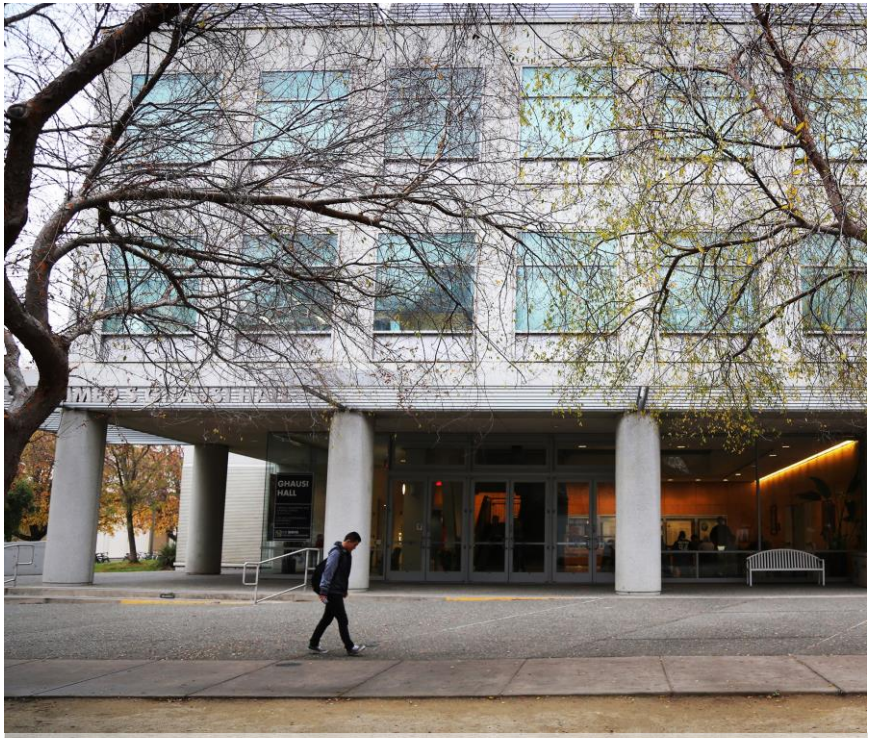
Multidisciplinary Collaboration for Student Education

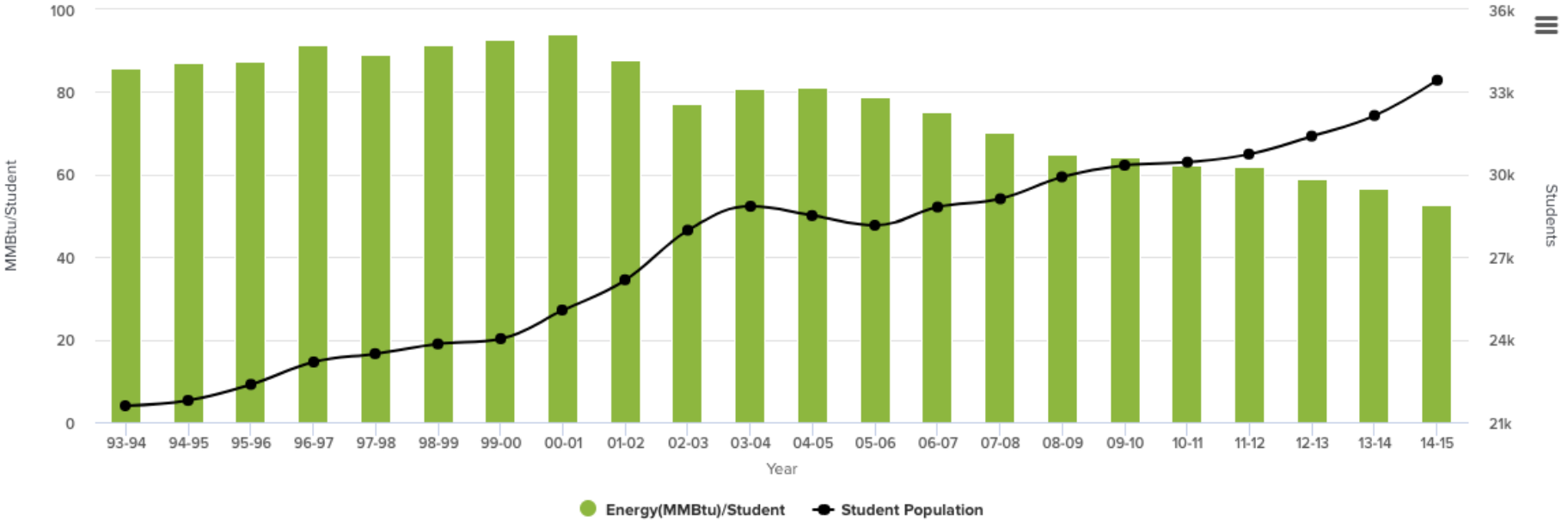
Kiernan Salmon | Product Developer

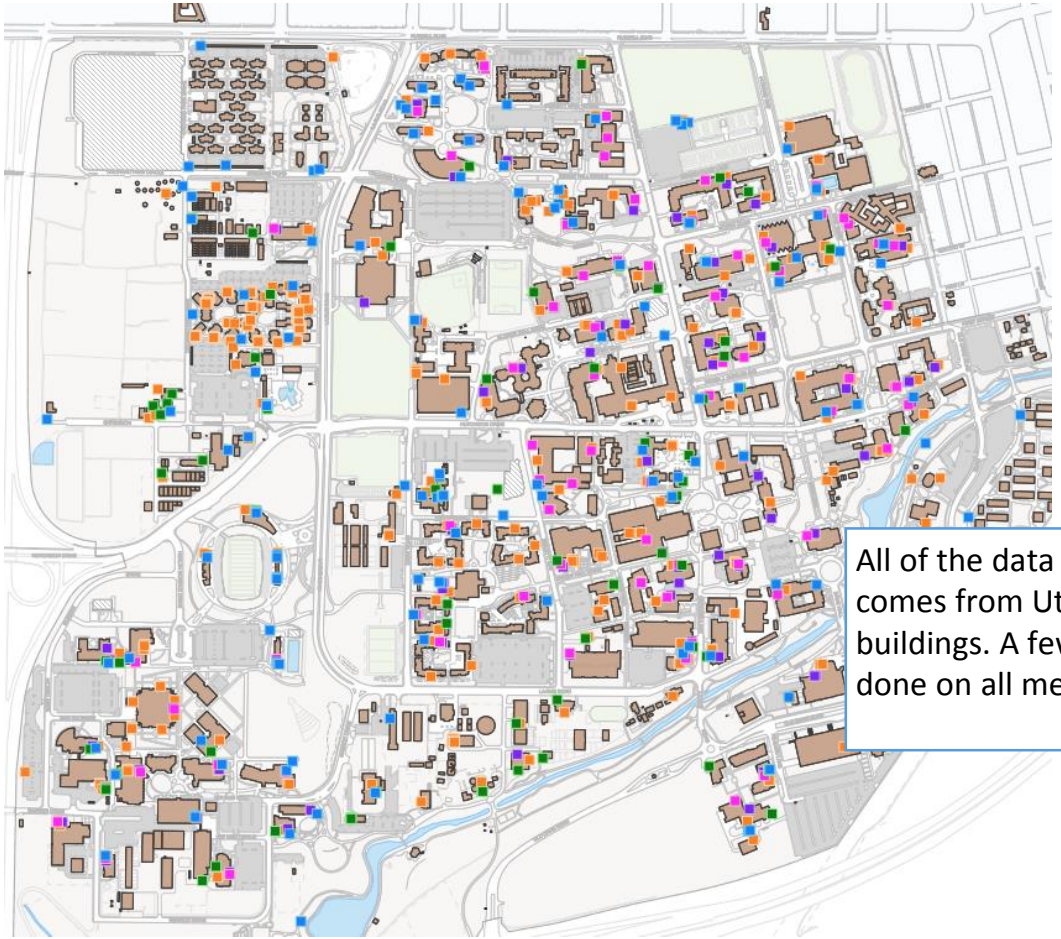
UC DAVIS
FACILITIES MANAGEMENT

energy
conservation
office

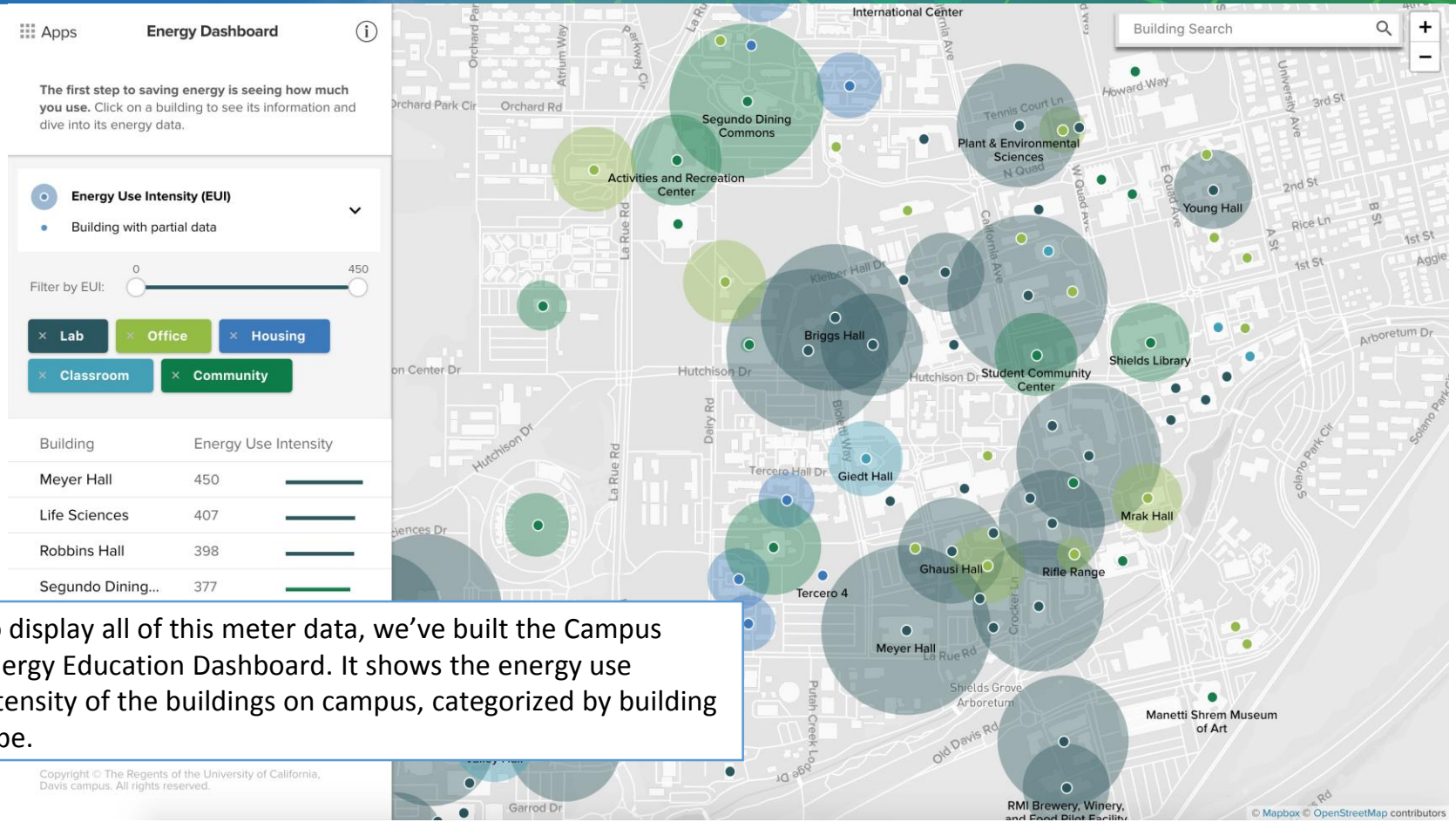


While student enrollment continues to rise,
the University is using less and less energy each year.





