

Net Zero Energy Installations



Photo from MCAS Miramer, NREL/PIX 18238



Photo from U.S. Army – Michael J. Pach, NREL/PIX 18635

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WREF, 17 May 2012
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Key Points

- A net zero energy installation (NZEI) is one that produces as much energy from on-site renewable sources as it consumes
- NZEI assessment provides a systematic approach to energy projects
- Goal of analysis is to lead to project implementation
- DoD is leading the way and has great potential



NREL/PIX 17394



NREL/PIX 08699

Background

DoD Energy

- \$3.5B in facility energy FY09
- 2 B square feet
- Average EUI 104
- 29 M acres of land (1.2% of U.S.)

Baseline

- Current energy consumption

Energy Efficiency

- Retrofit improvement potential
- New construction design optimization

Renewable Energy

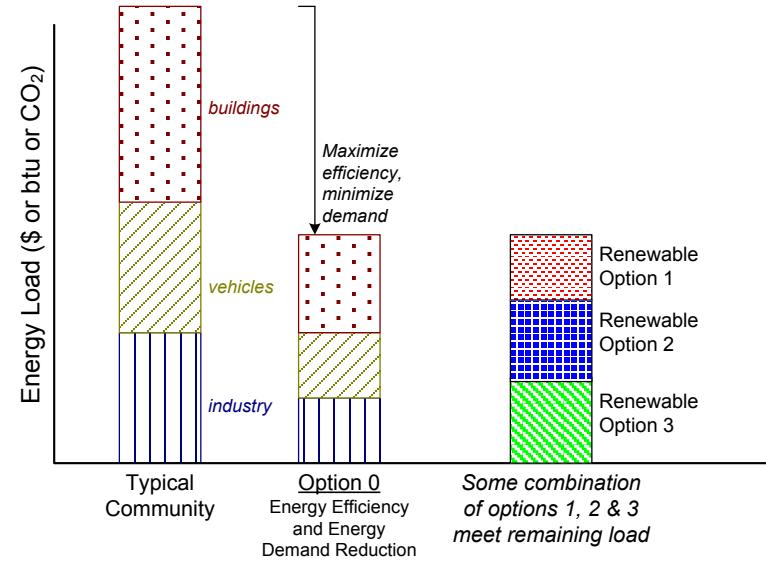
- Deployment of renewable energy

Electrical Systems

- Interconnection and microgrid

Transportation

- Reduce and replace fossil fuel use



NREL/PIX 14955

NREL NZEI Project Locations



NREL Campus – A NZEI Model

Onsite Renewable Generation

World Class, High-Efficiency Buildings



Research Support Facility



Science & Technology Facility



Solar Vehicle Charging Station



~1.95 MW
onsite PV



3 Megawatt-scale research turbines
270% of the site's power needs



Renewable Fuels Heating Plan
Offsets 4.8 MBtu Natural Gas Annually

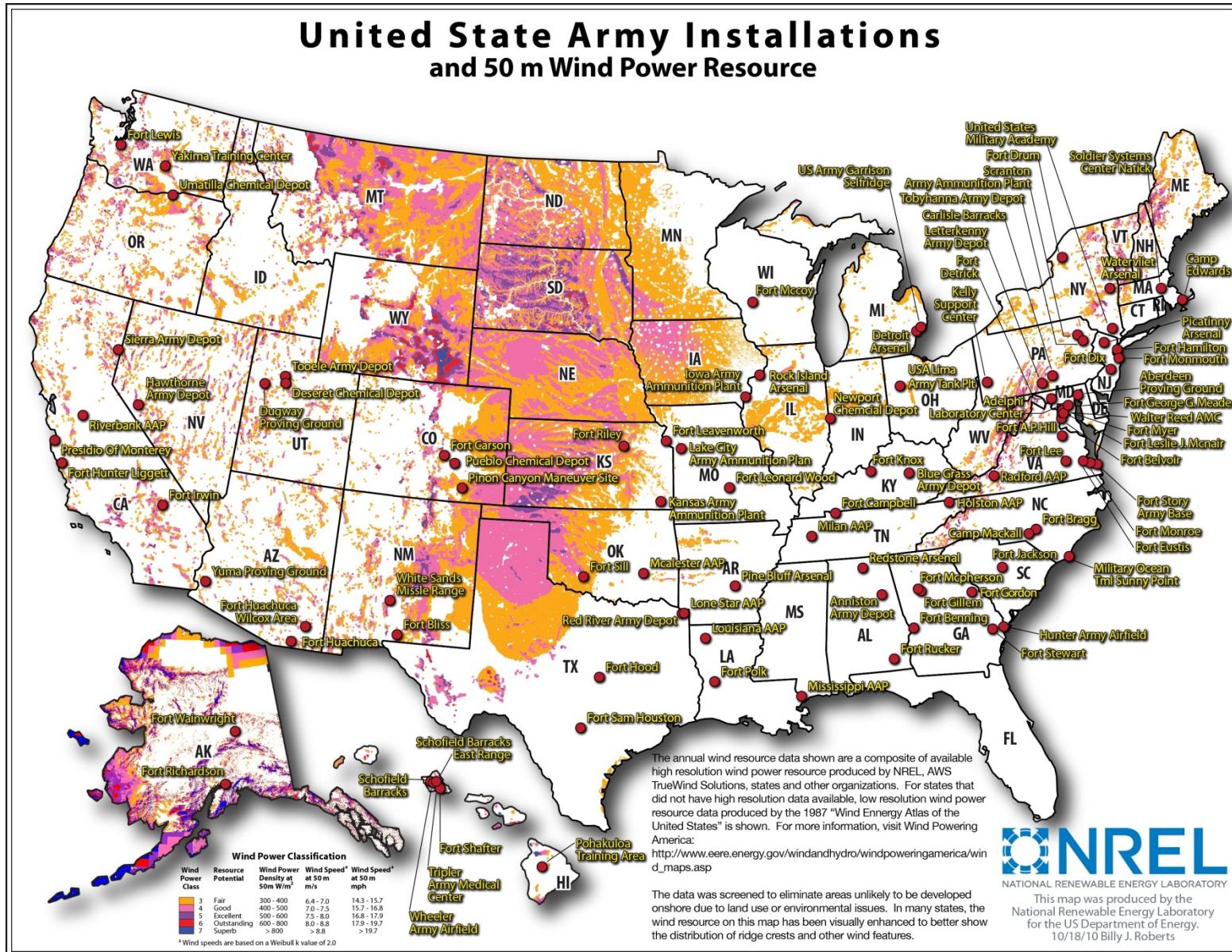
Army Net Zero Site Selection

- NREL support to develop program, application, and reviews
- 53 Installations applied for NZ
- Energy, water, and waste
- Opportunity to make a significant impact on energy use!
 - Army (\$4 B and 295 T BTU annually)
- Currently in the assessment phase

