



UNIVERSITY
of HAWAII®
MĀNOA

Office of Facilities and Grounds

The Climate Registry 

University of Hawaii at Mānoa Energy Status Report November 2010



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November 2010

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54% of UHM Operating Expenses are for Energy vs. 36% of other RUVH





A Quiet Beginning

- In 2001 Manoa's OFG Engineering made a decision to split up the poorly functioning chill water loop installed by DAGS into smaller parts in order to fit the needed repairs into the CRDM program.
- From 2001 onward OFG began a series of energy retrofit and modernization CRDM projects.
- In 2007 OFG formally identified Energy as one of three key priorities along with Health & Safety, and Building Envelopes (roofs and fenestration)
- By the end of FY07-09 OFG was investing 30% of allotted CRDM (\$31 M) on energy retrofit and modernization projects.



2007 Energy Usage Reduction Plan

Baseline Electrical Usage	2006	2007	2008	2009	2010	2011	2012	2013	2014
Baseline Annual kWh (2004)	121,350,873	121,350,873	121,350,873	121,350,873	121,350,873	121,350,873	121,350,873	121,350,873	121,350,873
Energy Program Savings kWh									
Mechanical Systems kWh	8,500,000	9,000,000	12,400,000	13,000,000	15,000,000	17,000,000	19,000,000	21,000,000	23,000,000
Conservation kWh				2,000,000	6,000,000	8,000,000	8,000,000	8,000,000	8,000,000
Performance Contracting kWh					2,000,000	8,000,000	12,000,000	16,000,000	20,000,000
RCx kWh				200,000	800,000	2,000,000	2,000,000	2,000,000	2,000,000
PV Systems kWh					1,000,000	2,000,000	2,000,000	2,000,000	4,000,000
Total Program Savings kWh	8,500,000	9,000,000	12,400,000	15,200,000	24,800,000	37,000,000	43,000,000	49,000,000	57,000,000
Net Requirement kWh	112,850,873	112,350,873	108,950,873	106,150,873	96,550,873	84,350,873	78,350,873	72,350,873	64,350,873
Percent Reduction Targets									
Mechanical Upgrades		7.4%	10.2%	10.7%	12.4%	14.0%	15.7%	17.3%	19.0%
Conservation		0.0%	0.0%	1.6%	4.9%	6.6%	6.6%	6.6%	6.6%
Performance Contracting		0.0%	0.0%	0.0%	1.6%	6.6%	9.9%	13.2%	16.5%
RCx		0.0%	0.0%	0.2%	0.7%	1.6%	1.6%	1.6%	1.6%
PV Systems		0.0%	0.0%	0.0%	0.8%	1.6%	1.6%	1.6%	3.3%
Total Reduction	7.0%	7.4%	10.2%	12.5%	20.4%	30.5%	35.4%	40.4%	47.0%



FY2009 Performance

- Manoa Campus' net electrical usage for Fiscal Year 2009 declined by over 7% to 101,171,623 kWh from the prior year of 108,950,873 kWh and 16% in total from the FY2004 baseline of 121,350,873 kWh
- This reduction of 7,779,250 kWh is equivalent to approximately \$1.5 million in expense savings equivalent to the full-time annual tuition for 230 undergraduates or the fully loaded salaries of 15 faculty members per year.
- This is the fourth straight year in the decline of net energy usage from the campus peak usage of 121,350,873 kWh in FY2004 contributing \$9 million in cumulative savings



