Session I: Renewables for Net Zero Energy Installation

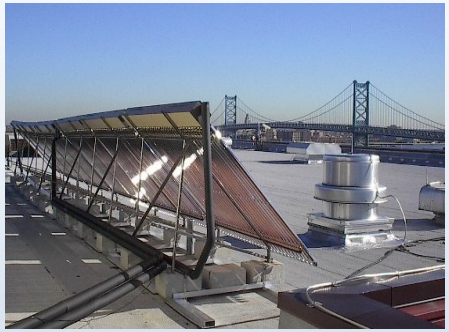
Session Chair: Dr. Andy Walker, NREL, "Renewable Energy Optimization for Net-Zero"
Topic I: Dr. R. Boehm, UNLV Energy Center, "Zero Energy Buildings"
Topic 2: Heidi Anne Kaltenhauser, Concurrent Technologies Corporation,
"Case Study of Privatized Net-Zero Homes at Fort Campbell"
Topic 3: Cecile Warner, NREL, "Building-Integrated Photovoltaic"
Topic 4: Tony Jimenez, NREL, "Wind Energy"

Renewable Energy Technologies

Photovoltaics

Wind Power

Solar Water Heating



Solar Vent Air Preheat

Concentrating Solar Heat/Power

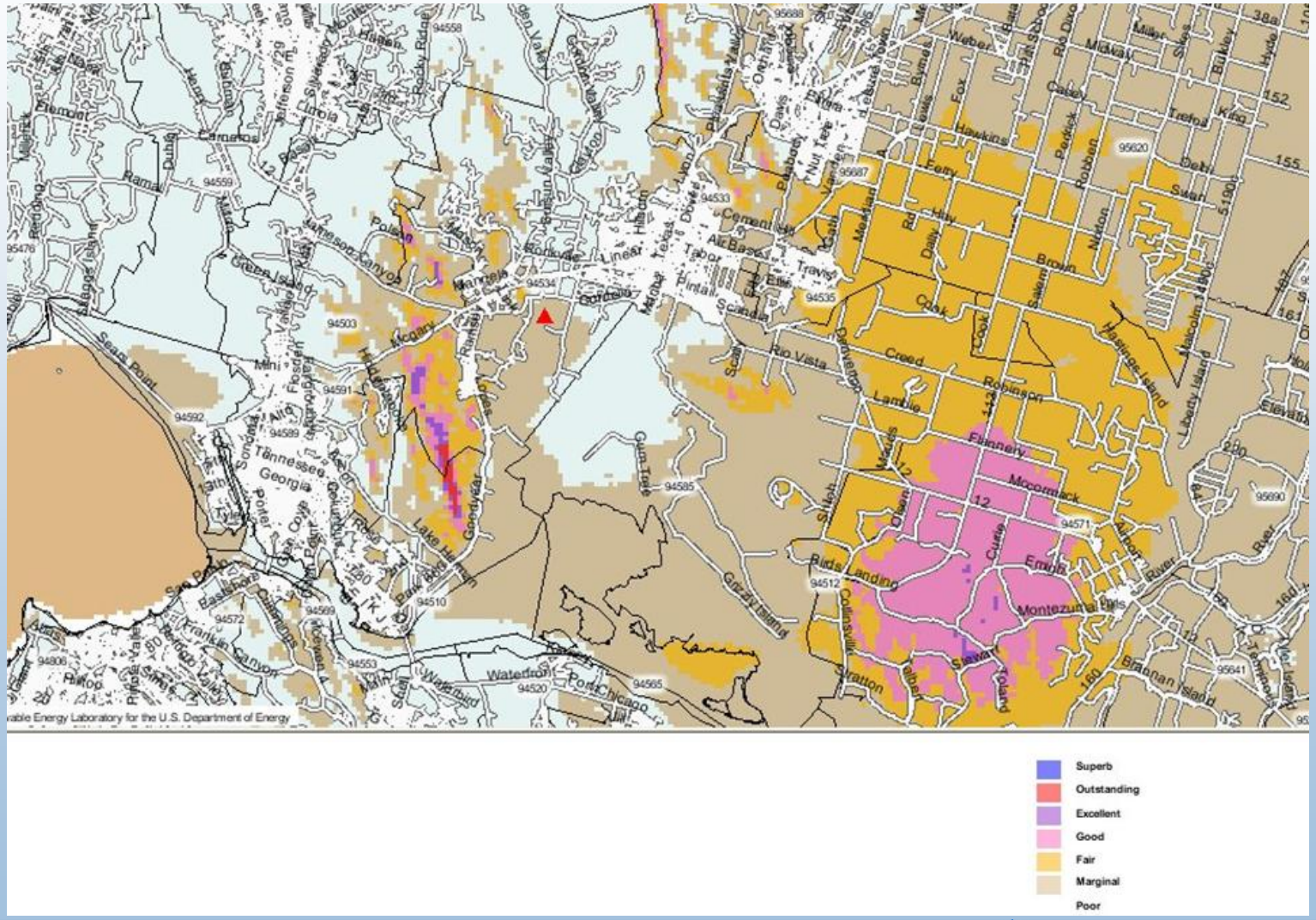
Biomass Heat/Power

Daylighting

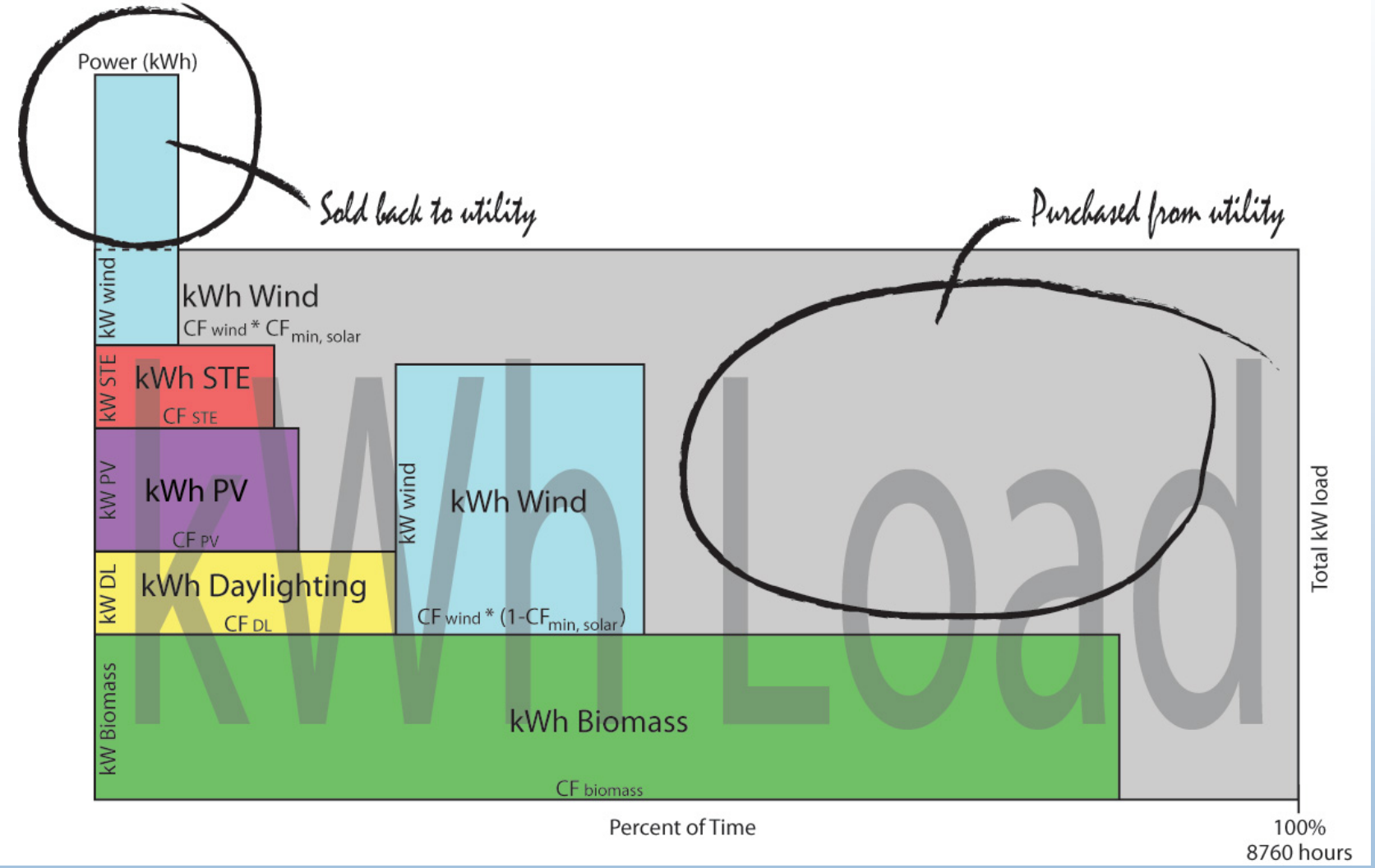
Best Mix of Renewable Energy Technologies Depends on:

- Renewable Energy Resources
- Technology Characterization
  - Cost ($/kW installed, O&M Cost)
  - Performance (efficiency)
- Prevailing Utility Rates
- State, Utility and Federal Incentives
- Economic Parameters
  - Discount rates
  - Fuel Escalation Rates

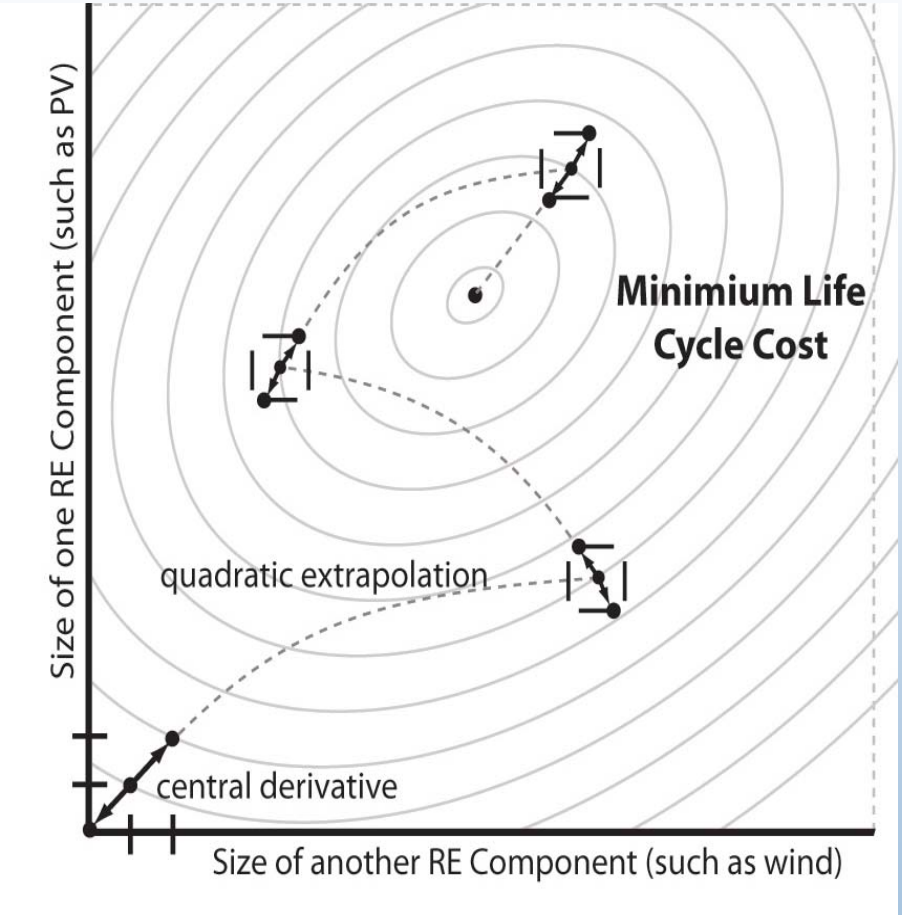
Example of NREL GIS Data
Wind Energy in vicinity of Fairfield CA



