OCTOBER 24, 2023

UC Davis: Aiming for a 100% renewable electricity campus by 2025

David Trombly, UC Davis

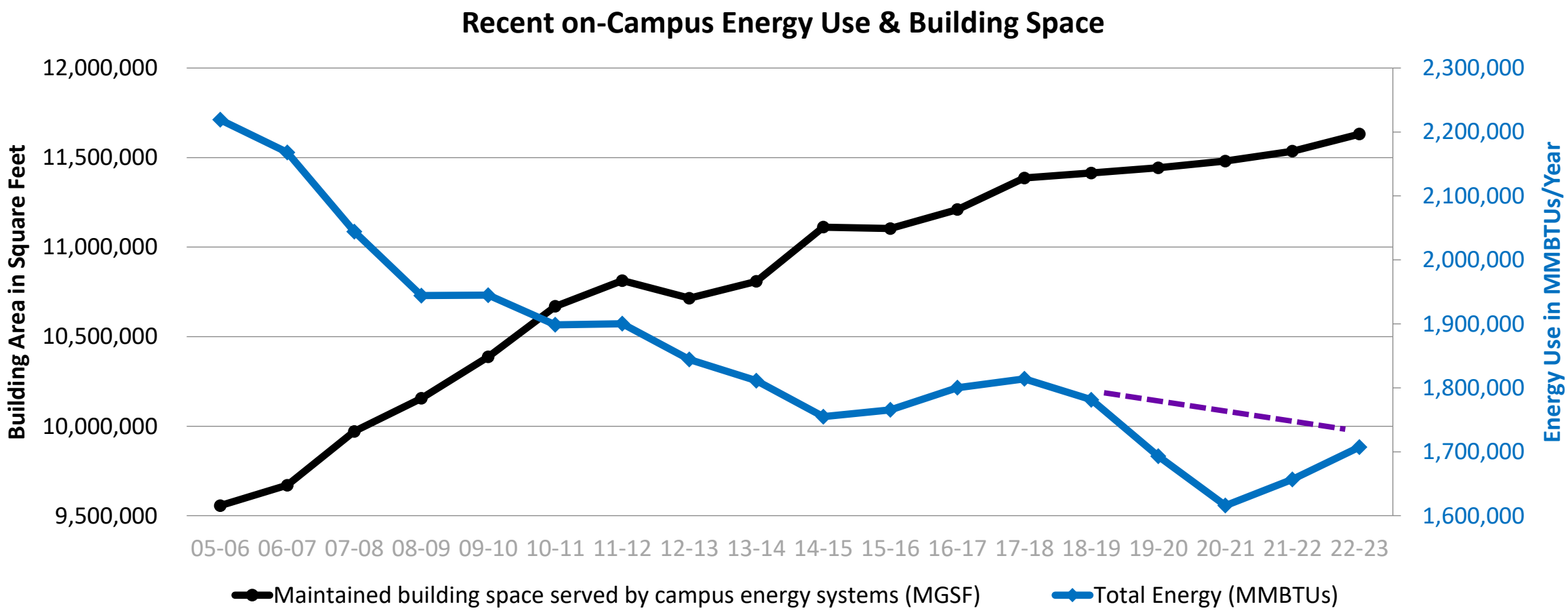
Introduction of University of California – Davis

- 40k Students
- 24k Faculty & Staff
- 1000+ Buildings, ~250 over 10,000 SF
- 11.3M SF total; 5,300 acres Land
- Founded 1905, Average Building Age: > 40 years
- $20M annual electricity spend
- 211M kWh/year electricity (average house is 11K kWh/year)

Innovation and sustainability at UC Davis

- Collaborations between faculty, students and staff on innovation, campus as a living lab projects, and accomplishments of key initiatives
- Many student internships with operations
- Project-based courses
- Deep dedication to sustainability at all levels

UC Davis energy journey



100% renewable electricity by 2025

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UC makes bold commitment to 100 percent clean electricity

