NREL
NATIONAL RENEWABLE ENERGY LABORATORY

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

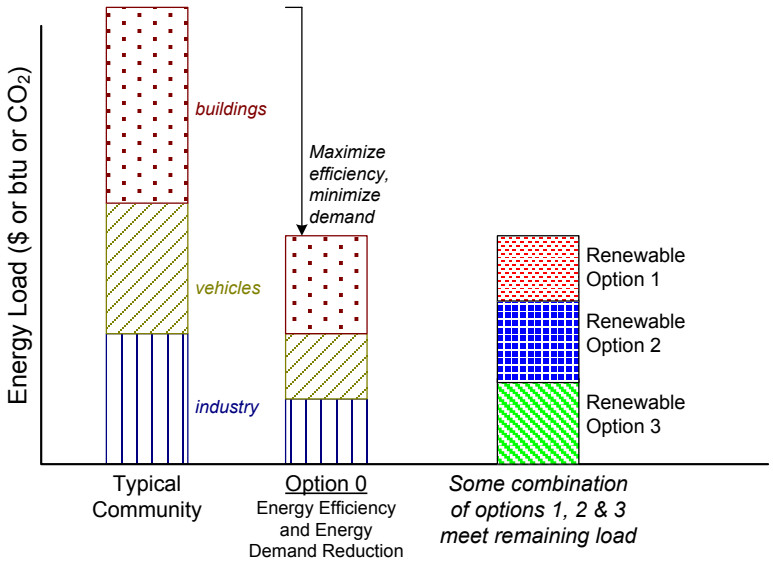
- Deployment of renewable energy

Electrical Systems

- Interconnection and microgrid

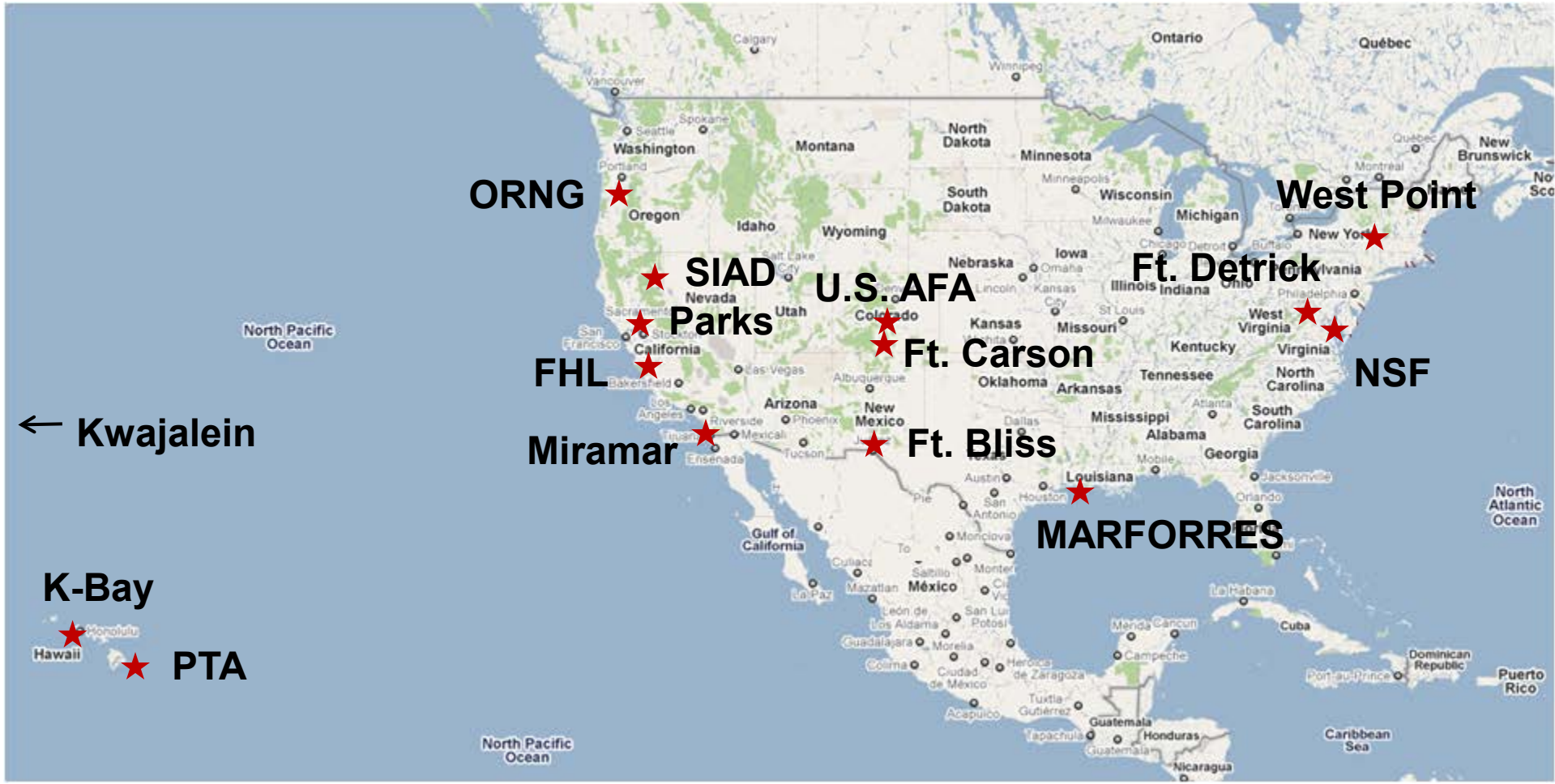
Transportation

- Reduce and replace fossil fuel use



NREL/PIX 14955

NREL NZEI Project Locations



