



UNIVERSITY of HAWAII®



Informational Briefing on Net-Zero Status for the University of Hawaii

Informational Briefing Notice HEARING_EEP-EDN-HET_07-13-21_INFO_10:00am

presented to
Committee on Energy & Environmental Protection

June 13, 2021

Agenda:

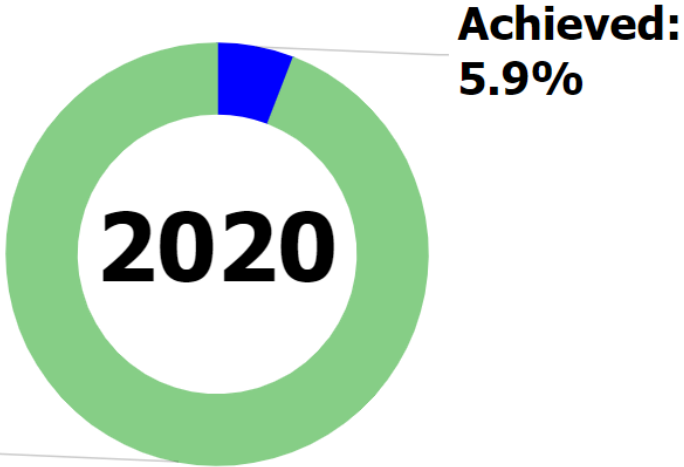
- I. High Level Overview of System
- II. Mānoa Main Campus
 - A. General Progress
 - B. COVID Impact
- III. The Look Ahead
- IV. Community Colleges Progress



For Additional Information Please Visit:
<https://www.hawaii.edu/sustainability/energy/>



Net Zero by 2035 Status FY2019-20



Pursuant to HRS 304A-119

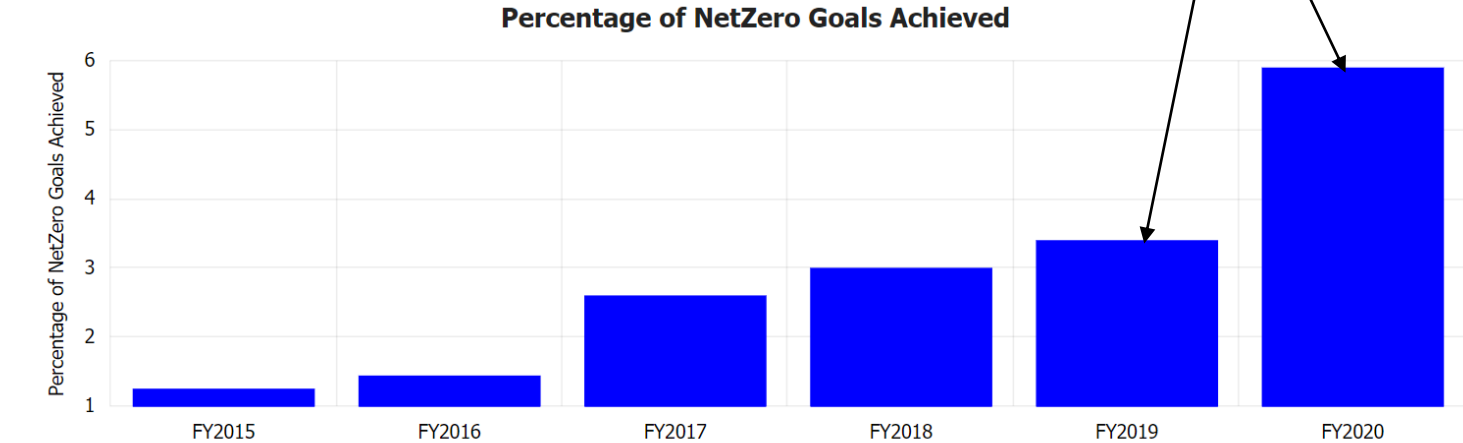
Target Production: 198,000,000 kWh

Total Production: 11,618,197 kWh*

Net Zero Status: 5.9 %

* For period July 1, 2019 – June 30, 2020. Many recently constructed solar systems were not yet energized during this Performance Period.

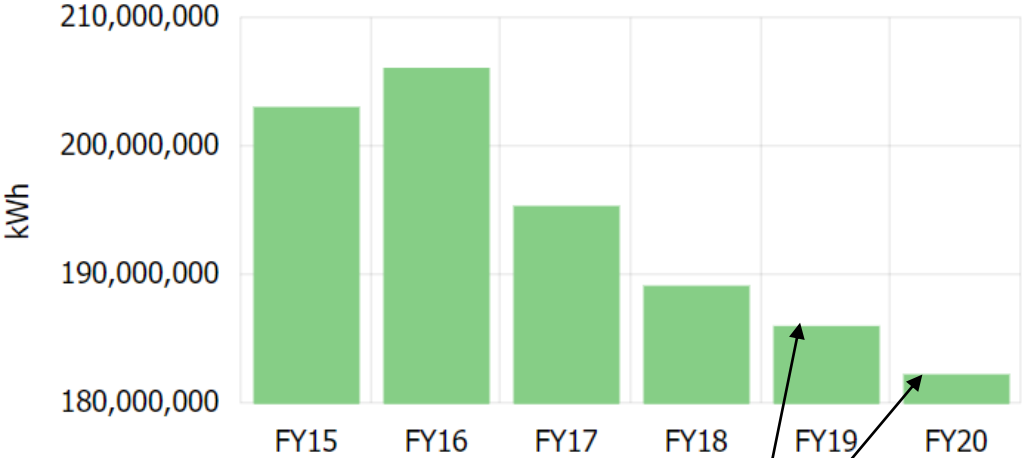
74% Change



Renewable Energy Production and Utility Purchased

Annual Energy Consumption

Utility Purchased Energy

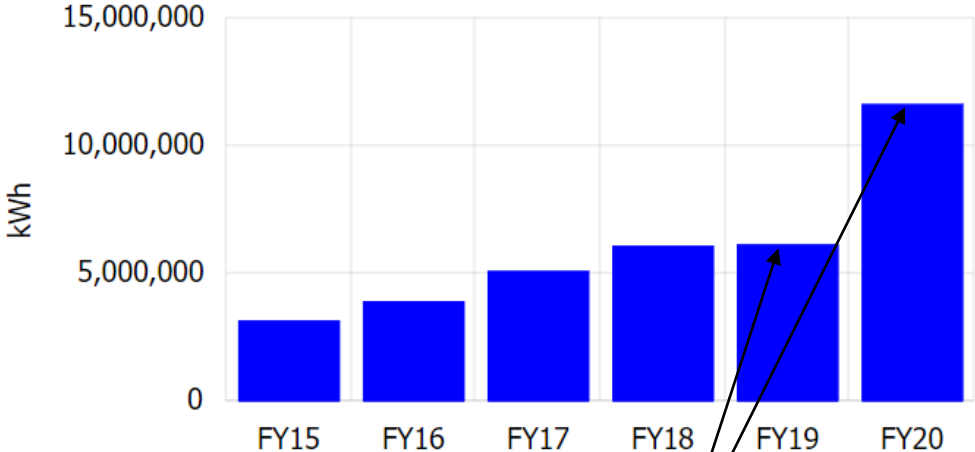


-2% change

* Additional Efficiency, Increased PV penetration
Operational Enhancements, Covid-19

Annual Energy Production

From Renewables



90% change

* For period July 1, 2019 – June 30, 2020. Many recently constructed solar systems were not yet energized during this Performance Period.



