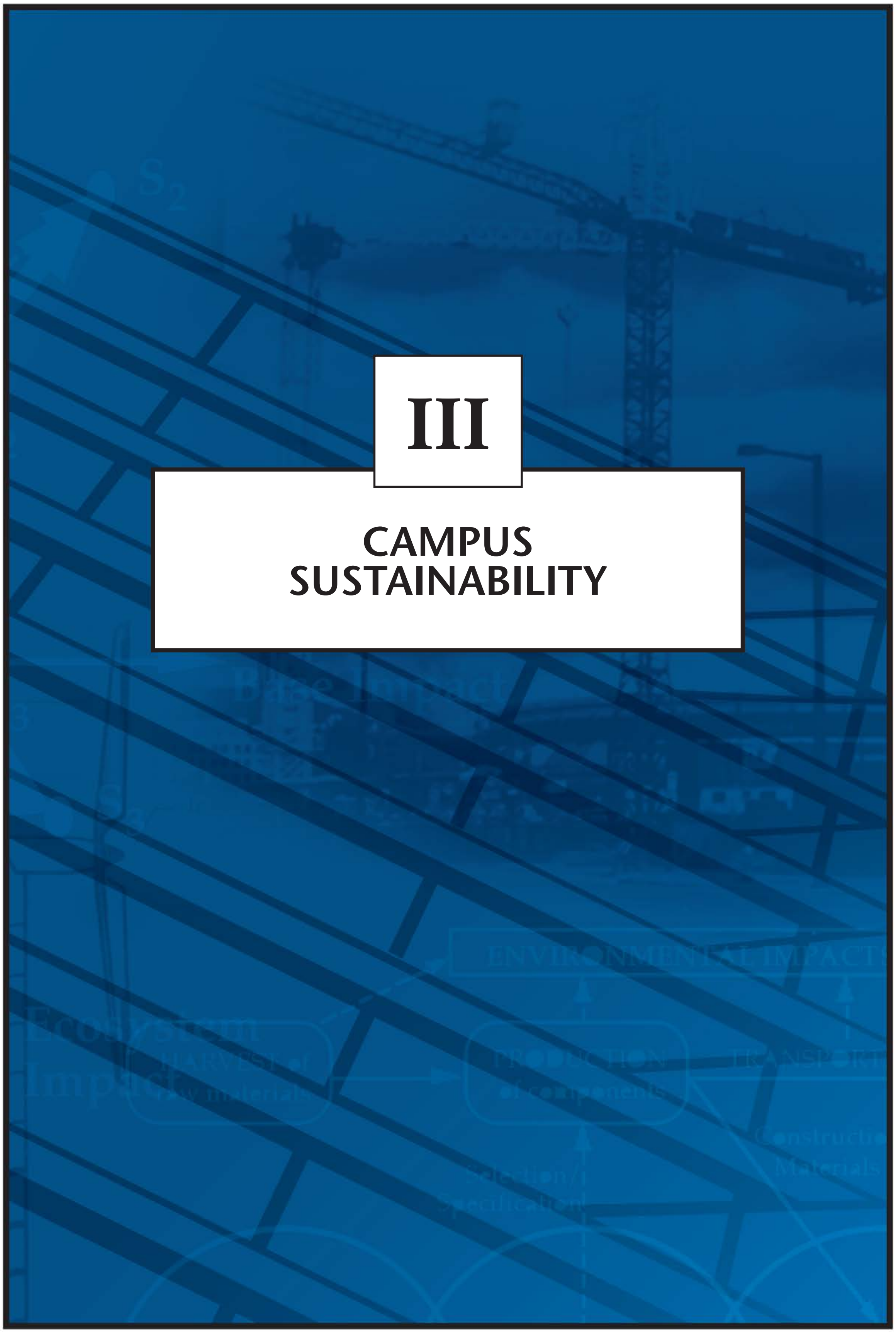


III

CAMPUS SUSTAINABILITY

COMMUNITY, CAMPUS, AND CLIMATE AT CENTRAL COMMUNITY COLLEGE—3C INITIATIVE

Kearney Center Living Learning Lab and Ecosystem

Craig Boroff,[1] Jason Eickmeier,[2] Kali Eklund,[3] Cynthia Garcia,[4] Scott Miller,[5] Benjamin Newton,[6] Brian Pecka,[7] Toby Samuelson,[8] Joanell Staab,[9] Olivia Whittaker[10]

INTRODUCTION

Central Community College (CCC) has multiple campuses and centers in rural agricultural communities throughout Central Nebraska and College President, Dr. Greg Smith, was an early adopter to the vision of economic and environmental sustainability. Central Community College has been a Cum Laude Leader since 2011 and signatory of the *Climate Commitment* as part of the Climate Leadership Network (previously the ACUPCC). CCC made a commitment to educate, implement and model the practices needed for a sustainable future. For our communities and ultimately globally, we believe environmental sustainability is important and necessary for healthy communities, people and economic sustainability. Each CCC campus and center also has available land to commit to renewable energy, typically not available in most major metropolitan campuses. The State of Nebraska is a late adopter to renewable energy, but with the potential for reduced operating costs, is now embracing sustainable development with CCC and providing leadership with our 3C initiative and Environmental Sustainability Action Plan.

KEYWORDS

climate neutral, electrochromic windows, bioretention gardens, energy efficiency, daylighting, renewable energy, plug load

1. COMMUNITY, CAMPUS, AND CLIMATE—3C INITIATIVE

The Central Community College service area covers approximately 14,000 square miles across 90 communities and 25 counties in rural central Nebraska. The college has three main campuses in Grand Island, Columbus, and Hastings, and three satellite education centers. Central Community College finalized its climate action plan in 2014 and set a target of 2034 for achieving carbon neutrality. This 20-year plan is an achievable goal of reducing emissions 5% per year and CCC is ahead of target with a 1.7 megawatt 432-foot wind turbine at the Hastings campus

1. 1,4,5,6 & 10. Central Community College, 3134 W. Highway 34, Grand Island, NE 68802, www.cccneb.edu, benjaminnewton@cccneb.edu. 2 & 8. Morrissey Engineering, 4940 N. 118th St., Omaha, NE 68164, www.morrisseyengineering.com. 3 & 9. Wilkins ADP, 2908 W. 39th St., Kearney, NE 68845, www.wilkinsadp.com. 7. Big Muddy Workshop, 4502 S. 42nd St., Omaha, NE 68107, www.bigmuddyworkshop.com.

that went into operation in January 2017. The college has a 25-year agreement with Hastings Utilities to purchase the power. The wind turbine provides over 100% of the electricity needs for the Hastings campus almost every month since it began operation. The college is now also doubling down on energy efficiency with LED light conversions, more efficient boilers and chillers, new windows and insulation, reducing plug loads, and incorporating auto controls and temperature set points. Various geothermal installations and a 17kW ground mounted tracking solar project is also present across CCC campuses and centers.