NREL Campus – A NZEI Model

World Class, High-Efficiency Buildings

Research Support Facility

Science & Technology Facility

Onsite Renewable Generation

Solar Vehicle Charging Station

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

~1.95 MW onsite PV

720 KW Mesa Top Array

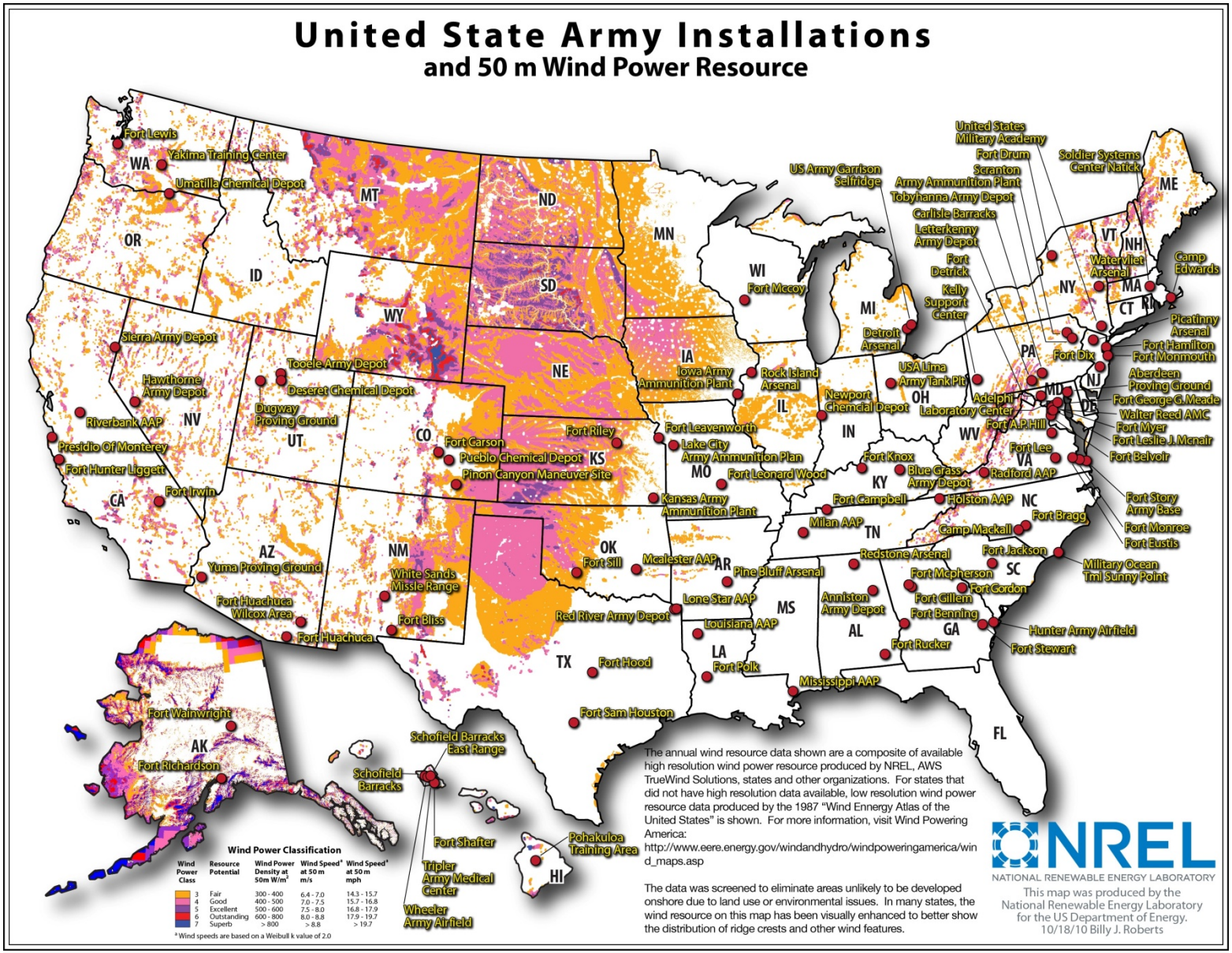
Renewable Fuels Heating Plan
Offsets 4.8 MBtu Natural Gas Annually

