CPower

CASE STUDY: UMASS AMHERST

State-of-the-art battery storage, an innovative solar PV system, and "stacked" demand management programs provide energy savings, steady revenue, reduced greenhouse gases, and grid reliability for this revolutionary institution.

A REVOLUTIONARY APPROACH TO SUSTAINABILITY YIELDS REVOLUTIONARY RESULTS

The University of Massachusetts Amherst (UMA) is the flagship campus of the University of Massachusetts system. UMA has an annual enrollment of more than 30,000 students and employs approximately 1,300 faculty members. It offers academic degrees in 109 undergraduate, 77 Master's, and 48 doctoral programs across nine schools and colleges.

UMA has long integrated sustainability programs into every facet of campus life, including academics, research, campus living and student life, buildings, and infrastructure. Programs include:

- **Northeast Climate Adaption Science Center** A unique research facility that brings together graduate students, post-docs, research scientists, and UMA faculty to investigate the climate system, climatic variability, and global change issues.
- **UMA Climate Action Plan** A comprehensive plan for future sustainability efforts across all aspects of the campus, with established metrics and sustainable goals.
- **Comprehensive Campus Energy Plan (CCEP)** An overarching energy plan that defines and prioritizes projects based on minimum cost and highest measure of greenhouse gas emissions reduction. This plan also focuses on renewable energy production, conservation measures, and the understanding of the economics and decision-making process for the conservation, purchasing, and distribution of energy on campus for the future.

As part of the CCEP, UMA built a new Central Heating Plant (CHP) in 2009 which includes a 10-megawatt combustion turbine, a 2-megawatt heat recovery steam generator, a 4-megawatt steam turbine, and four natural gas boilers. The CHP provides electricity for 70% of the campus and 100% of the steam that is needed for heating and cooling for buildings across campus. The award-winning facility replaced the UMA's 80-year-old coal-burning power plant and has helped to reduce campus greenhouse gases by approximately 27% (FY2019) since the FY 2002-2004 average. In 2016, the CHP added a solar hot water system, which reduces fossil fuel usage by preheating condensate water used in the steam making process.

INNOVATION THROUGH RENEWABLES

In 2017, UMA significantly increased its on-campus solar footprint with new solar parking canopies and rooftop systems featuring 15,000 photovoltaic panels generating 5.5 MWs (DC) of renewable energy. These installations will reduce greenhouse gas emissions on the regional grid by the equivalent of 1,535 short tons per year, and are estimated to cut UMA's electric bills by $6.2 million over 20 years.

As UMA expanded its onsite renewable energy generation, it increasingly saw the need for greater operational flexibility in how the campus generates and delivers power around campus via UMA's microgrid. Pairing large-scale intermittent solar generation with the CHP's substantial generation capacity poses potential reliability concerns if not managed effectively, i.e. if onsite generation exceeds campus electrical demand.

As the solar projects neared completion in 2016, UMA became aware of the Massachusetts State of Charge Report, a comprehensive study of energy storage in Massachusetts undertaken as part of the state's Energy Storage Initiative (ESI). The study presented a suite of policy recommendations to generate 600 MW of advanced energy storage in the Commonwealth by 2025 – with a 200 megawatt hour (MWh) energy storage target to be achieved by January 1, 2020. In addition to being the potential solution to reliability concerns, UMA felt this initiative spoke directly to its own ambitious sustainability goals and began to explore on-site storage opportunities to complement its own evolving initiatives.

ACES DEMONSTRATION — FLEXIBILITY IN ACTION

In December 2017, UMA was awarded one of 26 Advancing Commonwealth Energy Storage (ACES) grants, a key component of the ESI, through a competitive solicitation process. UMA's ACES grant covers nearly half of the battery system's installation cost.

UMA's 1.32 MW, 4 MWh storage battery gives the campus flexibility in how and when it dispatches the battery in response to grid events. It can dispatch 1 MW for four hours, reduce it to 500 kw for eight hours, or ramp it to its maximum 1.32 MW for up to three hours of dispatch. The additional energy capacity permits UMA it to accommodate longer event windows, and to even choose how much or how little of that window to fill (depending on the demand management program).

