




UConn | UNIVERSITY OF
CONNECTICUT

Campus Master Plan

A Appendix: **Sustainability Framework Plan**

SKIDMORE, OWINGS & MERRILL LLP
MAY, 2015





Executive Summary

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Volume 2: District Guidelines

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Overview

The University of Connecticut is committed to leadership in campus sustainability. This commitment is clearly exemplified in the depth and breadth of the environmental initiatives that the University has undertaken. These initiatives are motivated and driven by several departments, committees, task forces, and working groups, many of which are led by the Office of Environmental Policy (OEP) and overseen by the Environmental Policy Advisory Council (EPAC).

UConn's Office of Environmental Policy brings faculty, staff, students, and community members together for a more environmentally sustainable campus.

The OEP was established in 2002 "to focus on and pursue excellence in environmental performance, emphasizing sustainability initiatives ranging from climate change to water conservation and green building." UConn's Environmental Policy Statement was issued in 2004 and revised in 2007 to reaffirm a foundation in compliance with environmental laws and regulations. The policy addresses six principles: Performance, Responsible Management and Growth, Outreach, Academics, Conservation, and Teamwork. In addition, there are many academic programs, classes, and student-driven initiatives regarding environmental, energy, and sustainable development, policy, design, engineering, and technology.

Sustainability initiatives and activities at UConn have been grouped by the OEP into one or more categories, including Climate, Environmental Literacy, Progress,

Sustainable Development, Recycling, Transportation, Energy, and Water Conservation. UConn has developed a wide range of programs and policies addressing water conservation and leak prevention, composting, ecological pest and plant management, office supply procurement, green cleaning, trayless dining, sustainable food, alternative transportation, bio-diesel production, EcoMadness, Green Game Days, and other environmental awareness tours and events.

In recognition of these widespread efforts, the University has been ranked in the top ten of the Sierra Club 'Coolest School' Survey of more than 2,000 schools, ranging from small liberal arts colleges to large public and private research universities. In 2013, the University of Connecticut was ranked at #1. These rankings are based on performance in areas such as energy supply, efficiency, food, academics, purchasing, transportation, waste management, administration, and financial investments. UConn uses the widely accepted Association for the Advancement of Sustainability in Higher Education Sustainability Tracking Assessment and Rating System (AASHE STARS) to measure and report progress.

UConn issued its first Sustainability Progress Report in November 2014 and reports its Climate Action Plan progress formally through the ACUPCC website. Understanding and mapping the organizational relationship and leadership roles of OEP, EPAC, and its various working groups as well as other campus sustainability stakeholders will be essential to all future initiatives. The University's website and many supplemental pages meticulously document environmental activities, policies, and operational decisions which affect all aspects of the University.



UConn Campus Farmers Market



UConn Forestry Management Faculty



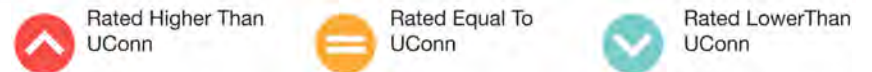
Overview

The University of Connecticut has established itself as an important member and inspiring leader of the college and university community. UConn will need to continually strive for best-in-class status across a wide range of sustainability metrics.

In comparison with peer institutions, UConn is a leader in many respects – especially in energy efficiency, green infrastructure, composting, and water conservation initiatives – but could emulate some universities' more advanced policies and achievements. According to Sierra Magazine in its aggregate sustainability rankings for 2013, when UConn was ranked #1, it led other universities cited as peers: Georgia Tech, University of Washington, UC Berkeley, UMass Amherst, UCLA, and UNC Chapel Hill. While UConn outranked these peers in the categories of energy, investment, waste, and water, each of these institutions matched or outranked UConn in the other six areas as depicted in the chart below.

Rank	Institution	Co-Curricular	Energy	Investment	Food	Innovation	Instruction/Research	Planning	Purchasing	Transport	Waste	Water
1	University of Connecticut	93%	89%	100%	71%	100%	89%	100%	47%	62%	99%	71%
8	Georgia Institute of Technology	↑	↓	↓	↑	=	↑	=	↑	↑	↓	↓
12	University of Washington	↑	↓	↓	↑	=	↓	=	↑	↑	↓	↓
26	University of California - Berkeley	↓	↓	↓	↑	=	↓	=	↑	↑	↓	↓
28	University of Massachusetts - Amherst	↓	↓	↓	↑	=	↓	↓	↓	↑	↓	↓
33	University of California - Los Angeles	↓	↓	↓	↓	=	↓	=	↑	↑	↓	↓
56	University of North Carolina - Chapel Hill	↓	↓	↓	↑	=	↓	↓	↓	↑	↓	↓

Summary of Sierra Magazine Sustainability Rankings (2013)



All peers ranked higher than UConn in transportation, mostly due to more extensive bicycling and ride-share programs. In the categories of food and purchasing, these peers were also recognized for more extensive sustainable food sourcing and purchasing programs. Most had adopted LEED Gold as their benchmark for new construction and renovation. Many had developed well-used centralized sustainability information systems which tied various programs together for easy access by students, faculty, staff, and visitors. All had signed the ACUPCC and set carbon neutrality goals similar to UConn.

Among these schools, only UMass Amherst has a similar climate and setting to UConn. In most categories, #1 UConn scored the same or better, but #28 UMass Amherst rated higher in sustainable food and transportation initiatives, including its partnerships with local permaculture gardens and organic farms as well as an established bikeshare program.

UConn's nearest ranked peer was #8 Georgia Tech, which mandated LEED Gold and the use of its "Yellow Book" sustainable design guidelines. It engaged in a variety of transportation partnerships and features CNG powered buses and an on-line cycling community, "Bike GT." Its Green Buzz site was a centralized resource for informing, showcasing, and encouraging green behaviors, activities, initiatives, and events. #12 University of Washington won the International Sustainable Campus Network 2014 Excellence in Integration Award for demonstrating sustainability management in campus operations, research, teaching, and community outreach. #26 UC Berkeley had reduced its greenhouse gas emissions to 1990 levels and reported its buildings' energy dashboard performance on-line. UCLA ranked #33, but outshined UConn with its LEED Gold requirement and bicycle-friendly programs.

Finally, #56 UNC Chapel Hill gained recognition for its progressive stormwater management practices, employing green roofs, cisterns, infiltration beds, permeable pavement parking lots, and reclaimed cooling tower water.

In 2014, Sierra Club ranked UConn #9, securing a top-ten spot for the third consecutive year – an honor shared only by 3 other schools in the country. UConn has established itself as an important member and inspiring leader of the college and university community. To maintain its leadership in this or other ranking systems, UConn will need to continually strive for best-in-class status across a wide range of sustainability metrics.



Students at Spring Valley Farm



UConn Depot Campus Fuel Cell

Drivers and Planning Considerations

UConn is currently implementing efforts to meet its carbon neutrality commitment by 2050, but finds that more administrative support, operations and maintenance resources, and continuity independent of student matriculation are necessary to continue on the correct trajectory. In order to meet this ambitious goal, every new infrastructure, landscape, transportation, and building project will endeavor to achieve net zero site energy. Driven by NextGenCT and the emphasis on STEM growth, UConn faces an even greater challenge to approach every new project as an opportunity for climate-positive design, engineering, and construction with awareness of UConn's unique ecosystem and biota in their regional context.

Currently, UConn measures and reports its building-related emissions reductions in avoided tons of CO₂ annually. All new building projects will need to be exceptionally efficient while integrating some form of renewable energy. New and existing buildings will need energy metering systems to properly measure and verify energy efficient performance. Comprehensive energy assessments of existing buildings will quantify energy use intensity to help prioritize retrofitting and recommissioning projects. UConn's carbon accounting will need to be enlarged to encompass more Scope 3 emissions, like those from faculty and staff travel, and credits, such as offsets from green space enhancements. The integration of green roofs and walls as well as the preservation and planting of trees will need to be quantified for carbon offsets. Every planning and purchasing decision has a potential impact on UConn's carbon footprint.

The method for attaining this level of climate-positive development will depend on the adoption of stronger sustainable design policies and standards. All projects are recommended to meet LEED Gold criteria and an EPA

Energy Star Portfolio Manager score of 75, at minimum, with an emphasis on achieving LEED Platinum or other, more stringent certification. This includes consideration of LEED for Multiple Buildings and Campuses and LEED for Existing Buildings Operation and Maintenance as useful guidelines. All design, engineering, and construction teams will need to be accountable for contributing toward this goal through the implementation of continually improving design and technology standards.