The challenge is reducing transportation related greenhouse gas emissions across such a large service area, but significant changes to vehicle technology and rideshare programs will help reduce future emissions. Also, CCC facilitates college-wide department meetings through web-conferencing to reduce employee travel between campuses and centers. And to reduce summer commuter miles by 20%, CCC transitioned to a four-day summer work week for three months. In addition to an all electric college maintenance vehicle fleet, CCC currently has hybrid vehicles available for faculty and staff to travel between campuses. The next proposed project the Environmental Sustainability office is focusing on includes photovoltaic electric vehicle charging stations for fleet vehicle travel between campuses. CCC is committed to on campus strategies of efficiency, reduction of travel, and then adding additional renewable energy projects. Lastly, the embraced momentum towards carbon neutrality has resulted in developing renewable energy academic programs due to increased employment opportunities in central Nebraska clean technology.

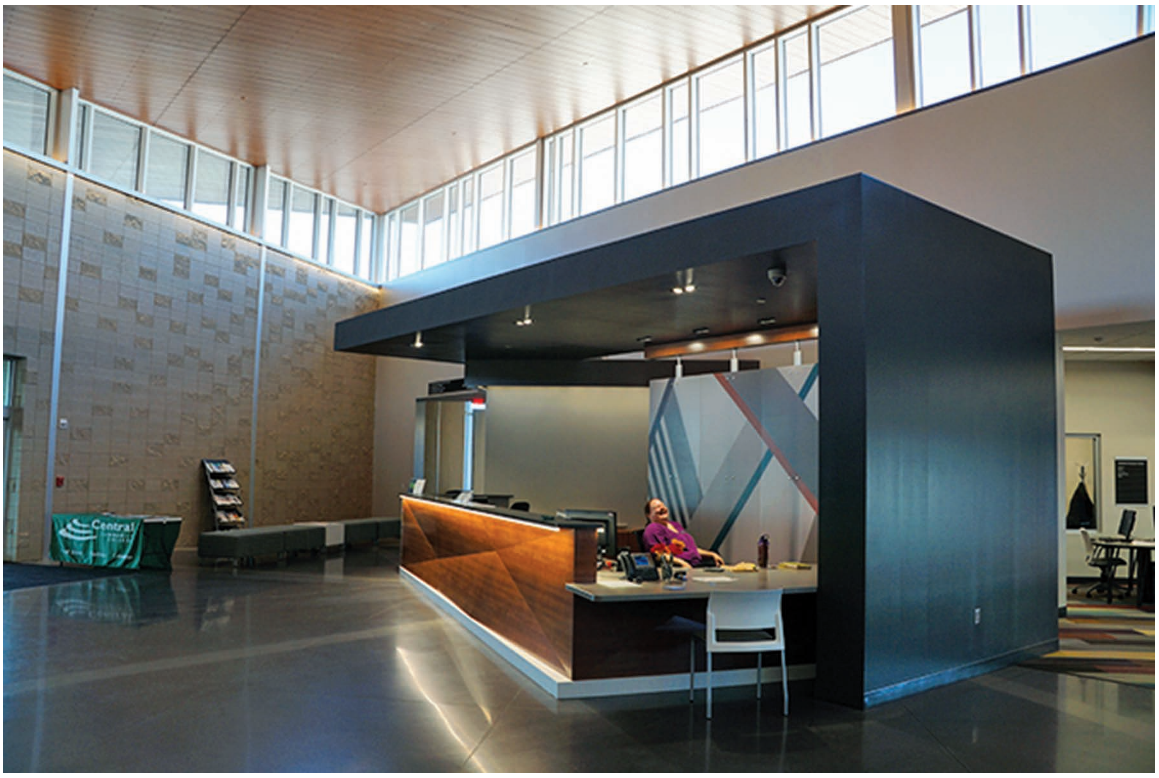
2. NEW KEARNEY CENTER ENERGY MONITORING

In August 2017 construction was completed on a 66,000 square foot Kearney Center, and it was built to LEED silver standards. The building did not pursue LEED certification, but included many of the key elements in the design features. Optimized energy performance is the key Net-Zero Ready design feature of the new Kearney Center with a goal of an average of 31 kBtu/sf/yr, while the national average college campus building energy usage index is 130.7 kBtu/sf/yr (Energy Star, 2016). Currently, the building is trending around 29 kBTU/sf which speaks well of the design, implementation, and Central Community College's commitment to sustainability.

The building has energy sub-meters installed to measure the total building, HVAC, lighting, and plug load power consumption. The meters allow the energy usage of the building to

FIGURE 1. Exterior View of Central Community College Kearney Center. Photo: Scott Miller

FIGURE 2. Welcome Desk at Central Community College Kearney Center. Photo: Scott Miller



be continuously monitored so benchmarks can be established and areas for improvement can be identified. A real-time dashboard displays and tracks electricity consumption that can be displayed on the campus website or lobby video wall. This data is connected into the building automation system to allow for load shedding strategies to be implemented when the building demand exceeds a predetermined level.

Currently, the real-time energy monitoring software has a live summary since September 7 that can viewed at http://www.egauge3169.egauge.es/5a0f6. The e-Gauge software can differentiate between plug loads, HVAC, and lighting. The energy monitoring system has a real time interface revealing potential issues every second. Also, eGauge sends facilities directors text and email alerts for unexpected demand or other costly failures (https://www.egauge.net).

2.1 Insulation

An air and weather barrier composed of 100% silicone liquid is designed to protect against air infiltration and water penetration. There is 4" of two staggered layers of rigid exterior insulation to minimize the gap in the thermal barrier and a total pre-cast wall thickness of 12".

All classrooms and offices are intentionally built on the interior of the building and away from the windows so that the hallways act as a barrier for the heat/cold. Students and staff transiently use the hallways while walking to and from classes and meetings, so a few degrees above or below normal is not a huge issue, while the classrooms and offices are occupied for longer periods of time and an optimal temperature is the goal to assist learning.

