



# Energy & Sustainability: Thoughts for the 21st Century

## Class of 1997 Reunion Planning

November 13, 2020

Martha M. Larson, CEM  
*Manager of Campus Energy and Sustainability*  
Alex Miller  
*Sustainability Program Coordinator*



# Carleton

## Energy & Sustainability at Carleton (an overview)





## Martha Larson

### Manager of Campus Energy & Sustainability

BS Mechanical Engineering  
Northwestern University



- Department strategy & priorities
- Energy metering systems
- Energy conservation programs
- Energy & utility projects
- Transportation plans & projects
- Student projects related to energy
- And much more...

## Alex Miller

### Sustainability Program Coordinator

BS Environmental Management  
Bemidji State University



- Student development
- Student projects
- Disposal of surplus goods
- Campus food programs
- Campus waste systems
- Outreach and communications
- Events
- And much more...

# Sustainability Assistants 2019-2020



**Simran Kadam**  
She/Her/Hers  
Class of 2023  
Outreach



**Jacyn Schmidt**  
She/Her/Hers  
Class of 2021  
Food/Energy



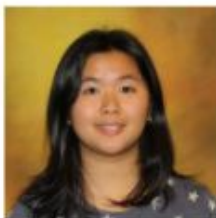
**Rebecca Muhlheim**  
She/Her/Hers  
Class of 2021  
Outreach



**Andrew Farias**  
He/Him/His  
Class of 2021  
Waste & CCCE



**Grace Pearson**  
She/Her/Hers  
Class of 2021  
Outreach



**Kyra Ngai**  
She/Her/Hers  
Class of 2021  
Energy



**Rebecca McCartney**  
She/Her/Hers  
Class of 2021  
Outreach



**Becca Horwitz**  
She/Her/Hers  
Class of 2022  
Waste



**Beck Woollen**  
He/Him/His  
Class of 2023  
Energy

# American College & University Presidents' Climate Commitment

The screenshot shows the homepage of the American College & University Presidents' Climate Commitment website. The navigation bar at the top includes links for Home, About, Signatories, Supporters, Resources & Support, Reporting, News & Events, Take Action, and Search. The main content area features a large group photo of signatory presidents and a sidebar with statistics and a registration call to action.

Home About Signatories Supporters Resources & Support Reporting News & Events Take Action Search

AMERICAN COLLEGE & UNIVERSITY PRESIDENTS' CLIMATE COMMITMENT

Number of Signatories to Date »  
0 6 7 4

Submitted GHG Inventories »  
1 5 2 9

Submitted Climate Action Plans »  
0 4 5 1

Register Now!

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

Recent Signatories

Join us...

“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.



CARBON  
FREE  
BY  
2050

Carleton's 2011 CAP  
is divided into two sections:

- Campus Operations
- Education & Outreach



Carleton College

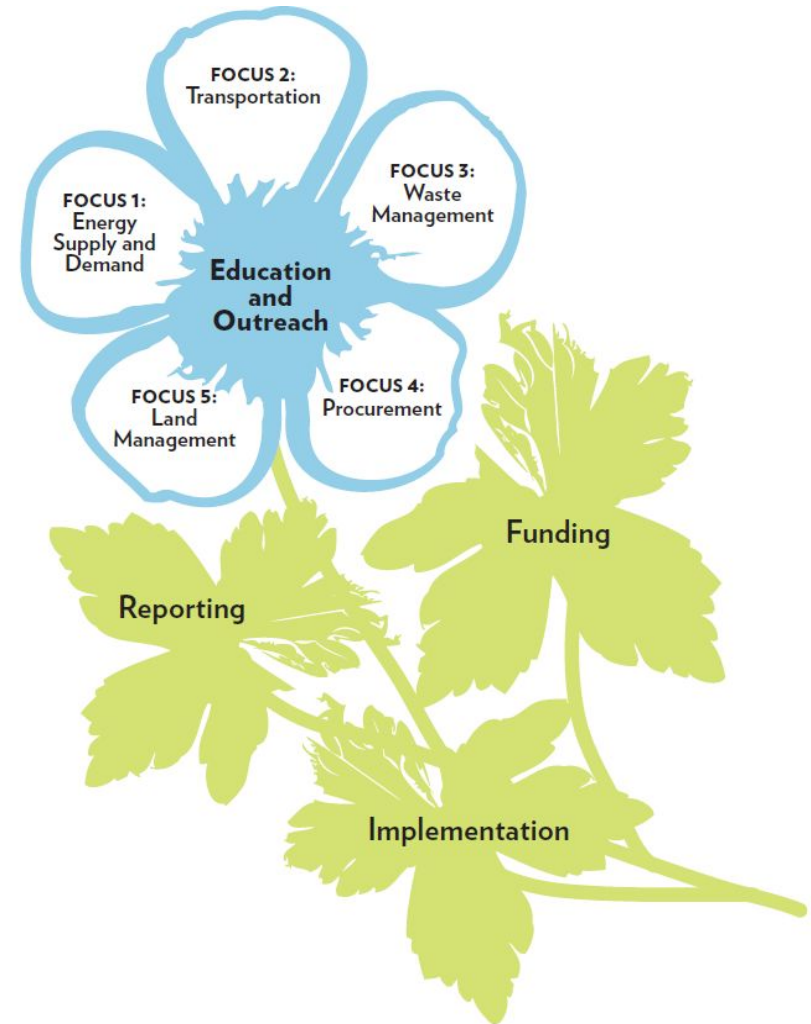
Climate Action Plan  
May 2011

*Carleton Climate Action Plan Steering Committee*

## CAP Structure:

The campus operations section includes five focus areas, all surrounding a core mission of Education & Outreach.

The plan is supported by strong reporting, funding and implementation plans.



Each section includes a list of specific recommended actions.

After ten years of progress, many of these items are now institutionalized, complete or superseded by other strategies

#### RECOMMENDED ACTIONS: CAMPUS/COMMUNITY ENGAGEMENT

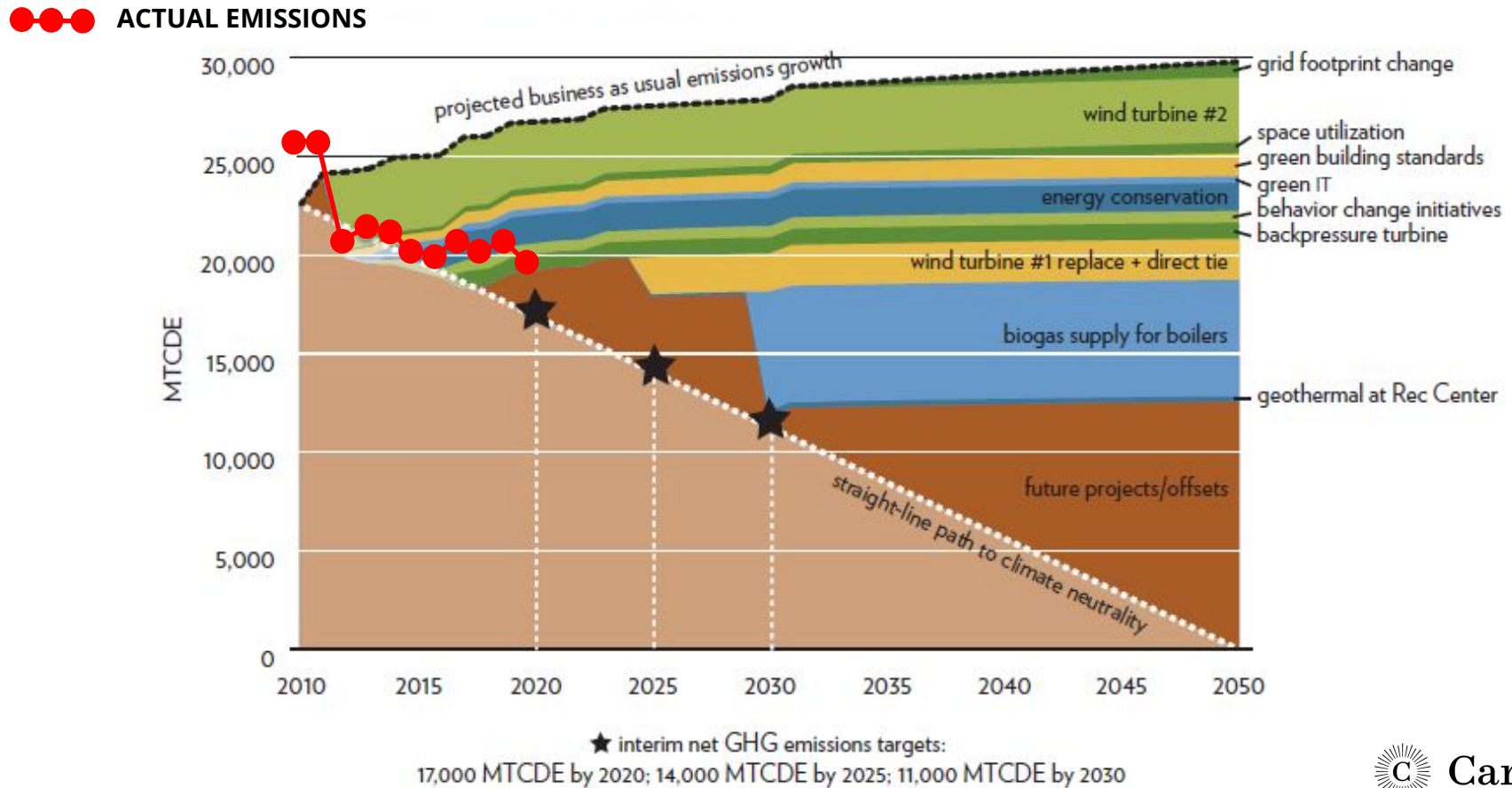
1. Collaborate with campus organizations to organize a sustainability seminar series that invites speakers to campus (convocation, guest lecturers, Headly House visitors, etc.).
2. Evaluate opportunities for community interaction and education in collaboration with Carleton sustainability research and facilities projects.
3. Coordinate with external relations division to continue providing updates to the community about Carleton's sustainability efforts and carbon reduction progress.
4. Explore opportunities for partnering with other community groups such as St. Olaf College, the Northfield Public School District, the Northfield Environmental Quality Commission, Northfield Home Matters, and others to expand individual sustainability projects into community-wide collaborations.
5. Create a reading/discussion group through the Perlman Center for Learning and Teaching with a focus on sustainability.
6. Develop action guides for College departments and offices to help the campus community adopt widespread sustainability best practices, and create opportunities to engage staff and faculty members in sustainability competitions or events.
7. Establish environmental sustainability at Carleton

#### RECOMMENDED ACTIONS: FOCUS #3—WASTE MANAGEMENT

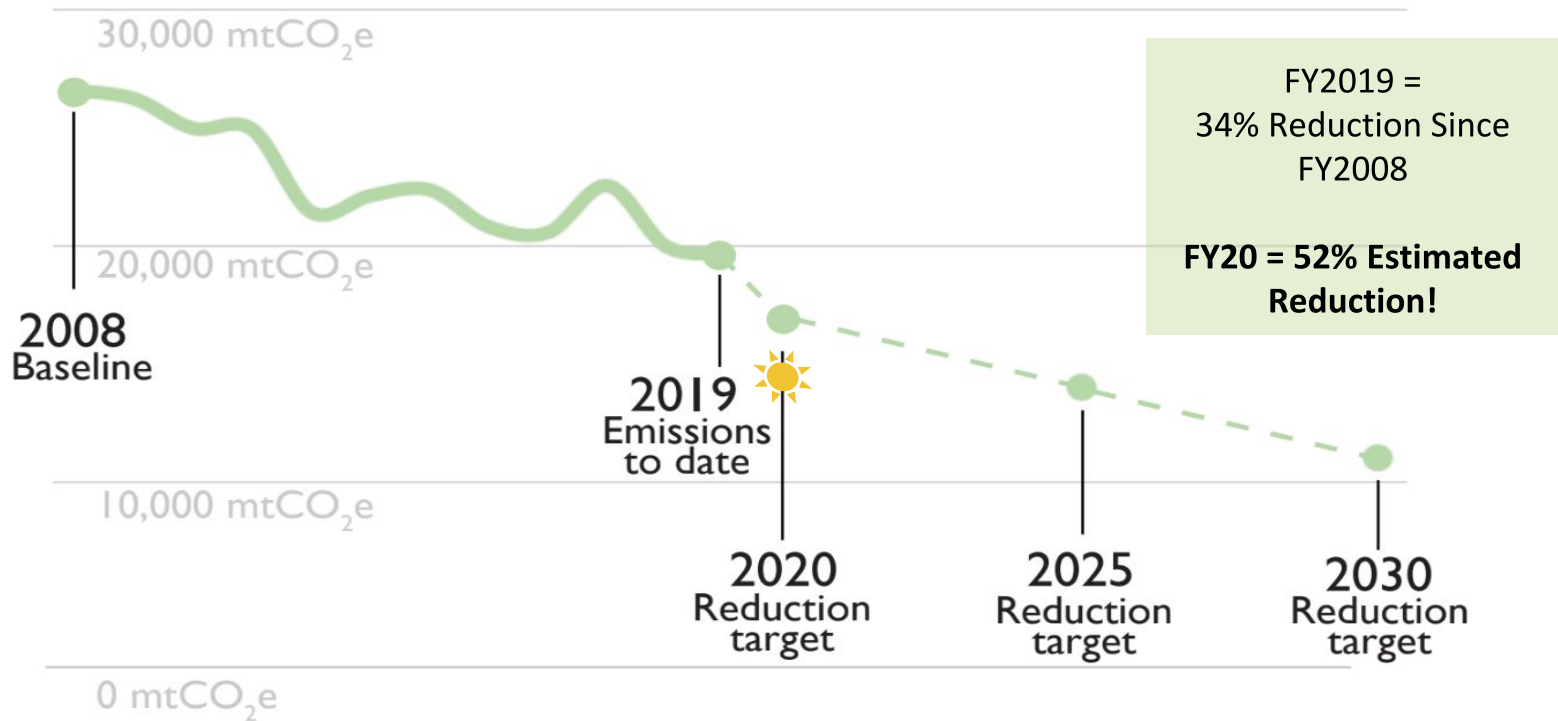
1. Work with waste hauler to commence a monthly recycling and compost reporting system.
2. Partner with Minnesota Waste Wise to conduct annual or biannual waste management audits.
3. Improve and expand communication and education about what is recyclable, compostable, and waste. Work with food service provider to label café items accordingly.
4. Consider expanding composting to administrative and academic buildings in addition to residence halls.
5. Expand residence hall bathroom composting program to include all on-campus residence halls with the eventual inclusion of all primary campus buildings.
6. Institute a campus-wide IT policy that all standard office and computer lab printer defaults are set to duplex mode.
7. Reduce the number of plastic bag inserts in Carleton office waste baskets by reducing the number of waste baskets in each office and reusing or eliminating plastic inserts.
8. Establish a Web-based inventory system for excess office supplies and office furniture so requests can be filled with a reused item rather than a new purchase whenever possible.
9. Work with students, the Environmental Advisory Committee, and Carleton's waste hauler to evaluate whether Carleton should participate in the nationwide higher education Recyclemania competition which is listed as a "tangible action" in the ACUPCC. ([www.recyclemania.org](http://www.recyclemania.org)).