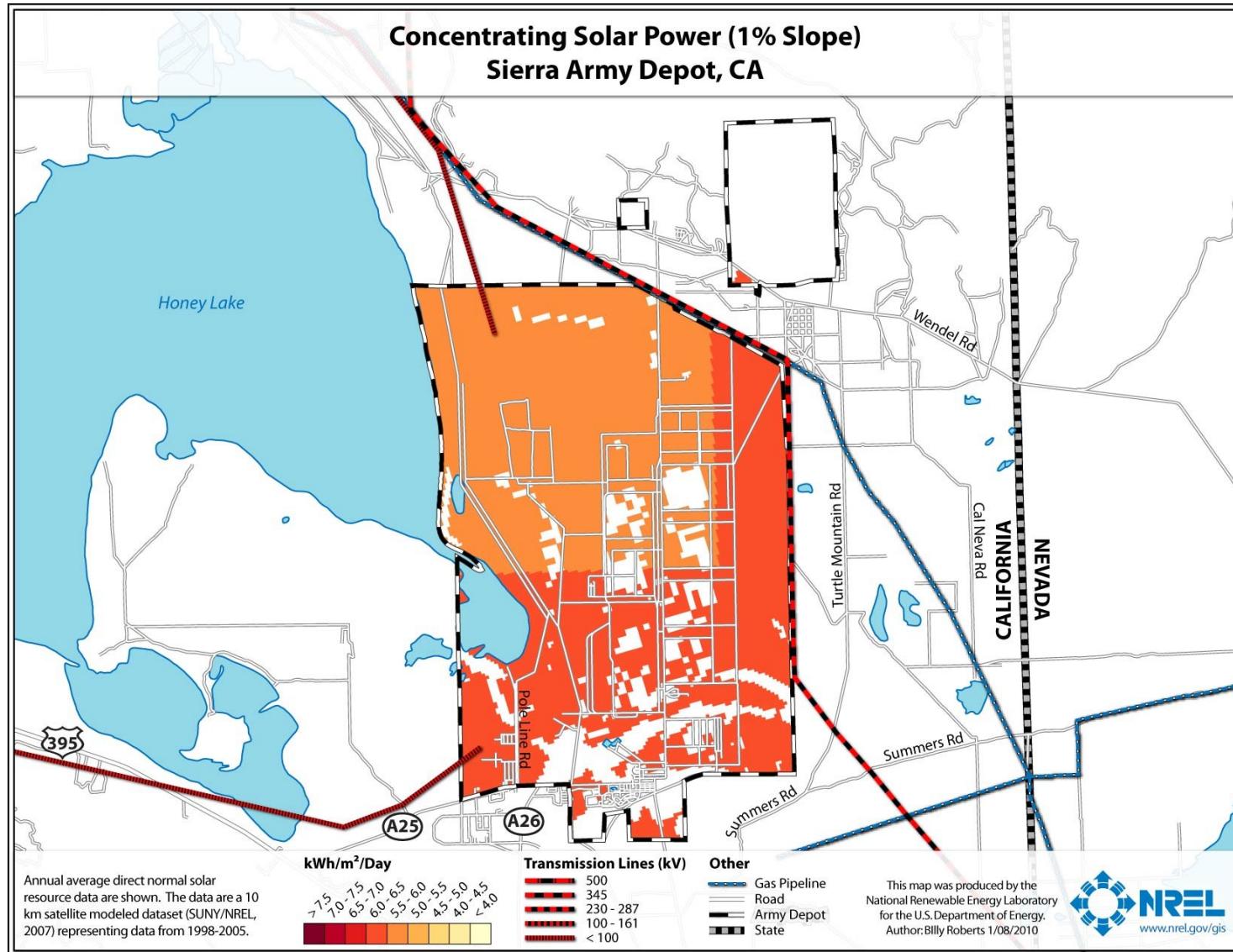


"Net Zero is a Force Multiplier"

Army Wind Resource

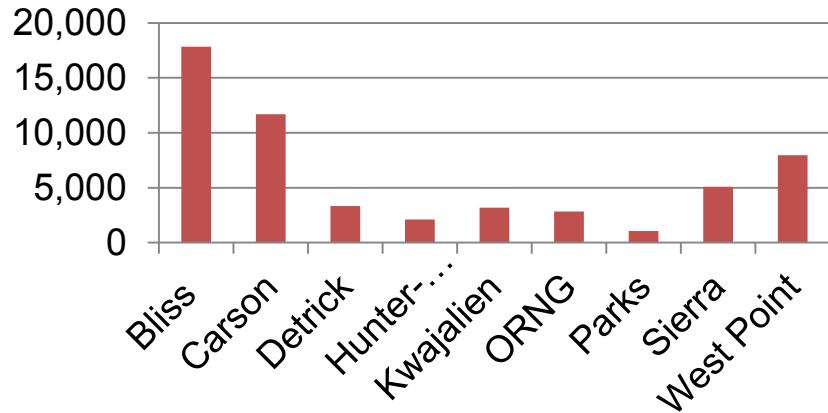


Example Results: Site-Specific Studies

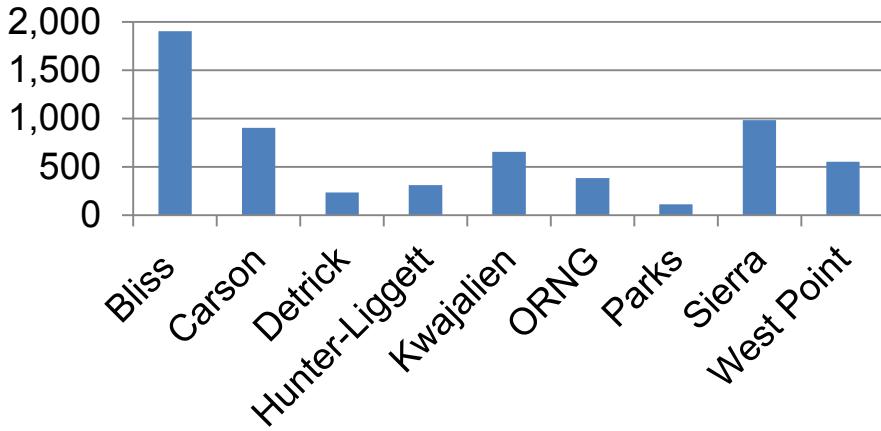


Real Property (One size doesn't fit all)

