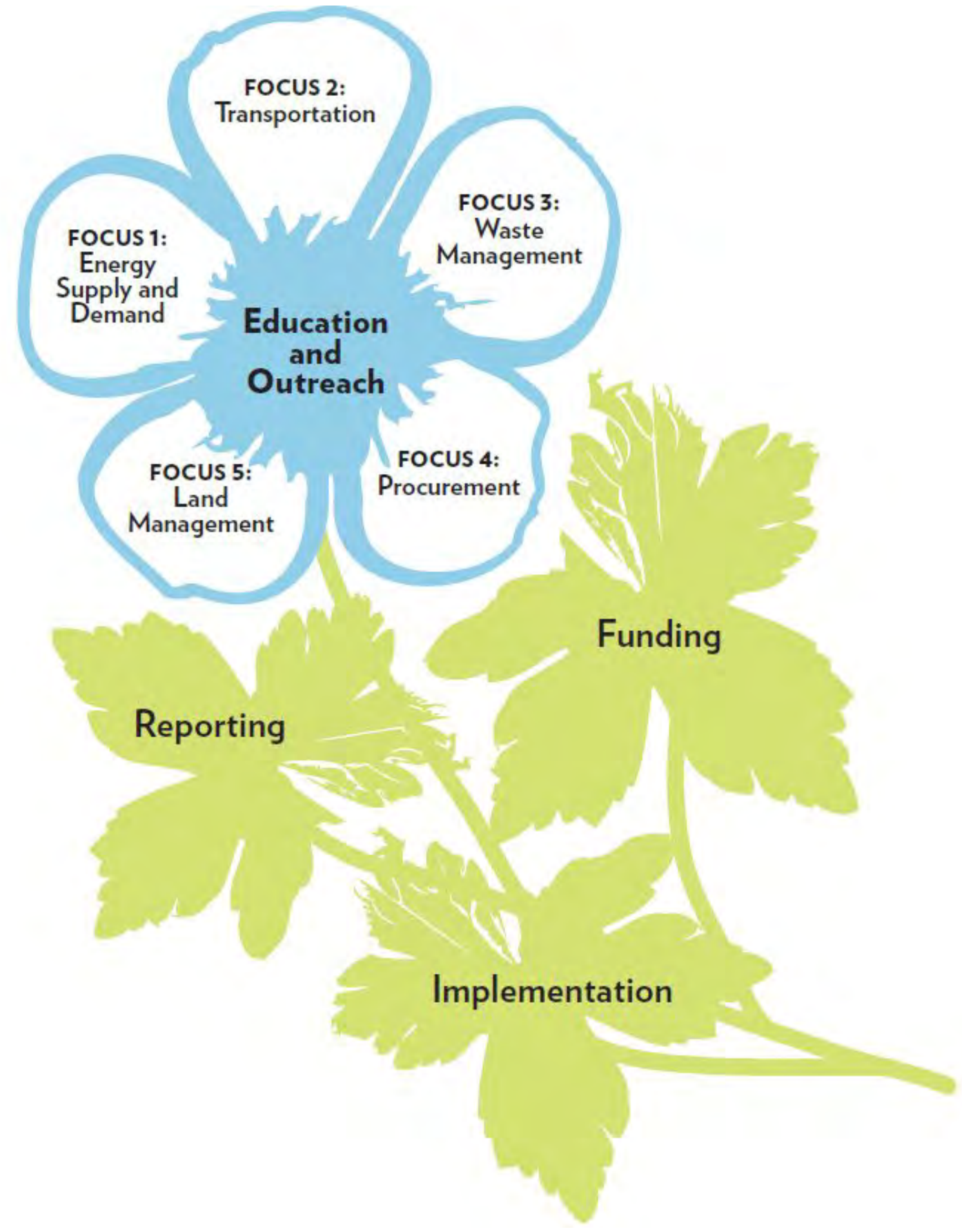
Carleton College



CARBON
FREE
BY
2050

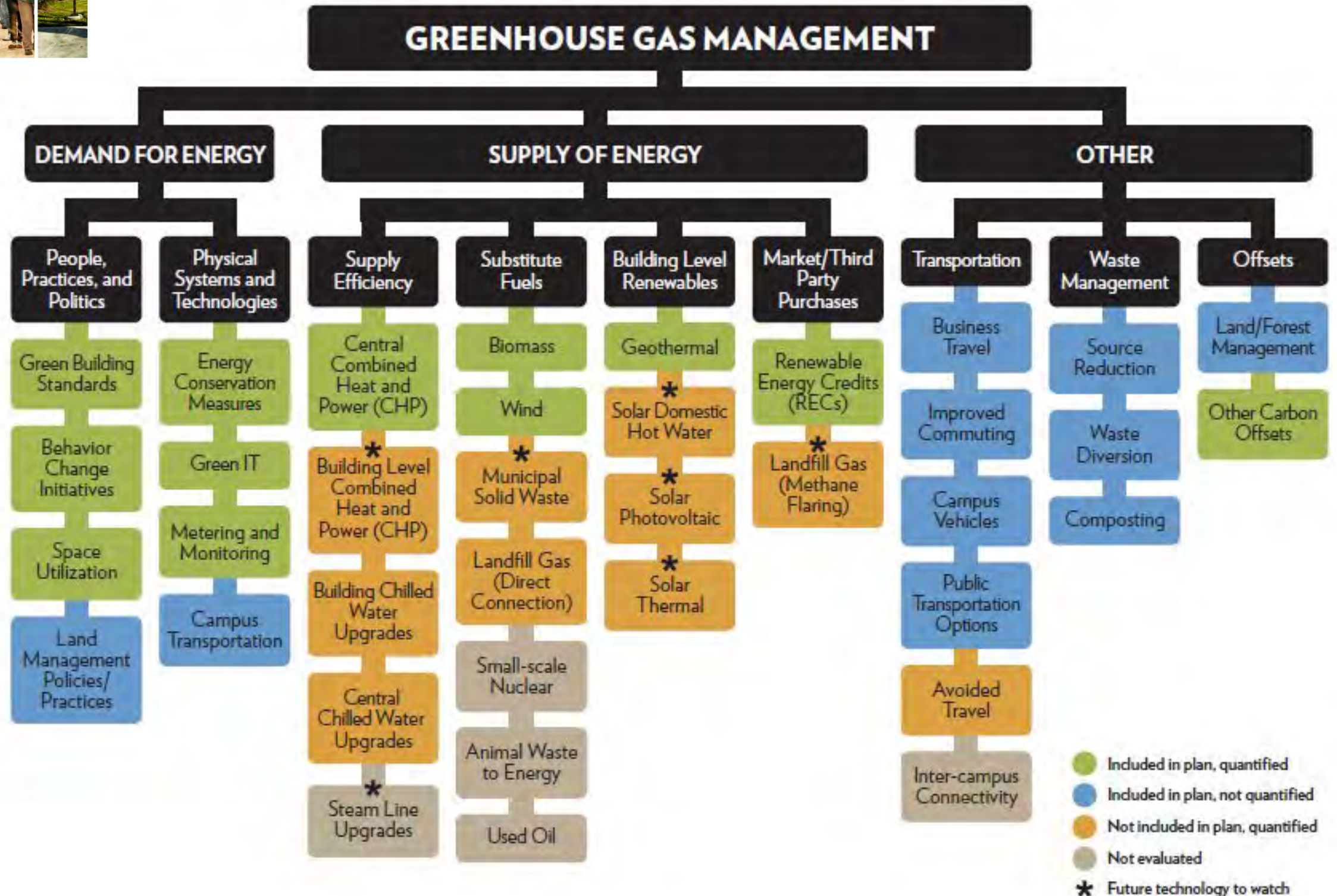
Climate Action Plan
May 2011

Carleton Climate Action Plan Steering Committee





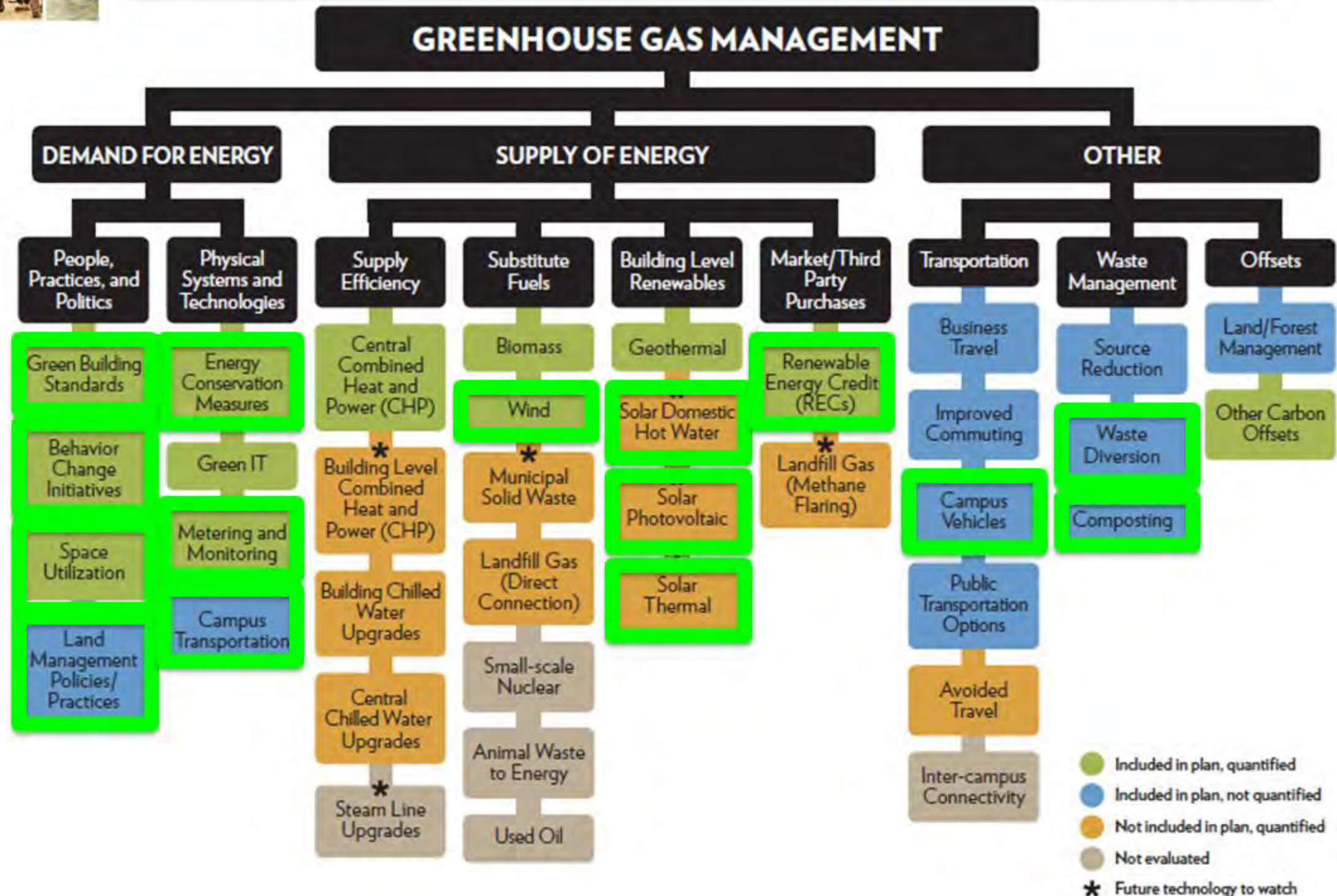
2011 CAP: carbon reduction strategies





2011 CAP: carbon reduction strategies

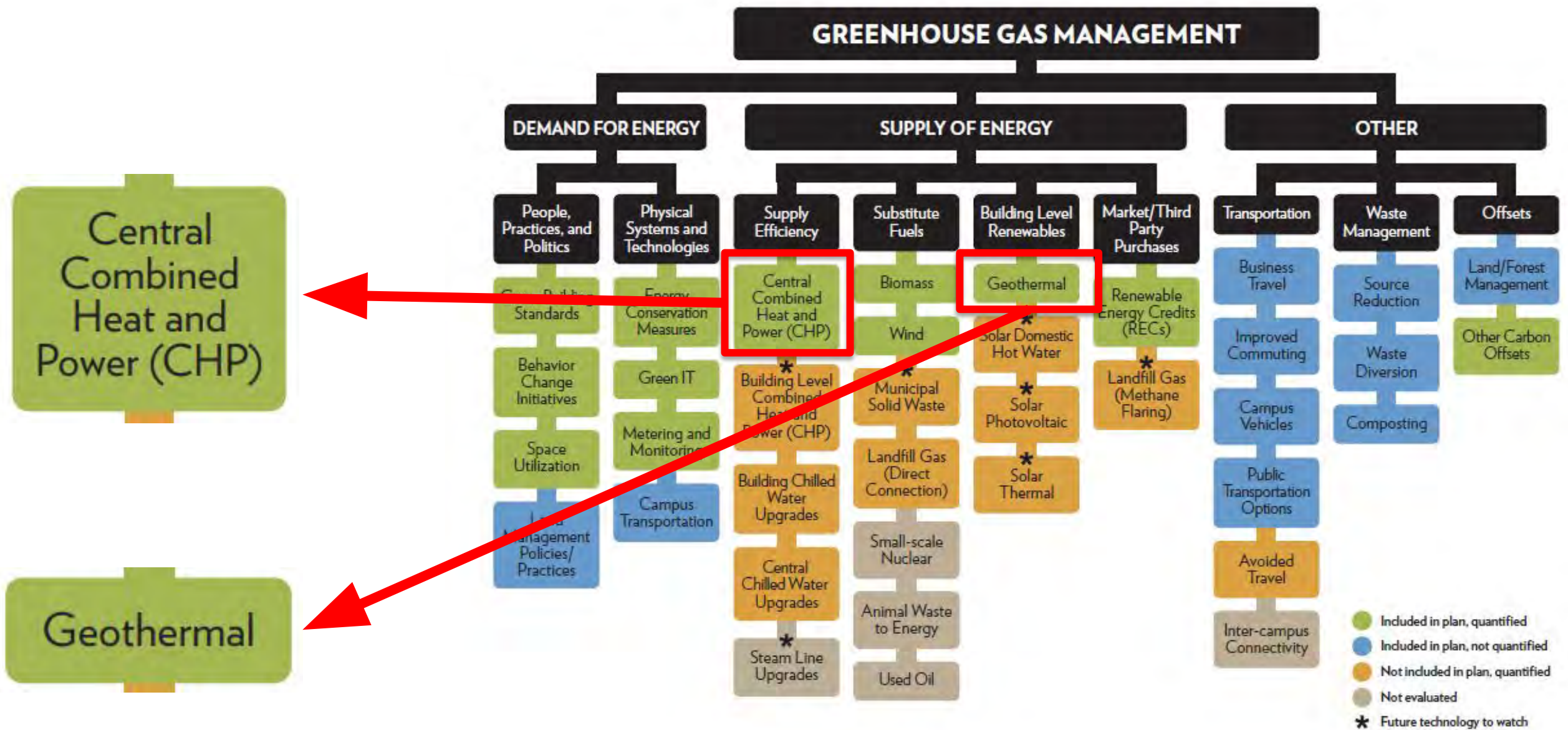
Strategies that are complete and ongoing.





2011 CAP: carbon reduction strategies

What are the utility planning opportunities?



Central Combined Heat and Power (CHP)

Geothermal



2012 Strategic Plan: six “critical next steps”

What are the utility planning opportunities?

1. Prepare students more robustly for fulfilling post-graduation lives and careers
2. Enhance our curriculum to improve liberal arts teaching and learning
3. Strengthen the socio-economic diversity of our student body
4. Maintain a self-sustaining economy with a growing endowment per student
