# Sustainable Residence Halls: Exploring the Possibilities

The Office for Sustainability has conducted research on many sustainable residence halls, some of which are lauded as the most sustainable in the world. This report aims to outline the benefits of sustainable residence halls for both institutions and students, as well as describe how to advance our sustainability commitments. This document can act as an inspiration and guide for Western Michigan University (WMU) as it attempts to build living, learning communities that reflect its sustainability culture, values, and commitments.

WMU includes sustainability in its "Mission and Vision" statement and has made several commitments to sustainability initiatives, such as signing the Tallories Declaration in 2008 and the American College and University Presidents Climate Commitment in 2009. Following those commitments, WMU created a Climate Action Plan in 2012, which targets net zero greenhouse gas emissions by 2065. Student Affairs is now presented with an opportunity to build on these and other sustainability commitments while simultaneously fulfilling its unique responsibility to provide students with top-tier housing options. Green, sustainable residence halls are an increasingly popular element in the movement towards furthering sustainability culture in higher education **based on their economic viability.** Certifications and rating systems including Passive House, Leadership in Energy and Environmental Design (LEED), and Living Building Challenge (LBC) guide the designing, building, and maintenance processes for sustainable buildings in higher education and around the world.

## Save the living planet: lower greenhouse gas (GHG) emissions

Perhaps the most important aspect of sustainable dorms is the low levels of emitted GHGs and associated operating costs for consumed energy. According to the U.S. Green Building Council, buildings account for 39% of $CO_2$ emissions in the United States. The most significant contribution to these emissions is electricity use.

Passive House (PH) is one of the most rigorous international building standards for energy efficiency. Certified PH buildings have substantially reduced ecological footprints through minimizing the required energy for heating and cooling due to the use of high performing materials and hyper-insulated building envelopes. In 2017 the largest and tallest certified PH was completed for Cornell Tech's campus in Manhattan. "The House" is 26 stories, with 335 apartment-style units that accommodate 530 residents. According to energy models, The House is projected to save 882 tons of $CO_2$ annually in comparison to a similar building with conventional construction; a 60-80% emission reduction. Extremely airtight building envelopes with minimal thermal bridging are key design elements used to achieve PH certification and reduce a building's energy use. The House is also on track to becoming LEED-Platinum certified, LEED's highest level of certification. LEED, the rating system of the U.S. Green Building Council, provides a framework for healthy, sustainable, and cost efficient buildings.

Berea College is home to Deep Green Hall, the highest rated LEED-Platinum residence hall in the world. 120 students are housed in this 42,000-square foot, three-story facility. To reduce GHG emissions, 114 solar photovoltaic panels collect sunlight which generates 13% of the building's energy. A geothermal heat pump and recirculation system reduces heating/cooling and ventilation energy requirements by 50%. Stormwater is collected in rain gardens and bio-retention ponds to manage water runoff, and low-flow water fixtures are installed to cut down on water usage. During construction, building materials were sustainably harvested and transported from local forests to reduce the emissions associated with transporting materials to the construction site.

## Save your wallet: lower life cycle cost

Tied closely with greenhouse gas emission reduction is the low life cycle cost of sustainable buildings. If pending and future costs of projects are taken into consideration during the planning phases, life-time costs can be reduced. Utility bills reflect when fewer resources are used in daily building operations. Nearly every case study reviewed demonstrates significant annual savings resulting from lower energy bills, which in turn, reduces the overall life cycle cost.

The EcoDorm, renovated in 2003, at Warren Wilson College in Swannanoa, North Carolina was the first existing building on a college campus to achieve LEED-Platinum certification. Design and construction for the 2-story, 9,000 square foot dorm that houses 38 students were funded by a $1.8 million grant from The Steelcase Foundation of Grand Rapids, Michigan. Annually, the EcoDorm saves $8,765 by cutting energy usage by 69% and water consumption by 74% compared to previous years. The EcoDorm uses solar photovoltaic panels to generate electricity, has high efficiency Energy Star rated appliances and utilizes ultrasonic sound devices to control lighting and cut down on

unnecessary energy consumption. To reduce water consumption, a 10,000-gallon cistern collects rainwater on site, which is dispensed to toilets and outdoor water spigots. Additionally, there are two waterless composting toilets installed in the dorm.