All of the data we work with at ECO comes from Utility meters at the buildings. A few years ago, an audit was done on all meter types and locations.



To display all of this meter data, we've built the Campus Energy Education Dashboard. It shows the energy use intensity of the buildings on campus, categorized by building type.

Apps

Energy Dashboard

The first step to saving energy is seeing how much you use. Click on a building to see its information and dive into its energy data.

Energy Use Intensity (EUI)

Building with partial data

0 450

Filter by EUI:

× Lab × Office × Housing × Classroom × Community

Building	Energy Use Intensity
Meyer Hall	450
Life Sciences	407
Robbins Hall	398
Segundo Dining...	377

See Full Ranking >

Some of Our Current ECO Interns

Communications

Civil Engineering

Electrical Engineering

Computer Science & Engineering

Working at ECO has been an eye opening experience for me.

It has has allowed me to work with employees with diverse technical backgrounds.

I've been able to learn about the systems such as PI in order to **organize and evaluate the large amounts of data produced by sensors all across campus**.

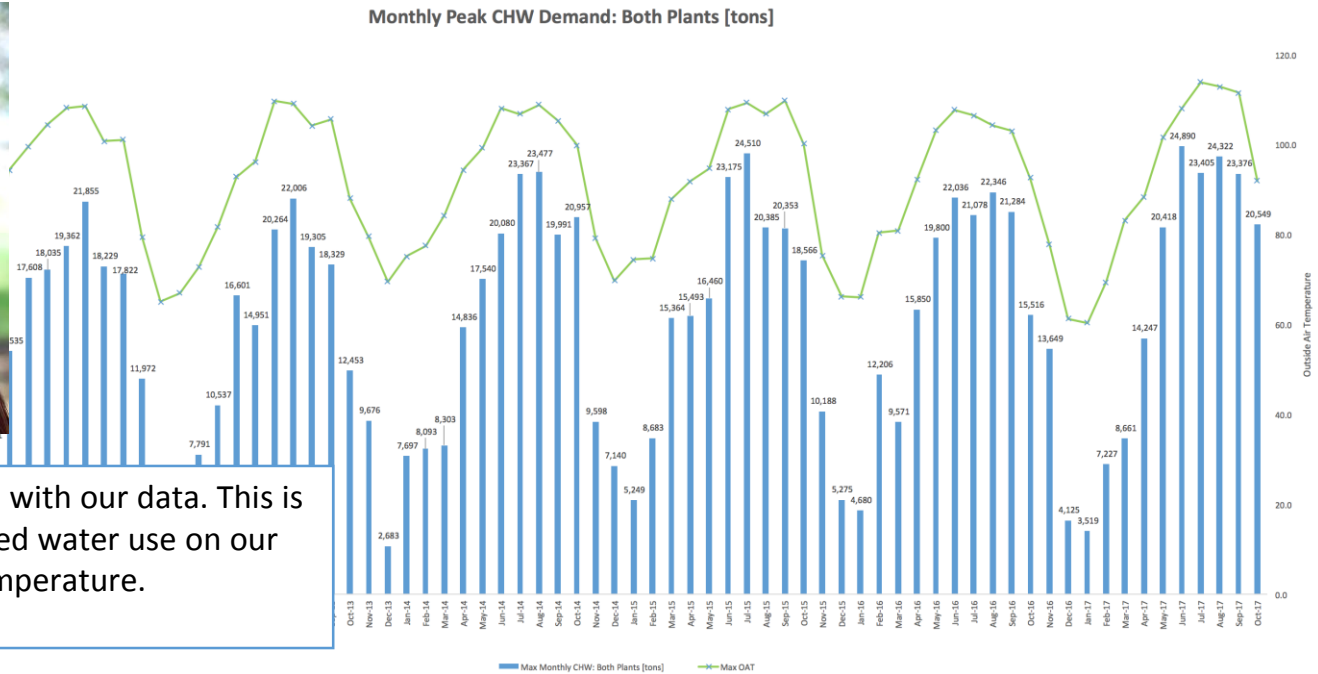
Before my internship with ECO, I never even thought about the fact that buildings use energy.

I never understood what "time series" and "real time data" meant until I started working with it everyday.

I now understand its importance and am constantly thinking of ways to incorporate real time data into everything, whether it's ECO or research and personal projects.

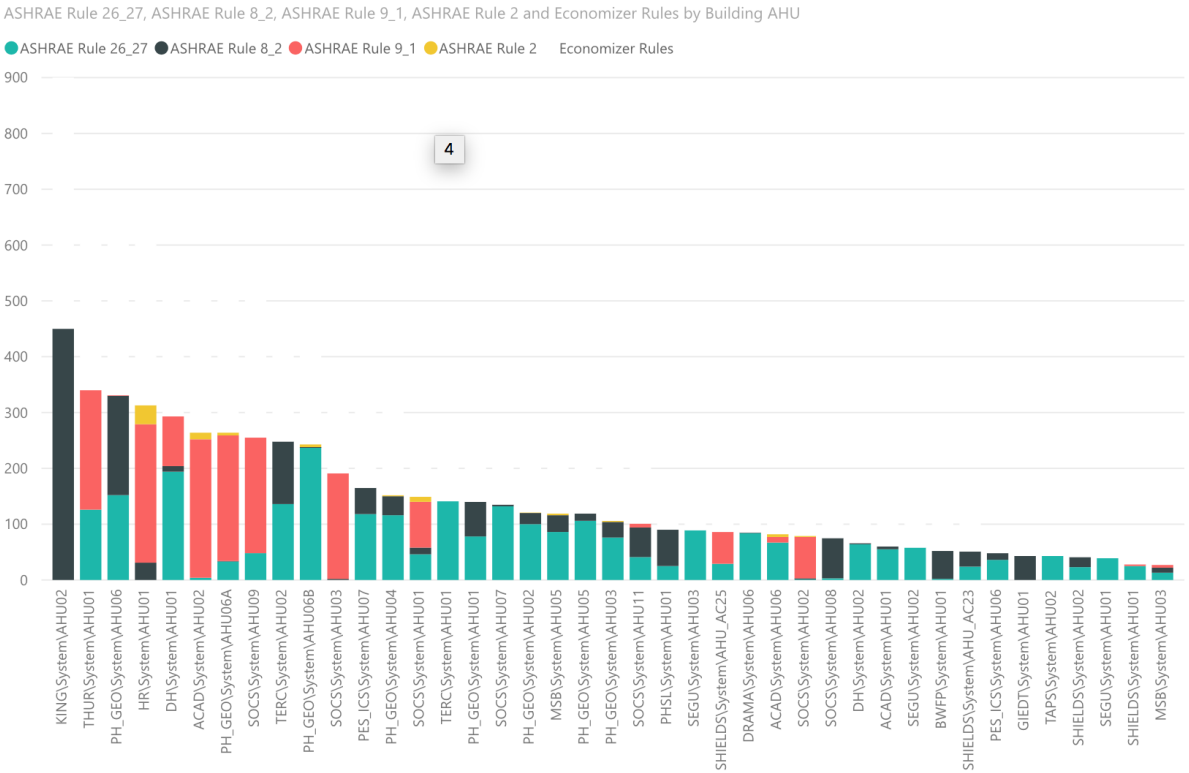
At ECO I have gained valuable experience not only in the area of software development, but in **working with interdisciplinary teams** and learning about the improvement of campus equipment and energy conservation.

Current Work by ECO Interns



We do a lot of other things with our data. This is a graph of six years of chilled water use on our campus and outside air temperature.

Rule 2: Too much OA% in HTG
Rule 8:2 Not Enough OA% in FREE CLG
Rule 9_1: Too much OA% in MECH CLG
Rule 26_27: MAT Sensor Error

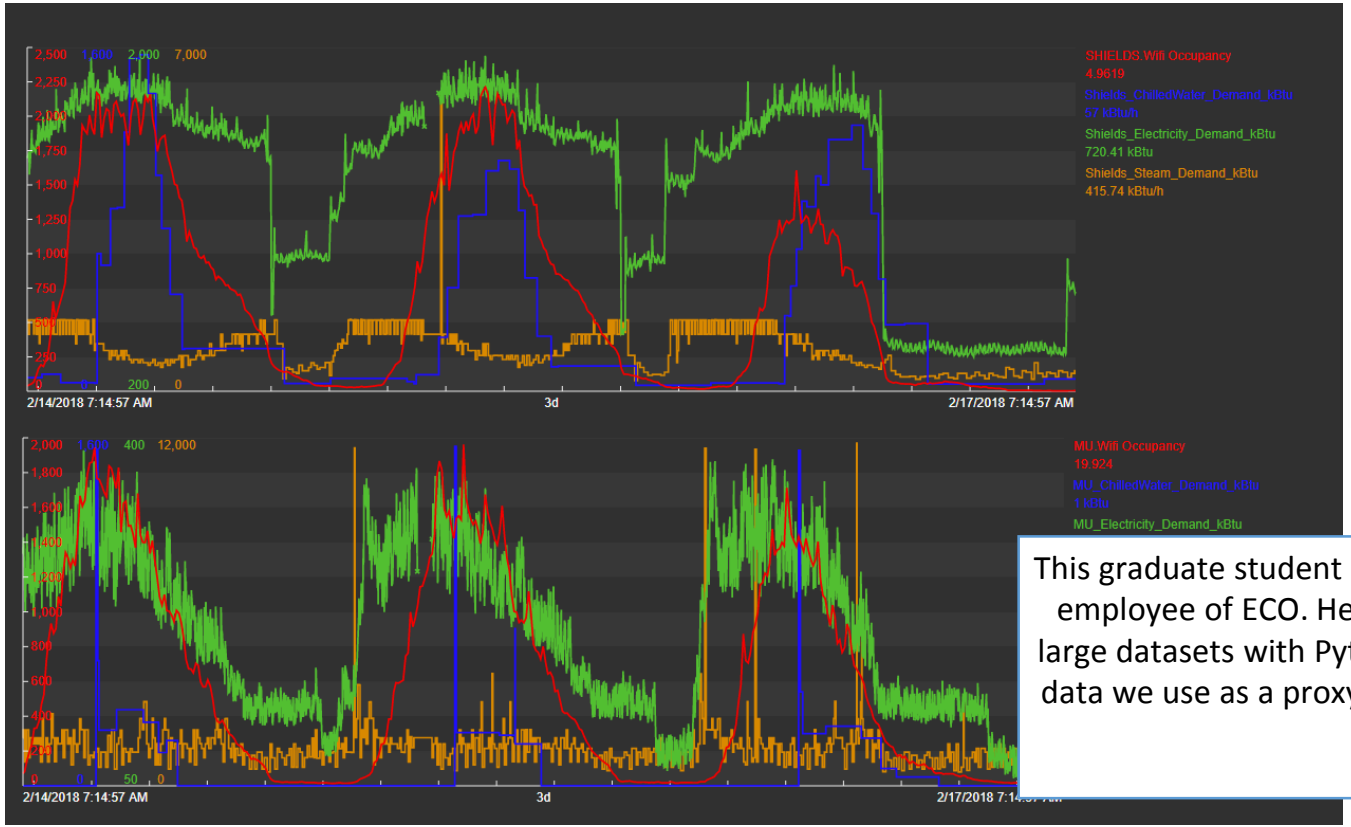


This student is using Python to create complex “rules” for our datasets. For example, when there is too much outside air used in the cooling systems.