Army Net Zero Site Selection

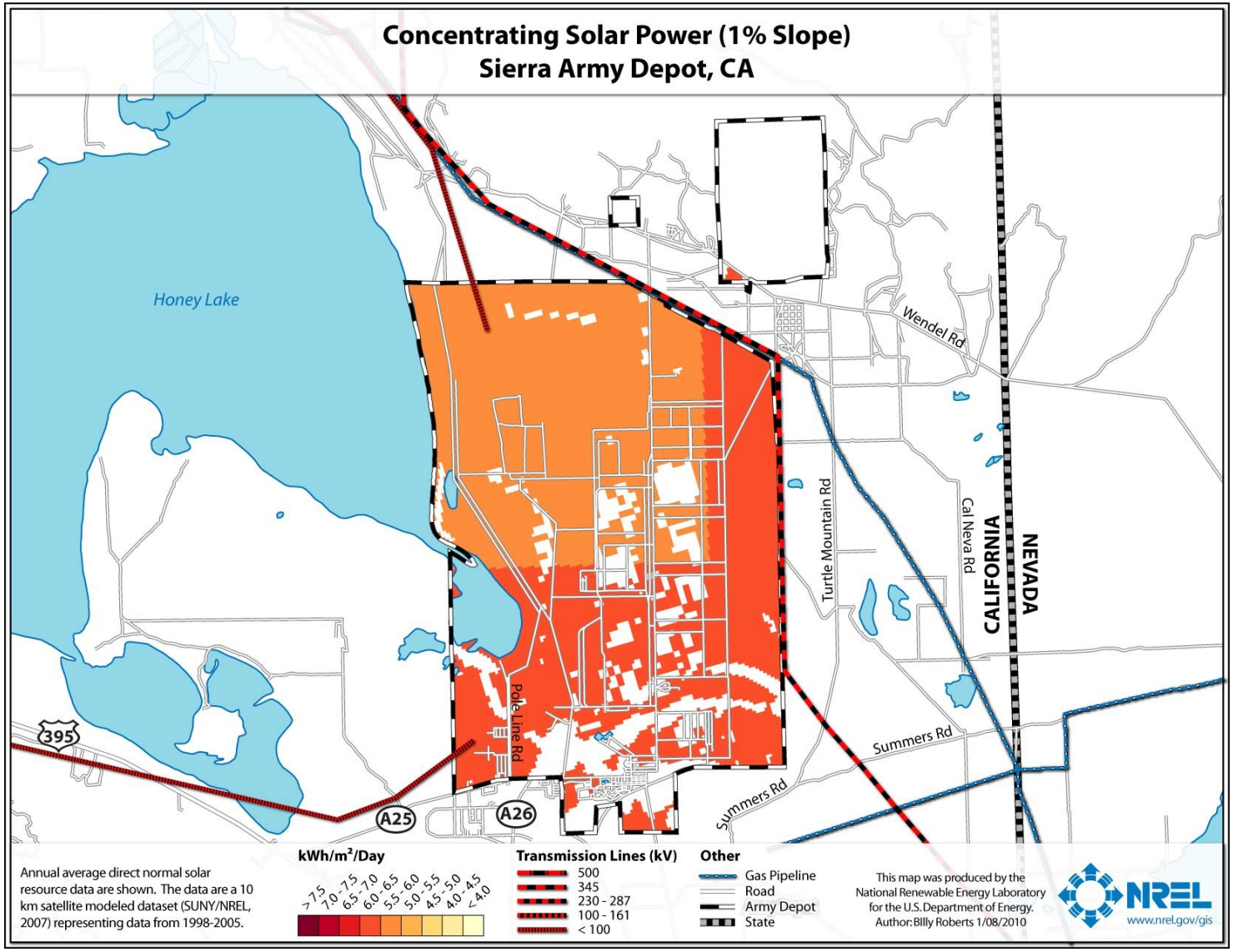
- NREL support to develop program, application, and reviews
- 53 Installations applied for NZ
- Energy, water, and waste
- Opportunity to make a significant impact on energy use!
  - Army ($4 B and 295 T BTU annually)
- Currently in the assessment phase

"Net Zero is a Force Multiplier"

