

# Cornell University Lake-Source Cooling and Geothermal Heating System

An aerial photograph of the Cornell University campus during autumn. The central focus is the tall, brick clock tower with a blue, diamond-patterned roof. The surrounding area is filled with trees in various shades of orange, yellow, and green. In the background, a large body of water is visible under a clear blue sky. The text 'Cornell University' and 'Lake-Source Cooling and Geothermal Heating System' is overlaid at the top in white.

October 24<sup>th</sup>, 2019  
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# Presentation Outline

1. Cornell University Energy Needs
2. Heat Demand in Eastern U.S.
3. Climate Action Plan
4. Current and Future Campus Energy Infrastructure
5. Lake-Source Cooling System
6. Combined Heat and Power Plant
7. Earth-Source Heat System

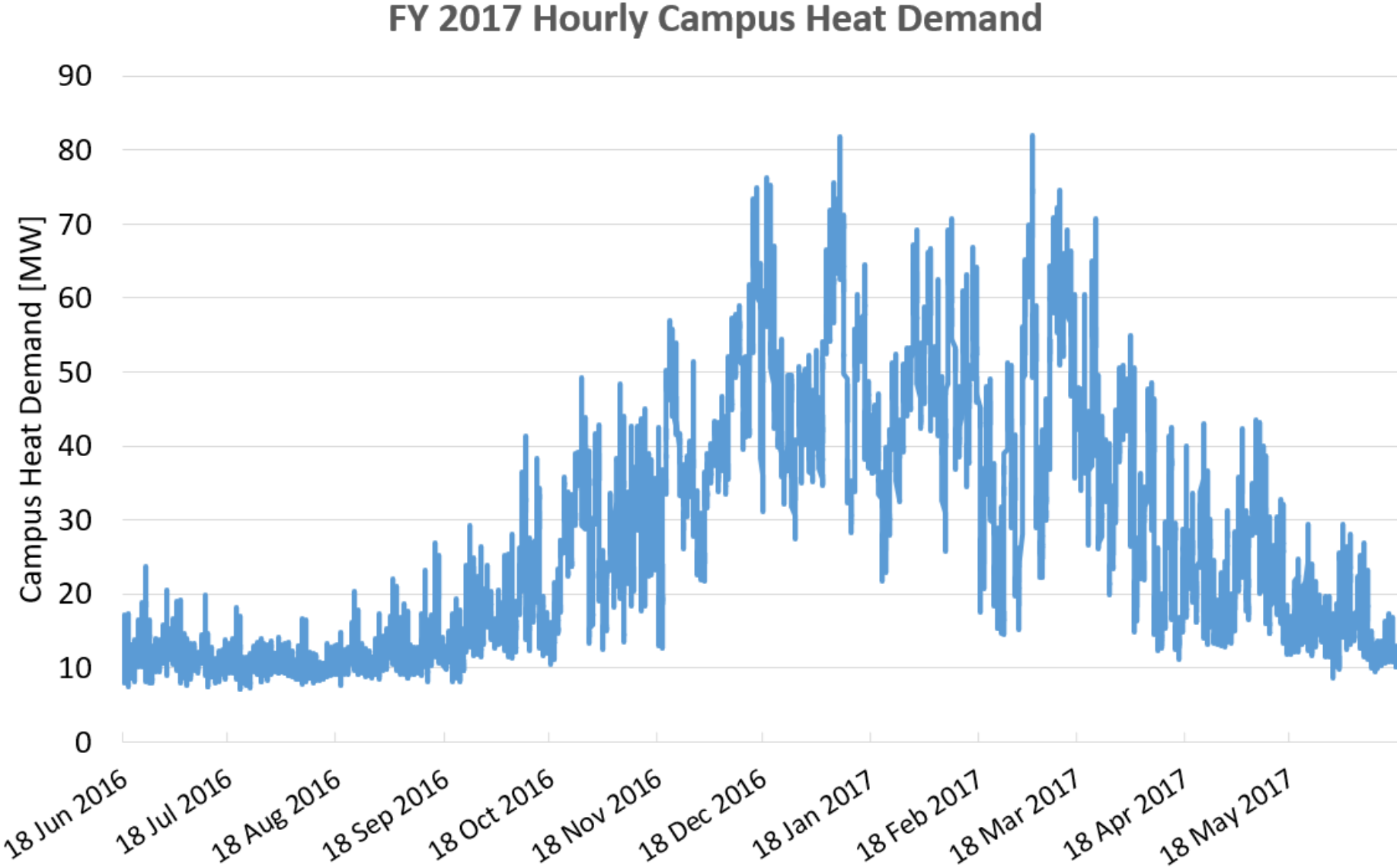
# Cornell University Energy Statistics

- Main campus located in Ithaca, NY
- 33,000 student, faculty and staff
- 2018 Energy Needs:

	Peak	Aver	Min
Electric ( $MW_e$ )	35	22	20
Heat ( $MW_t$ )	90	28	8
Chilled Water ( $MW_t$ )	90	16	11