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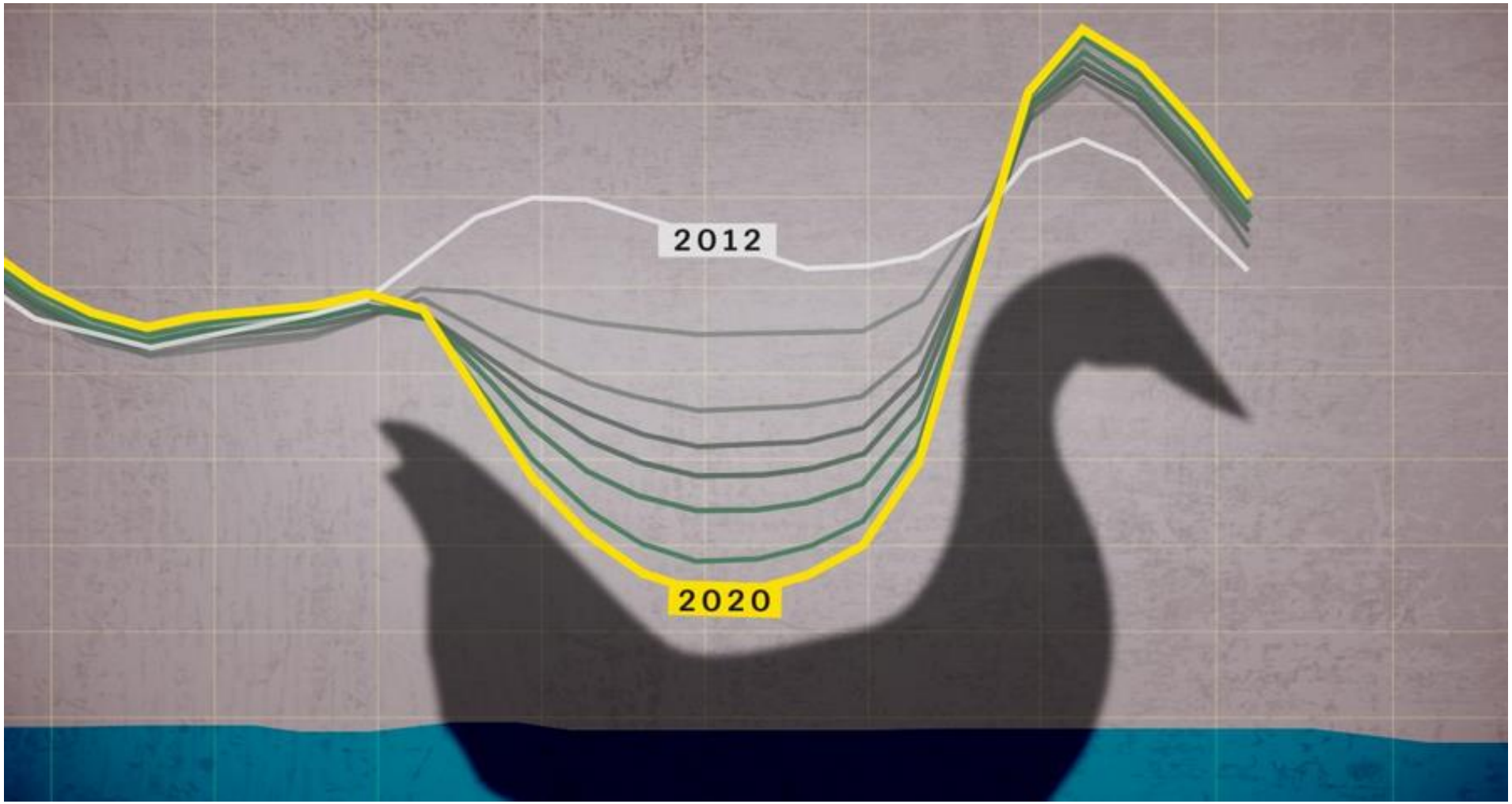
October 29, 2018

Article by: Robyn Schelenz robyn.schelenz@ucop.edu

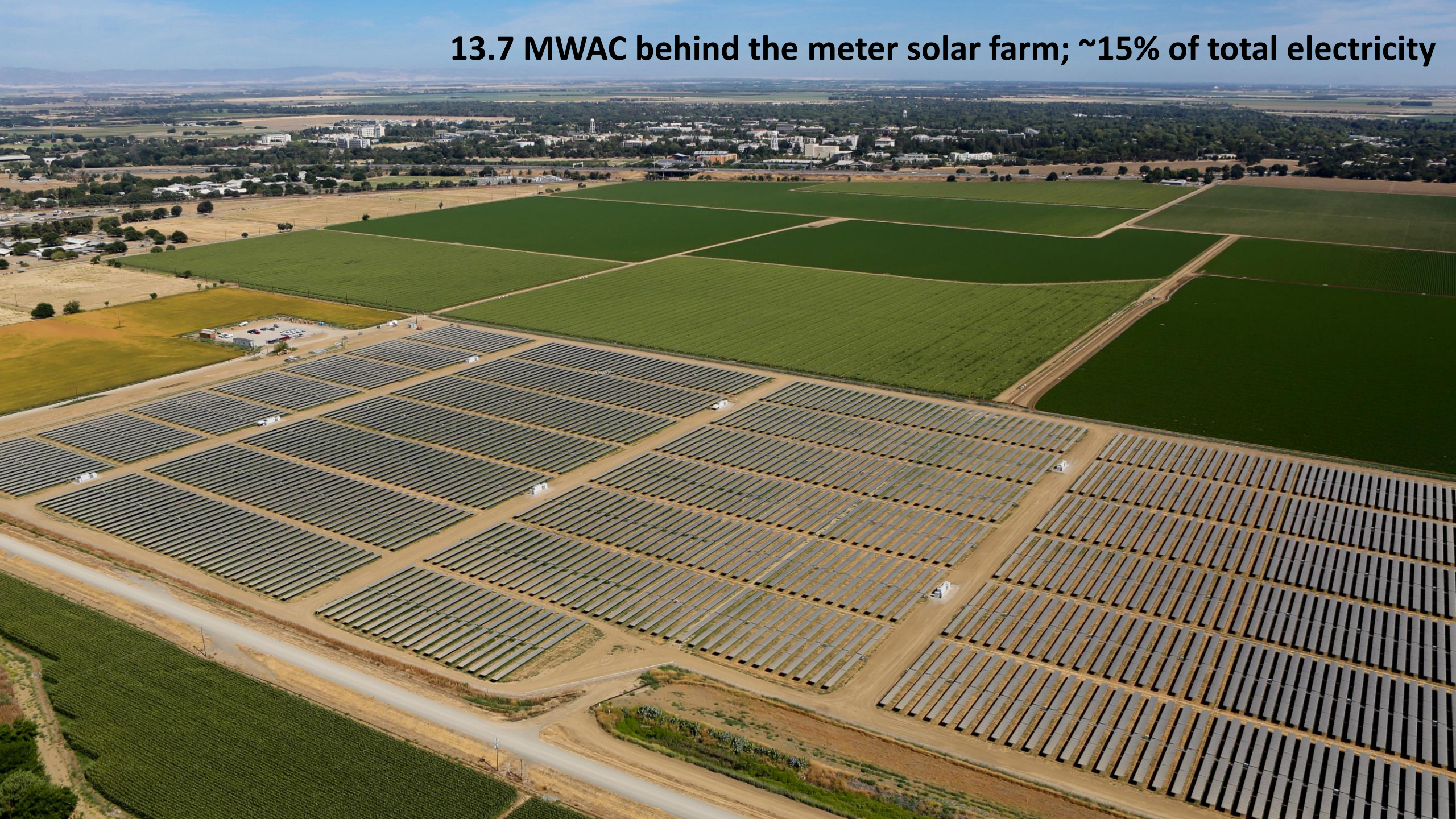
As the impacts of global climate change grow ever more alarming, we have some good news: Clean energy is catching on among cities, states and other big institutions across the country.