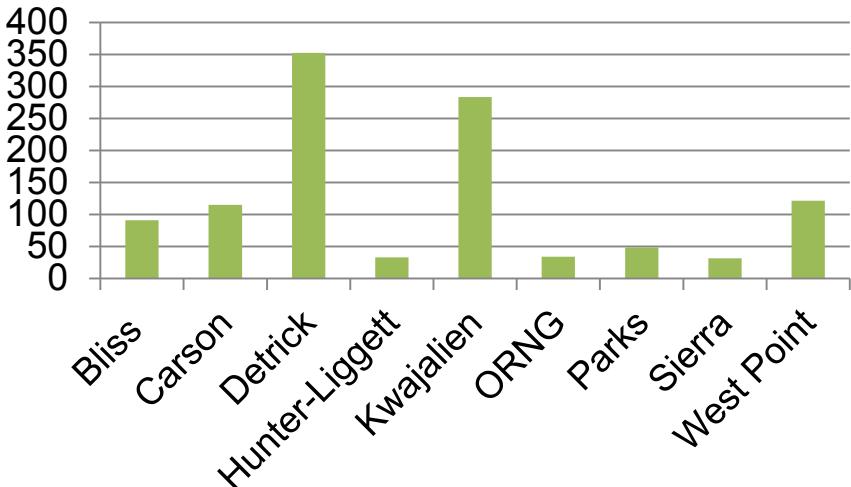
Square Feet



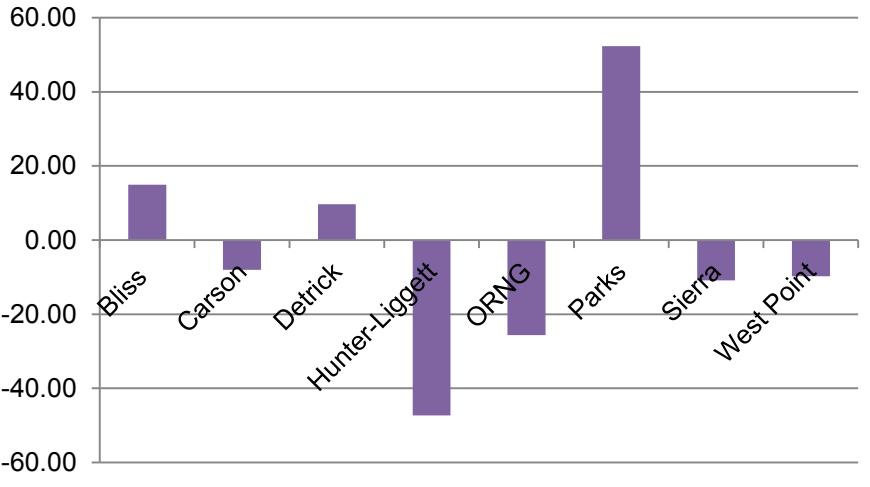
Of Buildings



EUI



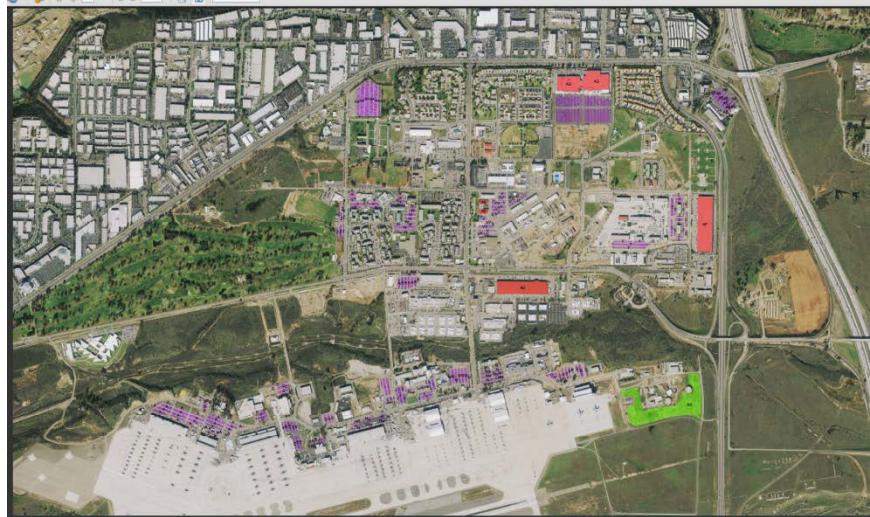
% Change EUI 2003/2010



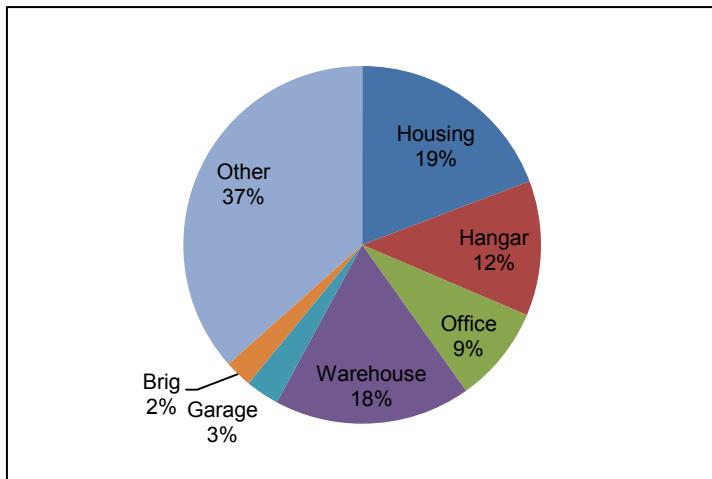
Sample Analysis From Miramar