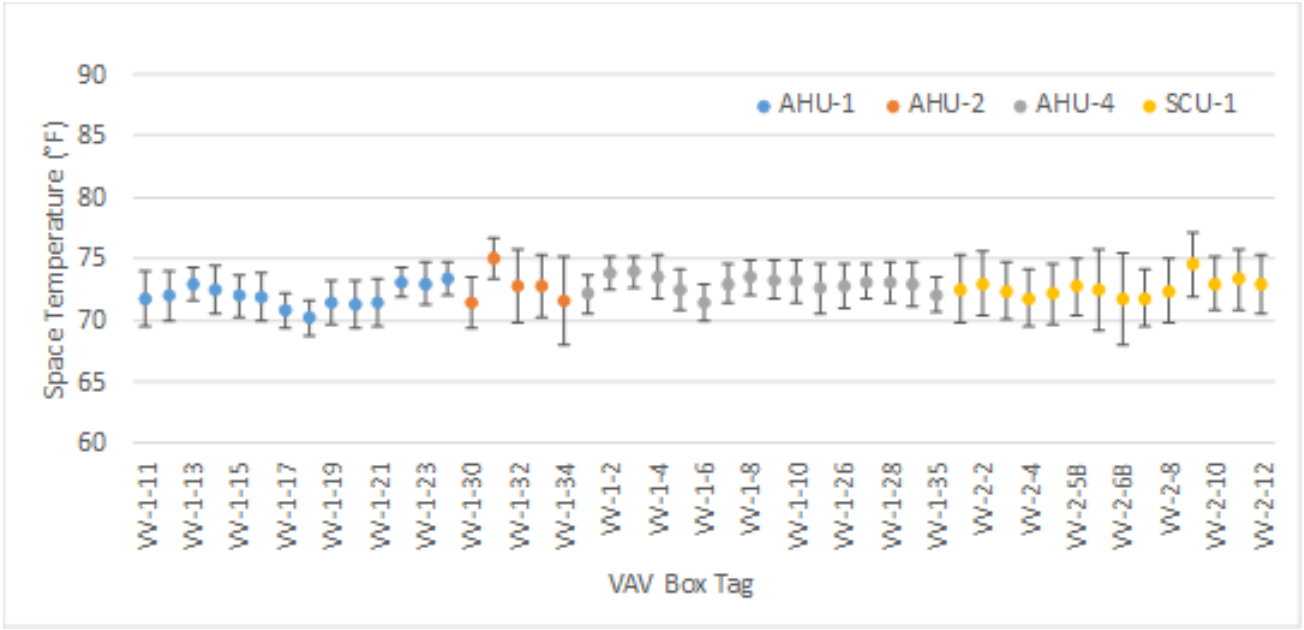
Building Breakdown Building Projects ▾ ● Persistence?

Building Project	Electricity	Steam	Chilled Water	Monthly Savings
Ghausi Hall	**$988** ●	$1,847 ●	$1,847 ●	$3,052 ●
Plant and Environmental Sciences	$x,xxx ●	$x,xxx ●	$x,xxx ●	$x,xxx ●
Totals	$x,xxx ●	$x,xxx ●	$x,xxx ●	$x,xxx ●

We continuously add new features to the Campus Energy Education Dashboard. A new feature is a Measurement & Verification tool for our engineers to track the energy efficiency projects they do in buildings. This feature is also being built entirely by one of our computer science students.

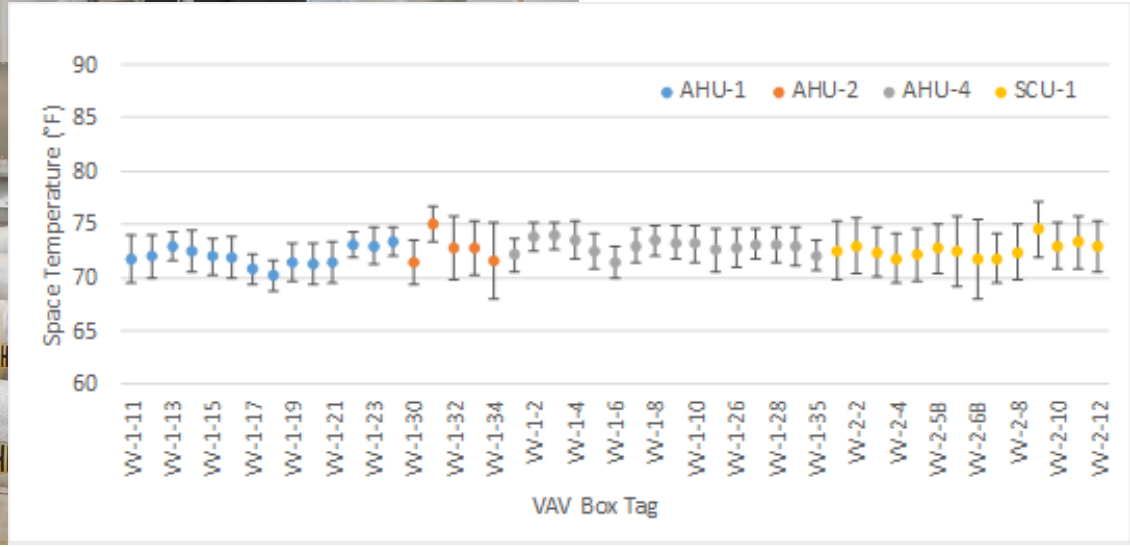


This graduate student has moved on to become an employee of ECO. He's now working on analyzing large datasets with Python. Here he's overlaid Wifi data we use as a proxy for occupancy, with energy demand data.



One of ECO's goals is to educate the campus about our energy use and savings. Students research and write about the work we're doing, and send out a monthly newsletter, What's Watt with Joules the Cow. Here an intern is researching air handlers.

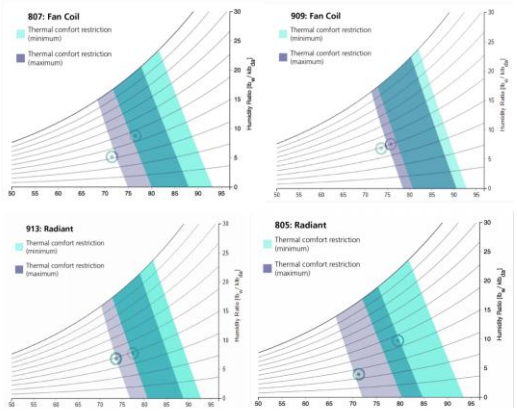
Research at ECO includes tours of the building's mechanical equipment.

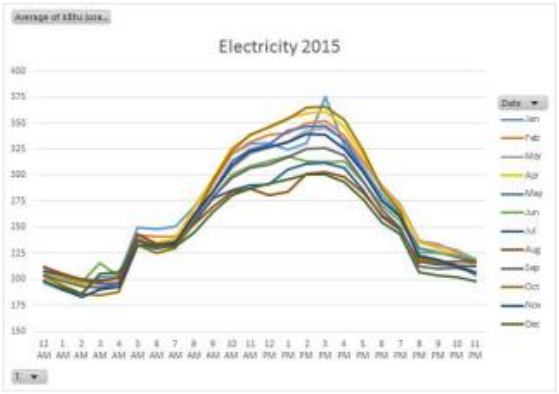


Computer science students get a tour of the Central Heating and Cooling Plant to see the data they'll be working with.

We try to take students out on campus as much as possible to create experimental learning opportunities.

Here a student is learning how to take an air balance measurement with an energy engineer.





Academic Partnerships

- Computer Science Senior Capstone
- Mechanical Engineering Senior Design Capstone
- Bending the Curve: Climate Change Solutions
- Path to Zero Net Energy
- Energy Policy
- Energy Graduate Group

UC Davis
Teaching & Research Winery Sustainability

Jill Brigham
Executive Director, Sustainable Wine & Food Processing Center

About UC Davis

UC DAVIS
COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Leadership in Education

1st in the nation for agriculture

1st in the nation for viticulture and enology

1st in the nation for launching women into STEM professions

About UC Davis

UC DAVIS
COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Leadership in Sustainability