One of UMA's principal goals for battery storage is managing coincident peak demand, which focuses on one the key energy challenges all Massachusetts ratepayers face in the coming years: How to control generation and transmission capacity costs. As the Massachusetts State of Charge report points out, New England is experiencing significant amounts of generation retirements with the planned shutdown of 4,200 MW of generation by 2019 and an additional 6,000 MW at risk of retirement by 2020. Furthermore, since 2002, more than $12 billion in reliability transmission investment (largely driven by peak demand) has been placed into service, is currently under construction, or is in the planning phase. These rising generation and transmission capacity costs are the leading factors behind increasing energy costs for UMA, with annual charges in each category tripling over the past five years.

> "The Battery Storage Unit charging and discharging will be targeted to reduce peak electrical transmission and capacity demand charges, optimize onsite solar photo voltaic production, and improve campus electrical system resiliency."
>
> -- Mr. Ray Jackson, Director of UMA's Physical Plant Division

UMA's business model under the ACES program is driven by the value of reducing campus peak electricity demands where UMass incurs capacity costs from both wholesale generation and transmission. UMA currently purchases its wholesale electricity supply on the ISO New England (ISO-NE) spot market, with the campus' wholesale generation capacity obligation (also known as its capacity tag) structured as a pass-through charge. In collaboration with CPower and Competitive Energy Services (CES), UMA has implemented a peak demand management plan, leveraging third party ISO-NE peak forecasts to target load reduction on hot summer days when the ISO-NE annual system peak hour may occur. The battery system is a valuable and flexible additional asset to help UMA bolster its existing capabilities to reduce the campus' capacity tag, in turn, helping to control peak generation requirements for all Massachusetts ratepayers. UMA is uniquely positioned to realize the full value of peak demand reduction, as its utility tariff and supply procurement are structured to incentivize management of these capacity factors.

UMA's battery operations will offer a detailed track record on the effectiveness of targeting coincident peak demand across the year, providing a model for Massachusetts to scale coincident peak demand management through battery adoption.

ANALYZE, OPTIMIZE, MONETIZE

Together, UMA, CES, and CPower undertook a thorough analysis of the battery's integration with and impact on grid demand and devised a comprehensive demand-side energy management plan that would optimize participation on multiple revenue-generating programs in a process called "stacking." By stacking the various programs available, UMA was able to monetize their battery asset through multiple revenue streams, greatly enhancing its value to the UMA community.

UMA and CES understood that they had the resources in hand with CPower to recoup their investment and improve their ROI on the battery system as they had already done so with UMA's revolutionary 5.5 MW solar array. The battery was fully commissioned in July 2019, and in the system's first four month of operations, UMA has generated over $200,000 in electric bill savings and demand response revenue.