This progressive approach to infrastructure and building may be facilitated by a carbon avoidance incentive program. Carbon avoidance, which is markedly different from carbon offsetting, provides a value proposition for the initial elimination of carbon emission. An example of this would be reduced parking cost for a zero-emission vehicle. Carbon offsets are typically purchased by consumers of fossil fuels and make a reduction in emissions in order to compensate for an emission made elsewhere. As demonstrated by the College of the Atlantic and Princeton University, carbon emissions can be correlated with a dollar value to balance investment in highly efficient buildings and renewable energy projects. This approach can be applied to purchasing policies, sustainable food programs, and parking strategies to help drive decisions that can measurably reduce carbon impacts. These kinds of progressive policies and financial strategies will be needed to help UConn move steadily toward its sustainability goals.

While energy is a critical concern in the pursuit of carbon neutrality, the Phase 1 Sustainability Workshop with EPAC (April, 2014) also identified water, land, materials, and movement as areas of focus for this 20-year plan. The active engagement of students, faculty, staff, and the Storrs community is an essential element of this vision, common to all the areas of focus. The ongoing initiatives organized by EPAC and various student-

driven sustainability activities raise awareness and enthusiasm for making measurable improvements. The neighboring community of Mansfield has undertaken its own "Mansfield Tomorrow" plan for development and preservation. UConn's approach to sustainable design and growth can support Mansfield's eventual environmental goals.

This framework closely supports the Academic Plan for excellence in research and scholarship, undergraduate and graduate education, teaching effectiveness, and public engagement by operationalizing sustainability at all levels. Climate-positive policies and development will open new opportunities for research and inter-departmental study. The following section organizes several recommended strategies for five interrelated Areas of Focus:

- Energy
- Water
- Land
- Materials
- Movement

Each of these areas of focus must also consider five key qualities or attributes for each strategy, necessary for sustainable and climate positive development:

- Adaptability – addressing changes in program and usage
- Scalability – fitting a range of micro to macro needs
- Vitality – serving human and environmental health and well-being
- Connectivity – relating across academic and operational departments, as well as among districts, campuses, and neighboring communities
- Resilience – designing for durability and reliability to withstand extreme climate and unanticipated challenges



Sustainability Areas of Focus

Summary

This summary includes key points contained in the subsequent report sections, which discuss the five areas of focus for sustainability in this Master Plan. These areas of focus help structure the overall framework for sustainability at UConn, bringing a myriad of diverse initiatives under simple umbrellas to help support its development and implementation.

The pages that follow describe in more detail the concepts of the Sustainability Framework in a matrix format. These matrices provide a concise view of each area of focus. The main objective or challenge for a given area of focus is stated at the top of the matrix along with a list of campus goals and assessments of progress. The matrix also outlines actions for the current campus and near term, as well as actions for the long term.

The objective statement highlights the high-level challenge and goal for each area of focus while the action items represent campus-focused recommendations and provide a basis for moving forward with the Master Plan in the context of sustainability. More specific district-level recommendations are contained in the District Guidelines document.



Sustainability Area of Focus

Energy



Achieve carbon neutrality by 2050

CAMPUS GOALS	CURRENT AND NEAR TERM	LONG TERM
<ul style="list-style-type: none"> • Focusing on energy use is crucial for UConn to serve its Climate Action Plan and its carbon neutrality goals. The University needs to immediately move toward carbon neutral buildings, especially given anticipated growth. • All new construction targets LEED Gold and a score of 75 or better on EPA’s Portfolio Manager. LEED Platinum and more stringent benchmarking systems can serve as stretch goals to meet carbon neutrality by 2050. • Reduction of fossil fuel use to power, heat, and cool buildings and drive transportation reduces carbon emissions and yields energy independence. • STEM labs and residence halls with higher energy use intensity (EUI) may benefit from ground source/ air source heat pump hybrid systems, less energy intensive buildings may benefit from variable refrigerant flow technology. • Careful siting and orientation of buildings mitigates heat island effect and improves thermal comfort and energy performance. • On-site renewable energy systems will be required. The UConn Renewable Energy Preliminary Feasibility Study and Strategic Plan (RESP) studied renewable energy on campus and is intended to encourage the proliferation of these energy sources. Solar hot water systems may be useful for residence halls with significant domestic hot water demands. Fuel cells, geothermal, and ground source heat pumps are also potentially viable but require further evaluation on a site-specific basis. Particularly viable technologies for the region, whether installed on-site or off-campus utilizing purchase power agreements and virtual net metering, are solar photovoltaics and wind power. For wind to be cost-effective, it must be installed at a larger scale and located optimally. 	<ul style="list-style-type: none"> ❑ Sub-meter and smart-meter buildings, in order to track energy consumption, manage for maximum efficiency, and reduce carbon impact ❑ Design new buildings to achieve LEED Gold certification using the appropriate LEED rating system ❑ Retrofit energy consuming systems in all existing buildings ❑ Establish appropriate energy use intensity targets for all building types ❑ Refer to RESP for near term renewable and clean energy projects with proven viability ❑ Follow Climate Action Plan and associated acceleration proposals to remain on planned trajectory 	<ul style="list-style-type: none"> ❑ Connect all buildings to central monitoring and control system ❑ Commission all new buildings to ensure proper energy usage and control ❑ Implement energy efficient systems in new construction projects ❑ Integrate appropriate renewable and clean energy technologies ❑ Implement more stringent benchmarking and building rating systems as they become available and applicable ❑ Review Climate Action Plan and accelerate as needed to maintain trajectories toward neutrality

Sustainability Area of Focus

Water



Minimize potable water consumption and optimize rainwater management

CAMPUS GOALS	CURRENT AND NEAR TERM	LONG TERM
<ul style="list-style-type: none"> • Water conservation is a key part of the University’s sustainability program and usage minimization, reclamation, and reuse will need to continue. • With new connections to a water main extension, water supply is expected to meet or exceed demand through the next 20 years, but potable water use reductions are still necessary to meet sustainability goals. • UConn targets a potable water use reduction of 40% in the next 10 years. This typically requires aerators, ultra-low flow fixtures, and process water reductions. • Greywater or stormwater reuse systems will mitigate potable water use. Rainwater can serve as a harvestable and useful resource. • Water reclamation facility can reduce peak potable water demand by 20% when operating properly but must be seasonally optimized to address inconsistent water quality. • Reducing irrigation needs by planting drought-tolerant species decreases the peak demand loads. • Addressing stormwater quality, quantity, and drainage issues on-site, rather than conveying drainage off-site, is a priority. • UConn is currently targeting volume of stormwater runoff reduction by 2021, but these calculations do not consider the impact of NextGenCT or other STEM development on the campus. • It will be necessary for UConn to continue implementing green infrastructure and low impact development (LID) strategies as standard practice. 	<ul style="list-style-type: none"> ❑ Establish appropriate water consumption targets for all building types ❑ Meter all buildings and track water consumption ❑ Upgrade to ultra low-flow fixtures in all existing buildings ❑ Implement landscape to minimize or avoid irrigation ❑ Engage student and faculty further in water conservation practices ❑ Detect and repair all system leaks ❑ Optimize water reclamation facility to meet operational potential 	<ul style="list-style-type: none"> ❑ Design new buildings to meet or exceed water savings target ❑ Capture and reuse rainwater and greywater to offset potable water usage ❑ Reduce process water use from food service, laundry, and cooling towers

