



***Cornell University—Ithaca
Building Energy Report
Fiscal Year 2020***

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Executive Summary:

Fiscal year 2020 building energy consumption for central energy plant provided commodities (i.e. electric, steam and chilled water) was 3.7% below budget. Total building energy consumption was 1,943,000 mmBTU versus the budgeted value of 2,016,000 mmBTU. Actuals are 3.5% below the weather corrected budget. Notable factors impacting energy consumption are the following:

1) COVID-19:

In response to the COVID-19 pandemic, the Ithaca Campus went on “pause” for the 4th quarter of fiscal 2020. Students were sent home. Faculty and staff were required to work remotely and only “critical” staff such as Cornell police, animal care, plant care and other mission critical research were permitted on campus.

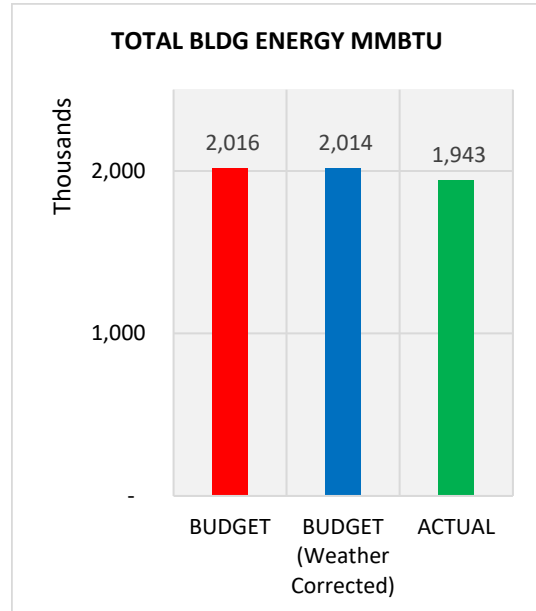
At the onset of the pandemic and the “pause”, Energy Management orchestrated a campus-wide load shed effort with a focus on vacant buildings. Temperatures were reduced and system operation was minimized to save energy. The effort resulted in a 14% reduction in budgeted campus utilities from March to June.

2) Neutral weather:

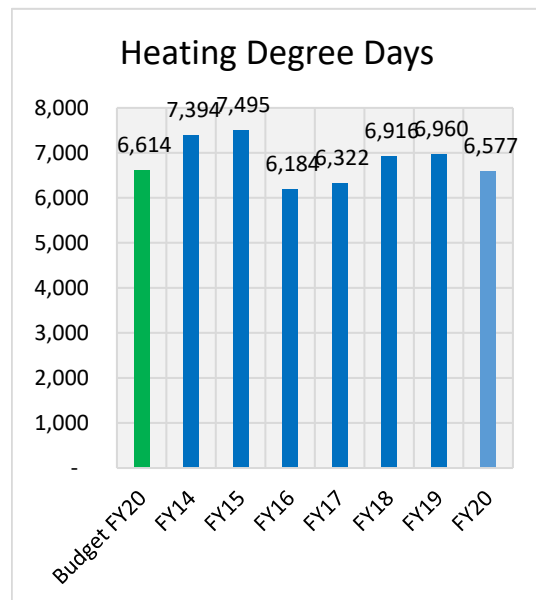
Actual heating degree days or HDD (an engineering heating metric) were <1% below projected weather. Actuals were 6,577 heating degree days versus a forecast of 6,614.

Enthalpy (a metric that considers temperature and relative humidity) was <1% above forecast for the cooling season May-September. However, July weather was significantly warmer than budget.

