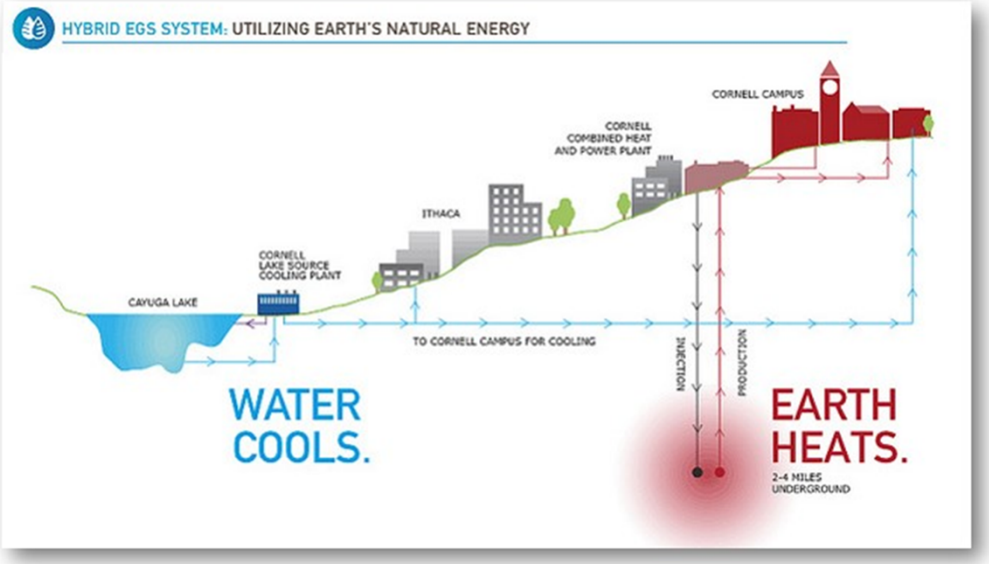
Cornell Energy Goals and Standards

November 29, 2018 PMT

Steve Beyers
Mark Howe
Vincent Knapp

Agenda

- Into to Cornell energy: *we're different*
- Cornell's path to carbon neutrality (and what that means for your design team)
- PAR requirements and what is the PM's role?
- Cornell design standards and details



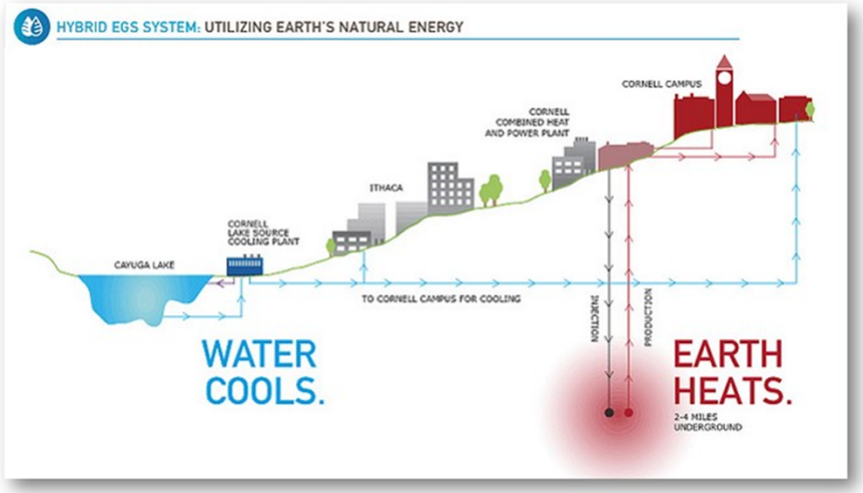
Cornell Energy Goals and Standards:

Cornell's Path to Carbon Neutrality

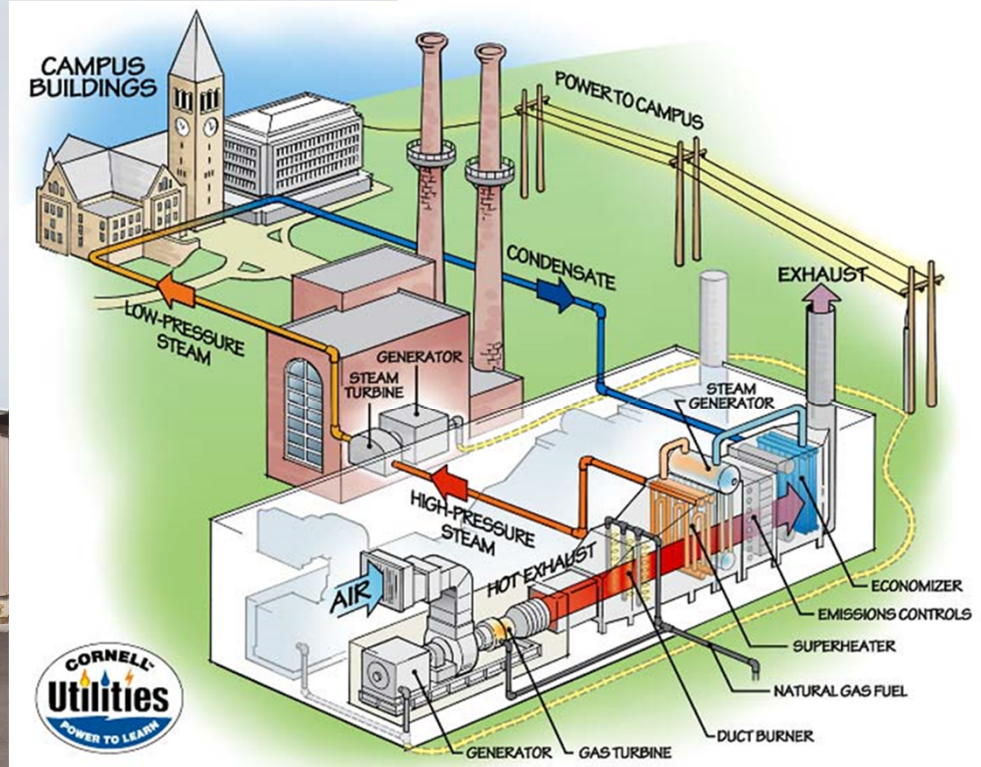
Steve Beyers
Manager
FCS Civil and Environmental Engineering

Cornell is different – *and changing*

- District Energy: Electricity, water, heat, and cooling "district" utilities, owned and operated by Cornell
- Unique and extraordinary:
  - Lake Source Cooling
  - Combined Heat and power.
- Cornell's systems, standards, and requirements *are changing* as the campus steps up renewable energy integration

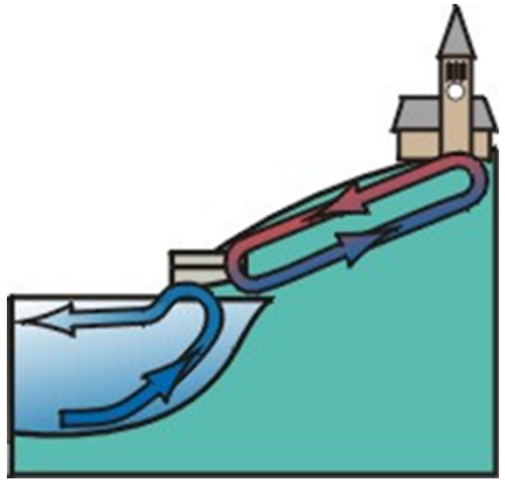


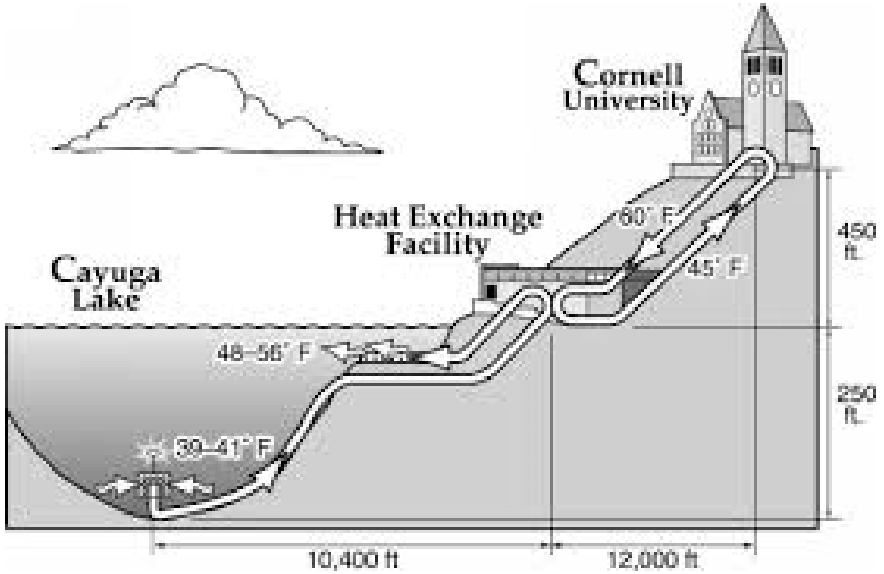
Cornell's Central Energy Plant (Combined Heat & Power)

