The background of the slide is a photograph of the University of California, Merced campus. In the foreground, there is a field of dry, golden-brown grass. In the middle ground, several large, modern university buildings with glass and dark facades are visible. To the right, there are two large, cylindrical industrial-style tanks. The sky is overcast with grey clouds, and a faint rainbow is visible in the background, arching over the buildings.

Piloting An Integrated Renewable Energy Portfolio for the UC Merced Community

Gerardo Diaz
School of Engineering
University of California, Merced

Energizing California's Communities with Renewables: A Central Valley Perspective
San Joaquin Valley Air Pollution Control District , September 23, 2015



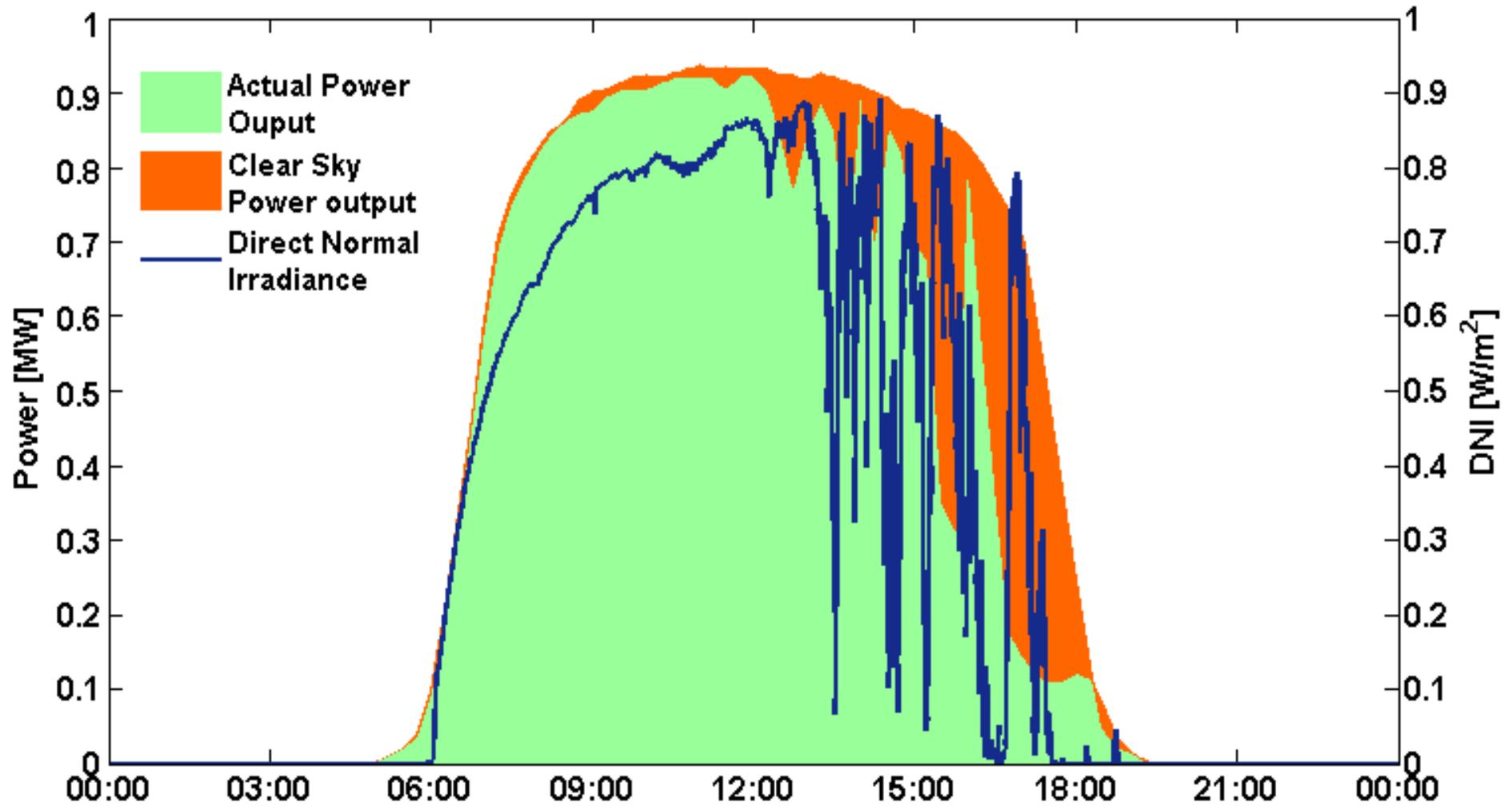
Sustainability UC MERCED

Green from the Ground Up

- Increase student population from 6,200 to 10,000 by 2020
- More than double the footprint of the campus (100 acres to 246 acres)

Ramp Rates

Example fast drop in power from 1 MW PV array at UC Merced



06/06/2011

Source: Carlos Coimbra, UCSD

Main Goal

The logo for UC Merced's Triple Zero initiative. It features the text "UC MERCED" in a grey sans-serif font at the top right. Below it, the word "triple" is in a grey sans-serif font, and "zero" is in a bright green sans-serif font. A thin green horizontal line runs under both "triple" and "zero". Below the line, the text "zero net energy. zero landfill waste." is written in a grey sans-serif font, with "zero" in green. The second line of text is "zero net greenhouse gas emissions.", also in grey sans-serif font, with "zero" in green.

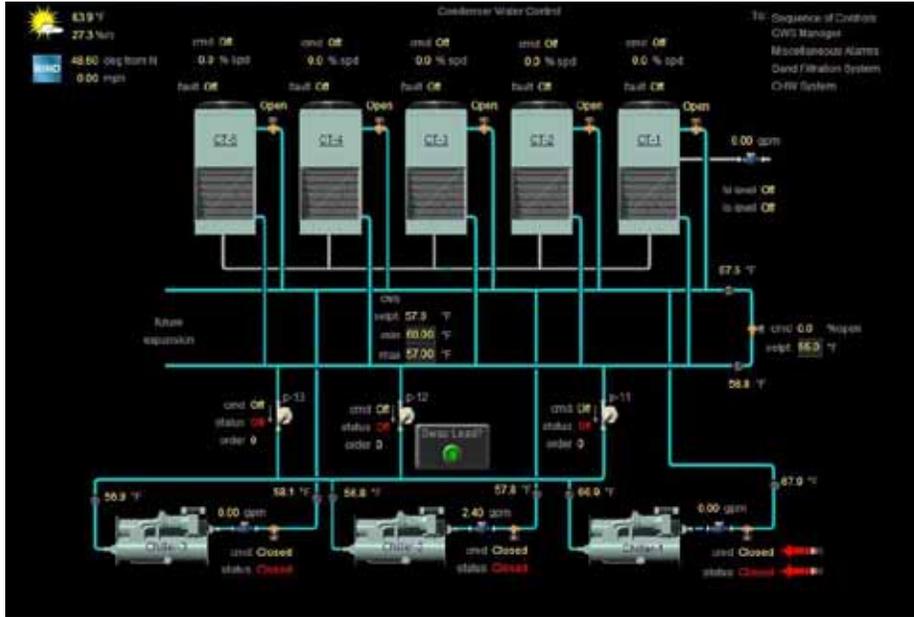
UC MERCED
triplezero
zero net energy. zero landfill waste.
zero net greenhouse gas emissions.

- Produce as much energy as we consume
- Reduce and offset all green house gas emissions produced
- Divert all waste from landfill

Objectives

- Develop an **energy performance monitoring approach** so that energy efficiency and the ability to control loads can be maintained.
- Develop an **integrated energy portfolio** at timescales from hours to years
- **Characterize intermittent solar renewable generation** sources at the campus and build the capability to **forecast generation and local loads**.
- Advance the ability to smooth generation profiles and **optimize integration strategies**.
- Investigate the potential to **use local waste** materials **for energy production**.
- Develop the ability to **control and dispatch energy generated through plasma gasification technology**