Actual Energy consumption 3.7% below budget



Neutral weather relative to budget

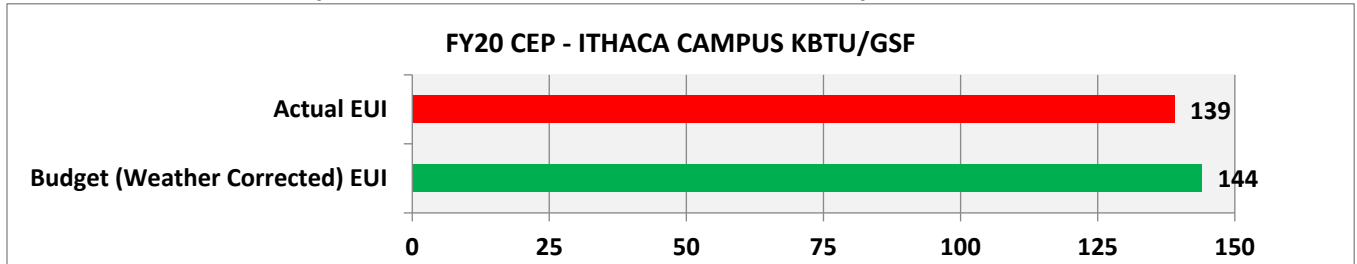




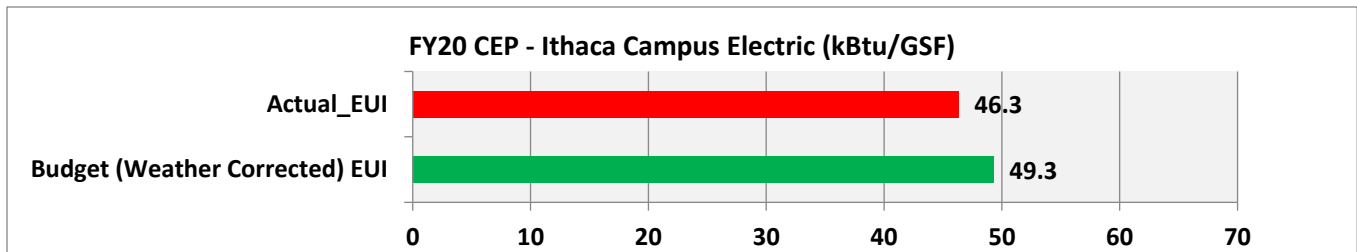
Energy Use Intensity:

Energy Use Intensity (kBtu per GSF) for each commodity versus the respective weather corrected projected values is provided below. Please note (1) cooling energy is the actual energy of the cooling versus the electric energy input to produce the cooling and (2) GSF for each commodity is different.

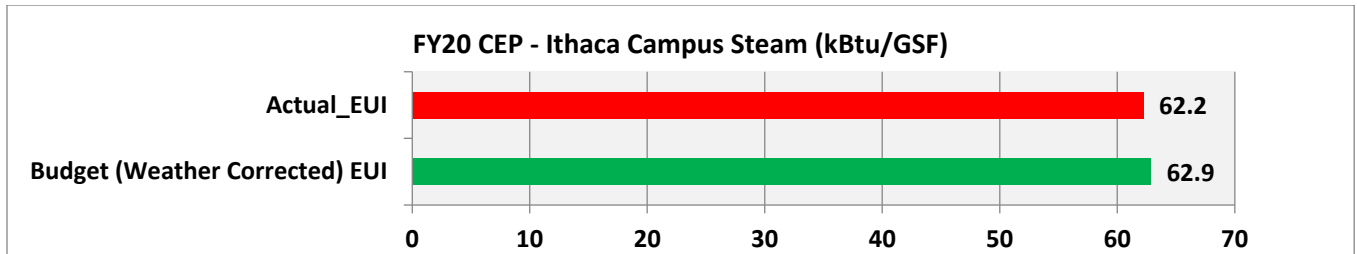
ALL COMMODITIES (ELECTRIC, STEAM, CHILLED WATER) GSF: 13.9 million GSF



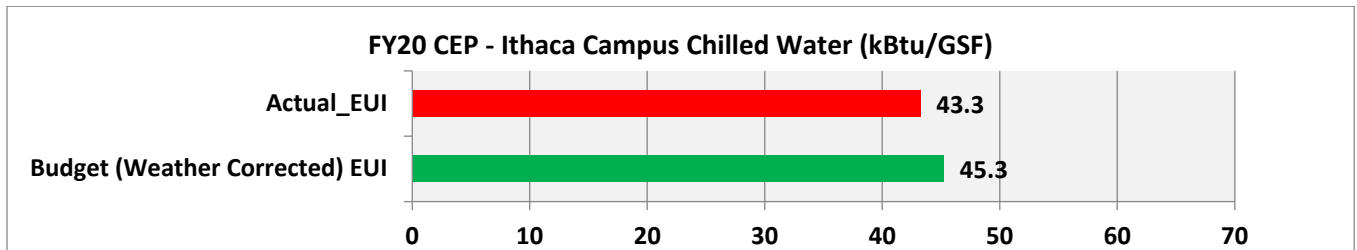
ELECTRIC GSF: 13.9 million GSF



STEAM GSF: 13.0 million GSF



CHILLED WATER GSF: 11.0 million GSF





Building Metering:

The Cornell Central Energy Plant provides campus heating (steam), electric and cooling (chilled water) to Ithaca campus facilities. These facilities are metered to allow for the recovery of the costs of production, procurement, and maintenance from University departments and administrative units based on usage for each utility. The meters are “Revenue” grade versus “HVAC” grade. A brief introduction of the metering system for each commodity follows:

Electric meters: Over 200 facility codes are metered. In addition, there are numerous sub-meters, especially for newer buildings to allow for enhanced usage visibility (i.e. plug load versus lighting). The Electric metering system has a circuit report. Circuits are verified from the building level up through hierarchical circuits to the main production meters. Meters can be verified either from a parallel data logger installed on the service or a revenue grade replacement meter is installed in its place

Steam meters: Over 150 facilities are metered. The condensate is actually metered because of the difficulty in reliable steam metering. This Steam/Condensate Metering System is verified monthly by a sales to production report. Anomalies are flagged. Suspect units are checked vs their consumption history. Metering units are standardized to two manufacturers to facilitate competition, as well as, to keep simple enough for document record keeping.

Chilled Water meters: Over 100 facilities are metered for chilled water. Chilled Water Metering is verified based by use of a sales to production report. Anomalies are flagged. Suspect units are checked versus their consumption history. Meters are also checked by a download of meter information to an excel spreadsheet for an initial check for suspect data.