#1 COOL SCHOOL
SIERRA MAGAZINE

UI GreenMetric
World University Rankings

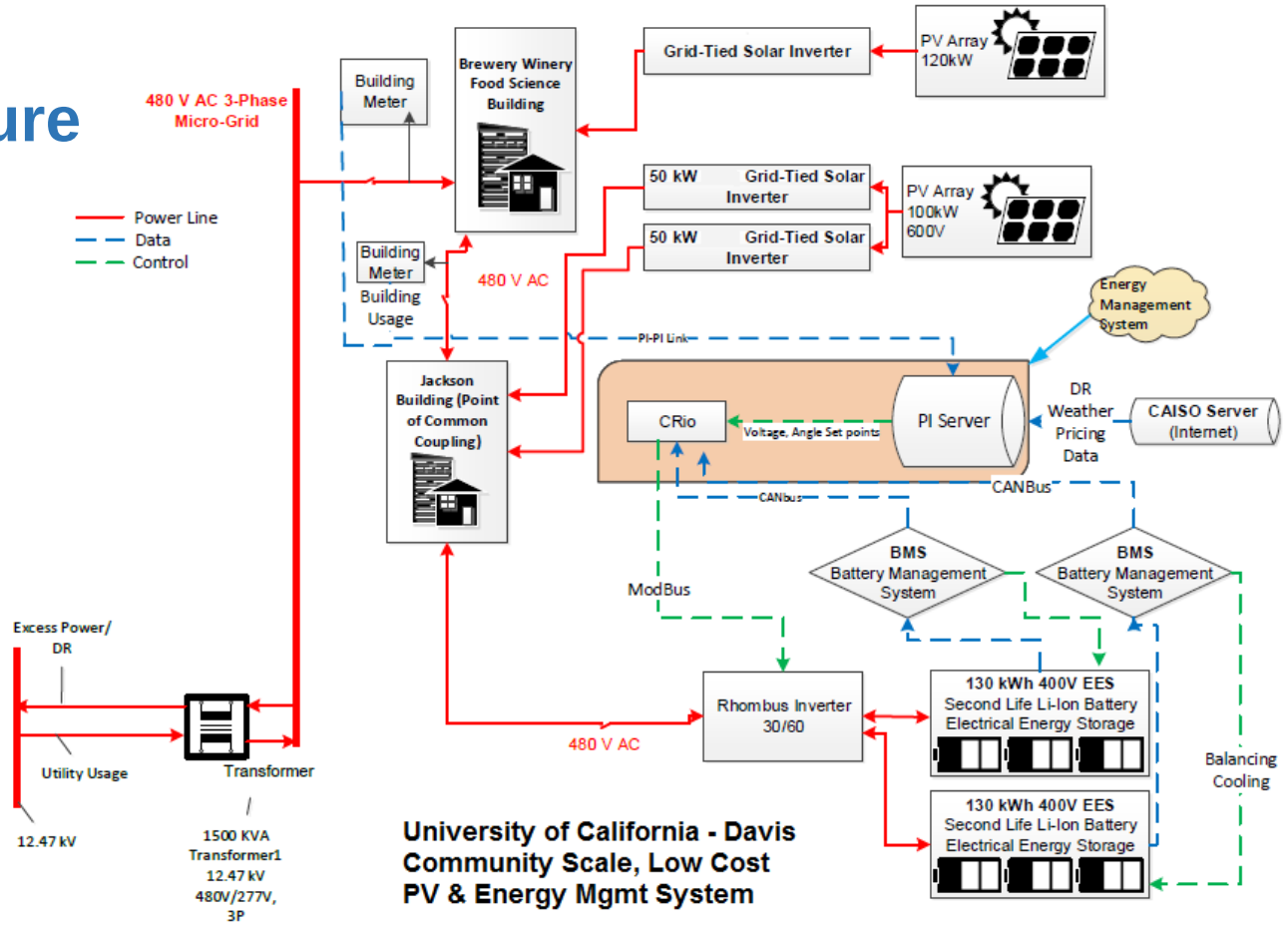
Winery Microgrid

PV Energy

Li-Ion Battery Storage

Energy Management System

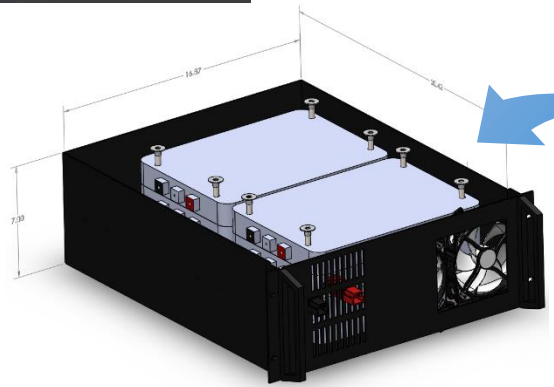
Microgrid Architecture

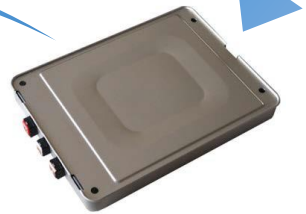


Second Life Li-Ion Batteries

260 kWh battery storage

Donated by Nissan and 4R Energy



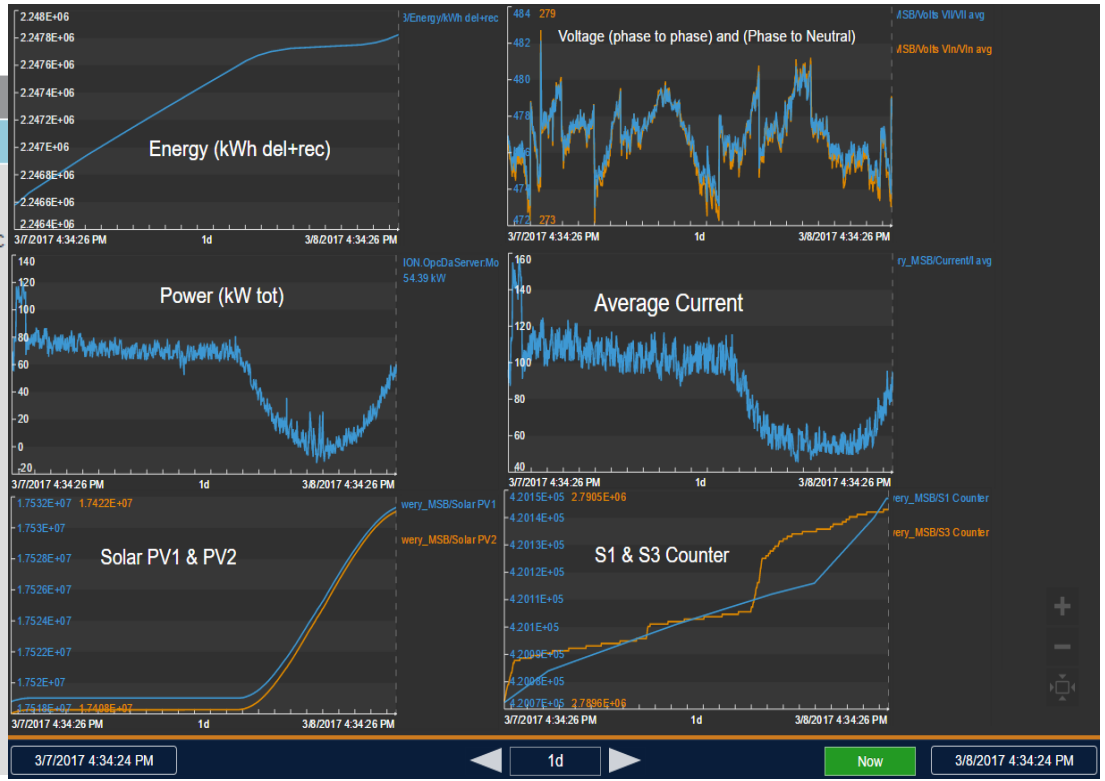


PI-to-PI from UCD Utilities for Brewery Winery Food Bldg

ven-cec-core-services

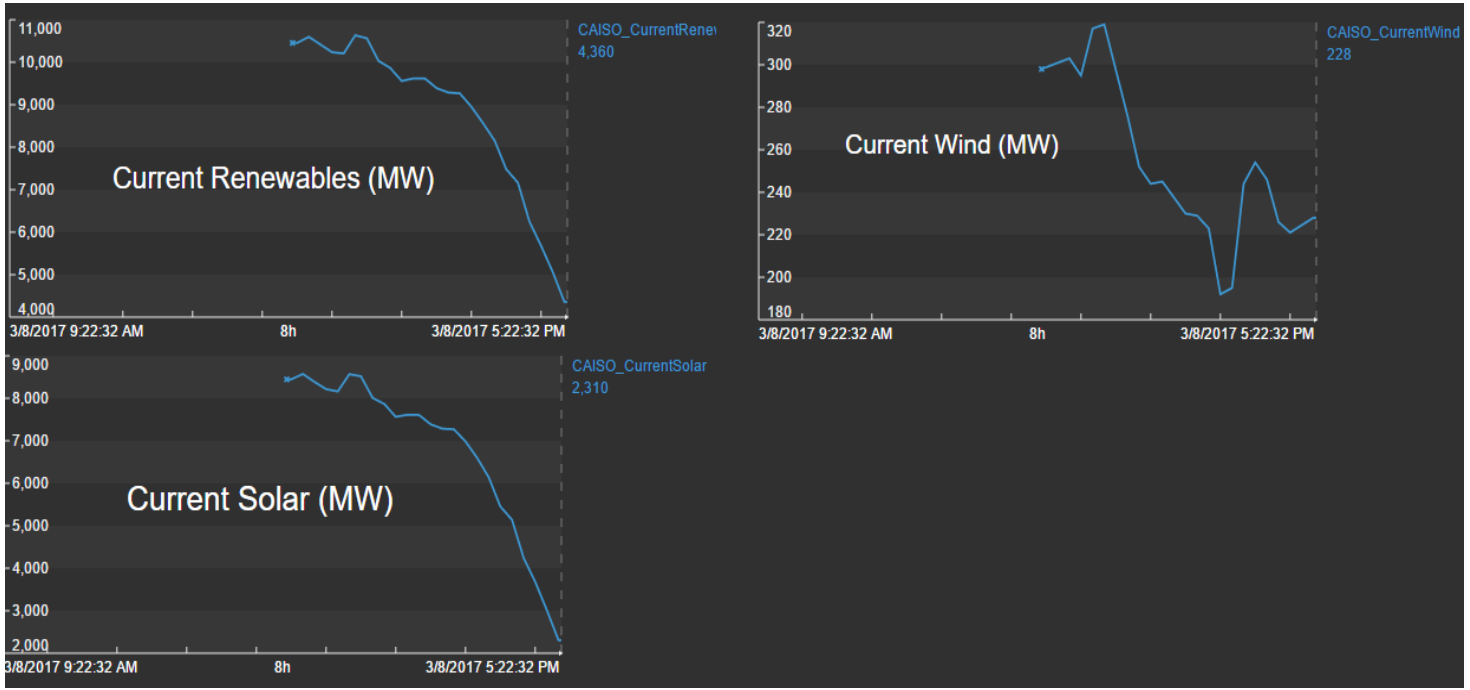
"ion"

- ION.OpcDaServer:Mondavi.Brewery_MSB/Current/I avg
- ION.OpcDaServer:Mondavi.Brewery_MSB/Energy/kWh del+rec
- ION.OpcDaServer:Mondavi.Brewery_MSB/Power/kW tot
- ION.OpcDaServer:Mondavi.Brewery_MSB/S1 Counter
- ION.OpcDaServer:Mondavi.Brewery_MSB/S3 Counter
- ION.OpcDaServer:Mondavi.Brewery_MSB/Solar PV1
- ION.OpcDaServer:Mondavi.Brewery_MSB/Solar PV2
- ION.OpcDaServer:Mondavi.Brewery_MSB/Steam_Flow_Rate
- ION.OpcDaServer:Mondavi.Brewery_MSB/Steam_Usage
- ION.OpcDaServer:Mondavi.Brewery_MSB/Utility Water
- ION.OpcDaServer:Mondavi.Brewery_MSB/Volts Vll/Vll avg
- ION.OpcDaServer:Mondavi.Brewery_MSB/Volts Vln/Vln avg



CAISO Renewables Data

- http://www.caiso.com/informed/Pages/CleanGrid/TodaysRenewables.aspx



ven-cec-core-services

"CAISO"

