



UH Mānoa Energy Sustainability Program

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A Mānoa Facilities Lab Project

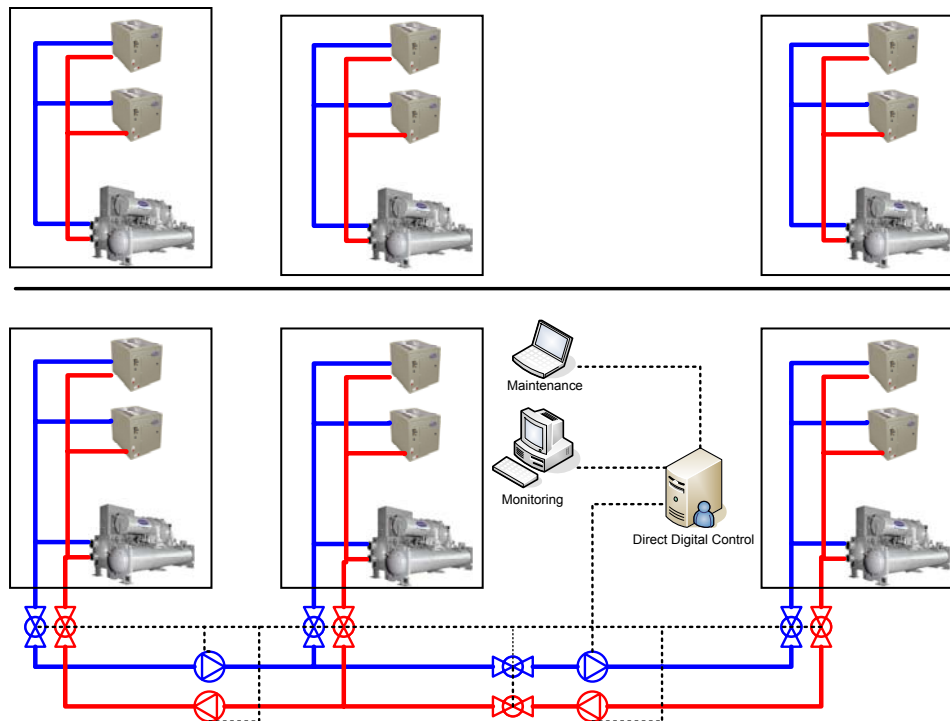
Introduction

As the State of Hawai'i's flagship research university the University of Hawai'i at Mānoa Office of Facilities and Grounds actively engages in energy sustainability projects that renew and advance the performance of campus' physical plant as part of its overall mission. Starting in the late 1990's UHM Facilities has implemented a series of energy sustainability projects, as part of its on-going Capital Renewal and Deferred Maintenance program, in the developing field of "Smart Grid" technologies.

Smart Grids as "Smart Loops"

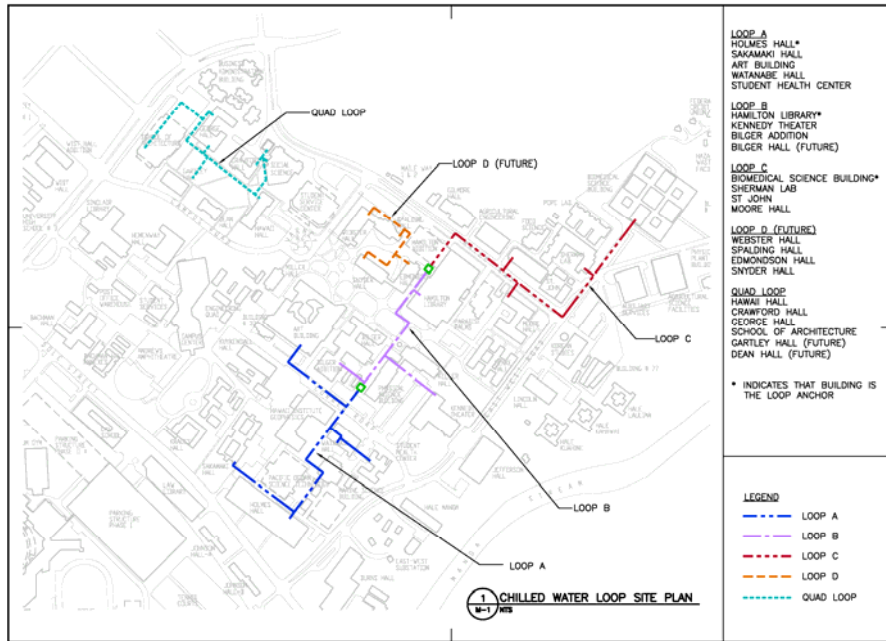
A major focus of this effort has been the extensive retrofit and replacement of older stand-alone HVAC systems. Over the past three biennia UHM Facilities, working with their Hawai'i based consultants, have invested over \$60 million in GO Bond funded projects (approximately 30% of the total allocated funds) in HVAC replacement and modernization projects.