Specific carbon-reduction strategies are layered in here:



# Carbon Emissions by Fiscal Year:



 PROJECTED FY 2020 EMISSIONS (DATA VERIFICATION IN PROGRESS)





## Scope 1- Direct GHGs

Natural gas & fuel oil for heating, facilities fleet, fertilizers, & refrigerants.

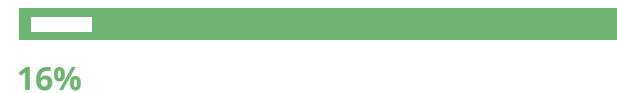


Scope 1:  
Significant  
reductions  
expected as  
geothermal  
comes online



## Scope 2- Upstream GHGs

Purchased electricity from Xcel energy



Scope 2:  
Significant  
reductions  
expected as  
Xcel reaches its  
carbon-free  
goals



## Scope 3- Indirect GHGs

Commuting, staff & faculty air travel, OCS air travel, waste, wastewater, paper, T&D



## CAMPUS GOVERNANCE

*Environmental Advisory  
Committee***Climate Action Plan (CAP) Review 2020**

Environmental Advisory Committee

**Climate Action Plan (CAP) Review  
2020**Workshop 1.1: The Last Ten Years of  
Climate Action at CarletonWorkshop 1.2: The Role of Higher  
Education (& Carleton) in the Global  
Climate CrisisWorkshop 1.3: Climate Action Plan  
Structure & FrameworkWorkshop 1.4: Phase I Reflection &  
Phase II Prep

EAC Charter

Committee Membership

EAC Minutes

Stewsie Awards



<https://www.carleton.edu/sustainability/>

<https://www.carleton.edu/committees/environmental/climate-action-plan-cap-review-2020/>

# WASTE



**COMPOST**

 **Food Waste**  
(including meat)

 **Plant-Based Plastics**  
PLA

 **Soiled Paper Products**



Questions? Contact [wastebusters@carleton.edu](mailto:wastebusters@carleton.edu)

**RECYCLE**

 **Glass**

 **Clean Paper Products**

 **#1-7 Hard Plastics**

 **Metal & Foil**



Questions? Contact [wastebusters@carleton.edu](mailto:wastebusters@carleton.edu)

**LANDFILL**

 **Coated Paper Products**

 **Styrofoam**

 **Film Plastic**

 **Mixed Materials**  
(candy wrappers, bottle caps, etc.)



Questions? Contact [wastebusters@carleton.edu](mailto:wastebusters@carleton.edu)









## Lunch:

791 of total guests

Average edible food waste per guest: **0.08 lbs**

## Dinner:

693 of total guests

Average edible food waste per guest: **0.11 lbs**

## Goals:

- Inform chefs on portion size and type of foods not eaten by students
- Create awareness about food waste

# REPAIR FAIR!

**FREE AND  
FOR SALE**

**F  
R  
E  
N  
Z  
Y**

**GREAT HALL**  
**8TH SUNDAY**

**SALE  
3-5**

**ITEM DROP OFF  
12-2**







In 2019, the sale earned **\$37,000**  
which was donated to 3 local non-profit organizations.





In a 10-Week Term

## Reusables

Green2Go

**3,500  
containers**

(One-time Cost)

**\$14,350**

Total

## Disposables

Compostables

**126,000  
containers**

(Ten weeks (12,600/week))

**\$32,718**

Total

FOOD



## 100,000+ lbs of food per year

delivered to local schools and non-profits in the 2018-2019 academic year because of Food Recovery Network efforts.





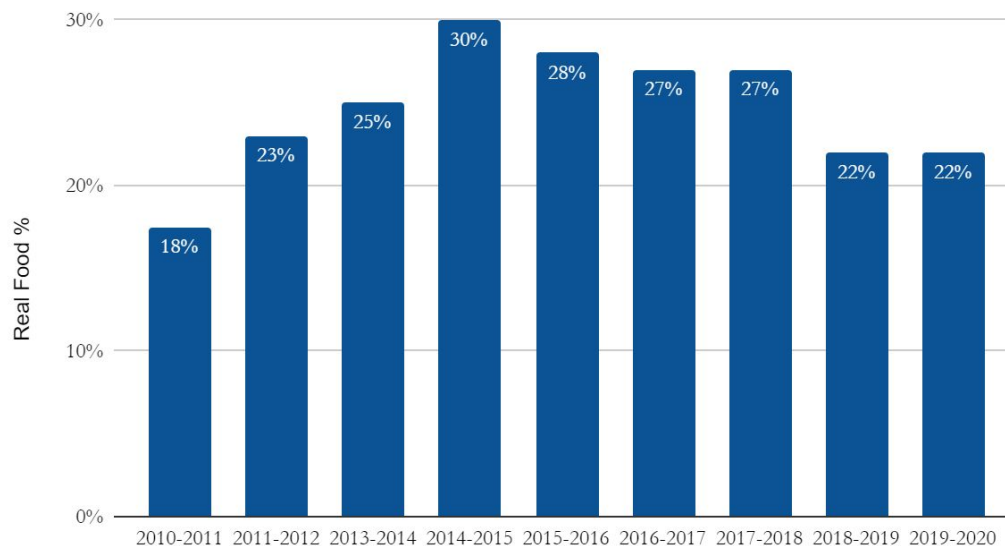


## 2020 Results: 22%



## Humane Local & Community Based Fair Ecologically Sound

Real Food % by Year



# LAND USE





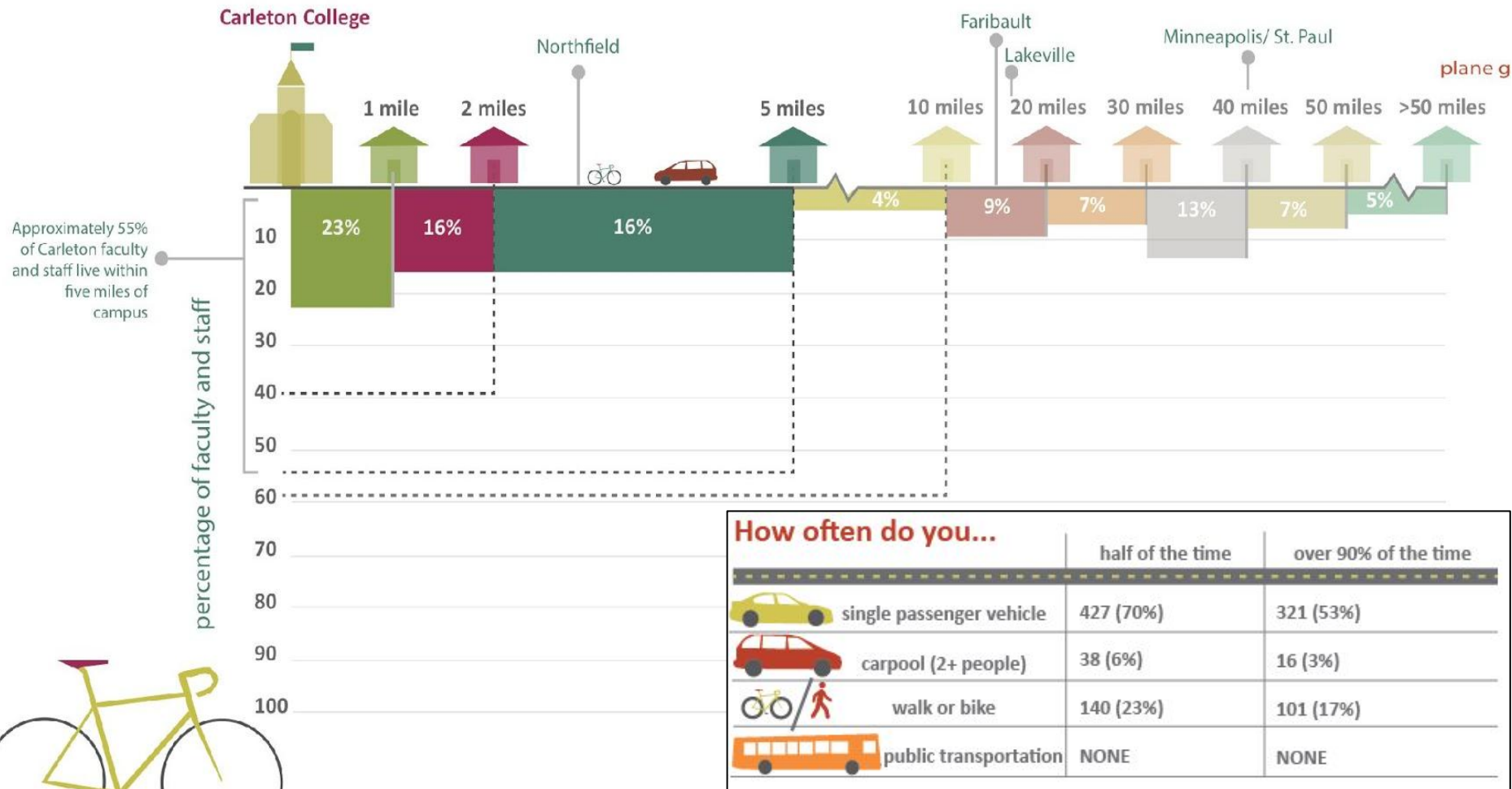


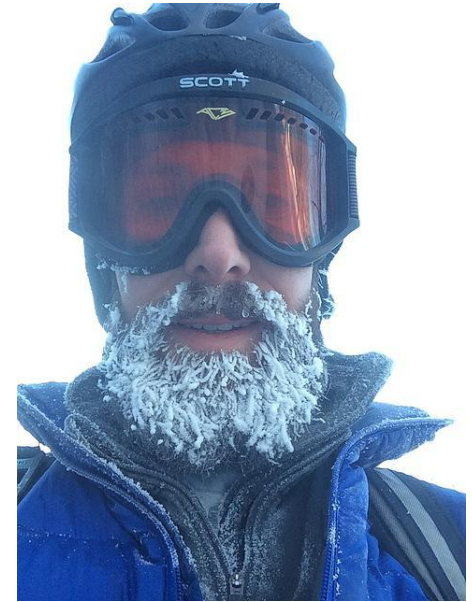




# TRANSPORTATION

## Faculty and Staff residences proximity to campus...





Carleton's Second Annual  
**Bike to Work Week**  
May 15-19, 2017



To sign up, go to: [tinyurl.com/BTWWregistration](https://tinyurl.com/BTWWregistration)







History Professor David Tompkins  
commutes from Minneapolis in his Nissan Leaf.

# ENERGY

## Wind Turbine #1

- 1.65 MW Vestas V87
- Installed September 2004
- Serves public grid - utility pays wholesale rate for power

## Kracum Wind Turbine

- 1.68 MW GE XLE
- Installed October 2011
- Serves the campus grid
- 25 - 30% of annual campus electricity





REMARKS 11/23/11

Key Name: Suffix Trend Definitions Used  
 Point\_1: SSTOTALWK 5 minutes  
 Time Interval: 5 Minutes  
 Date Range: 7/1/2010 00:00:00 - 11/18/2011 23:59:59  
 Report Timings: All Hours

CONTROL BUILDING TEMPERATURE: 57°F

ENCLOSURE TEMPERATURE: 70°F

<>Date	Time	Point 1
11/13/2011	10:30:00	2024.25
11/13/2011	10:35:00	2025.75
11/13/2011	10:40:00	2056.5
11/13/2011	10:45:00	2057.25
11/13/2011	10:50:00	2042.25
11/13/2011	10:55:00	2037

## GENERATOR #1 (SOUTH) GEN

ENGINE CHECKLIST	
Fuel	FULL
(4) Circuit Breakers On	YES
BATTERIES	

AU42									
1 2011 Xcel Energy Invoices									
2 ENTER ALL DATA HERE									
3 NOTE: Usage recorded in red are estimated readings									
4									
5 INVOICE # 51-5015604-7									
LOCATION	ADDRESS	METER NUMBERS	KWh	Elec \$	cfd	Gas \$	KWh	Elec \$	cfd
40 Secombe House	111 & 113 Nevada	60843632	2490 \$	262.58			2434 \$	254.22	
41 Secombe House	111 & 113 Nevada	61453860 / 20053899	623 \$	72.50	409 \$	336.94	600 \$	69.65	367
42 Sperry House	107-109 Nevada St.	61453589	270 \$	36.56			343 \$	43.78	
43 Sperry House	107-109 Nevada St.	61453862 / 615479	352 \$	47.99	427 \$	386.10	293 \$	41.42	384
44 Stinson House	300 E. First	58954929 / 584504	1547 \$	164.44	331 \$	274.26	1682 \$	176.40	297
45 Strong House	118 College	61745254 / 615129	1545 \$	166.35	492 \$	404.35	1509 \$	160.27	451
46 Whittier House	514 E. Second	61454973	1925 \$	205.06			1900 \$	204.42	
47 Williams House	109 Union	61739817 / 615173	853 \$	93.78	344 \$	285.39	875 \$	97.19	311
48 Wilson House	115 Division	61746714 / 20249752	575 \$	65.54	281 \$	234.48	595 \$	64.91	227
49 TOTAL			50009 \$	5,533.55	16436 \$	13,594.48	48775 \$	5,295.80	14655
12/28/10 - 1/27/11									
1/27/11 - 2/27/11									
54 INVOICE # 51-5543243-8									
LOCATION	ADDRESS	METER NUMBERS	KWh	Elec \$	cfd	Gas \$	KWh	Elec \$	cfd
55 Weitz Center for Creativity	320 Third Street	5147215 / 10003589							
57 Weitz Center - Street Lts	320 Third Street	non-metered							
58 Allen House			426 \$	51.50			358 \$	27.91	
59 Chiller Plant (CPS)									
60 Faculty Club									
12/29/10 - 1/30/11									
1/26/11 - 2/26/11									