This fall, the University of California joined the growing list of institutions that have committed to 100 percent clean electricity (as did the state of California, which also announced its pledge to transition to clean energy by 2045).

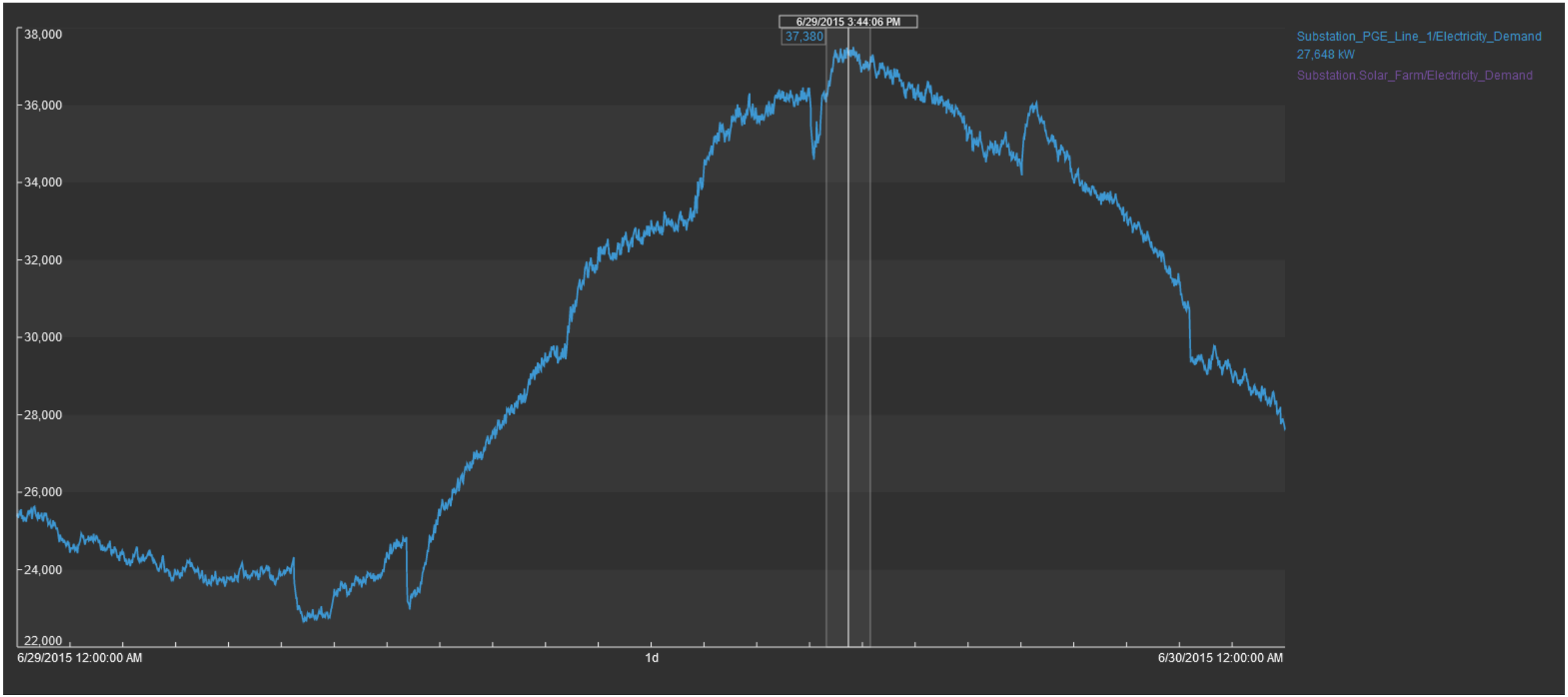
Duck curve



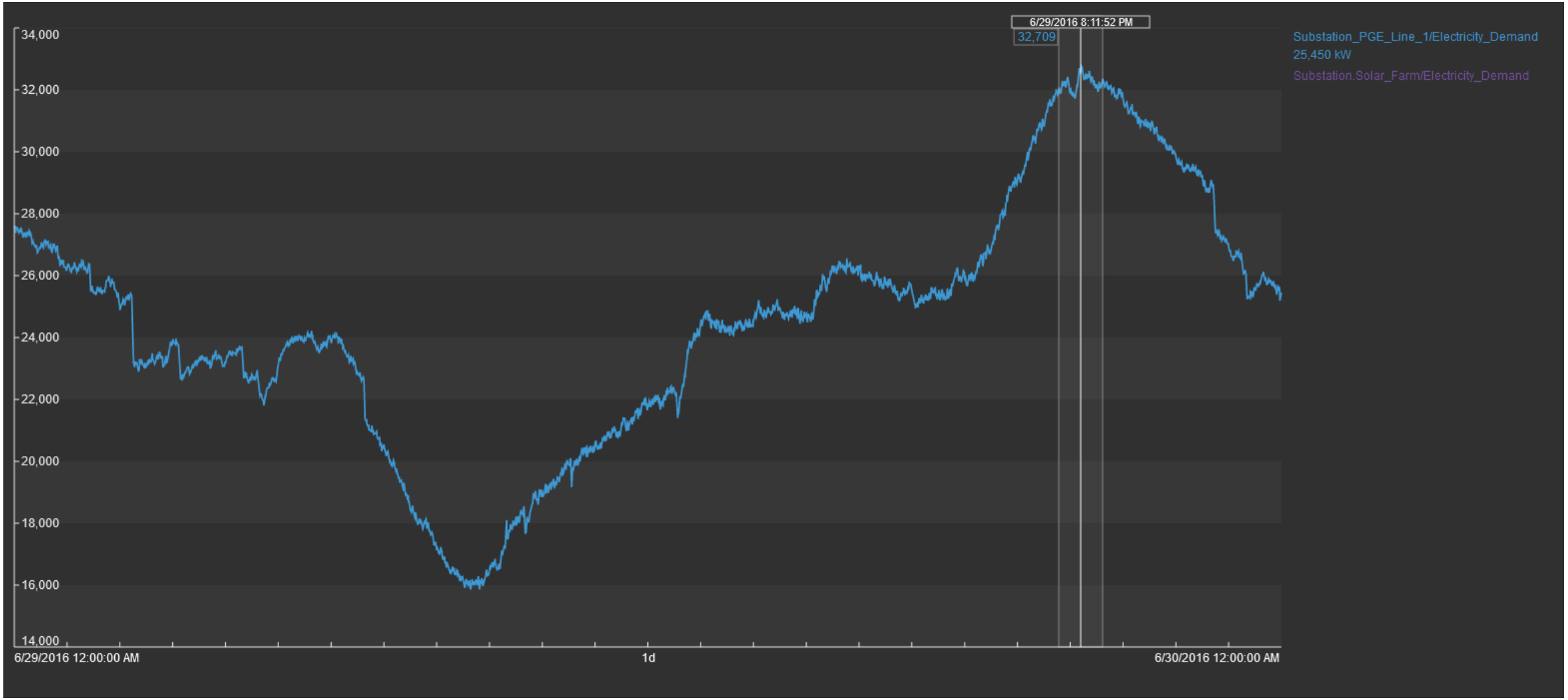
13.7 MWAC behind the meter solar farm; ~15% of total electricity