- 5. Make focused investments in facilities that directly advance our mission**
6. Embrace collaborative opportunities with other institutions to enhance our academic programs and save costs



With a focus on **replacement** and **renovation**, the 2014 Facilities Master Plan anticipates only **3% net growth** in total campus square footage over the next 20-30 years.



2014 Facilities Master Plan Priorities

What are the utility planning opportunities?

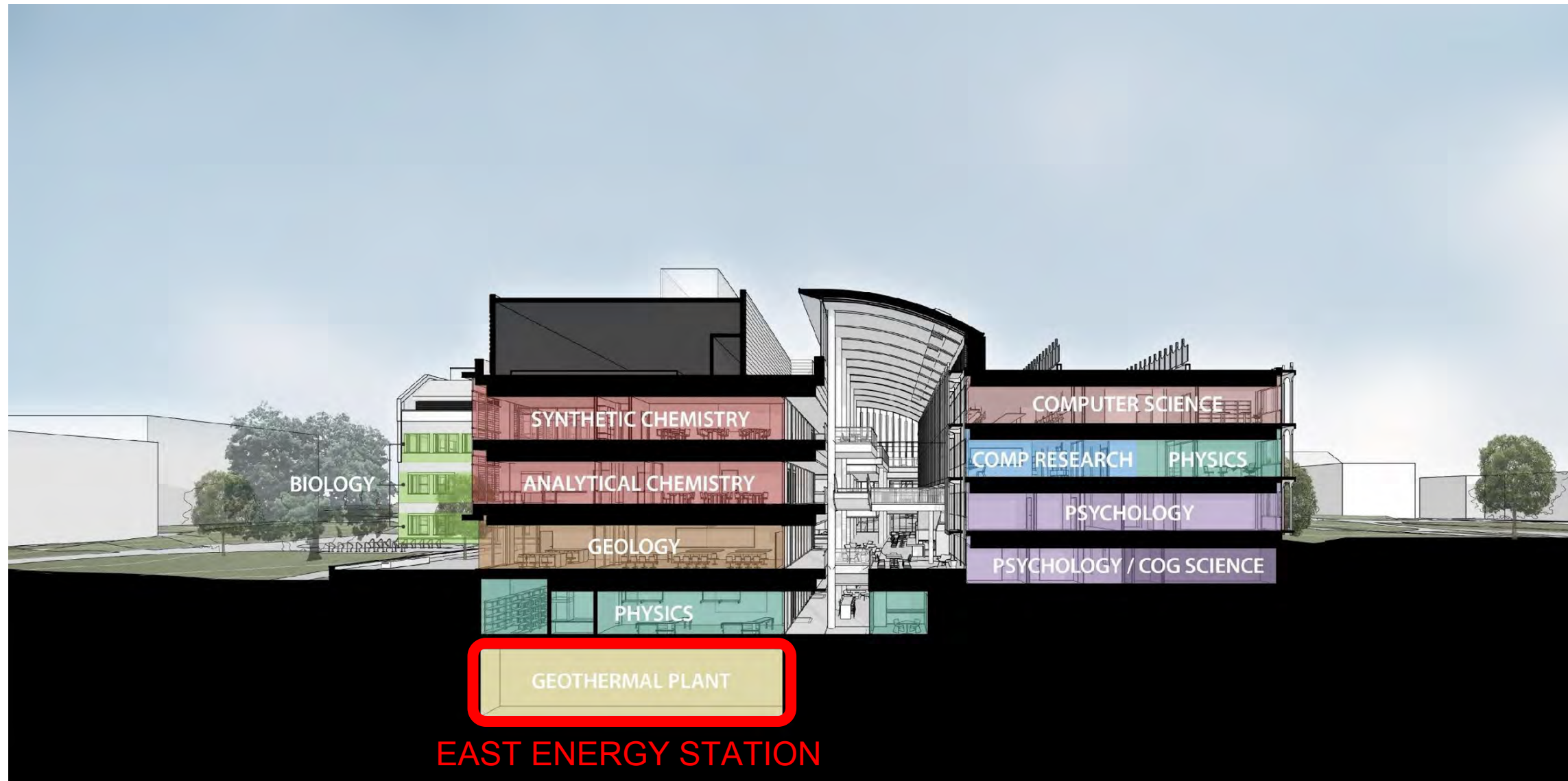
- Long-term precinct plan for the campus
- Investment in science facilities
- Investment in music & public event facilities
- Assess number, location, and size of needed classrooms
- Other needs incl. admissions and Academic Support Center



PRIORITY: Investment in music and event facilities

OPPORTUNITY: Skinner Chapel Upgrade

First low temperature (120 deg) hot water building.