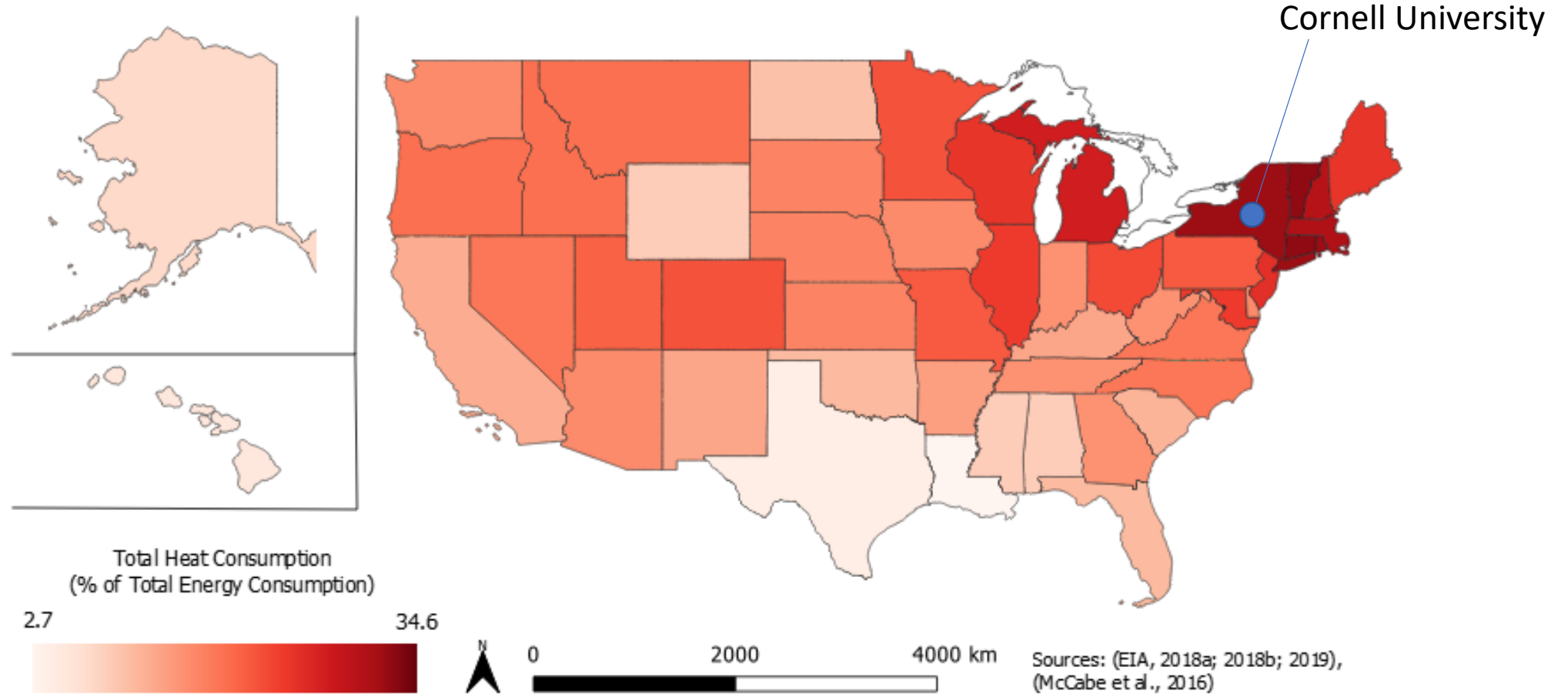


# Campus heat demand concentrated in winter

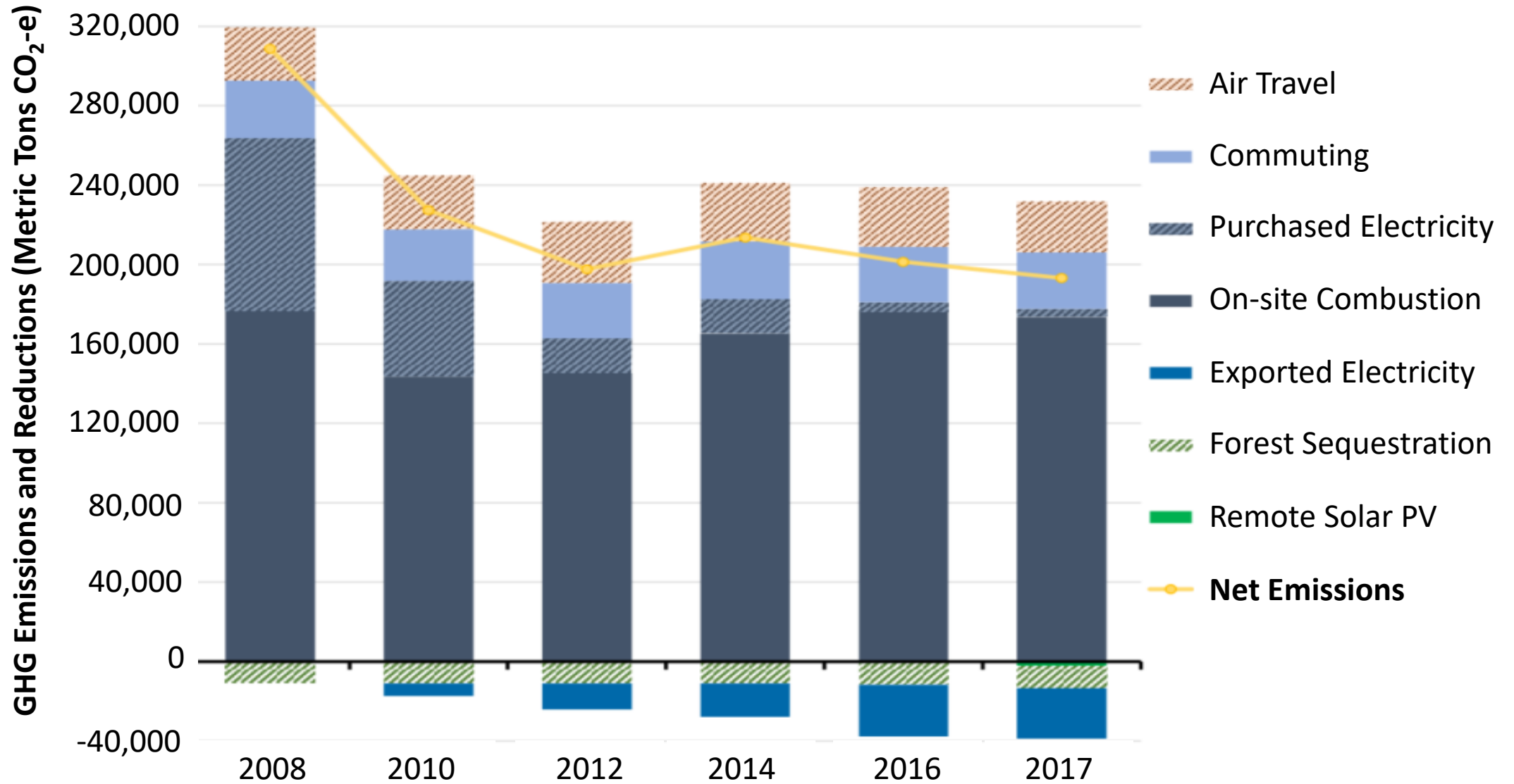


# Significant Heat Demand in Eastern U.S.

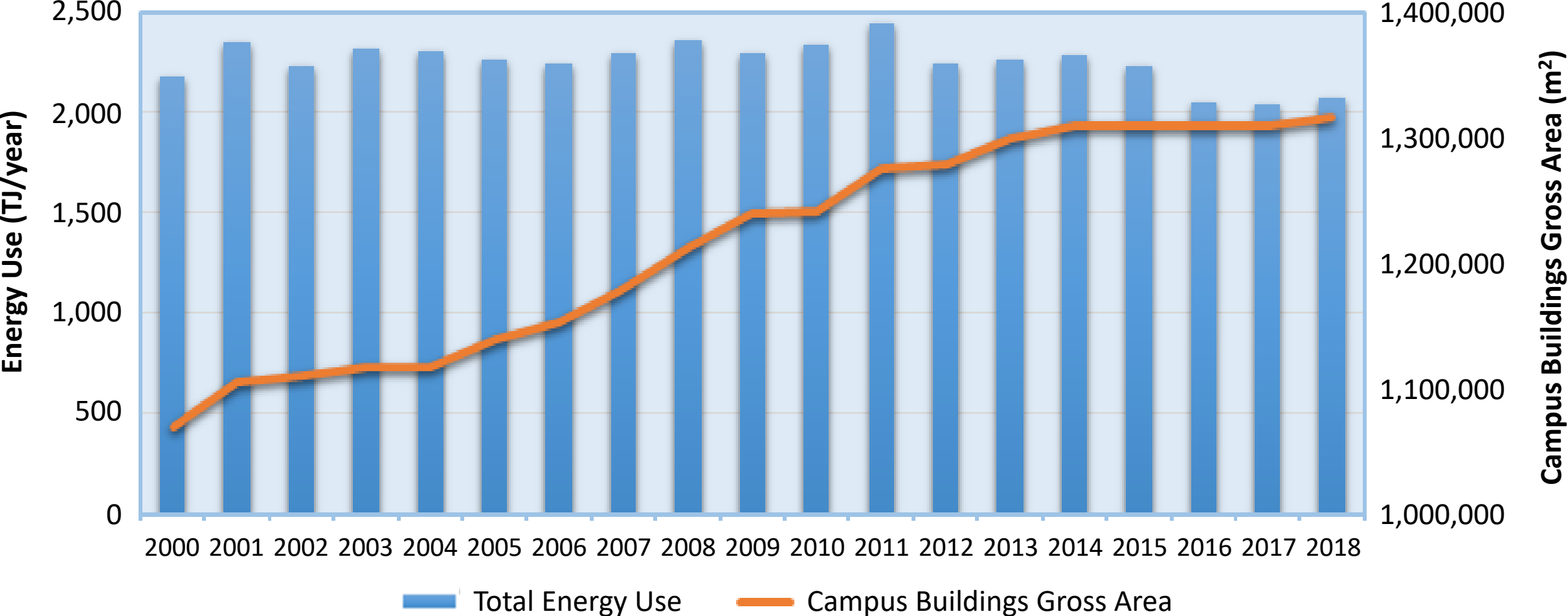