The House at Cornell Tech is projecting 60-80% savings on energy bills, similar to Hickory Hall at William and Emory College (to be further discussed in the next section), which routinely receives 50-70% reduced energy bills. The "Deep Green" residence hall at Berea College estimates a 55% annual energy savings by using sustainable design, construction, and maintenance principles.

## Don't believe everything you hear; low initial costs are feasible!

The U.S. Green Building Council (USGBC) challenges the misconception that additional upfront costs to reduce energy or improve indoor environmental quality are comparable to additional costs for superficial elements. Costs for sustainable features come with substantial benefits, as outlined here, and as pointed out in the previous section, will yield long-term savings.

A common assumption is that green building materials and methods are more expensive than traditional means. A report published by the Council on Tall Buildings and Urban Habitat found that the average cost of green and non-green buildings is not significantly different and that LEED buildings are often within their budget. It was emphasized that sustainable features will be following the initial scope **if sustainability goals for a building project are set early.** This avoids the risk of perceiving sustainable features as separate or additive endeavors.

Hickory Hall at Emory and Henry University was the largest certified Passive House at the time (completed in 2013). The total cost per square foot was less than that of Elm Hall, a traditionally built residence hall of comparable size. Both Hickory and Elm take in 117 students in 61 units. However, Hickory Hall cost $118.75/SF up front compared to Elm at $125/SF. This initial cost reduction is the result of careful planning and the reduction in mechanical systems that result from the signature Passive House airtight envelope. The mechanical systems necessary to maintain Hickory Hall are sized at less than a quarter of Elm's.

## Student well-being and success

Green buildings have better indoor environmental quality than traditional buildings, which creates a healthier and more comfortable living environment for residents. Indoor environmental quality is a category for LEED certification that can be achieved by limiting tobacco use (something WMU already embraces as a tobacco-free campus), installing indoor potted plants, and using materials with low volatile organic compounds (flooring, paints, sealants, insulation). Additionally, a 2017 study conducted by Harvard University and the State University of New York Upstate Medical University found that workers in certified green buildings scored 26.4% higher on cognitive function tests than workers in non-green buildings. Workers in green buildings also had 30% fewer sick building symptoms.

Student engagement during the development of campus buildings is expected to generate ample educational and experiential opportunities. During the entire construction process of the "Deep Green" dorm at Berea College, educational opportunities were plentiful. At the early stages, students participated in the archeological site dig of the building. As a part of Berea's Work Program, students built all of the furnishings and interior trim from wood harvested solely from the FSC Certified Berea College Forest. The color scheme development was aided by Fine Art majors, and student art work was integrated into the dorm. These opportunities are advantageous for both students and institutions because they provide a service while fostering collaboration and improving the community. Similar results could be generated at WMU by working with fine arts, engineering, and design students.

## But wait, there's more!

Unexpected benefits of green buildings on campus include improved retention rates and free publicity which serves as a recruiting tool. After the EcoDorm was completed, the director of Warren Wilson College's Environmental Leadership Center, Stan Cross, claimed improved enrollment and retention as a result of providing a housing experience that challenges and develops the sustainable behavior of its residents. The New York Times has published features about the EcoDorm at Warren Wilson College, as well as The House at Cornell Tech. With green dorms on campus, WMU has an opportunity to enhance its already robust sustainability culture and improve its rankings on the Sierra Club's Cool Schools list and the Princeton Review's Green Colleges. Lists like these are highly accessible platforms used by prospective students when making their choice on what school to attend.

## Try something new! Small-scale experimental options

Some features of the ultra-sustainable projects discussed may be challenging to create at the scale WMU requires for the South Neighborhood endeavor. Creating a smaller, ultra-sustainable

option with more experimental and research-oriented site-specific features to work in conjunction with larger dorms could be a valuable addition.