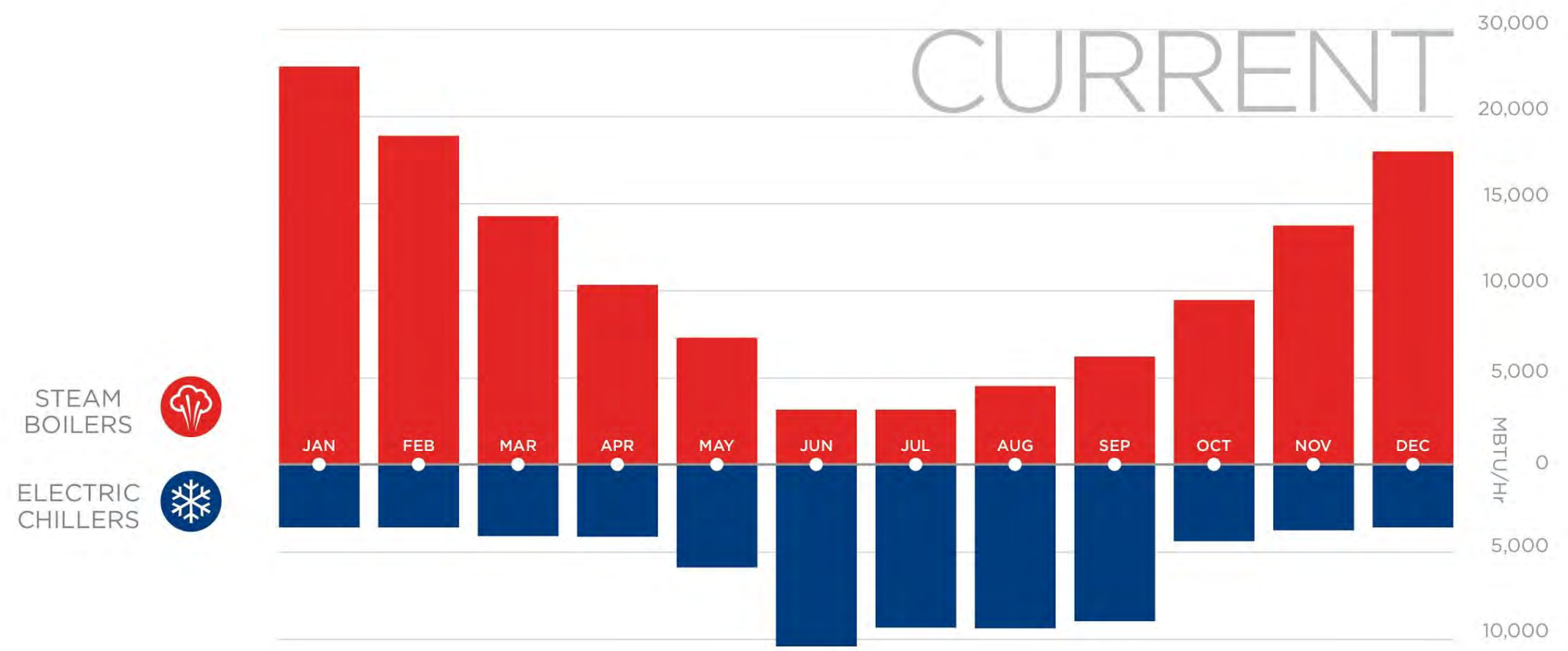
PRIORITY: Investment in science facilities

OPPORTUNITY: New Science Complex

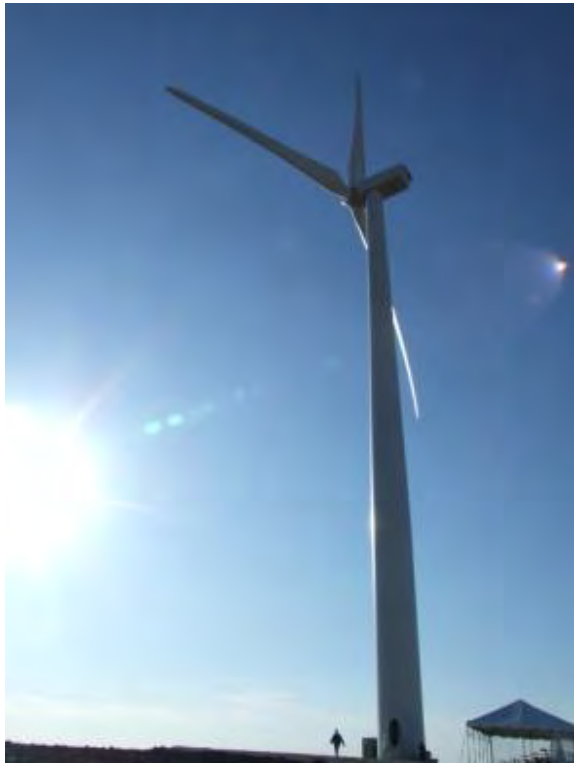
New geothermal satellite plant (East Energy Station)

The analysis.