## CHILLER PLANT

Chiller Location:

## LIQUID CHILLER

System No.:

Date		Time															
Time		Midnight	2:00 AM	4:00 AM	6:00 AM	8:00 AM	10:00 AM	12:00 PM	2:00 PM	4:00 PM	6:00 PM	8:00 PM	10:00 PM	12:00 AM	1:00 AM	3:00 AM	
Hour Meter		3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	3/1/11	
O.A. Temperature D/W/B		51.15	52.16	51.16	51.17	50.77	52.13	50.57	52.63	50.14	51.18	51.29	51.41	51.43	51.43	51.43	
Compressor	Oil Level	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
	Oil Pressure	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
	Oil Temp	15.4	14.5	14.5	13.2	12.1	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
	Seal Oil Level	0	0	0	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	
Motor	Discharge Temp	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	
	% Motor Current	4.0	4.0	4.0	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
	Volt	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	
	Amper	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	
Heating	Suction Pressure	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
	Seal Temp	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
	Inlet Pressure	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	
	Return Temp	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	
Cooler	Outlet Pressure	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
	Leaking Temp	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	
	Flow Rate GPM	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	
	Discharge Pressure	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
Condenser	Seal Temp	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	
	Return Temp	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
	Inlet Pressure	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	
	Leaking Temp	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
MC TEMPS	Flow Rate GPM	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	18.45	
	MC1ZLT	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	
	MC2OWS	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
	Other	AC Temp	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9

## Carleton College Water Meter Readings - Off Campus Buildings

		Year: 2011											
Building	Meter #	Account #	Ser. Code	December 2010 Reading	January Reading	Usage from Previous Month	February Reading	Usage from Previous Month	March Reading	Usage from Previous Month	April Reading	Usage from Previous Month	May Reading
Headley House	18059304	1-00941-01	WR1	8,478	8,806	328	9,378	572	9,579	201	9,985	406	10
Headley Cottage		1-00951-04	WR1	10,648	10,953	305	11,275	322	11,715	440	12,088	363	11
Rogers House		1-00961-04	WR1	30,718	32,055	1,337	32,799	744	33,857	1,058	34,661	804	31
Secombe House	98165354	1-01381-02	WR1	15,034	16,037	1,003	16,870	833	17,887	1,017	18,832	945	11
Sperry House		1-01391-04	WR1	26,062	26,849	787	27,217	368	27,619	402	28,219	600	21
Whittier House	18062480	1-01461-01	WR1	22,452	23,789	1,337	24,842	1,153	26,116	1,174	27,610	1,494	21
Raymont House		1-01581-02	WR1	10,761	11,138	377	11,461	323	11,814	353	12,176	362	11
Hoplin House	17832568	1-01621-00	WR1										
108 Winona Street		1-01631-01	WR1										
Pollock House	88378117	1-01941-00	WR1										
Benton House	17060593	1-01961-00	WR1										
210 Winona Street		1-02001-01	WR1										
Parish House	98075801	1-02041-01	WR1										
Douglas House	18871644	1-02051-00	WR1										
Hill House	16239029	1-02061-00	WR1										
Huntington House	17060595	1-02081-00	WR1	1	280	368	3,660	340	0	122,826	420	0	24
Bird House	10941025	1-02111-01	WR1	2	290	383	5,320	354	0	105,529	420	0	24
Strong House	18871643	1-02181-00	WR1	3	340	427	4,420	409	0	122,320	450	0	24
Jones House	17060601	1-02191-00	WR1	4	334	420	4,570	402	0	152,983	420	0	24
Rice House	94003580	1-02201-00	WR1	5	265	333	3,640	319	0	98,494	2,740	0	24
216 College Street	16827228	1-02211-02	WR1	6	264	339	4,490	322	0	125,489	400	0	24
PAGE House		1-02221-04	WR1	7	323	417	6,370	390	0	109,671	520	0	24
Arts Union		1-02238-01	WR1	8	325	410	4,200	390	0	131,529	300	0	24
Nutting House	17060598	1-02301-01	WR1	9	327	415	4,490	396	0	94,454	590	0	24
Ryberg House	09943744	1-02341-02	WR1	10	356	446	4,070	425	0	91,042	380	0	24
Williams House	90309602	1-02391-00	WR1										
Henry House	18735590	1-02401-00	WR1										
Hall House		1-02411-00	WR1										
Stinson House	17832568												
Reynolds House	18827213												
Hunt Cottage	97051842												
Dacie Moses House	99309609												
Berg House	17832572												
212 2nd Street E.													
208 Union													
Lawson House	18082467												

## Performance

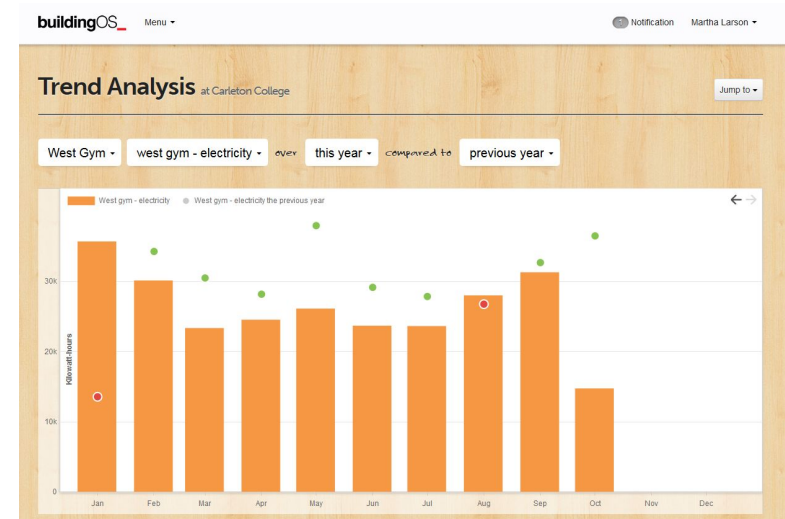
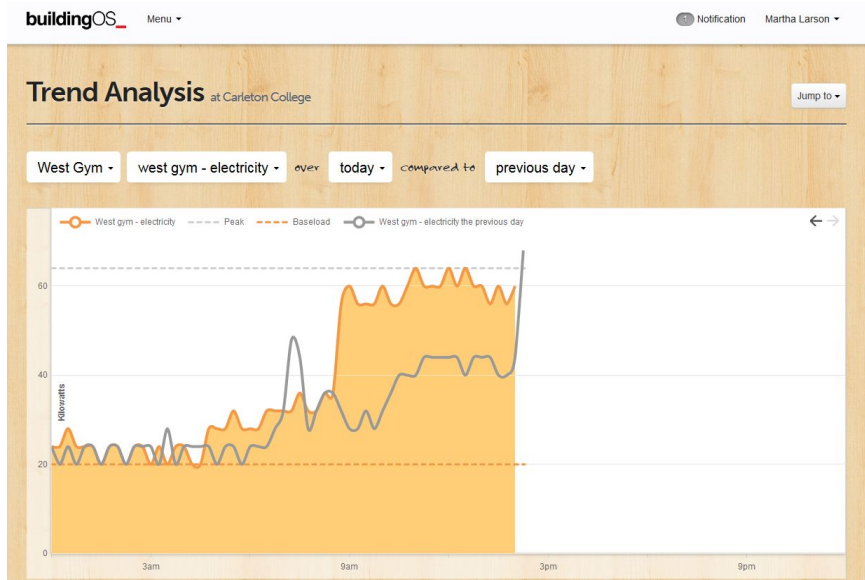
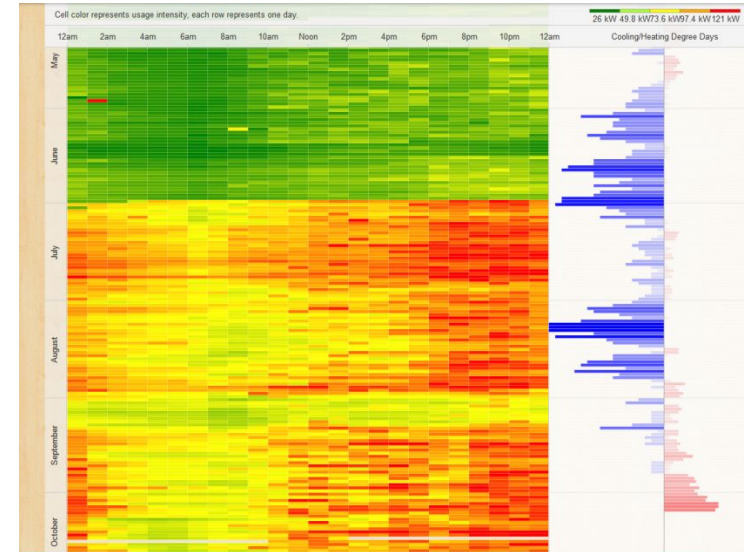
Start Time: 11/1/2011 12:00:00 AM End Time: 12/1/2011 12:00:00 AM

Selected Systems:

System	Availability (%)	Production (kWh)	Consumption (kWh)	Grid Operating Time (hh:mm:ss)	Turbine OK (hh:mm:ss)	Down Time (hh:mm:ss)	Service Time (hh:mm:ss)	Repair Time (hh:mm:ss)	Grid Outage (hh:mm:ss)	Weather Outage (hh:mm:ss)	External Stop Time (hh:mm:ss)	External Power Time (hh:mm:ss)
WTG001	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:00:00
Sum	NA	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:00:00
Average	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:00:00
Minimum	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:00:00
Maximum	99.99	476958.00	610.00	612:35:08	701:18:46	00:00:00	00:02:37	00:00:00	00:00:00	19:38:37	00:00:00	00:00:00

# Energy Data BEFORE : a mess!

Facility	Meter	Scope	Data Service	Last reading	Status
Faculty Club / An...	Faculty Club/A...	Bill	Urjanet Bills	Sep 23, 2014 23:00	✓ Online
Geffert House	Geffert House - ...	Whole building	Urjanet Bills	Aug 25, 2014 23:00	✓ Online
Geffert House	Geffert House - ...	Whole building	Urjanet Bills	Aug 25, 2014 23:00	✓ Online
Goodhue Hall	Goodhue - Ele...	Whole building	SIEMENS	29 minutes ago	✓ Online
Goodhue Hall	Goodhue Hall - ...	Whole building	SIEMENS	29 minutes ago	✓ Online
Goodhue Hall	Goodhue Hall - ...	Whole building	SIEMENS	29 minutes ago	✓ Online
Gould Library	Gould Library - ...	Whole building	SIEMENS	29 minutes ago	✓ Online
Gould Library	Gould Library - ...	Whole building	SIEMENS	29 minutes ago	✓ Online
Gould Library	Gould Library - ...	Whole building	SIEMENS	29 minutes ago	✓ Online
Headley Cottage	Headley Cottag...	Whole building	Urjanet Bills	Aug 24, 2014 23:00	✓ Online
Headley Cottage	Headley Cottag...	Whole building	Urjanet Bills	Aug 20, 2014 23:00	Offline
Headley House	Headley House...	Whole building	Urjanet Bills	Aug 24, 2014 23:00	✓ Online



Energy Data AFTER: neat and tidy!





## It all adds up.

The Language and Dining Center lighting retrofit alone (controls and LEDs) saved 160,000 kWh / yr. This single project reduced TOTAL campus electricity consumption by 1%.

# EDUCATION & OUTREACH



- Sustainability outreach
- Waste education
- Office supply swap shop
- Climate Action Week
- Northfield Earth Day
- Real Food Challenge
- Energy Team
- Conference attendance
- And more...





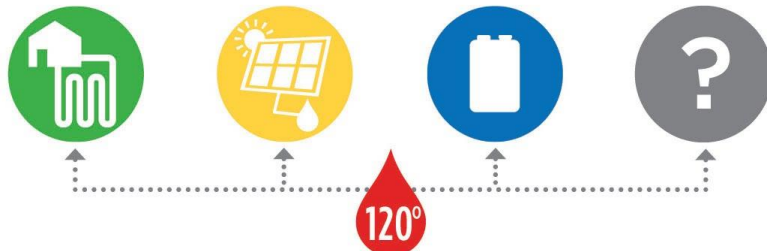


**60 miles**  
OF GEOTHERMAL PIPING  
TO BE INSTALLED UNDER  
THE CARLETON CAMPUS

THE NEW UTILITY SYSTEM WILL  
**REDUCE ANNUAL  
ENERGY USE**  
BY

**84,000,000,000**  
BTUs

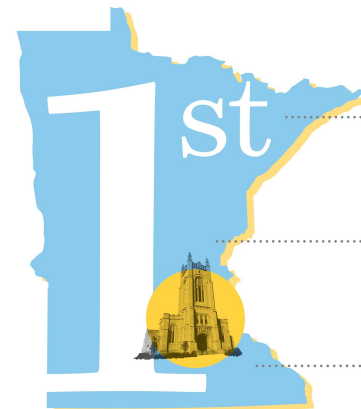
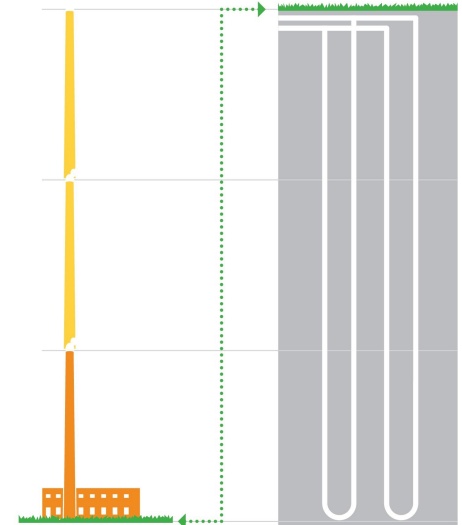
Equal to adding **6** wind turbines  
(15,000 MMbtu each)



The new **120 degree hot water heating system** will be capable of connecting to many different technologies including geothermal, solar thermal, fuel cells and other emerging technologies, resulting in a more diverse and resilient energy system with reduced carbon emissions.