Dispatch Algorithm: How RE technologies work together



Optimization Problem



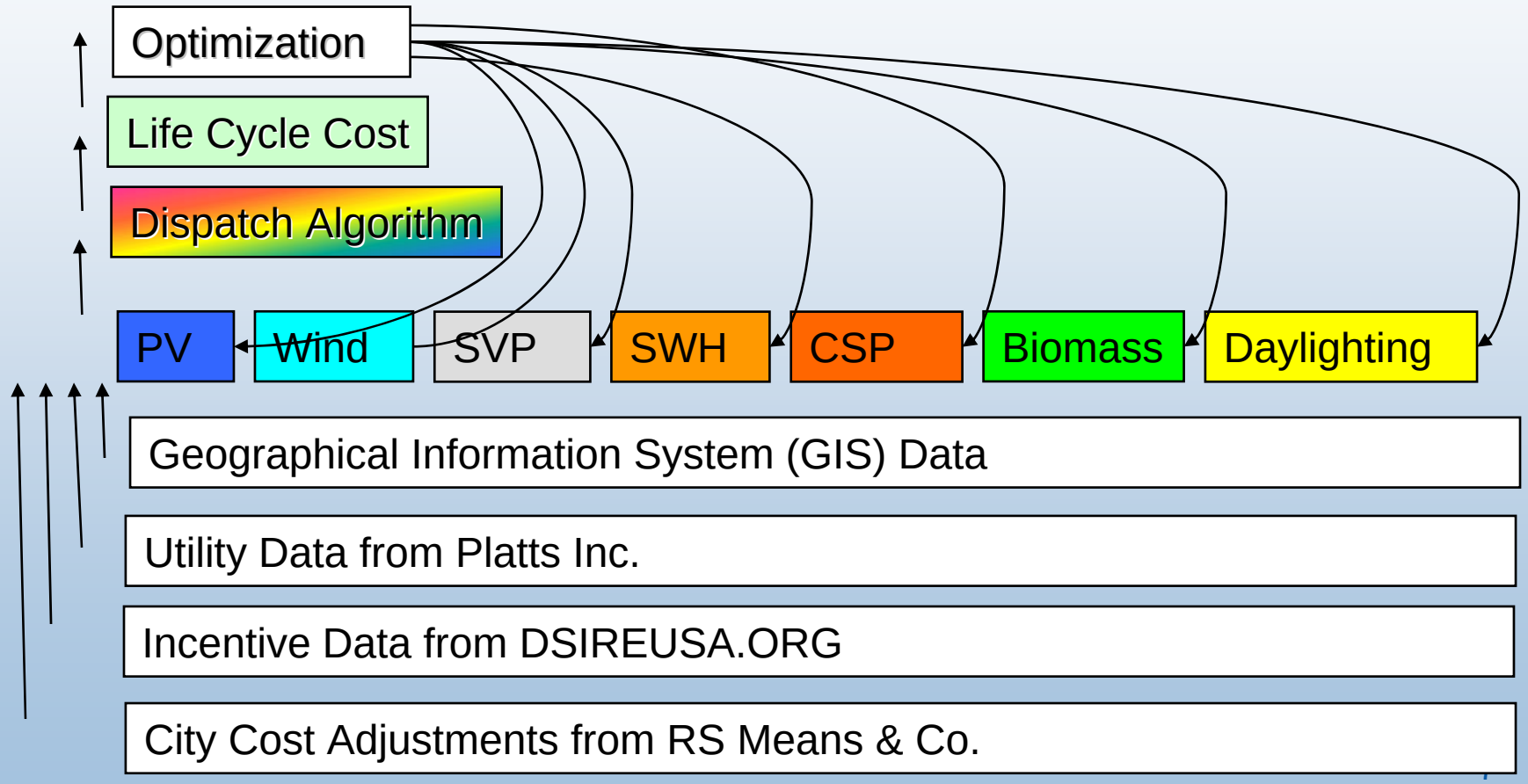
Determine the least cost combination of renewable energy technologies for a facility