CARLETON HEATING & COOLING LOAD PROFILES



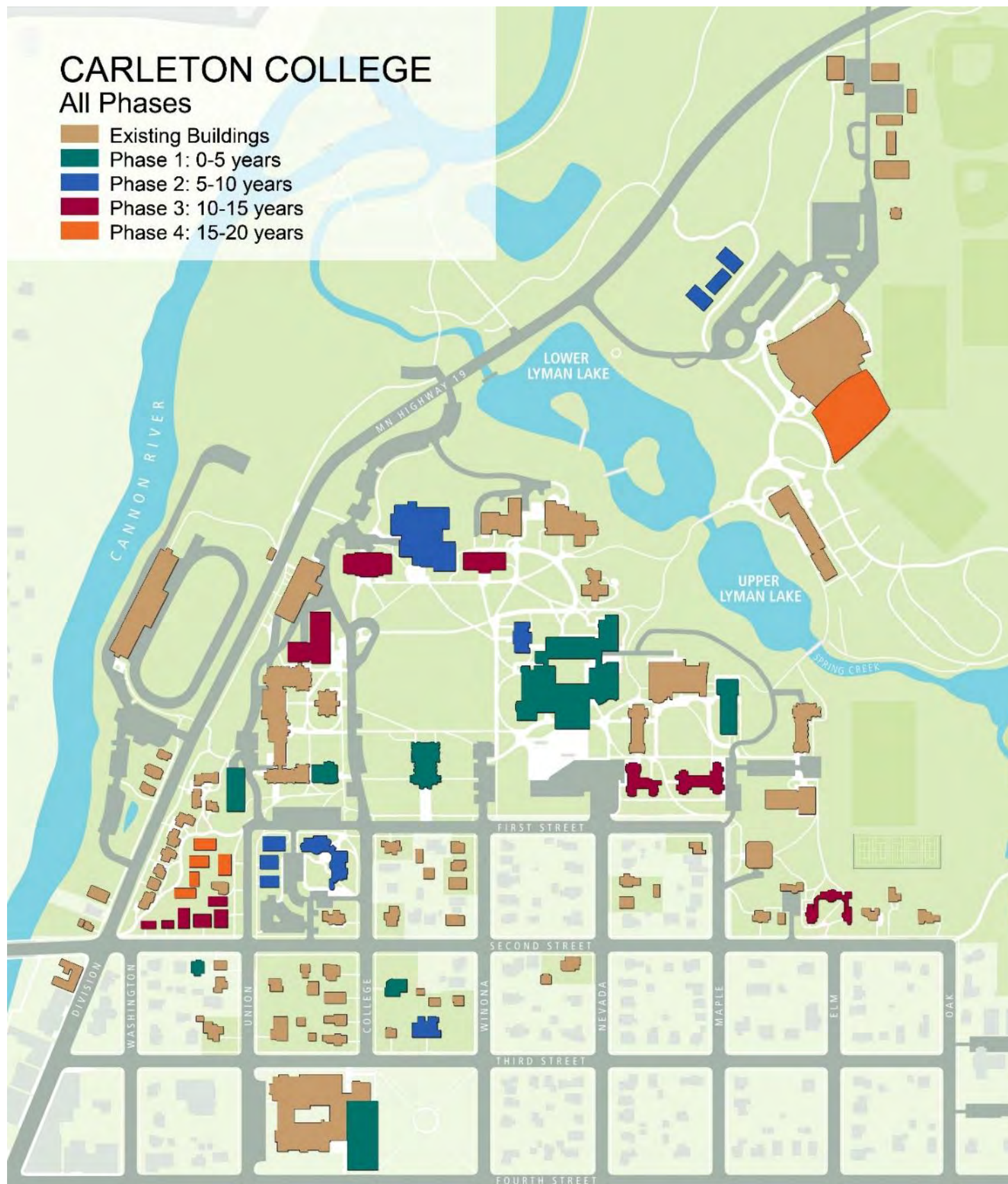
EXISTING ENERGY PROFILE - VERY HEATING DOMINANT



ASSETS

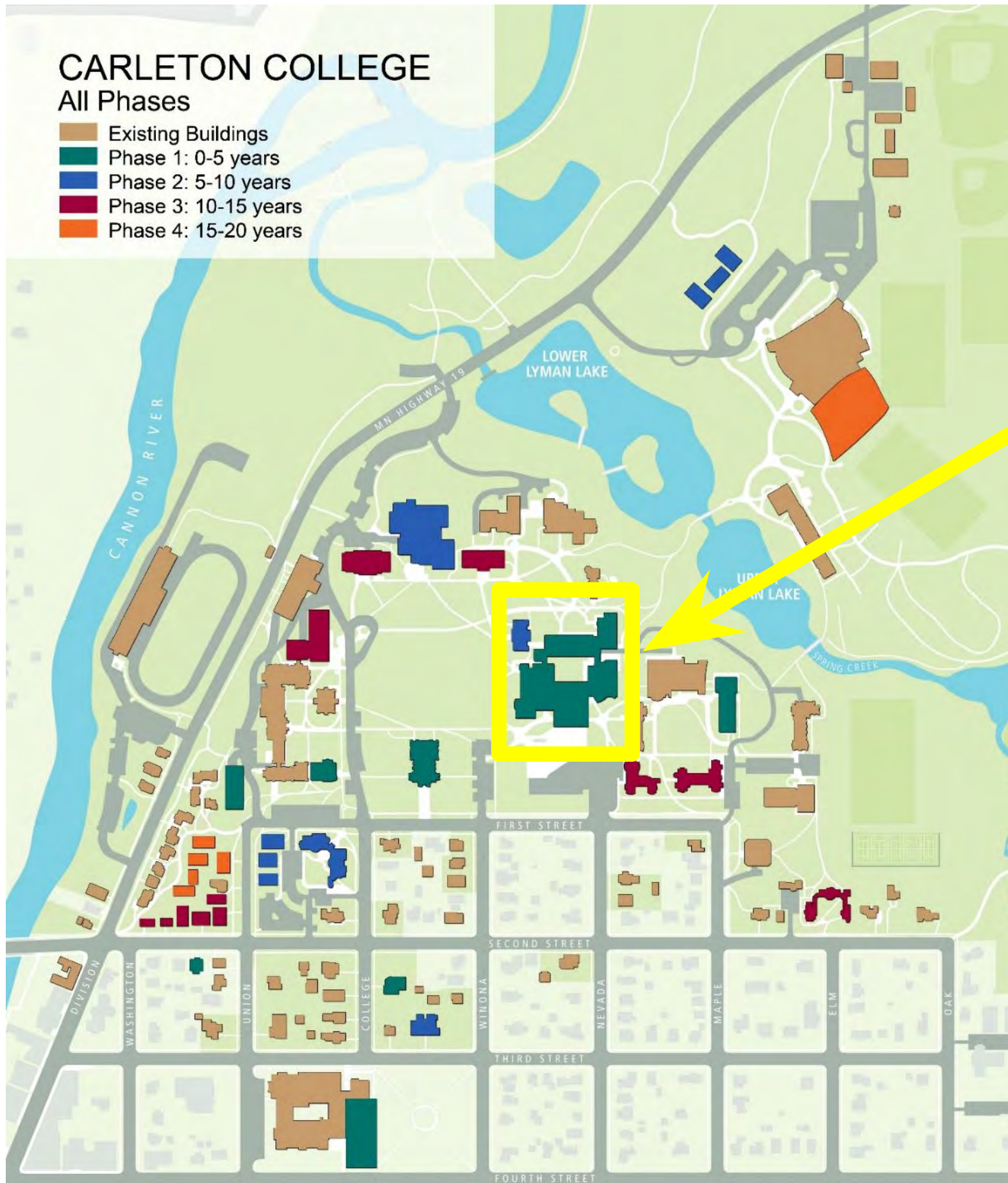


LIABILITIES



Planned Renovation & Construction

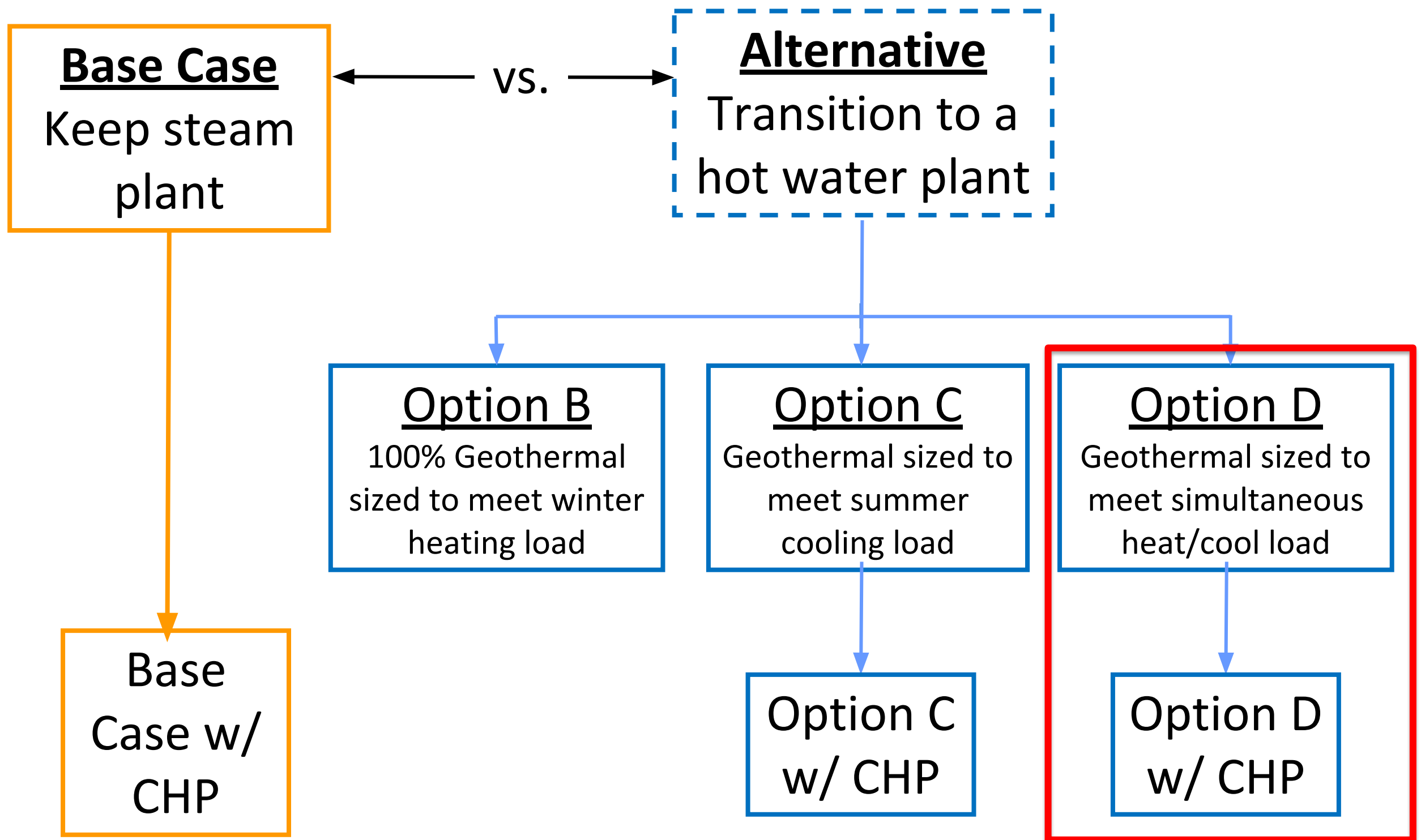
- 0-5 years
- 5-10 years
- 10-15 years
- 15-20 years