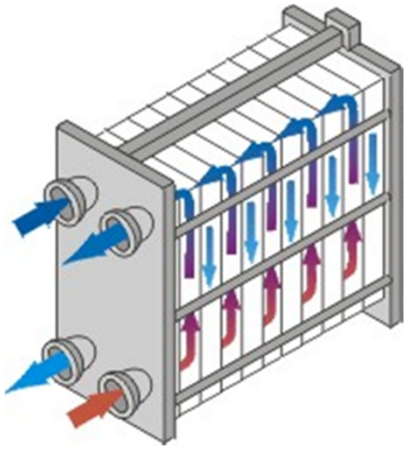


Combustion Turbine with Heat Recovery Steam Generator

Lake Source Cooling implemented over 17 years ago – campus-wide central cooling with an effective COP of >25!



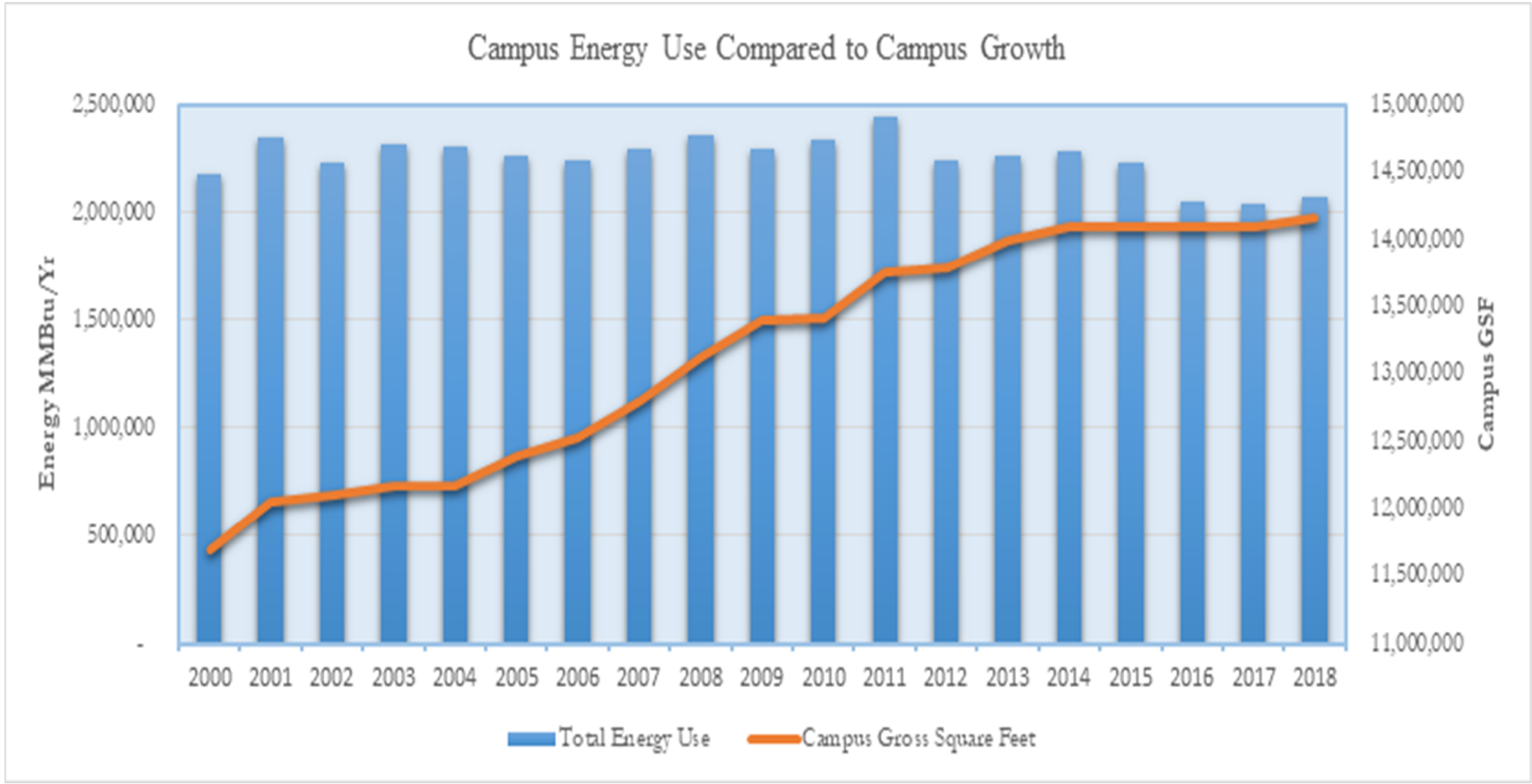




Unique and *Extraordinary* Cornell Utilities

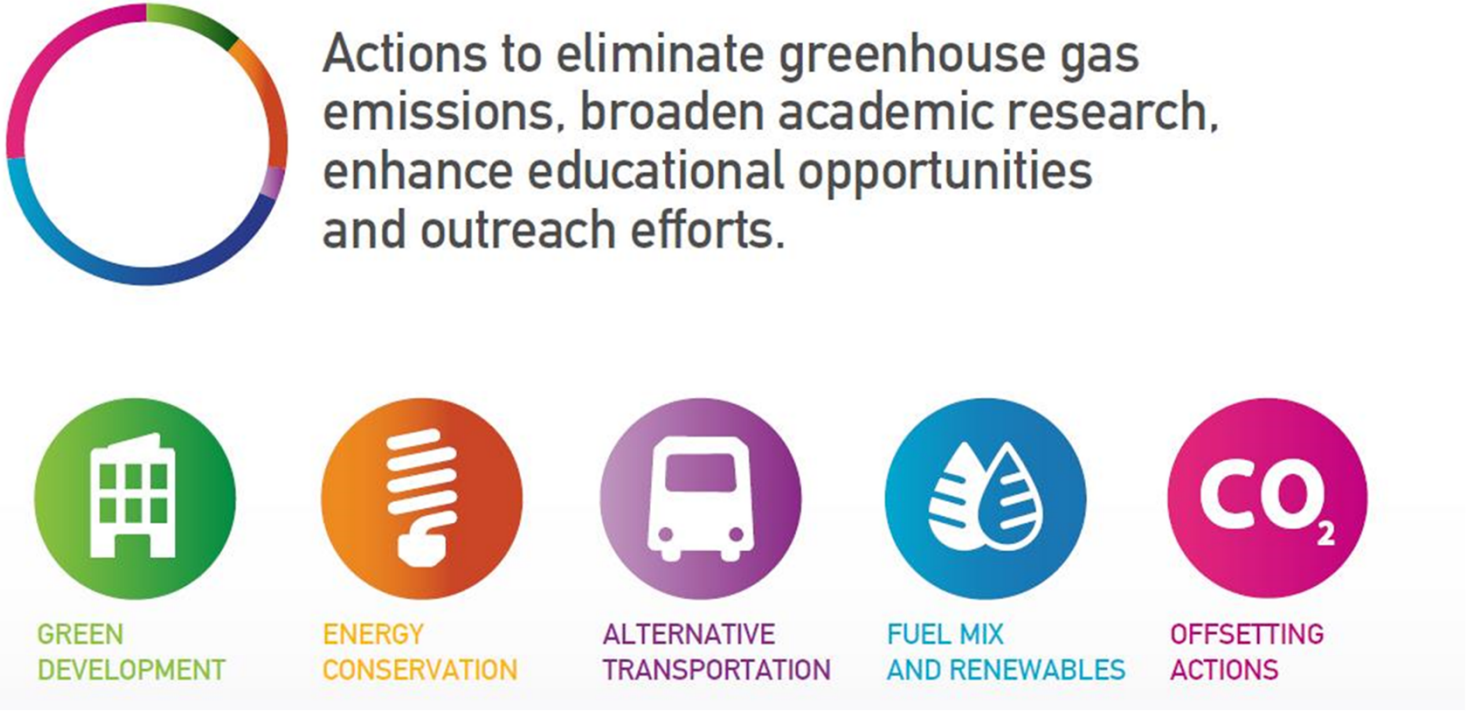
- Why is **Lake Source Cooling** unique?
  - Superior performance to **any** other option: Needs only a fraction of the energy of an efficient heat pump, and **no refrigerants**
  - Lake Source provides **>20 times** the cooling energy of the input electric energy (Coefficient of Performance: COP > 20)
- Why is **Combined Heat and Power** extraordinary?
  - Efficient, campus-produced power: reduced transmission losses
  - Heat produced as a by-product of the electricity generation heats campus -- annually ~**90% of campus heat is "repurposed waste"** (~10% supplemental boilers)