The key feature has been the UHM adaption of intelligent or "Smart Grid" concepts in the design of chill-water "Smart Loop Systems" that permits the sharing of interconnected building chill-water plants so that where possible a single building chill water system – operating at higher efficiency – can be cross-connected to provide chill-water to multiple buildings thus cutting the cost to all.



Single independent building chill water system (upper frame) versus an interconnected (loop) share system (lower frame)

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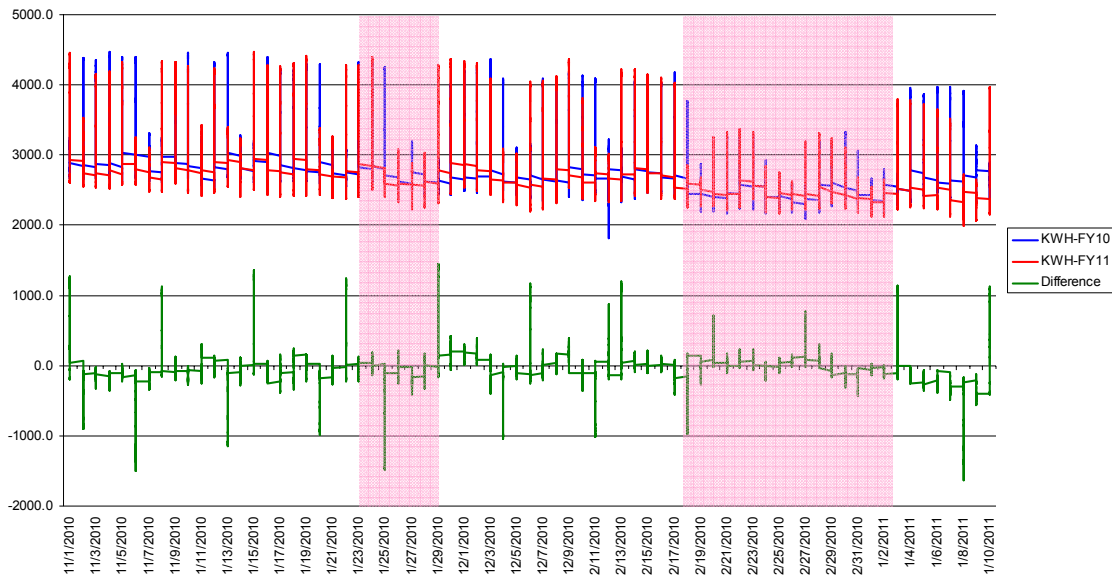
Current and planned Mānoa Campus Chill Water Loops

Digital Control Systems

While experience shows that HVAC modernization is generally responsible for the first 75% of energy savings the effective evolution of adaptive energy distribution systems (i.e. “Smart Grids”) requires the implementation of control technologies that leverage user behaviours. Manoa Green Days was implemented to take advantage of Furlough Days and Holidays to reduce consumption and to test new HVAC control technologies and procedures.

Over twenty main campus buildings currently participate in the program representing nearly 1,000,000 GSF of campus floor space. Starting July 2009 pilot “power-downs” were implemented on selected buildings. Then in November 2010 the program was expanded to all participating buildings during the weekends, Thanksgiving break, and Christmas break (November 1 – January 10, 2011).

As a result of the MGD program the campus experienced **a reduction of over 800,000 kWh or 1% of its annual usage**. More importantly, Facilities developed the necessary expertise to perform real-time control over its chill-water and electrical distribution system.