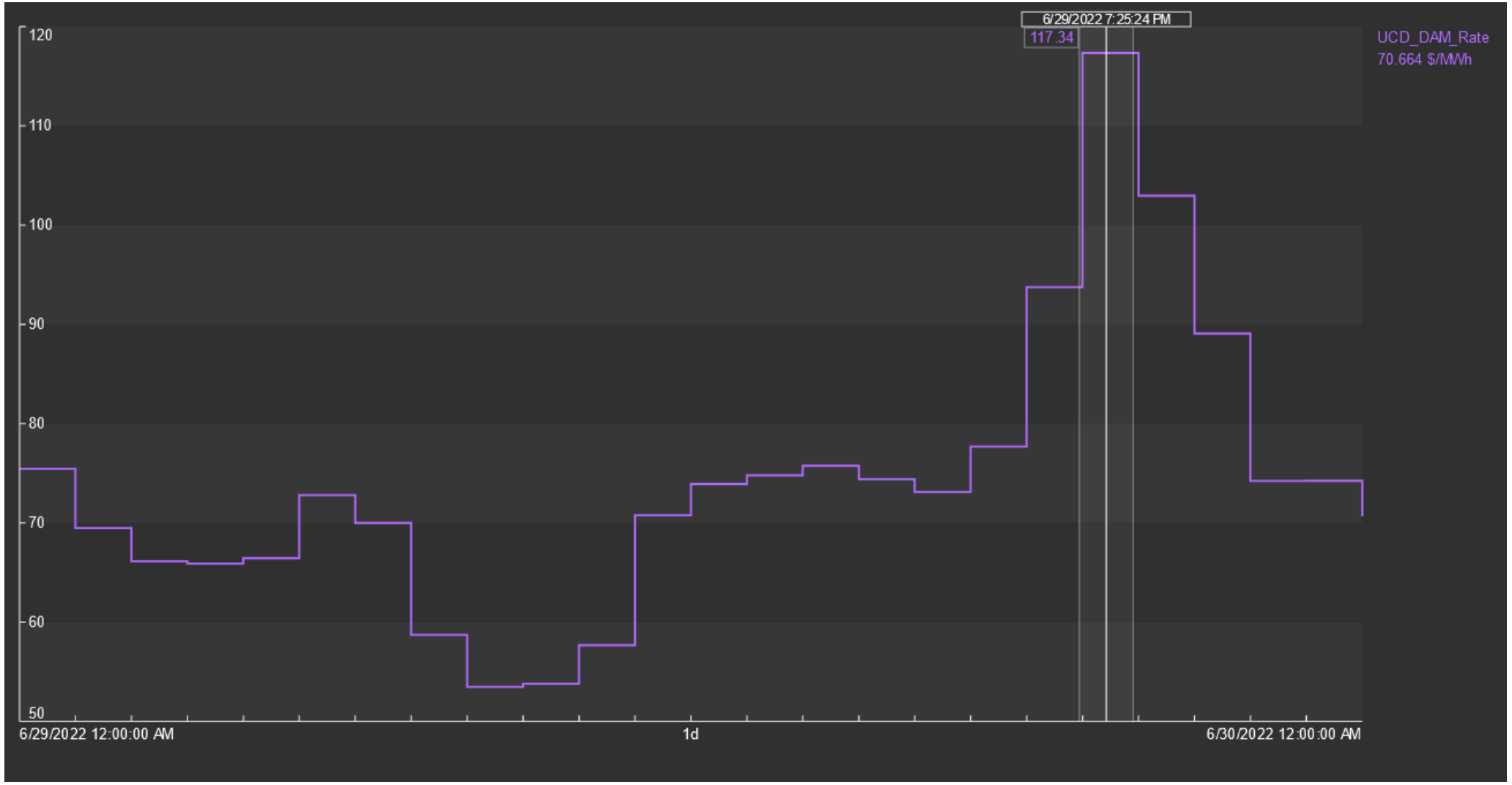
Grid draw before solar farm



Grid draw after solar farm



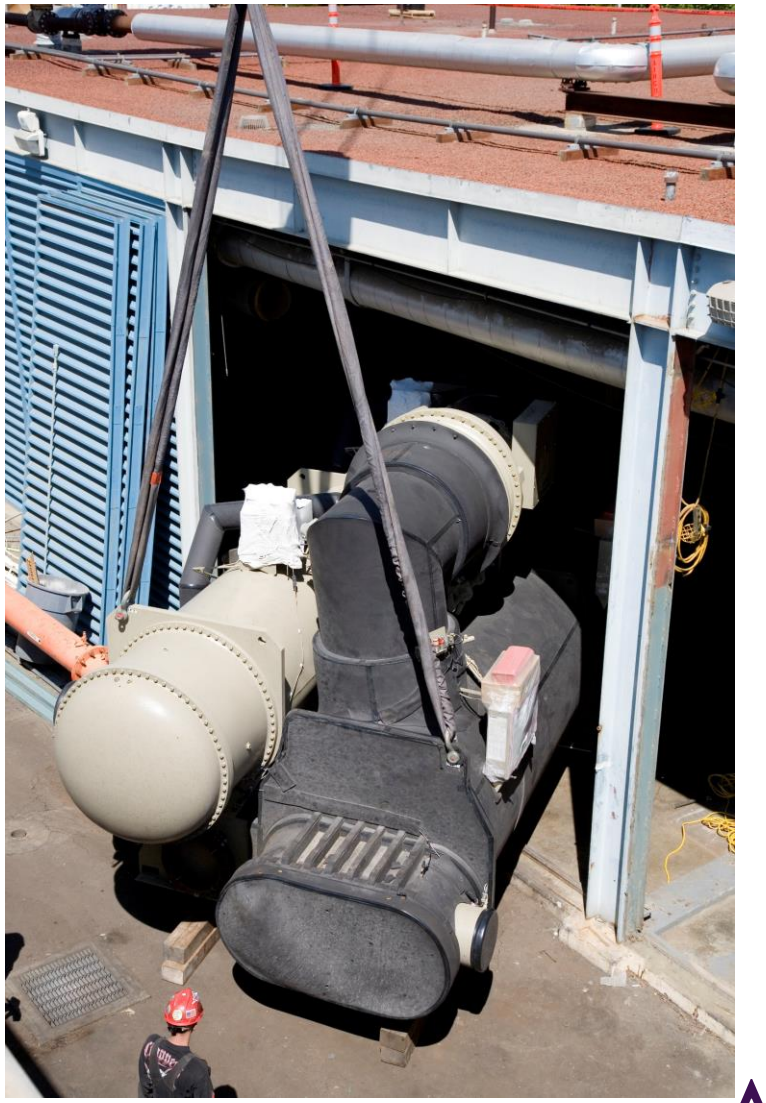
Electricity price – grid supply



Duck curve solutions

- Base load power
- Flexible loads
- Storage (battery, energy storage, etc.)
- How can UC Davis help?