FIGURE 3. Three day eGauge real time energy window December 4–7, 2017.

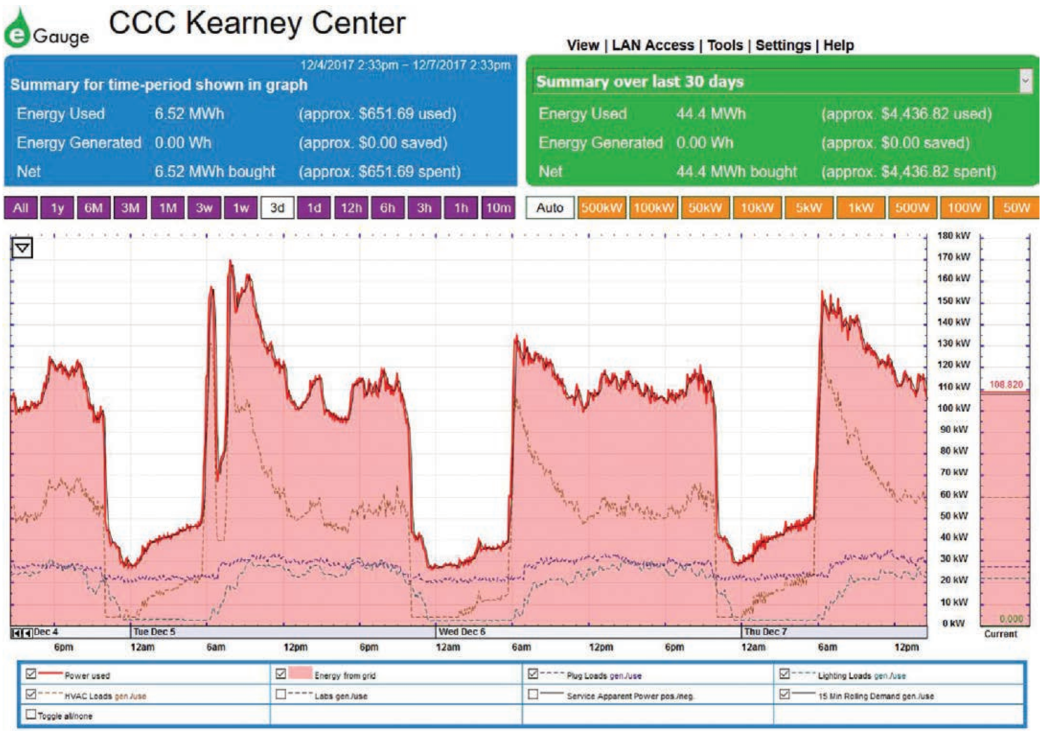


FIGURE 4. Ten minute eGauge window December 7, 2:24 pm–2:34 pm.

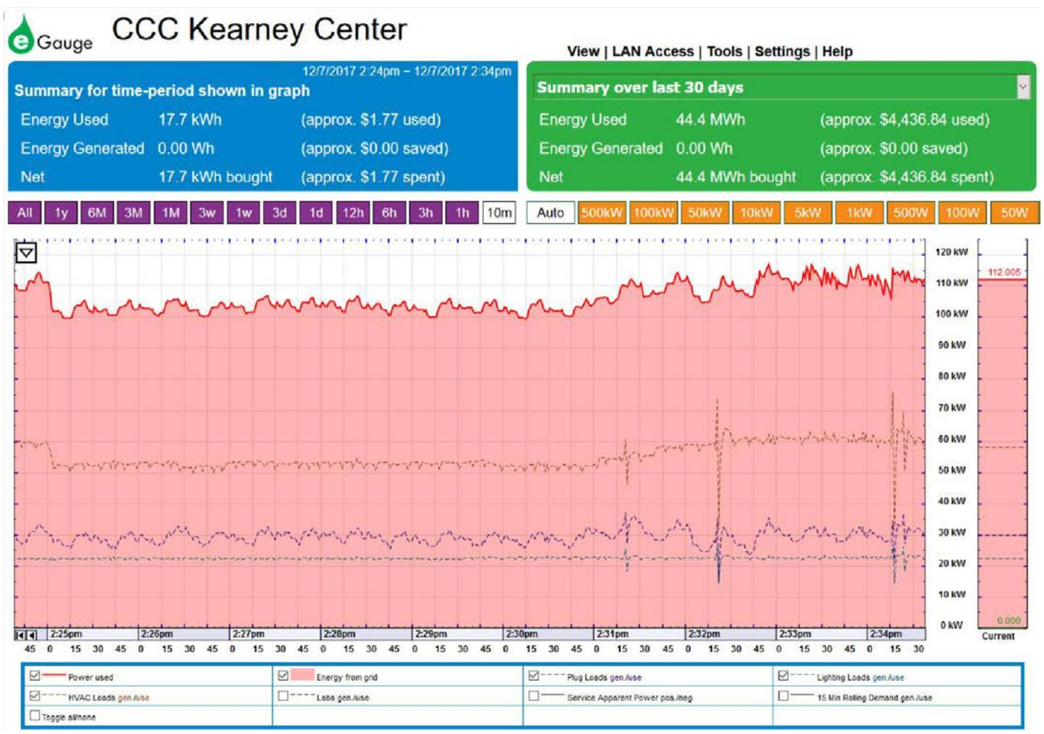
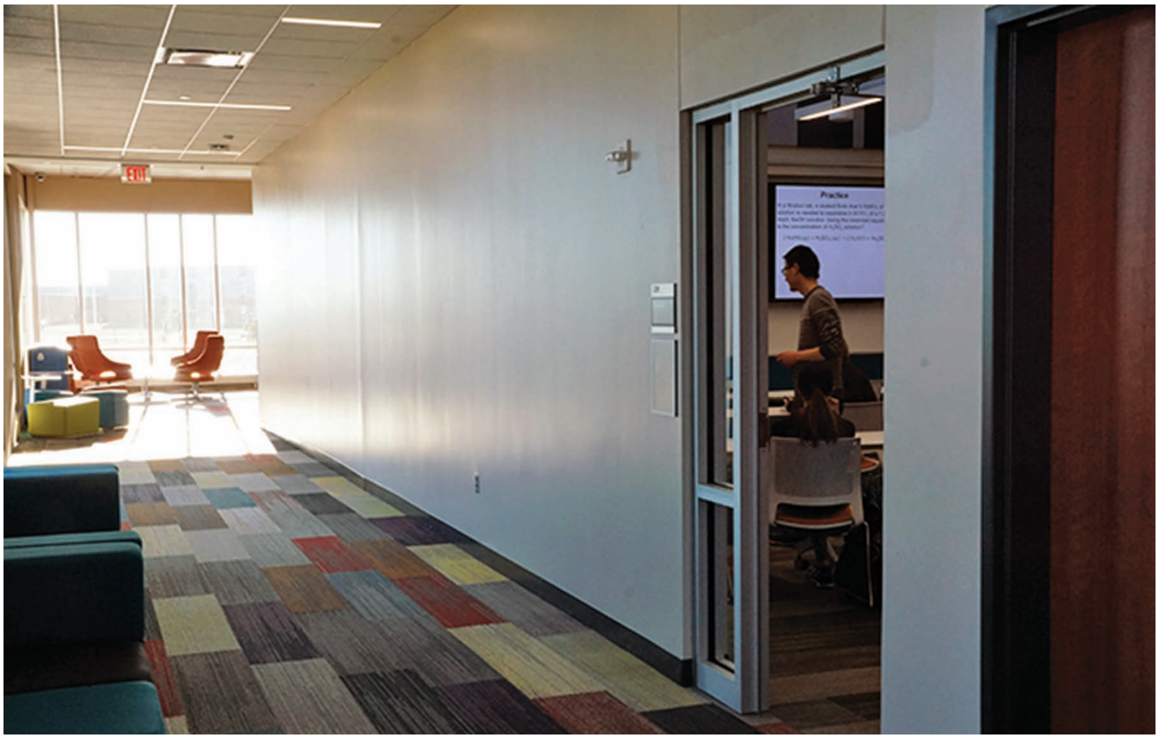