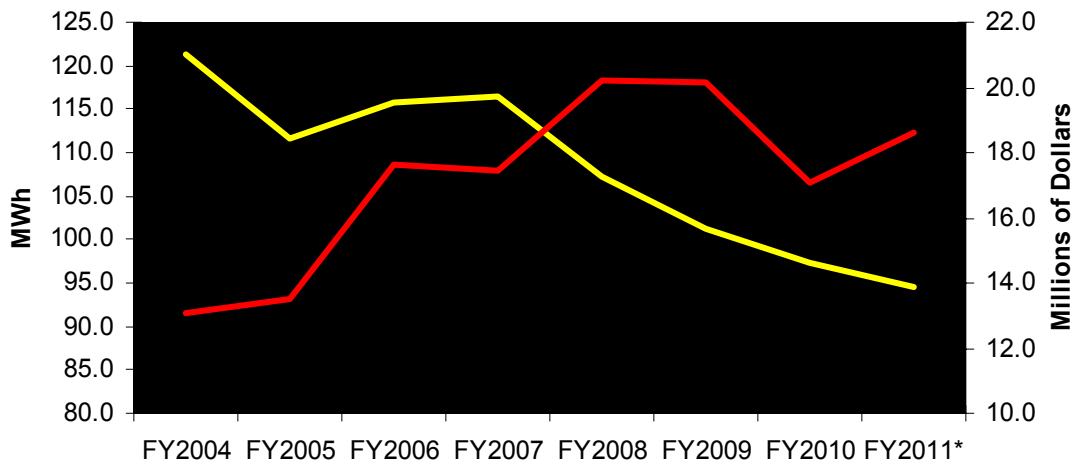
Manoa Green Days effect for the November-January period 2009-2010 versus 2010-2011

Results

By the end of June 2011 UH Mānoa Facilities Engineering will have achieved a **22% net reduction** in the amount of electrical energy used by the Mānoa Campus compared to the amount used in 2004 as a consequence of these programs.

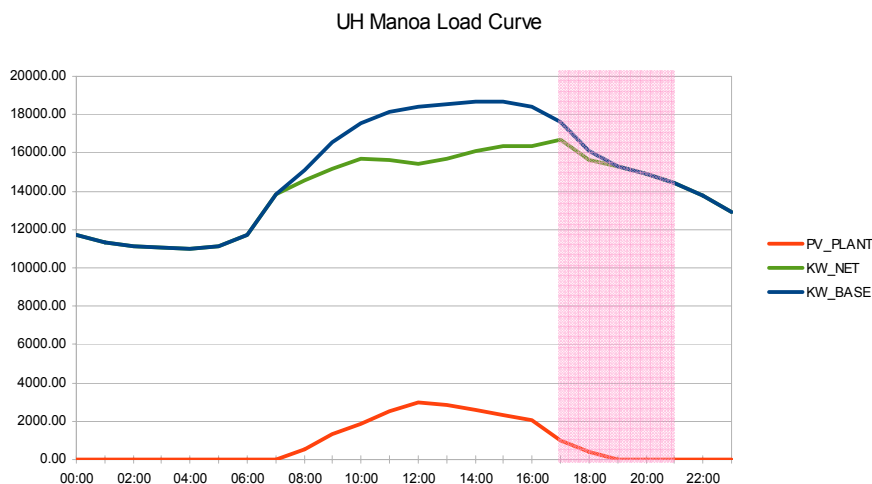
On a cumulative basis this is expected to have saved the main campus more than \$13.7 million dollars and reduced the amount of carbon released into the atmosphere by an estimated 124,445,809 pounds of CO₂ over the past seven years. At the present cost per kWh this represents \$4.2 million in annual savings go forward.

Manoa Energy Usage and Cost



The Next Step: Distributed Generation

To achieve energy sustainability the University will need apply these Smart Grid technologies to alternative/distributive generation. A key factor to large-scale alternative/distributive generation is the interconnection to the local utility. What happens when the clouds come over the photovoltaic panels? Distributed generation must be intricately meshed with the local grid to avoid production restrictions. UH Mānoa is seeking to install a minimum of 5 MW of photovoltaic generating capacity in the next 12 months. To be successful the University will need to overcome control, storage, **and real estate constraints** to achieve energy sustainability. When combined into an integrated solution Smart Grid technologies demonstrated by UHM Facilities will help realize practical solutions to meet Hawai'i's energy needs.