Objective: Minimize Life Cycle Cost ($)

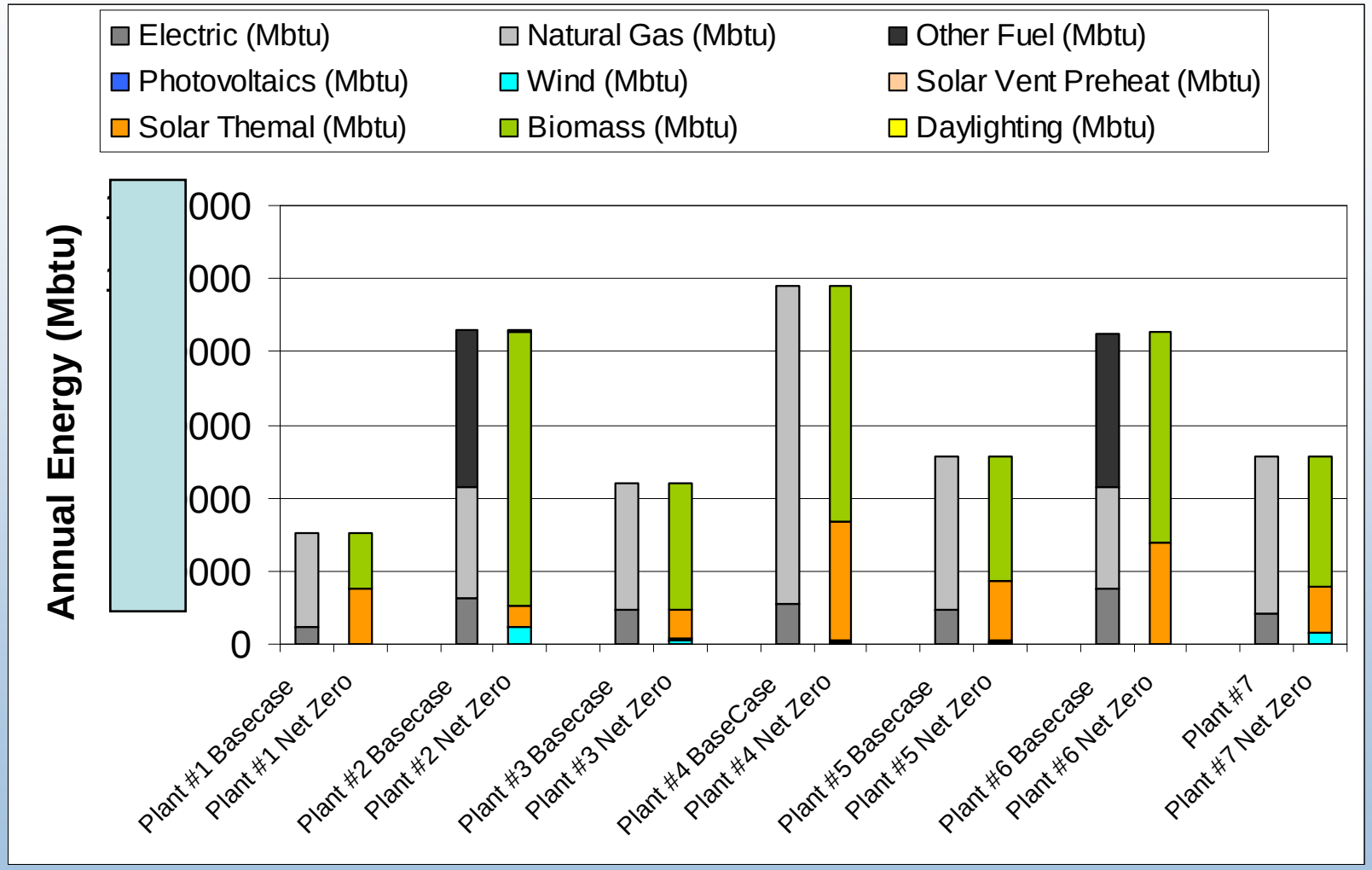
Variables: Size of Each Technology (kW of PV, kW of wind, etc)