To meet financial reporting deadlines the billing month for consumption data is not the same as the calendar month

The number of billing days in the billing month does vary from FY to FY and needs to be considered when comparing monthly values



Campus Space Snapshot:

The amount of space associated with each commodity differs significantly. This is important when performing energy use intensity (EUI) analysis which focuses on energy (kBtu) per gross square foot (GSF). The space hierarchy is Electric GSF > Steam GSF > District Cooling GSF. For FY 2020 the GSF associated with each commodity is as follows:

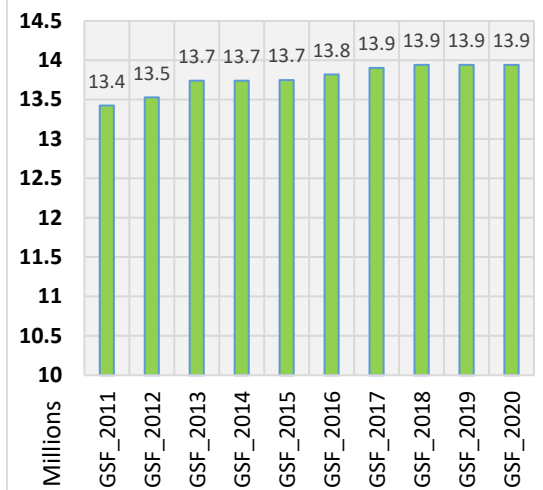
Commodity	GSF connected (approx.)
Electric	13,900,000
Steam	13,000,000
District Cooling (i.e. Lake Source Cooling)	11,100,000

We categorize the campus space with each facility assigned a College/Unit. Campus Life (i.e. dorms/campus housing) is the largest category with 19% of the total GSF. The College of Information Science (i.e. Gates Hall) is the smallest at < 1%.

College/Unit	GSF (1,000s)	% of Total
CAMPUS LIFE	2,700	19%
CALS	2,500	18%
ARTS SCIENCES	2,000	14%
ENGINEERING	1,200	9%
ADMIN SUPPORT	1,100	8%
VET SCHOOL	1,000	7%
ATHLETICS PHYSED	700	5%
PROVOST SPECIAL	500	4%
HUMAN ECOLOGY	400	3%
LIBRARIES	400	3%
HOTEL ADMIN	300	2%
ILR	300	2%
ARCH ART PLAN	200	1%
LAW SCHOOL	200	1%
JOHNSON MBA	200	1%
BTI	100	1%
INFORMATION SCIENCE	100	1%
TOTAL GSF	13,900	100%

Since 2008, Cornell has added over 1 million GSF of new conditioned space, most lab & research type buildings

GSF History





Steam Consumption:

FY 2020 steam consumption was approximately 795,000klbs (819,000 mmBTU). Actuals were 1% below budget. The steam budget was based on 6,614 HDD; however, the actual HDD were 6,577.

Steam usage has decreased over the last 20-years despite significant campus growth and renovation. Without conservation, steam usage would be 25% - 30% higher.

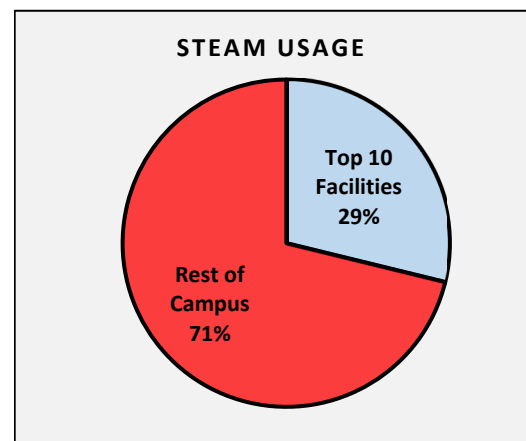
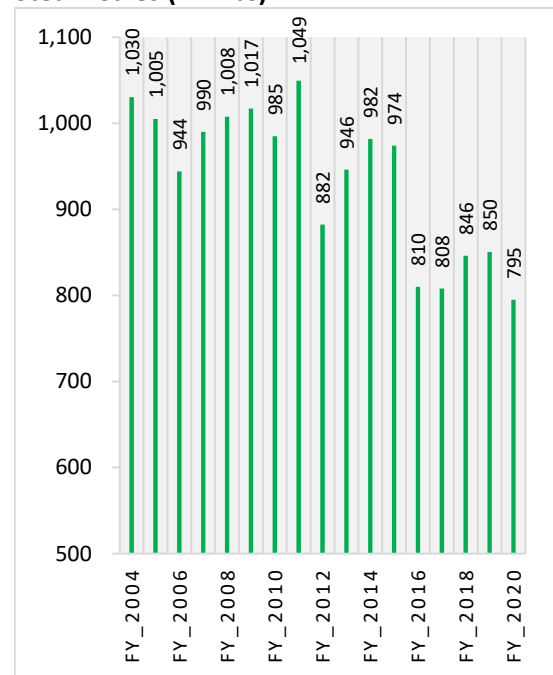
Ten facilities/complex consume 28% of campus steam. These facilities are primarily large research/lab buildings that have significant outdoor air requirements or special heating requirements (i.e. greenhouses).