<https://www.hawaii.edu/sustainability/energy/dashboard/>

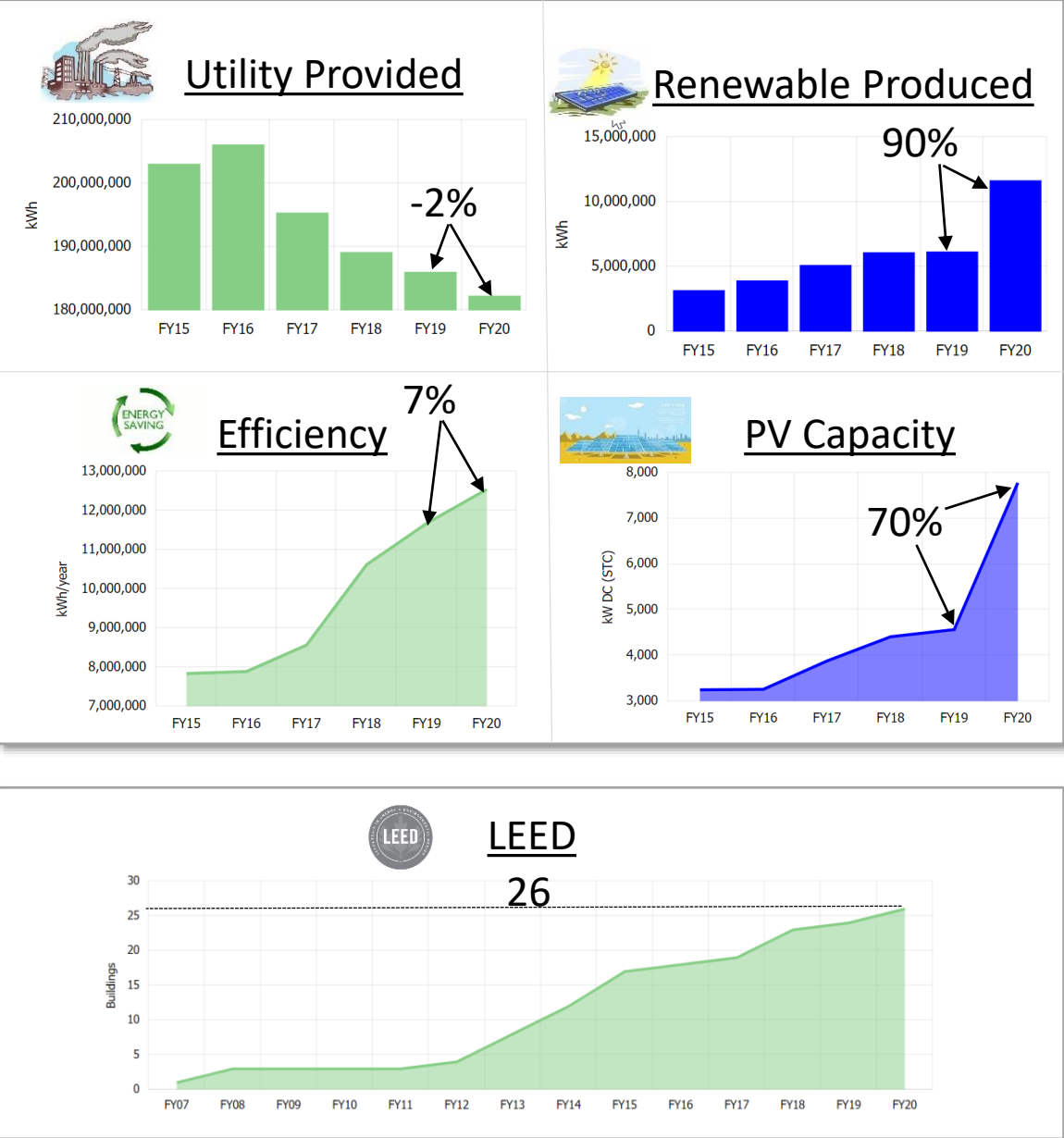
Energy Dashboard

FY18-19 to FY19-20 % changes

- Utility Purchased -2%
- Renewable Production 90%
- Efficiency 7%
- PV Capacity 70%

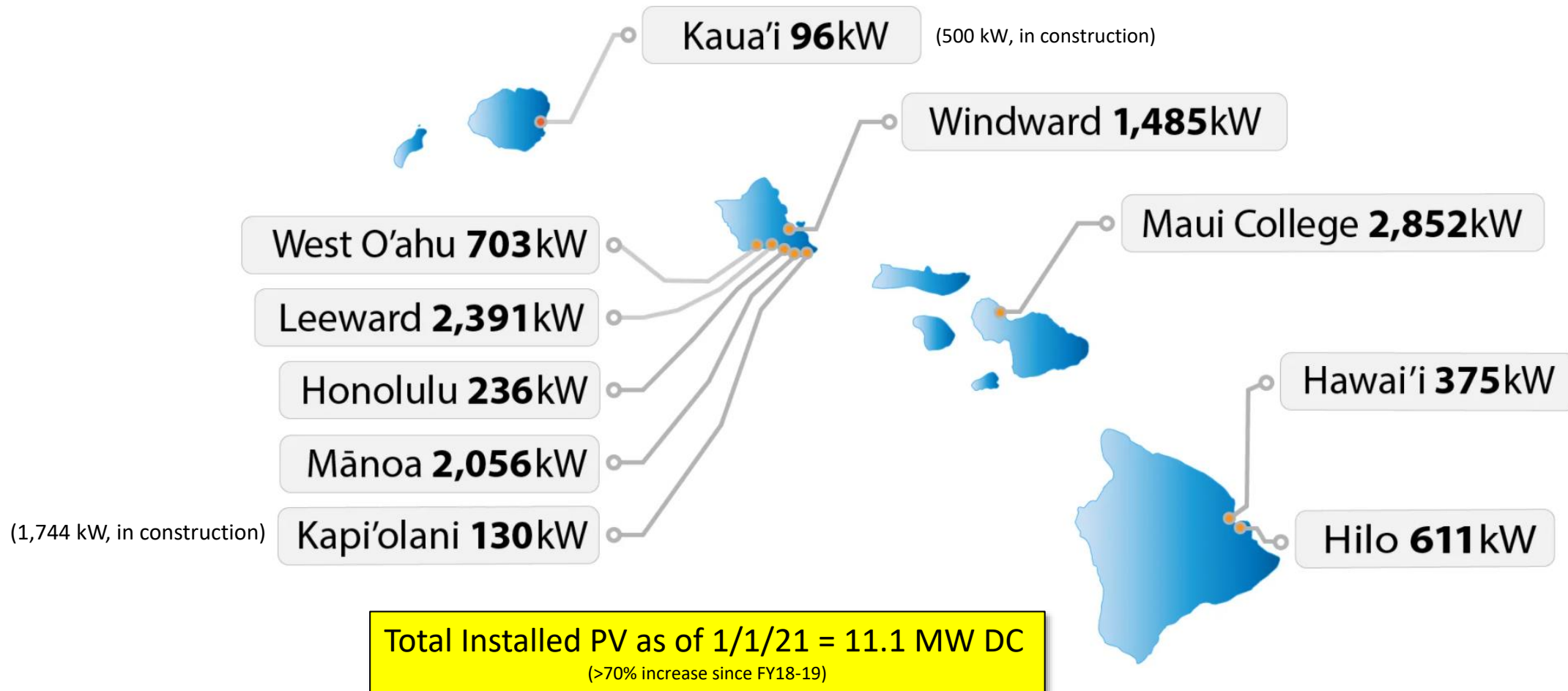
26 LEED Buildings

- 2 platinum
- 12 gold
- 9 silver
- 2 certified



<https://www.hawaii.edu/sustainability/energy/dashboard/>

University of Hawai'i PV Systems



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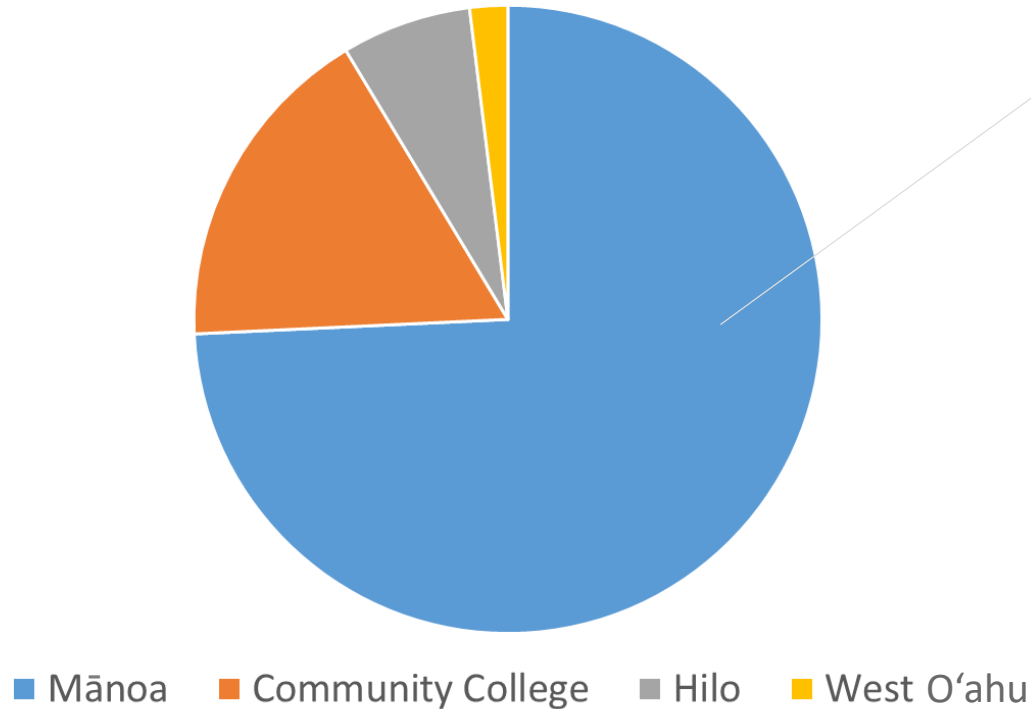


