



Net Zero Building Commissioning

Jarrell Wenger, PE, LEED AP BD+C
Engineering Economics, Inc.

jarrell.wenger@eeiengineers.com

Commissioning (Cx)

- ASHRAE:
 - Quality-oriented process for achieving, evaluating, and documenting that performance of buildings, systems, and assemblies meets defined objectives and criteria
 - Cx Authority (CxA) is an independent and objective advocate for the owner
- CxA's role: make sure it works right for the owner
- Cx is essential for complex and high performance buildings
- From design, through construction, acceptance and warranty
- Identify issues as early as possible; track to resolution

Natural Energy Laboratory of Hawaii Gateway Energy Center

- Kailua-Kona, Hawaii
- Visitor Center
- 3,600 square feet
- Solar driven natural ventilation
- Daylighting
- Deep seawater cooling system
- Deep seawater irrigation system
- 20 kW photovoltaic array
- Design, bid, build; completed 2004
- LEED Platinum



National Renewable Energy Laboratory Site Entrance Building

- Golden, Colorado
- Campus security entrance
- 1,500 square feet
- Ground source heat pumps
- Radiant heating and cooling
- Energy recovery ventilation
- Wind catch tower for natural ventilation
- Design-build; completed 2012
- LEED Platinum



National Renewable Energy Laboratory Parking Structure

- Golden, Colorado
- Parking structure
- 550,000 square feet on 5 levels
- Extensive lighting control system
- Parking information system
- Entrance/exit on multiple levels
- Electric vehicle charging stations
- 1.1 MW photovoltaic array
- Design-build; completed 2012
- LEED Platinum



National Renewable Energy Laboratory Research Support Facility

- Golden, Colorado 25 kBTU/SF performance criteria before renewables
- Office building 360,000 square feet \$254/SF
- Chilled and hot water Evaporative cooling Radiant heating and cooling
- Underfloor air distribution
- Data center heat recovery
- Exhaust air heat recovery
- Labyrinth to precondition ventilation air
- Transpired solar collector
- Heat pump domestic water heating
- Rooftop PV array + parking structure
- Design-build; completed 2011
- LEED Platinum



Observations and Lessons

- Define criteria for high performance – before renewables
- “Exotic” systems have become mainstream
- Heating and cooling energy recovery
- Avoid brute force – leverage local environment
 - Orientation, geometry and shading
 - Local heat sources and sinks
- Systems may be complex and unique
- Cx strategies may be complex and unique
- Utilize CxA's experience and expertise
- Allow time for fine-tuning
- NZ requires commitment, creativity and collaboration