Each vertical bore is

**520**  
**FEET DEEP**  
= to the height of **3**  
CARLETON  
**SMOKE**  
**STACKS**



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**









# Sustainability clubs & CCCE groups

Environmental Carls Organized (ECO)

Energy Club

Food Truth

Carleton Farm/Farming Club

Kids for Conservation (KFC)

Food Recovery Network

Take Back the Tap

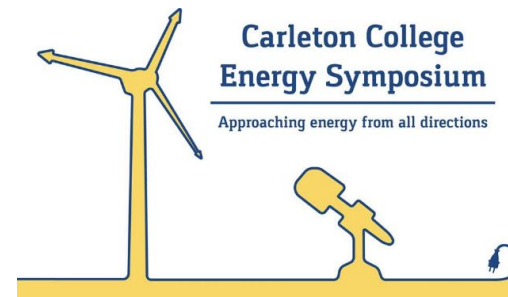
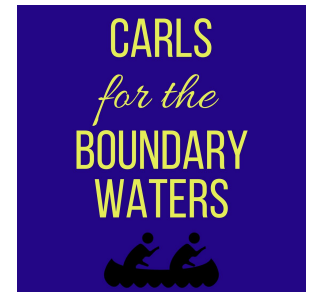
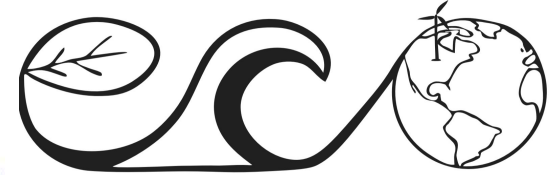
Gleaning

Carleton Clothing Connection

Divest Carleton

Arbor

Carls for the Boundary Waters



# Carleton Office of Sustainability

Snapchat @sustaincarleton

Twitter @sustaincarl

Instagram @carletonsustain

Facebook @carletonsustainability

Online [go.carleton.edu/sustainability](http://go.carleton.edu/sustainability)





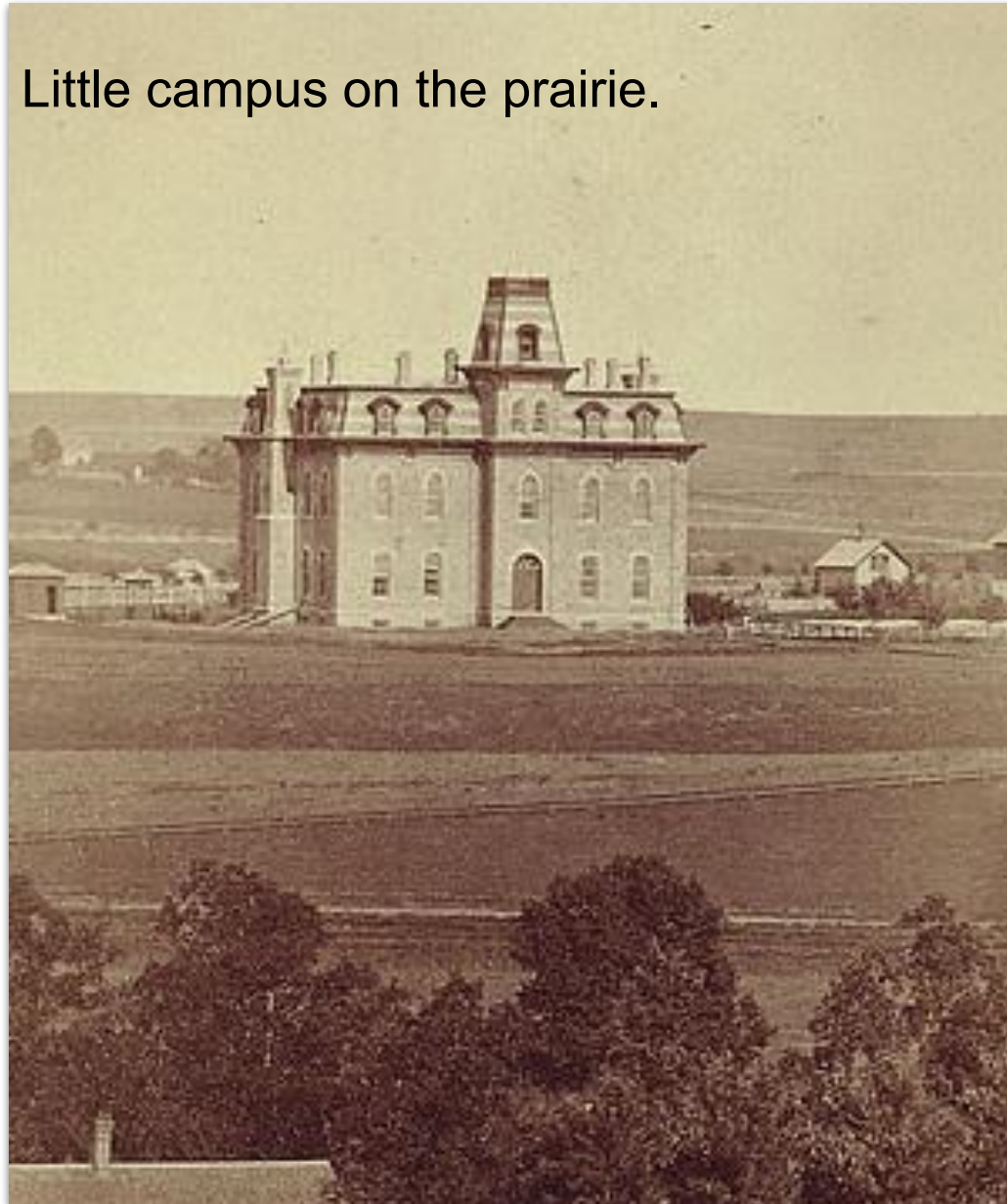
Carleton

# 100 Years of District Energy: Carleton's Utility Transformation





Little campus on the prairie.





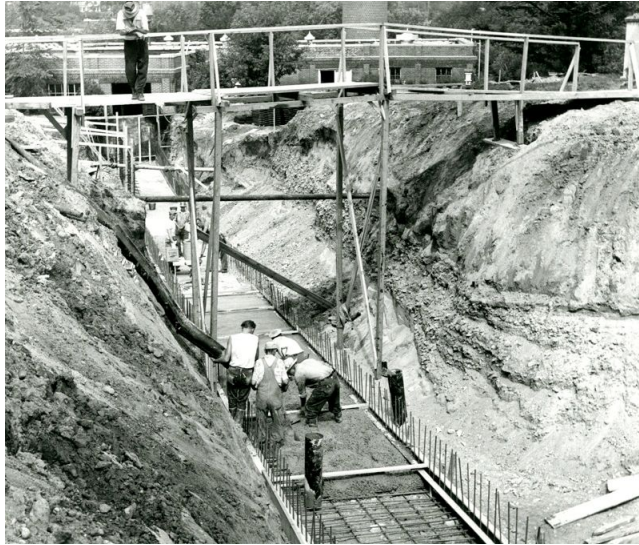
First building constructed in the 1910 campus master plan





2017 - developing a plan for the *next* 100 years.





Expanding the steam tunnels

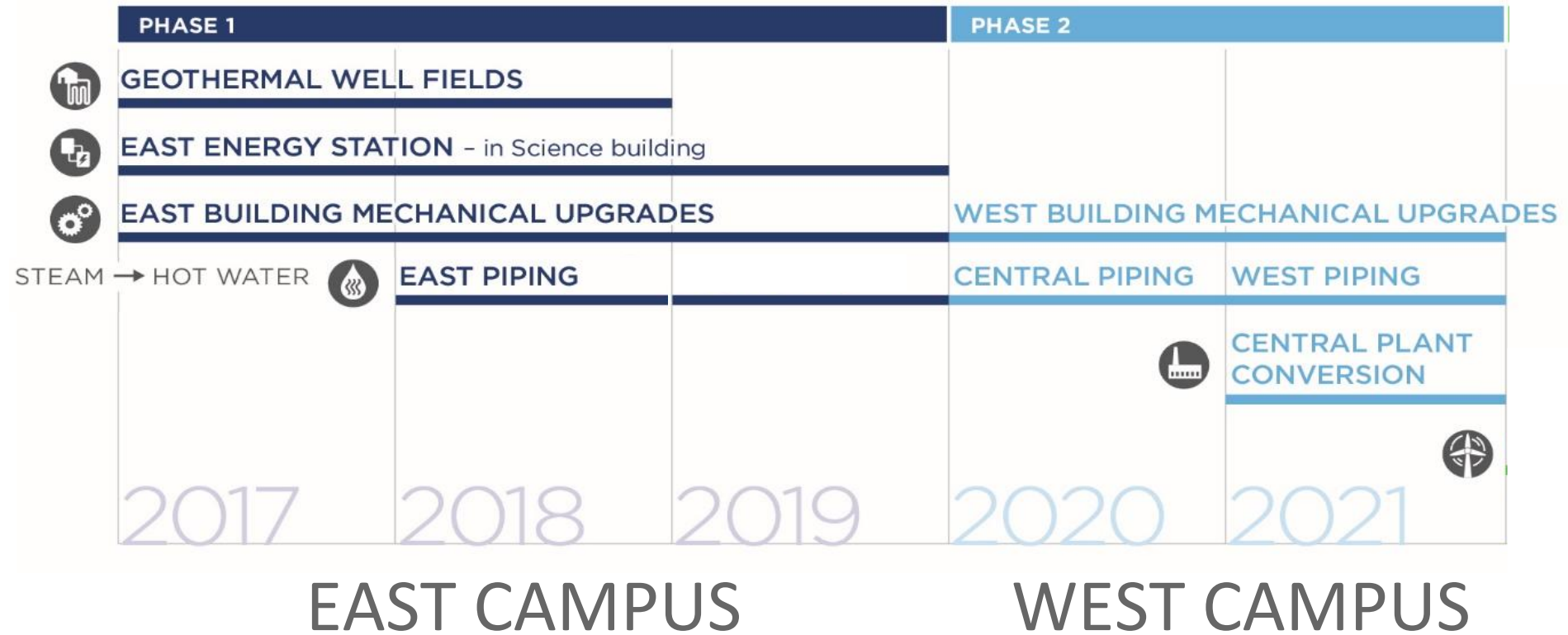


Installing a wind turbine (2011)

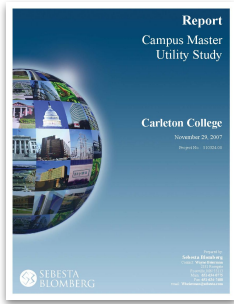
## The big questions:

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

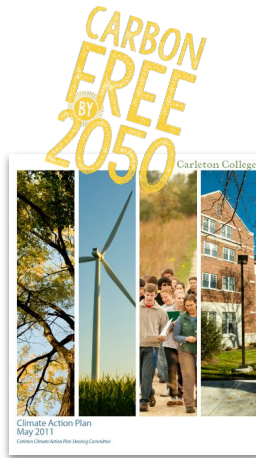
## UTILITY MASTER PLAN TIMELINE



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



## 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

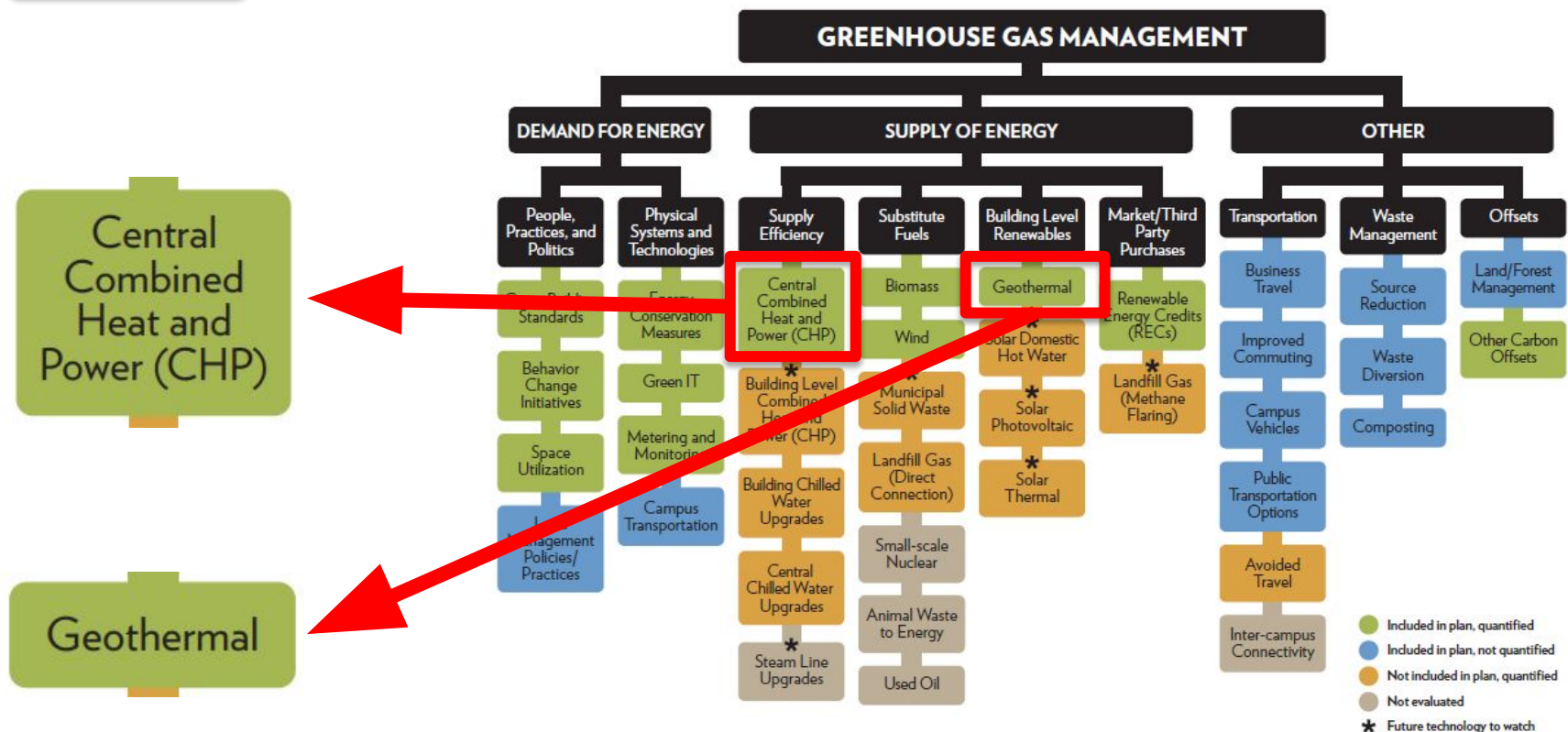
How can we incorporate the goals of other strategic plans into the utility planning process?