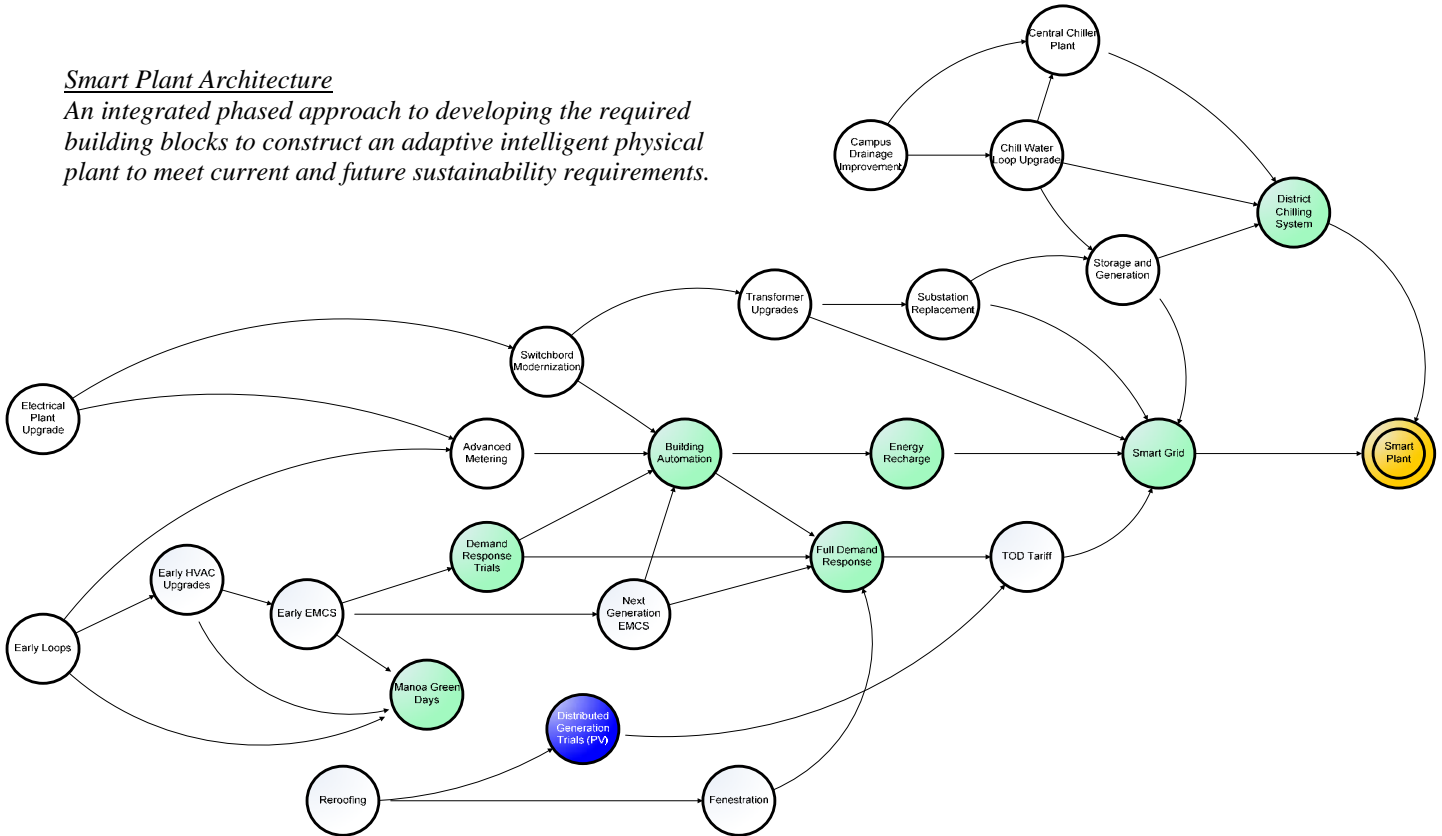
Photovoltaic Distributed Generation (DG) will provide additional energy during the peak day time periods.

The Smart Plant of Energy Grant University

Hawai'i's future is vitally dependent on the development of sustainable cost-effective energy. As the physical plant manager of Hawai'i's flagship research university the UHM Office of Facilities and Grounds is committed to the development and application of knowledge and technologies that will sustain and advance the University's mission to serve the State of Hawai'i and its people. As Land Grant Universities of the 18th century evolve into the "Energy Grant Universities" of the 21st century the faculty, staff, and students will continue to be engaged in projects that provide benefits to the University and the Community at-large.

Smart Plant Architecture

An integrated phased approach to developing the required building blocks to construct an adaptive intelligent physical plant to meet current and future sustainability requirements.



Acknowledgements

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For Additional Information

For Additional Information please contact the University of Hawai'i at Mānoa's Office of Facilities & Grounds. Attention: Assistant Vice Chancellor for Facilities and Grounds, Dave Hafner, at the following address:

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