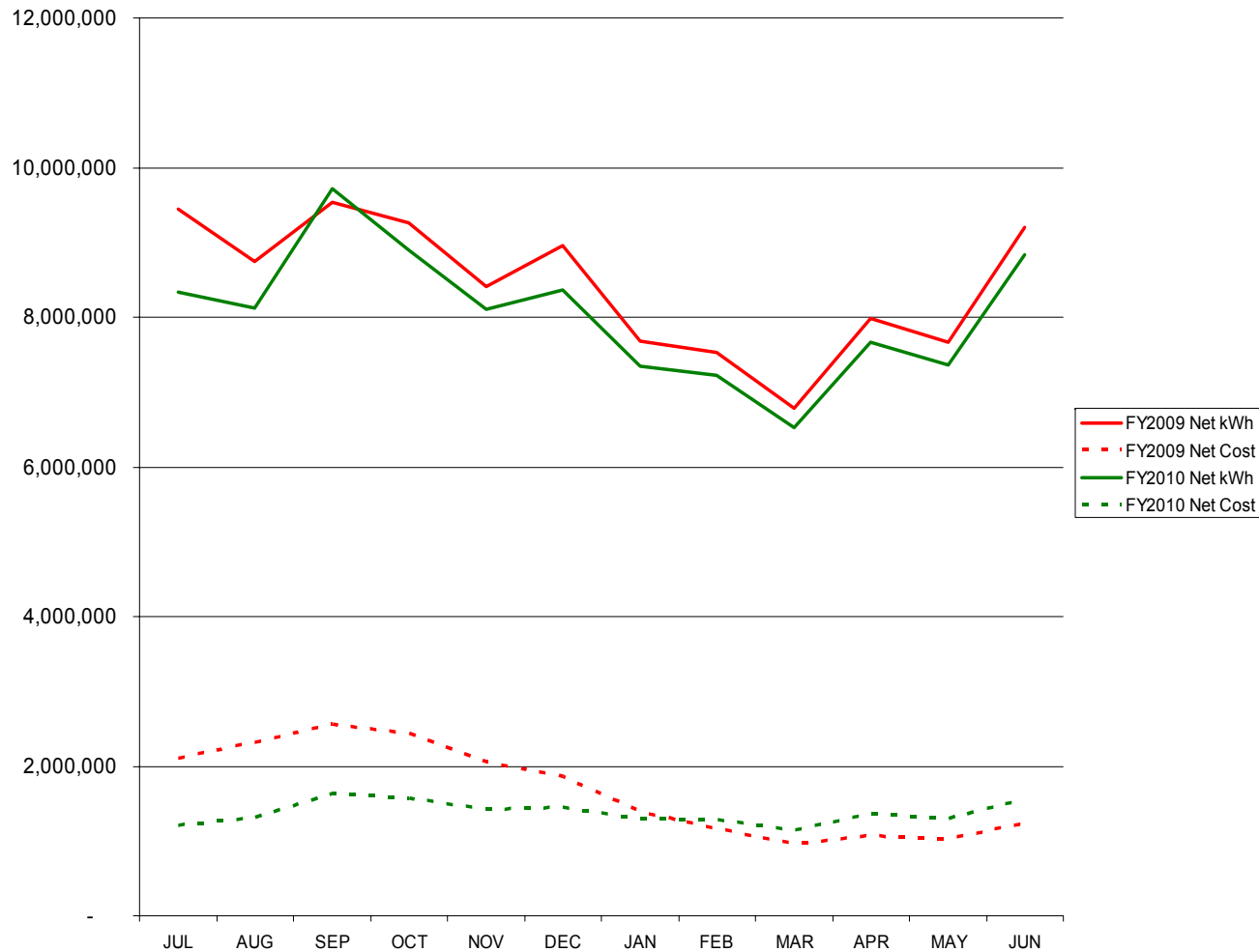
FY2010 Performance

- For the fifth consecutive year UHM will achieved a reduction in electrical usage.
- UHM will achieved of 6% reduction of 6.1 million kWh compared to the prior year to meet the total reduction goal of 20%.
- **FY2010 Savings of \$3.5 million in Tuition Funds**
- This accomplishment firmly establishes OFG Engineering as Hawaii's most successful Energy Management service provider.

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
FY2009 Net kWh	9,439,875	8,740,202	9,538,908	9,255,010	8,406,202	8,950,639	7,682,634	7,521,655	6,789,159	7,990,181	7,660,117	9,197,041	101,171,623
FY2009 Net Cost	\$2,093,612	\$2,314,950	\$2,554,068	\$2,434,209	\$2,055,118	\$1,860,322	\$1,380,825	\$1,152,110	\$ 958,326	\$1,070,870	\$1,026,398	\$ 1,227,727	\$20,128,535
FY2010 Net kWh	8,332,216	8,119,950	9,723,818	8,901,461	8,102,553	8,368,679	7,344,269	7,220,789	6,517,593	7,670,574	7,353,712	8,829,159	96,484,773
FY2010 Net Cost	\$1,199,788	\$1,306,168	\$1,631,647	\$1,562,507	\$1,421,497	\$1,448,242	\$1,292,152	\$1,270,859	\$1,147,096	\$1,350,021	\$1,294,253	\$ 1,553,932	\$16,478,163