Chiller/energy storage tank system (like a battery)

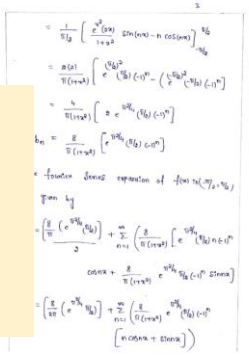


11% of total campus electricity

Chiller Dispatch Optimization

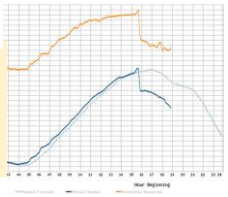
Weather Forecasts

Load Predictions (Machine Learning)



California ISO

Electricity Price (CAISO API)



PI Web API

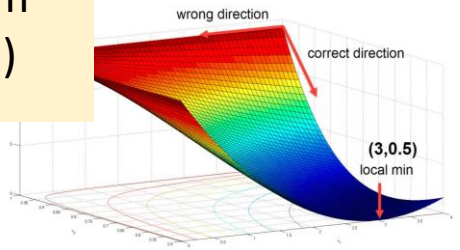
UFL Interface

Chiller/Chilled Water System Performance (AVEVA System Platform)

RDBMS Interface

AVEVA PI System

Optimization Algorithm (Python)



OPC Interface

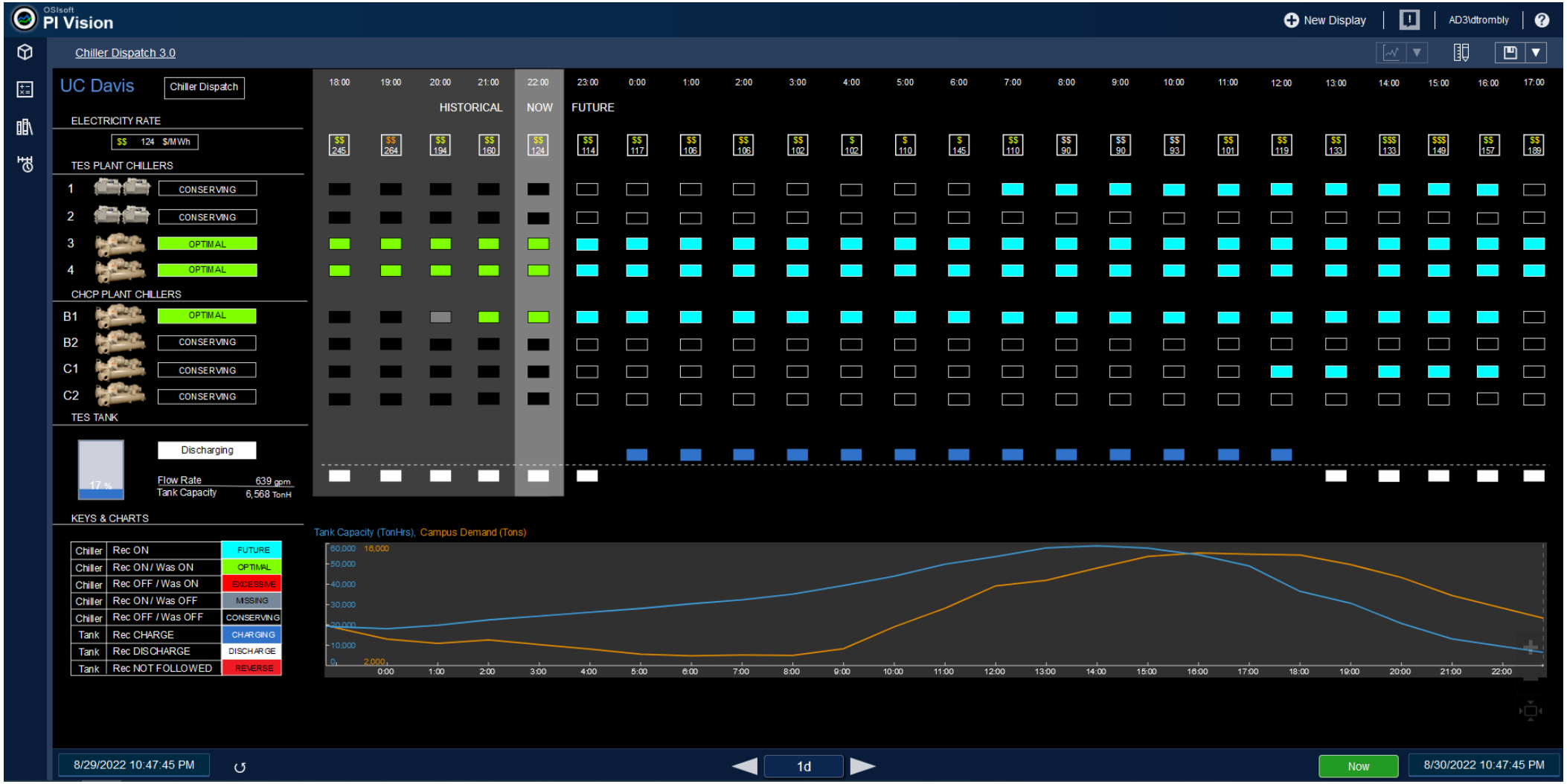
PI Vision

Electricity Metering (Schneider Electric ION)

Operator Visualization

AVEVA

Operator Engagement



Campus Engagement

- Research paper with two professors, three grad students three staff
- Master's thesis

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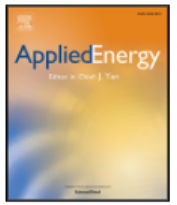