Facility	Actual klbs	% of Total	Cumulative %
1164 Vet Medical Center	40,366	5.1%	5.1%
2000 Duffield Hall	30,515	3.8%	8.9%
1028B Bradfield Hall + 1028E Emerson Hall	27,348	3.4%	12.4%
1014 Weill Hall	23,988	3.0%	15.4%
1045A/1045G Ken Post Lab and Greenhouses	23,250	2.9%	18.3%
2087 Uris Hall	18,484	2.3%	20.6%
2019 Baker Laboratory	16,890	2.1%	22.8%
1018 Biotechnology	16,520	2.1%	24.8%
1068 Guterman Complex	15,962	2.0%	26.8%
2083 Olin Chemistry Research Wing	15,679	2.0%	28.8%
Top 10 Totals	229,002	28.8%	
Campus Totals	794,841		

Ten major facilities consume ~30% of heating

Building steam usage is trending downward despite campus growth

Steam Sales (mmlbs)





Electric Consumption:

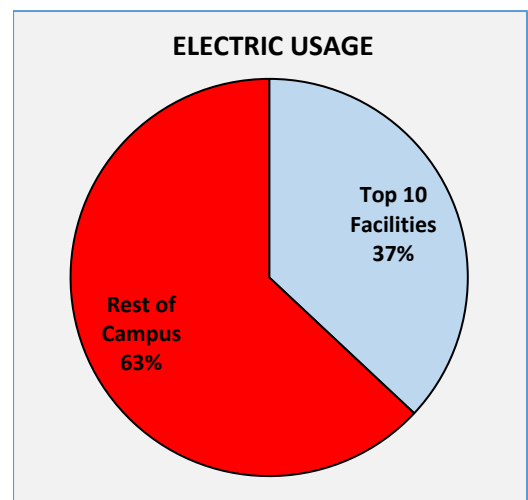
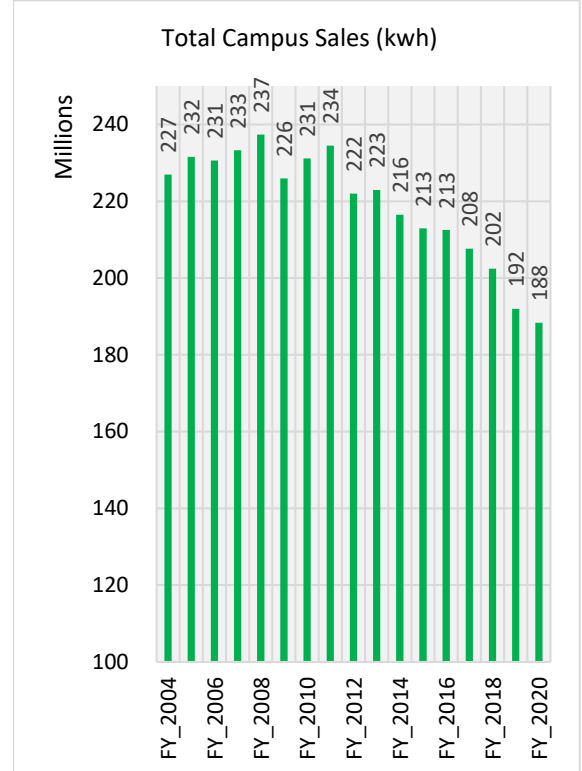
Electric consumption for FY 2020 was 188.4 million kwh; approximately 15.7 million kwh below the budgeted value of 204.1 million kwh.

As previously discussed, in response to the COVID-19 pandemic, the Ithaca Campus went on “pause” for the 4th quarter of fiscal 2020. Students were sent home. Faculty and staff were required to work remotely and only “critical” staff such as Cornell police, animal care, plant care and other mission critical research were permitted on campus. The result was a significant reduction in electric consumption during 4th quarter of fiscal 2020.

Ten facilities (see table below) are responsible for 37% of the campus electric sales despite being just 16% of the space. These ten facilities have a large research/lab focus.

Facility	Actual kwh	% of total	Cumulative %
2085 Wilson Synch	22,062,123	12%	12%
1164 Vet Medical Center	7,954,620	4%	16%
2000 Duffield Hall	7,470,648	4%	20%
1014 Weill Hall	6,294,372	3%	23%
2051 Frank H T Rhodes Hall	5,854,253	3%	26%
2076 Physical Sciences Building	4,325,574	2%	29%
2082 Clark Hall	4,119,659	2%	31%
1068 Guterman Complex	4,076,557	2%	33%
1028B Bradfield Hall + 1028E Emerson Hall	3,764,987	2%	35%
1076 Boyce Thompson Institute	3,715,582	2%	37%
Top Ten Totals	69,638,375	37%	
Campus Totals	188,352,413		

FY20 Electric Sales are the lowest in the last 20 years; despite campus growth of over 2 million GSF





Chilled Water Consumption:

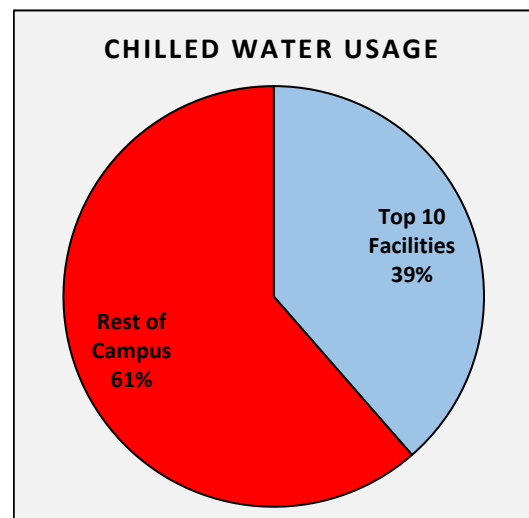
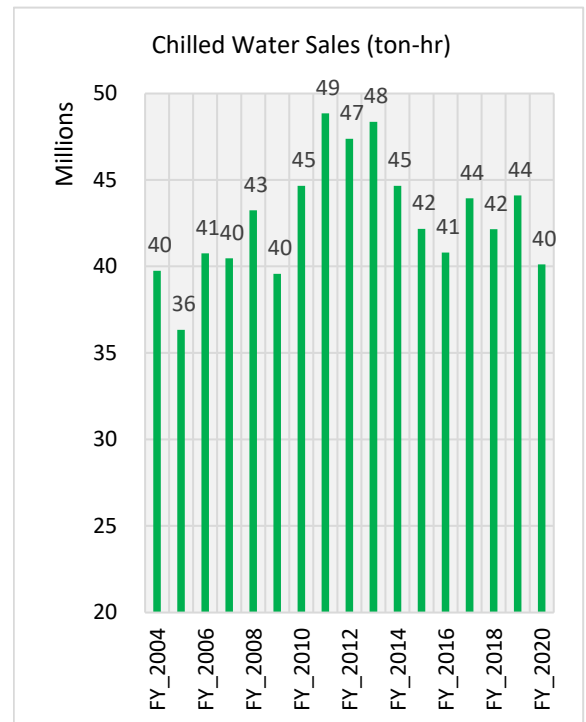
Chilled Water consumption for FY 2020 was 40.1 million ton-hrs; 1.8 million ton-hrs lower than the weather adjusted budgeted value of 41.9 million ton-hrs.

In response to the COVID-19 pandemic, the Ithaca Campus went on “pause” for the 4th quarter of fiscal 2020. Less students and staff lowered internal heat gains; thus, lowering cooling demand. The result was a significant reduction in cooling consumption during 4th quarter of fiscal 2020.

Ten academic facilities use 39% of the campus chilled water. The facilities are major lab/research facilities with significant airflow requirements and were not as impacted by the “pause” compared to dorms/dining and the Staler Hotel School.

Facility	Actuals	% of total	Cumulative %
2000 Duffield Hall	2,348,371	6%	6%
2085 Wilson Synch	1,979,446	5%	11%
1164 Vet Medical Center	1,893,608	5%	16%
1014 Weill Hall	1,813,342	5%	20%
2051 Frank H T Rhodes Hall	1,619,236	4%	24%
2082 Clark Hall	1,412,184	4%	28%
1028B Bradfield Hall + 1028E Emerson Hall	1,232,956	3%	31%
2076 Physical Sciences Building	1,138,021	3%	33%
2087 Uris Hall	1,021,942	3%	36%
1018 Biotechnology	1,018,617	3%	39%
Top Ten Totals	15,477,723	39%	
Campus Totals	40,112,841		

Since 2000, GSF associated with chilled water has grown 37%, over 2.3 million GSF of new/renovated conditioned space.