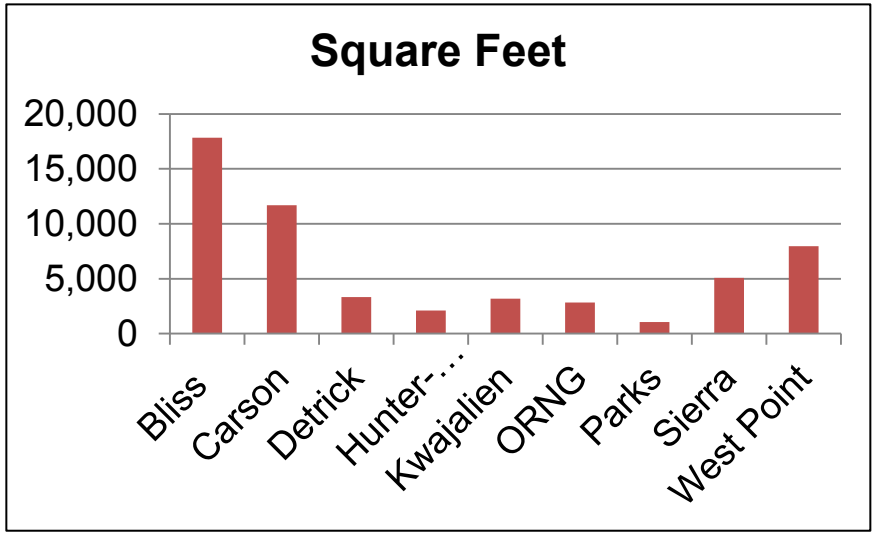
Army Wind Resource

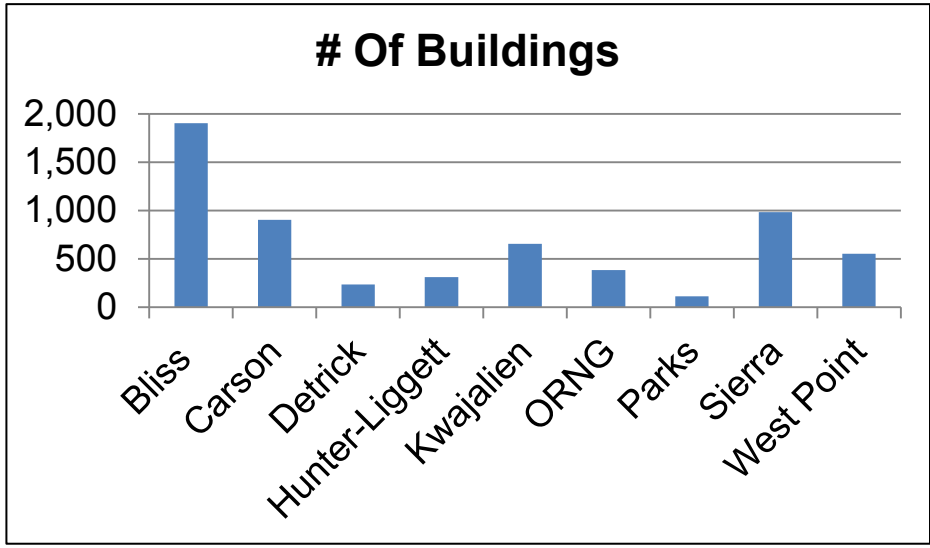


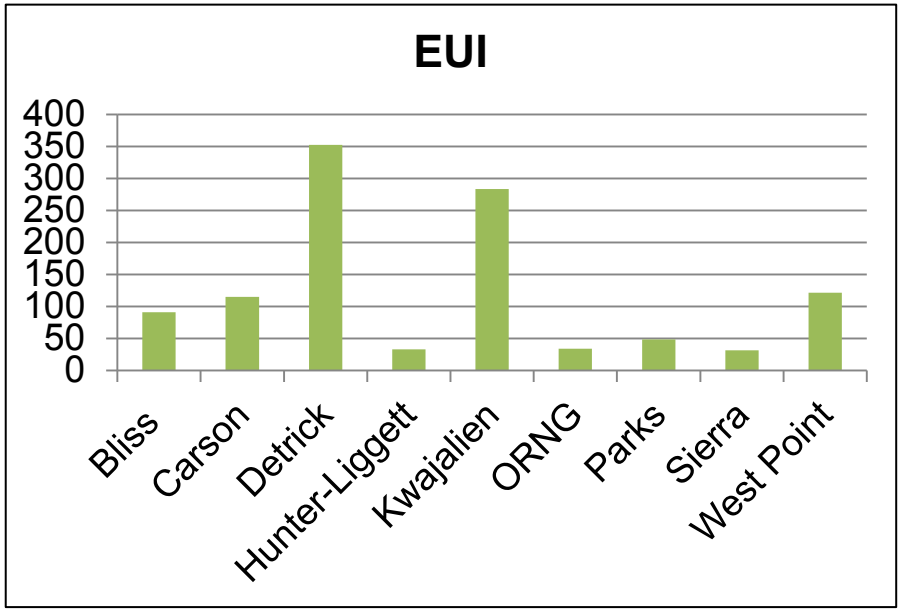
Example Results: Site-Specific Studies

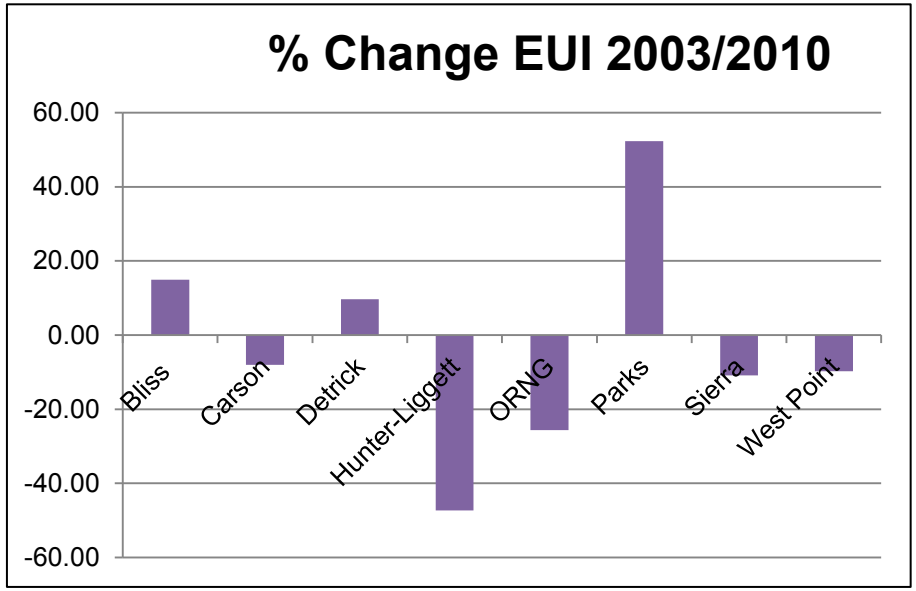


Real Property (One size doesn't fit all)