2016 U.S. Heat Consumption in Residential, Commercial, Manufacturing and Agricultural Sector



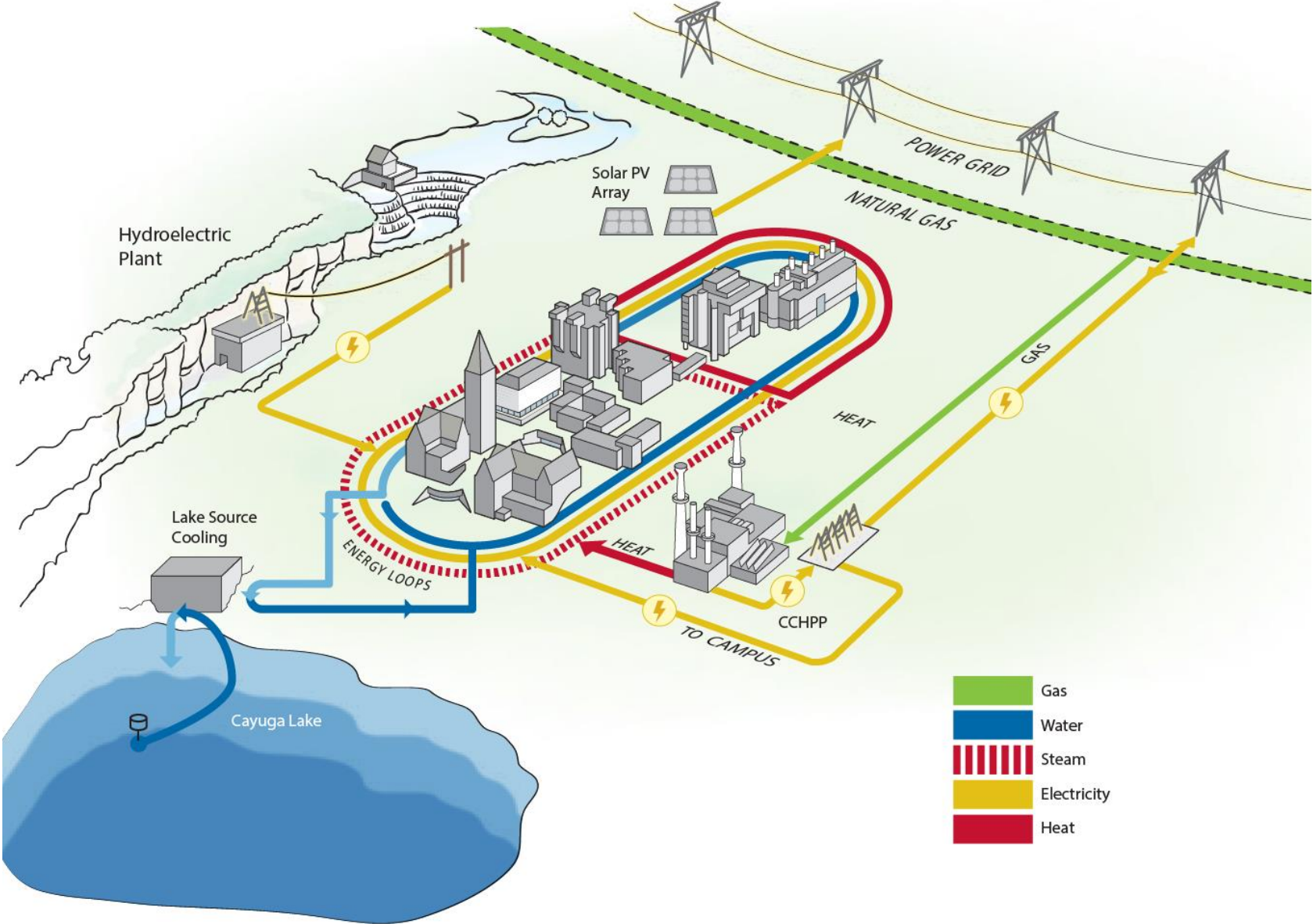
# Cornell University targets climate neutrality by 2035 with Climate Action Plan