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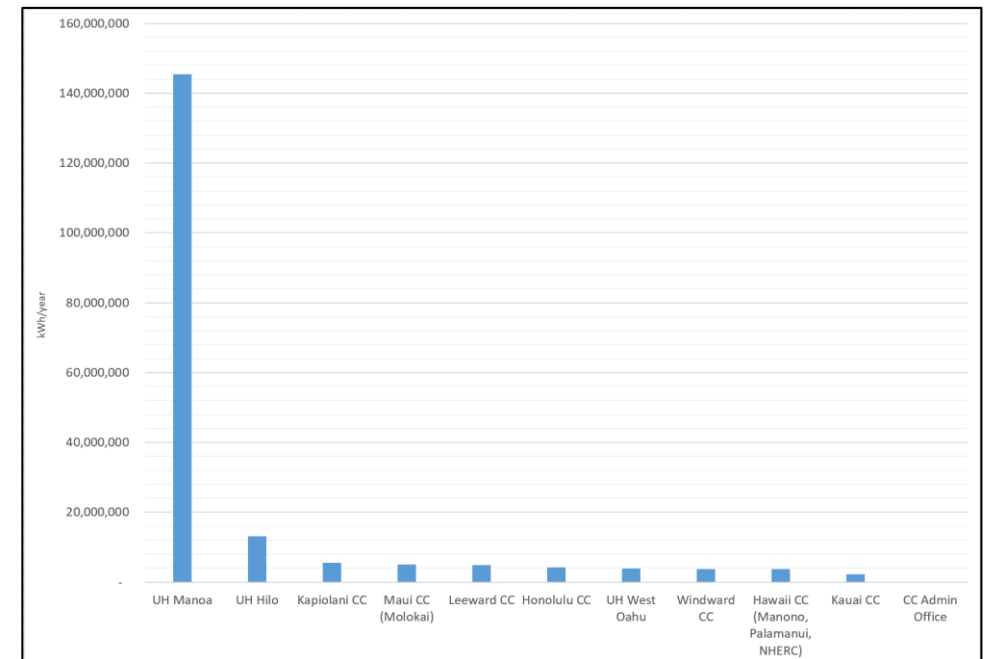
Breakdown by Campus Affiliation

kWh by campus affiliation FY19-20



	Total (kWh)	Total Cost
Mānoa	145,403,480	\$ 34,894,674.63
Community College	33,494,361	\$ 8,079,377.13
Hilo	13,075,504	\$ 3,878,266.90
West O'ahu	3,827,133	\$ 859,441.54

80% of Mānoa consumption @
UHM Main Campus (117,077,916 kWh at UHM)



Affiliations Include Main campuses and Off-sites
(i.e., Mānoa-Affiliated: JABSOM, Aquarium, Lyon, Pier 35, CTAHR farms, etc.)



Magnitude of UH Mānoa Main Campus

Substation Fed

- R1 Research Facility
>18 Research Bldgs
- Dorms
17 Housing Bldgs
- Division 1 sports
7 sporting arenas
- 3 Libraries
- ITC - Data Center
- Many Buildings
Cooled 24/7



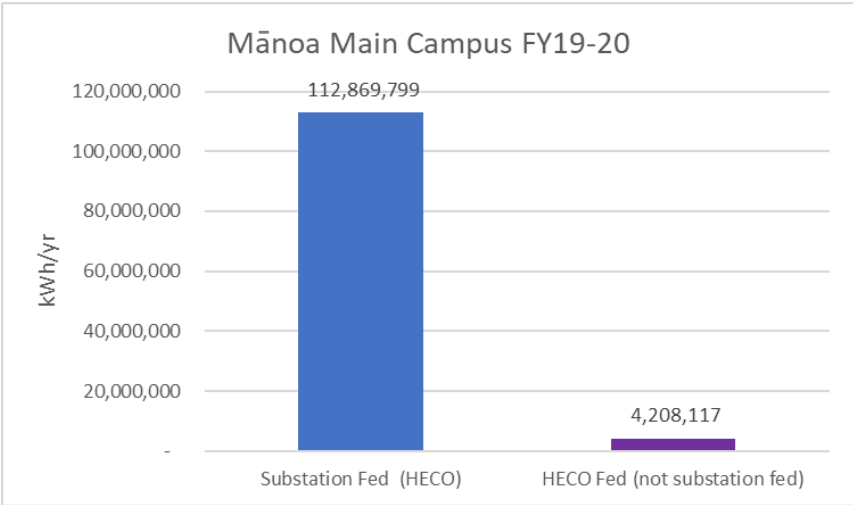
Notional Population ~23,000: ~5,000 staff and faculty, ~18,000 students



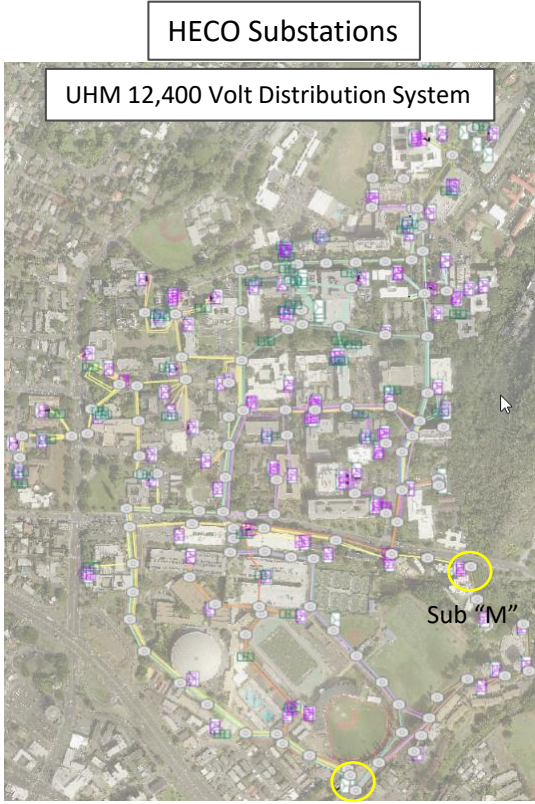
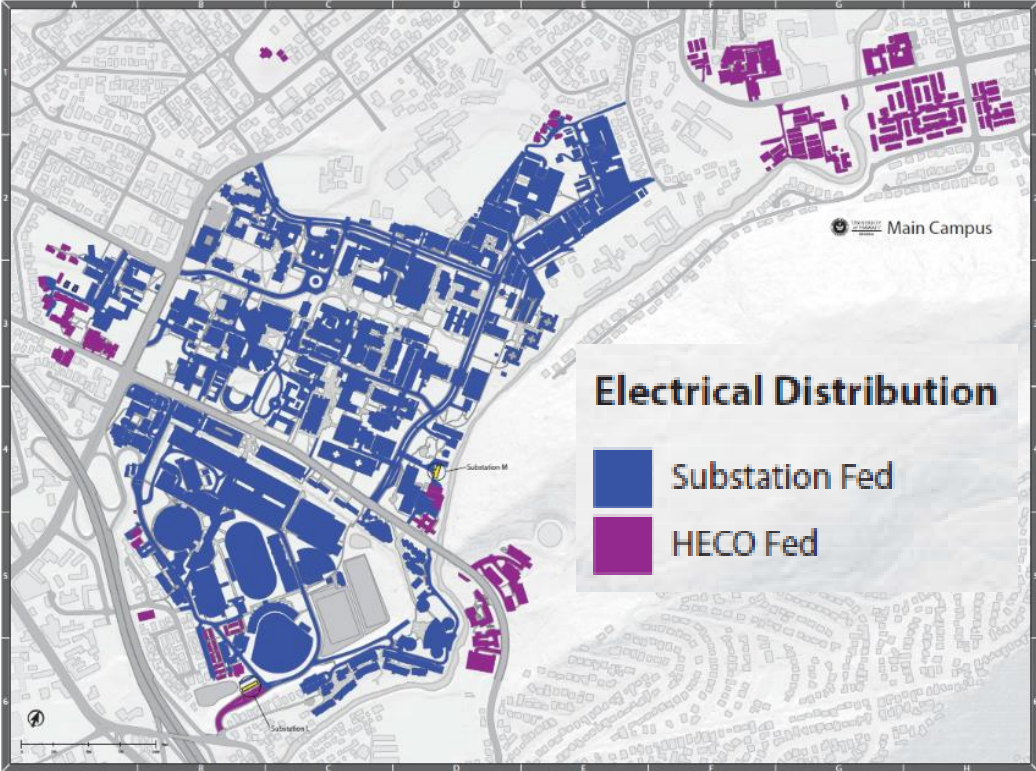
Mānoa Main Campus FY19-20

Main Campus FY19-20	Substation 12.4kV Fed (kWh)	HECO Fed (kWh)	Total (kWh)
Total	112,869,799	4,208,117	117,077,916