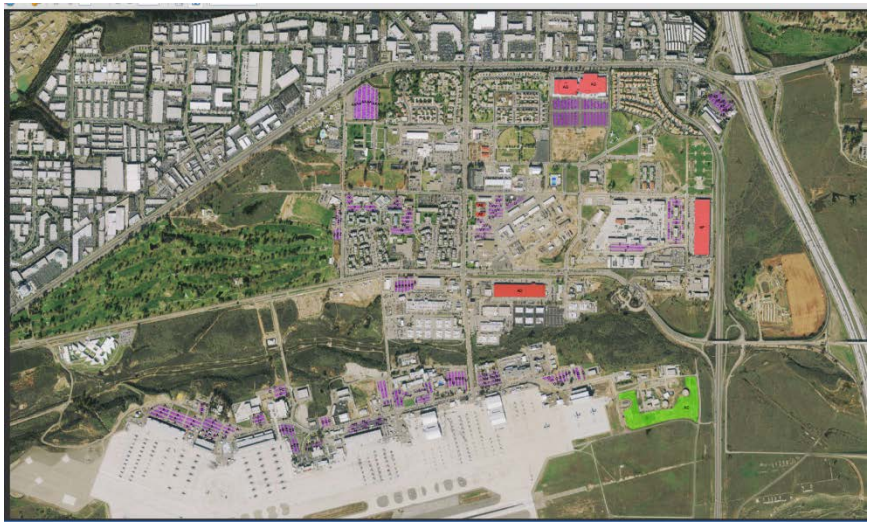




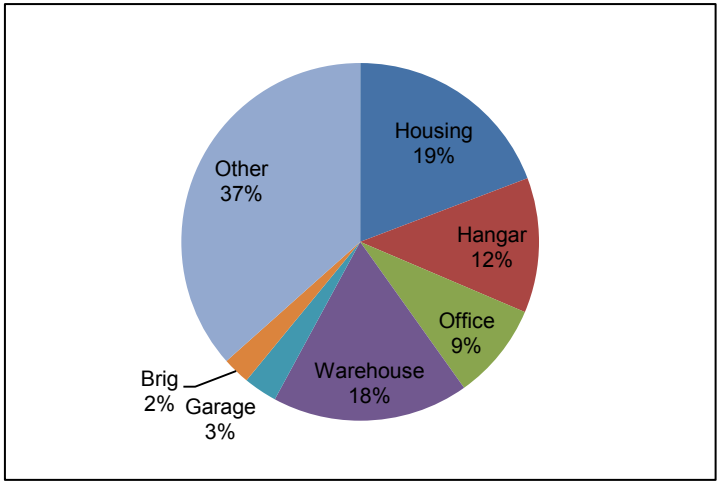
Note: Kwajalien % change is 517%

Sample Analysis From Miramar

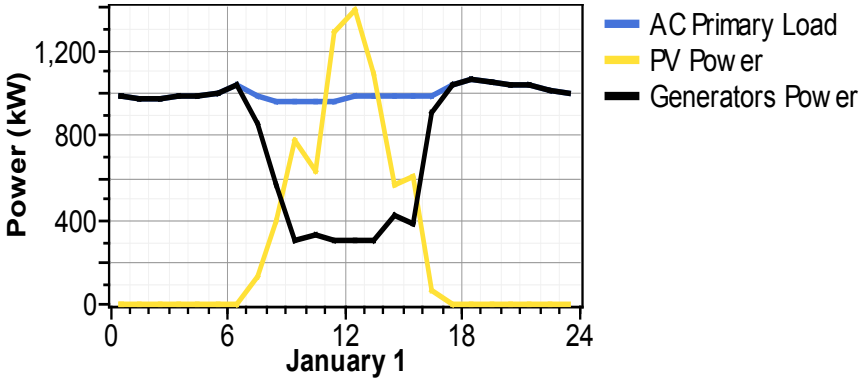
Baseline Annual Energy Usage Information	
Electricity (kWh)	66,543,615
Natural Gas (therms)	1,316,149
Fuel (Gallons)	
Gasoline	89,500
Diesel	10,000
Biodiesel	31,000
Comp. Natural Gas	45,000



Building Portfolio Breakdown

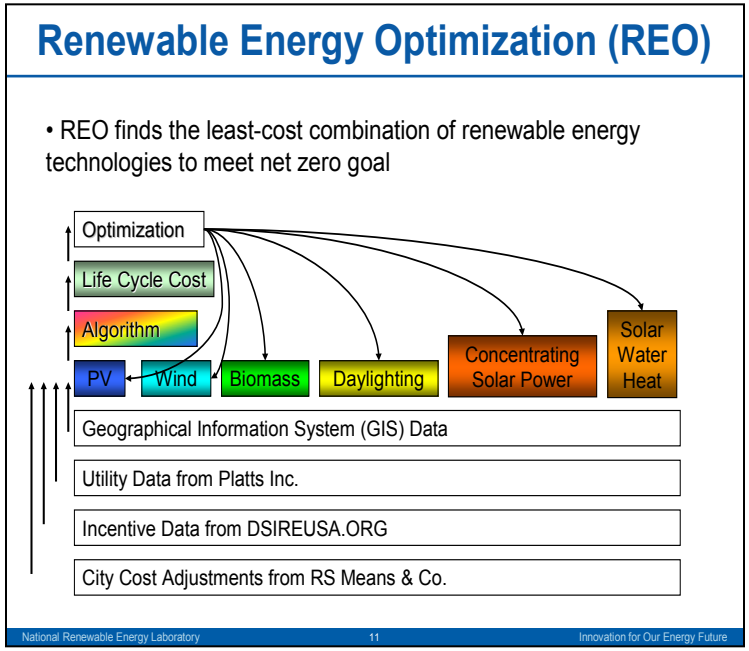


Microgrid Operation with PV and Generators



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.