# Steady Campus Energy Use Despite Campus Growth

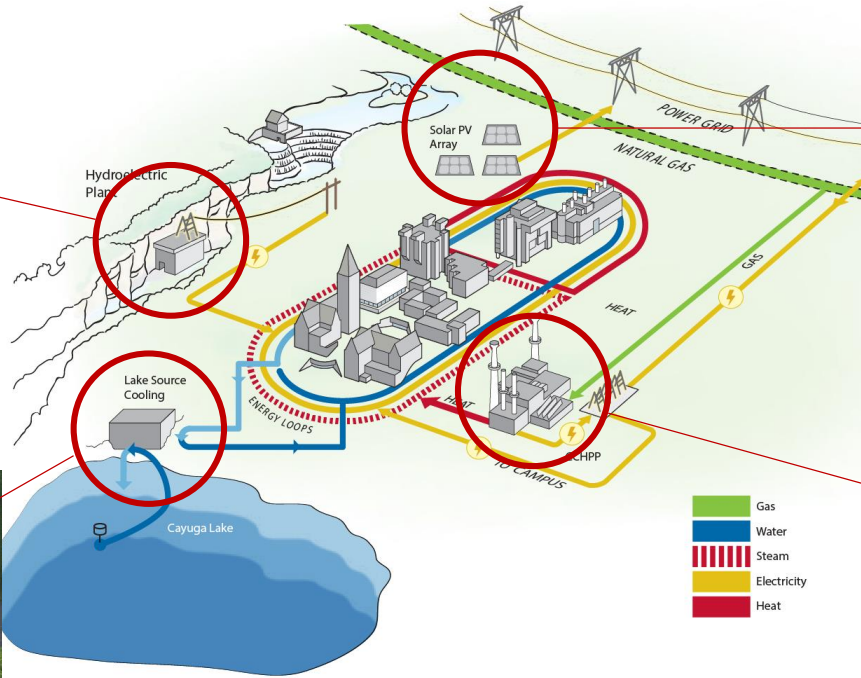


# Existing Cornell University Campus Energy Infrastructure



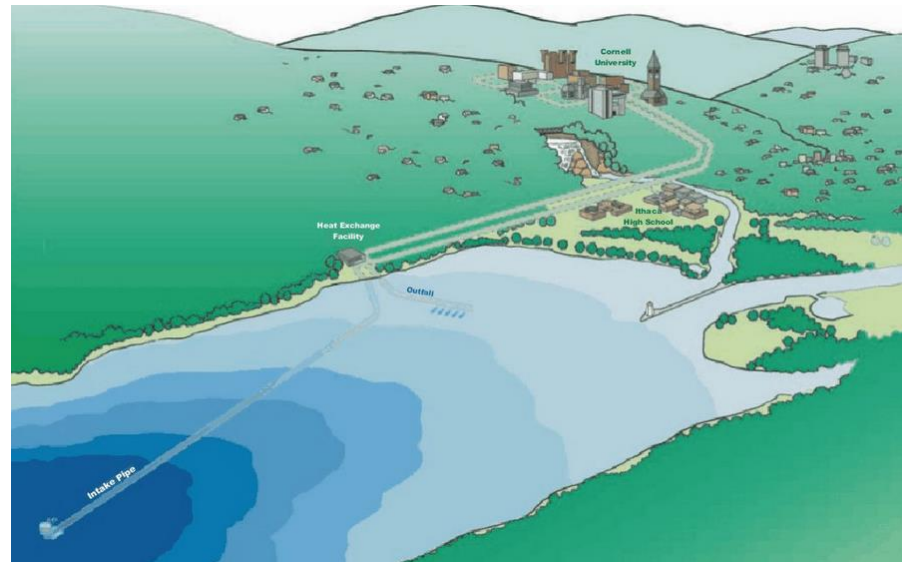
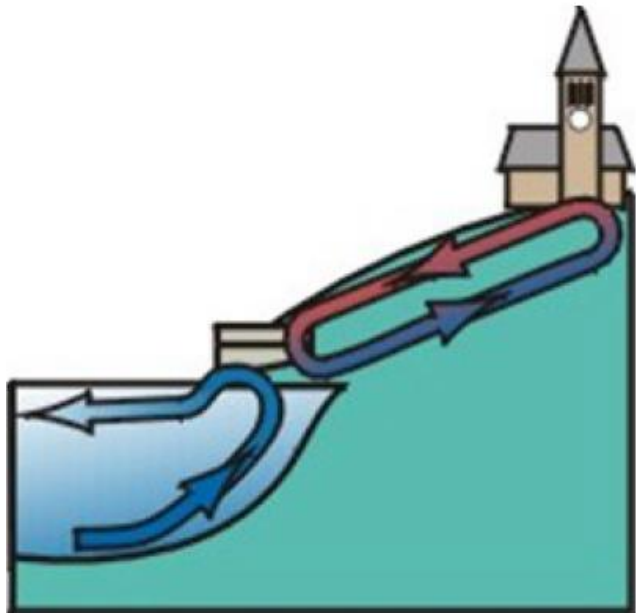


# Existing Cornell University Campus Energy Infrastructure



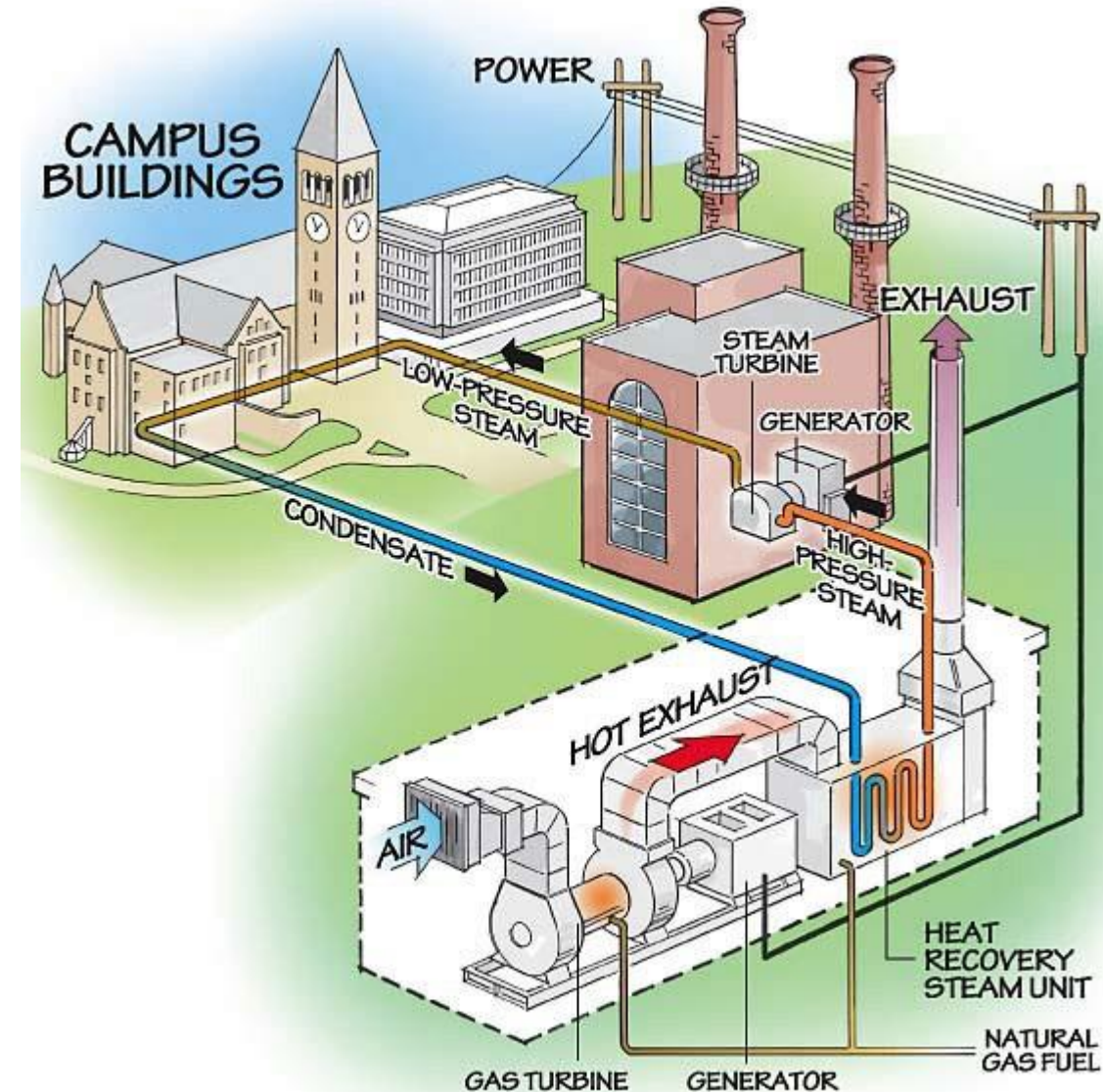
# Lake-Source District Cooling System

- Provides 98% of chilled water for campus
- Operates at COP of 25+
- Reduces summer electrical load by 10 MW<sub>e</sub>
- Cold water extracted at 4°C at 76 m depth and reinjected around 11°C near surface
- Negligible thermal impact on Cayuga Lake