Baseline Annual Energy Usage Information

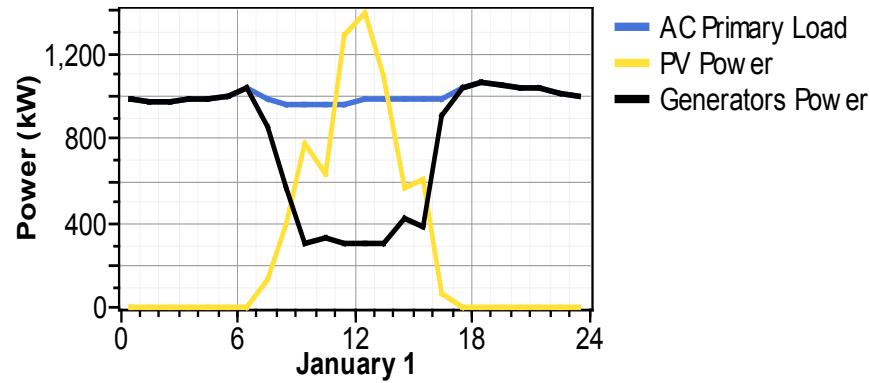
Electricity (kWh)	66,543,615
Natural Gas (therms)	1,316,149
Fuel (Gallons)	
<i>Gasoline</i>	89,500
<i>Diesel</i>	10,000
<i>Biodiesel</i>	31,000
<i>Comp. Natural Gas</i>	45,000