Substation (PV+HECO)	112,869,799
PV	1,902,199
HECO	110,967,600



Most of the Energy is Substation fed



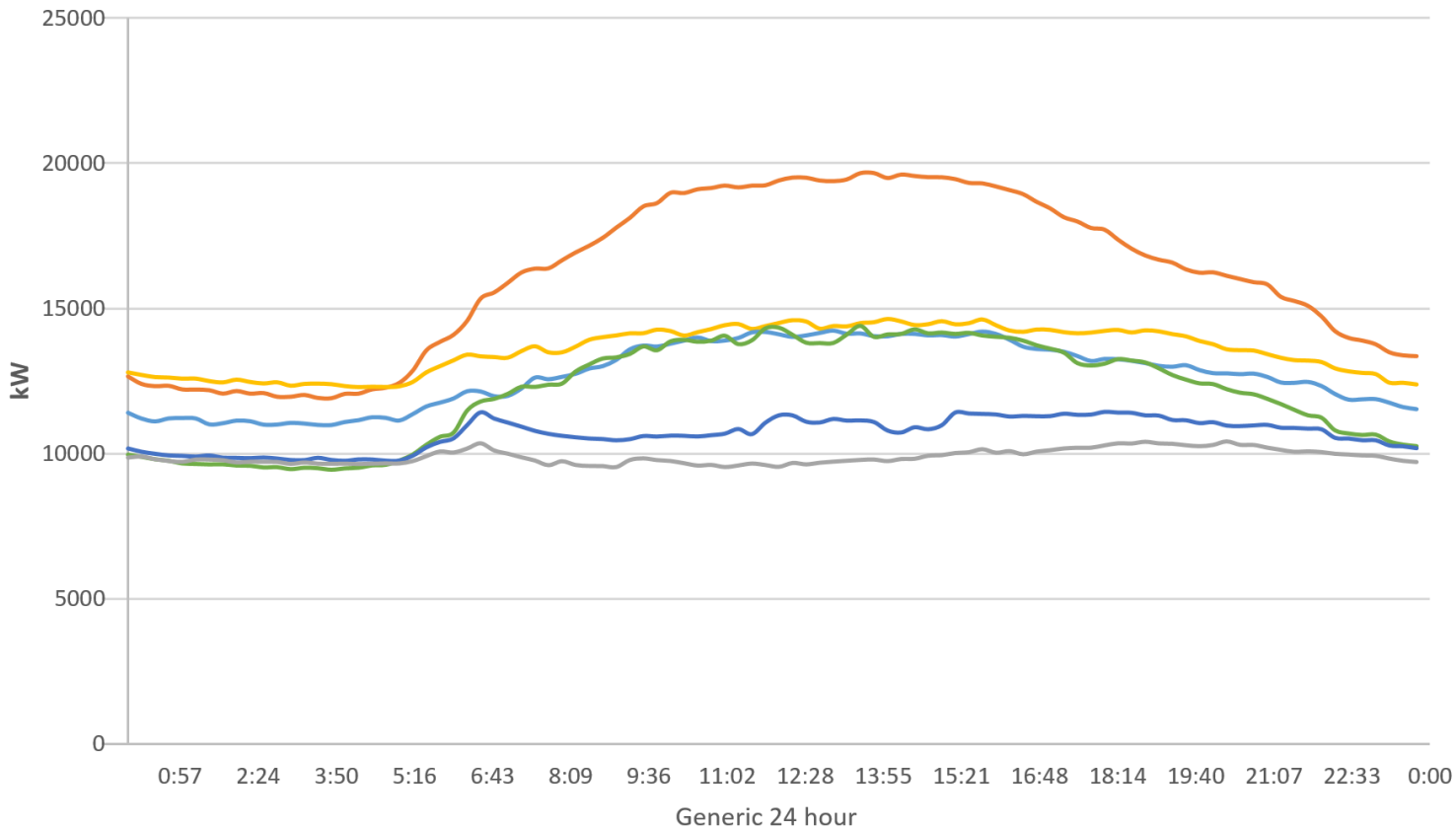
- HECO stops at the Edges
- UHM Maintains 12,400 Volt distribution Grid
- Either Substation can run the entire campus



FY19-20 Substation

Peak Demand Statistics

Substation HECO Provided Demand Data FY2019-20 (kW)

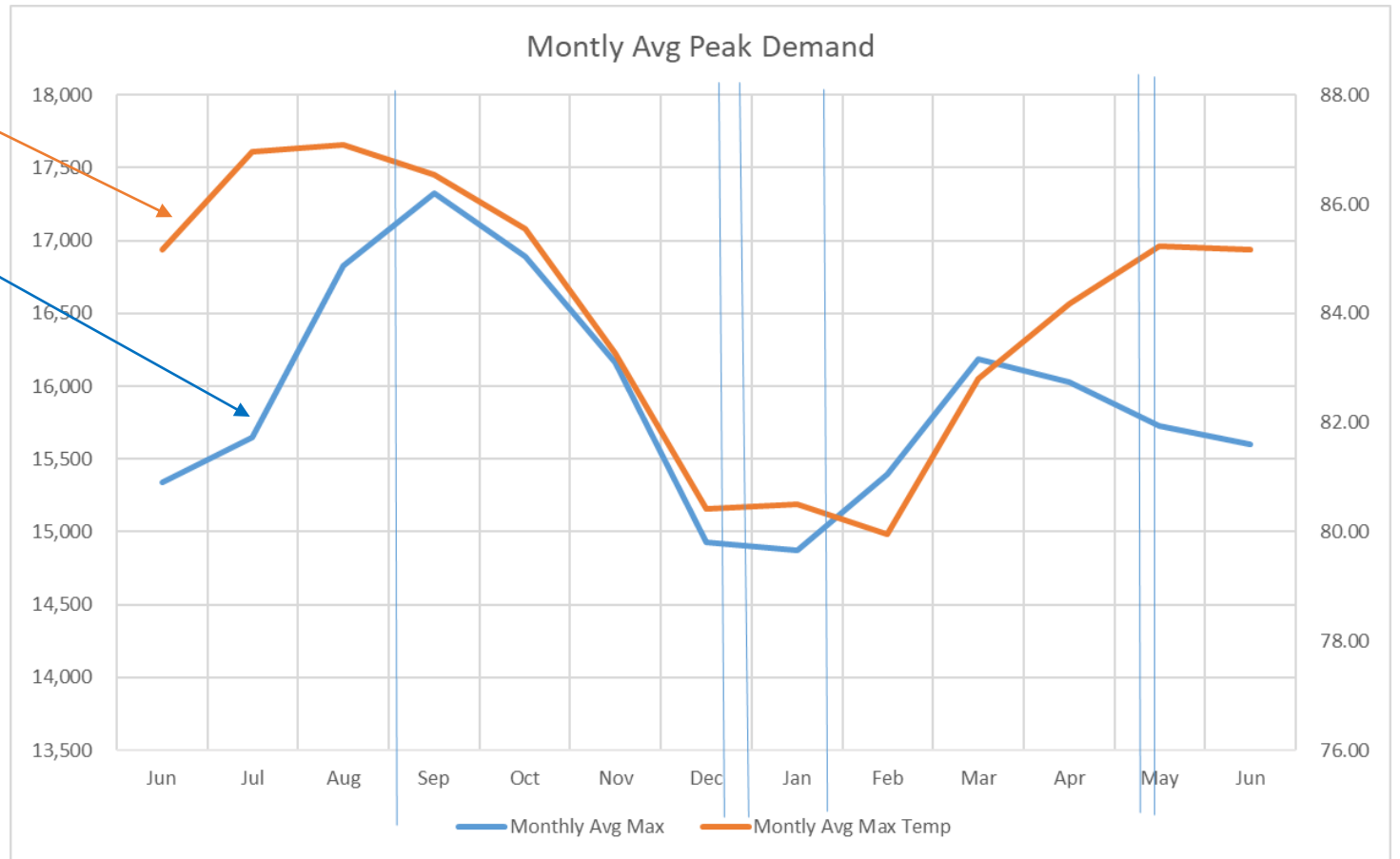


Peak kW	Date	Time of Peak kW	Description
19,660	9/5/2019	1:45 PM	Max Peak kW day
14,620	9/28/2019	2:00 PM	Mean Peak kW representative day
14,202	8/10/2019	1:00 PM	Median Peak kW representative day
14,403	2/11/2020	1:30 PM	Mode Peak kW representative day
11,444	1/1/2020	6:00 PM	Historical Min Peak kW Day
10,418	4/12/2020	8:15 PM	Min Peak kW day

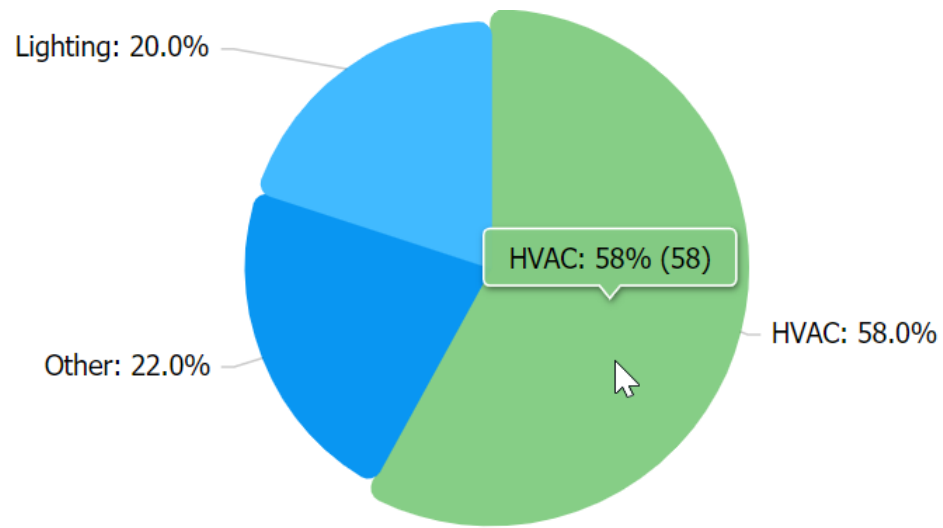
- 9/5/2019
- 9/28/2019
- 8/10/2019
- 2/11/2020
- 1/1/2020
- 4/12/2020