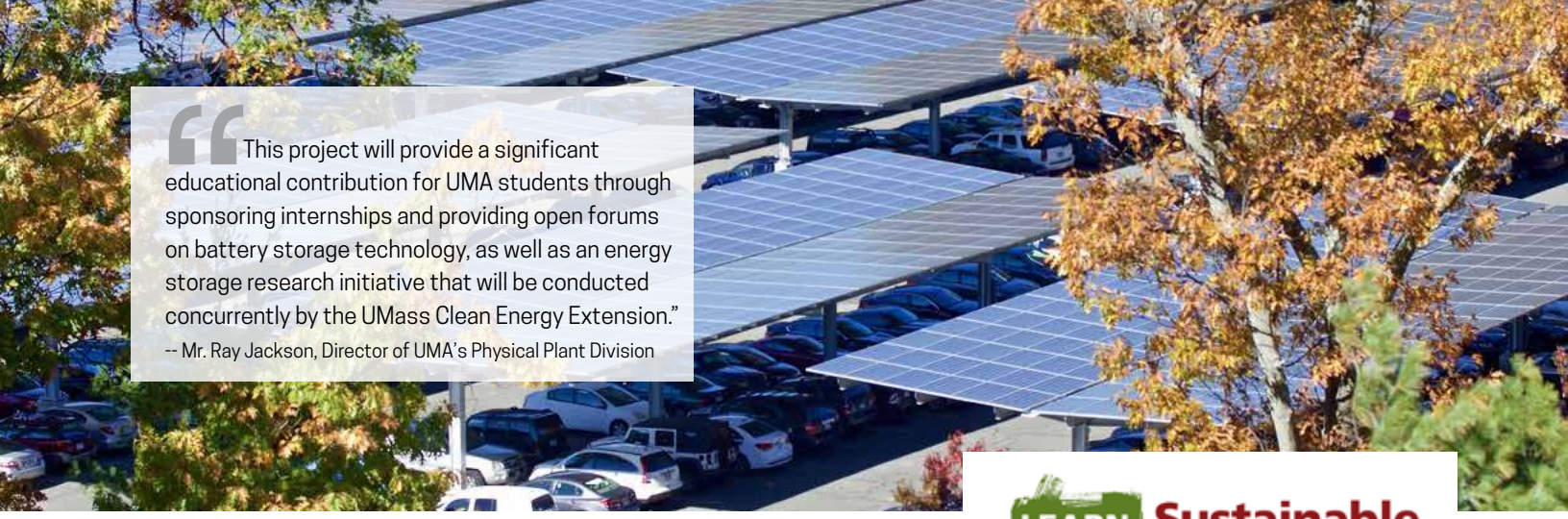
Competitive Energy SERVICES

REVOLUTIONARY RESULTS

By participating in the Eversource Daily Dispatch demand management program, UMA projects an annual revenue benefit in excess of $200,000 in this one utility program alone. Over ten years, the revenue from one single utility demand response program will provide essentially a full return on investment. Additionally, the battery has shown the capability to provide a powerful boost to the university's load-shedding program performance. During an event called by Connected Solutions on August 19, 2019, the battery contributed 1192 kW on top of the 2,823 kW of load shed by UMA, for a total of more than 4 MW.

By participating in ISO-NE's On Peak program, in which they enrolled through CPower, UMA's solar arrays have earned $234,000 for UMA since June 2018. That's in addition to the $223,000 in demand response revenue earned since joining CPower from its predecessor Constellation Energy in 2014.

Because the established peaks of its various programs do not always line up, UMA can choose its own hours that take the best advantage of all available programs, thus maximizing the cost reduction and monetization potential. In terms of grid reliability, UMA helps reduce what needs to be built in the future to meet growing and changing peak needs.



> "This project will provide a significant educational contribution for UMA students through sponsoring internships and providing open forums on battery storage technology, as well as an energy storage research initiative that will be conducted concurrently by the UMass Clean Energy Extension."
> -- Mr. Ray Jackson, Director of UMA's Physical Plant Division

GIVING BACK

While UMA's business model is driven by monetizing peak demand management, the campus also provides one of the Commonwealth's best test cases for how distributed renewable generation can be integrated at scale to maximize value for the grid. As noted above, as UMA has expanded its behind-the-meter solar deployment (with over 75% of existing capacity coming online in the last year), the campus faces increasing reliability risks due to integration challenges between the intermittent solar output and baseload cogeneration units. UMA plans to manage battery cycling to alleviate balancing constraints that would otherwise require the cogeneration or solar generation to be curtailed.

UMA's onsite generation mix also offers an opportunity to demonstrate the resiliency benefits of battery storage as a value-added service. The battery system will be interconnected to the campus' distribution loop that is designed to island in the case of an Eversource outage. This feeder serves the Mullins Center, which is designated as a regional emergency shelter for Hampshire County's population of roughly 160,000 residents.

The project also includes a fundamental focus on advancing the campus' educational mission. Borrego Solar Systems (the battery system installer) has agreed to provide a range of educational opportunities for UMass staff and students. These opportunities include paid internships, career mentorships, lectures, and curriculum development related to solar and energy storage.

LEARN LIVE LEAD Sustainable UMASS

AWARD-WINNING INNOVATION

UMA's sustainability leadership has long been recognized by its peers. Since 2011, it has received a gold rating from the Association for the Advancement of Sustainability in Higher Education; made it onto the Princeton Review's Green Honor Roll; and received two National Climate Leadership Awards.

The astonishing success of UMA's battery storage program did not go unnoticed outside of higher education. As 2019 came to a close, UMA received word that the project had won the 2020 Innovation Award for Energy Storage & Microgrids from Smart Energy Decisions. The award is given to organizations who are using innovative strategies and methods to transform the way they procure and manage energy.

Competitive Energy SERVICES

CES is a full service energy management company that advises clients from every sector on the full range of energy market issues including procurement, renewable energy, cogeneration, demand response, fuel arbitrage, multi-fuel strategies, and demand management.

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