NEW SCIENCE ADDITION

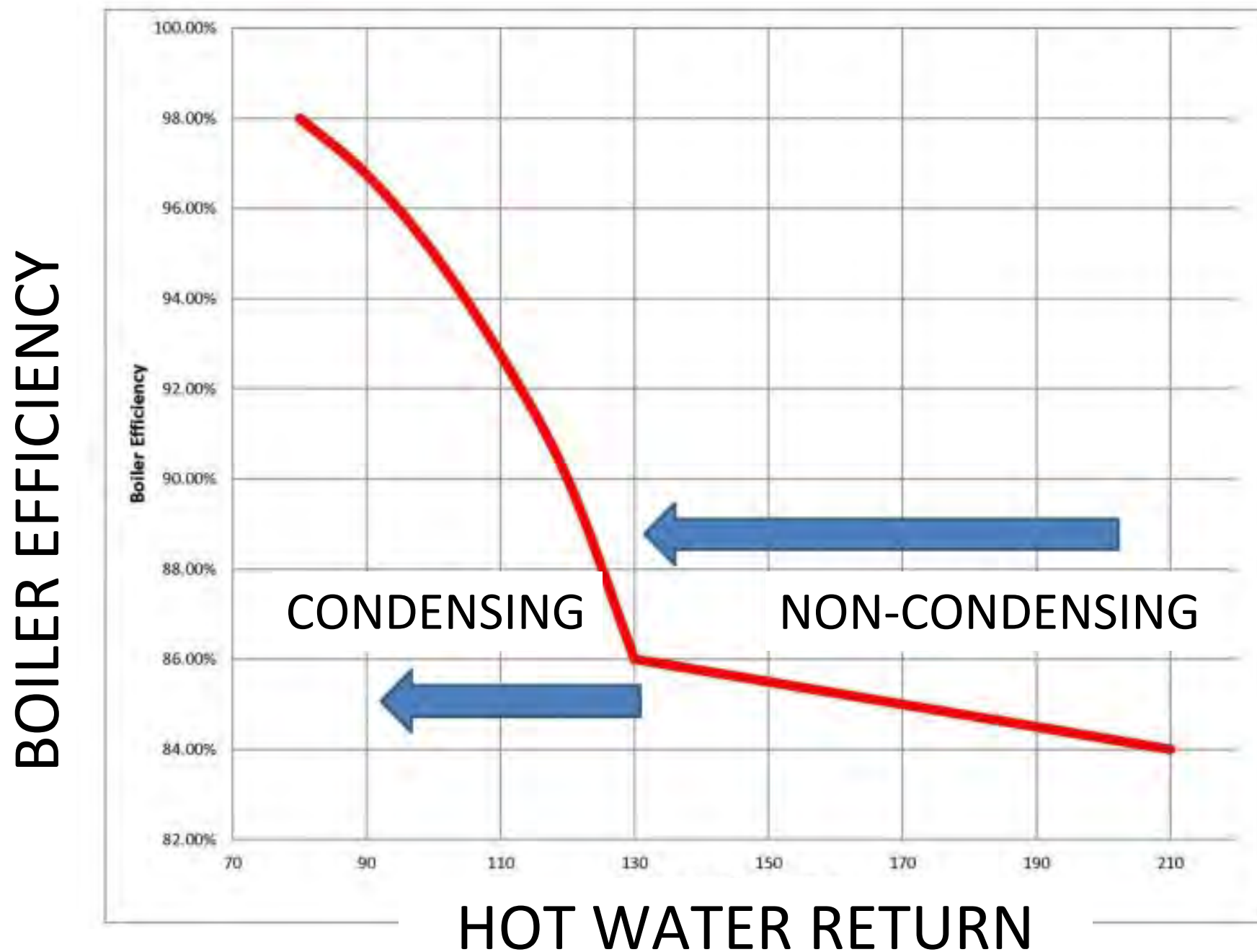
- Located at center of campus

- Highest energy use intensity buildings



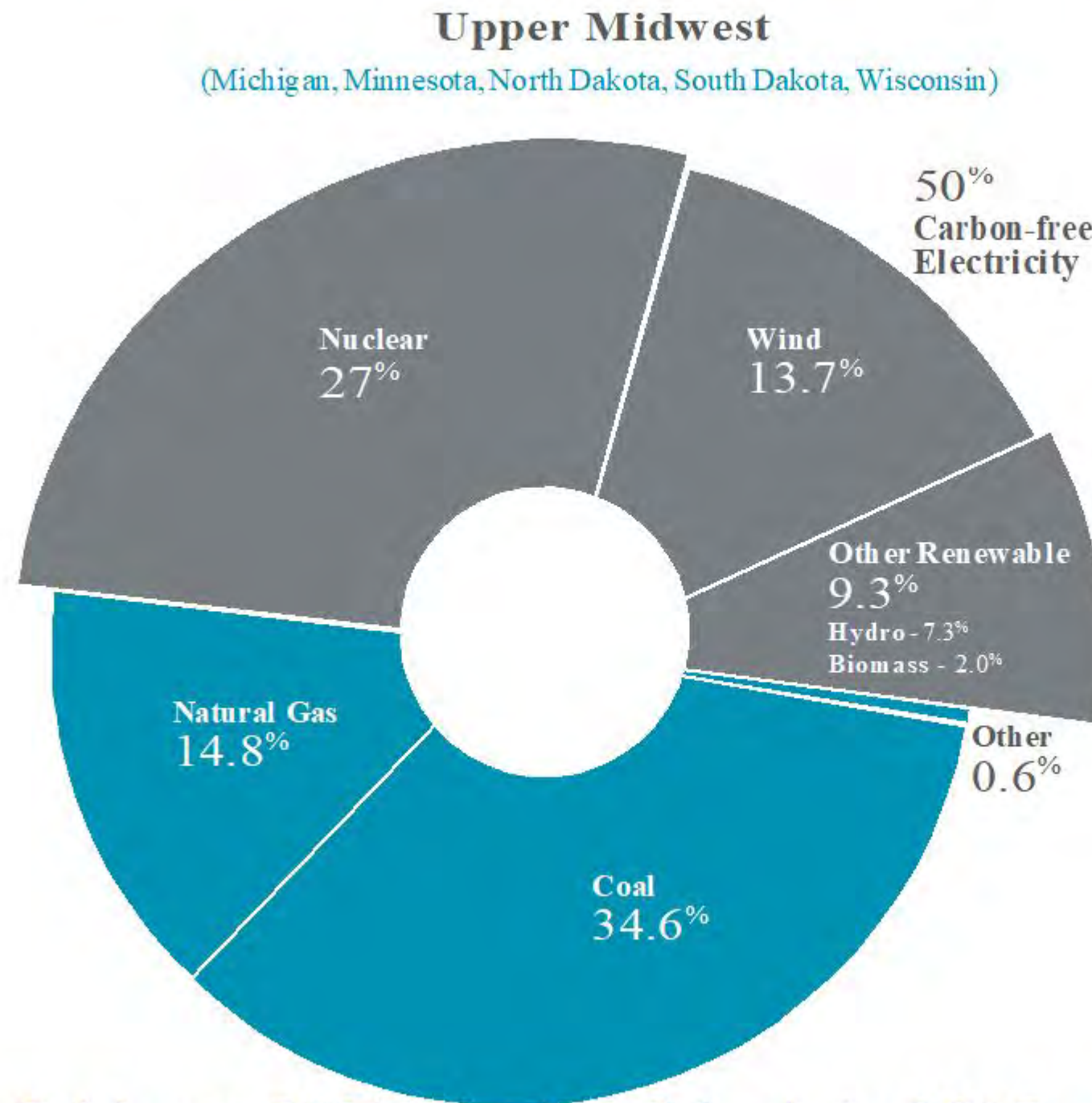
CHP = Combined Heat and Power

Concept #1: “Low Temperature” Hot Water



Lower water temperature increases boiler efficiency and allows use of technologies like solar thermal, heat pumps and geothermal well fields.

Concept #2: Electricity as Green Energy



Xcel Energy Grid was 50% non-fossil fuels in 2015, and growing more so in the future

Concept #3: Storing and Repurposing Energy



Connecting the heating and cooling cycles allows them to share energy.
Connecting to geothermal well fields stores energy like a thermal battery.

Geothermal testing on the Bald Spot (Summer 2016)



Carleton has very high conductivity, probably enhanced by high groundwater flow in the region.

Life Cycle Cost Analysis:

- Cost
- Carbon
- Energy

Sensitivity Analysis:

- Price of electricity
- Price of natural gas
- Price of bore field drilling

The plan.

Recommendations:

1. Transition from central steam to **hot water distribution**
2. Install a central **geothermal heat pump**
 - captures simultaneous heating and cooling energy
 - uses the earth's mass as a thermal battery
3. Install **high efficiency condensing boilers** to supplement the heat pump during peak heating demand
4. **FUTURE PHASE:** Invest in efficient and/or renewable **electrical generation system(s)**

**ENERGY
STATION**
(existing)

WIND
(existing)

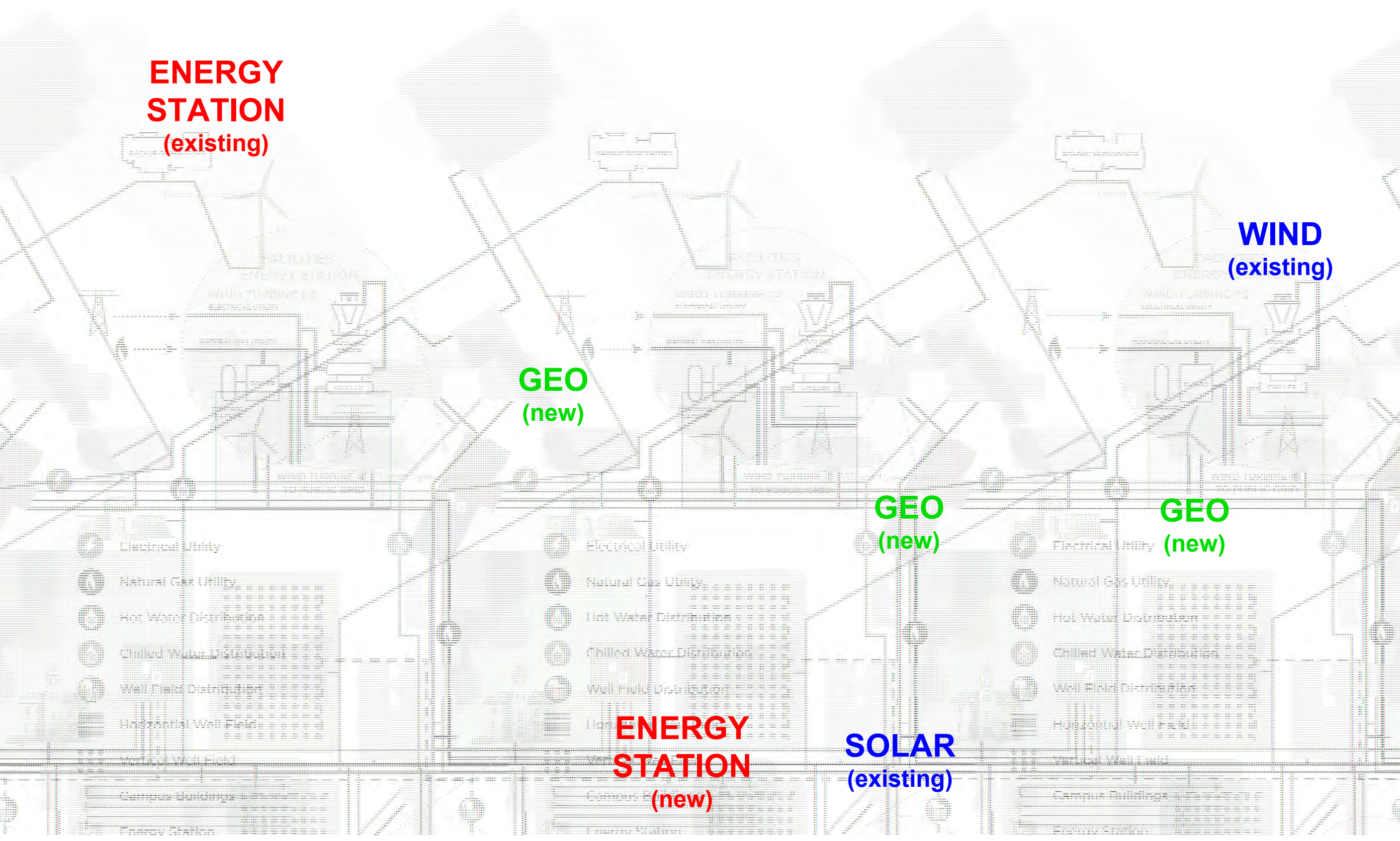
GEO
(new)

GEO
(new)

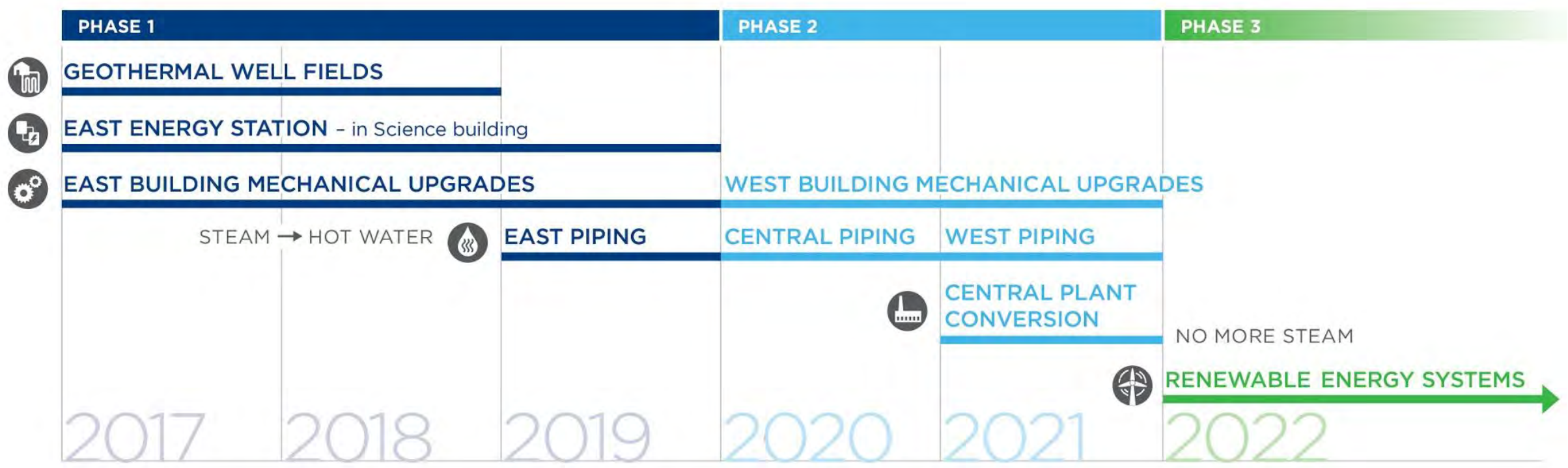
GEO
(new)