Air Conditioning Uses the Most Energy



Outside Temperature
Energy Demand

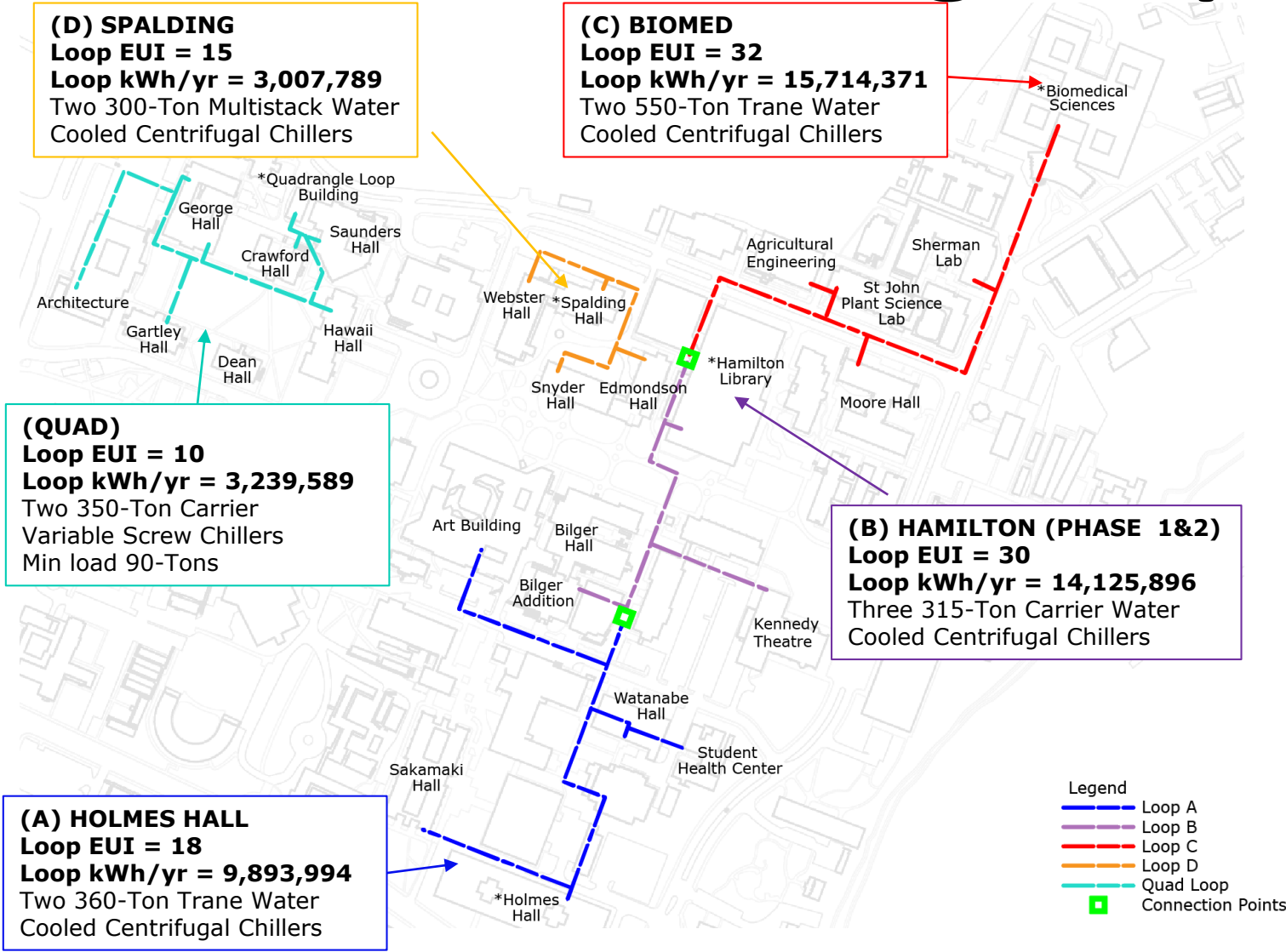


* %s According to 2011 Study

Outside temp plotted against Energy use at Mānoa FY17-18



UH Mānoa Cooling Loops 2020



Use Type	LOOP A
	ART BUILDING
Research	HOLMES HALL
	SAKAMAKI HALL
	UNIVERSITY HEALTH SERVICES
Research	WATANABE HALL
	LOOP B
Research	BILGER ADDITION
Research	BILGER HALL
Library	HAMILTON LIBRARY PHASE 1 & 2
	KENNEDY THEATRE
	LOOP C
Research	AGRICULTURAL SCIENCE BUILDING
Research	BIOMEDICAL SCIENCES BUILDING
	MOORE HALL
Research	SHERMAN LABORATORY
Research	ST. JOHN PLANT SCIENCE LABORATORY 1
Research	ST. JOHN PLANT SCIENCE LABORATORY 2
	LOOP D
Research	EDMONDSON HALL
Research	SNYDER HALL
	SPALDING HALL
	WEBSTER HALL
	QUAD LOOP
	ARCHITECTURE BUILDING
	DEAN HALL
	GARTLEY HALL
	GEORGE HALL
	HAWAII HALL
	SAUNDERS HALL



Top 45 Buildings (FY19-20)

Cooling Loops
(25 buildings)

Top 20
(20 buildings)

Use	Building Group	kWh	Sqft	kWh/sqft
Research & Library	Hamilton 1&2 Loop B =	14,125,896	475,681	30
Research	Biomed Loop C =	15,714,371	498,492	32
Research	Holmes Loop A =	9,893,994	546,299	18
Research	Spalding Loop D =	3,007,789	197,219	15
Office/Classroom	Quad Loop Q =	3,239,589	312,249	10
Research	POST	9,823,189	225,000	44
IT	INFORMATION TECHNOLOGY SERVICES	6,390,468	73,754	87
Athletics	STAN SHERIFF CENTER	3,464,637	190,000	18
Library	HAMILTON LIB PH III	3,431,574	121,453	28
Athletics	HPER MAIN MTR (GYM 1 and GYM 2)	3,141,529	176,559	18
Research	HIG	2,376,992	126,708	19
Research	AG SCIENCE	2,175,925	93,591	23
IT	KELLER and PHYSICAL SCIENCE	2,009,401	97,402	21
Research	C-MORE	1,960,472	26,997	73
Library	LAW SCHOOL AND LIBRARY	1,804,306	86,435	21
Research	MARINE SCIENCE	1,652,335	95,500	17
Research	GILMORE HALL	1,495,580	73,180	20
Office/Class	BUS_ADMIN_BLDG_SHIDLER	1,427,093	122,052	12
Office	QLCSS	1,096,385		
Library	SINCLAIR/ANNEXS 1-2	827,598	121,491	7
Museum	KRAUSS and Annexs	881,350	27,583	32
Research	PBRC	644,771	16,294	40
Office/Class	KUYKENDALL/ANNEX	632,215	88,265	7
Music	MUSIC COMPLEX	554,122	69,168	8
Athletics	LES MURAKAMI STADIUM	508,602	81,244	6
		92,280,183	Total top 45 Buildings	