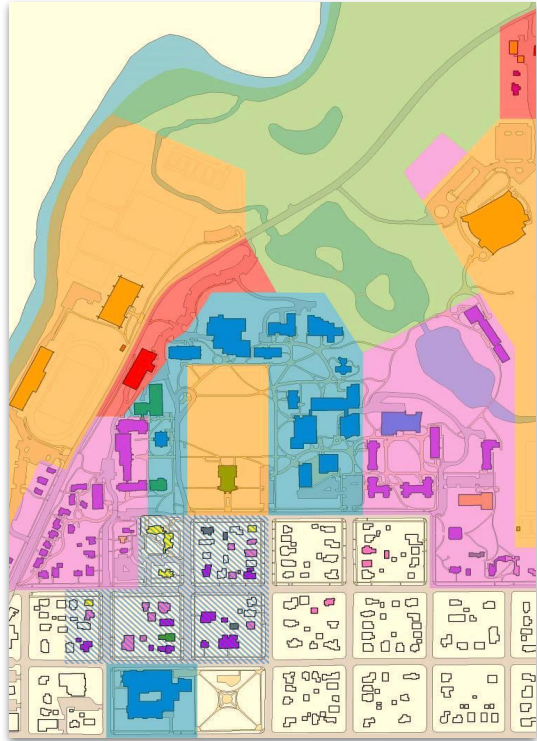


## 2011 CAP: carbon reduction strategies

### *What are the utility planning opportunities?*







## 2014 Facilities Master Plan Priorities

*Which priorities align with utility planning opportunities?*

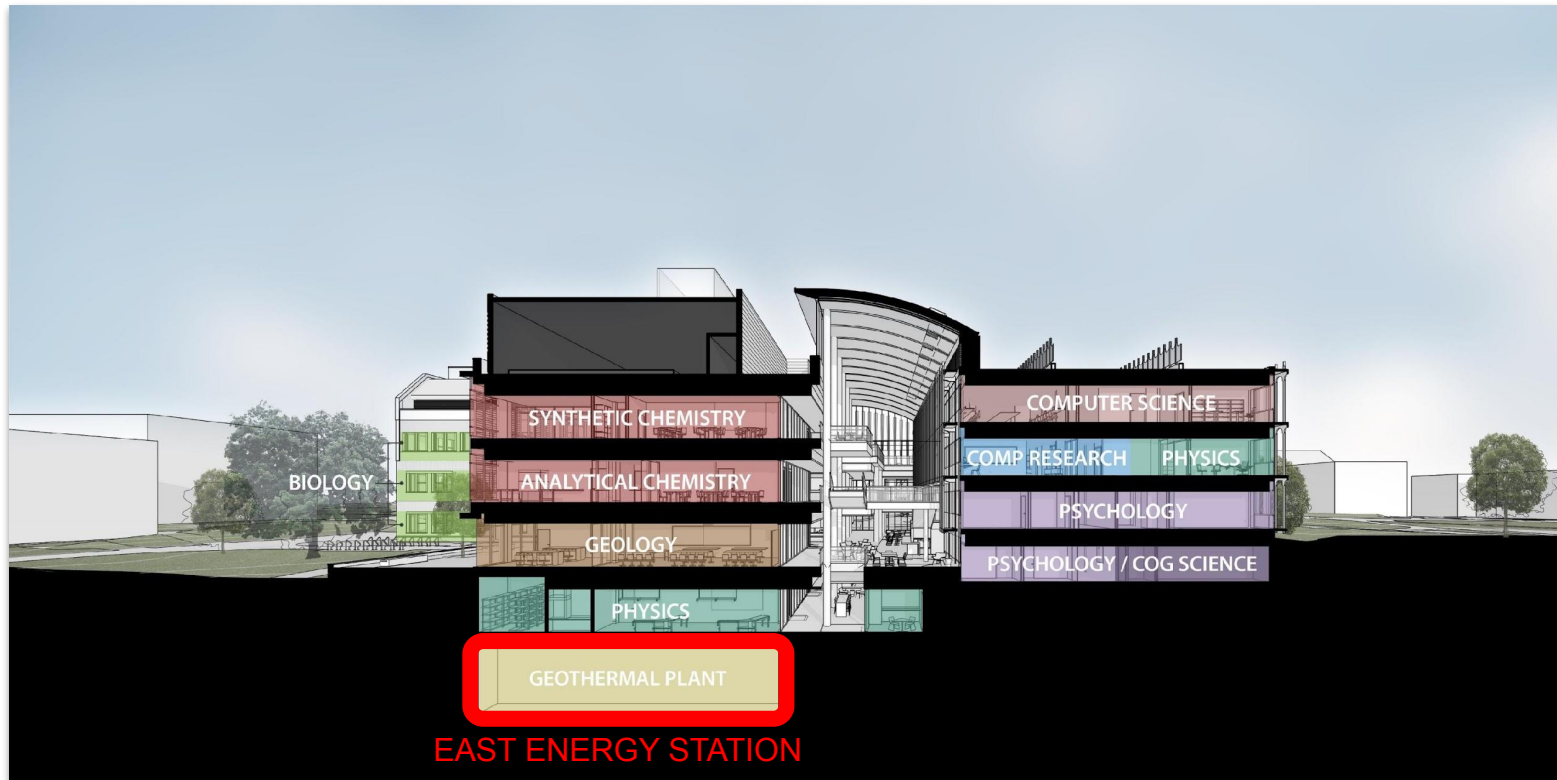
- Long-term precinct plan for the campus
- Investment in science facilities
- Investment in music & public event facilities
- Assess number, location, and size of needed classrooms
- Other needs incl. admissions and Academic Support Center



**PRIORITY:** Investment in music and event facilities

**OPPORTUNITY:** Skinner Chapel Heating System Upgrade

Pilot project for low temperature (120 deg) hot water supply.



**PRIORITY:** Investment in science facilities

**OPPORTUNITY:** New Science Complex

Location of new geothermal plant ( “East Energy Station”)



WHAT WE DID

# Geothermal Bore Fields



Drill rigs on the Bald Spot





# Bald Spot - 134 Vertical Bores



Tying the loops into a single circuit



# Bell Field - 95 Horizontal Bores





# Bell Field - 95 Horizontal Bores





# Bell Field - 95 Horizontal Bores





# Mini Bald Spot - 77 Vertical Bores





# Mini Bald Spot - 77 Vertical Bores





# Mini Bald Spot - 77 Vertical Bores

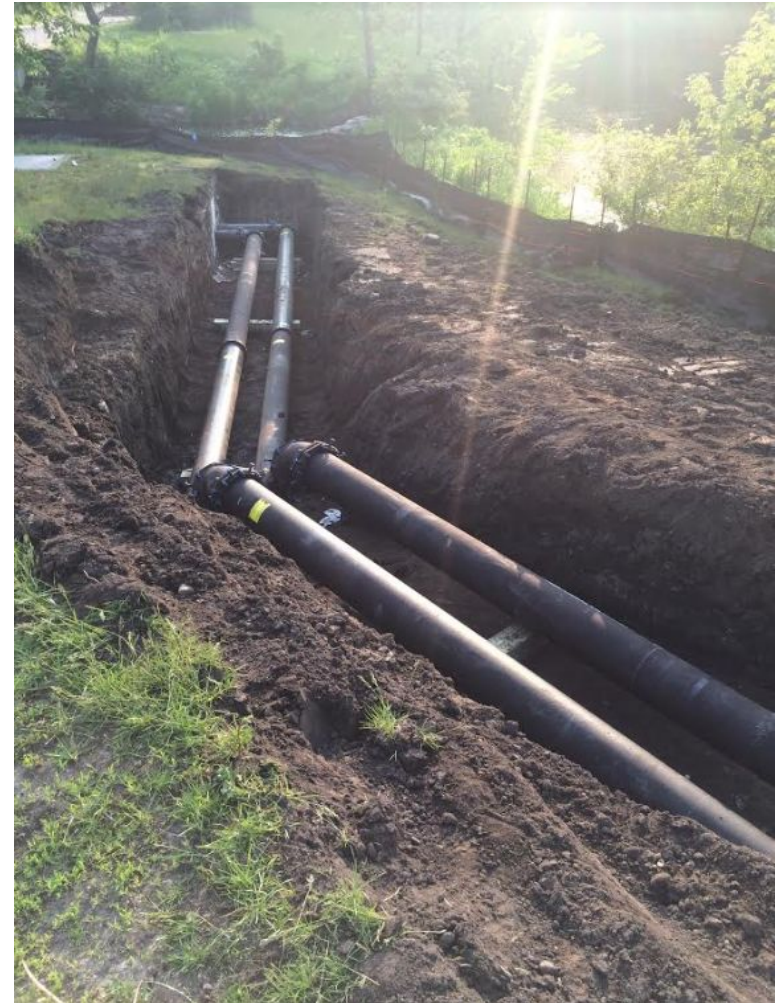




# Replaced Steam Pipes w/ Hot Water Piping



In tunnels



Underground

# Radiator & Unit Heater Updates



Building conversions to 120° F hot water (East Campus)  
Lower water temp + more surface area = same BTUs