Building Portfolio Breakdown



Microgrid Operation with PV and Generators

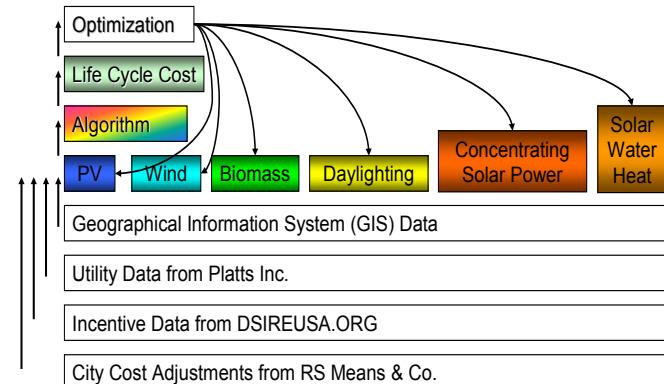


Renewable Energy

- **Process**
 - Start with screening tools
 - Conduct further analysis of promising technologies
 - Make recommendations
- **Data Needs**
 - Available buildings and land for siting of renewable energy projects
 - Site technology restrictions (e.g., not interested in biomass project due to truck security concerns)
- **Analysis tools**
 - GIS resource screening tools
 - Renewable Energy Optimization (REO), PV Watts, IMBY, RET Screen, Solar Analysis Model (SAM), etc.
- **Considerations**
 - Think outside the “standard tool” box → fuel cells, microturbines, solar pools, etc.

Renewable Energy Optimization (REO)

- REO finds the least-cost combination of renewable energy technologies to meet net zero goal



National Renewable Energy Laboratory

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Innovation for Our Energy Future



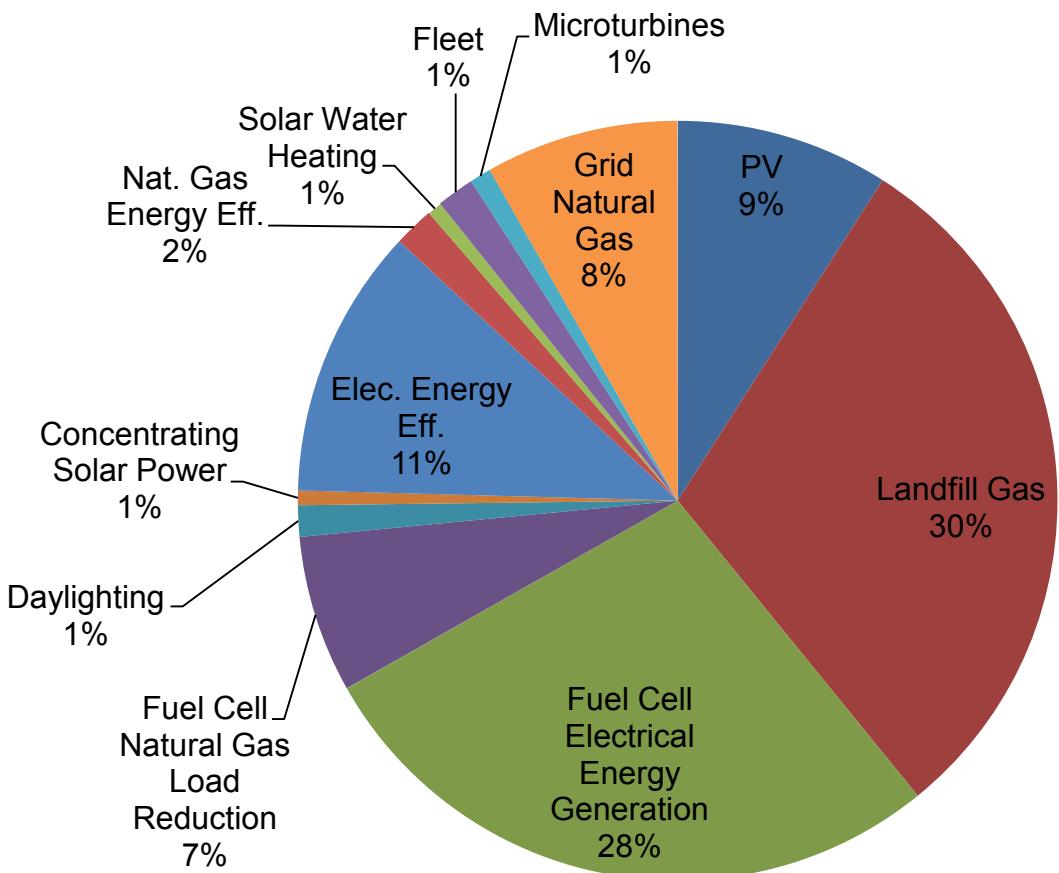
MCAS Miramar NZEI Summary

Results: 90% NZEI source Btu reduction

Implementation

- 20-year project lifetime analysis
- Capital costs ~\$60M
- \$26 million in savings
- NPV of \$6.7 million
- Landfill gas and fuel cell PPA's
- ESPC and appropriations for other projects

