

# Energy Use and Greenhouse Gas Emissions Among University of Wisconsin System Campus Buildings

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## INTRODUCTION

In the United States, buildings alone account for 70% of all electricity use and 40% of national CO<sub>2</sub> emissions (US Green Building Council, 2017). In fiscal year 2015, the UW System buildings consumed approximately 118,600 BTUs of energy per square foot (gross square feet: 55,193,000). Although the University of Wisconsin System assesses campus-level annual energy usage, little information is tracked on the variability of usage by specific buildings. This is important because policies are designed to manage energy efficiency at the building level.

## PURPOSE

In this study we:

- Compared energy use intensity and greenhouse gas emissions among buildings across five UW System Campuses: Eau Claire, La Crosse, Oshkosh, River Falls, and Whitewater (Figure 1)
- Assessed variations in energy use intensity and greenhouse gas emissions by campus, building type, and year of construction
- Identified priorities for improving energy efficiency

## METHODS

### CAMPUS SELECTION

Project scope: 13 4-year UW System campuses

- Received energy reporting contact list for each campus
- Contacted 13 campuses to request data
- Data made available for 5 campuses

For several campuses, energy metering was not available for individual buildings or multiple buildings were on a single meter

- *Included:* Academic Buildings, Residence Halls, and Student Centers
- *Excluded:* Maintenance buildings, Athletic buildings, etc.

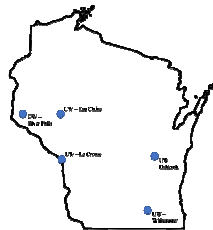


Figure 1: Locations of all University of Wisconsin campuses that participated in this study: Eau Claire, La Crosse, Oshkosh, River Falls, and Whitewater

### DATA COLLECTION

Individual-level building energy use data were provided by facilities managers from each campus. Electrical, natural gas, and steam usage data were provided for all 105 study buildings for a 12-month period beginning July 1, 2014 and ending June 30, 2015.

## DATA ANALYSIS

The United States Environmental Protection Agency Energy Star Portfolio Manager, a free, web-based tool that analyzes building energy use data, was used to assess energy use and emissions for study buildings. For each building, Portfolio Manager calculated the Energy Use Intensity (EUI = energy use/sqft/year) and Greenhouse Gas Emissions (GGE = lbsGHG/sqft). Portfolio manager provides a validated and consistent strategy for analyzing energy and carbon emissions data across all buildings.

Data were summarized using descriptive statistics. Kruskal-Wallis one-way analysis of variance (ANOVA) for independent samples of equal or different sample sizes was conducted to determine whether significant differences occurred among building outcome measures (GGE, EUI) by campus location, year of construction, and building type.

## RESULTS

Of the 105 buildings studied, 52 were academic buildings, 48 were residence halls, and 5 were student centers (Table 1). Mean EUI and GGE were lowest for UW Oshkosh and UW Eau Claire and highest for UW LaCrosse and UW Whitewater (see Figure 2).

Table 1: Summary of buildings by campus, size, and building type

Campus	Total # of Bldgs	Total # Used in Study	% of Total Bldgs Used in Study	Academic Bldgs	Residence Halls	Student Centers
Eau Claire	28	17	60.71	7	9	1
La Crosse	33	22	66.67	11	10	1
Oshkosh	31	19	61.29	10	8	1
River Falls	34	20	58.82	9	10	1
Whitewater	37	27	72.97	15	11	1
Total	163	105	64.42	52	48	5

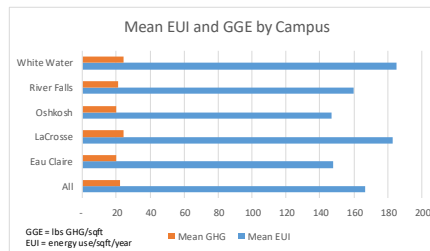


Figure 2: Mean EUI and GGE by the 5 UW System campuses

Across all campuses, Student Centers generated the highest EUI and GGEs due to the intensity and multiple use nature of these buildings (food, conferences, offices, etc.). When comparing performance measures between residence halls and academic buildings, residence halls had lower EUI and GGE (Figure 3 and Figure 4). This may be due to higher construction standards for residence halls and to the fact that on average these buildings tend to be younger than academic buildings. Residence halls may benefit from newer construction materials and designs that may improve building performance.

Figure 3: Energy Use Intensity by Campus and Building Type

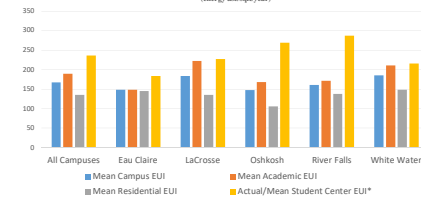
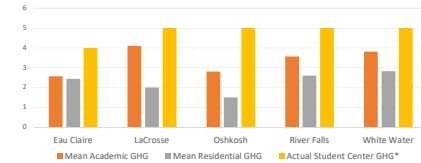


Figure 4: GGE by Campus and Building Type



Using the Kruskal-Wallis one-way analysis of variance (ANOVA), we found there were no significant differences in EUI and GGE by campus. However, there were significant differences based on building type and year of construction. Student centers and academic buildings contributed higher EUI and GGE values than residence halls, and newer buildings contributed lower values than older ones.

## IMPLICATIONS

The USEPA Energy Star Portfolio Manager provided a unique opportunity to compare building performance among UW System campuses.

- At the system-level, decisionmakers may want to target lower performing campuses (such as Whitewater and LaCrosse) to improve building performance.
- At the campus-level, facilities managers may want to focus energy efficiency improvements on older academic buildings.
- All UW System buildings need to be metered so that building-level performance can be measured and assessed.

## LIMITATIONS

Our sample size was small because we were not able to gather data from all UW System 4 year institutions. This was due to the lack of meters on individual campus buildings. Energy Star measures are based on the performance of similar types of buildings across the country. Benchmark data were limited for academic buildings and student centers. Proxies had to be used (i.e. office buildings) which may not fully reflect the characteristics of the study buildings.

## REFERENCES

US Green Building Council (USGBC). 2017. Benefits of Green Building. <http://www.usgbc.org/articles/green-building-facts>

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