# Domestic Hot Water (showers, faucets, pools)



BEFORE: Storage Tanks

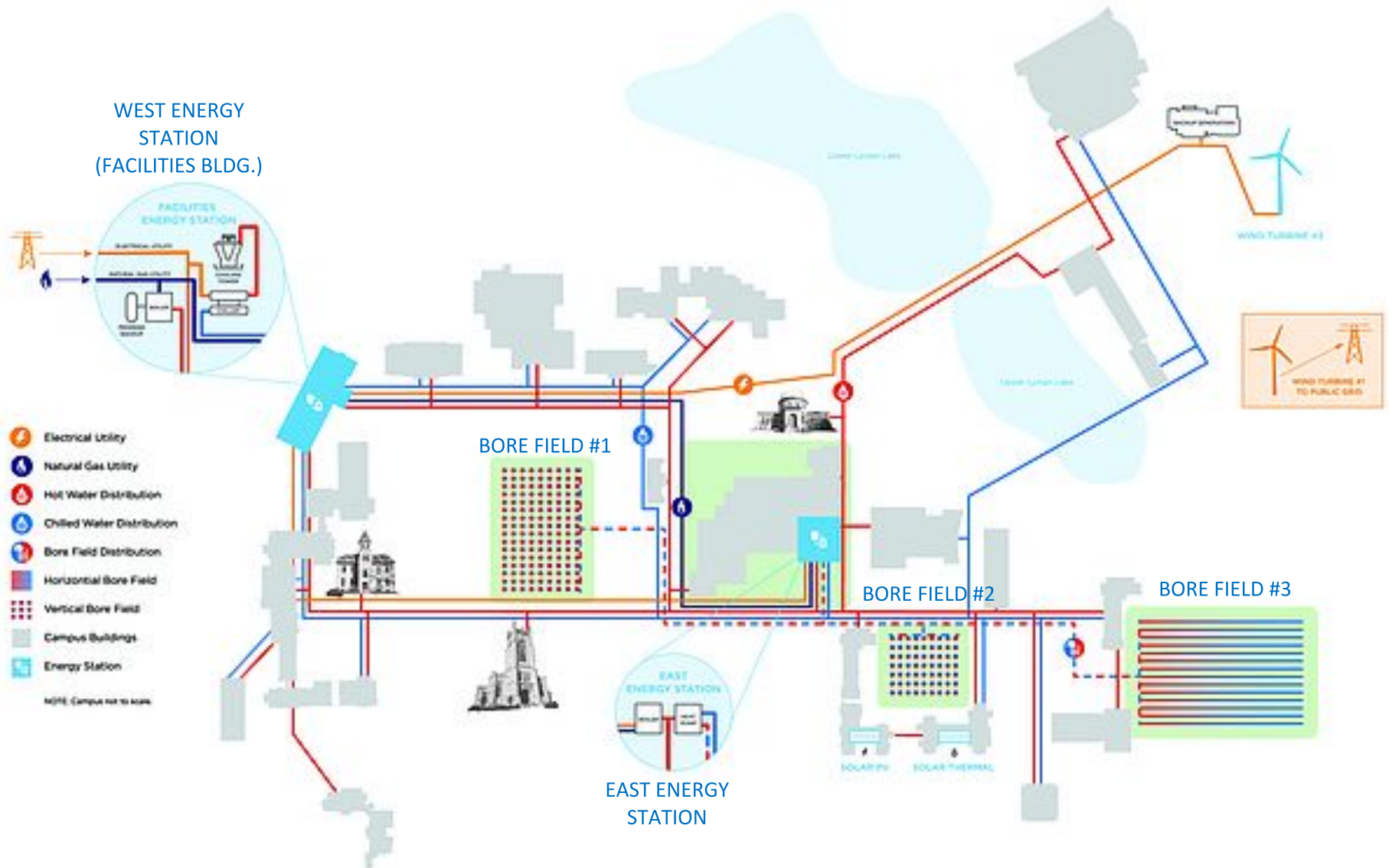


AFTER: Heat Exchangers

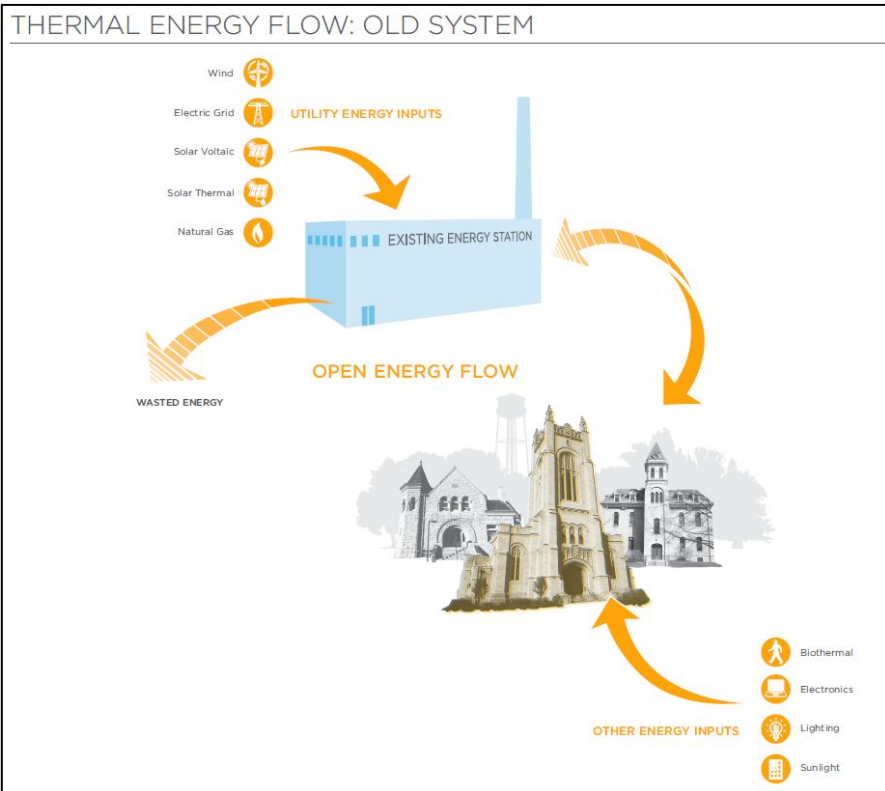


HOW IT WORKS

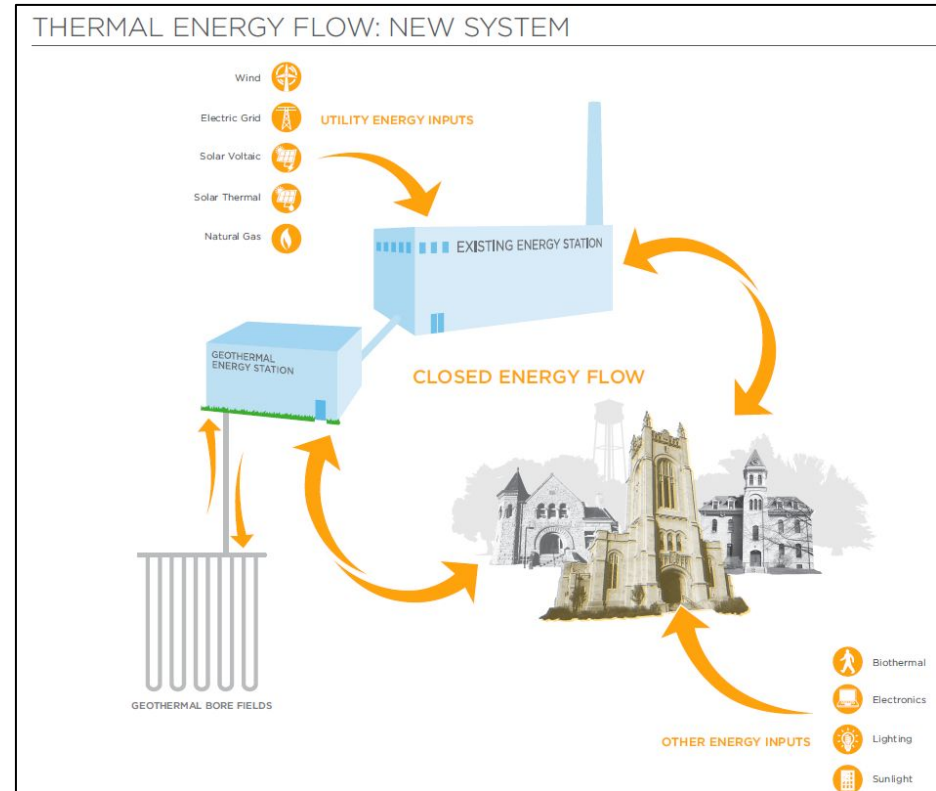
# Carleton's District Energy System



# Capturing and Reusing “Waste” Heat



**OPEN LOOP**  
Waste heat released to  
the atmosphere



**CLOSED LOOP**  
Waste heat captured and  
reused on campus



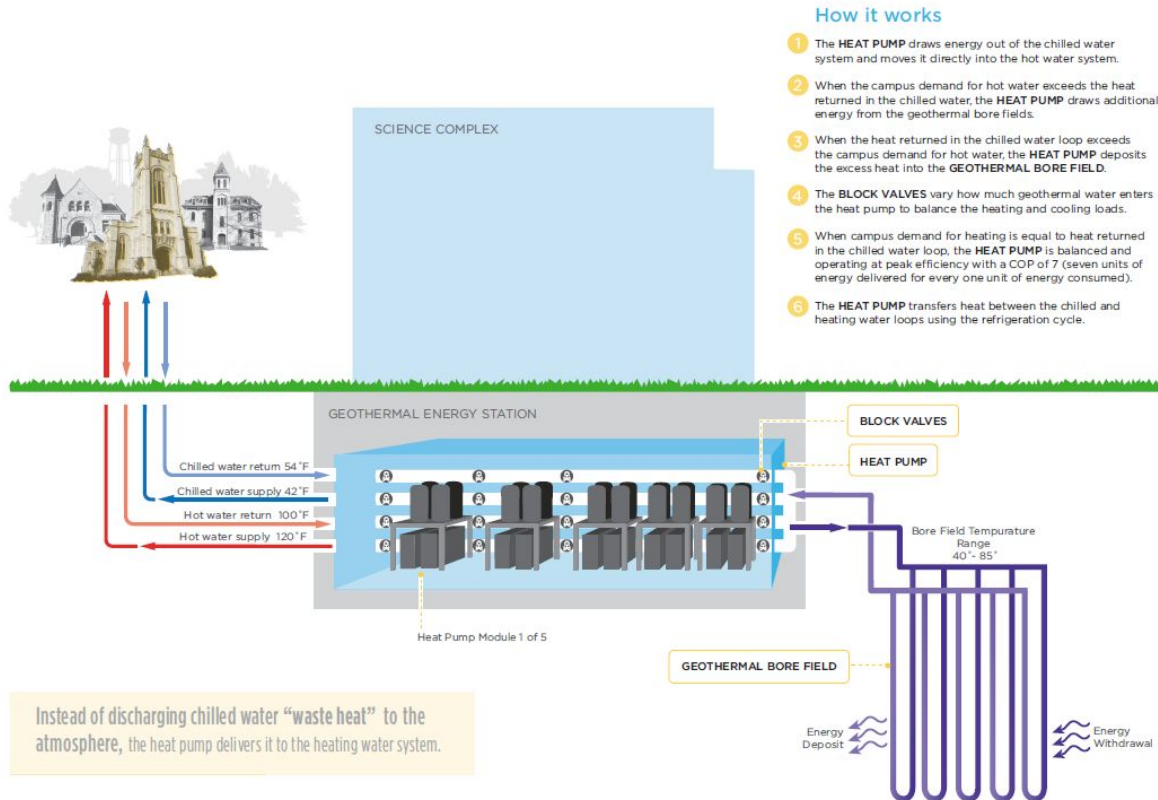
# Carleton's Heat Pump "Recycles" Energy



The heating water, cooling water and geothermal water loops meet here to exchange energy. When perfectly balanced, the heat pump is 700% efficient!

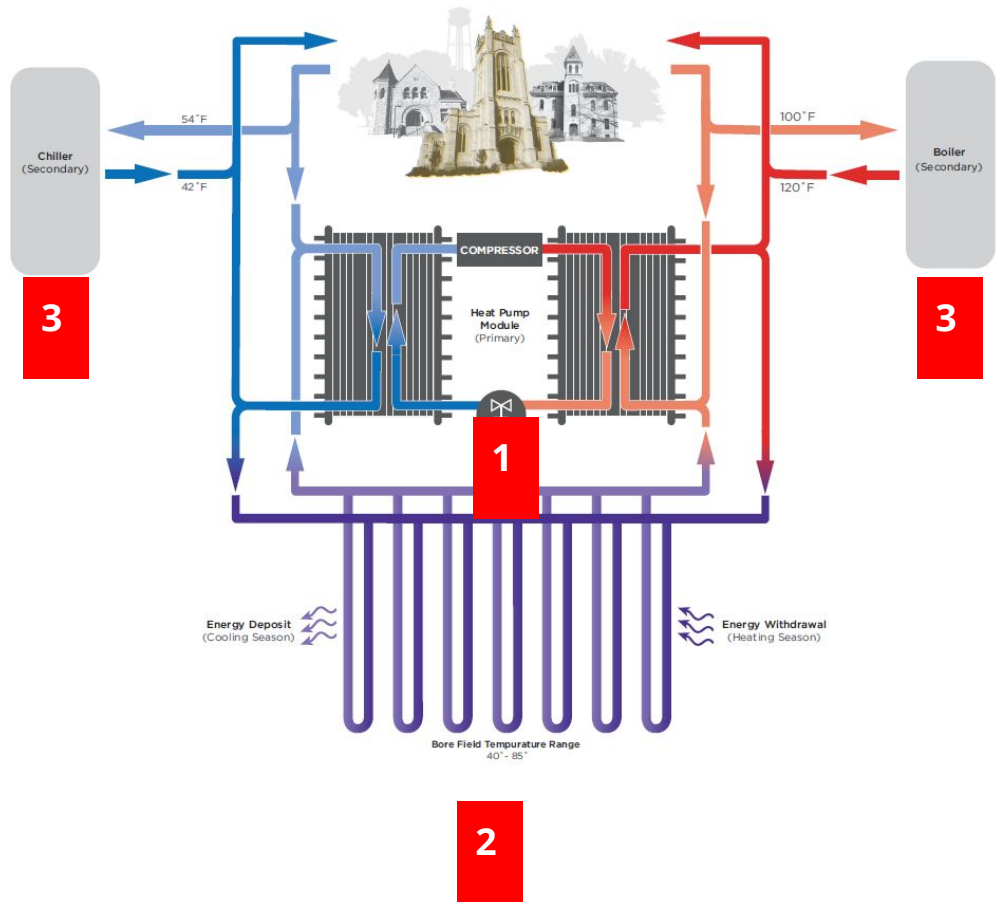
# Carleton's Heat Pump Recycles Energy

## GEOHERMAL HEAT PUMP - MACRO VIEW



# Three Tiers of Heating / Cooling

## HEAT PUMP ENERGY EXCHANGE (PRIMARY)



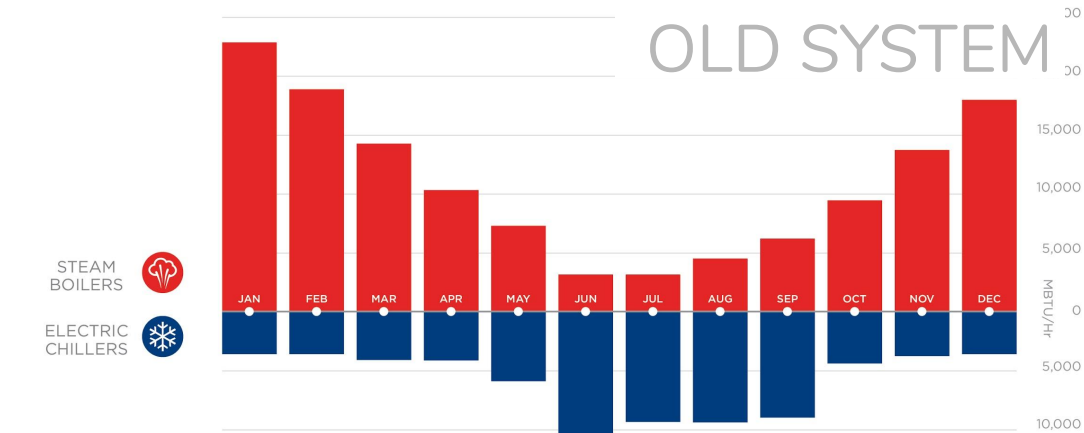
- 1) **Directly** transfer excess heat from the cooling loop to the heating loop
- 2) **Access or deposit** excess heat to/from the geothermal bore fields
- 3) **Supplement** with boilers and chillers during peak heating and cooling season