Final Source BTU Generation/Displacement/Reduction Mix by Energy System Type



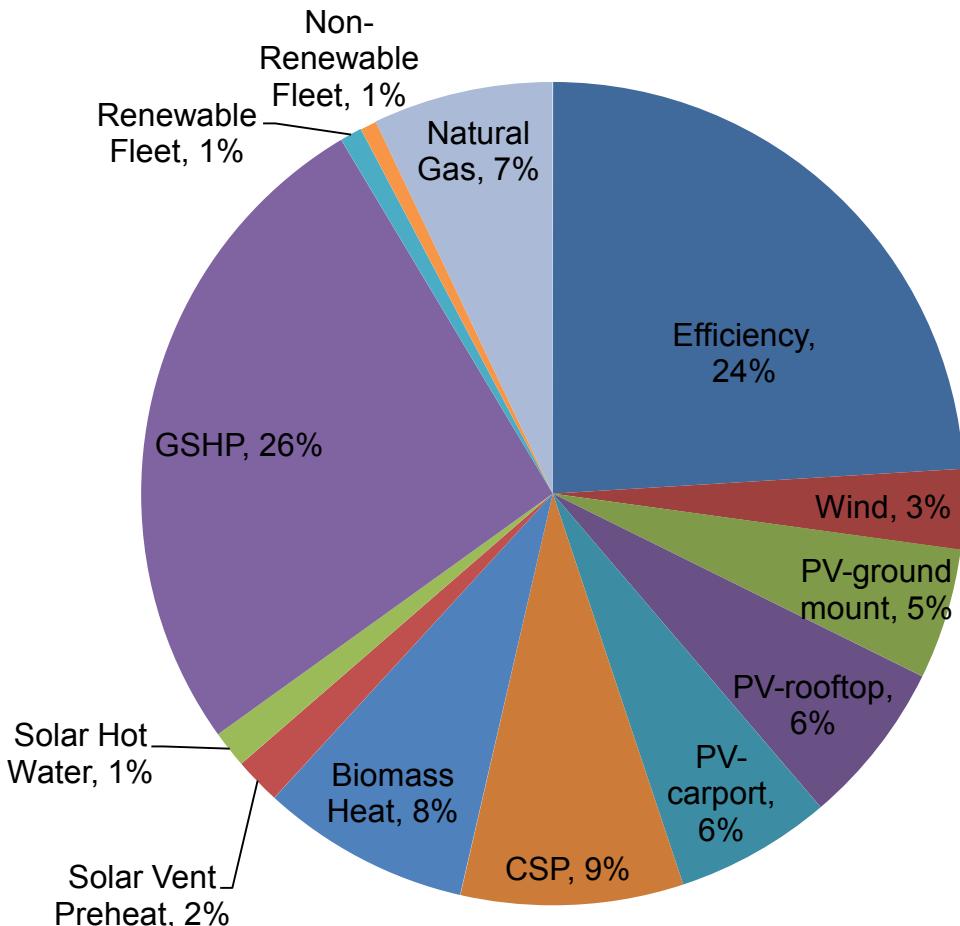
Fort Carson NZEI Summary

Results: 95% NZEI source Btu reduction

Implementation

- 35-year simple payback
- Cost: \$842 million
- NPV (40yr): \$96 million

Project Development Support Through Army NZEI Program



Project Implementation Planning

Site

- Where will the project be located
- Proximity to grid and thermal hosts



Resource

- Available land
- Years of life left at landfill

Off-take

- Who will buy the power and/or thermal energy
- Levelized costs

Permits

- Interconnection
- Emissions limits for criteria pollutants



Technology

- Technical performance goals (MWh per year, time of delivery, cost)
- Willingness to take technology risk