FIGURE 5. Classrooms built on interior of the building away from the windows. Photo: Scott Miller



2.2 Electrochromic Windows

The entire Kearney Center building is angled to maximize sunlight from the North. Windows that embrace natural light allow occupants to stay connected to the outdoors, resulting in increased productivity and learning. There is an electrochromic coated SageGlass on the east side of the CCC-Kearney Center for the community room, academic success center, and break room that provides an ideal tint based on the season and time of day. The tint reduces energy consumption through an electrochromic coating consisting of five layers of ceramic material by applying a less than 5-volt DC electricity, which darkens the coating as lithium ions transfer from one layer to another. The darkened glass absorbs and reradiates away heat and glare as well as blocking sun rays from fading furniture, carpet, and the interior. The transparent conductor forms a sandwich around the electrochromic layer (EC), the ion conductor (IC), and the counter electrode (CE). By reversing the voltage polarity, the electrons return to the original layer and the glass returns to its clear state. The clear state allows maximization of daylight and solar energy (http://www.sageglass.com).

The US Department of Energy includes electrochromic windows in its roadmap to achieving zero-energy buildings and estimates that electronically tintable window systems are capable of providing up to (United States Department of Energy):

- a 20% savings in operating costs
- a 24% reduction in peak demand charges
- a 25% decrease in the size of HVAC systems

FIGURE 6. Electrochromic windows at the new Kearney Center that allows and blocks natural light. Photo: Scott Miller.

FIGURE 7. Solatube mounted on top of roof. Photo: Scott Miller

FIGURE 8. Natural daylighting inside the classroom. Photo: Scott Miller

Most classes have windows, but the advanced manufacturing lab classrooms have Solatube Daylighting Systems that deliver natural light and can be dimmed. It is a capture-transfer process to deliver natural light through illumination intensity, thermal performance and light consistency (Solatube).

2.3 Mechanical Systems

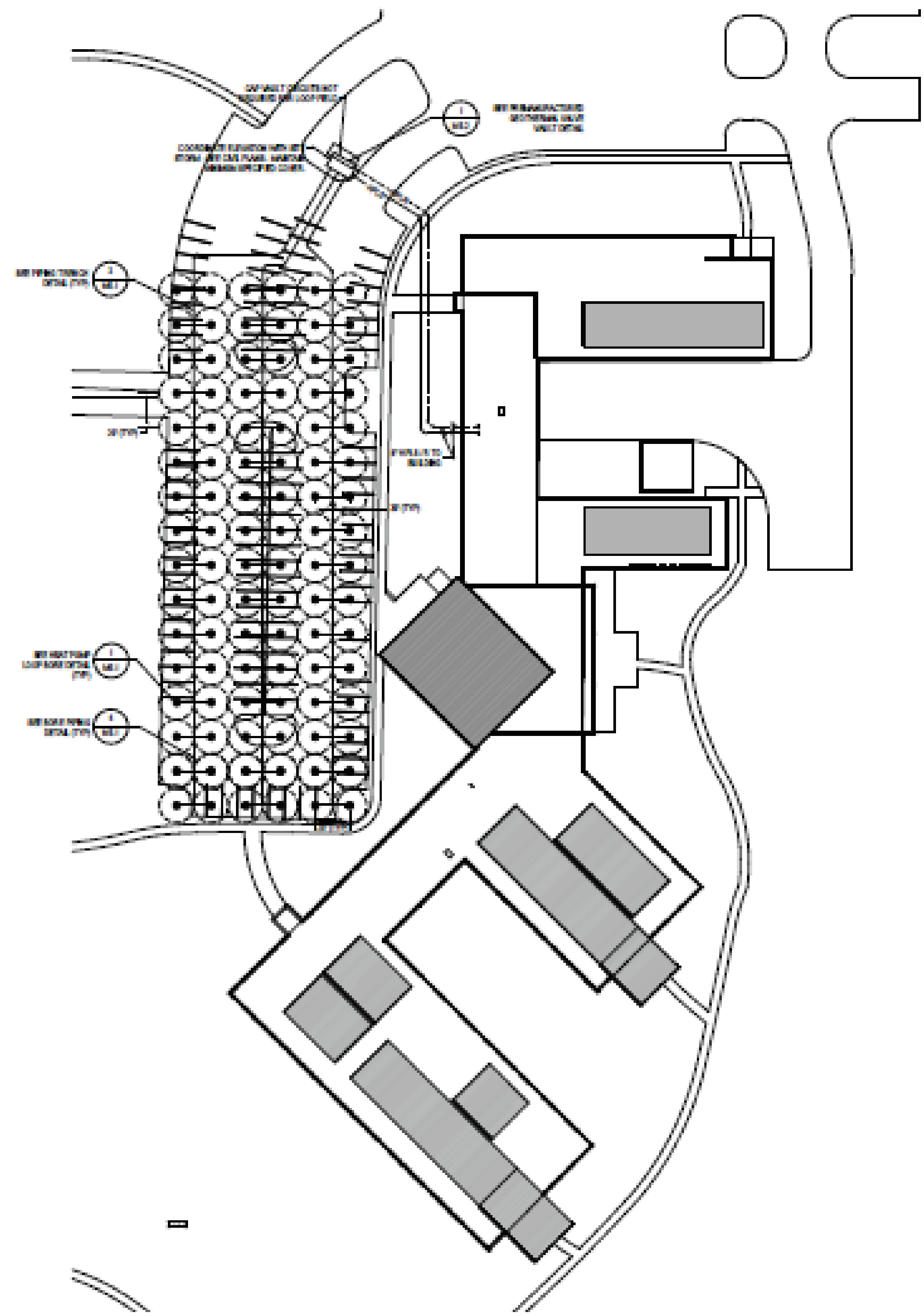
The mechanical system of the building is a closed loop geothermal heat pump system that rejects and extracts heat to and from ninety-six, 280-foot-deep wells located under the main parking lot for the building. The water loop from the wellfield serves forty-three water source heat pumps which meet the heating and cooling demands for the building. The heat pumps are all high efficiency, and utilize two stage compressors and variable speed electronically commutated fan motors to maximize part load efficiency. The heat pumps are located in mechanical rooms where feasible to enhance maintenance over the life of the building and to allow the building staff to keep the equipment operating as intended. Outside air is provided directly to the building heat pumps.