Demonstrated success: Growing the campus without growing energy use

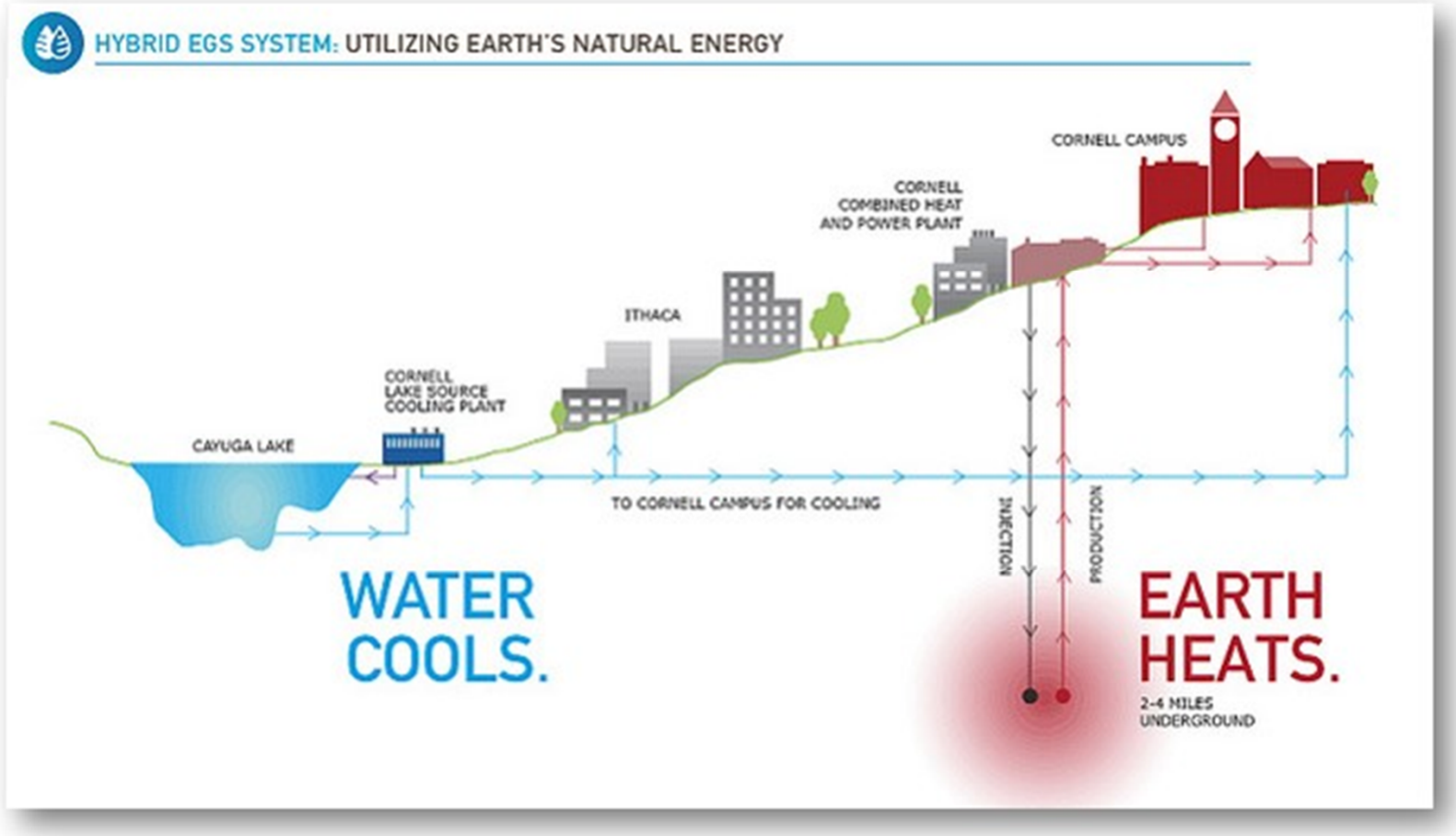


Development within a Campus-Wide Energy and Sustainability Approach

Cornell's detailed campus-wide Climate Action Plan (CAP): reduce or offset *all* Greenhouse Gas emissions



Earth Source Heat & Renewable Electricity: A long-range vision to “get off gas” by 2035



Future Infrastructure: Pre-Insulated Hot/Chilled Water Piping & Heat Exchangers (no steam!)