CAISO_CurrentRenewables

CAISO_CurrentSolar

CAISO_CurrentWind

A Sustainable Winery

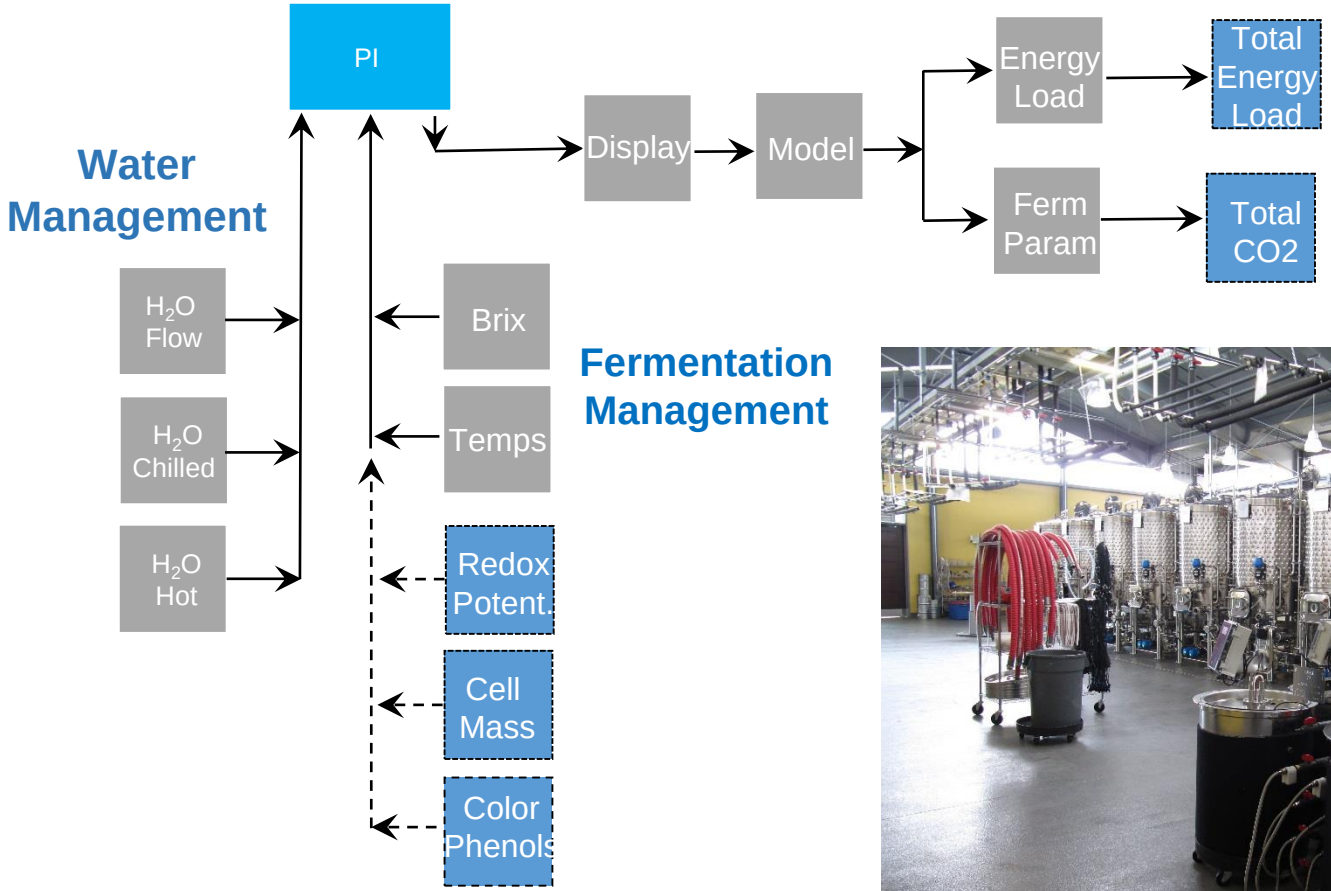
How the PI System will Enable the UC Davis Winery to be Net Positive in Energy & Water

Our Vision

- **Create a sustainable research & teaching winery that is net-positive for water & energy and carbon neutral**

- **Water Positive**
  - **Rainwater Capture**
  - **Reuse process water & cleaning solutions multiple times**
  - **No wastewater pond**
- **Energy Positive (kW & kWh basis)**
  - **Renewable Power & Storage**
  - **Solar Panels**
  - **Li-Ion Batteries for Energy Storage**
- **Carbon neutral**
  - **Capture CO_2 & ethanol**