Ten facilities use 37% of the chilled water for FY19



Building Energy Use Intensity

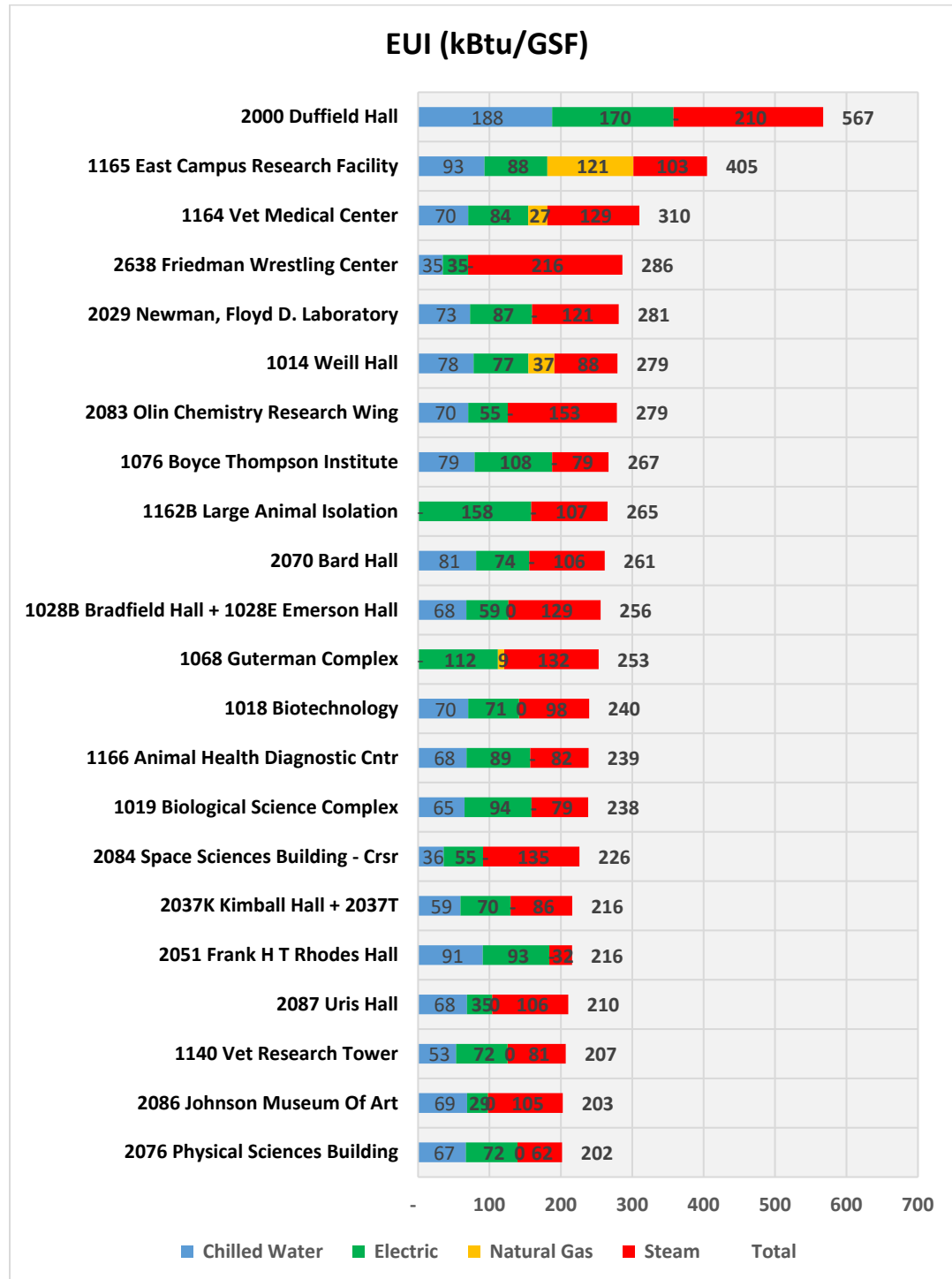
Building Energy Use Intensity (EUI) is provided for each commodity (chilled water, electric and steam) along with natural gas usage at the building (if data readily available from ebs). The EUI is based on the connected GSF. The highest EUIs are associated with intensive lab/research spaces.

The list below only include facilities with at least two commodities provided by the central energy plant. This typically includes electric and steam.

The campus average EUI is 145 kBtu/GSF, 35 for chilled water, 46 for electric, 59 for steam and 5 for natural gas used at the buildings based on 13.9 million GSF.