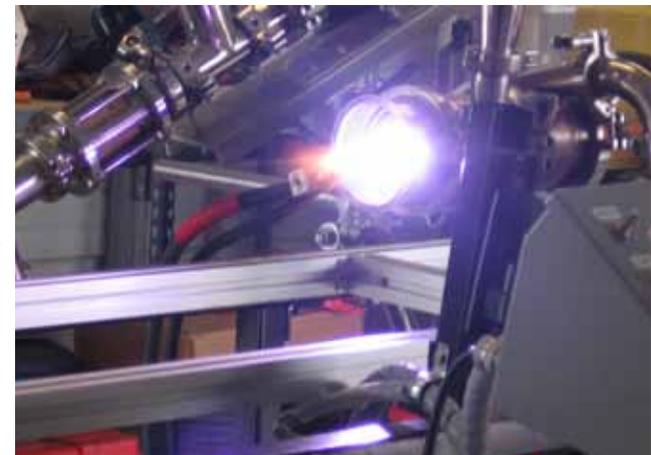
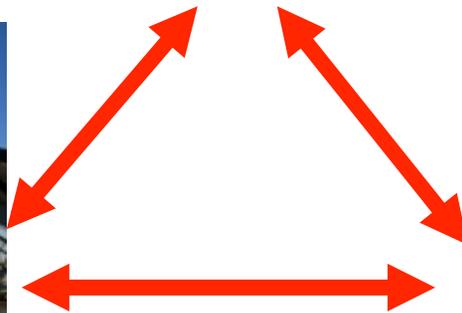
Strategy