Optimal real-time dispatching of chillers and thermal storage tank in a university campus central plant

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District Cooling
Central chiller plants
Process scheduling

ABSTRACT

Recent studies have indicated a great potential for applying predictive methodologies to the operation of Heating, Ventilation and Air Conditioning (HVAC) systems. Particularly for Centralized Chiller Plants with Thermal Energy Storage (TES) used for District Cooling, there is a substantial opportunity for cost savings when responding to variations in electricity price and ambient temperature. The present work addresses the problem of closed-loop scheduling of a large-scale chiller plant with TES tank under a Day-Ahead (DA) electricity price program. The main contributions include: (i) formulating the problem for a real large-scale complex system; (ii) comparing different dispatching policies with varying degrees of optimality, constraint satisfaction and operational complexity; and (iii) designing an optimization-based scheduling tool and describing its implementation and results. The proposed Mixed-Integer Linear Programming (MILP) formulation extends

Results: 9/4/22 through 9/9/22

TOP (KW):

TOTAL CAMPUS POWER

TOTAL CHILLER PLANT POWER

BOTTOM ($/MWH):

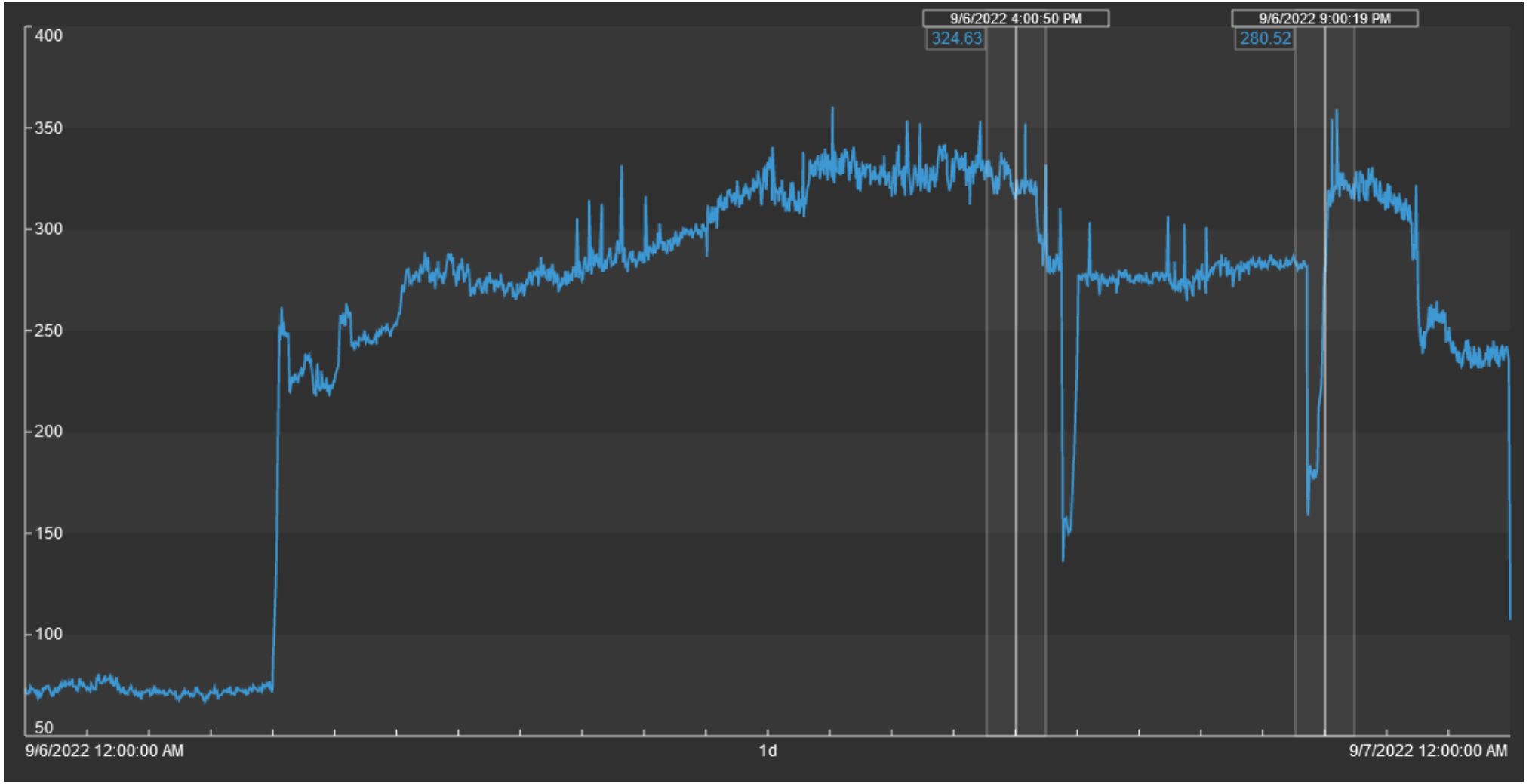
DAY AHEAD MARKET RATE

REAL TIME RATE

Results in 6-day window (9/4/22 through 9/9/22)

- Baseline savings: $150k/year
- Estimated 91MWh DR provided
- Estimated $60k savings
- $272k DR payments