45 Largest Energy Users:

- 18 Research Buildings
- 2 IT Centers
- 3 Libraries
- 3 Athletic Venues

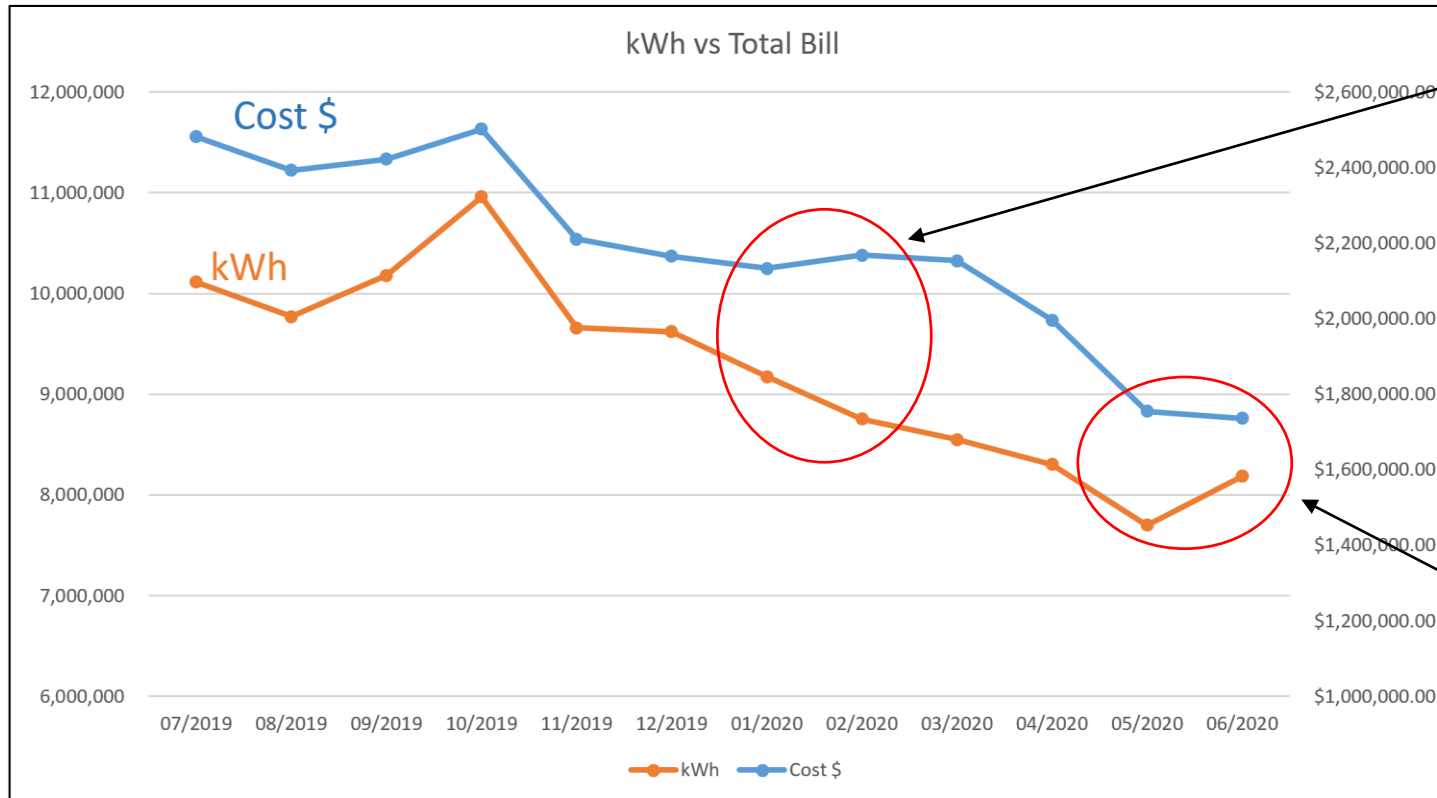
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	QUAD LOOP
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	GARTLEY HALL
	GEORGE HALL
	HAWAII HALL
	SAUNDERS HALL

* Loops on previous page

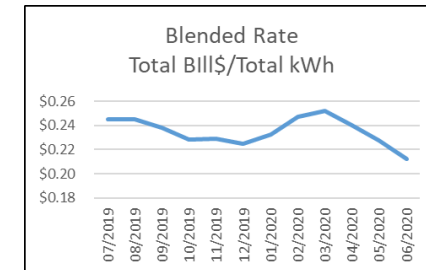
Student Housing and Campus Center were omitted from this analysis