Campus Energy Efficiency

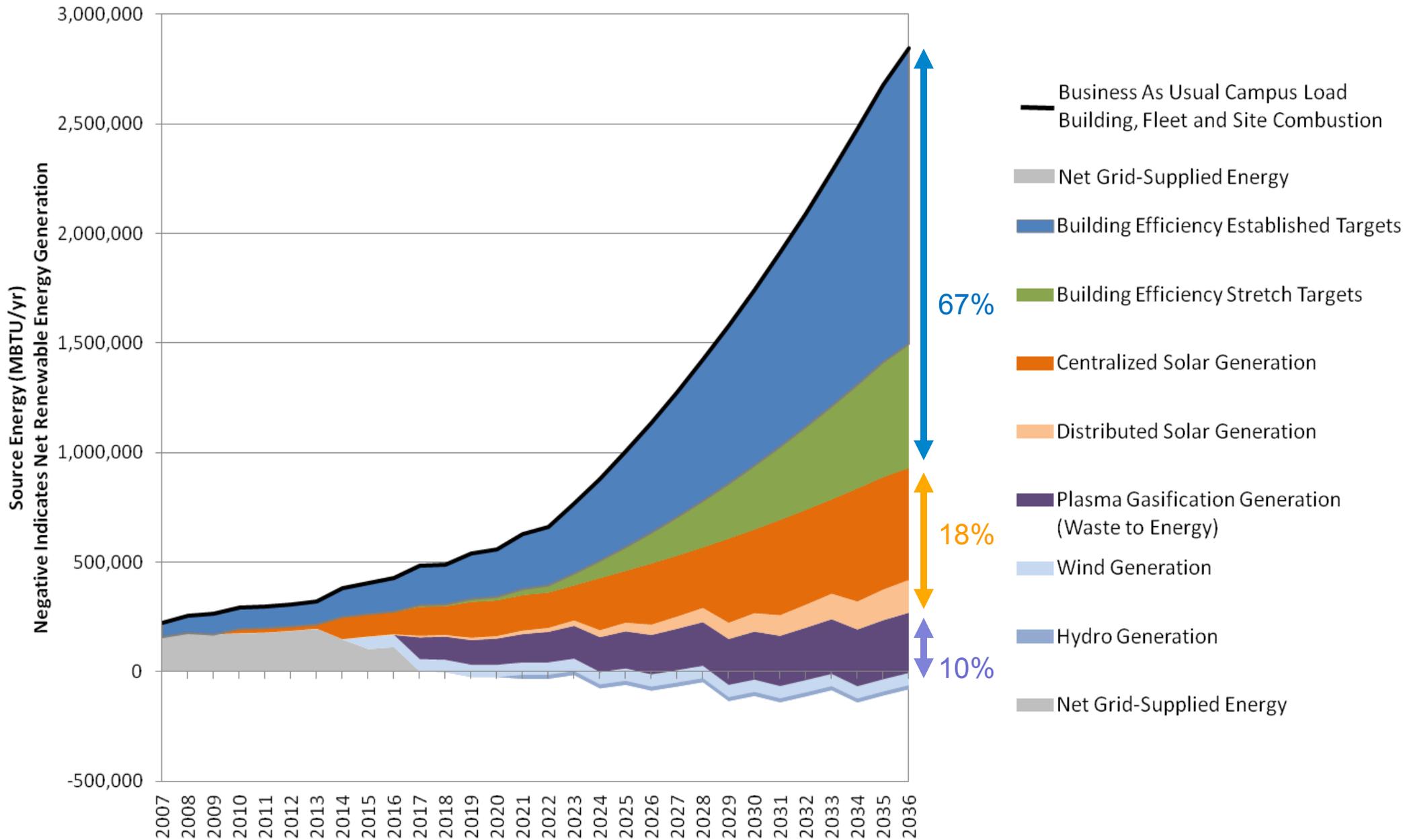


Solar Energy and Forecasting



Local of Waste and Plasma Gasification

UC Merced Business as Usual Load and "Wedges" to Achieve Zero Net Energy Over Campus Build-out

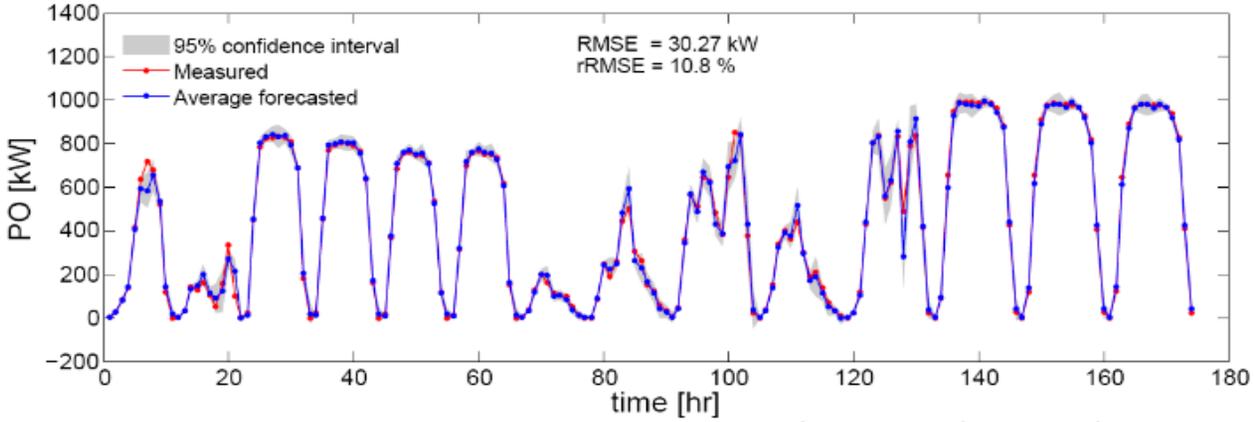
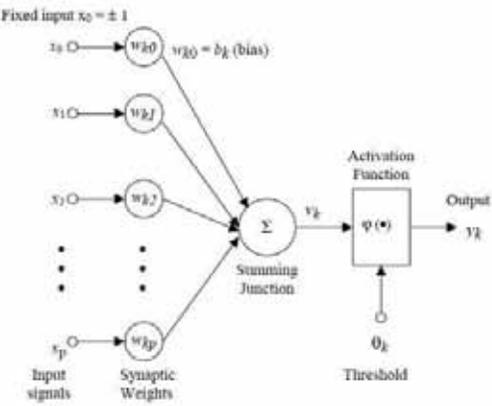
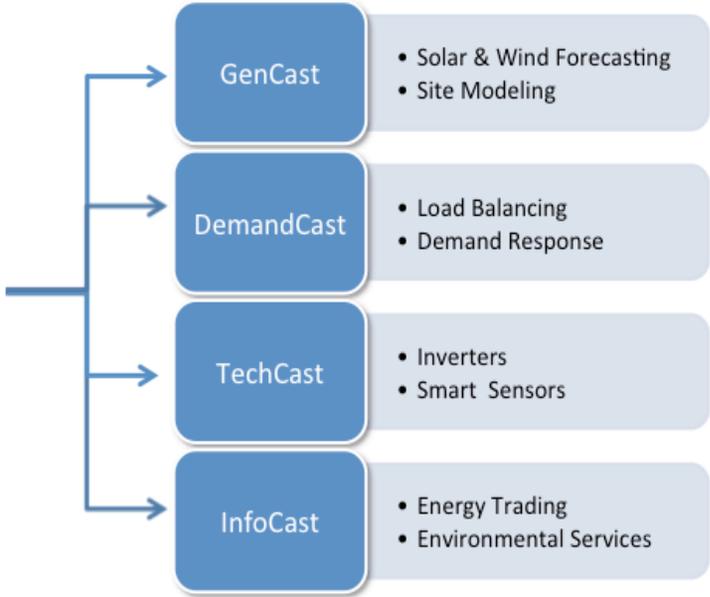