The Kathryn W. Davis Student Residence Village (Davis Village) is advertised as the most sustainable housing option at the College of the Atlantic (COA); a campus leading the way in higher education sustainability. The COA is often regarded as one of the most sustainable campuses in the country according to the Sierra Club Cool Schools Ranking (#1 in 2017) and the Princeton Review Green Colleges list (#1 in 2017). All bathrooms within the Davis Village are equipped with waterless composting toilets and all buildings are oriented specifically for optimum solar energy harvesting. A wood pellet boiler is the Village's primary heat source, a system that is both local (pellets) and rapidly renewable, and it is paired with a heat recovery ventilation unit to further reduce energy waste. Building materials, including flooring and ceiling panels, were made from recycled or local materials whenever possible. During the design process, students had significant opportunity for input, which gave them an empowering experience and a physical space that better reflected their own values and desires.

WMU's Gibbs House, located near the College of Engineering and Applied Sciences and operated by the Office for Sustainability, houses 4-5 student Gibbs House Fellows annually. The Fellowship provides a unique, sustainability-focused cooperative living arrangement and research opportunities for the Fellows. Student research was recently completed that investigated methods to convert the historic farmhouse into a Passive House. There is now an opportunity to bring options like this to a much larger population of students by creating a small-scale, student-engaging, cutting-edge sustainable dorm which includes characteristics potentially too ambitious for larger buildings.

## What do all of these dorms have in common?

These sustainable dorms share common attributes including airtight building envelopes that result in minimal heating and cooling, layouts that optimize daylight energy harvesting through windows and solar panels, high efficiency appliances and mechanical systems, and locally produced materials. Students were often included in planning, design, and sometimes construction processes. Systems to track and measure resource production and usage were made accessible to residents, which promotes intentional awareness and can result in more responsible behaviors. These characteristics could be considered fundamental elements to sustainable residence halls. Additional features and planning can push the envelope to create net zero energy and water buildings.

## Western Michigan University can (and should) do it too!

The examples presented in this report provide an outline for the possibilities and potential of sustainably built residence halls. These themes and design principles can be applied to WMU's sites, climate, budgets, and requirements to create the benefits illustrated. **It is important to note that WMU made a commitment to net zero GHG emissions by 2065. New residence halls will still be a part of campus at that time.** If building a new net zero housing option is not feasible for this project, the space should be designed for flexibility to incorporate future improvements (e.g. installing rooftop solar). Building with the intention of future sustainable retrofitting will be a huge service to WMU down the line.

Colleges and universities have proven that sustainable student living options bring many benefits to the institutions, students, and planet. Now, Western Michigan University and its constituents can start reaping these same benefits. The Office for Sustainability is committed to assisting the University and Student Affairs in planning, policy, design, and oversight for this project and any other future projects that have the potential to improve quality of life for all.*

◆ Prepared by Brittney Blokker in April, 2018.

*The mission of the Office for Sustainability is to guide and assist the Western Michigan University community in fulfilling and growing its sustainability commitments. Through building a diverse and flourishing learning community around sustainability, we will continually explore and develop new opportunities to create a culture of sustainability and improve quality of life for all.

The House

https://thehouseatcornelltech.com/sustainability/
https://handelarchitects.com/project/the-house-at-cornell-tech?pagi=residential
http://passivehouse-database.org/index.php?lang=en#d_5202

Hickory Hall

http://passivscience.com/case-studies/hickory-hall/
http://shellywilliamsco.com/wp-content/uploads/2016/03/emory-henry-Hickory-Hall-Writeup-2.pdf
https://hub.aashe.org/browse/presentation/10446/designing-for-the-future-building-a-passive-house-residence-hall-at-emory-henry-college

Deep Green Residence Hall

https://www.berea.edu/news/berea-college-deep-green-residence-hall-achieves-living-building-challenge-certification/
https://www.usgbc.org/projects/deep-green-residence-hall?view=overview
http://www.hastingschivetta.com/projects/deep-green-residence-hall/

The EcoDorm

https://www.usgbc.org/projects/ecodorm-warren-wilson-college?view=scorecard
http://www.nytimes.com/2009/09/27/magazine/27Ecodorm-t.html?_r=2&
http://samselarchitects.com/project/ecodorm/

Kathryn W. Davis Student Residence Village

https://www.coa.edu/live/files/36-kwddeeringbookletpdf
http://www.hpbmagazine.org/attachments/article/11851/13Su-College-of-the-Atlantic-Student-Housing-Village-Bar-Harbor-ME.pdf