Constraints: such as 15% of energy from renewables

Optimization Procedure



Example: Frito Lay North America Minimum Life Cycle Cost (Net Zero constraint)



Example: Frito Lay Optimization for Seven Manufacturing Plants Constraint: Net Zero

	Photovoltaics Size (kW)	Wind Capacity (kW)	Solar Vent Preheat Area (ft2)	Solar Thermal Area (ft2)	Biomass Boiler Size (M Btu/h)	Biomass Cogeneration Size (kW)	Daylighting Office Utility Skylight/Floor Area Ratio	Daylighting Warehouse Skylight/Floor Area Ratio
Plant #1	200	491	5456	509196	19	1669	2.2%	2.1%
Plant #2	0	6187	8953	391987	87	3097	3.8%	2.0%
Plant #3	0	3107	13098	469621	44	3180	4.9%	3.6%
Plant #4	1011	1000	10213	1360535	78	4108	3.4%	1.8%
Plant #5	1003	998	10327	704140	44	3327	6.1%	3.4%
Plant #6	0	0	10322	1529609	74	6020	err	err
Plant #7	0	3699	10802	673761	43	2193	3.3%	3.7%

"All the News That's Fit to Print"

The New York Times

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In Eco-Friendly Factory, Low-Guilt Potato Chips

Frito-Lay's Venture Joins the Rush to Be Green

By ANDREW MARTIN

CASA GRANDE, Ariz. — At Frito-Lay's factory here, more than 500,000 pounds of potatoes arrive every day from New Mexico to be washed, sliced, fried, seasoned and portioned into bags of Lay's and Ruffles chips. The process devours enormous amounts of energy, and creates vast amounts of wastewater, starch and potato peelings.

Now, Frito-Lay is embarking on an ambitious plan to change the way this factory operates, and in the process, create a new type of snack: the environmentally benign chip.

Its goal is to take the Casa Grande plant off the power grid, or nearly so, and run it almost entirely on renewable fuels and recycled water. Net zero, as the concept is called, has the backing of the highest levels of corporate executives at PepsiCo, the parent of Frito-Lay.

There are benefits besides the potential energy savings. Like many other large corporations, PepsiCo is striving to establish its green credentials as consumers become more focused on climate change. There are marketing opportunities, too. The company, for example, intends to advertise that its popular SunChips snacks are made using solar energy.

"We don't know what the complete payoff for net zero is going to be," said Indra K. Nooyi, PepsiCo's chairman and chief executive. "If this works even to 50 or 60 percent of its potential, that is fantastic, and it's so much better than what we already have."

From coast to coast, more companies are thinking about how much fossil fuel they use and ways to conserve energy. Venture capital money is also pouring into fledgling green technology.

Only a few years ago, Andy Walker, a government engineer, pleaded with companies to tackle the problems but got blank stares. "Now, my phone is ringing off the hook," said Mr. Walker, who works at the National Renewable Energy Laboratory of the Department of Energy in Colorado.

But advocacy groups contend that for all the interest in saving energy, many companies also exaggerate small improvements for marketing purposes.