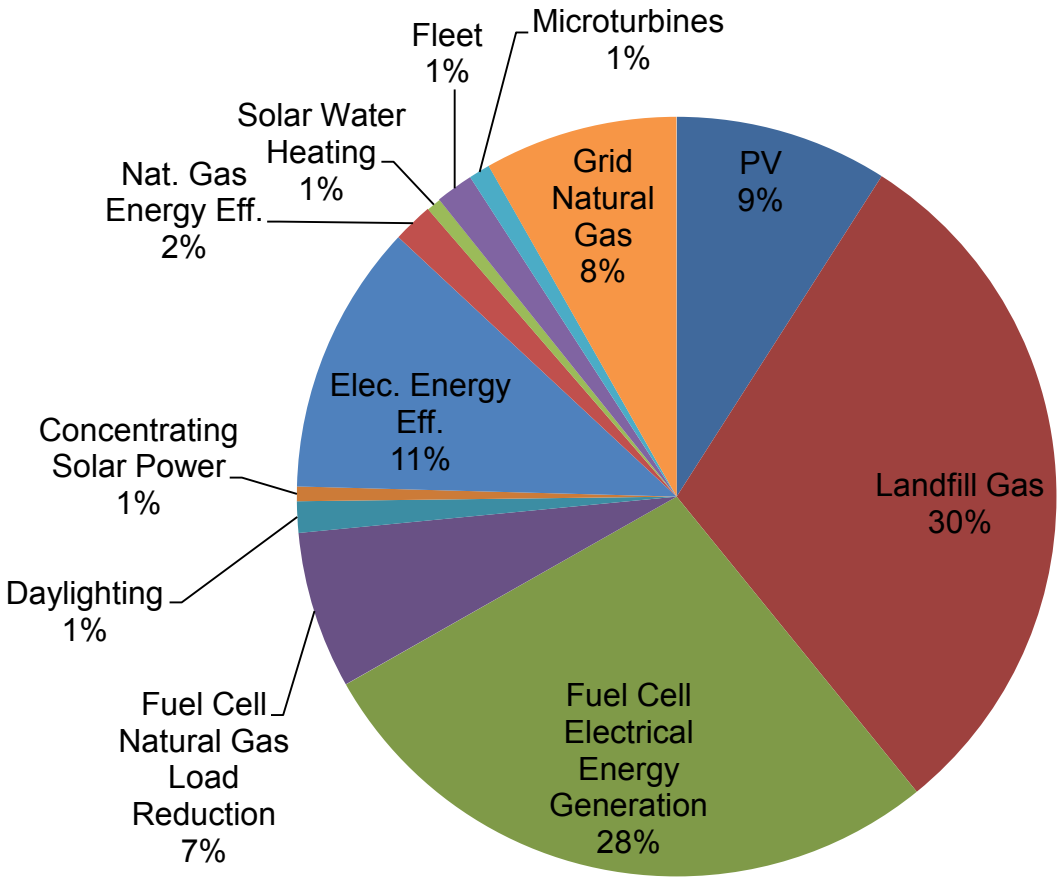
MCAS Miramar NZEI Summary

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



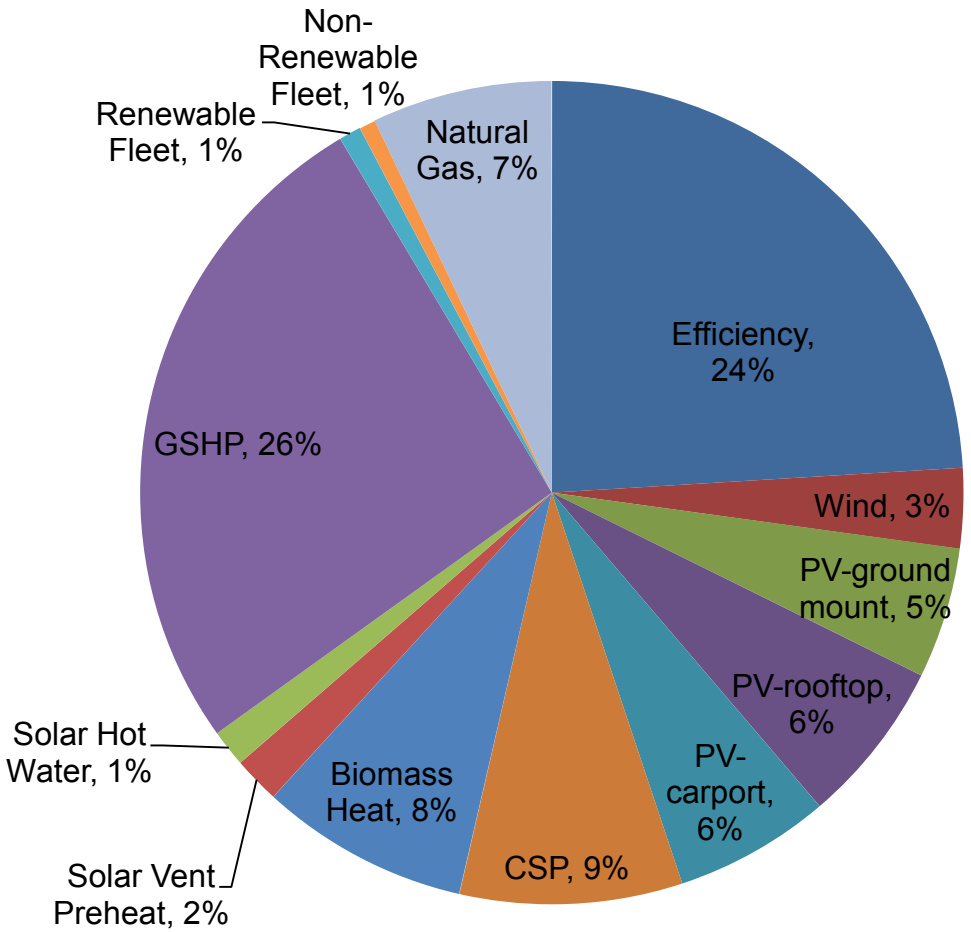
Fort Carson NZEI Summary