**ENERGY
STATION**
(new)

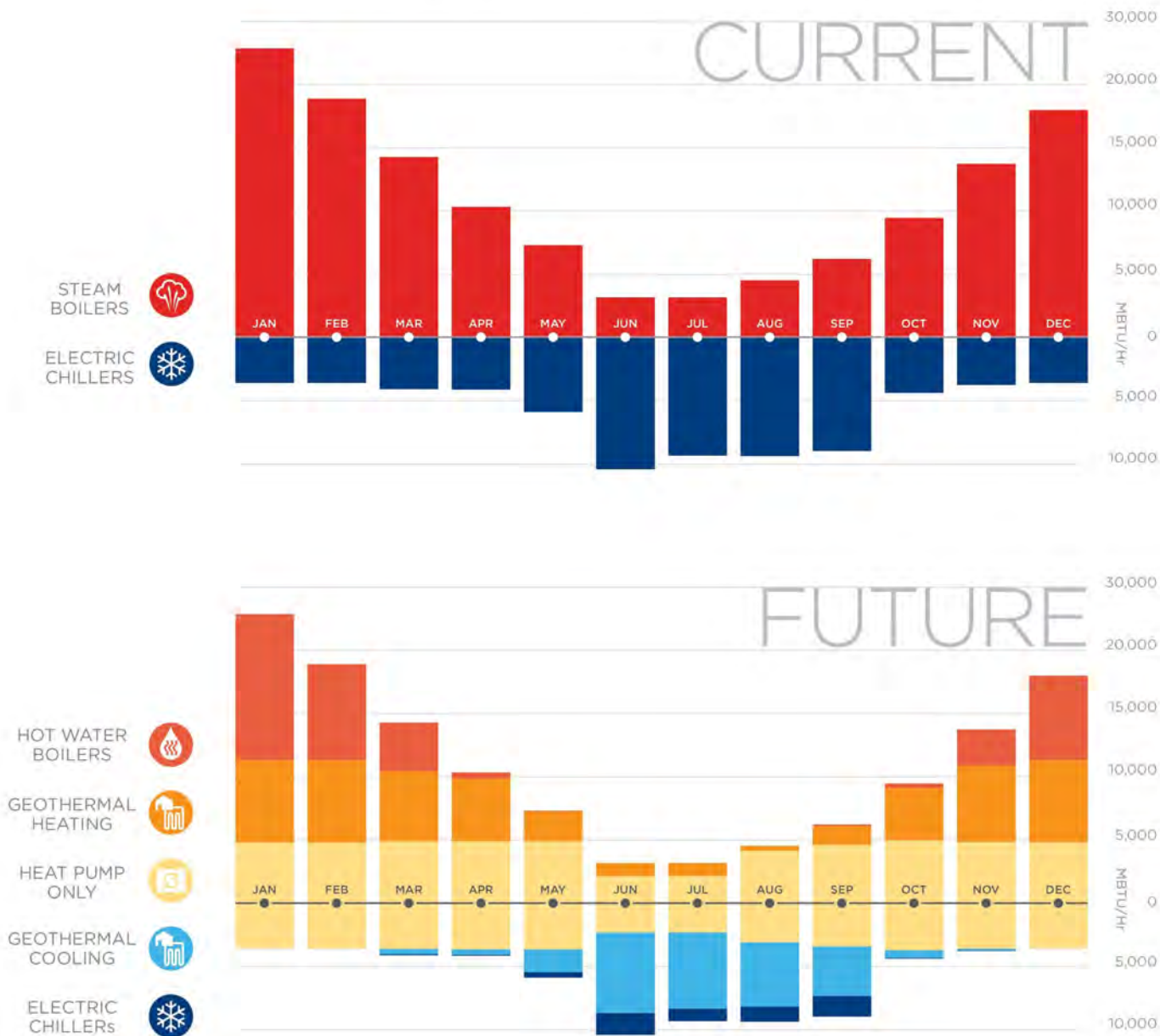
SOLAR
(existing)



UTILITY MASTER PLAN TIMELINE

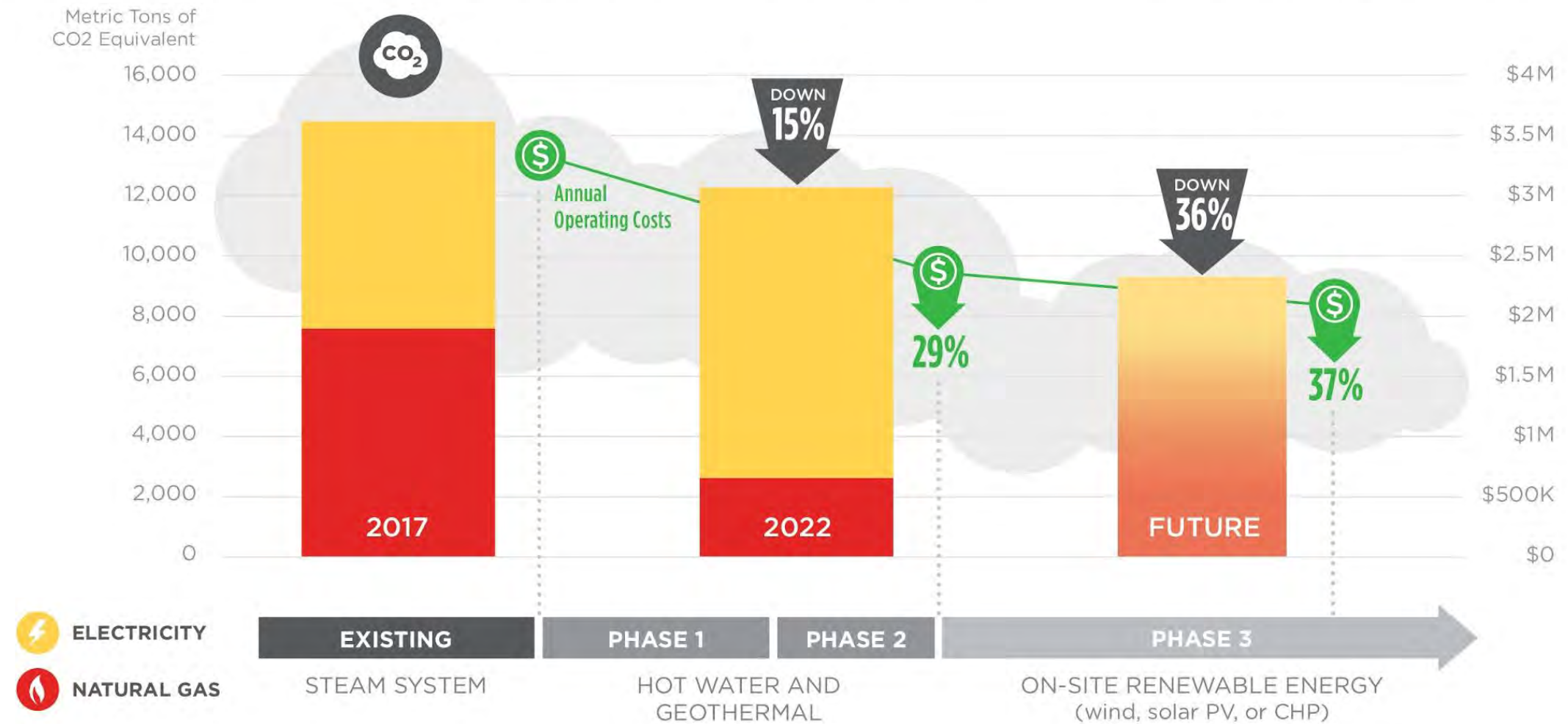


CARLETON HEATING & COOLING LOAD PROFILES



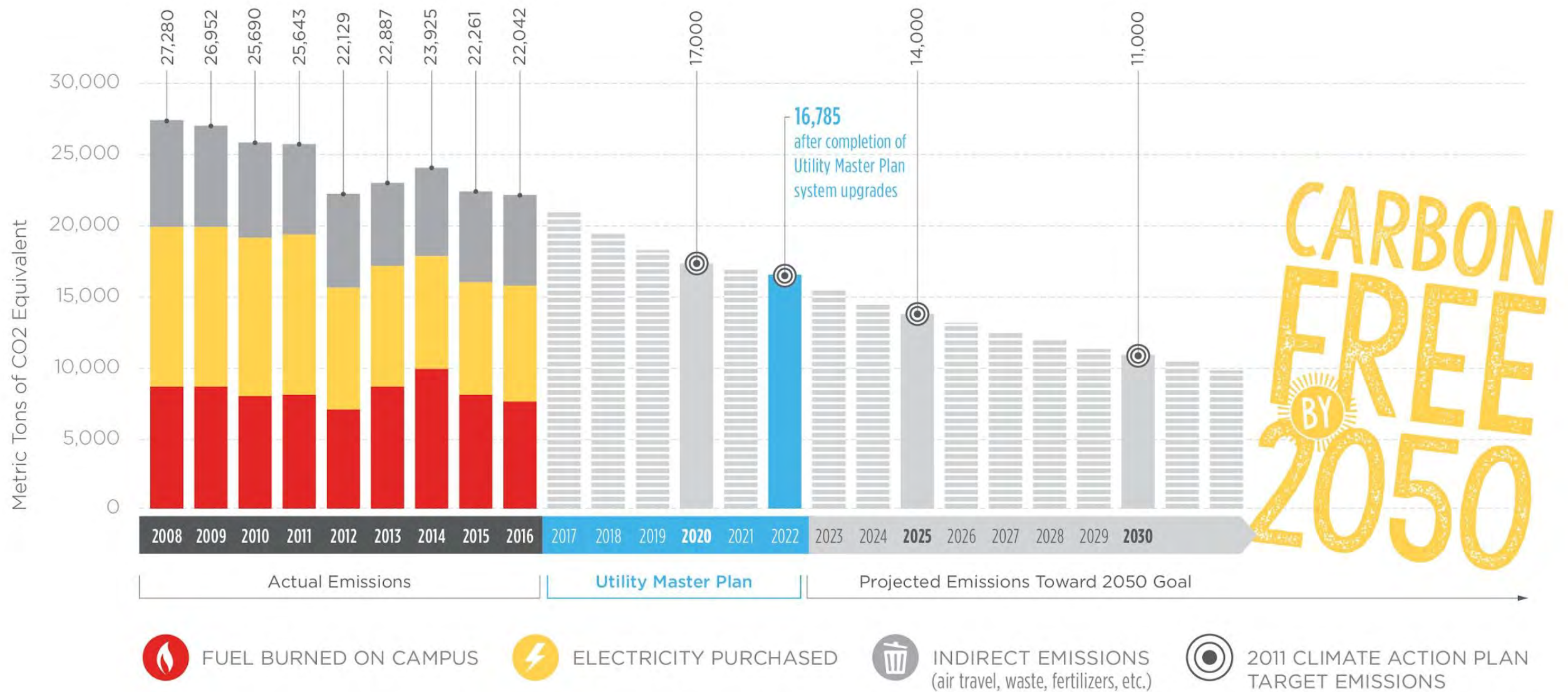
KEY MESSAGE #1: The proposed utility plan diversifies our fuel mix and introduces much more flexibility to incorporate current and future technologies.