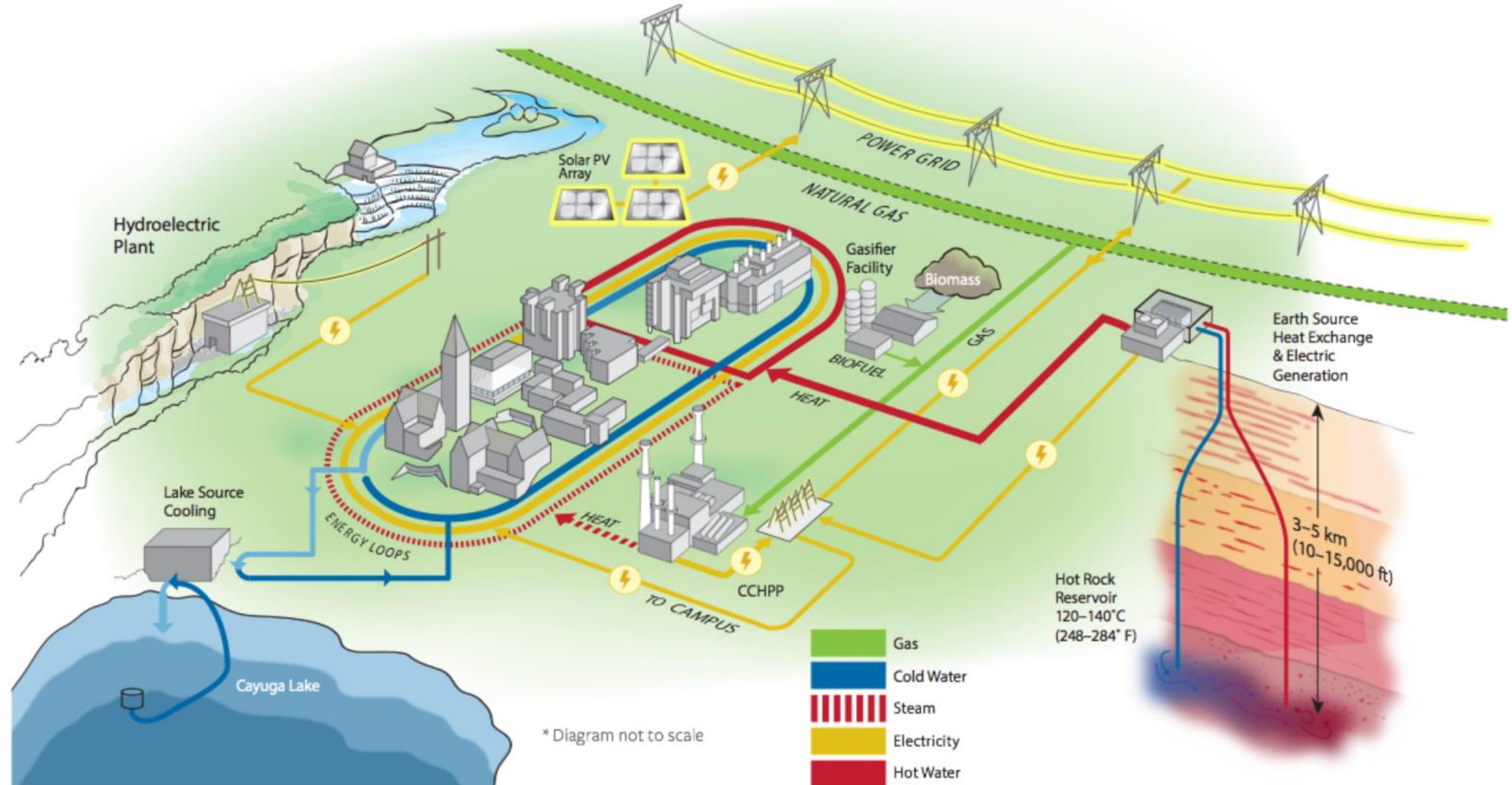


# Combined Heat and Power (CHP) Plant

- Natural gas CHP commissioned in 2009
- 2 x 15 MW<sub>e</sub> gas turbine generator sets
- Provides 90% of campus heating
- 2018: ~270,000 MWh of electricity and ~260,000 MWh of heating