Sustainability Area of Focus

Land



Preserve campus biota (or ecosystems) and enhance landscapes and landholdings

CAMPUS GOALS	CURRENT AND NEAR TERM	LONG TERM
<ul style="list-style-type: none"> • Proper land management, especially when coordinated with utility projects, contributes to resilience during significant weather events. • UConn continues to provide research to the State to inform the Stormwise Management Practices program. • Providing human scaled, walkable pathways improves movement through campus and provides unique opportunities for well-distributed and maintainable utility infrastructure. Underground electric utilities are an aspiration of the University and are pursued to promote climate resilience, public safety, and maintain valuable viewsheds. • Sustainable Sites Initiative benchmarking system is adopted for major site developments, which complements LEED certification. • Continue to revitalize brownfields, such as the Depot Campus, and preserve and restore natural areas around Hillside Environmental Education Park, a former landfill, as a preferred alternative to developing greenfields. • Prime farmland lost to development is replaced. UConn has a rich agricultural past and continues to provide education and development of new agricultural practices and technologies, including sustainable farming and scalable food production. • Water quality issues are addressed through land area modifications – vegetated swales, roofs, and walls reduce and treat runoff, and impervious areas are disconnected from water bodies. • Landscape is used to impact building energy use where green roofs and appropriate plantings provide insulation and shading to buildings which may otherwise have significant solar loads. 	<ul style="list-style-type: none"> ❑ Use the Sustainable Sites Initiative, either independently or in conjunction with LEED, to develop landscape in a beneficial and measurable way ❑ Complete Hillside Environmental Education Park expansion ❑ Continue to participate in Arbor Day Foundation Tree Campus USA program and integrate with UConn Forestry ❑ Install pervious surfacing materials as standard practice ❑ Consider green roofs and high SRI roofs for all new buildings ❑ Require low or zero irrigation landscaping for new developments ❑ Continue to advance LID and green infrastructure initiatives ❑ Expand and enhance campus forests, woodland corridors, and the campus arboretum as a learning landscape ❑ Maintain and improve existing green space ❑ Replace prime farmland lost to development ❑ Move to district and campus-wide approach to LID and green infrastructure via woodland corridors, pervious paving, and other strategies ❑ Increase support for UConn Forestry program 	<ul style="list-style-type: none"> ❑ Analyze the potential for underground utilities and implement as appropriate ❑ Develop Depot Campus as a remediated brownfield and sustainable community ❑ Experiment with alternative surfacing and landscaping techniques to reduce impervious cover ❑ Address steam line issues that may pose hazardous material/brownfield risk

Sustainability Area of Focus

Materials



Encourage environmentally preferable materials procurement, usage, and waste reduction

CAMPUS GOALS	CURRENT AND NEAR TERM	LONG TERM
<ul style="list-style-type: none"> • Vendor code of conduct is reviewed and revised regularly to accommodate changes in vendor products and policies. Lifecycle assessments guide UConn’s purchasing decisions. Material is biodegradable, recycled, and low- or non-emitting whenever possible. • Buildings are evaluated to determine if demolition or renovation is more appropriate and waste is salvaged for reuse on campus to reduce virgin material demand, or otherwise diverted from landfills or incinerators. • Embodied carbon of new buildings is balanced carefully against potential insurmountable energy challenges for existing building retrofits. • Food served is healthful and grown on or near campus. This promotes freshness and seasonality and reduces food cost /carbon footprint. • UConn expands current food related programs, including current composting practices, and composts all biodegradable food waste by 2035. • Recycling programs are continuously improved, and UConn develops comprehensive strategies for increasing overall diversion rates, including waste reduction and reuse practices, such as purchasing standards that minimize packaging. • The Sustainable Design Guidelines and associated policies are revised to incorporate more stringent benchmarking targets. UConn adopts LEED Gold certification as a minimum performance standard for construction – similar to its peers. • EPA Energy Star Portfolio Manager and other progressive benchmarking systems are implemented for some development projects. • Local procurement is prioritized and encourages market transformation and economic development. 	<ul style="list-style-type: none"> ❑ Develop procedure for evaluating demolition and redevelopment projects and materials ❑ Review vendor code of conduct annually ❑ Strengthen the Sustainable Design Guidelines and other policies with regard to material procurement ❑ Continue to emphasize local, sustainably grown food and vegetarian options ❑ Buy local when option is available ❑ Enhance existing recycling programs and begin to emphasize reductions in packaging to minimize the initial waste stream ❑ Adopt LEED Gold certified as a minimum performance standard ❑ Enrich ongoing recycling and waste management initiatives ❑ Develop procedures for standard lifecycle assessment on purchases 	<ul style="list-style-type: none"> ❑ Identify opportunities to influence market change where UConn has purchasing power ❑ Expand composting practices and equipment ❑ Adopt building benchmarking systems which are stringent in the building materials category ❑ Leverage UConn’s agricultural knowledge to retain and enlarge the sustainable food program and increase on-campus sustainable farming ❑ Expand Ecohouse experience to include gardening and small scale food production

Sustainability Area of Focus

Movement



Incentivize transit and alternative modes of transportation to reduce related emissions

CAMPUS GOALS	CURRENT AND NEAR TERM	LONG TERM
<ul style="list-style-type: none"> • Future growth necessitates measures to avoid increased parking demand and worsened traffic congestion. Solutions must contribute to carbon neutrality goals. • Reducing single occupancy vehicles is critical. Shuttle and bus services are accepted as desirable, reliable alternatives to driving. Routes are streamlined, there are plentiful covered waiting areas, and electronic tracking access is available. • UConn is integrated with local and regional transit service. • Parking is covered and vertically stacked. A comprehensive plan to assigns proper value to parking, establishes a graduated rate structure, and electronic parking management system that leverages peak demand and proximity to the campus core. • UConn’s fleet is alternatively-fueled, hybrid, or electric. Fuel costs and air/noise pollution decrease. Fleet vehicles are sized for purpose, small buses make frequent loops to promote convenience, deliveries are centralized and shuttled to their final destination. • Prioritizing pedestrians fosters a culture of carbon-responsible campus travel. Walking is safe and connects users to nature, while campus walks are connected to a larger trail network for increased utility. Photovoltaic and full-cutoff site lighting reduces energy consumption and addresses light pollution. • UConn is a League of American Bicyclists Bicycle Friendly University. Bicycle sharing is improved via more convenience and availability. 	<ul style="list-style-type: none"> ❑ Assess the impact of future growth on transit needs ❑ Improve bus and shuttle services by providing more frequent service, better service communication, and more accommodating service infrastructure, such as sheltered waiting areas and enhanced user interface options ❑ Continue to purchase alternatively fueled vehicles under the existing DOT grant ❑ Minimize footprint of all new parking structures ❑ Meet the criteria for a Bicycle Friendly University ❑ Streamline and separate vendor delivery and distribution system and schedule ❑ Develop an enhanced seasonal facilities plan to improve pedestrian pathways and transit stops during winter and summer months ❑ Strategize and implement a campus lighting plan to address safety, energy use, and aesthetics ❑ Enact a strong bicycle sharing service on campus and begin to implement more bicycle infrastructure within roadway projects ❑ Link to the larger bicycle network in the local and regional context ❑ Fully integrate bicycle transportation infrastructure within all campus districts ❑ Prioritize near-term routes to make biking more viable in the very near future 	<ul style="list-style-type: none"> ❑ Connect to the regional rail system ❑ Implement intelligent system for vendor deliveries, warehousing, and campus distribution via small vehicles on campus ❑ Design and install renewable energy and green infrastructure on new parking lots and structures ❑ Move fully toward alternatively-fueled fleet ❑ Manage parking demand to address long-term growth with smart parking systems and improved wayfinding