A Sustainable Winery



Fermentation Management

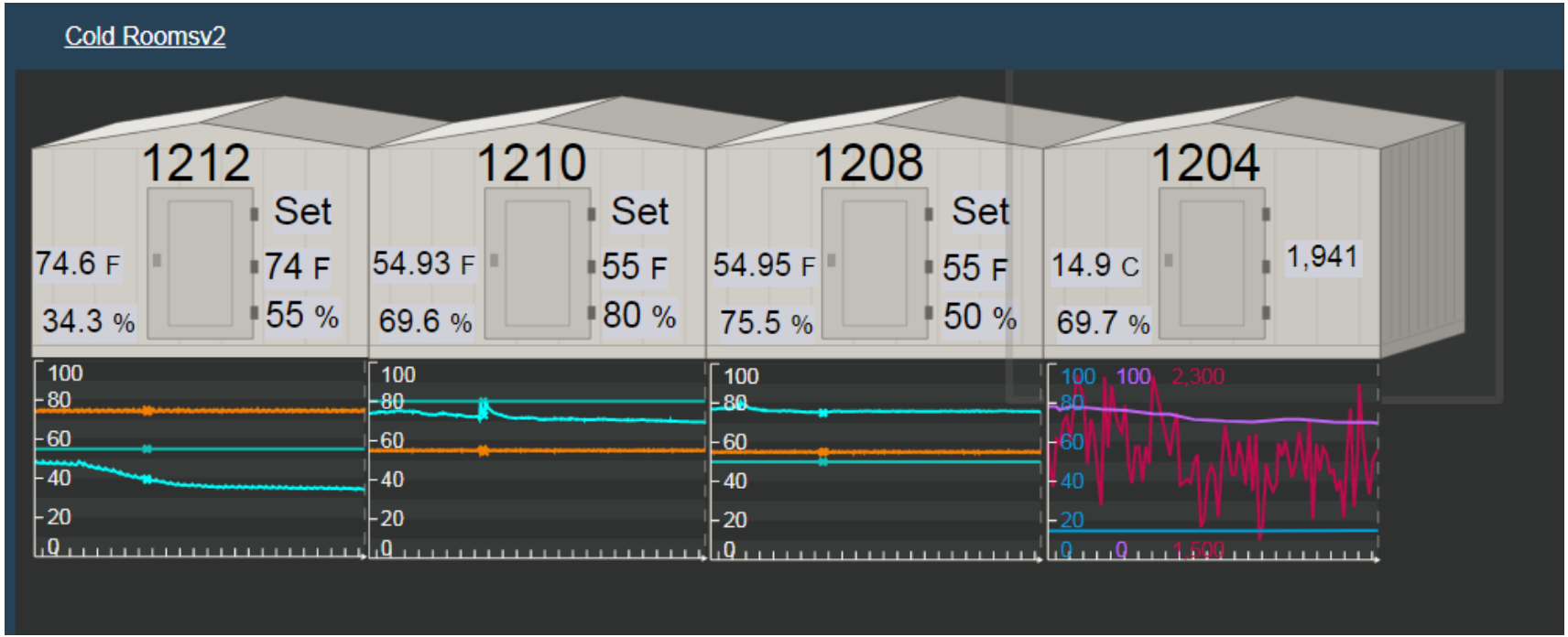
ModBus

PI System

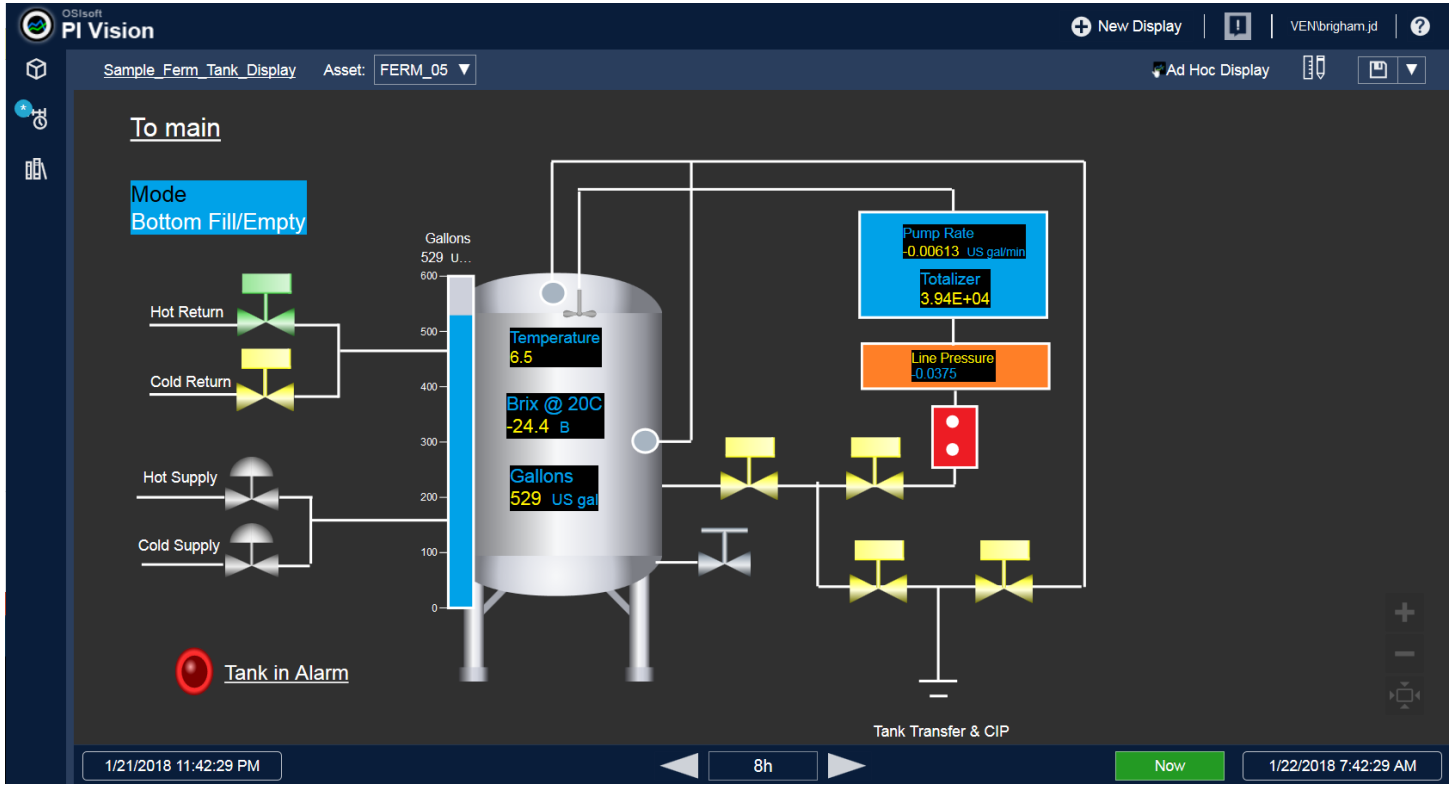
CyFi via SQL

Fermentation Monitoring

Walk-in Coolers & Barrel Room



Fermentation Control System Status



Tank Management

Winery Energy and Water Systems

Solar PV to Li ion Battery Energy Storage

Rainwater to RO Water

NF Recovery of Cleaning Solutions

Ice making for CW and Passive Solar HW

On-site Carbon Dioxide Sequestration

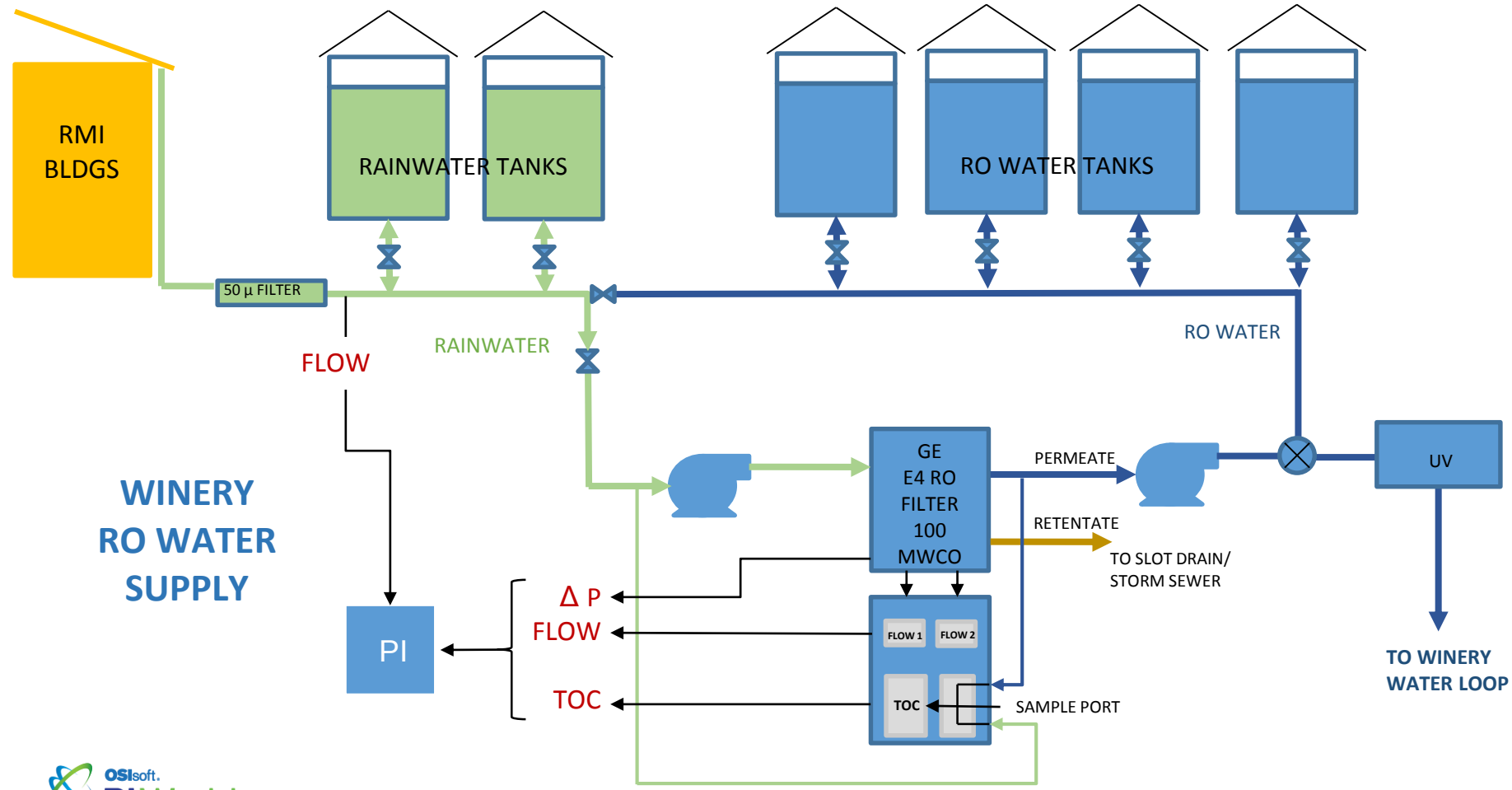
Electrical Demand & Solar Generation

Rainwater to RO Water System

Flow Rates, Permeate and Retentate
Membrane Differential Pressures
and Total Organic Carbon (TOC)

Potable Water - Rainwater Harvest

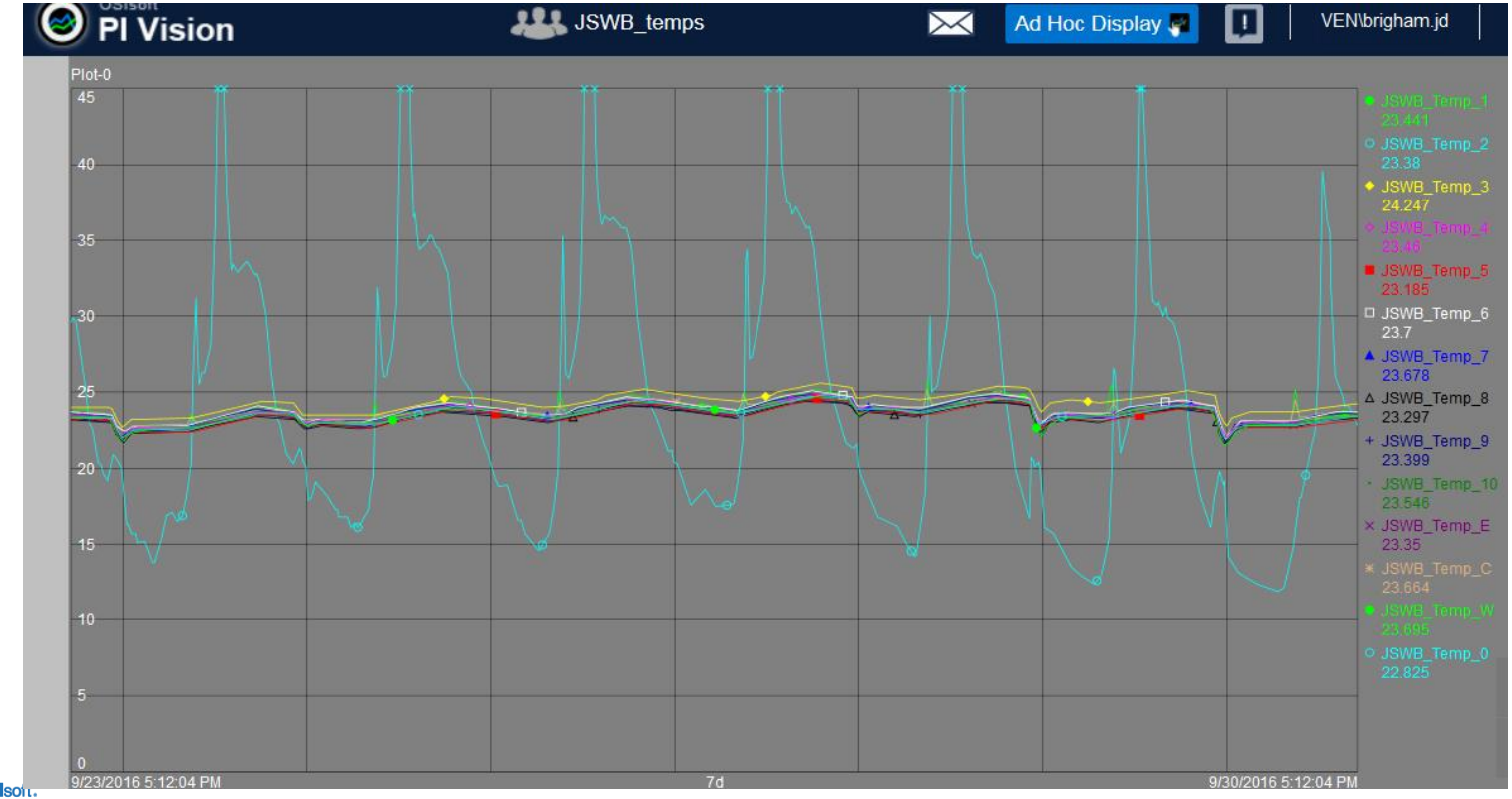
Water Storage
Potable: 1,000K L
Non-Potable: 680K L



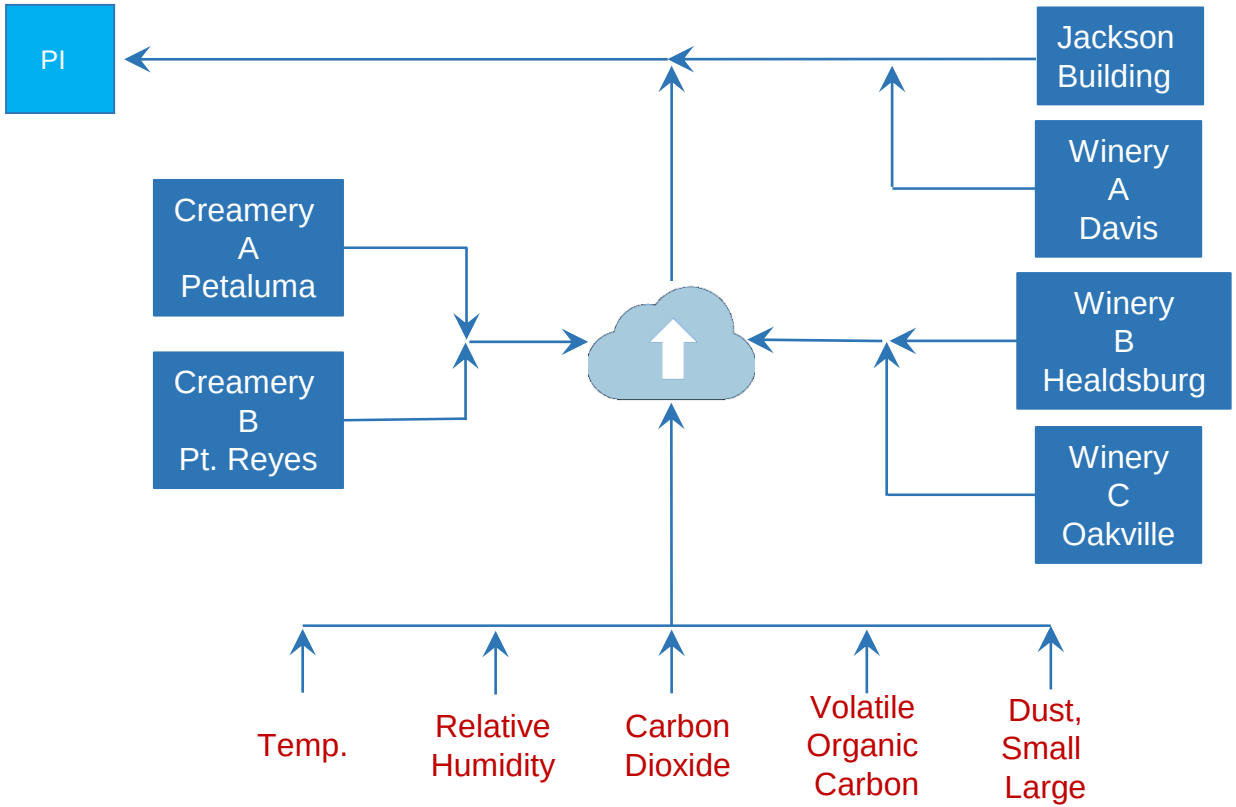
Building Performance Network

Winery & Jackson Building at UC Davis
5 Site Building Network

Thermal Performance of J. Jackson Sustainable Winery Bldg.