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

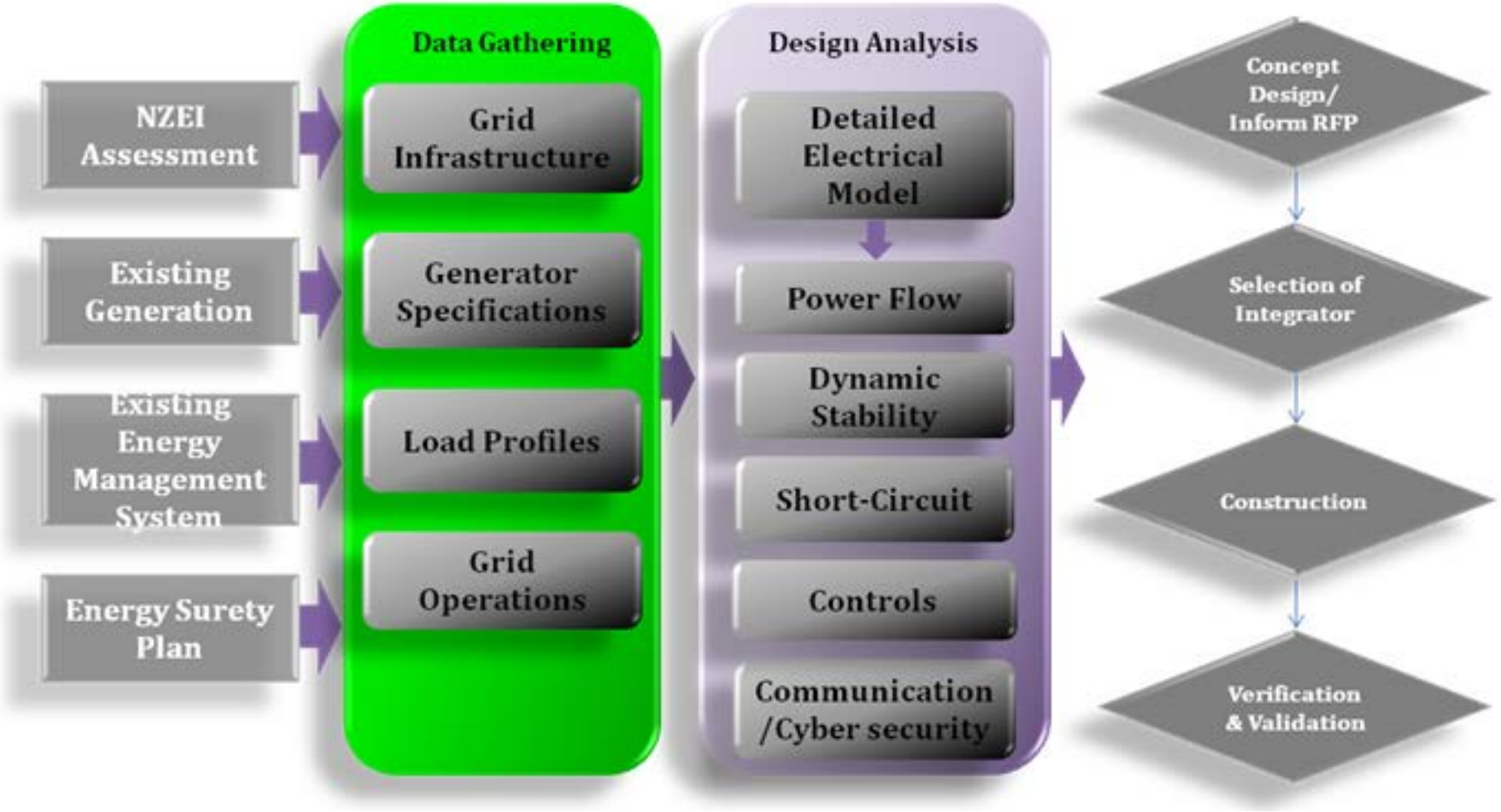
Technology
- Technical performance goals (MWh per year, time of delivery, cost)
- Willingness to take technology risk

