

Energy-Water Nexus and Site Resilience



Energy-Water Opportunities Improve Operational Resiliency

Alicen Kandt

National Renewable Energy Laboratory (NREL)

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Microgrids

- What is a microgrid?
 - A microgrid is a local energy grid with control capability, which means it can disconnect from the traditional grid and operate autonomously.¹
- Energy-water microgrids incorporate the design and operation of energy and water systems in a coordinated framework.
 - Provide an abundance of benefits in the context of resiliency.

1. <https://energy.gov/articles/how-microgrids-work>

Energy-water microgrids

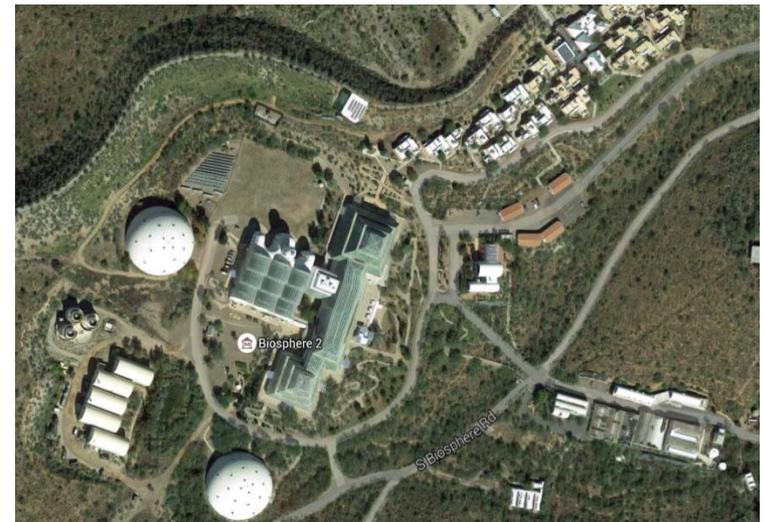
- How can energy-water microgrids be designed, operated, and deployed in a variety of different locations to improve the resilience and efficiencies of food, energy, and water infrastructure?
- What are the opportunities and limitations to microgrid adaptation in response to food, energy, and water resource uncertainty at multiple time-scales?
- What is the value of adding resilience to our energy-water systems?

Energy-water opportunities

- Traditional water reduction opportunities
 - Reducing irrigation water use, identifying leaks, decreasing domestic water use
- Investigate largest water consumers and consider critical loads and applications
 - Cooling towers
 - Irrigation
 - Fire suppression
 - Data centers
 - Water pumping
- What happens to these loads and to operations if the electrical grid goes down? Or if water supply isn't available?
- Consider water supply and potential for adding redundancy and increasing reliability.

Biosphere 2 example

- 3.14 acre Biosphere on 40 acre site
- 7 model ecosystems
- Active research facility
- Commercial, residential, industrial components
- Energy:
 - Grid-connected (4 feeds)
 - Reliability concerns
 - Occupant comfort, biome temperatures and humidity, and research activities drive energy usage
- Water:
 - Groundwater supplied (currently)
 - No cost for water
 - Numerous water storage tanks
 - On-site wastewater treatment system augmented by septic system
- Energy-water interdependencies



Energy and water system interactions

Water requirements for energy

- Cooling towers represent largest water consuming energy system at B2

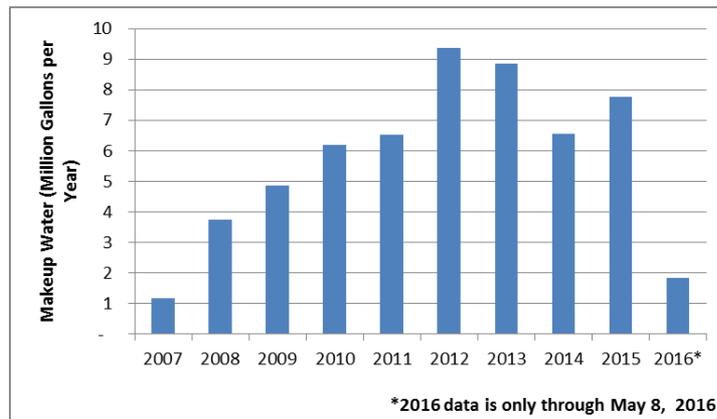


Energy requirements for water

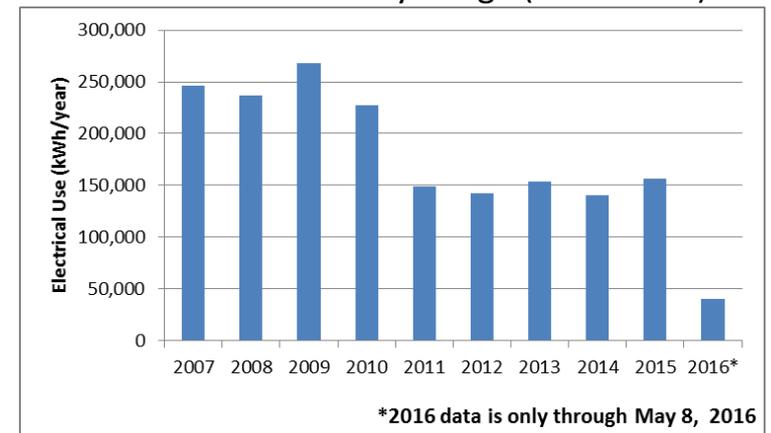
- Pumping from wells
- Ocean infrastructure (heating and movement)
- Biome requirements (raining)
- Water treatment
- Water heating
- Chillers



Annual Cooling Tower Makeup Water (2007-2016)



Annual Well Electricity Usage (2007-2016)



Potential opportunities

- Traditional energy efficiency and water efficiency opportunities
- Shifting water pumping to night time
- Adding pumped hydro to water storage system
- Adding RE systems to help with electrical reliability issues
- Adding RE and batteries at pumps
- Investigate co-location of PV and agriculture

Open Questions and Discussion

Laura Montoya, OSD

laura.i.montoya.civ@mail.mil

(571) 372-6846

Andrew Baughman, Navy

andrew.baughman@navy.mil

(619) 532-1461

Marc Kodack, Army

marc.d.kodack.civ@mail.mil

(571) 256-4197

Alicen Kandt, NREL

alicen.kandt@nrel.gov

(303) 384-7518