CENTRAL PLANT ANNUAL EMISSIONS & OPERATING COST REDUCTIONS



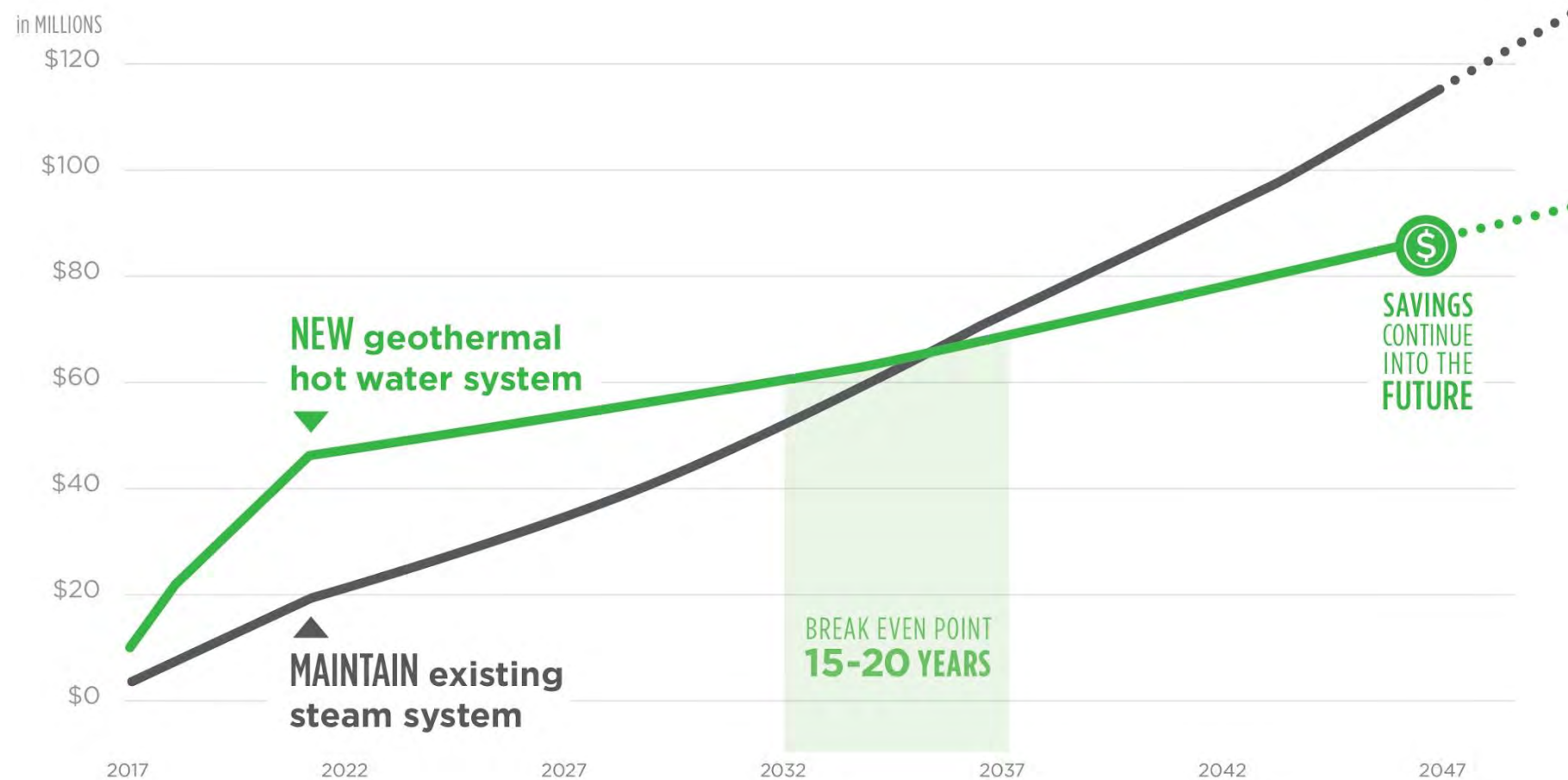
KEY MESSAGE #2: The proposed utility plan reduces both annual operating costs and carbon emissions.

GROSS EMISSIONS PROJECTIONS



KEY MESSAGE #3: The proposed utility plan keeps us on track with carbon reduction goals outlined in our 2011 Climate Action Plan.

CAPITAL + OPERATING COST COMPARISON



KEY MESSAGE #4: The proposed utility plan breaks even in 15-20 years compared to the cost of maintaining the existing steam plant.

Phase 1: \$24.1 M

East Energy Station (in science)
Geothermal well fields
East side building mechanical modifications
West side steam to hot water conversion

Phase 2: \$12 M - 16 M

West side building mechanical modifications
West side steam to hot water conversion
Facilities Building equipment, **TURN OFF STEAM**

Phase 3: \$2 M – 4 M

Electrical generation system (CHP or other)

TOTAL: \$38 M – 44 M

Full steam ahead!

Student engagement and research opportunities tie the project to our core mission.

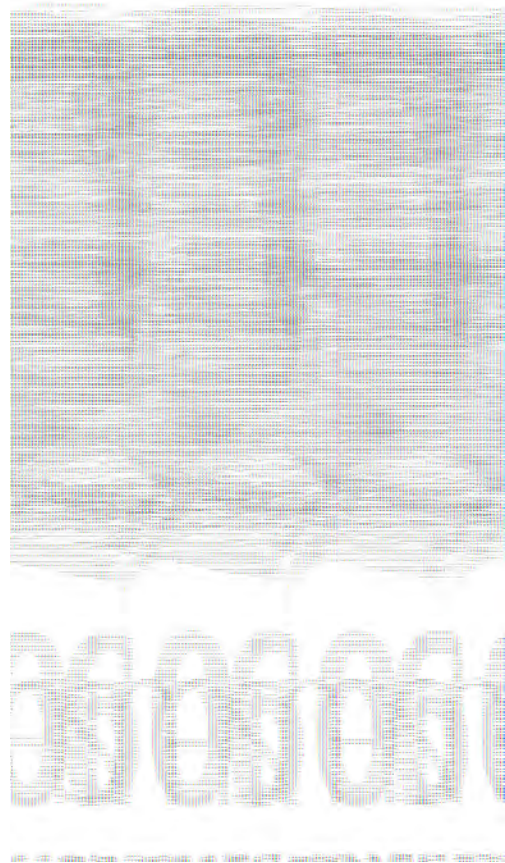


Carleton geology major and driller examining soil samples taken from a boring down to 520 ft. underground.



Minnesota Geological Survey staff taking geophysical measurements with their mobile unit.

Fun facts are not only “fun”, they also generate campus pride and support for the project.

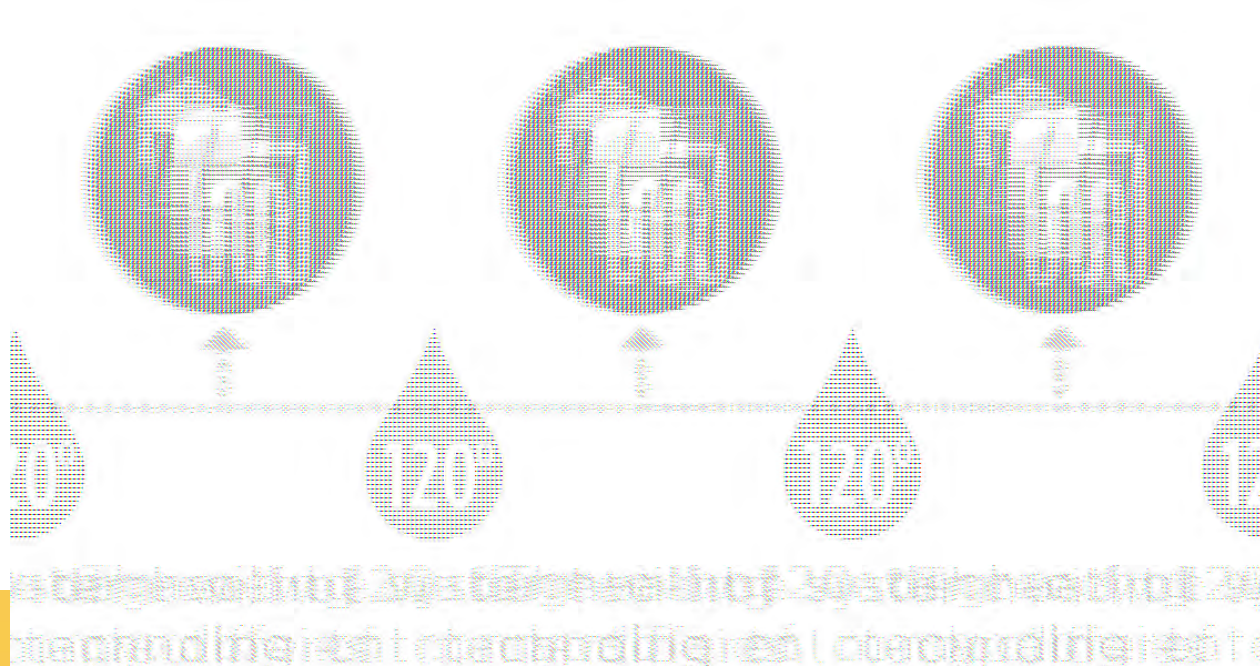


college campus in Minnesota to install a **district-energy scale geothermal system**