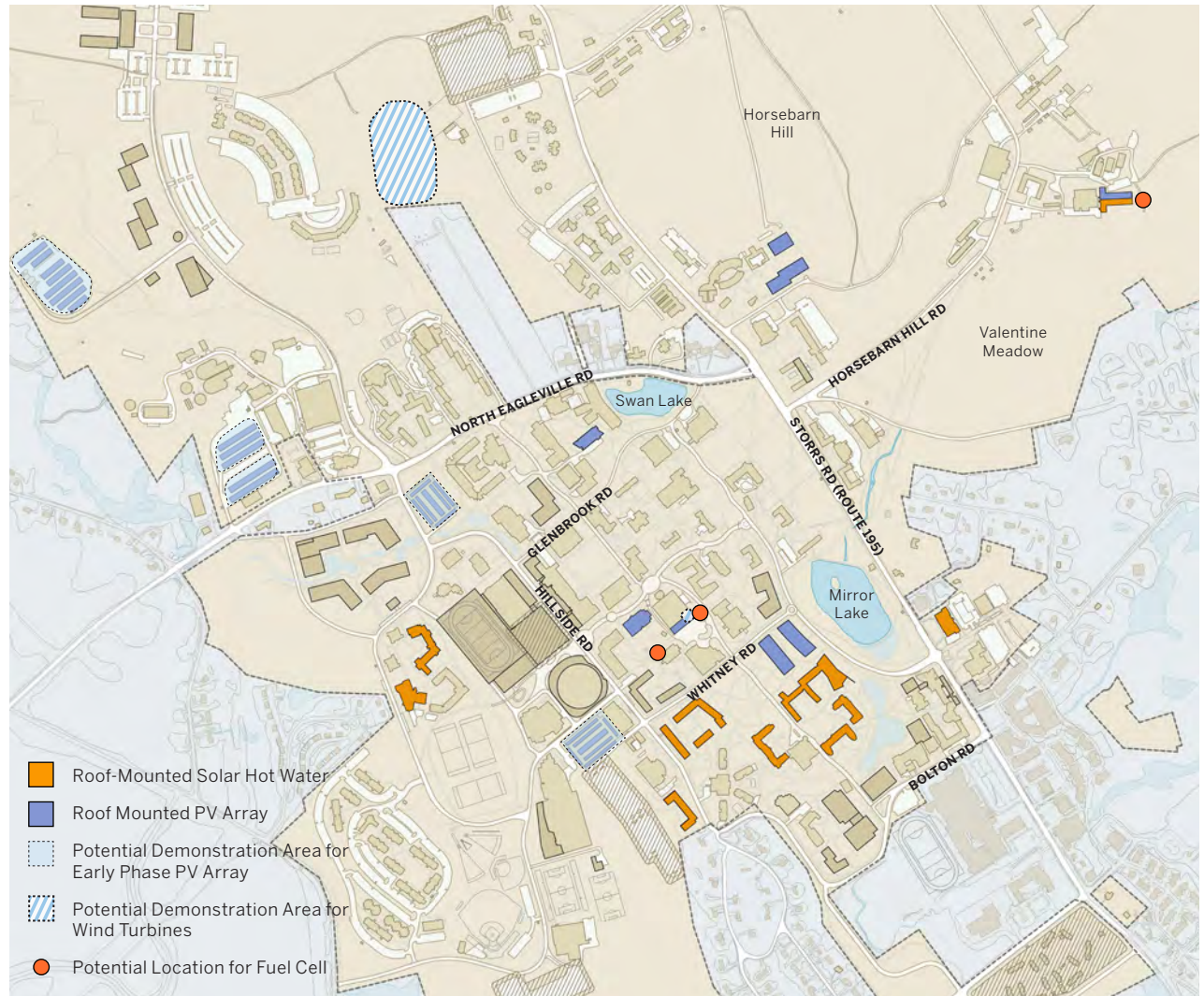
Area of Focus

Energy

Focusing on energy use is crucial for UConn to serve its Climate Action Plan, which was adopted in 2010 and serves to propel UConn toward its carbon neutrality goals by 2050. In 2012, President Susan Herbst reaffirmed the American College and University Presidents' Climate Commitment (ACUPCC) and pledged climate neutrality by 2050 at UConn's Main Campus. At that time, UConn also reaffirmed the Climate Action Plan with more than 200 action items ranked by relative feasibility and greenhouse gas reduction potential. This reaffirmation included an amendment to the plan which added a section related to climate adaptation which is intended to further drive UConn using its expertise and resources to make communities more resilient to the effects of climate change.

In collaboration with CT DEEP and US EPA, UConn has created the Connecticut Institute for Resiliency and Climate Adaptation, based at the Avery Point regional campus. UConn has also formed the Climate Adaptation Academy in partnership with CT Sea Grant and NOAA. This program is designed to promote exchange of information between researchers, municipal officials, and other professionals through research, policy development, and practical means, such as workshops.

The University will need to immediately move toward carbon neutral buildings to meet the goals of these ambitious programs and policies, especially given anticipated growth and the fact that buildings being planned now will remain operational and contribute to campus performance through 2050. In the next ten years, it is recommended that UConn begin transitioning to dual fuel systems, convertible natural gas systems, and micro-turbines. The 20-year goal will be to reduce fossil fuels significantly with a long term goal of eliminating them completely and move entirely to clean or renewable energy sources.



Potential Deployment of Renewable Energy Technologies

UConn has already taken on significant initiatives to address energy use on campus. To date, the University has retro-commissioned 19 and re-lamped 115 existing campus buildings, eliminating 17,000 tons of CO₂ annually and reducing UConn's carbon footprint by 12% of its 2007 baseline. A fuel cell microgrid is planned at the Depot Campus and the 25MW cogeneration plant at the Main Campus has been successfully integrated into the infrastructure. However the cogeneration plant is operating at capacity and will require supplementation, especially for chilling, to serve expected growth. The University has also embarked on an Energy Services Performance Contract (ESPC) in order to identify and implement through building performance audits certain building improvements, which can reduce energy consumption and costs.

UConn, in cooperation with the Connecticut Center for Advanced Technology, completed a Renewable Energy Preliminary Feasibility Study and Strategic Plan (RESP) in 2012, which studied renewable energy on campus and is intended to encourage the proliferation of these energy sources. This document evaluated six renewable and clean energy sources – solar thermal, photovoltaic wind, geothermal, fuel cells, and biofuel technologies – and their potential for application at UConn. The study yielded possible locations and sizes for installations and began to identify where more investigation might be warranted. Technologies found to be particularly viable in this climate are photovoltaic arrays (either building or site installed) and solar hot water systems, which are particularly useful for residence halls where domestic hot water demand can be significant for most of the year. It is recommended that UConn further study domestic hot water demands to guide the implementation of solar thermal systems, especially in residence hall applications. It is recommended that the RESP be periodically reviewed over the next 20 years as renewable

technologies evolve. Additionally, UConn would benefit from a comprehensive assessment of the energy use intensity of existing buildings to identify and prioritize energy optimization projects to eliminate unnecessary consumption. Building energy upgrades should include enhancements to improve the Central Utility Plant's steam, condensate, and chilled water piping, eliminate leakage at building envelopes, and reduce emergency power loads. On-site renewable energy systems will be required for UConn to meet energy and carbon reduction goals, and elimination of fossil fuel use in buildings and transportation is necessary for the University to reduce carbon emissions and gain energy independence.

The careful siting and orientation of buildings with regard to their landscape will mitigate heat island effect and further improve thermal comfort and energy performance. Design teams should consider advanced envelope strategies to optimize the passive energy performance of buildings as well as new and emerging mechanical and electrical system technologies. New parking facilities offer the potential for large-scale, canopy-mounted photovoltaic systems. STEM labs and residence halls, which will have higher energy use intensity (EUI), may benefit from ground source/air source heat pump hybrid systems, where less energy intensive buildings can benefit from variable refrigerant flow (VRF) technology. Geothermal and ground-source heat pumps are potentially viable but require evaluation on a building-specific basis to confirm appropriate geotechnical and geothermal characteristics. UConn Facilities is supportive of the use of geothermal systems and the University would like to investigate completing some economically feasible projects in the immediate future. Wind energy was also identified as viable in the RESP and may contribute to overall energy reduction; however, wind as a resource at UConn must be analyzed on a project basis, specified using the

proper technologies, and sited carefully. Typically in the Northeast, the most cost-effective wind power strategy is at a large scale, such as an array of wind turbines on a ridge with reliable wind. Smaller, building-mounted wind power systems may have project-specific potential.

Transportation emissions and energy use are projected to decrease as the UConn fleet converts hybrid or electric vehicles. UConn holds a Connecticut Department of Transportation Clean Fuel Grant which offsets a portion of the cost of clean fuel vehicles. The University has already begun the process of gradually replacing gas/diesel fleet vehicles with alternative fuel vehicles. Biomass and commercial bio-diesel have been studied and, according to the RESP, can be considered for deployment at UConn in the form of biomass gasification of certain organic wastes and bio-diesel from waste oil.