Team
- Who is the technology partner/developer

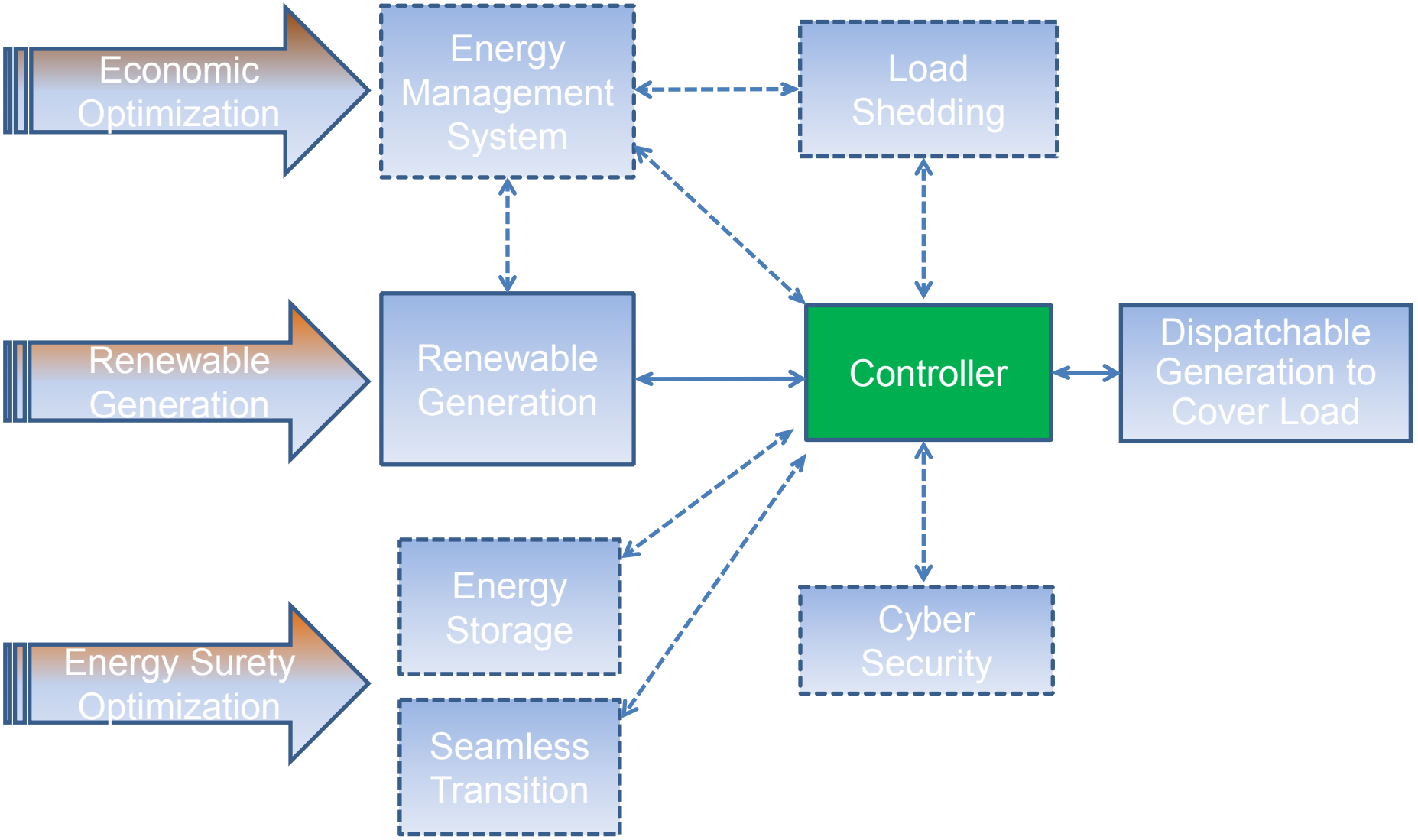
Capital
- Ownership structure

NREL's CORE Microgrid

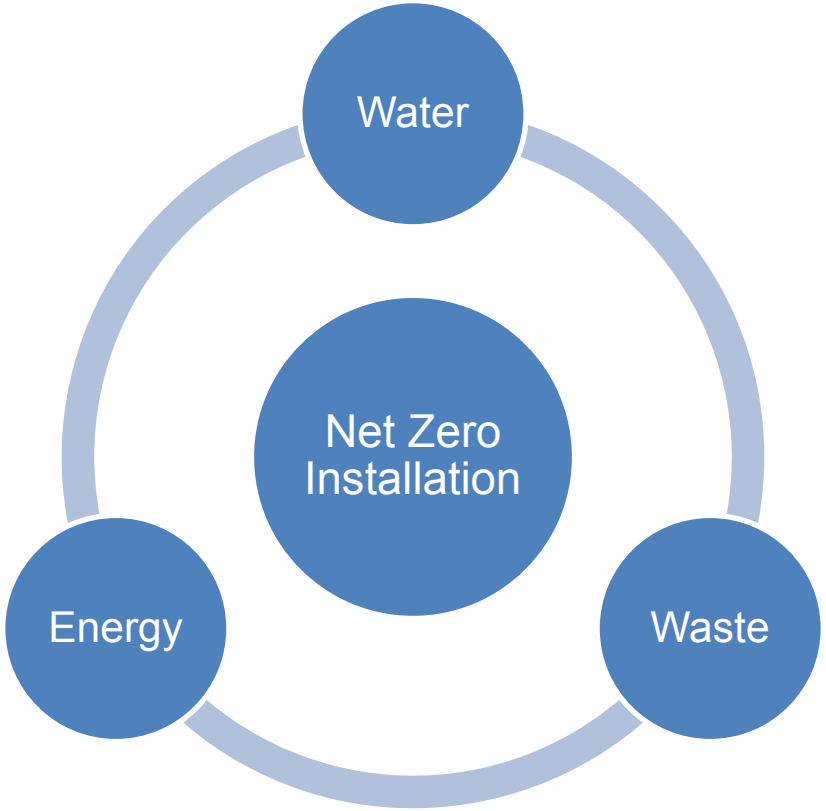
- Continually Optimized Reliable Energy (CORE) Design Process



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