Sample Photos of Pre-insulated Hot Water Piping –
U of Rochester, N. Europe sites

Future Infrastructure Connection: Hot Water/Chilled Water Heat Exchangers

These compact systems easily replace former steam convertors, boilers, furnaces, or chillers (with room to spare)

Photo from U. of Rochester (recent steam to hot water conversion)

Cornell Energy Goals and Standards:
PAR requirements & The PM's Role

Mark Howe
Director
Utilities Distribution and Energy Management

PM Role: Inform and Enforce

1. All campus projects to meet **low energy use standards**
    1. Specific project-by-project energy targets (CEUIs)
    2. ~30% less energy than State energy code proven by modeling
    3. Metering and modeling to ensure performance
2. Most Ithaca campus projects will tie into Cornell's District electric, water, heat, and cooling
3. Document energy performance through analysis and commissioning as part of third-party LEED review and certification
4. Design for lower temperature heat, even for existing building mods.

PM Responsibilities

- New processes for project development and initiation will be completed by the UA's office in concert with Utilities, FE and campus partners.
- The PM will:
  - Receive data as part of intake paperwork and will be responsible for ensuring that the designers are working towards the intended goals for energy savings.
  - Revise spreadsheets as the design completes and must be able to document if and why target goals have changed or not been met.
  - Will follow up during commissioning and the 9 month post occupancy walkthrough to validate success of construction in meeting EUI and ECM commitments.

Tiered approach for Implementation

- **Projects < $2M**: **Not mandated**, but energy conservation measures (ECM) **are to be considered** when developing the project Basis of Design (BOD).

- **Projects $2M-$5M**: Projects are **to seek EUI goals** in alignment with the High Performance (HP) requirements identified in the Cornell design standards for affected building systems. Projects must justify if identified ECM's to meet the HP requirement are not being pursued.

- **Projects > $5M:** Projects **are required** to pursue EUI goals in alignment with the High Performance (HP) requirements as identified in the design standards for affected building systems.

In all cases, the Project Plan and Design Phase PARs are to define the goals and the Construction Phase PAR is to compare the original project goals with the completed design

PAR Changes / Requirements

- Qualitative and quantitative analysis of the energy performance for proposed project.
- Ensuring that cost effective energy conservation measures are incorporated into scopes of work, and that future spaces are compatible with a carbon neutral campus by 2035.
- Reducing the need for new sources of renewable energy, reduce long-term life cycle costs, and reduce wear and tear on the campus energy infrastructure.
- Allows Cornell to be ahead of the ongoing efforts of the Town and City of Ithaca's implementation of Green Building Guidelines into their own Code. These changes will directly impact all permitted work completed on campus

Project Data section- scope of work

PROJECT DATA

Scope of Work:

The Energy Use Intensity target for this project is _____ (kBtu/gsf-yr). (Provide text as described in PAR guidelines narrative requirements.)

Narrative Requirements:

Identify, evaluate, and document Energy Conservation Measures (ECMs) considered during the development and refinement of the project's Scope of Work and "Basis of Design (BOD)." Define the Energy Use Intensity (EUI) target for the project. All projects that affect a building system including passive envelope features are required to complete this section. Projects that do not affect building systems or the envelope are to respond "Not Applicable". Reference the Cornell Design Standards for the EUI targets using campus metered energy utilities at the buildings for High Performance requirements. (Cornell Design Standards: 08110, 018120, 01830).

PAR: EUI "Energy Use Intensity" Resources

- Energy and Sustainability:
  - **Mark Howe** (607) 255-1523
  - **Cole Tucker** (607) 255-7031
- Mechanical:
  - **Elizabeth Kolacki** (607) 255-9650
  - **Tom Jordan** (607) 255-9728
  - **Vince Knapp** (607) 255-7364
- Civil, Environmental and Utilities
  - **Steve Beyers** (607) 255-5491
  - **Matt Kozlowski** (607) 255-3029
  - **David Frostclapp** (607) 254-2954
- Electrical:
  - **Erich Reichard** (607) 255-3934

Operating & Maintenance Costs

OPERATING AND MAINTENANCE COSTS

CHANGES IN OPERATING AND MAINTENANCE COSTS							
	Custodial	**Utilities**	**Planned Maintenance**	**Routine & Preventive Maintenance**	**Grounds**	**Safety and Compliance**	**Total**
Endowed	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Department	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Contract Colleges	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
TOTAL	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0

Changes to Utility Costs:

Complete the utility column in dollars using the EUI goals and modeled values provided above clearly state why energy and water/sewer costs are increasing or decreasing with a before and after EUI total. Please contact Facilities Engineering for existing EUI per facility, and for the current Utility rates.