The building automation system is integrated with the lighting control system to receive occupancy inputs from the room's occupancy sensor. This is used to raise or lower each room's cooling or heating setpoints when the room is unoccupied to maximize energy savings.

2.4 Daylighting

During the design phase, the team studied building orientation, roof monitor size and location, and shading strategies to reduce solar heat gain and optimize daylighting potential. This

FIGURE 9. Geothermal Well Field (Morrissey Engineering).



analysis informed the final daylighting strategies, but reduced daylighting where excessive solar head gain began to reduce efficiency. The roof monitors were designed to completely daylight the classrooms during the day while providing an opportunity for future photovoltaics on the tilted roof. The south metal scrim perforations were designed to shade the building, and also provided a great opportunity for building signage.

FIGURE 10. Metal scrim that shields the many windows on the south exposure from direct sunlight to eliminate the greenhouse effect. Photo credit—Scott Miller

FIGURE 11. *Northwest Facing Clerestories*—Radiation Map-cooling period June 1-Oct. 1 (Morrissey Engineering). Optimal daylighting into interior teaching spaces and orientation for potential solar panels.

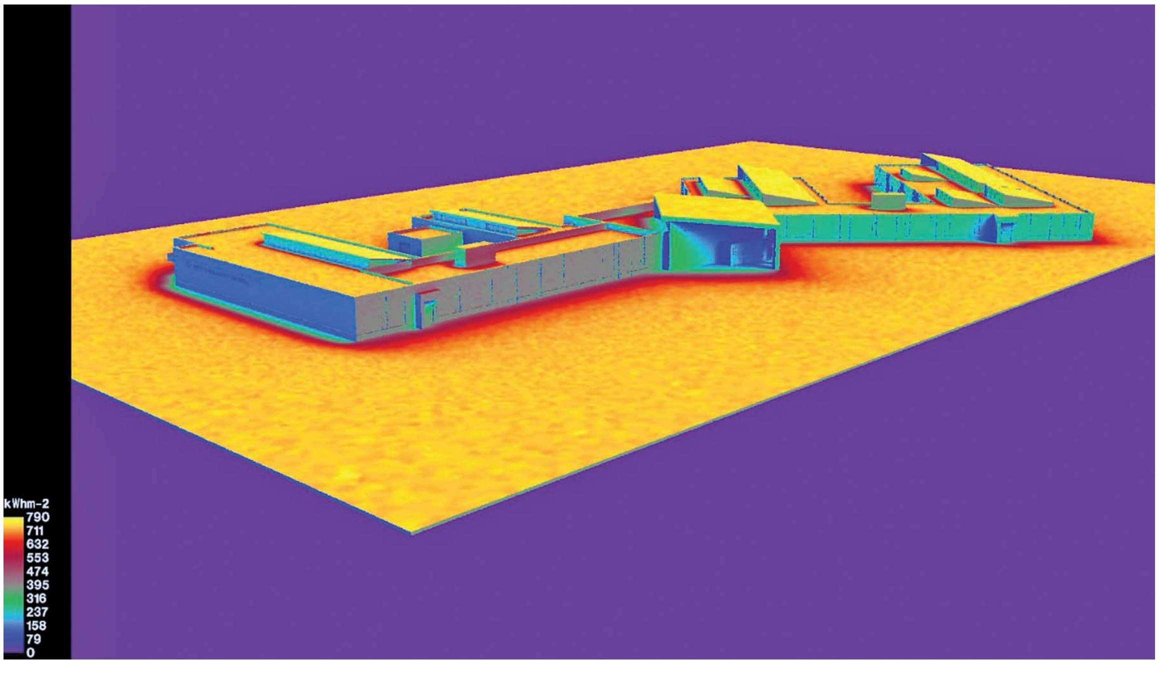


FIGURE 12. *Northeast Facades* Radiation Map-cooling period June 1-Oct. 1 (Morrissey Engineering). High performance insulated glazing to allow green views and increase biophilia and Central Community College metal scrim (see Figure 10).