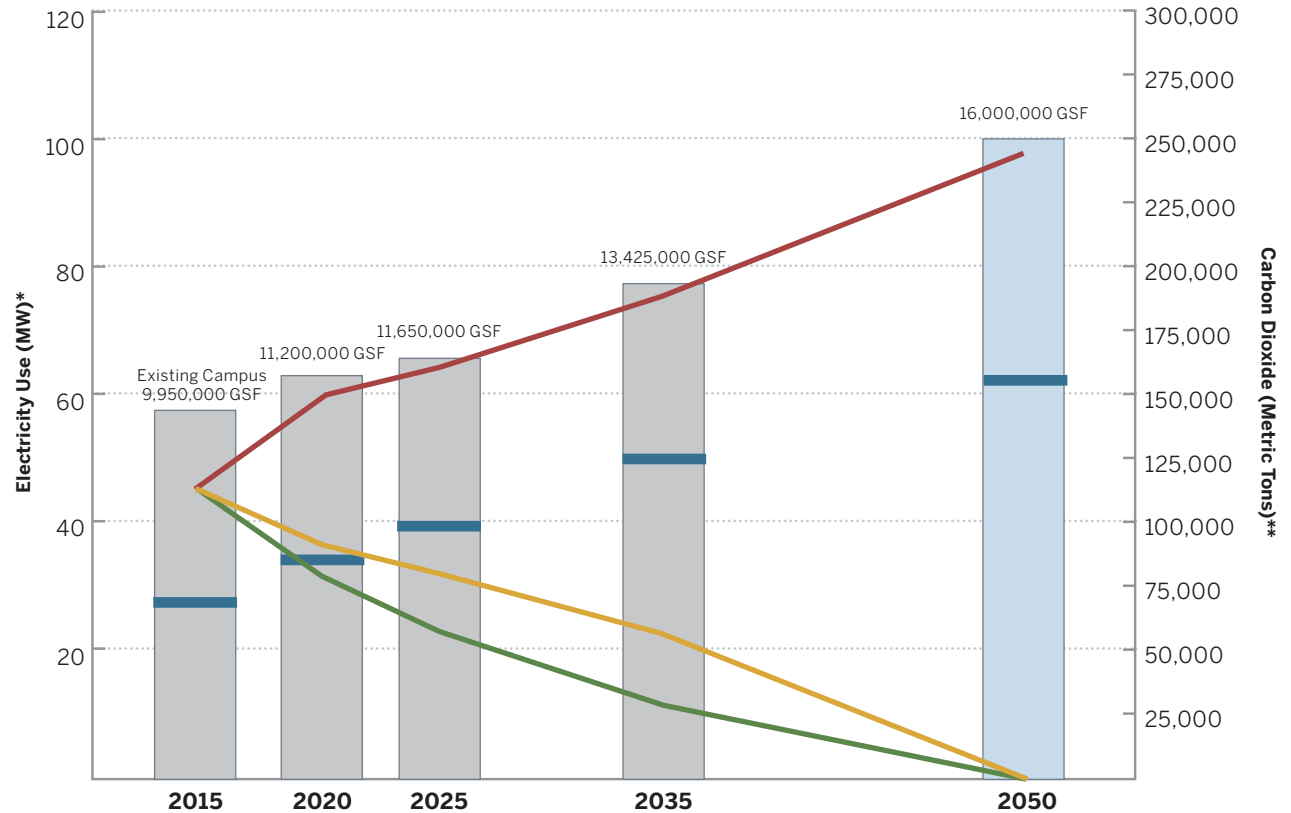
The consideration of clean energy such as fuel cells or micro-turbines can provide efficient, localized power generation, but should be dual-fueled and convertible for hydrogen. A strategic conversion plan is recommended along with development of these technologies. The carbon impact of other alternative sources and clean energy strategies including cogeneration and fuel cells will need to be studied carefully to understand if the technology will serve larger carbon goals. UConn has significant land area and investment potential to facilitate renewable energy. For example, a public/private partnership between UConn and local utilities could simultaneously promote and demonstrate renewable energy on campus and create a potential supply of power to the grid.

Area of Focus

Energy

Benchmarking and building-level metering will be critical to measuring and verifying energy performance. In a 2014 Climate Action Plan (CAP) Acceleration Proposal, the OEP presented a LEED Gold minimum as the new campus standard and also proposed accelerations in carbon neutrality targets and target dates. While this proposal was ultimately tabled, it remains an aspirational goal. Subsequent meetings have led to an even more collaborative and urgent effort to stay on track with CAP and identify opportunities to reduce carbon and achieve net zero energy buildings. It is recommended that this proposal be adopted, the position of Climate Action Plan Project Manager be filled, and all new construction at UConn target LEED Gold as a minimum plus UConn district-specific design requirements.

LEED Platinum and other stringent benchmarking systems can serve as stretch goals to accelerate toward carbon neutrality goals by 2050. Focusing on net-zero energy will help to propel the campus forward toward its climate neutrality goals.



Master Plan Projected Growth, Energy Use, and Carbon Emissions

* Based on Utilities Master Plan Load Calculations
 ** Baseline per 2013 AASHE STARS Reporting for UConn
 + Based on Campus Master Plan Growth Projections
 ++ Assumes linear growth trajectory

Area (GSF) Projected Beyond 20 Years++
 Area (GSF) Projected in Master Plan+
 Electricity Use (MW)
 CO₂ No Action (metric tons)
 CO₂ Current CAP (metric tons)
 CO₂ Accelerated CAP (metric tons)



Area of Focus

Water

Water conservation is a key part of the University's sustainability program. As the campus grows, it will need to continue and augment its various strategies for usage minimization, as well as reclamation and reuse. UConn and the Connecticut Water Company (CWC) have jointly filed for a DEEP diversion permit that would allow 1.85 million gallons per day (MGD) to be released from CWC's reservoir in Vernon to UConn for water supply to the campus and town residents. Work is anticipated to begin on the CWC water main extension in 2015 and should be completed within eighteen months of the commencement of construction. With the connection of the CWC water main to the UConn system, water supply is expected to continue to meet or exceed demands projected at 3.12 MGD through the next 20 years. However, potable water use reductions are still necessary to meet UConn sustainability goals. Water use at UConn is currently at 15% below 1990s levels, which is described in more detail in the stormwater section of the Utility Master Plan. Future projects will need to achieve an overall water savings of at least 40% above EPA baselines. This requires water conserving aerators, ultra-low flow fixtures, and process water reclamation, as well as extensive water collection and reuse. Though UConn is not currently using waterless fixtures, it will continue to evaluate alternative technologies and design approaches.



Campus Hydrology and Stormwater Management

Greywater or stormwater reuse systems will mitigate potable water use for sewage conveyance, irrigation, cooling tower makeup, or fire protection. UConn has an existing water reclamation facility which can process up to one million gallons of non-potable water for cooling and irrigation each day. The facility must be seasonally optimized to address chemical imbalances and inconsistent reclaimed water quality, but when operating properly can reduce UConn's peak potable water demand by 20%. It will be necessary to quantify water use in the context of energy consumption and associated carbon impacts toward carbon neutrality goals as the campus grows. In the next ten years, it is recommended that UConn analyze the potential for rainwater as a resource to be harvested, the energy and carbon savings associated with proper water management, and the necessity for irrigation of new campus developments.

Addressing stormwater quality, quantity, and drainage issues on the site are priorities. A Water Supply Emergency Contingency Plan has been developed by the University and is intended to reduce impact on local rivers, especially the Fenton River, which provides water to UConn's well fields. Mirror Lake is not currently at its maximum potential holding capacity, and it is recommended that this be studied and addressed. The University is subject to a TMDL related to the impervious surfaces on campus and their impact on Eagleville Brook. The TMDL prescribes reductions in impervious area via disconnection and area reductions. UConn is currently targeting a reduction of volume by 2021, but these calculations do not consider NextGenCT and STEM development on the campus. It will be necessary for UConn to implement other Low Impact Development (LID) and green infrastructure strategies to mitigate the

water impacts of future growth. LID strategies identified by the U.S. EPA include green roofs, trees and tree boxes, rain gardens, vegetated swales, infiltration planters, pocket wetlands, vegetated median strips, reforestation, and protection and enhancement of riparian buffers and floodplains— supplemented with other decentralized storage and infiltration approaches, such as the use of permeable pavement and rain barrels and cisterns to capture and re-use rainfall for watering plants or sewage conveyance.⁴ This definition is mirrored in the 2004 CT Stormwater Quality Manual and is the basis of a Memorandum of Agreement between the Connecticut Department of Energy and Environmental Protection and the University of Connecticut, which indicates that UConn will reduce annual runoff by 797,600 cubic feet through low impact development.