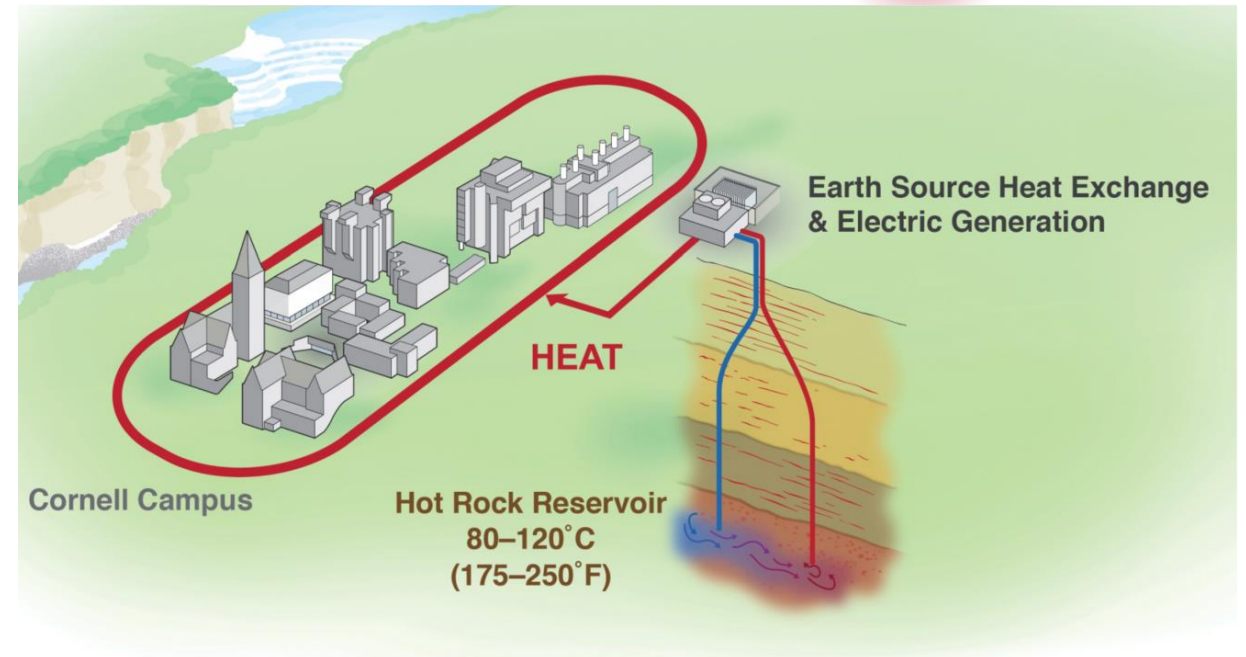
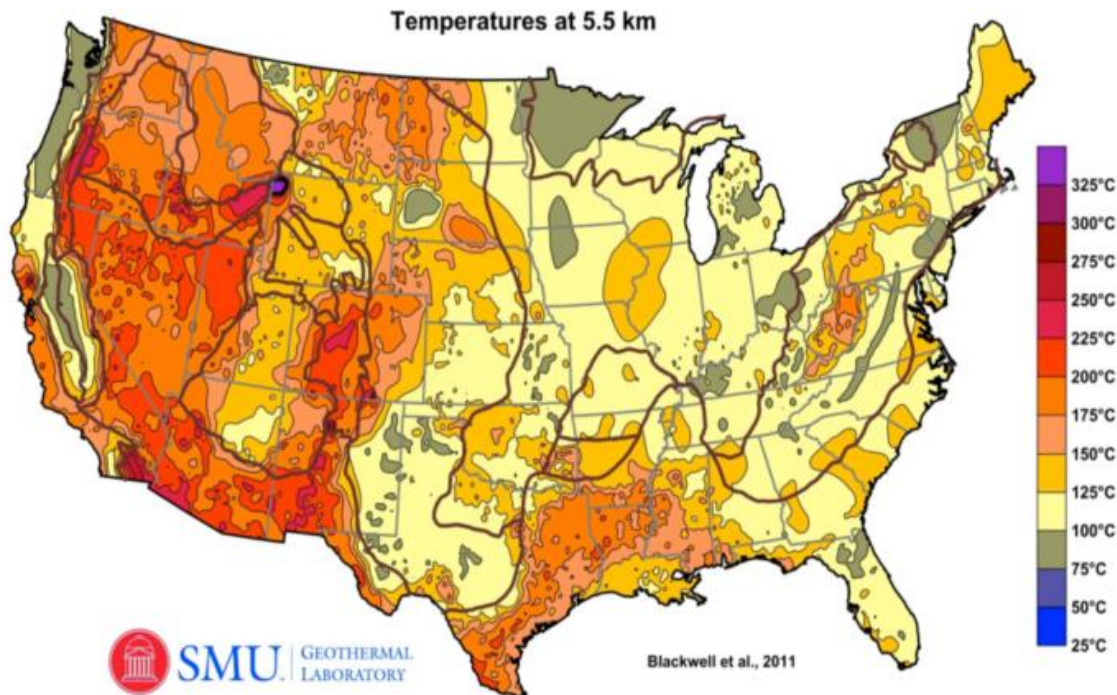
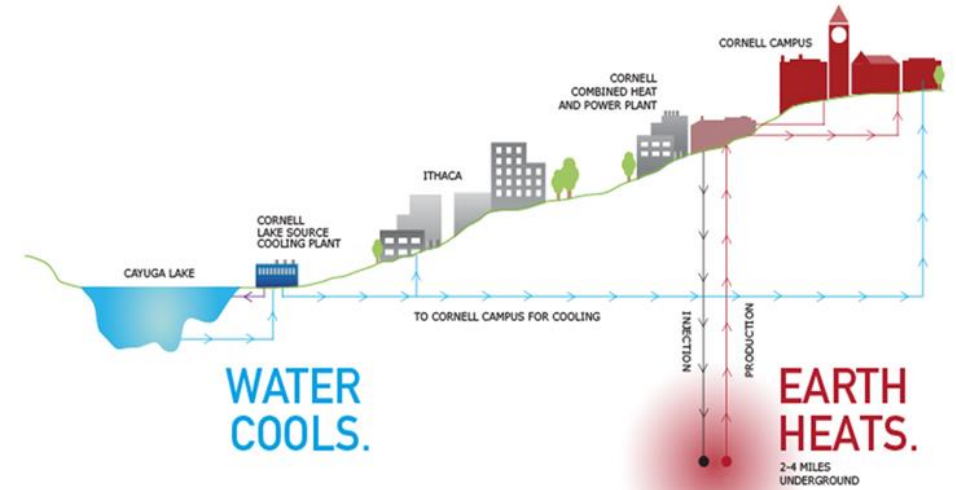