college campus to **completely transition off steam heating**

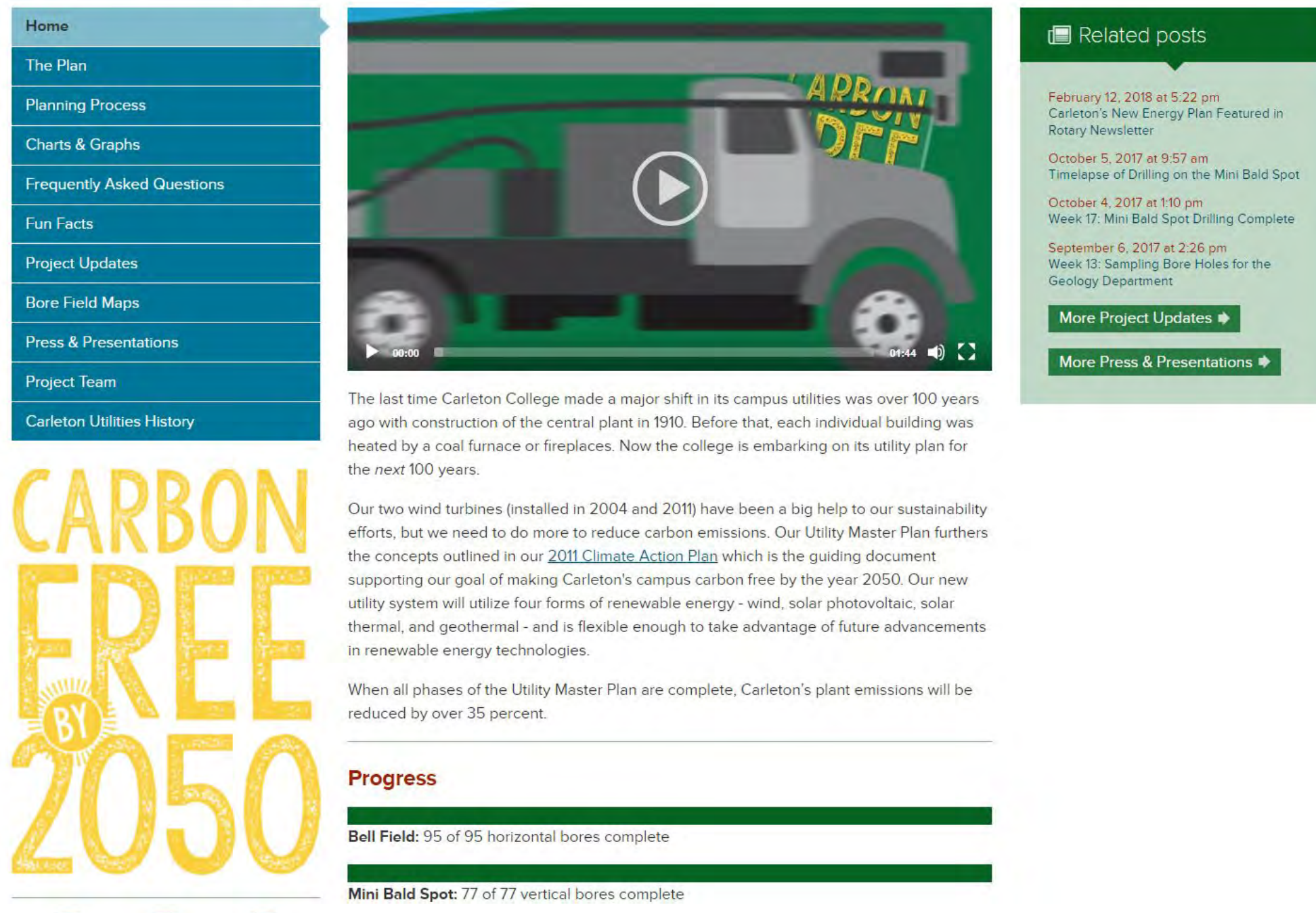
college campus to install a **commercial-size wind turbine** (now two)

1 OF **3** campus-scale **geothermal projects** in the **Midwest**



The project website is a one-stop-shop for project information....

Carleton College Utility Master Plan



The screenshot shows the website's navigation menu on the left, a central video player with a play button, and a 'Related posts' sidebar on the right. Below the video is a text block about the college's utility history and goals, followed by a 'Progress' section with two progress bars.

Home
The Plan
Planning Process
Charts & Graphs
Frequently Asked Questions
Fun Facts
Project Updates
Bore Field Maps
Press & Presentations
Project Team
Carleton Utilities History

Related posts

- February 12, 2018 at 5:22 pm
Carleton's New Energy Plan Featured in Rotary Newsletter
- October 5, 2017 at 9:57 am
Timelapse of Drilling on the Mini Bald Spot
- October 4, 2017 at 1:10 pm
Week 17: Mini Bald Spot Drilling Complete
- September 6, 2017 at 2:26 pm
Week 13: Sampling Bore Holes for the Geology Department

More Project Updates ▶
More Press & Presentations ▶

CARBON FREE BY 2050

The last time Carleton College made a major shift in its campus utilities was over 100 years ago with construction of the central plant in 1910. Before that, each individual building was heated by a coal furnace or fireplaces. Now the college is embarking on its utility plan for the *next* 100 years.

Our two wind turbines (installed in 2004 and 2011) have been a big help to our sustainability efforts, but we need to do more to reduce carbon emissions. Our Utility Master Plan furthers the concepts outlined in our [2011 Climate Action Plan](#) which is the guiding document supporting our goal of making Carleton's campus carbon free by the year 2050. Our new utility system will utilize four forms of renewable energy - wind, solar photovoltaic, solar thermal, and geothermal - and is flexible enough to take advantage of future advancements in renewable energy technologies.

When all phases of the Utility Master Plan are complete, Carleton's plant emissions will be reduced by over 35 percent.

Progress

Bell Field: 95 of 95 horizontal bores complete

Mini Bald Spot: 77 of 77 vertical bores complete

go.carleton.edu/geothermal

...and progress updates.

- Frequently Asked Questions
- Fun Facts
- Project Updates**
- Bore Field Maps
- Press & Presentations
- Project Team
- Carleton Utilities History

Bald Spot this summer and fall.
[Read more of "Timelapse of Drilling on the Mini Bald Spot"](#) Permalink

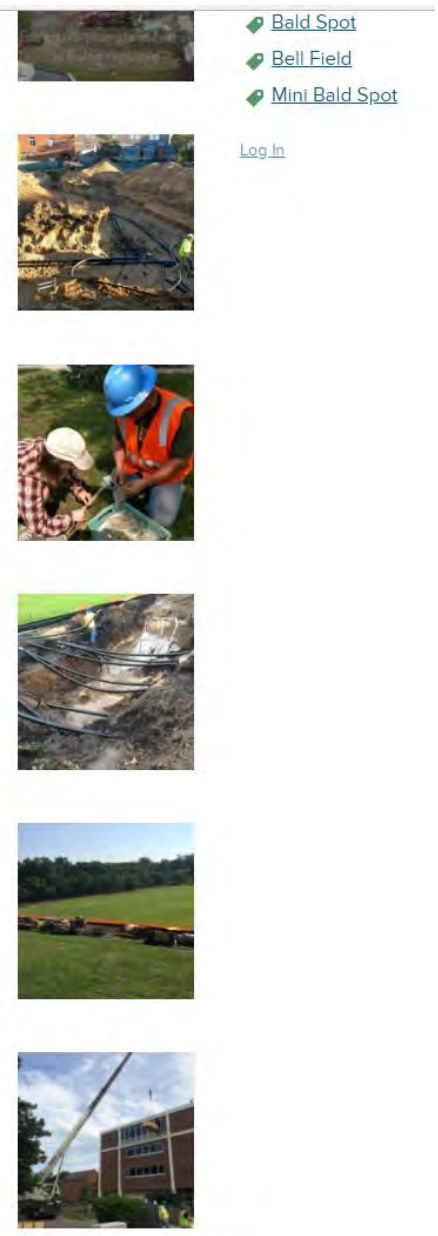
Week 17: Mini Bald Spot Drilling Complete
 Wednesday, October 4, 2017
 A cheer went up across the Mini Bald Spot at 7pm on Tuesday evening as drillers completed bore hole #77, the last hole on the field.
[Read more of "Week 17: Mini Bald Spot Drilling Complete"](#) Permalink

Week 13: Sampling Bore Holes for the Geology Department
 Wednesday, September 6, 2017
 The geology department is taking advantage of drilling on the Mini Bald Spot to get samples from 520 ft. below our campus.
[Read more of "Week 13: Sampling Bore Holes for the Geology Department"](#) Permalink

Week 12: Bell Field Landscape Restoration
 Wednesday, August 30, 2017
[Read more of "Week 12: Bell Field Landscape Restoration"](#) Permalink

Week 9: Bell Field and Mini Bald Spot Drilling Updates
 Tuesday, August 8, 2017
 Bell Field drilling is almost complete.
[Read more of "Week 9: Bell Field and Mini Bald Spot Drilling Updates"](#) Permalink

Week 8: Myers Hall Heating Conversion
 Thursday, August 3, 2017
 Myers Hall undergoes heating conversion.
[Read more of "Week 8: Myers Hall Heating Conversion"](#) Permalink



- [Bald Spot](#)
- [Bell Field](#)
- [Mini Bald Spot](#)
- [Log In](#)











Mini Bald Spot - 77 Vertical Bores







Questions?