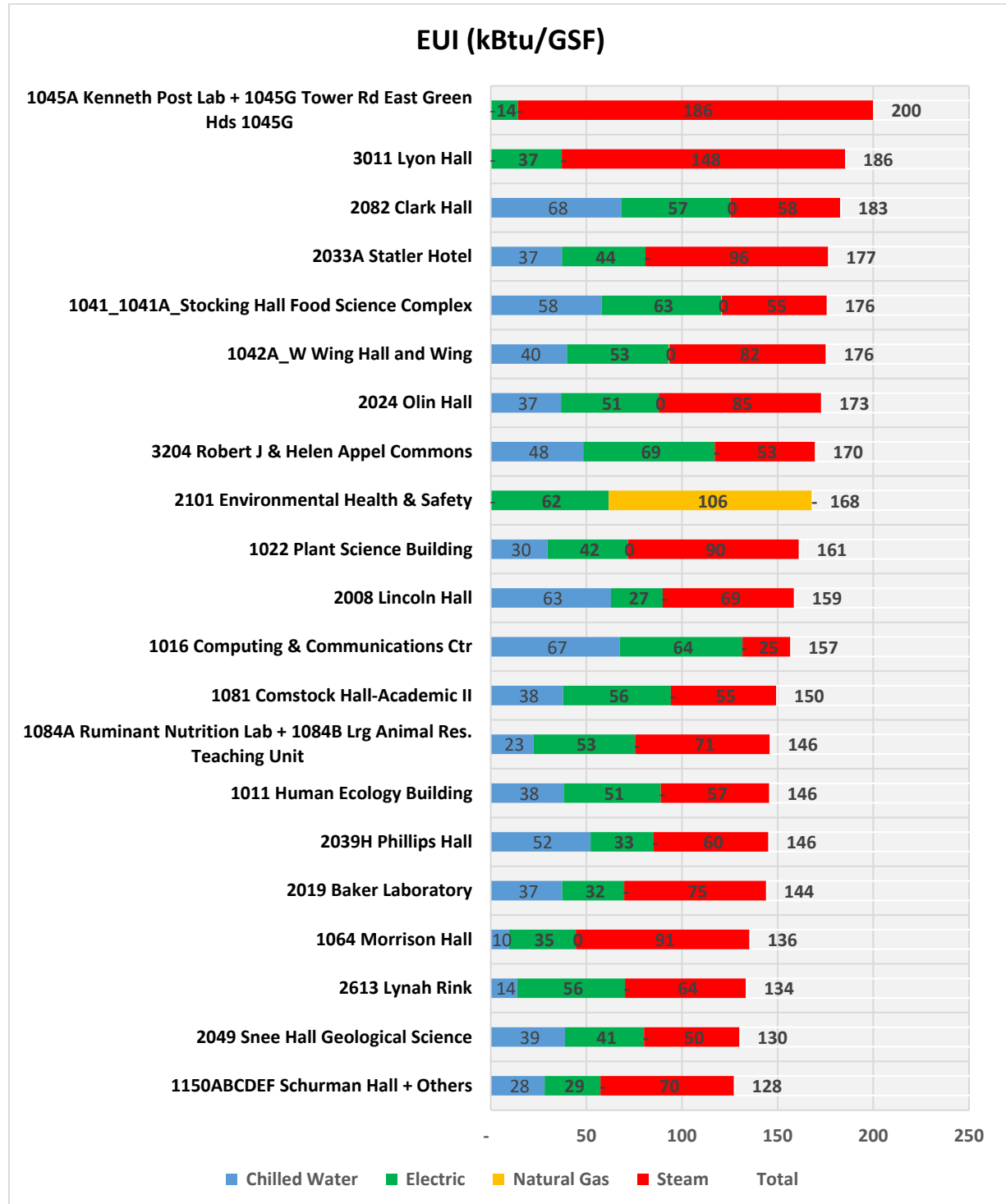
EUI > 200 kBtu/GSF: These facilities are lab/research and greenhouses. Duffield Hall is the highest at 567, followed by East Campus Research Facility. ECRF uses a large quantity of natural gas for hot water cage washing. Note: for this analysis we have excluded two unique facilities, (1) Wilson Lab and (2) Vet Waste Management Facility.