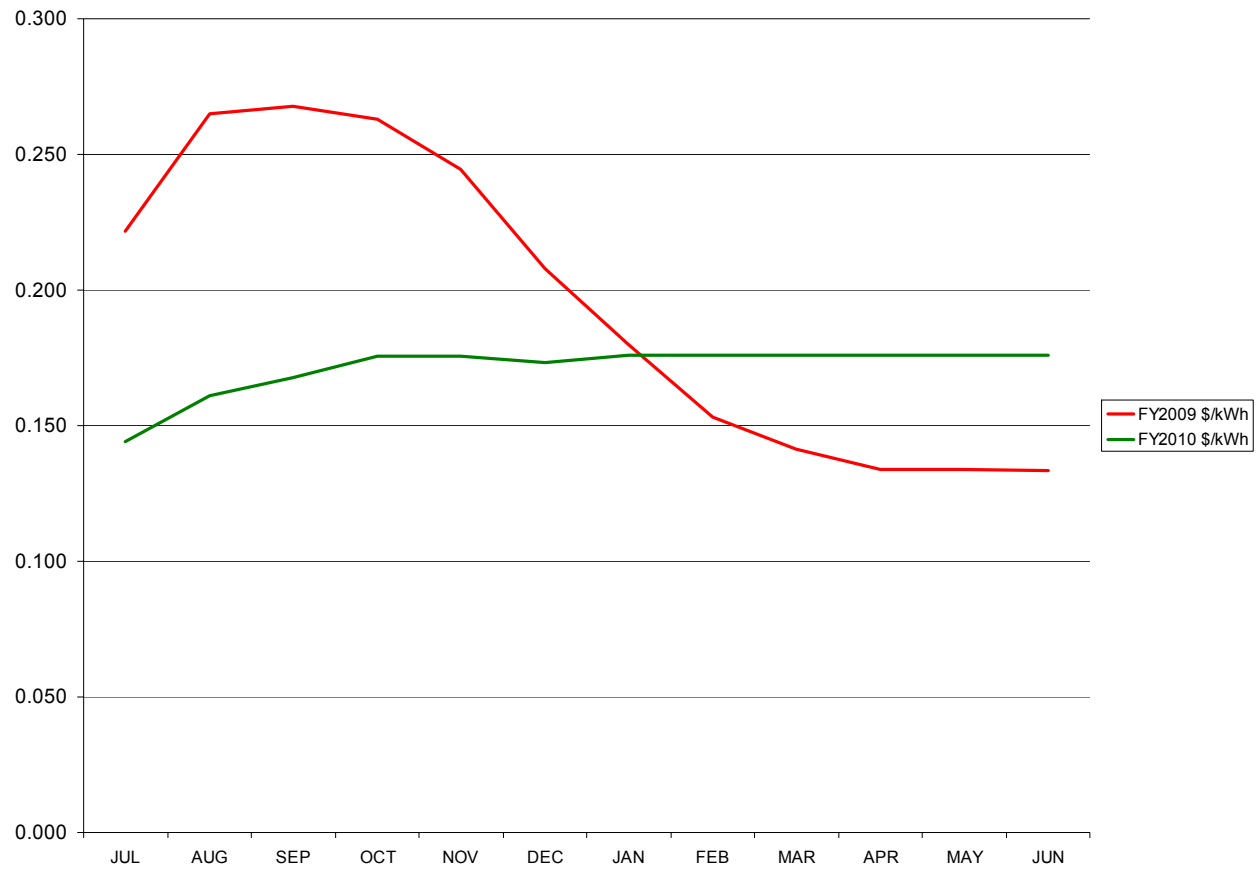


UHM Monthly Net Energy Usage



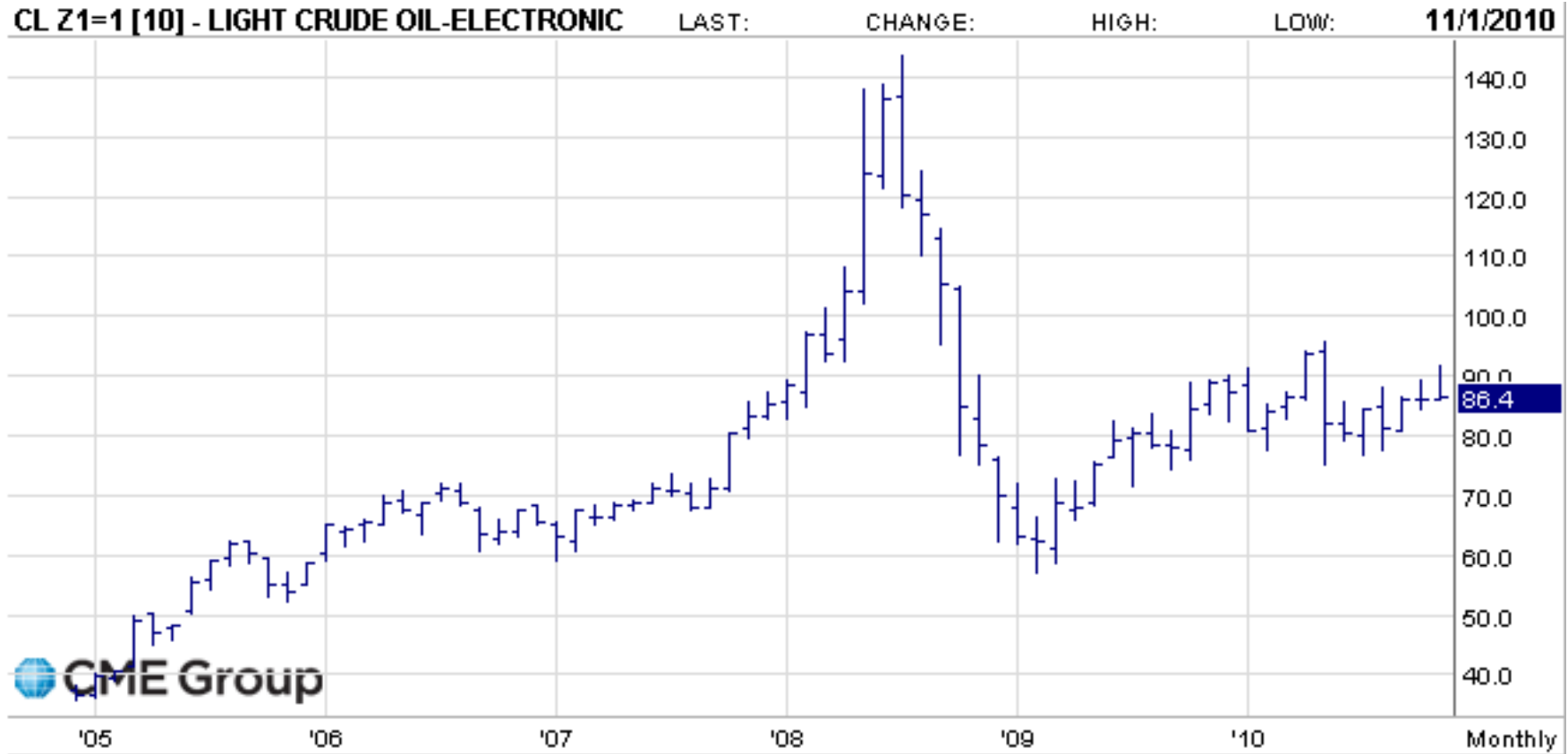


Price per kWh





Futures December 2011





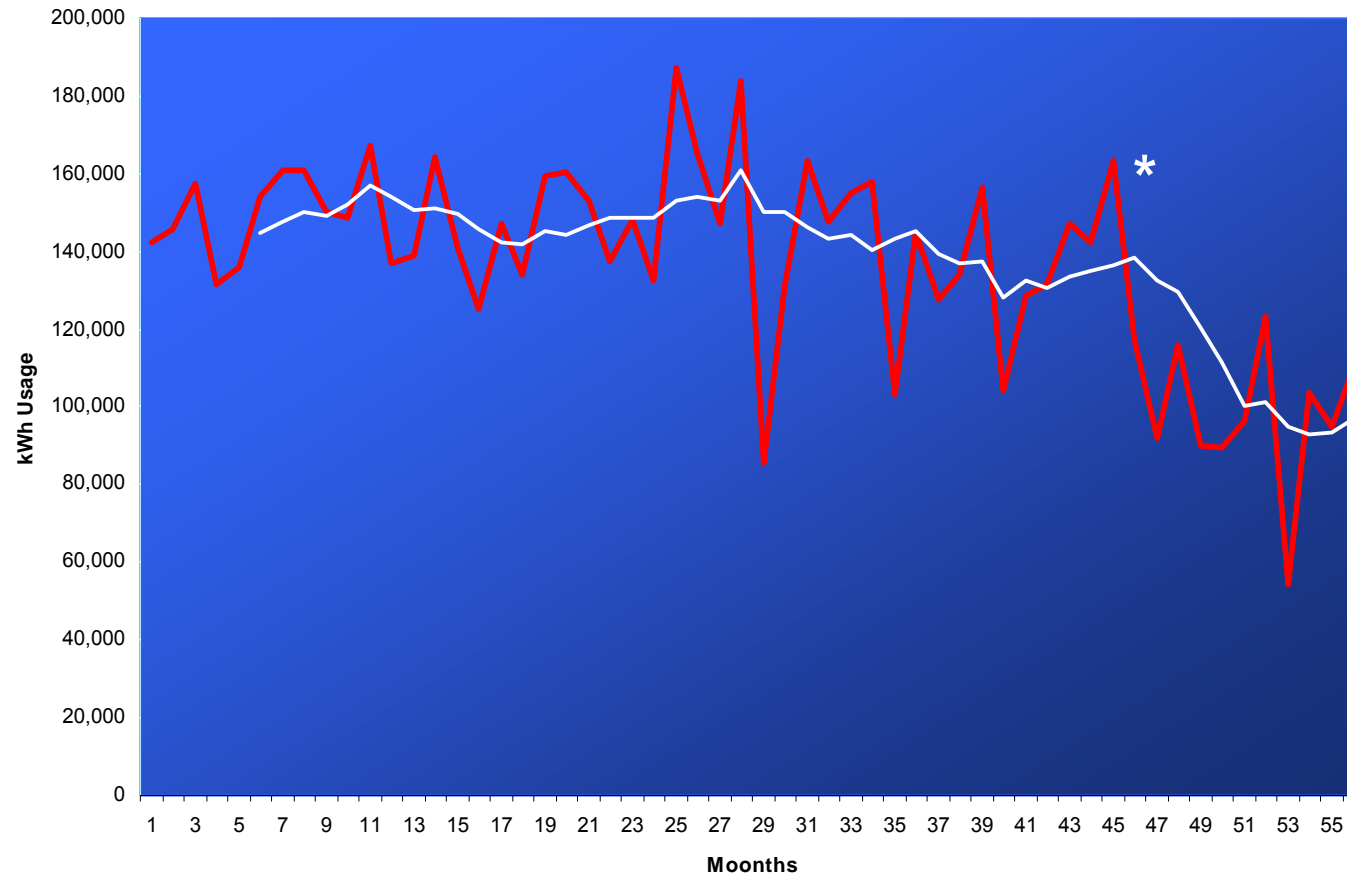
Energy Program Drivers

- These results have been made possible by an established program of capital investments in HVAC mechanical upgrades and energy retrofits as part of the campus' biennium Campus Renewal and Deferred Maintenance program.
- Industry experience confirms that 75% of all energy savings are the result of HVAC mechanical upgrades and retrofits.
- The Manoa campus commits 30% of its biennium capital program towards this purpose.
- Additional savings are created through soft projects such as the Manoa Green Days conservation efforts.