PAR: Operating and Maintenance Resources

– **Cynthia Lockwood**	**Custodial:**	**(607) 255-1471**
– **Jeff LaPar**	**Utilities:**	**(607) 255-8425**
– **Jeff Parsons**	**Planned Maintenance:**	**(607) 255-4297**
-- **Jessie Wells**	**Routine & Preventative Maintenance:**	**(607) 379-0718**
– **Dan Schied**	**Grounds:**	**(607) 254-1655**
– **Tim Fitzpatrick**	**Safety and Compliance:**	(607) 254-4482

PAR: Space Usage Resources

SPACE USAGE

A. Net Square Feet Involved:

Room Type	Codes	Current	After Project
Unclassified	010-081	984	984
Classrooms	110-135		
Laboratories – Instructional	210-247		
Laboratories – Research	250-273	4,626	4,626
Office Facilities	310-355		
Study Facilities	410-455		
Special Use Facilities	510-585		
General Use Facilities	610-690	380	380
Supporting Facilities	710-760		
Health Care Facilities	810-895		
Residential Facilities	910-970		
	TOTAL		

B. Change in Gross Square Footage, if any:

Current	After Project

Space Usage:

Jane McCarty (607) 254-4754

Operating Energy Use and CO2 Emissions

Operating Energy Use and CO_2 emissions				
	Energy Use Intensity (EUI) Goal (kBtu/gsf-yr)	Peak Demand (klb/hr, tons, kW)	Annual Use Heating: klb Cooling: ton-hr Electric: kWh	Resultant CO_2 emission (tons/year)
Heating				
Cooling				
Electricity				
Total				

Assess the overall energy use of the proposed scope and evaluate the impact of the proposed ECM(s) quantitatively by filling out the Energy Use Table.

Energy Use Intensity (EUI): Complete the values for metered total, heating, cooling, and electricity.

Peak Utility Demand: Provide peak demand goals for each utility affected by the project to allow for planning new central plant generating capacity.

Resultant CO2 Emissions: Calculate the projected carbon emissions impact by multiplying each energy use by the Cornell carbon intensity factor, provided in our Design Standards.

Cornell Energy Goals and Standards:
Cornell Design Standards and Details

Vincent Knapp
Manager
FCS Mechanical Engineering

Campus Design Standards:
Cornell Energy Use Intensity (CEUI)

1. Laboratories 150 kbtu/gsf/yr
2. Office and classrooms 50 kbtu/gsf/yr
3. Residence halls 50 kbtu/gsf/yr

*These targets represent **total metered energy inputs** (chilled water, steam, electricity, and natural gas) for building heating, cooling, ventilation systems, service water heating, lighting, receptacle loads, and process energy use.*

Translation: ***These CEUIs are HARDER TO MEET than EUIs that the consultant is used to (with the same numerical value).***

New Campus Design Standard: designing for low/no carbon future

- Cornell's **new campus design standard** – comfortable heat using lower temperature water (**130°F** vs 180°F) – and **100°F** return
- Distribution pipes will carry **hot water, not steam** (cheaper, safer)

New Campus Design Standard: designing for low/no carbon future

- Why lower temperatures?
  - **Distribution losses are lower; distribution capital costs are lower**
  - **Earth Source Heat becomes viable**. The amount of energy produced by a geothermal well is directly proportional to the temperature differential
  - **Creating a host of other conservation and renewable opportunities** (integrate ESH, biomass/waste heat, solar HW, ASHPs, GHPSs, etc.)

FACILITIES
AND CAMPUS SERVICES

2018 Design and Construction Standards

Click on a heading to expand the list.