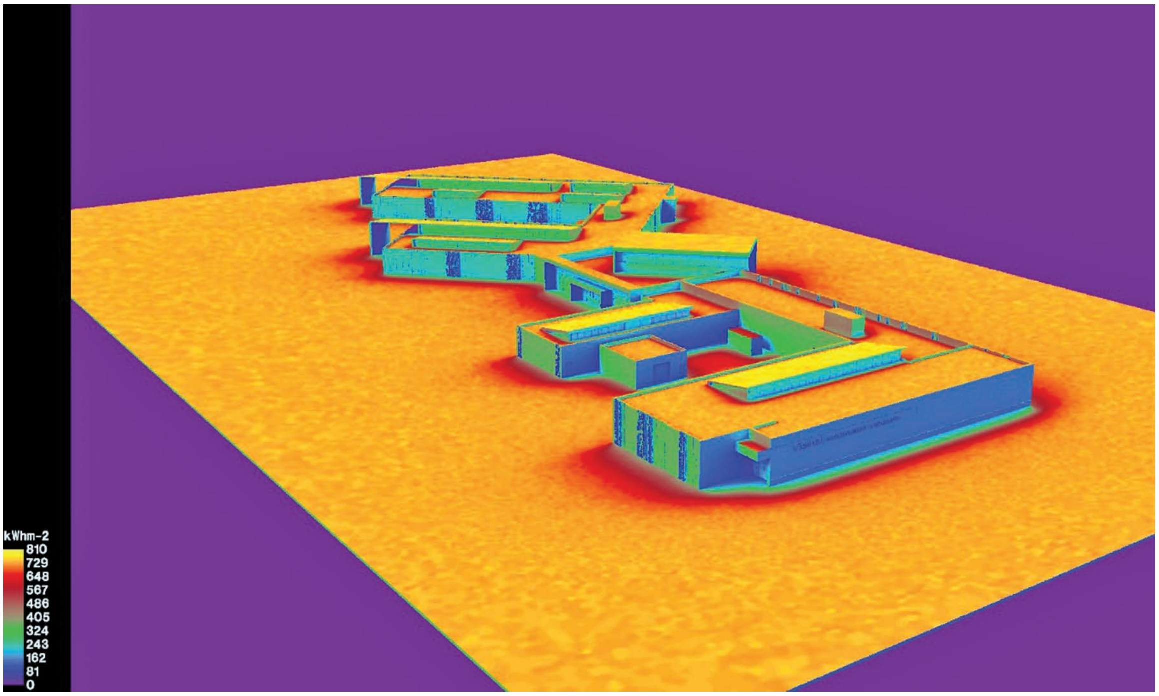
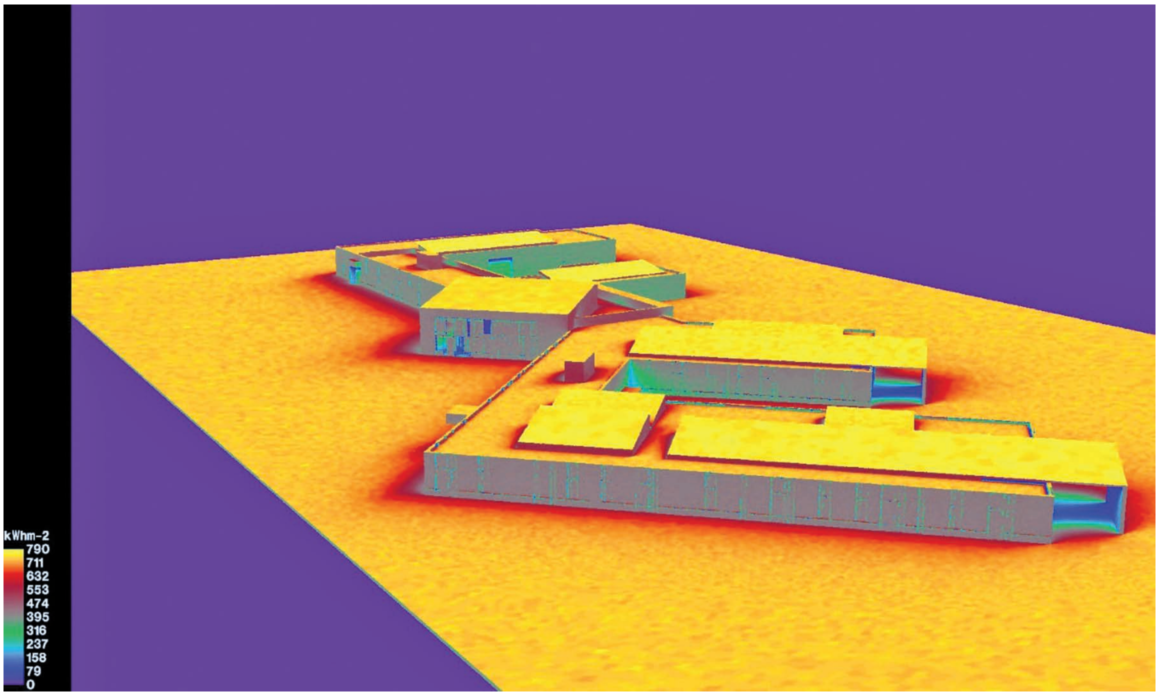


FIGURE 13. *Southwest Facades* Radiation map-cooling period June 1-Oct. 1 (Morrissey Engineering). Architectural precast wall panels with 4″ continuous insulation and fenestration pattern coordinated with screen wall and large overhangs to reduce solar heat gain.