Energy Retrofit Results

Moore Hall March
2005 to October 2010





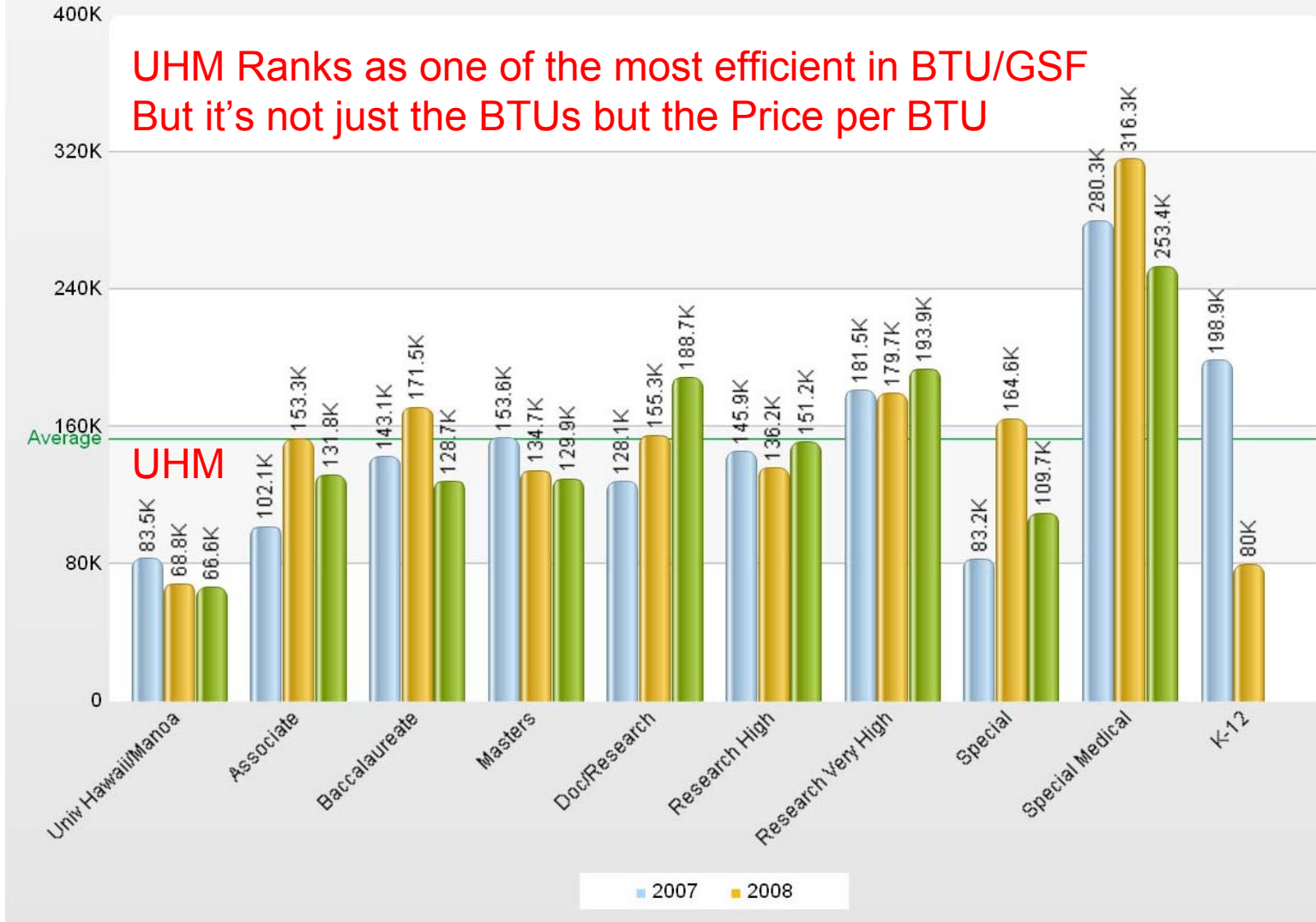
Manoa Green Days

- A/C Shutdown during the Holidays (Thanksgiving, Christmas/New Year) and Spring Break
- To provide information on sustainable energy initiatives of campus buildings
- To drive collaboration between campus constituents - promote partnerships
- To communicate progress and energy conservation results of campus buildings
- Christmas Break savings of \$40,000 (two weeks)

<http://www.manoa.hawaii.edu/facilities/mgd>



Energy BTU/GSF -- Averages Summarized By: Carnegie Class -- Fiscal Year 2008-09 APPA FPI Report





New Buildings Coming

C-MORE	\$22,500,000	
GSF	25,000	
PM & Minor Repair	\$2.96	\$74,113
Unscheduled Maintenance	\$2.16	\$53,900
Renewal & Replacement (CRDM Budget)	\$5.24	\$131,075
Custodial	\$1.20	\$30,000
Grounds	\$0.21	\$5,250
Electricity	\$14.50	\$362,520
Gas	\$1.42	\$35,450
Water/Sewer	\$0.06	\$1,552
TOTAL	\$27.69	\$692,308
ITC Building	\$36,700,000	
GSF	74,170	
PM & Minor Repair	\$2.50	\$185,351
Unscheduled Maintenance	\$0.80	\$59,058
Renewal & Replacement (CRDM Budget)	\$2.30	\$170,814
Custodial	\$1.20	\$89,004
Grounds	\$0.21	\$15,576
Electricity	\$10.11	\$750,000
Gas	\$0.34	\$25,000
Water/Sewer	\$0.06	\$4,500
TOTAL	\$17.52	\$1,299,302



Goals and Opportunities

- Align UHM resources by reducing energy costs per BTU through direct reinvestment in Distributive Generation (i.e. PV and Wind)
- Establish UHM as an acknowledge leader in Energy Management applications (*Engage State Leadership*)
- Extend UHM Energy Management services to off-campus UHM units other UH System units.
- Engage UHM Faculty, Staff, and Students in research and learning opportunities to create Smart Grid Research collaborations



Going Forward

- **Smart Grid Research Collaborations**
 - Sea Grant Center for Smart Buildings – Re-lamping
 - Economics Department - Climate Registry and Energy Star reporting
 - Physics Department and ICS Collaboration – WattDepot and PV
 - College of Engineering - PV and Water Resources Modeling
 - Energy Management and Control Systems
 - New Advanced technology campus electrical substation
- **Distributed Generation Investments**
 - 1 MW Photovoltaic Car Canopy and PHEV Recharging System
 - 1 MW Photovoltaic roof top systems
 - 3 MWh Energy Storage system