Team

- Who is the technology partner/developer

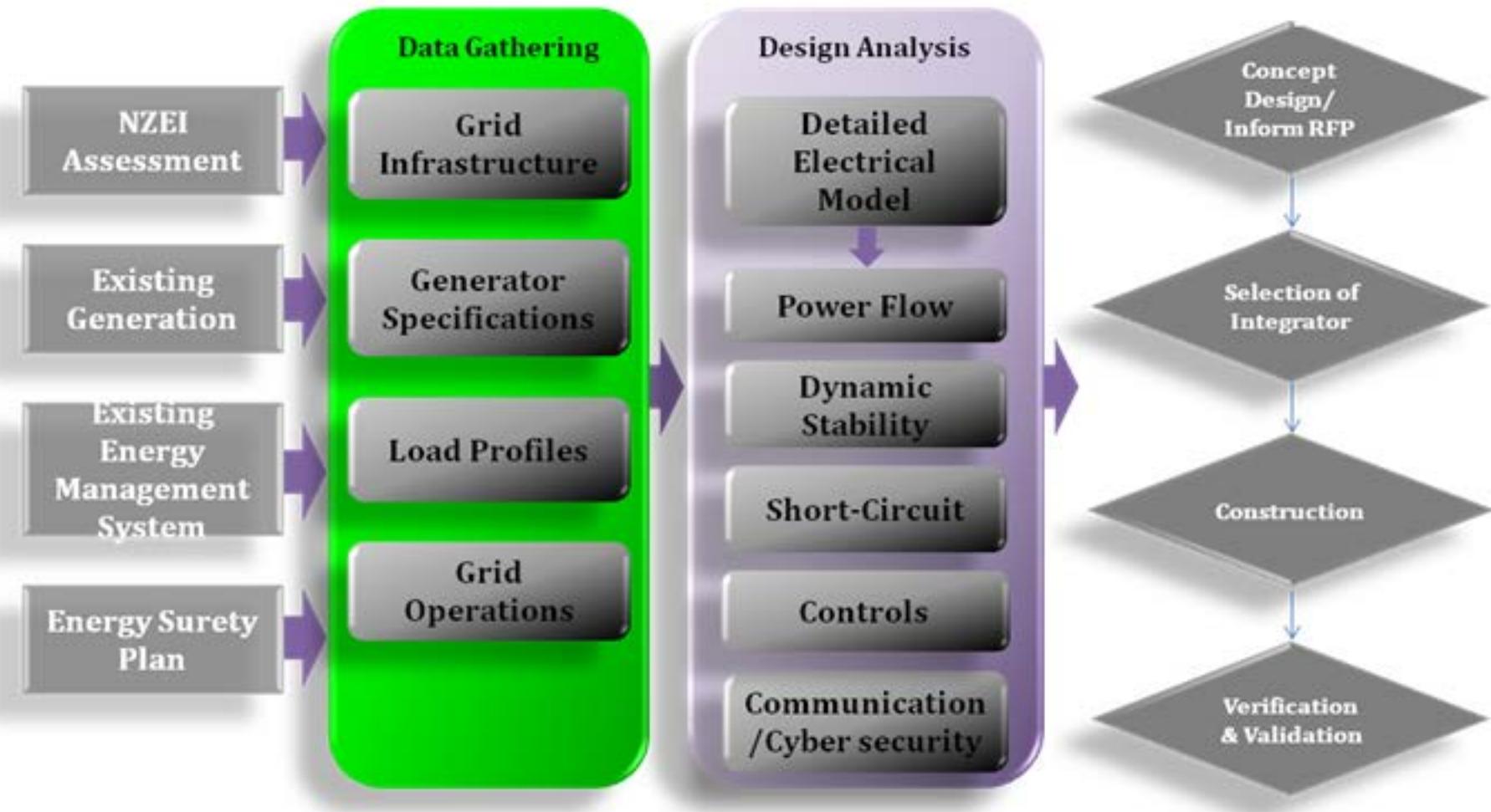
Capital

- Ownership structure

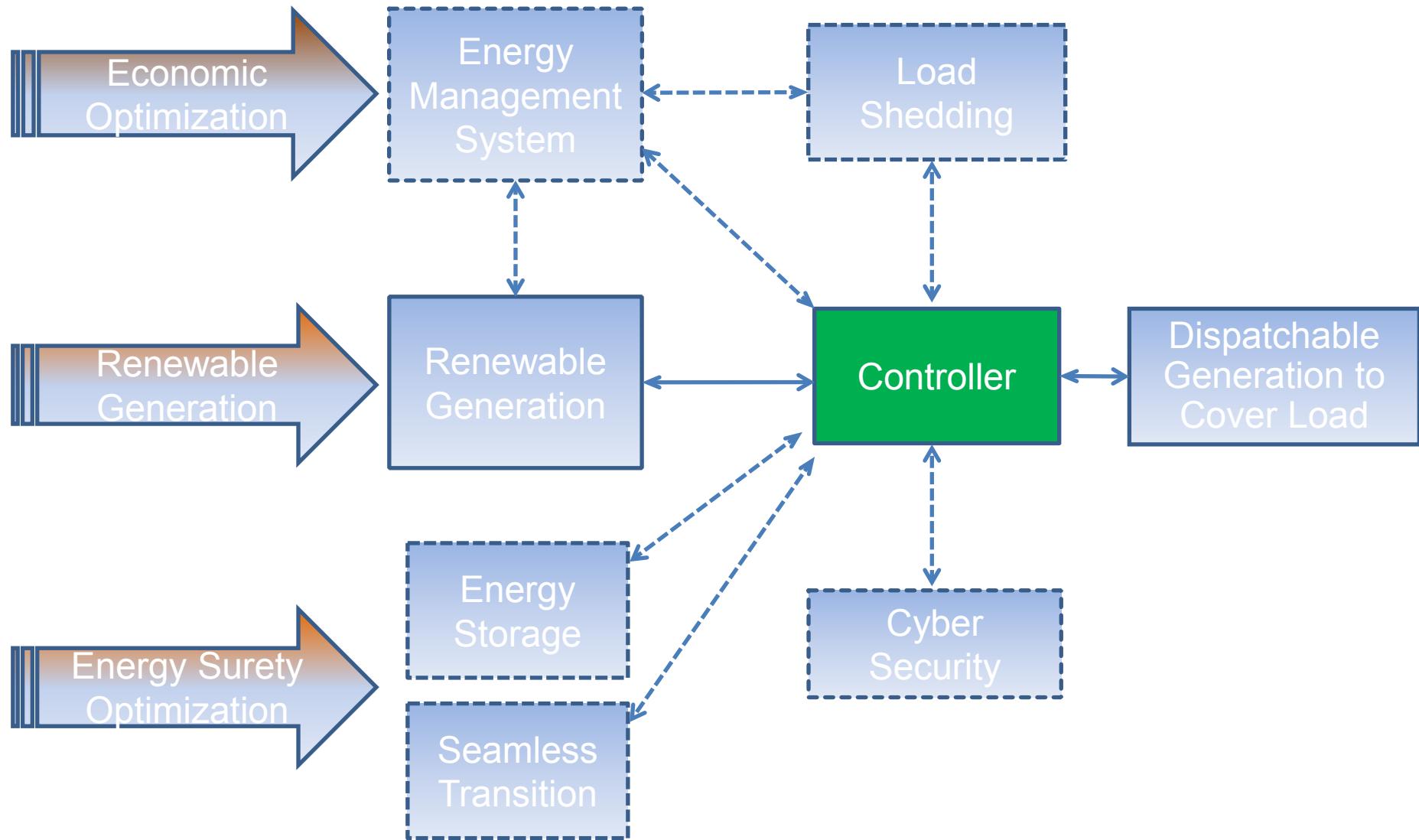


NREL's CORE Microgrid

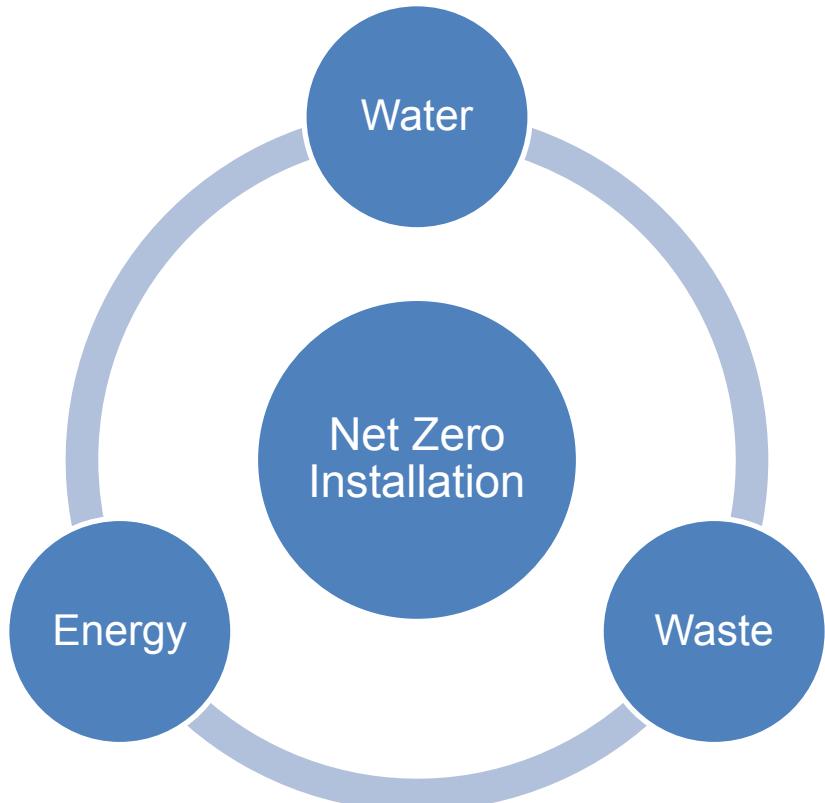
- Continually Optimized Reliable Energy (CORE) Design Process



Key Components of a CORE Microgrid



Complexities of Net Zero Water, Energy, and Waste



- Water, energy, and waste are interconnected in complicated ways
 - Energy requires water to produce
 - Water requires energy to treat and transport
 - Waste requires energy to transport and can be used to create energy

→ Accounting for this can be very difficult.

Thank You! - samuel.booth@nrel.gov - 303-275-4625