Seasonal Building Performance Monitoring

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UFL.WineryB.Main.Temp
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UFL.WineryB.Main.VOC
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Now
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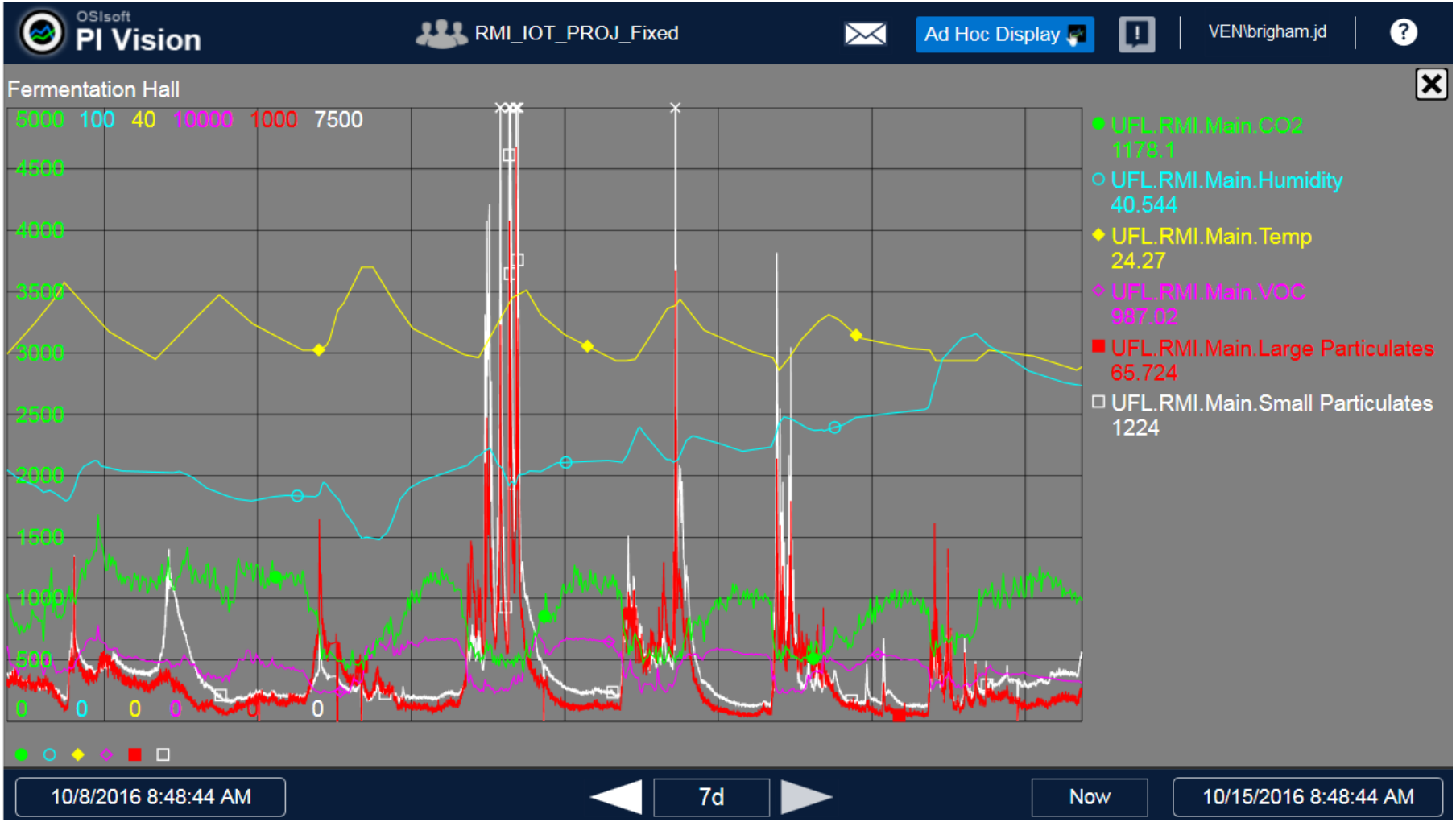
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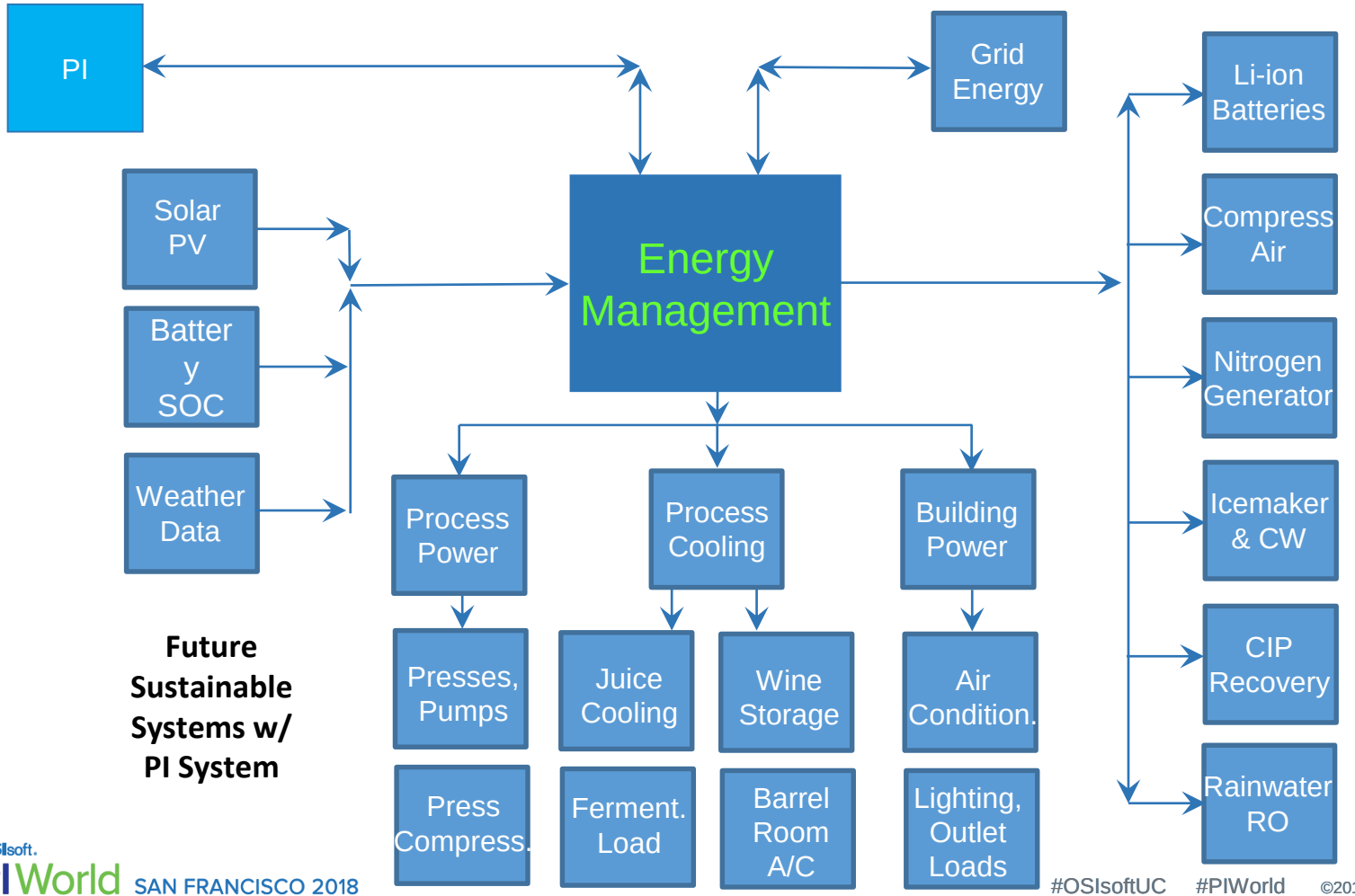