Distributed Generation



The largest PV system in the State



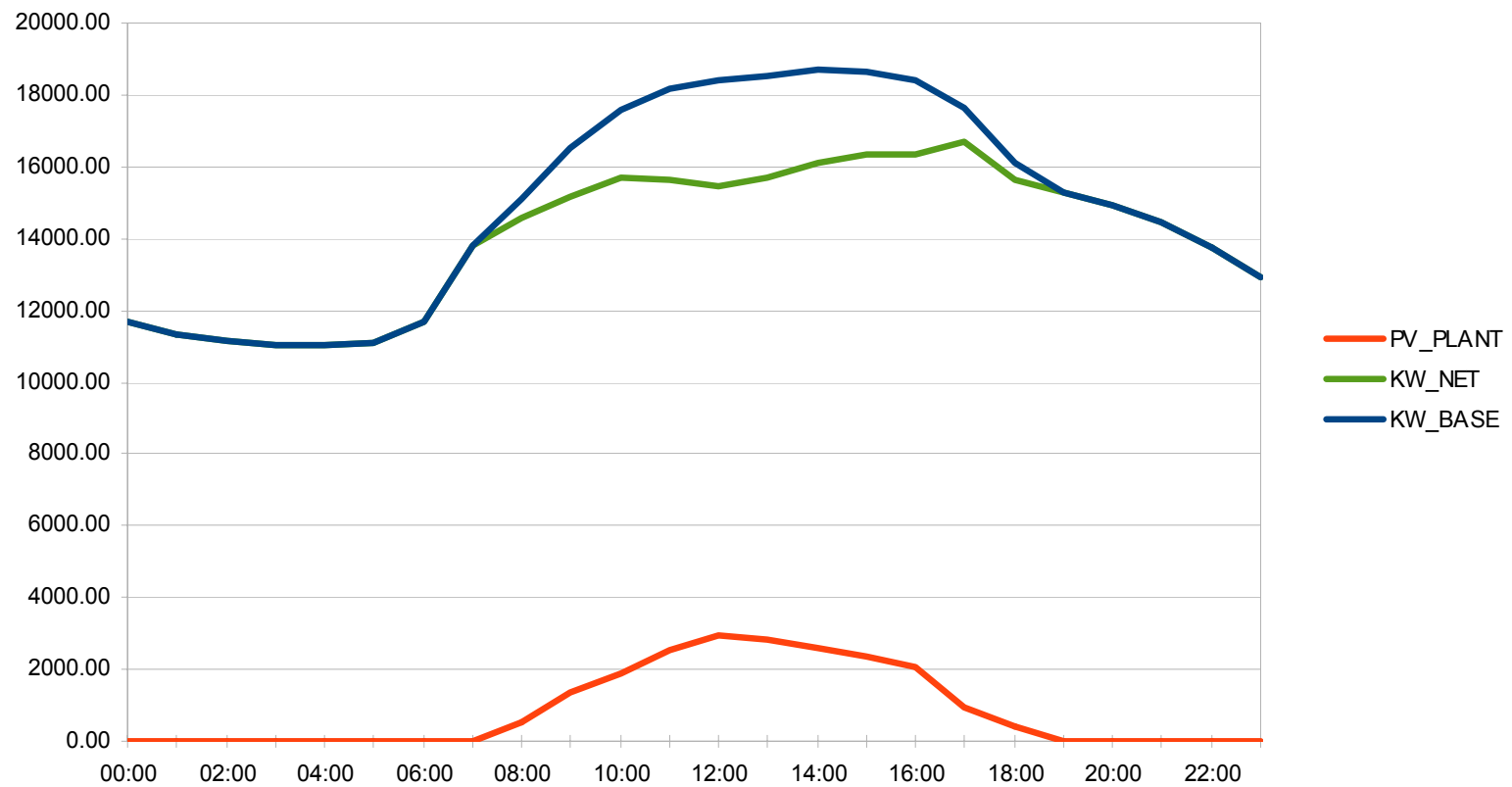
Roof top systems

OFG is partnering with Parking and Transportation to promote PHEV by providing widely available on-campus recharging stations for faculty, staff, and students. Future hydrogen refueling stations for fuel cells.



Smart Grid Application – Time of Day Usage

UH Manoa Load Curve





Long-Term Strategy – “Get the price down”

- Diminishing returns from energy retrofits and limited available on-campus PV and wind sites will require off-site solutions utilizing “virtual net metering”; sustainable fuel generation using sun & wind to hydrogen; and sun to bio diesel