Grid Responsive Buildings

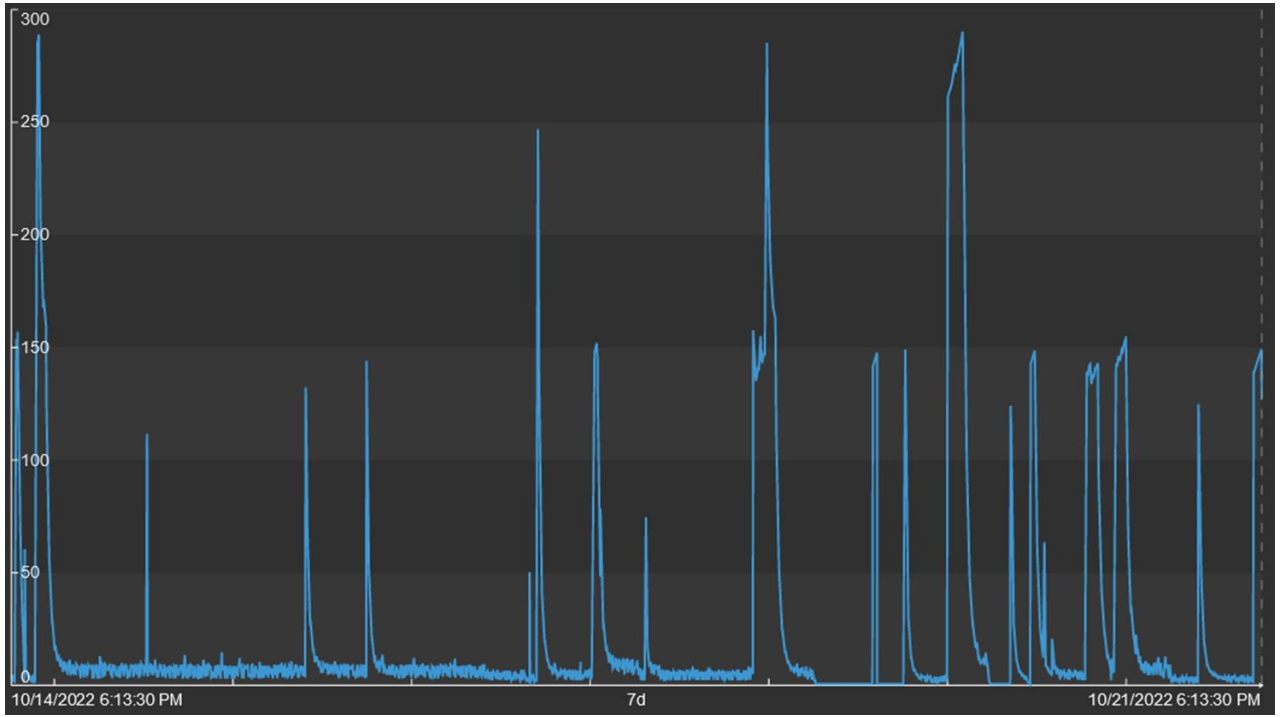


Battery Backup

- CPUC SGIP Grant for 750kW four-hour battery
- Backup of domestic water system pumps
- Economic dispatch/grid responsiveness
- COD: Spring 2025

Electric Bus Dispatching

Currently 6 Busses with 150 kW chargers



Bus Energy Use Exceeding High Rate Threshold

		Month											
		1	2	3	4	5	6	7	8	9	10	11	12
	0	0	3631	4114	6631	5149	0	0	0	0	0	0	0
	1	0	0	0	4811	3585	0	0	0	0	0	0	0
	2	0	0	0	2650	2124	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	702	791	672	560	0	0	0	0	0	0	0
	5	218	470	398	362	303	19	0	0	0	211	107	0
	6	1307	738	124	329	615	0	0	179	0	929	147	65
	7	1160	540	216	233	0	0	0	0	0	1293	153	78
	8	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0	0	0	0	0
Hour	11	0	0	0	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0	0	0	0
	14	0	0	0	0	0	19	0	0	0	0	0	0
	15	0	0	0	0	0	19	0	361	0	0	0	0
	16	415	176	0	0	0	19	313	720	500	0	48	190
	17	286	124	510	0	0	19	56	341	356	562	20	130
	18	248	137	363	416	469	19	248	476	288	578	16	307
	19	235	765	794	382	517	19	534	485	521	935	148	218
	20	1650	1982	1655	1173	260	19	144	534	727	651	172	206
	21	2263	3177	2475	1127	1090	19	214	227	1256	571	66	279
	22	2984	3379	3807	5349	4368	19	410	265	0	1877	82	391
	23	0	3192	4080	5878	4954	19	145	0	0	2263	22	0

OPPORTUNITY FOR SAVINGS IN THE LATE EVENING HOURS

Next steps

- Expanded DR market participation (market-based, capacity-based)
- Agrivoltaics research (project scoping with researchers)
- More onsite renewables (planning phase)
- More battery back up (ongoing economic feasibility assessment)
- Adjust for electrification of heating system
- Bus charging optimization
  - Planning for 50 electric buses, ~4MW of semi-flexible load
- Expanded shifting of building loads

AVEVA

Questions?

Please wait for the microphone.

State your name and company.

Please remember to…

Navigate to this session in the mobile app to complete the survey.

Thank you!

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