"Now I think there's a transi-

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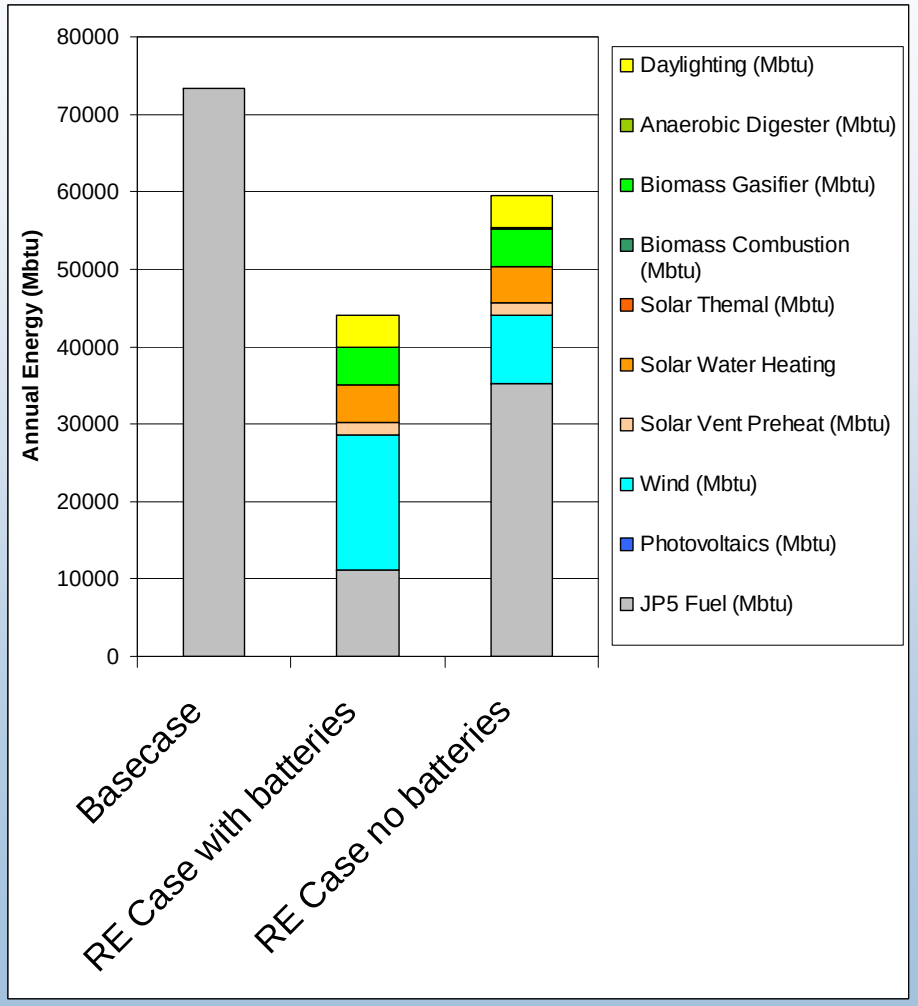
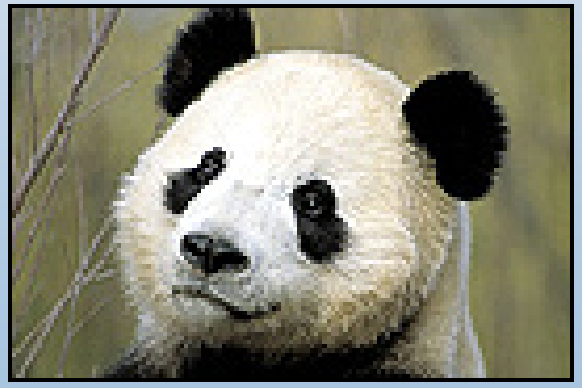
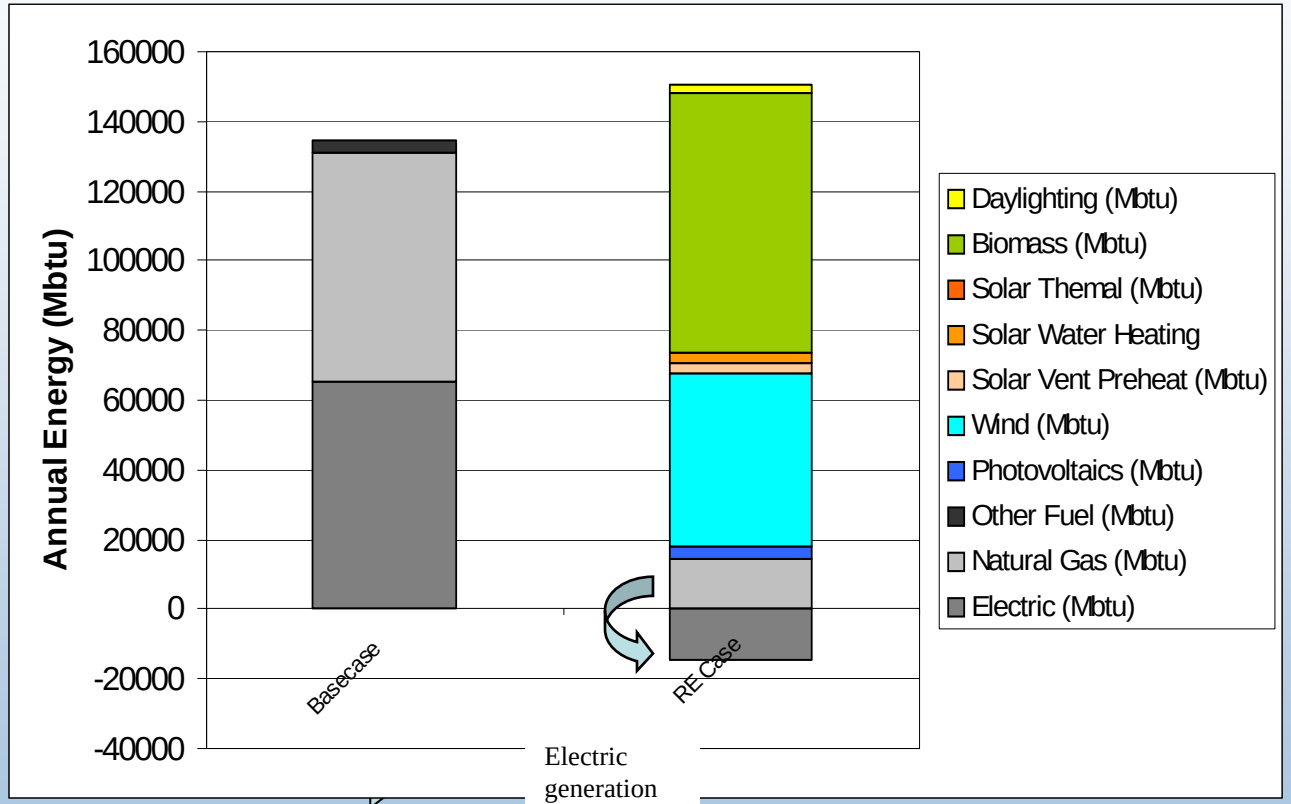
REO Example: Minimize Life Cycle Cost US Navy San Nicolas Island CA



REO Example: Net Zero Zoo
National Zoological Park (NZP) and Conservation Research Center (CRC), Washington DC





Electric generation at CRC Cancels remaining gas use at NZP

Zoo Entrance
Tai Shan the Panda

USCG Facility

Diamond Head, HI with incentives

Initial Cost for Renewable Energy Projects ($)	$90,868
Annual Electric Savings (kWh/year)	39,074
Annual Cost Savings ($/year)	$5,972
Simple Payback Period (years)	15.2
Rate of Return	7.0%
Percent Renewables	100%
Sizes of Each Technology:	
Photovoltaics (kW)	14.6
Wind Energy (kW)	2.4
Solar Water Heating (sf)	137.8
Skylight Area (sf)	272.4