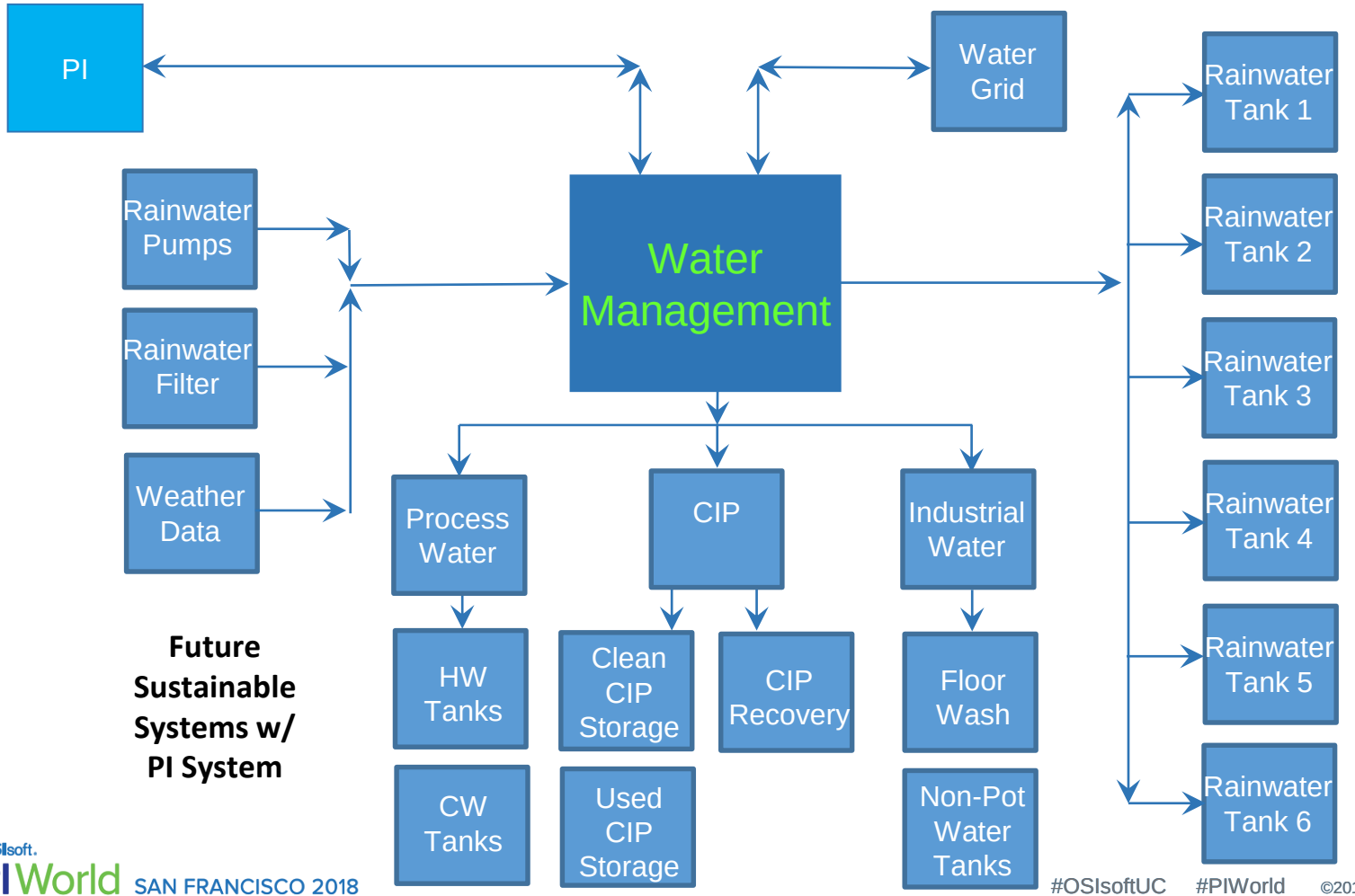

Future Sustainable Systems w/ PI System

PI System in the Classroom

VEN 298

Numerical Analysis of Fermentations

Prof. Roger Boulton

PI DataLink

Book1 -

FILE | HOME | INSERT | PAGE LAYOUT | FORMULAS | DATA | REVIEW | VIEW | PI DATALINK | PI

Cut
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E15

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7	28-Sep-13 12:10:00	24.57464218	6.810459614	9.
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19	28-Sep-13 14:10:00	25.37999916	9.383076668	10.61692333	4.800000191
20	28-Sep-13 14:20:00	25.37999916	9.28284359	10.71715641	4.817156792
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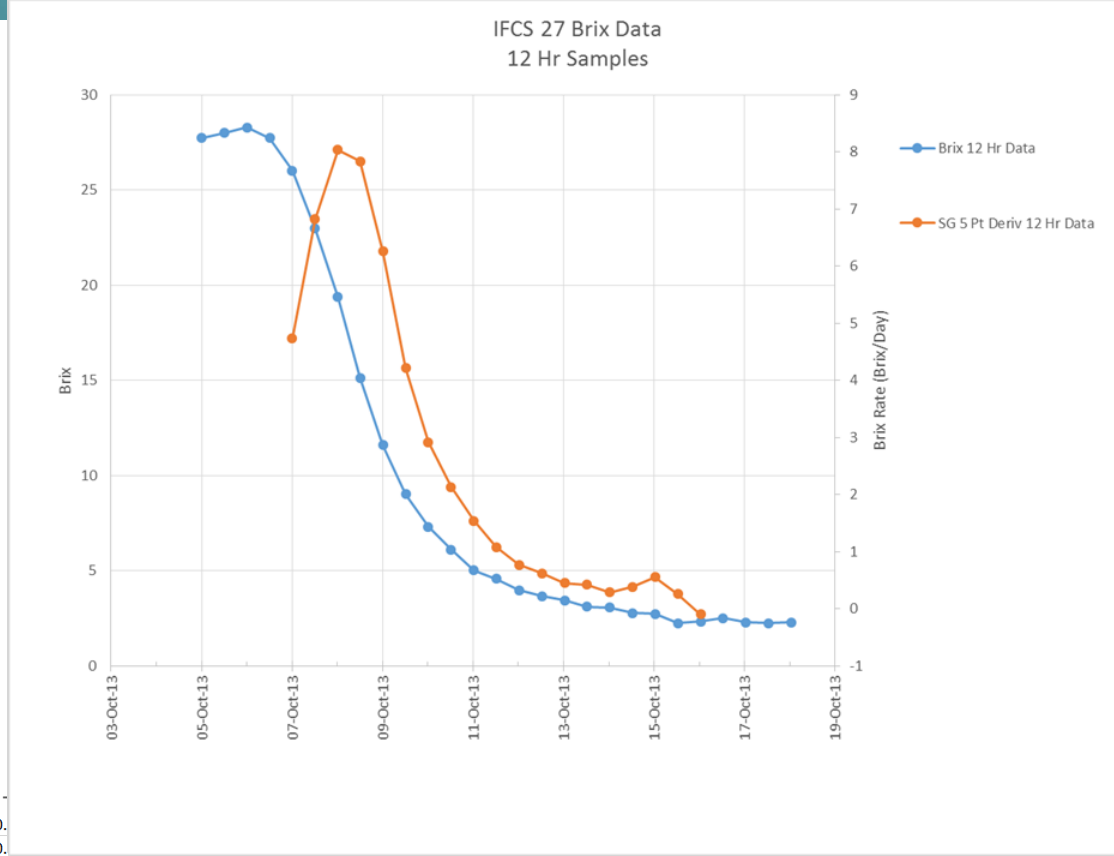
Sheet1 | Sheet2 | Sheet3 | Sheet4

READY



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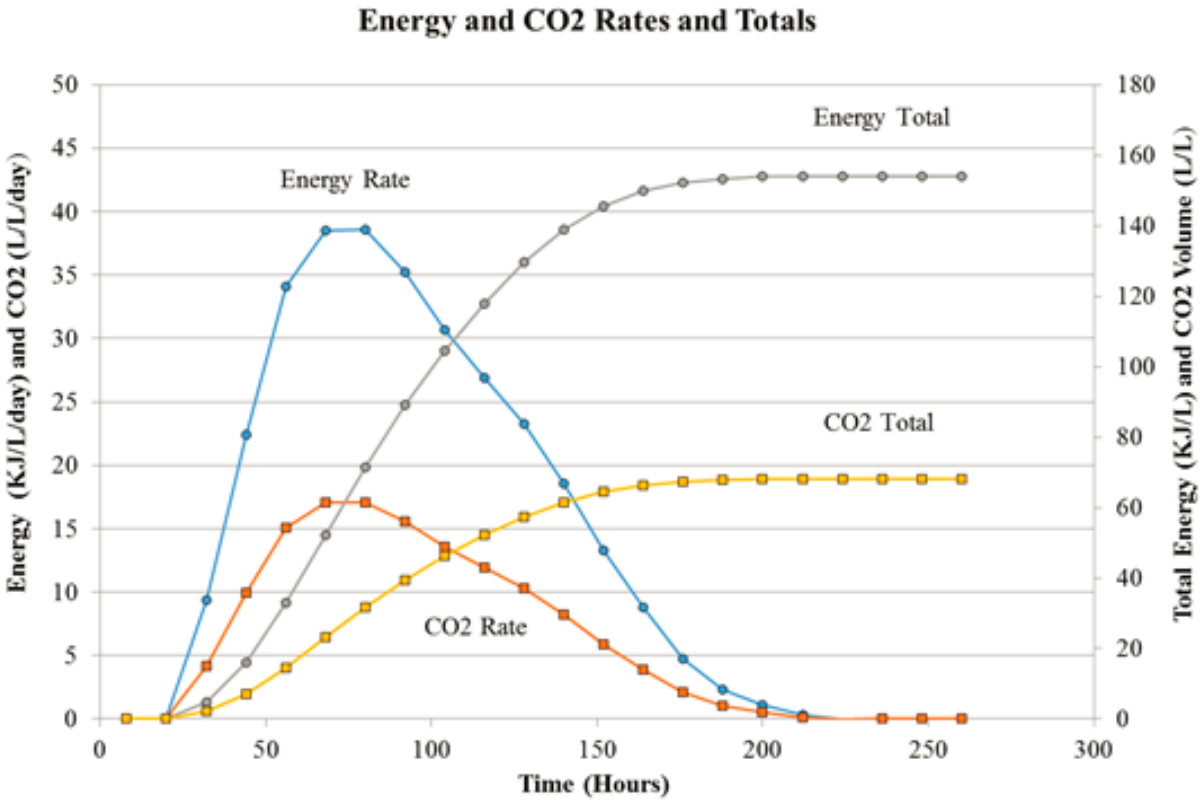
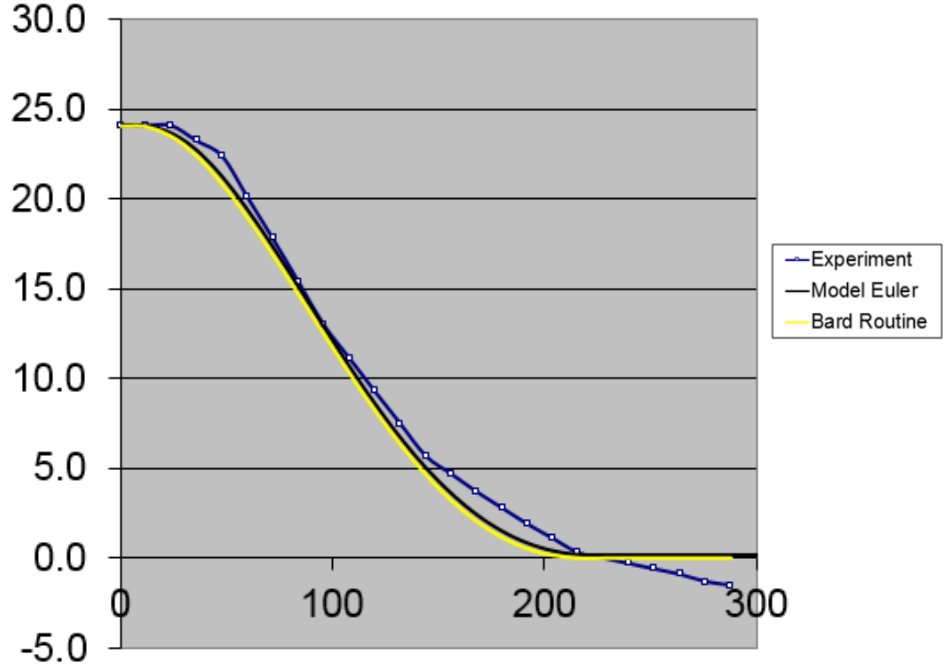
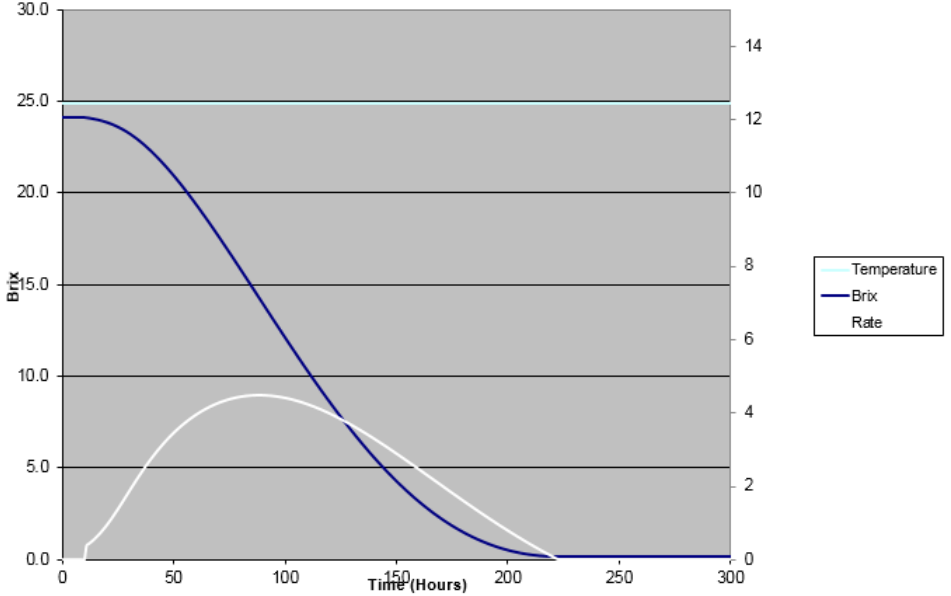


Fermentation Model Predictions

Measured vs. Predicted Brix



Brix Depletion, Rate, & Temperature



Educating future winemakers in data driven, sustainable practices

Multidisciplinary Collaboration for Student Education – UC Davis PI Systems for Learning & Research

Kiernan Salmon

- kmsalmon@ucdavis.edu
- Product Developer
- UC Davis Energy Conservation Office

Jill Brigham

- jbrigham@ucdavis.edu
- Executive Director – Sustainable Wine & Food Processing Center
- UC Davis – Dept. of Viticulture & Enology

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Merci

谢谢

Danke

Спасибо

Gracias

Thank You

감사합니다

ありがとう

Grazie

Obrigado

Optional: Click to add a takeaway you wish the audience to leave with.