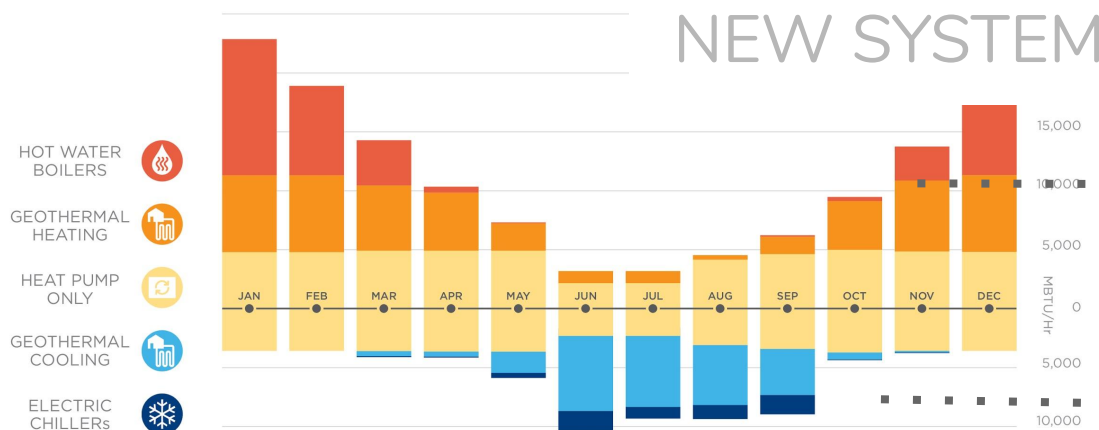
EXPECTED OUTCOMES

# Diversified Heating and Cooling Profile

## CARLETON HEATING & COOLING LOAD PROFILES



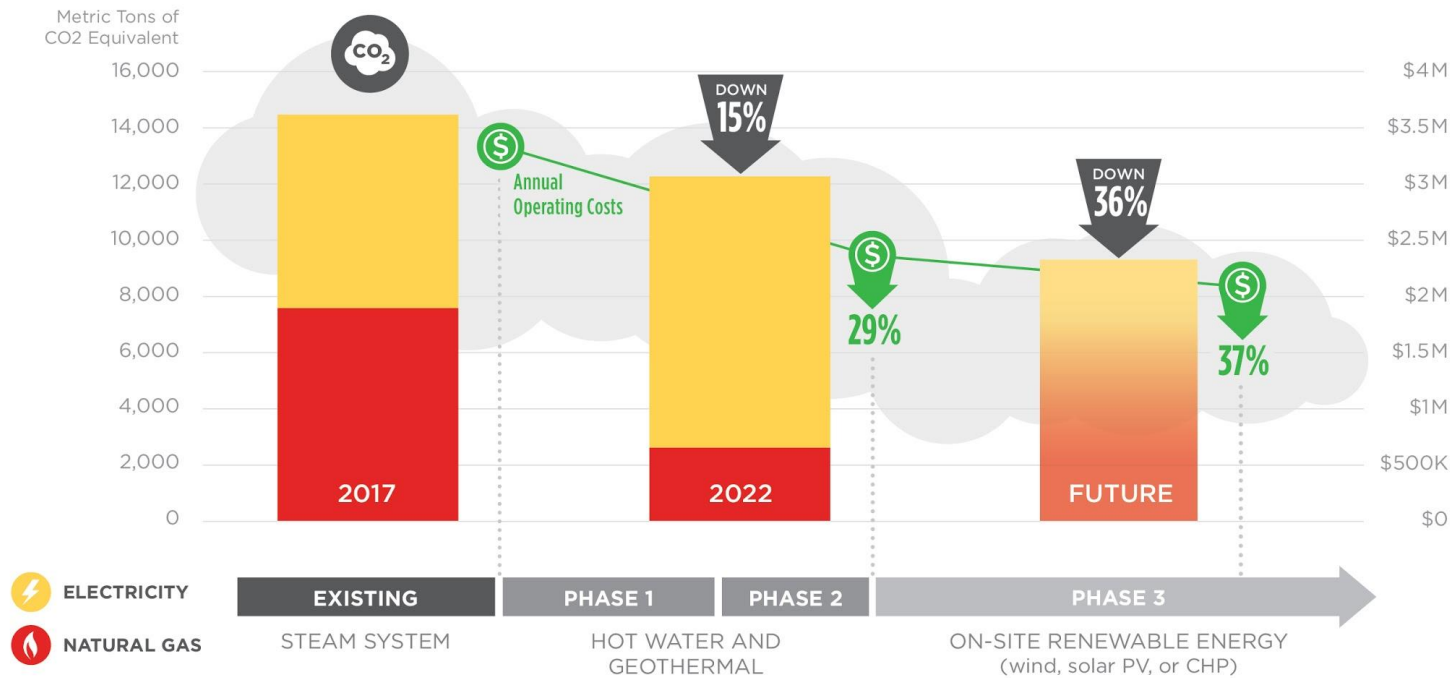
No connection between cooling systems that discard heat and the heating systems that need it.



The geothermal heat pump provides 70% of campus heating and cooling

# Reduced Cost and Carbon Emissions

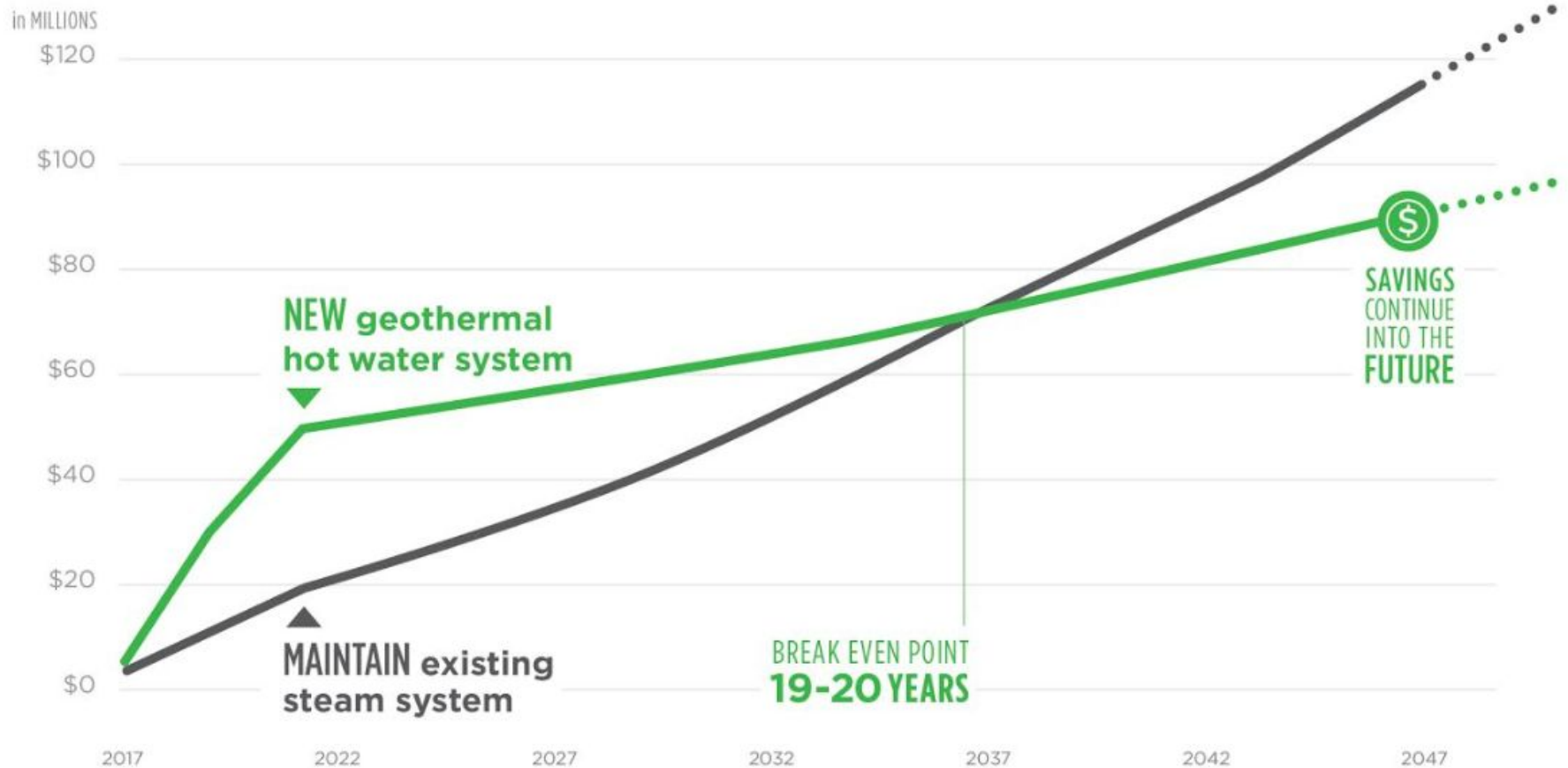
## CENTRAL PLANT ANNUAL EMISSIONS & OPERATING COST REDUCTIONS





# Financial “Break-Even” Point

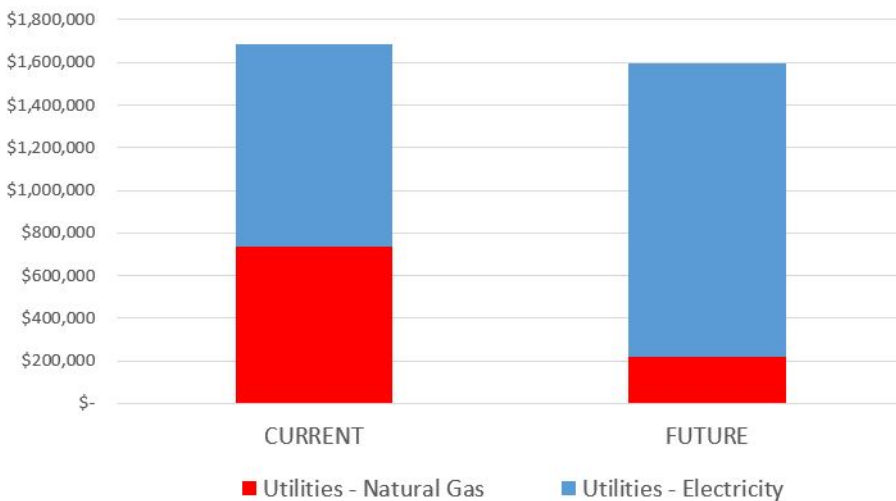
## CAPITAL + OPERATING COST COMPARISON



# Projected Operating Savings

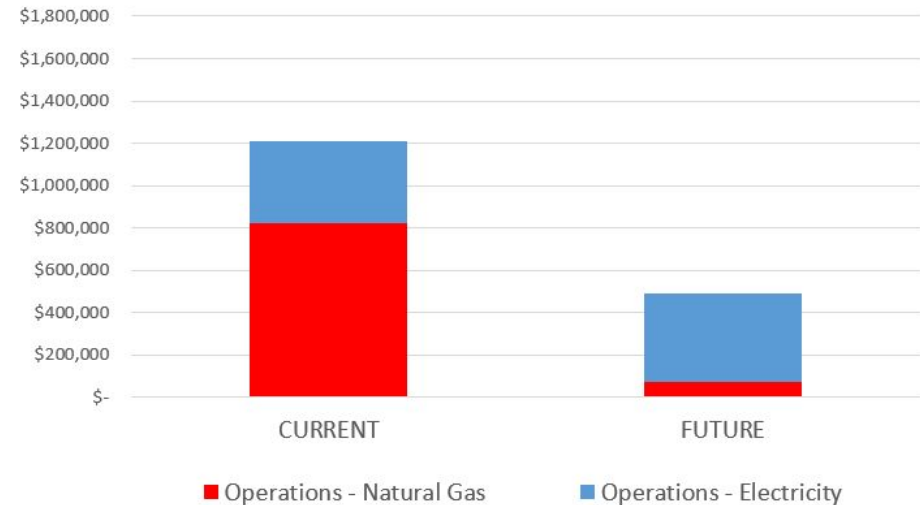
## Central Plant Operations Cost Comparison

Utilities Cost



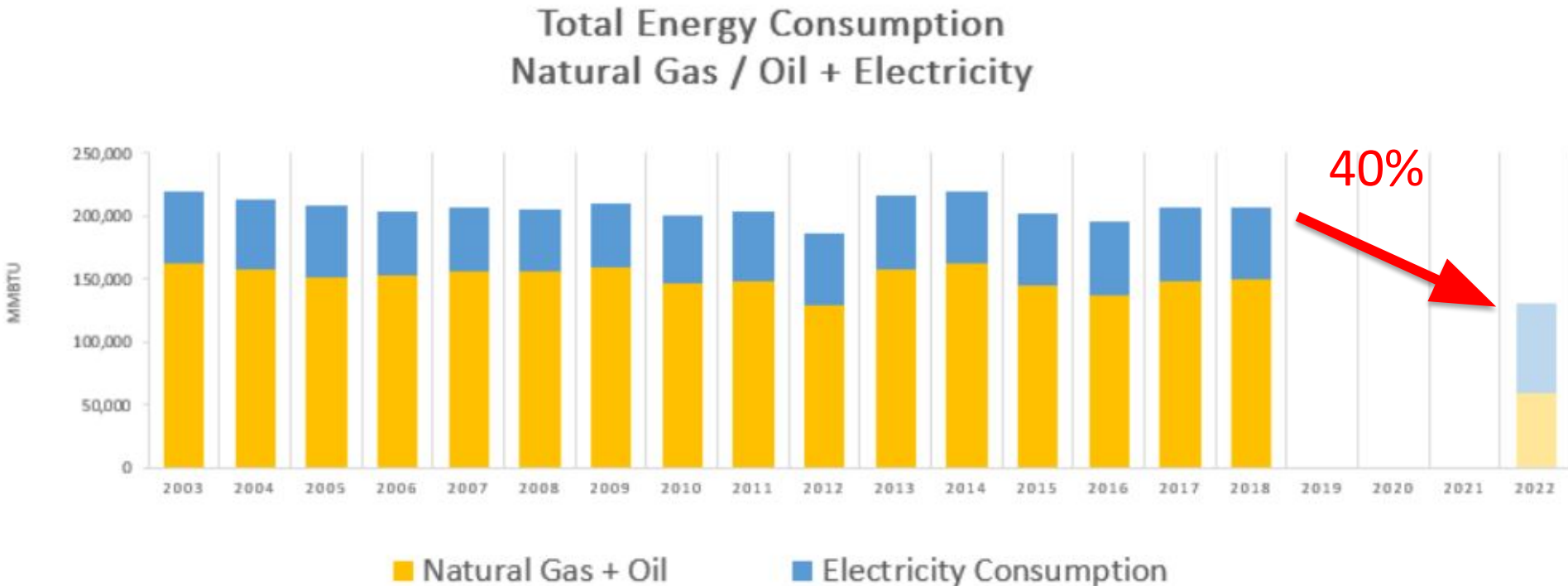
Utility costs will be  
slightly reduced  
*(less gas \$, more electricity \$\$\$)*

Maintenance Cost



Operating costs will be  
significantly reduced  
*(no more 24/7/365 operation)*

# Reduced Energy Consumption



By recovering and “repurposing” energy, the heat pump will help reduce central plant energy consumption by ~40%.