Concentrated Solar



25 kW Stirling Engine

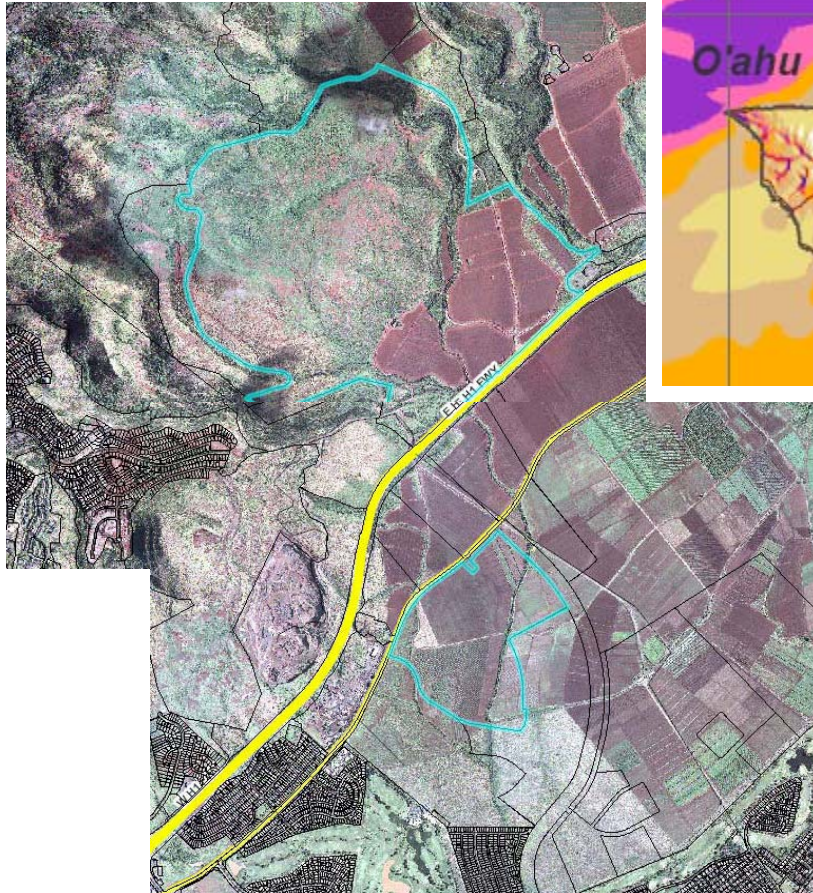


UCSD Bio-diesel farm

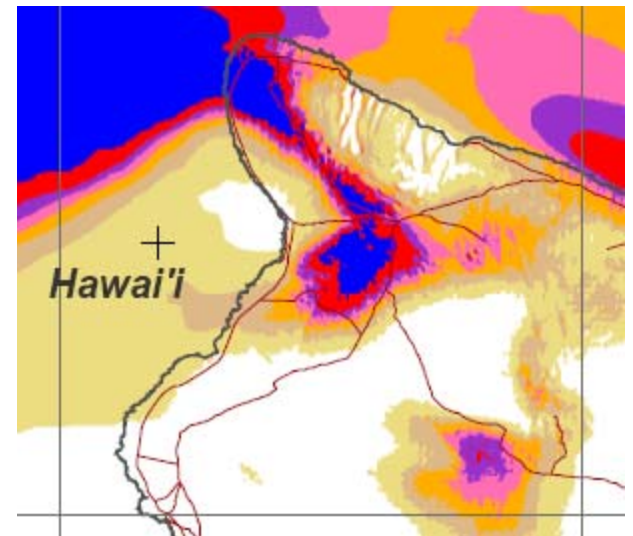
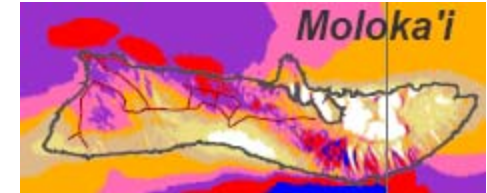
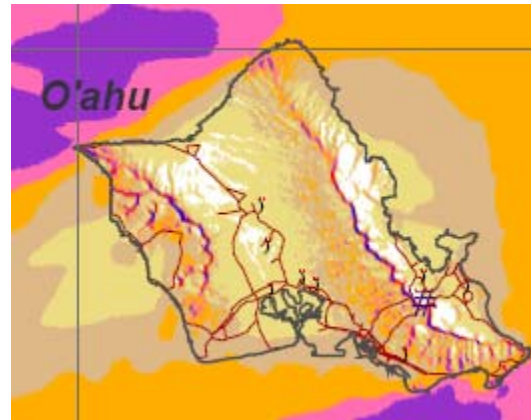


Potential Energy Lab Sites

Mauka Site



UH West Oahu





Summary Points

- Despite increasing efficiencies the current institutional model is unsustainable due to high energy costs and is placing UHM's role as the State's Flagship Land Grant University at risk
- UHM has the potential to become the “destination of choice” in Energy Research and Education – the New “Energy Grant” University





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People Serving Pride, Joy, and Aloha*