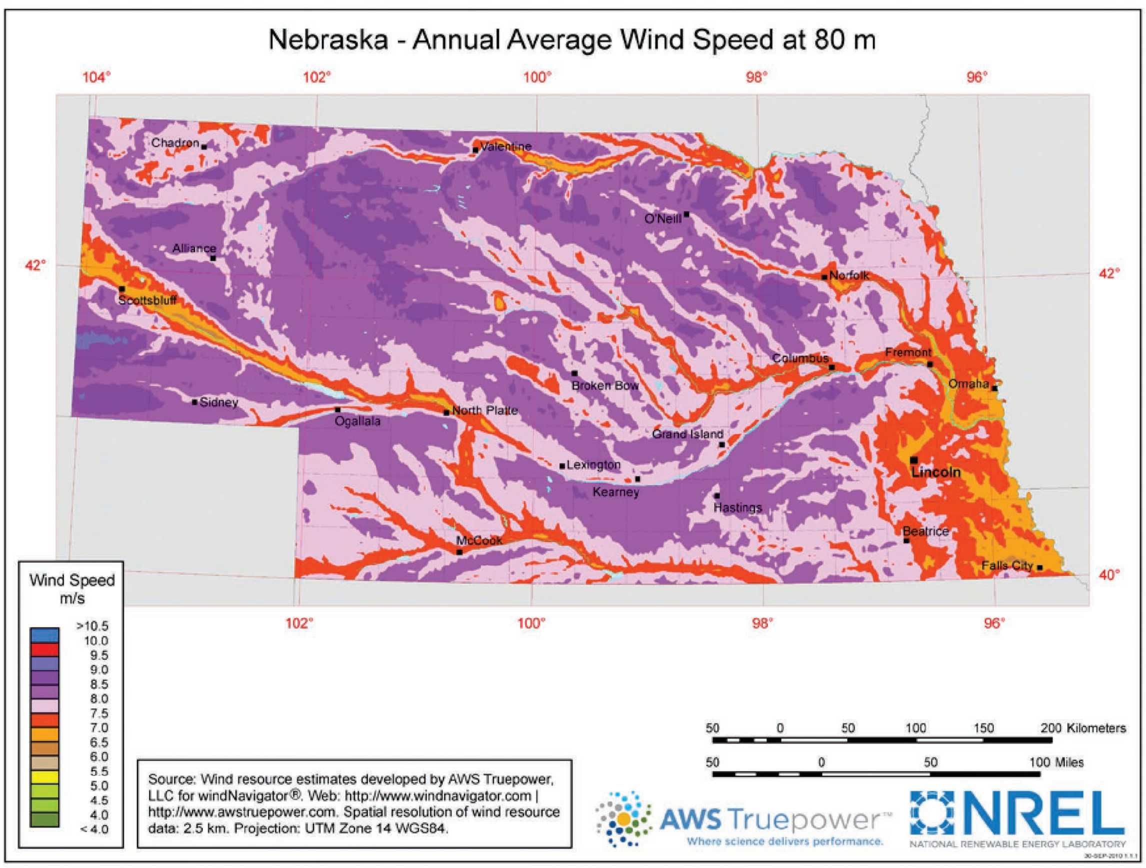
2.5 Lighting Controls

All the interior and exterior lighting is controlled and monitored by a sophisticated lighting control system. The system allows fine tuning, programming, load shedding, and daylight harvesting capabilities for maximum energy savings. An energy savings graphical user interface shows lighting energy savings over code, energy demand history, energy savings breakdown by strategy, and carbon reduction. The system also monitors plug loads to turn off unused equipment after hours or when spaces are unoccupied.

3. CARBON NEUTRALITY THROUGH KEARNEY SOLAR ARRAY

The Central Community College Kearney Center will be purchasing shares of 100% of its electricity annual load from the largest solar array project in Nebraska-Tech One Crossing located at 56th Street and Antelope Avenue, so it will be carbon neutral. The solar share energy rate power purchase agreement (PPA) is very competitive with the Nebraska Public Power District standard rate. The Kearney solar array will generate 5.8 MW, which is about 5% of the communities' peak demand. Also the University of Nebraska at Kearney will get 25% of its electricity from the solar array starting in 2018, which projects to save more than $250,000 over the next 25 years of the contract (Epley 8/16/17 Kearney Hub).

FIGURE 14. Nebraska Annual Average Wind Speed at 80 m (AWS Trupower LLC).



3.1 Future Renewable Energy

Later phases in the Kearney Center project may also include an onsite angled rooftop or ground mounted solar projects as Nebraska net metering policies evolve due to the high demand for renewable energy from communities and environmentally conscious businesses (Nebraska Public Power District, 2016).

3.2 Nebraska Renewable Energy Portfolio

Currently Nebraska is embracing clean energy being the best wind energy resource in the United States with a majority of the state annual average wind speed 8.0 m/s at 80 m (AWS Truepower, see figure 3). Also, there is no shortage of undeveloped land near smaller rural communities for solar farms. However, currently Nebraska is 39th in the use of renewables and was slower to adopt aggressive policy incentives than other states. In CCC's service district alone six new solar farms have been built in the last few years and many new large wind farms have been completed or are currently in development phases. The quick embrace is due to many Nebraska utilities being developed by local public power entities. Nebraska has the best wind energy resource in the United States and is ranked 13th in the nation with the greatest energy potential for solar power (Topline Strategy Group, 2006). The public owned utilities customers are requesting renewables or to attract tech companies' additional renewable energy resources are being added to Nebraska's portfolio for large data centers energy in rural areas.

4. NEBRASKA NATIVE ECOSYSTEM MOSAIC, BIORETENTION GARDENS, AND TRAILS

The Kearney Center will increase the mosaic of ecosystem benefits of Central Nebraska's pollinators and plant habitats, which have become fragmented due to large scale agricultural land use. The native grasses and wildflowers will take 2–3 years to become fully established and eventually will also need to be burned to provide a natural prairie ecosystem. Currently there are large swaths of low to mid-height native grass areas throughout the site to help absorb stormwater runoff which lowers the energy and labor inputs required for maintenance. There are also pockets of plug plantings located throughout native grass areas to provide immediate visual "punch" while seeded areas become established.

The Nebraska regionally hardy native plant palette are low-maintenance, able to endure cold and windy winters as well as hot and humid summers and bloom throughout three seasons to attract pollinator insects. There are fruit trees on the edge of native grass areas on the southeast side of the site.

4.1 Native Grasses and Trees

Listed below are ***some*** of the 11 total species of native grasses and canopy and understory trees of the native ecosystem, which also provide ideal shading for cooling:

*Native Grasses (not all inclusive)****:***

- Goldsturm rudebeckia
- Butterfly milkweed
- New England aster
- Plains coreopsis
- Purple coneflower

Trees (not all inclusive):

- Northwood red maple
- Bur oak
- Common baldcypress
- Pioneer elm
- Autumn brilliance serviceberry
- Vanderwolf's pyramid pine
- American sycamore
- North star cherry
- Anjou pear
- Bartlett pear
- Liberty apple
- Zestar apple

FIGURE 15. City of Kearney Parks and Recreation Trail Map. Source: Kearney Parks and Recreation Department http://cityofkearney.org/DocumentCenter/Home/View/2680.