# FY20 Energy Outcomes

vs. 3-year average (FY17- FY19)

Main Campus Utilities		
	COST	USE
NATURAL GAS	-53%	-44%
ELECTRICITY	+9%	+9%
TOTAL ENERGY	-13%	-28%



New stack (left), old stack (right)

# Future System Flexibility



SOLAR THERMAL



CONDENSING BOILERS



HEAT PUMPS

Hot water works with efficient and emerging technologies



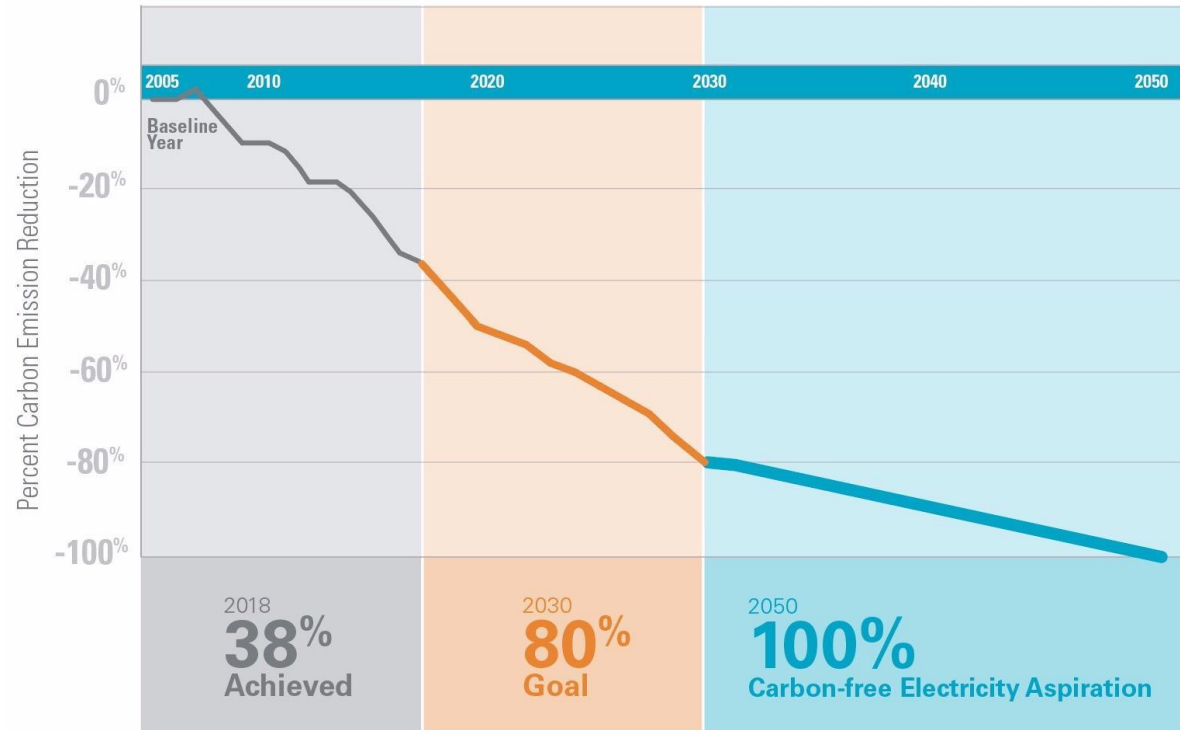
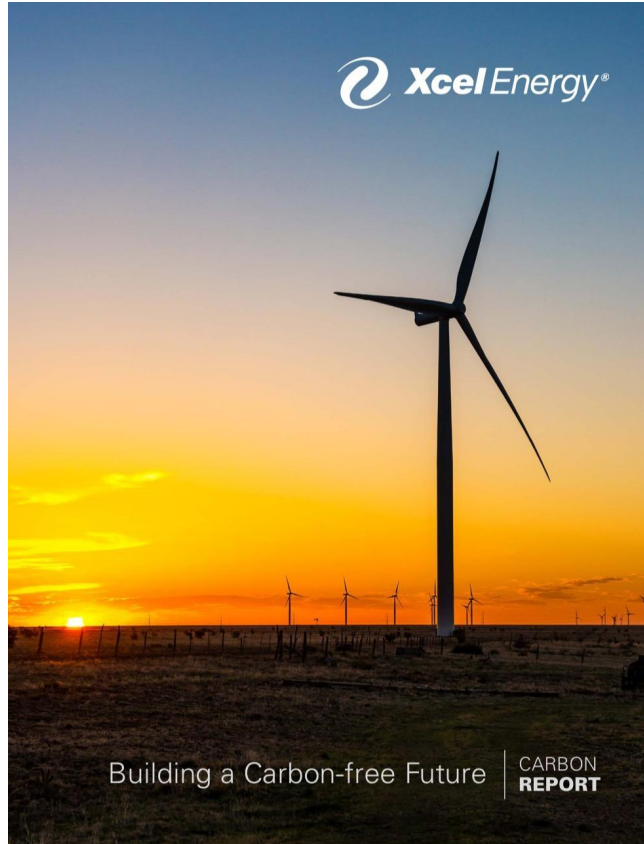
# Strategic Electrification



Lots of pumps & compressors = less gas, more electricity.



# Strategic Electrification



Electricity is easier to address with renewable energy sources and rapidly becoming much less carbon intense.

# STUDENT / FACULTY INVOLVEMENT

## Student engagement and research opportunities



Soil Samples  
Emma Link ('18) and Drilling Foreman



Geophysical Data Gathering  
MN Geological Survey





## Soil Sample Display

Emma Link ('18), Geology Major and Sustainability Assistant





## Geology / Physics Research

Installing 520 ft. deep fiber optic cables to measure temperature in four bores





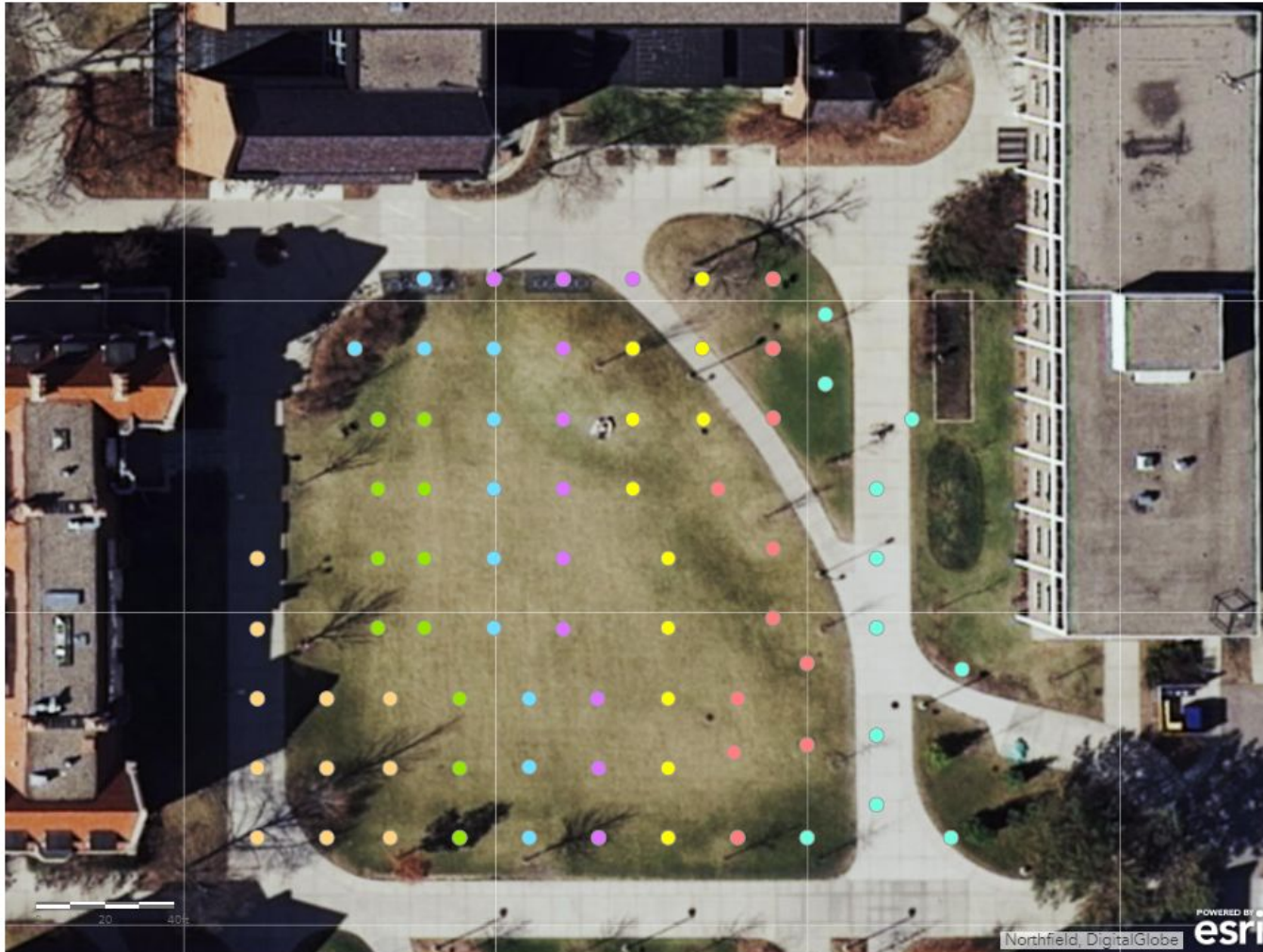


## Summer 2018

Carleton geology students taking soil samples and swapping stories with the drilling contractors



## Mini Bald Spot Bore Field



GIS Lab bore field mapping, Mini Bald Spot







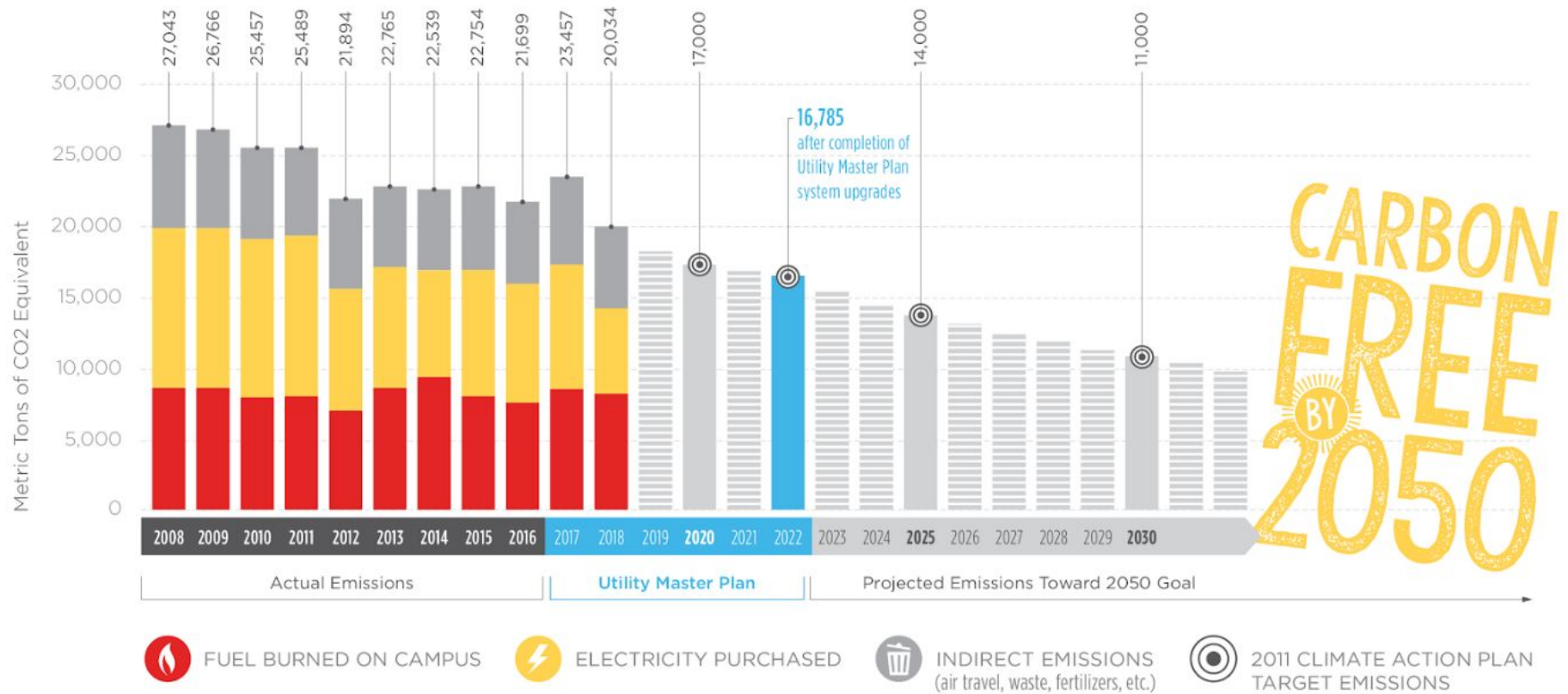


“Running out of Steam” ice cream party - May 2019



# Still a long way to go...

## GROSS EMISSIONS PROJECTIONS



# What's next?