Area of Focus

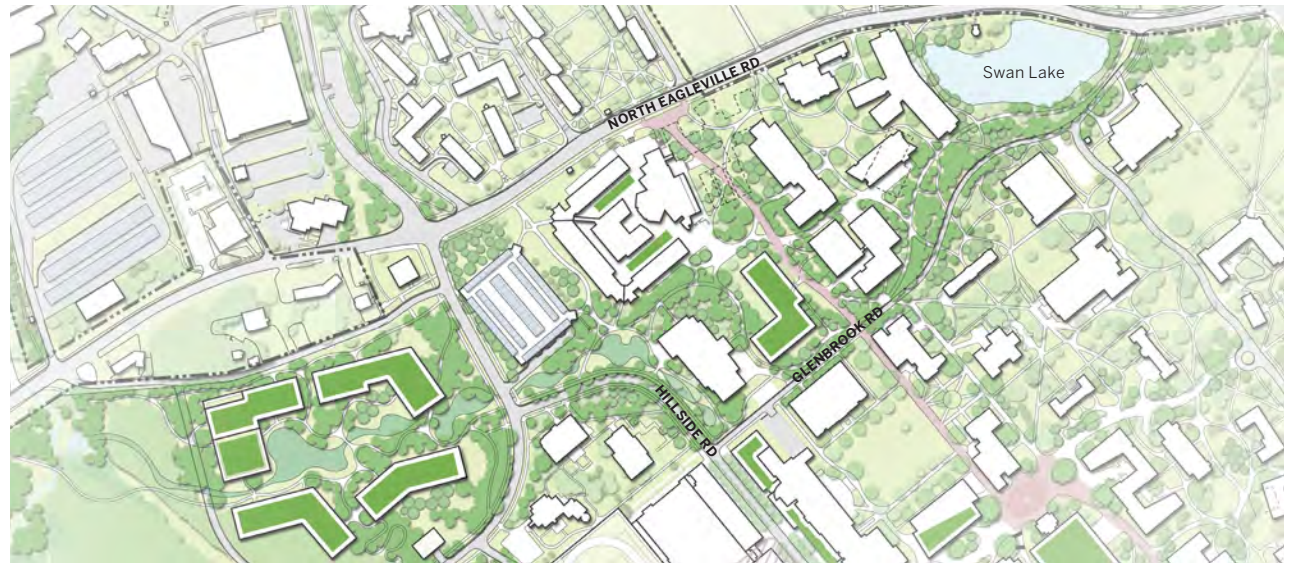
Land

UConn is a land grant institution with extensive resources that are historic, architecturally significant, agriculturally valuable, or otherwise important sites and structures. The preservation and conservation of these resources is an imperative for the University. The cultivation of green space at UConn enhances the campus experience. Sustainability strategies for land resources can reduce impervious surfaces, mitigate heat island and microclimate effects, improve outdoor air quality, minimize irrigation requirements, increase infiltration and groundwater recharge, and protect soils from wind and erosion damage. These land resources range from forest and agriculture holdings to developed properties to brownfields. Proper land management, especially when coordinated with utility projects, will contribute to UConn's resilience during significant weather events, such as heavy precipitation, high winds, or drought. UConn currently provides research to the State of Connecticut, utility companies, and other partners to inform the Stormwise Management Practices program. It is recommended that over the next 20 years, UConn maintain this important partnership and also continually improve its resiliency strategies.

The positive effect of landscape on building energy use cannot be overlooked, since vegetated roofs and appropriately located plantings will provide insulation and shading to buildings which may otherwise have significant solar loads. Some experimental landscape features that are not comprehensively validated, such as green walls, may be effective as research or demonstration installations.



Existing Science Core: Significant Impervious Surface Coverage



Proposed North Science Corridor: Expanded Landscapes and Green Roofs Maximize Permeability

Providing human-scaled, walkable pathways will improve movement through campus, but can also provide unique opportunities for distributed and maintainable utility infrastructure. Underground electric utilities have been identified as an aspiration of the University, and it is recommended that whenever possible they be pursued to promote climate resilience, improve public safety, and maintain valuable viewsheds. Addressing the separation caused by Route 195 will be an important part of connecting the agricultural-focused East Campus with the larger UConn community. UConn's existing water quality issues can also be addressed through a multitude of land area modifications, including developing vegetated swales, planting vegetated roofs, and disconnecting impervious areas from water bodies.

It is also recommended that the University adopt the Sustainable Sites Initiative benchmarking system for major site developments, which complements LEED certification. The Sustainable Sites Initiative (SITES) is a program based on the premise that land is a critical part of the built environment and can be planned, designed, developed, and maintained to protect and enhance the benefits derived from healthy, functioning landscapes. Sustainable landscapes create ecologically resilient communities better able to withstand catastrophic events and benefit the environment, property owners, community, and economy.

Land management, conservation, and remediation are critical strategies for UConn to meet its sustainability goals. The University has extensive, established forest tracts for which metrics exist and may prove useful in achieving carbon neutrality goals. UConn is the first Arbor Day Foundation Tree Campus USA designee in Connecticut – the third such campus in New England – and plans to maintain this designation. Historically significant areas, such as the Great Lawn and the old

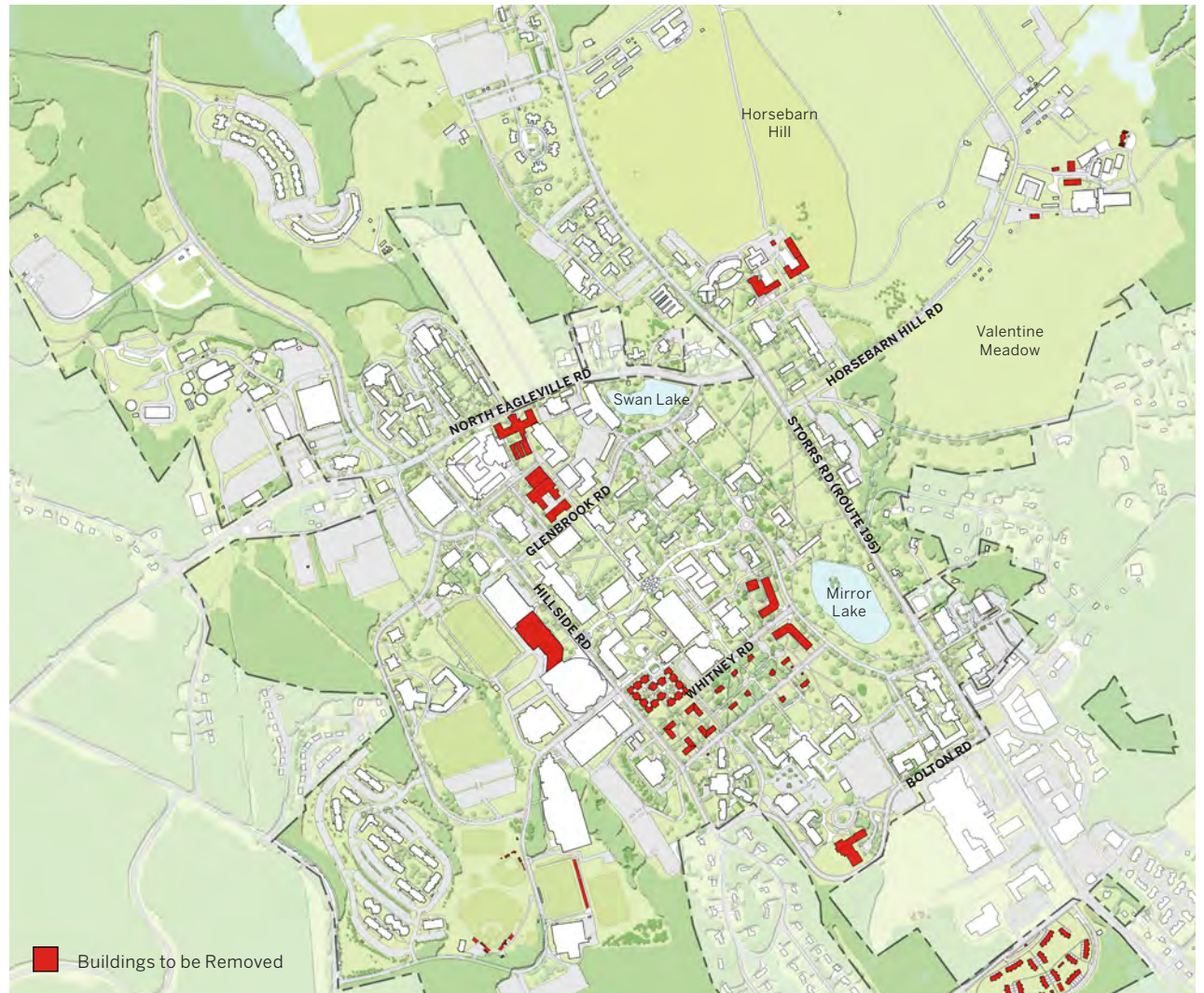
growth trees of the South Campus, will be maintained and enhanced in an environmentally responsible approach to managing natural resources. Some areas of UConn, most notably Depot Campus, offer unique opportunities for remediation and material salvage. Public and private partnerships can be a useful tool and are encouraged to revive the economic viability and improve the environmental health of areas like Depot Campus. UConn has already remediated a former 66-acre landfill to establish Hillside Environmental Education Park (HEEP) and plans to add 100 additional acres adjacent to the North Campus for hiking, bird watching, and other similar recreational activities. It is recommended that UConn continue on its path of revitalizing these types of areas as a preferred alternative to developing greenfields by identifying brownfields and other sensitive areas on all campuses and developing a strategy for optimizing these locations over the next 20 years.