# Future Cornell University Campus Energy Infrastructure

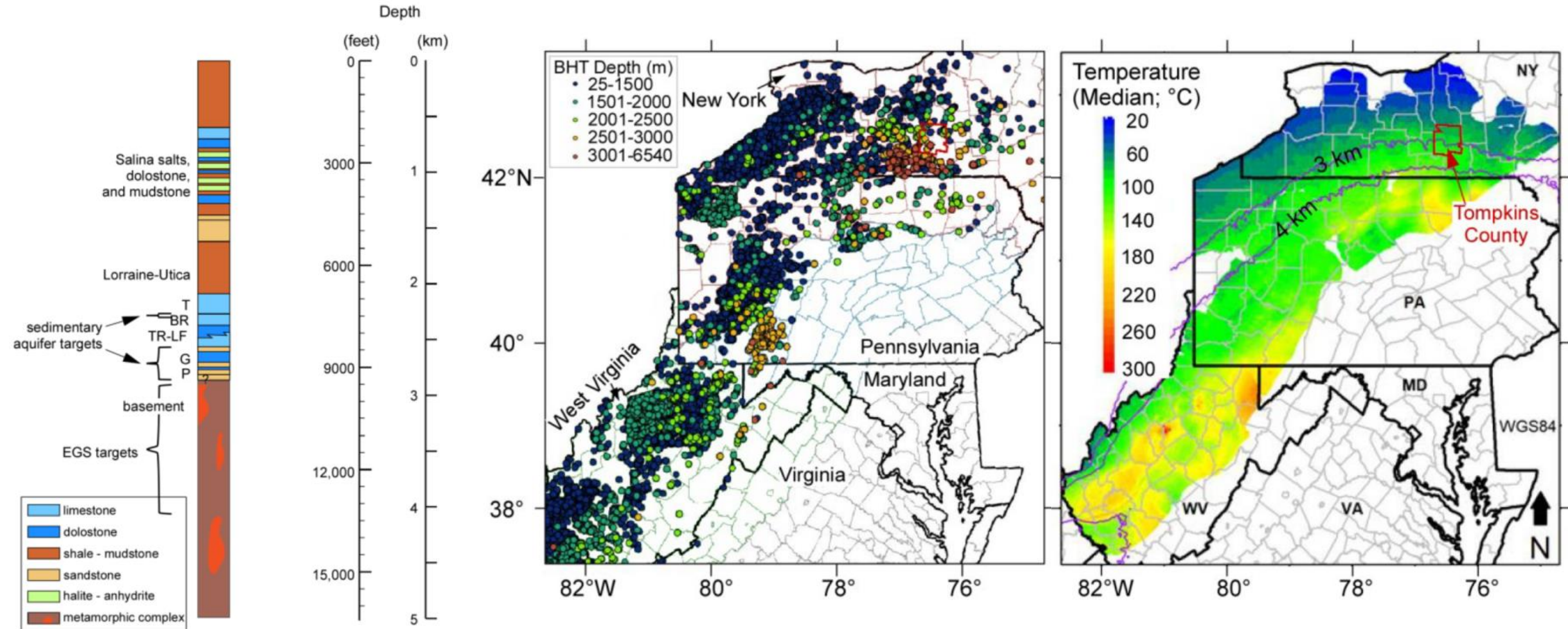


# Cornell University Earth-Source Heat Project

- Provide baseload heating to Ithaca campus
- Essential component for meeting carbon neutrality
- Demonstration project for Eastern U.S.
- Engage students, faculty, staff and local community in living laboratory project

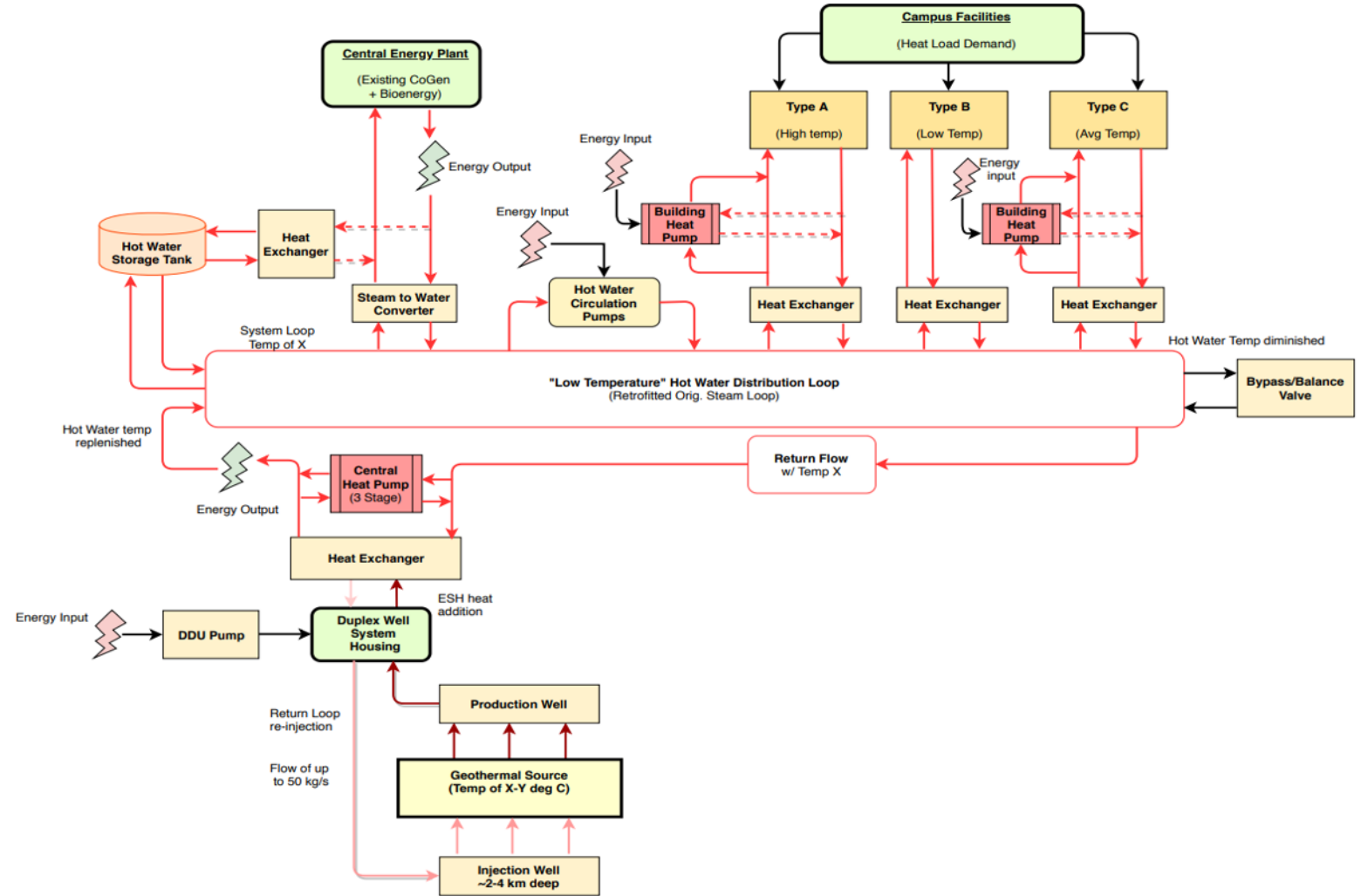
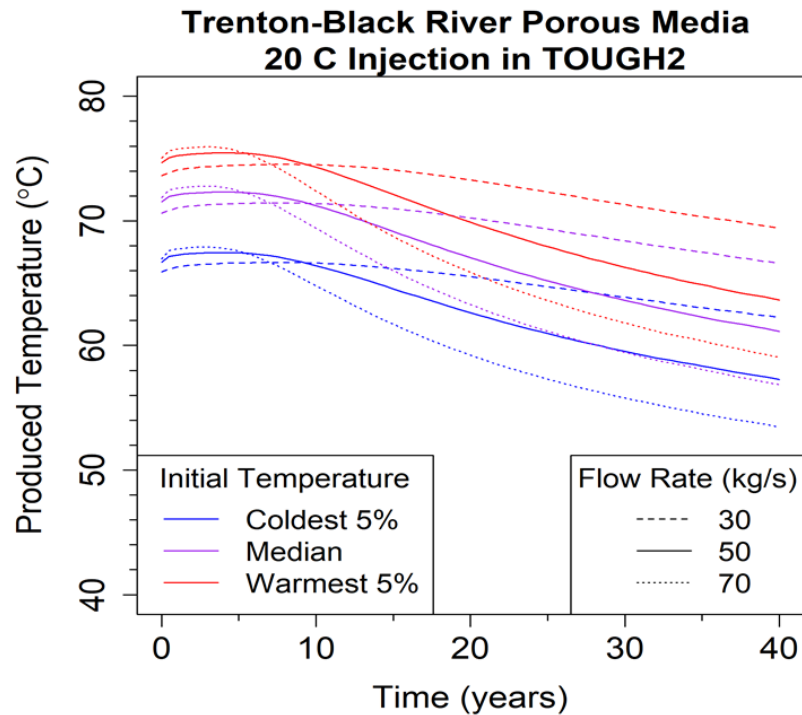