Substation Monthly kWh vs Cost



Cost can go up even when consumption goes down

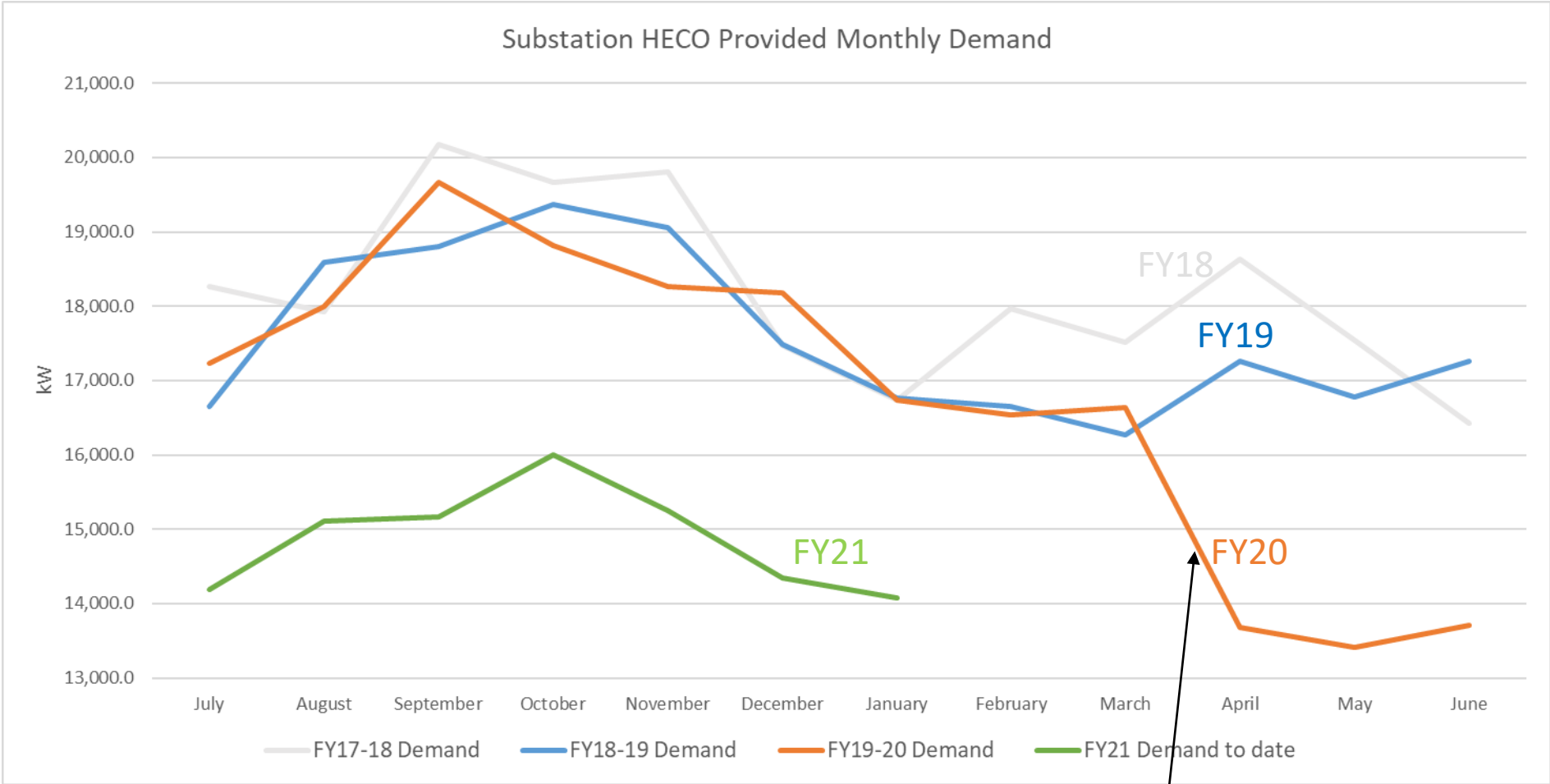


Cost can go down when consumption goes Up

Cost and Consumption are fluctuating independently



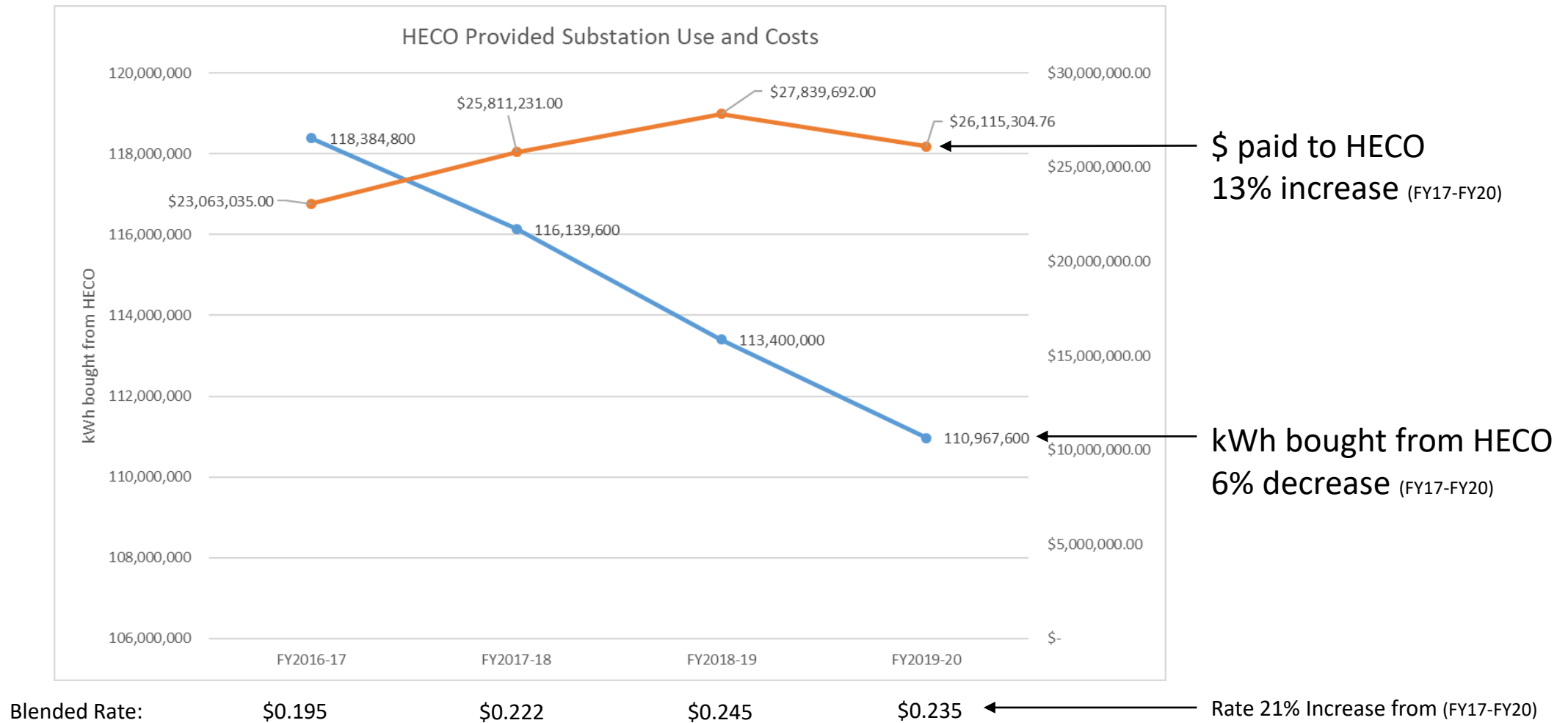
COVID Impacts on Energy



COVID Stay at home order effective 3/15/20
 ~\$4.7M less (cumulative April to Dec) spent on electricity

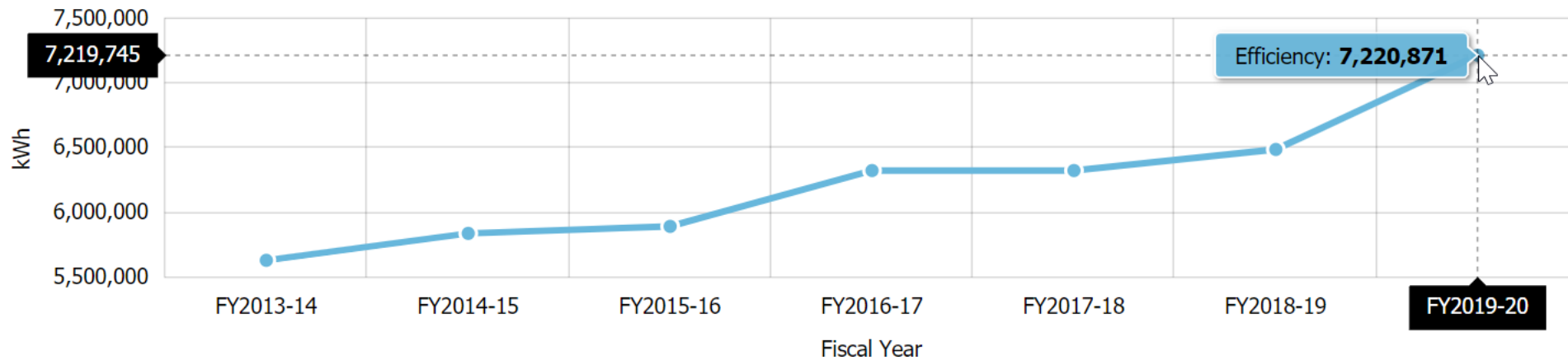


Substation Use and Cost Trend



Cumulative Efficiency Project Savings

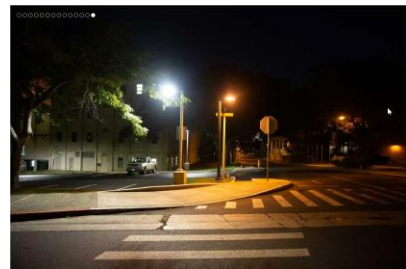
UH Mānoa Cumulative Annual Savings from Efficiency Projects



\$1,696,888.24 saved this year *



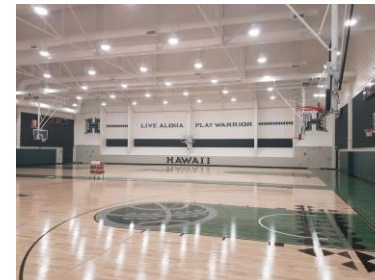
Chiller Replacements



Lighting Upgrades



Equipment Replacement



Major Renovations



New Construction



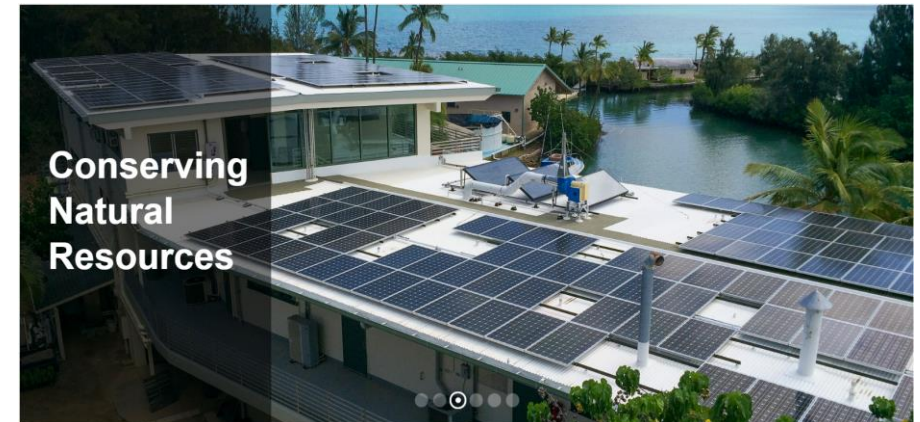
<https://www.hawaii.edu/sustainability/efficiency-projects/>

University of Hawai'i | Office of Energy Management

*7,220,801 x \$0.235 = \$1,696,888.24 avoided cost from the accumulated kWh saved in efficiency

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The Look Ahead

1. The buildout of the remaining 4 MW at Mānoa
2. Energy Saving Performance Contract (ESPC)
 - CCs Finishing phase 2
 - Mānoa Phase 1 (awarded 4/21)
3. LEED Done Right
 - Optimize for energy performance
 - PV for new and major renovations
4. Strategic Energy Management Plan
 - PV power plant study
 - Energy Optimization Modeling
5. AES PV Farm UHWO
6. HECO Green Tariff
7. Ongoing Efficiency via RIM



Manoa Parking Structure



Leeward – Parking Canopy



Maui – Ground Mount



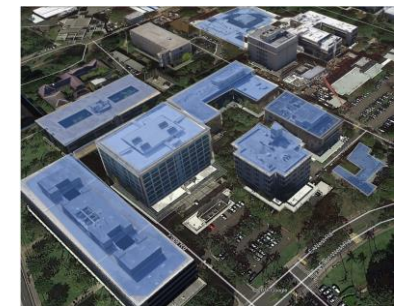
West Oahu – Creative Media



Manoa - Life Science Building



AES Mauka Lands



Manoa – ESPC – Phase 1

<https://www.hawaii.edu/sustainability/energy/>



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UNIVERSITY OF HAWAII Community Colleges



Advancing toward 100 percent renewable energy



By 2019, the University of Hawai'i (UH) Maui College will be capable of producing as much energy as it consumes. A total of five UH Community College campuses will cut their fossil fuel energy consumption by the following:



MAUI
CAMPUS



LEEWARD
CAMPUS



HONOLULU
CAMPUS



KAPI'OLANI
CAMPUS



WINDWARD
CAMPUS

Here's how UH is partnering with Johnson Controls to increase energy resiliency and self-sufficiency.