As part of the land management strategy, it is also recommended that areas of prime farmland lost to development be replaced. UConn has an agricultural past and continues to have a tremendous economic impact within the state. The Sustainability Framework recommends further promotion and development of sustainable farming and scalable food production operations. Implementing hydroponics, vertical farming installations, edible landscaping, and expansion of existing student farms, such as Spring Valley Farm and the Ecohouse development, can help UConn to move toward more significant yields which would supply local farm-to-table dining services. These expansions would support programs that are a source of important education and innovation for an industry that is integral not only to the University, but to the regional and national agriculture market.

Area of Focus

Materials

As UConn purchases, uses, maintains, and disposes of materials for ongoing institutional operation, it must also continue to manage these resources sustainably. UConn's purchasing power enables the University to drive markets in which it invests. Lifecycle assessments can guide UConn's purchasing decisions while allowing environmental viability to factor into selections. A lifecycle assessment will provide a better understanding of the environmental viability of a product and will also assist UConn in balancing upfront purchasing costs against operational costs for a variety of products and services. If expanded, local procurement programs giving preference to local vendors and contractors will encourage market transformation and economic development. Purchasing from other responsible corporations and entities ensures that UConn's mission will be supported by its procurement process. UConn has adopted a vendor code of conduct to encourage suppliers to exhibit environmentally-preferred practices. It is recommended that this policy be reviewed annually – and as needed at the renewal of contracts – to accommodate changes in vendor products and policies.



Buildings Identified for Potential Replacement in the Master Plan

Office supplies will continue to be purchased for sustainable characteristics, but thresholds of recycled and FSC paper content, biodegradable writing instruments, and recycled metal products need to be increased to encourage market growth and availability. Food service and cleaning supplies, like gloves, towels, and utensils need to be recyclable or reusable when regulations do not preclude. Food served to the UConn community is a critical component of sustainability on campus and must be healthful and, when possible, grown on or near campus. This promotes freshness and seasonality, as well as reduces food cost and carbon footprint. It is recommended that UConn strive to expand its Local Routes, Real Slow Foods, and Spring Valley Farm programs, move toward a fully local-food campus, and compost all biodegradable food waste by 2035. Currently, UConn uses high-speed food waste recycling units in five of eight dining halls to dehydrate food into a compost-like material. This reduces volume of food waste by 80%, but the chemical makeup of the waste is not suitable as a soil amendment, although there is potential for this material to be used as animal feed. It is recommended that UConn conduct analyses on the energy impacts of these dehydration units and identify composting methods that might lead to more viable soil amendments for food production and maintenance of UConn's gardens and green spaces.

Purchasing minimally packaged products is an effective step toward waste reduction. Biodegradable cleaning supplies can be concentrated in smaller bottles and preference given to vendors who provide leaner packaging. UConn is in the process of adding 10 water bottle filling stations in addition to the 15 already on campus and has been working with its beverage vendors to move toward plant-based bottle materials. Over the next 10-20 years, it is recommended that UConn advocate for its selected vendors to improve their

packaging through engineering of light-weight, bio-based plastics and recycled paper cartons. Recycling is currently widespread across UConn and is an important method for responsible waste handling; however, the University must develop more comprehensive strategies for addressing initial waste reduction, packaging, and composting. Along with larger development policies, UConn must optimize metrics to more accurately track waste reduction and associated carbon savings.

UConn issued its Sustainable Design Guidelines in 2004, adding a Sustainable Design and Construction Policy in 2007 requiring major building projects to achieve at least LEED Silver certification, resulting in nearly 2 million square feet of LEED Silver or Gold certified new or renovated facilities. It is recommended that the Sustainable Design Guidelines and associated policies be revised to incorporate more stringent benchmarking targets. As discussed in the Energy Area of Focus, the 2014 Climate Action Plan Acceleration Proposal presents LEED Gold minimum as the new campus standard, and it is recommended that this proposal be adopted. LEED Gold has become standard practice among many of UConn's peers and will help guide healthy, environmentally preferable material specifications. UConn must move fully toward the specification and research of products which are non-toxic, do not bio-accumulate, mitigate building heat absorption, and improve air quality. Building project teams will need to give preference to recycled materials and take advantage of manufacturer reclamation services that accept material removed from buildings.

Decommissioning of aging buildings needs to become part of UConn's construction policies. While the embodied carbon of an existing building will always be less than that of a new building, it can become impractical to retrofit an aging building to

achieve optimal energy performance or functionality. Responsibly managed demolition and new construction can be environmentally preferable. A protocol is needed for evaluating buildings to determine if demolition or renovation is more appropriate from an environmental perspective, as well as methods for evaluating demolition waste for salvage or reuse on campus. UConn is already diverting a great deal of its construction and demolition waste from landfills, but can reduce demand for virgin building materials by increasing reuse of building materials on campus. Furnishings and building products are largely governed through the use of LEED, but managing the existing stock will be important. Repairing, refurbishing, recycling, or donating are preferred methods to disposal that mitigate negative environmental effects of disposal.

Proper use and maintenance of building materials, furniture, equipment, supplies, consumables, or technology, will ensure that these products are used for the entirety of their useful life. As purchasing and maintenance policies evolve over the next 20 years, UConn will need to continue to train staff within these departments about the rationale for these practices.

Area of Focus

Movement

Future growth in the next 20 years at UConn, including increased student and staff populations, will necessitate measures to avoid heightened parking demand and worsened traffic congestion. UConn has an opportunity to reduce and ultimately eliminate carbon emissions related to vehicle use on campus. Traveling to and around the campus by means other than a single occupancy vehicle is critical to achieve the Master Plan goals. It will be essential for the University to make shuttle and bus services easy and convenient in order for those services to be accepted as preferable alternatives to driving. This includes streamlining routing, improving frequency and reliability, and implementing transit notification systems. Investing in infrastructure that can support the bus system, such as covered waiting areas, schedule guarantees, and electronic tracking access, will encourage commuters to use the system in lieu of their own vehicles. Future planning for integration with local and regional rail service is highly recommended to link UConn more directly with population centers like Hartford, Boston, and the surrounding Northeast region. A feasibility study for rail services is recommended within the next 10 years.

The University is currently replacing gas/diesel fleet vehicles with alternative fuel vehicles under the Connecticut Department of Transportation Clean Fuel Grant and has enacted a no-idling policy across all campuses. As UConn's fleet of shuttles, buses, and maintenance vehicles moves fully toward alternatively-fueled, bio-diesel, hybrid, or electric, it will see measurable savings in fuel costs, improvement in air quality, and reductions in vehicle-related noise pollution. Fleet vehicles need to be properly sized to be efficient for their purpose, such as small buses making frequent loops to promote convenience, or deliveries to a central location with smaller shuttles distributing to final destinations.



Network of Campus Walks and Bicycle Trails

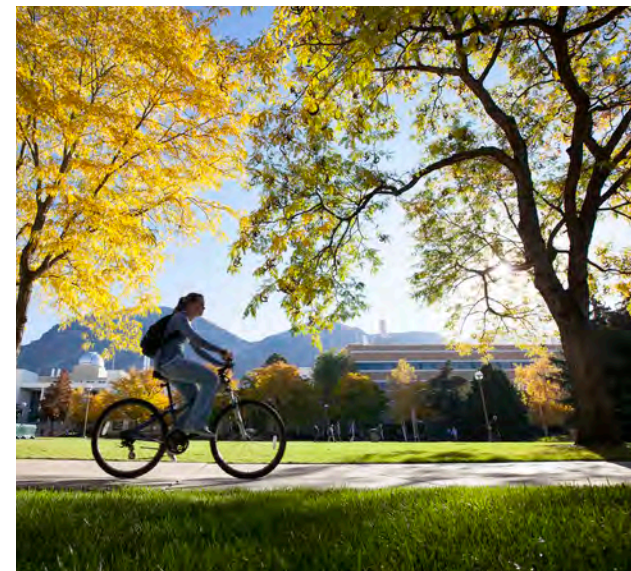
Where new parking is to be provided, it should be covered and vertically stacked. These facilities will also serve as opportunities for photovoltaic power generation from photovoltaic canopies or other renewable energy features. Establishing a graduated rate structure, single-occupancy vehicle reduction incentive program, or electronic parking management system to account for peak demand and proximity to the campus core can measurably reduce transportation-related carbon impacts. The Town has begun to consider the feasibility of alternative transportation with newer services such as rideshare boards and ride services such as Uber or Lyft. These services have potential to ameliorate some of UConn's transportation challenges.