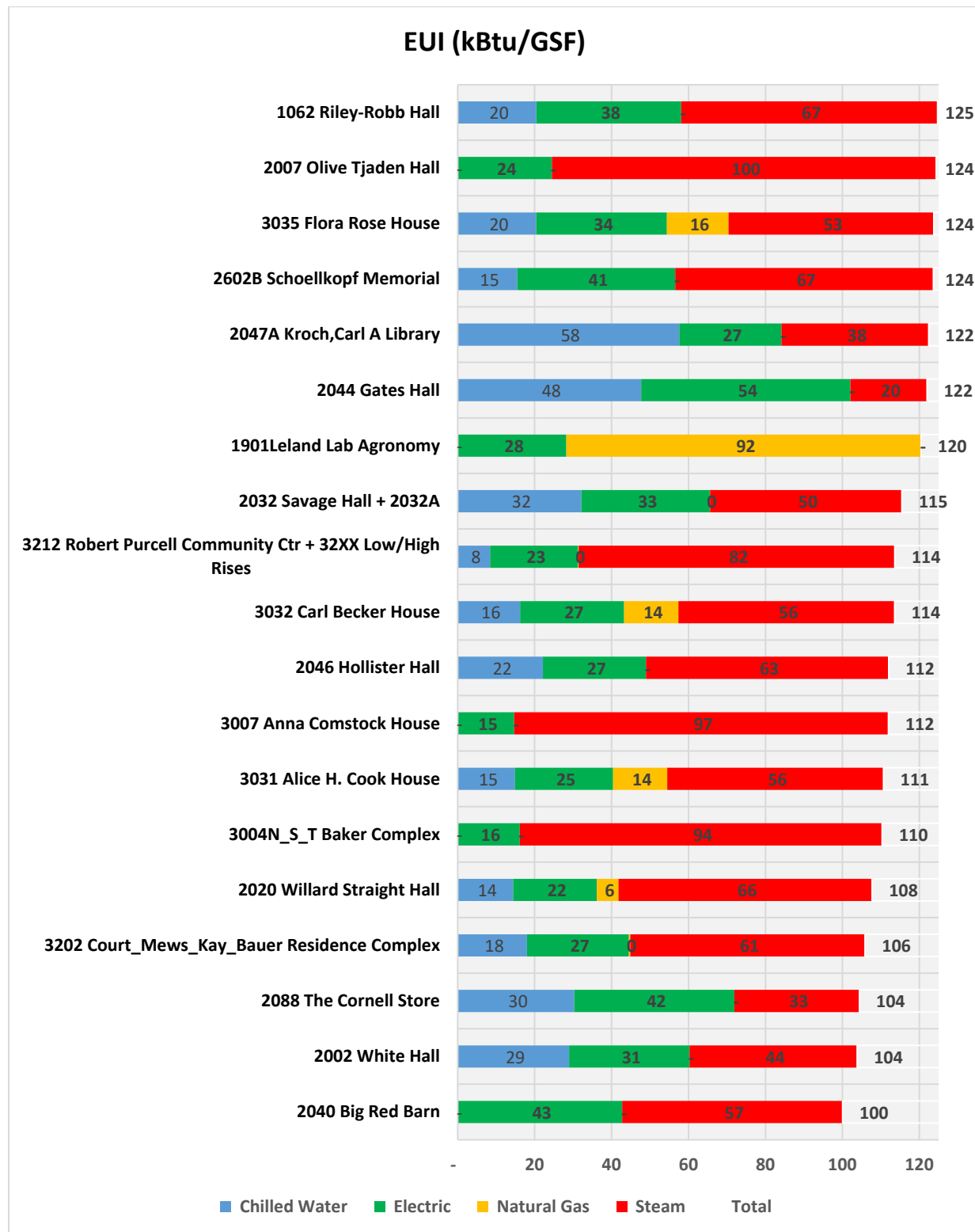
EUI: 125 to 200 kBtu/GSF

Many of the facilities have a significant lab/research component, or other unique high energy components (laundry, dining, greenhouses).



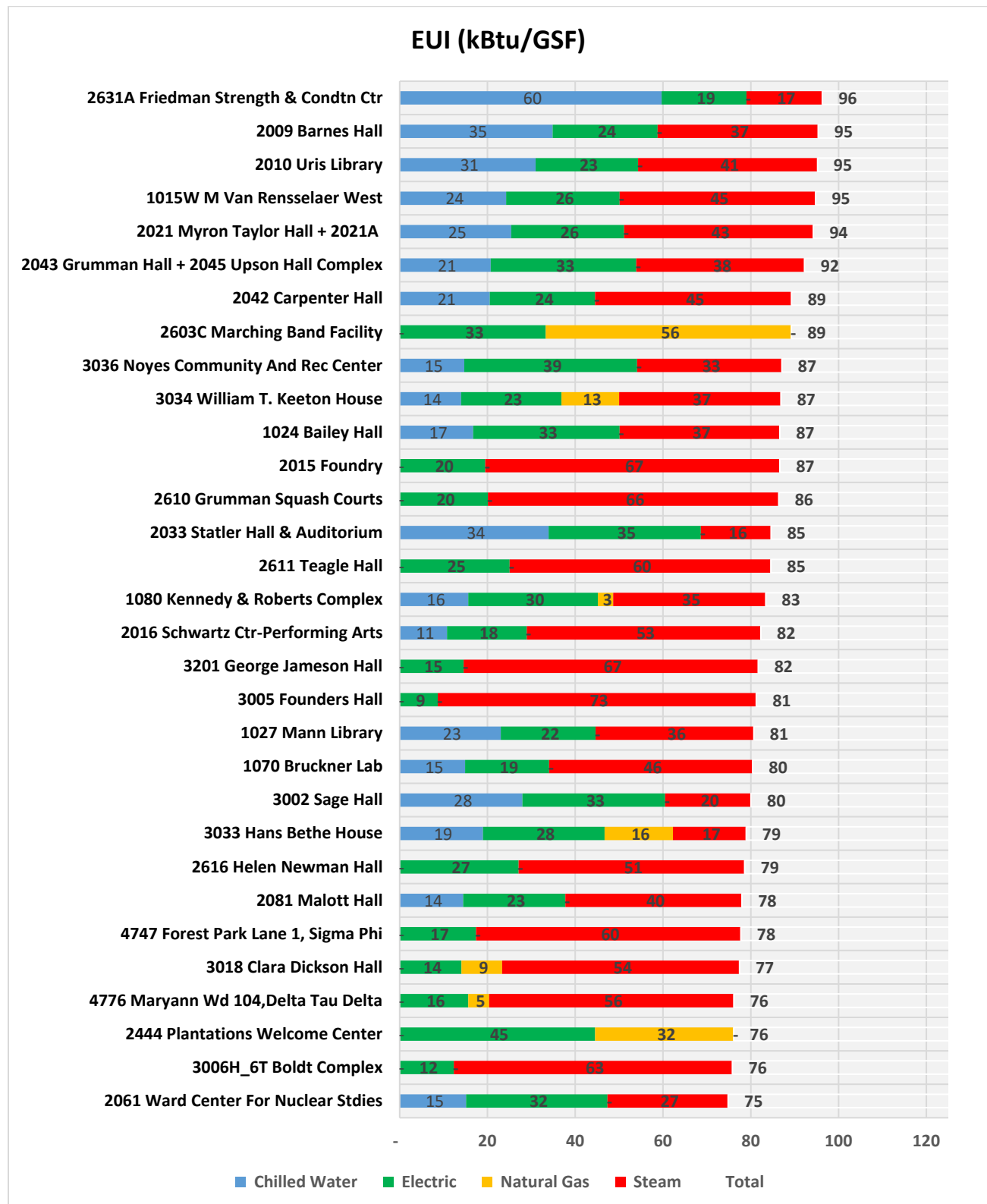


EUI: 100 to 125 kBtu/GSF





EUI: 75 to <100 kBtu/GSF





EUI <75