# Predicted temperatures in range 80-100°C in target reservoirs

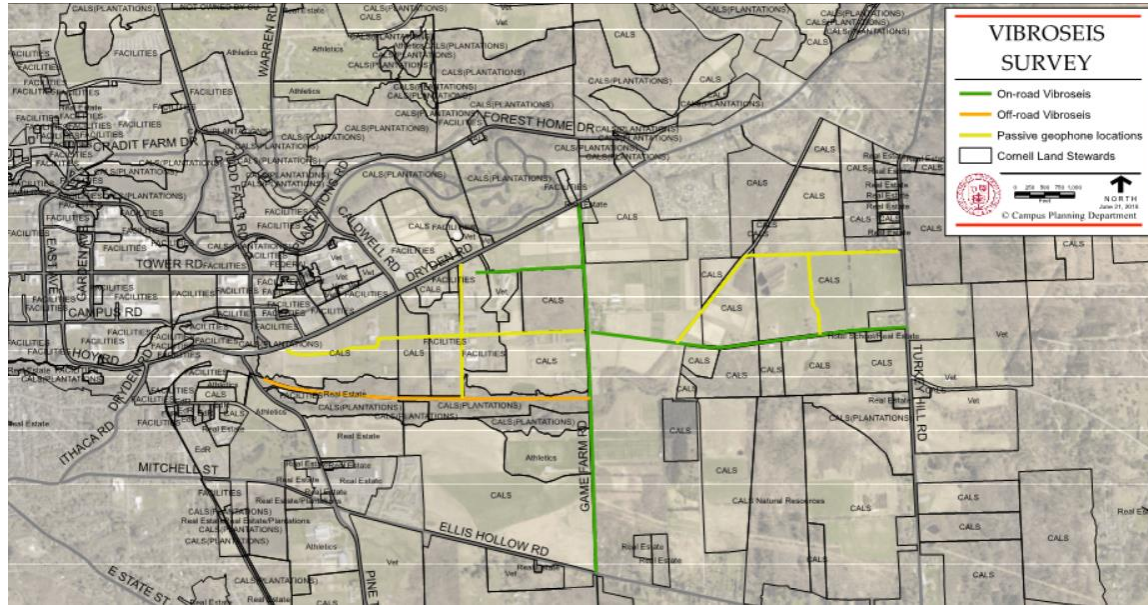


# Subsurface reservoir and surface equipment integration modeling

- Use of central heat pump
- System size on order of  $10 \text{ MW}_t$
- LCOH's on order of  $\$6/\text{MMBtu}$



# Ongoing seismic and geophysical analyses

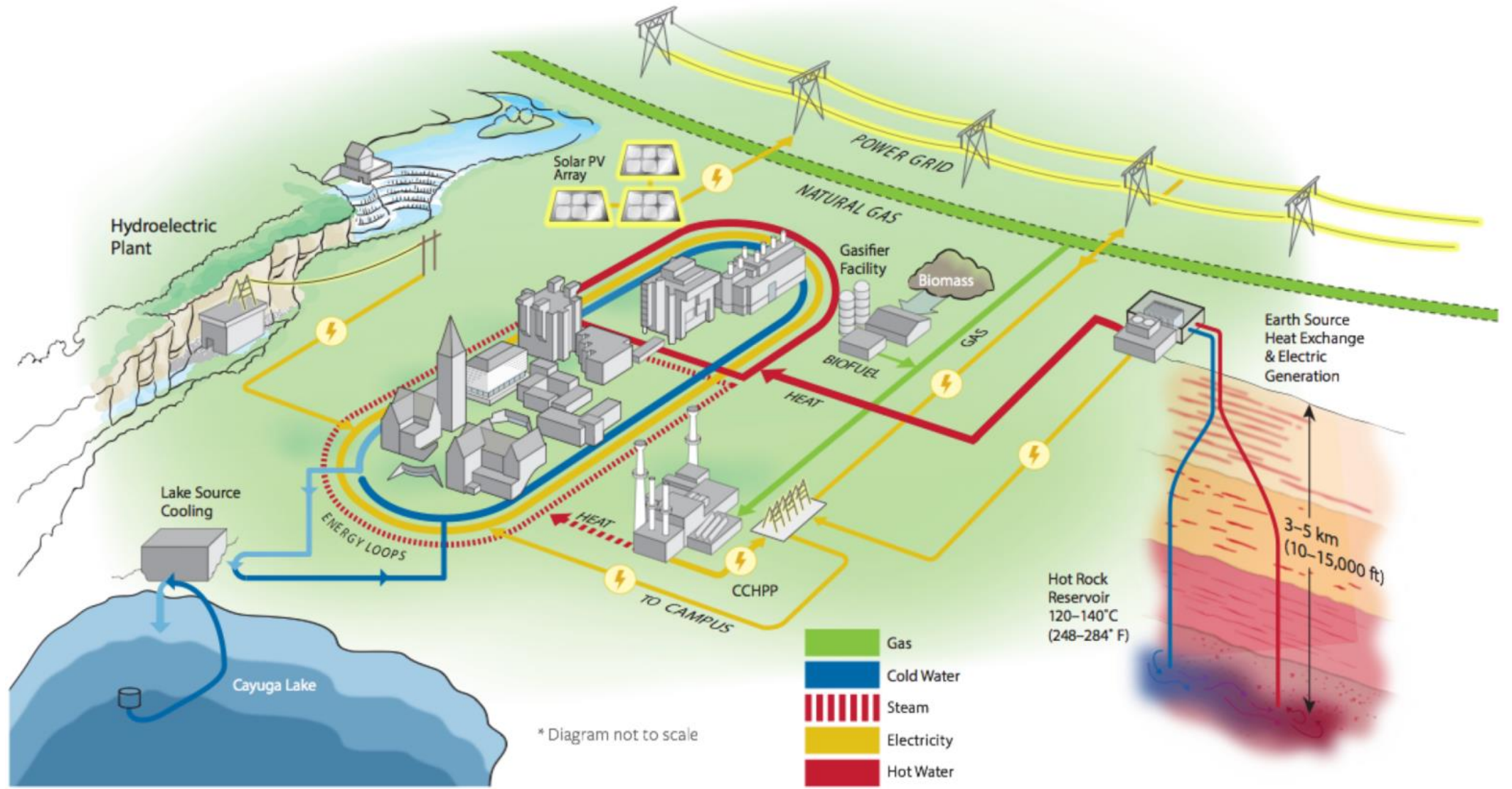




# Engagement with local community through town hall meetings



# Conclusions



Thank you

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Back-up Slides

### Average Lake-Source Cooling Performance