Design Standards

SECTION #	SECTION NAME	DATE REVIEWED	DATE REVISED
DIVISION 1: GENERAL DESIGN REQUIREMENTS			
011110	ENVIRONMENTAL HEALTH AND SAFETY GUIDELINES	08-09-16	08-09-16
013000	SPACE PROGRAMMING REQUIREMENTS	08-31-17	08-31-17
013010	ACCESSIBILITY FOR PEOPLE WITH DISABILITIES	06-30-15	06-30-15
013011	INCLUSIVE RESTROOM AND LOCKER/ SHOWER FACILITIES	12-08-17	12-08-17
013012	COLLABORATIVE SPACES	06-30-17	06-30-17
013013	LACTATION ROOM (MOTHERS' ROOM)	06-30-17	06-30-17
013014	CUSTODIAL REQUIREMENTS	06-30-15	06-30-15
017839	STRUCTURAL RECORD DOCUMENTS	06-30-17	06-30-17
018000	STANDARD PRACTICE BLDG ENVELOPE COMMISSIONING	06-30-15	06-30-15
018110	GREEN BUILDING GUIDELINES	11-16-17	11-16-17
018130	ENERGY MODELING GUIDELINES	11-16-17	11-16-17
	APPENDIX A LEED MODELING GUIDANCE	11-16-17	11-16-17
	ENERGY MODEL TEMPLATE	11-16-17	11-16-17
	LIFE CYCLE COST ANALYSIS	11-16-17	11-16-17
	TREATMENT OF DISTRICT OR CAMPUS THERMAL ENERGY	08-13-10	08-13-10
DIVISION 2: EXISTING CONDITIONS			
DIVISION 3: CONCRETE			

DIVISION 10: SPECIALTIES

DIVISION 11: EQUIPMENT

DIVISION 12: FURNISHINGS

DIVISION 13: PETROLEUM TANKS

DIVISION 14: ELEVATORS

DIVISION 21: FIRE PROTECTION

DIVISION 22: PLUMBING

DIVISION 23: HVAC

230000	BASIC HVAC REQUIREMENTS	01-29-16	01-29-16
230500	HVAC BASIC MATERIALS AND METHODS	06-30-17	06-30-15
230510	CHILLED WATER SYSTEM	06-30-17	06-30-15
230520	HEAT GENERATION	03-02-17	03-02-17
230523	VALVES	01-29-16	01-29-16
230530	CLEAN STEAM GENERATION	08-09-16	08-09-16
230540	LABORATORIES	06-30-17	06-30-17
230700	HVAC INSULATION	01-29-16	01-29-16
230900	BACS GUIDELINES	06-30-15	06-30-15
230901	BUILDING AUTOMATION & CONTROL SYSTEM COMMUNICATIONS & INTEROPERABILITY	06-30-15	06-30-15
231300	PETROLEUM TANKS	08-09-16	08-09-16
232300	REFRIGERATION	06-30-17	06-30-17
232500	HVAC WATER TREATMENT	01-29-16	01-29-16
233100	AIR DISTRIBUTION	08-09-16	08-09-16
234100	AIR CLEANING DEVICES AND FILTERS	06-30-15	06-30-15
237300	AIR HANDLING	03-02-17	03-02-17
238216	COILS	06-30-17	06-30-15

DIVISION 26: ELECTRICAL

DIVISION 27: COMMUNICATIONS

DIVISION 28: ELECTRONIC SAFETY & SECURITY

Standard Details

1.0 CIVIL/LANDSCAPING

1.1 Lawns:
1.2 Plantings:
1.3 Curbings:
1.4 Pavements:
1.5 Walks:
1.6 Stairs:
1.7 Foundation Drainage:
1.8 Miscellaneous:

2.0 Electrical

2.1 Power:
2.2 Lighting:
2.3 Grounding:

3.0 MECHANICAL

3.1 Chilled Water:
3.2 Steam:
3.3 Refrigeration:
3.4 General:
3.5 BACS, General:
3.6 BACS Device Control Points:
3.7 BACS Zone Controls:
3.8 BACS Central System Controls:

4.0 Utilities

2.1 Power:

2.2 Lighting:

2.3 Grounding:

3.0 MECHANICAL

3.1 Chilled Water:

3.2 Steam:

3.3 Refrigeration:

3.4 General:

3.5 BACS, General:

3.6 BACS Device Control Points:

3.7 BACS Zone Controls:

3.8 BACS Central System Controls:

4.0 Utilities

4.1 Chilled Water:

4.2 Steam:

4.3 Steam Vault:

4.4 Sanitary and Storm Sewers:

4.5 Water:

4.6 Water:

4.7 Non Conductive Utilities:

5.0 Reserved

6.0 Communications

6.1 Equipment Closets - Incorporated into details listed below


Questions?