Prioritizing pedestrian and cycle infrastructure is integral to creating a culture of zero-carbon campus travel. Pedestrians must have access to well-lit and accessible pathways. Site lighting with full cutoff luminaires and judicious placement will reduce energy consumption and negative wildlife impacts. This pedestrian infrastructure, powered by photovoltaics with photosensors for energy reduction and increased reliability, is recommended to be integrated into all building project designs.

The proposed development of woodland corridors, campus walks, and a new pedestrian green centered on Hillside Road will encourage walking as a preferred mode of campus circulation. Connecting to the larger campus trail network is also recommended to further increase pedestrian utility. The University is in the process of implementing a campus bike plan, which will replace the 2005 student-developed version and work toward earning the League of American Bicyclists 'Bicycle Friendly University' designation through dedicating pathways to pedestrians and cyclists, creating secure and distributed bicycle storage areas, and planning for pedestrian and cyclist safety at major traffic crossings.

Although bicycle sharing is currently offered to students, the bikes are only available at the core of campus during limited hours and must be returned there prior to closing. UConn is currently negotiating with Zagster to improve availability and convenience of bicycle services which is expected to increase use of bicycles on the campus. It is not evident that climate would be an obstacle to meeting this goal, as several universities and colleges in the Northeast have successfully established bicycle sharing programs. These institutions include UMass Amherst, Yale, and Boston University, among others. The Town of Mansfield has a bike route system that may also be modified to accommodate the mutual needs of UConn and the Town. It is recommended that research be conducted into the regional bicycle infrastructure network, its relationship to UConn, and the most effective ways of creating connections.

In the next 20 years, UConn must focus on improving its comprehensive transportation infrastructure, plan, and policies. The strategies discussed in this framework not only address the logistical challenges, but create opportunities to minimize the environmental impacts of moving people and things to and around UConn's campuses while improving the lives of those who live and work in the UConn community. Additional detail on these and other related initiatives can be found in the Transportation, Circulation, and Parking Plan.



Glossary of Terms

Alternative-fuel vehicles use low-polluting, non-gasoline fuels such as electricity, hydrogen, propane, compressed natural gas, liquid natural gas, methanol, and ethanol. In LEED, efficient gas-electric hybrid vehicles are included in this group.¹

Baseline building performance is the annual energy cost for a building design, used as a baseline for comparison with above-standard design.¹

Benchmarking is a process of evaluating and verifying a building and its performance by comparing it with a specified standard.

Bio-accumulation is a process by which toxins can build up progressively through the food chain; small organisms often store toxins in fat tissue, and when larger organisms eat them, those toxins became more concentrated.¹

Bio-based is a classification of products and materials derived from plant and animal sources as opposed to minerals. The U.S. Department of Agriculture has a program to promote the use of emerging bio-based products that defines them more narrowly, to exclude products that already have established markets, such as food, animal feed, and lumber.¹

Bio-diesel is a renewable, clean-burning diesel replacement, usually a mix of feedstocks including cooking oil, soybean oil, or animal fats.⁷

Brownfield is a real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.⁸

Carbon offset is a fiscal unit measured in metric tons of carbon dioxide-equivalent (CO₂e) representing six main categories of greenhouse gases. Aimed at reducing greenhouse gas emissions, one carbon offset represents the reduction of one metric ton of carbon dioxide (or its equivalent in other greenhouse gases). Carbon offsets are typically purchased by consumers of fossil fuels or products using fossil fuels, as a way to “offset” or negate their negative environmental impact.¹

Certified wood is wood from a source that has been determined, through a certification process, to meet stated ecological and other criteria. There are numerous forest certification programs in general use based on several standards, but only the Forest Stewardship Council’s standards, which include requirements that the wood be tracked through its chain-of-custody, can be used to qualify wood for a point in the LEED Rating System.¹

Climate positive buildings and developments actively generate benefits for the environment. This includes water treatment and energy generation as well as the pursuit of operations and services that result in carbon savings.

Carbon neutral (Climate neutral) is when the net amount of carbon dioxide or other carbon compounds emitted into the atmosphere is reduced to zero because it is balanced by actions to reduce or offset these emissions. Climate Neutral reflects the broader inclusion of other greenhouse gases – even if carbon dioxide is the most abundant – regulated by the Kyoto Protocol, namely: methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride.

Decommissioning is the planned shut-down or removal of a building, equipment, plant, etc. from operation or usage.

Embodied carbon is the amount of carbon released from material extraction, transport, manufacturing, and related activities.⁹

Energy use intensity (EUI) is a building’s energy use as a function of its size or other characteristics.¹⁰

Fossil fuels are natural fuels such as coal or gas, formed in the geological past from the remains of living organisms.

Fuel-efficient vehicles have achieved a minimum green score of 40 according to the annual vehicle-rating guide of the American Council for an Energy Efficient Economy (ACEEE).¹

Greenfields are previously undeveloped sites for commercial development or exploitation.

Greenhouse gases trap heat in the atmosphere, namely carbon dioxide, methane, nitrous oxide, and fluorinated gases.¹¹

Green infrastructure refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire (return water to the atmosphere either through evaporation or by plants), or reuse stormwater or runoff on the site where it is generated.²

Greywater is any domestic wastewater produced, excluding sewage. The main difference between greywater and sewage (or blackwater) is the organic loading. Sewage has a much larger organic loading compared to greywater.¹²

Heat island effect occurs when an urban area has higher average temperature than its rural surroundings owing to the greater absorption, retention, and generation of heat by its buildings, pavements, and human activities.

Glossary of Terms

Life cycle assessment is an analysis of the environmental aspects and potential impacts associated with a product, process, or service.¹

Low-emitting vehicles are classified as Zero Emission Vehicles (ZEV) by the California Air Resources Board or as fuel-efficient vehicles by the American Council for an Energy Efficient Economy (ACEEE).¹

Low-flow fixtures are plumbing fixtures that significantly reduce the amount of water released per use.

Low-impact development is an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible. LID employs principles such as preserving and recreating natural landscape features, thereby minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. There are many practices that have been used to adhere to these principles, such as bio-retention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements.²

Microclimate is the climate of a very small or restricted area, especially when this differs from the climate of the surrounding area.

Net-zero site energy is the amount of fossil-fuel generated energy consumed on-site, balanced by the same amount of renewable energy produced on-site.⁵

Net-zero source energy is similar to net-zero site energy, but goes a step further by including energy required to deliver both electricity and fuels. This energy expenditure must also be balanced by renewable energy production on-site.⁵

Net-zero energy emissions occur when a building or community produces and uses at least as much emissions-free renewable energy as it uses from emissions-producing energy sources. Emissions usually refer to emissions regulated by the U.S. Environmental Protection Agency (EPA), including carbon, nitrous oxides, and sulfur oxides.⁵

Photovoltaic cell (PV cell) is a specialized semiconductor diode that converts visible light into direct current (DC).

Prime farmland is land that has been used for irrigated agricultural production at some time during the four years prior to the relevant Important Farmland Map date and where the soil meets the physical and chemical criteria for Prime Farmland or farmland of Statewide Importance as determined by the USDA Natural Resources Conservation Service (NRCS).⁶

Process water is any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product.¹²

Rapidly renewable refers to a natural material that is grown and harvested on a relatively short-rotation cycle.¹

Recycled materials are reprocessed materials that would typically be considered waste.

Recyclable materials are raw or processed materials that can be recovered from a waste stream for reuse.

Renewable energy is any energy source that is naturally replenished, like that derived from solar, wind, geothermal or hydroelectric action.

Renewable energy certificates (REC) are tradable, non-tangible energy commodities in the United States that represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource.

Resilience (Climate resilience) is the capacity for a socio-ecological system to absorb stresses and maintain function in the face of external stresses imposed upon it by climate change and adapt, reorganize, and evolve into more desirable configurations that improve the sustainability of the system, leaving it better prepared for future climate change impacts.

Solar thermal energy is the use of solar energy to produce heat.

Sustainability refers to how biological systems remain diverse and productive.

Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation.¹³

Water reclamation is a process by which wastewater is cleaned using biological and chemical treatment so that the water can be returned to the environment safely to augment the natural systems from which it came.

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MAY, 2015