Energy Performance Contract

More than \$79 million in savings over 20 years, guaranteed



Solar + Storage

On-site capacity: 2.8 MW of solar PV and 13.2 MWh of battery distributed energy storage at UH Maui College, and 7.7 MW of solar PV and 28.6 MWh of battery distributed energy storage at the O'ahu UH Community College campuses



Smart Controls

Automation to maximize comfort, control and reliability



LED Lighting

Interior upgrades at all campuses



HVAC Enhancements

Replace and upgrade chillers and related equipment



Other Enhancements

Window film installation and new interior transformers at all campuses



Deferred Maintenance

\$20 million reduction across two phases, through efficiency projects and savings



Hands-On Learning

Furthers sustainability education



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COMMUNITY COLLEGES

Oahu Campuses



Kapiolani
Honolulu
Leeward
Windward



2012

AC/ Thermal

Controls

Solar

2015

HRS 304-119 requires
UH to become net zero
by January 1, 2035

2019

LED lighting

Chiller Controls

Solar + Storage

2021

Grid-Services

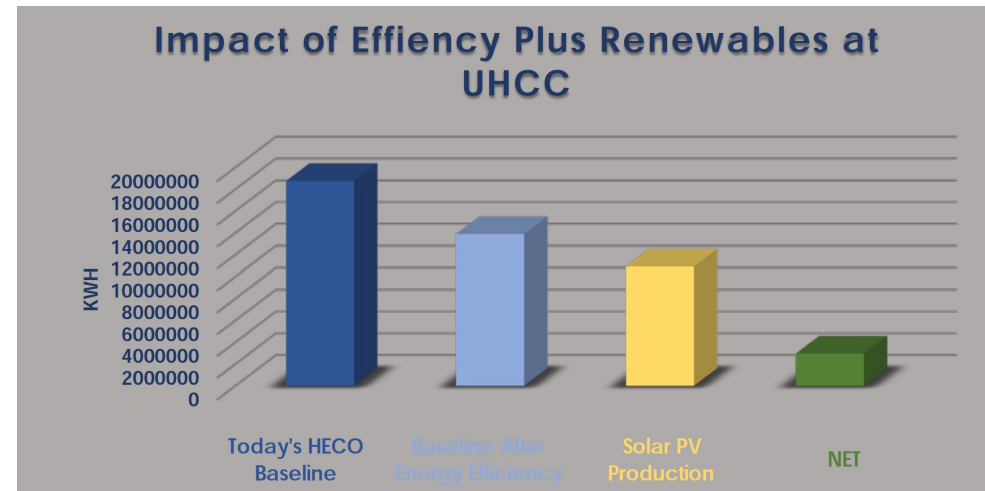
Resiliency & Revenue

Oahu Campuses: Phase 2 Efficiency (2019 - 2020)



UNIVERSITY of HAWAII*
MAUI COLLEGE

ECM #	Recommended Energy Conservation Measures (ECM)	Leeward Community College	Honolulu Community College	Windward Community College	Kapi'olani Community College	Dole St Offices
1	Interior LED Lighting and Controls	X	X	X	X	X
2	Exterior Pole Lighting Re-design	X				
3	Replace interior transformers	X	X	X	X	
4	Replace exterior oil filled transformers		X			
5	Install Window Film	X	X	X	X	
6	Chiller replacements			X		
7	Extend chilled water loop		X	X		
8	New Chilled Water Plant and Loop					
9	Install new pony chiller		X			
10	Roof Mount / Carport / Covered Walkway Solar PV+ Energy Storage	X	X	X	X	



18,770,400 kWh	13,895,102 kWh	10,922,820 kWh	2,972,282 kWh
Existing Annual HECO Utility Consumption	HECO Consumption After Energy Efficiency Measures	New Solar PV Production	NET
Baseline	26% efficiency	58% solar	84% total

Leeward Community College



System Info:

1.67 MW_{DC}
(3570) PV Modules
2.3 MW / 11.1 MWh BESS

System Stats:

COD: July 1, 2020
Year 1 est. energy: 2.83 GWh



UNIVERSITY of HAWAII*
MAUI COLLEGE



Maui Campus



2012

AC/ Thermal

Controls

Solar

2015

HRS 304-119 requires UH to become net zero by January 1, 2035

2019

LED lighting

Chiller Controls

Solar + Storage

2021

Grid-Services

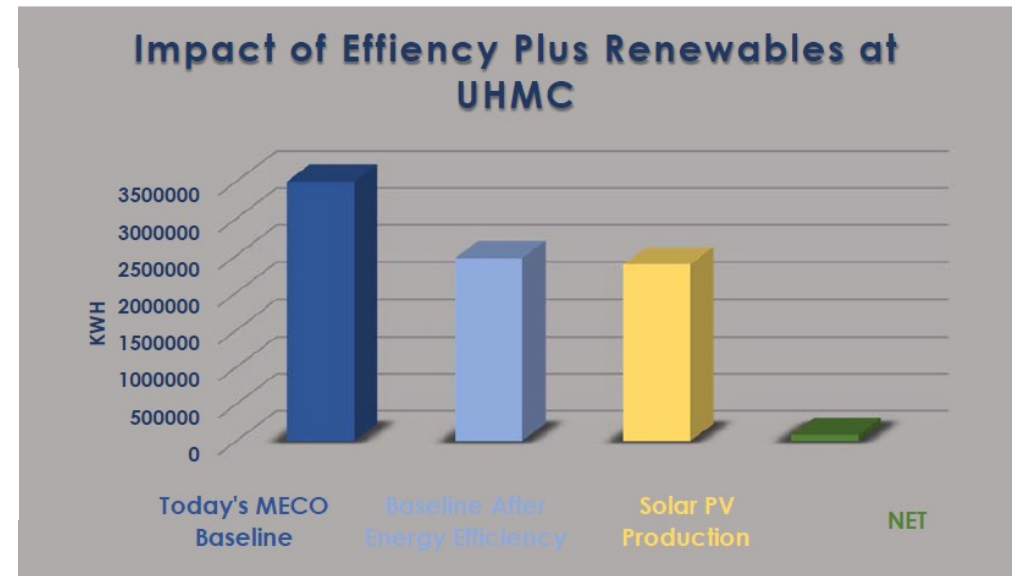
Resiliency & Revenue

Maui College: Phase 2 Efficiency (2019 - 2020)



UNIVERSITY of HAWAII*
MAUI COLLEGE

ECM #	Recommended Energy Conservation Measures (ECM)	Maui College
1	Interior LED Lighting and Controls	X
2	Replace interior transformers	X
3	Install Window Film	X
4	Replace outdated controls	X
5	Chiller replacements	X
6	Install new BTU submeters	X
7	Install Trash Compactor	X
8	HVAC Modifications	X
9	Roof Mount / Carport / Covered Walkway Solar PV + Energy Storage	X



The Impact of Solar plus Energy Storage

3,499,200 kWh	2,464,764 kWh	2,382,518 kWh	82,246 kWh
Existing Annual MECO Utility Consumption	MECO Consumption After Energy Efficiency Measures	New Solar PV Production	NET
Baseline	30% efficiency	68% solar	98% total

**+2 %
safety
factor**

**0%
remains**

Maui College



System Info:

1.58 MW_{DC}

(3360) PV Modules

2.3 MW / 13.9 MWh BESS

System Stats:

COD: January 4, 2021

Year 1 est. energy: 2.4 GWh

After Net Zero, what next?

- A. Grid Services & Resiliency for the Community
- B. Optimize energy assets to create additional revenue for the University
 - 1. Storage Grid Service: Load Shedding
 - 2. Storage Grid Service: Fast Frequency Response (FFR)

Total Incentives Grid Services: \$5,464,023*

GSPA Incentive Structure		O'ahu	Maui
Capacity Build	\$/kW/Month	\$3.00	\$5.00
Capacity Reduce	\$/kW/Month	\$2.00	\$5.00
	\$/kWh	\$0.1497	\$0.1441
FFR	\$/kW/Month	\$5.00	N/A

UH BESS Incentives	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Honolulu Campus	\$ 244,367	\$ 244,367	\$ 244,367	\$ 244,367	\$ 244,367	\$ 1,221,833
Leeward Campus	\$ 284,208	\$ 284,208	\$ 284,208	\$ 284,208	\$ 284,208	\$ 1,421,040
Windward Campus	\$ 132,417	\$ 132,417	\$ 132,417	\$ 132,417	\$ 132,417	\$ 662,086
Kapiolani Campus	\$ 130,190	\$ 130,190	\$ 130,190	\$ 130,190	\$ 130,190	\$ 650,952
Maui College	\$ 301,622	\$ 301,622	\$ 301,622	\$ 301,622	\$ 301,622	\$ 1,508,112
Total UH Campuses	\$ 1,092,805	\$ 1,092,805	\$ 1,092,805	\$ 1,092,805	\$ 1,092,805	\$ 5,464,023

Portion of grid services payments (45%) applied to battery service & augmentation

Solar Capacity: kW DC

Annual Solar PV Generation: kwh

Energy Storage Capacity: MWh

Status: Operating / Contracted



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COMMUNITY COLLEGES



Hawai'i



Honolulu



Kapi'olani



Kaua'i



Leeward



Maui



Windward

369 kW DC	1,900 kW DC	1,760 kW DC	575 kW DC	1,680 kW DC	2,920 kW DC	1,320 kW DC
234,518 annual kwh	3,088,056 annual kwh	3,055,056 annual kwh	829,725 annual kwh	2,835,651 annual kwh	4,213,560 annual kwh	1,045,048 annual kwh
0	6.331 MWh	6.331 MWh	0.174 MWh	9.623 MWh	13.262 MWh	6.331 MWh
Operating	Contracted	Contracted	Contracted	Operating	Operating	Operating

Sustainable Life & Practice (SLP)

Learning from the sustainable life & practices of Hawaii

Picture: Hokule'a, Polynesian Voyaging Society



Mahalo