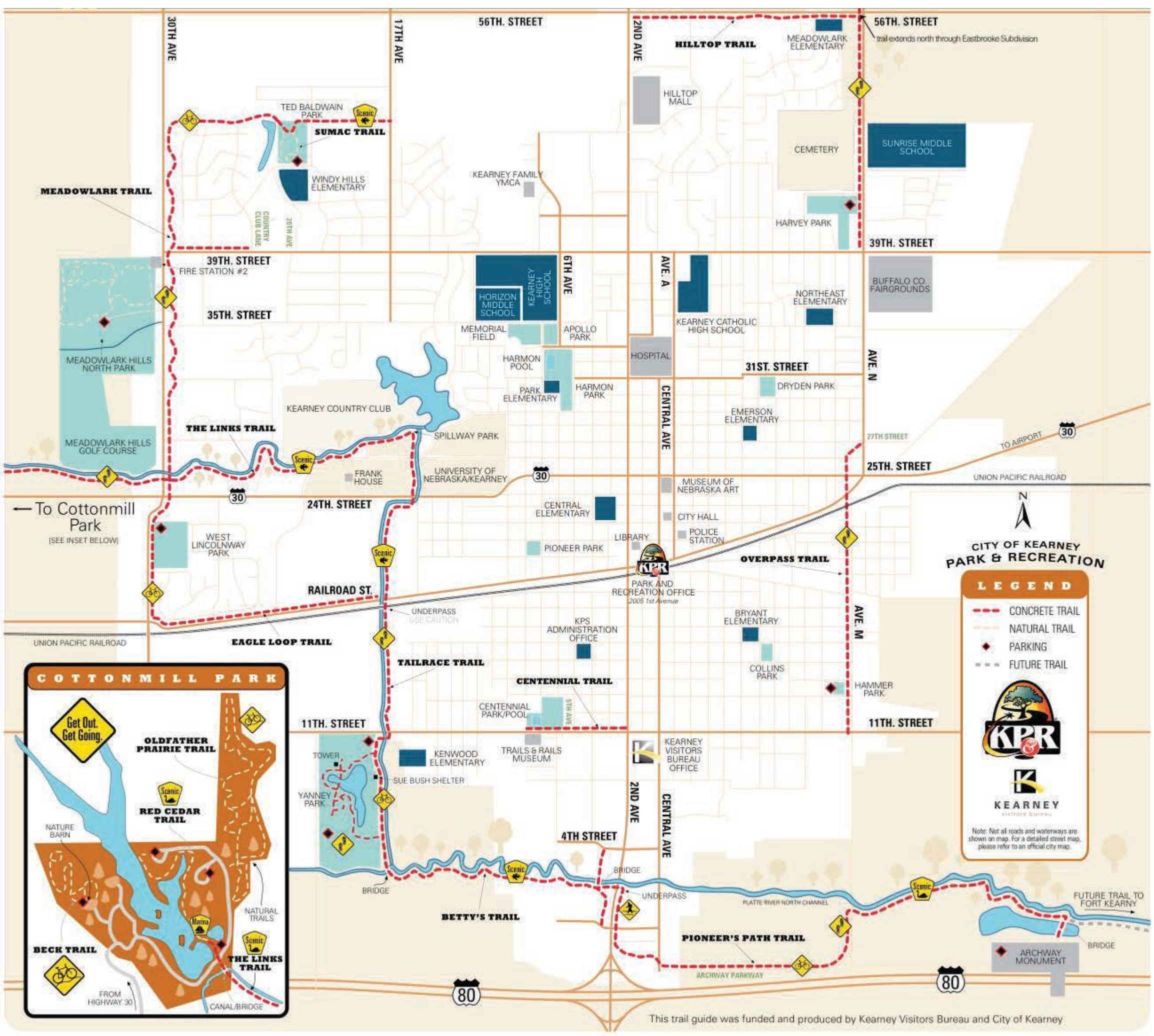


FIGURE 16. Kearney Center Site Plan.

Architect: Wilkins ADP
Landscape Architect: Big Muddy Workshop
Civil Engineer: Olsson Associates
Structural Engineer: Lange Structural Group
Mechanical & Electrical Engineer: Morrissey Engineering
And Photos credited to
Photographer: Paul Brokering

4.2 Bioretention Gardens

The CCC-Kearney Center has five bioretention gardens that help capture and treat storm water runoff before being released into on-site detention basins. The sediment traps help to collect silt/sediment at inflow pipes into basins. Although there are no current municipal requirements for water quality treatment, the bioretention gardens were sized to provide the water quality volume for 80% of the building site.

4.3 Reduced commuting emissions through public trail use

There are Kearney Recreational trail connections to Yanney Park, the north channel of the Platte River, and the University of Nebraska Kearney trail system from the facility and to the recently-constructed Kearney High School to the south. Also included are ample bike parking facilities provided on the west side of the building and a future bike share system that allows students and staff to check out a bike through an app at two other CCC campuses in Grand Island and Columbus. The trail system and bike share program will help reduce the transportation emissions footprint due to commuting, in a peak school congestion area. Finally, exterior plazas will provide opportunities for staff and students to socialize in the Nebraska native ecosystem.

5. CONCLUSIONS

Central Community College's commitment to carbon neutrality has been a team approach across multiple campuses and centers as a Cum Laude Leader and signatory of the Climate Leadership Network (previously the ACUPCC). Campus President Dr. Greg Smith had the initial vision of an Environmental Sustainability Office and committed to educate, implement and model the practices needed for a sustainable campus future. For our communities and ultimately globally, we believe environmental sustainability is important and necessary for healthy communities, people and economic sustainability.

The overall sustainability performance of the college tremendously evolved, since committing to a sustainability action plan with annual target goals in the strategic plan. Central Community College is providing students and the community with a campus-wide living learning laboratory for resiliency to climate change. Central Community College is committed to our sustainability action plan goals and is making great progress of implementing innovative sustainability strategies through operations, curriculum, policies, events, and education.

REFERENCES

CCC Kearney Center real time energy monitoring. http://egauge31619.egaug.es/5A0F6/.

Net Metering Service Rider Rate Schedule. Nebraska Public Power District. November, 2016. http://www.nppd.com/assets/nm-rider.pdf

U.S. Energy Use Intensity by Property Type. Energy Star®PortfolioManager®. March, 2016. https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf

Massachusetts Surprising Candidate for Solar Power Leadership.Topline Strategy Group, Newton, Massachusetts. 2006.

Zero Energy Buildings: A Critical Look at the Definition" Paul Torcellini, Shanti Pless, and Michael Deru, National Renewable Energy Laboratory; Drury Crawley, U.S. Department of Energy. National Renewable Energy Laboratory report: NREL/CP-550-39833. June, 2006.