Multiple Inputs Generate High-Fidelity, Full Temporal Spectrum Forecasts



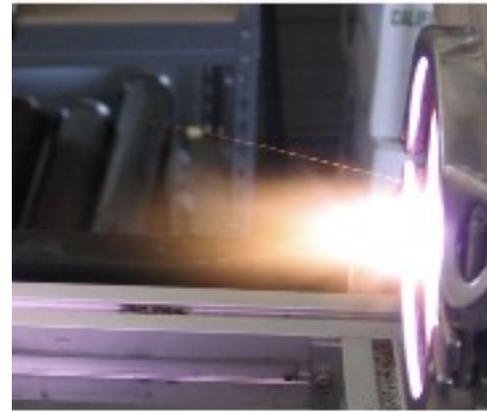
Forecasting Engine



Source: Carlos Coimbra, UCSD

Zero Net Waste

- Our goal is to divert 95% of the waste from the landfill
- Currently our diversion rate is 78% and climbing
- High quality synthesis gas through plasma gasification
- Fast start-up reaction



UC Merced Facilities Management



Sorting Line

Lessons Learned

Energy Efficiency

- **Get administration on board** since the very beginning (implementation requires funding)
- **At least LEED gold standard** for future buildings
- **Monitoring**
- On campus generation avoids demand charges (~50% of cost)
- A portfolio helps mitigate the weaknesses of different approaches (e.g. solar only viable during the day)
- We work with UCOP for purchased electricity allows competitive rates
- State goals and President Napolitano's zero-greenhouse gas initiative help to implement strategies faster.

Solar Forecasting

- **Better telemetry needed** in order to obtain high-quality data and predictions (from 15min to 30 seconds resolution)
- Integrated solar-load **forecasts** were **developed** for an active community **with high solar penetration levels**

Lessons Learned (cont.)

Integration

- Integrated solar-load **forecasts allow for ramping of dispatchable resources** (such as the plasma gasification system used in this work), and contribute the overall operation of energy systems at the community level

Waste Management and Plasma Gasification

- The **amount of waste generated at UC Merced is not enough** to produce a significant fraction of the campus energy demand.
- The **fast reaction of the plasma unit** in terms of start-up conditions makes it suitable to be utilized as a power generation smoothing tool for high penetration variable output renewable energy source.
- Very high quality synthesis gas obtained >50% H₂ + 30% CO
- Current **diversion rates** are at **78% and climbing**

Acknowledgements

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