



Ishkonige Nawadide Bad River Microgrids

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Bad River Band of Lake Superior Tribe of Chippewa Indians



- Located on a 125,000+ acre reservation in Northern Wisconsin on the south shore of Lake Superior
- Territory ceded by the tribe to the U.S. government includes the upper one third of what is now the State of Wisconsin.
- Has over 7,000 members, the majority living off the reservation, about 2,000 live on/near the reservation.



Ishkonige Nawadide Project Summary



- Focused on resiliency after the 2016 Flood and while experiencing electrical outages at crucial facilities, such as the Health & Wellness Center, the Tribe's community Clinic.
 - Post flood the Tribe developed an Emergency Response Plan identifying critical infrastructure and mitigation measures addressing future emergencies.
- The Bad River Tribe was awarded a USDOE Grant in 2019 for the Project.
 - Over 2.2 Million Dollar Project
 - 1.8 Million USDOE Contribution
- Tribe installed over 500 kW of solar with over 1000 kWh of battery storage at three tribal facilities located in the Odanah Community:
 - The Chief Blackbird Administration Building
 - Wastewater Treatment Plant (WWTP)
 - Health & Wellness Center (H&WC)



Timeline of Project

- 2018: Techno-economic feasibility study performed by muGrid Analytics
- 2019: Application for DOE Tribal Energy Grant
- Oct 2020: Grant awarded
- Feb 2020: RFP posted
- May 2020: Contractor selected
- September 2020: Construction started
- May 2021: Systems commissioned





Resilience is...

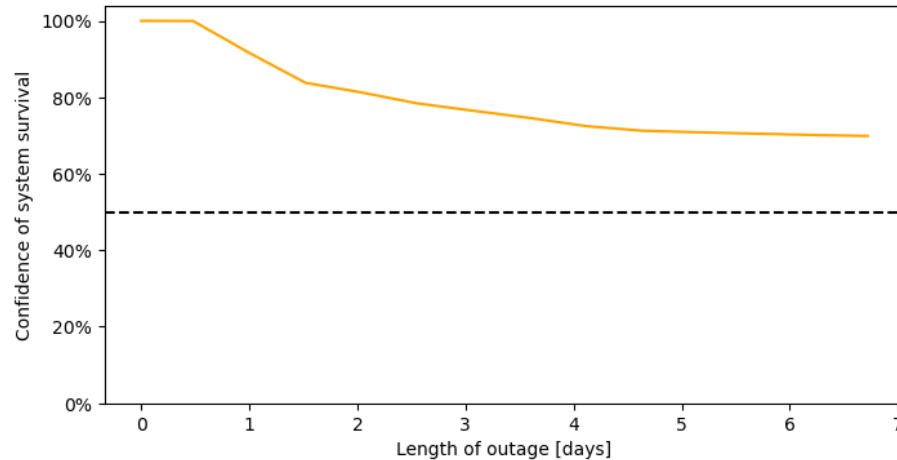
- a top priority for the Bad River Tribe
- a powerful differentiator in the grant process

- hard to define
- hard to value

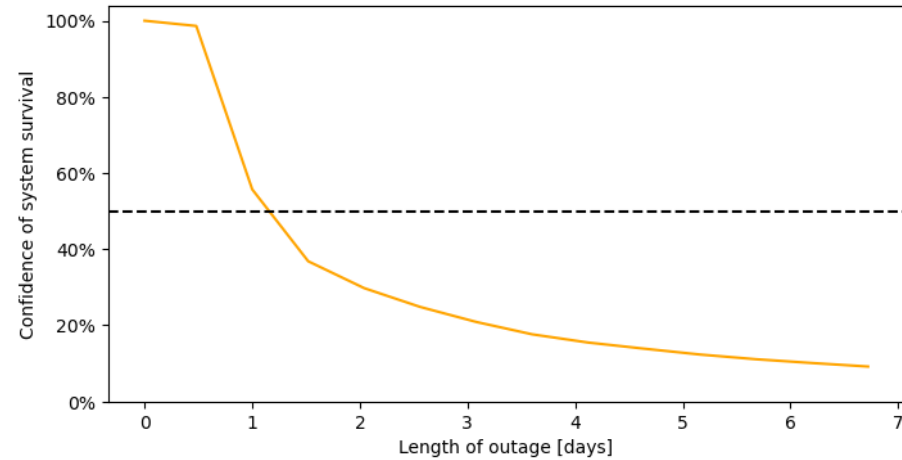


Stochastic Resilience

- Resilience duration is defined as the amount of time the system can support the building before failing
- Resilience performance is dependent on time of day, seasonality, load conditions at the building, etc. and therefore duration varies
- The following evaluations are for solar plus storage only; resilience may be supplemented by fuel-based generation



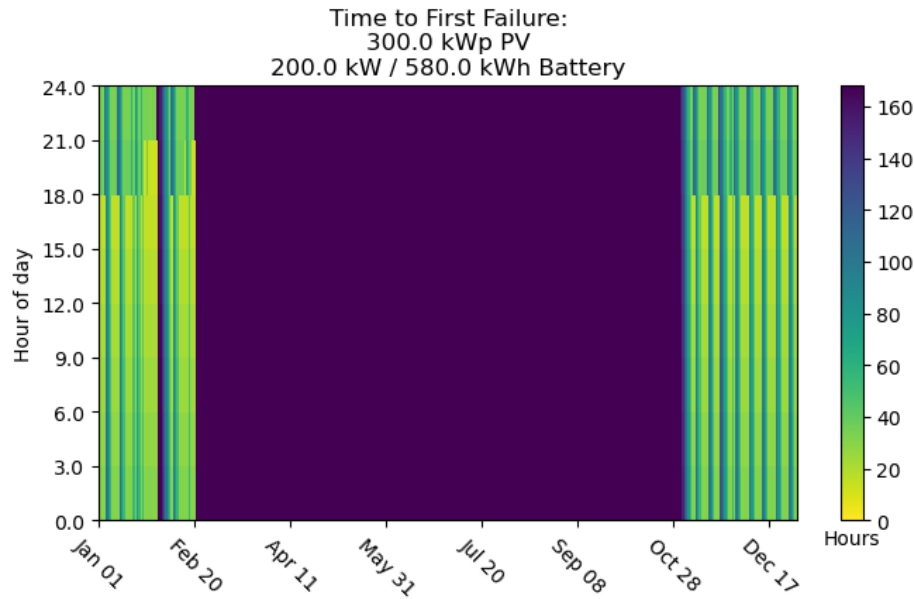
HWC



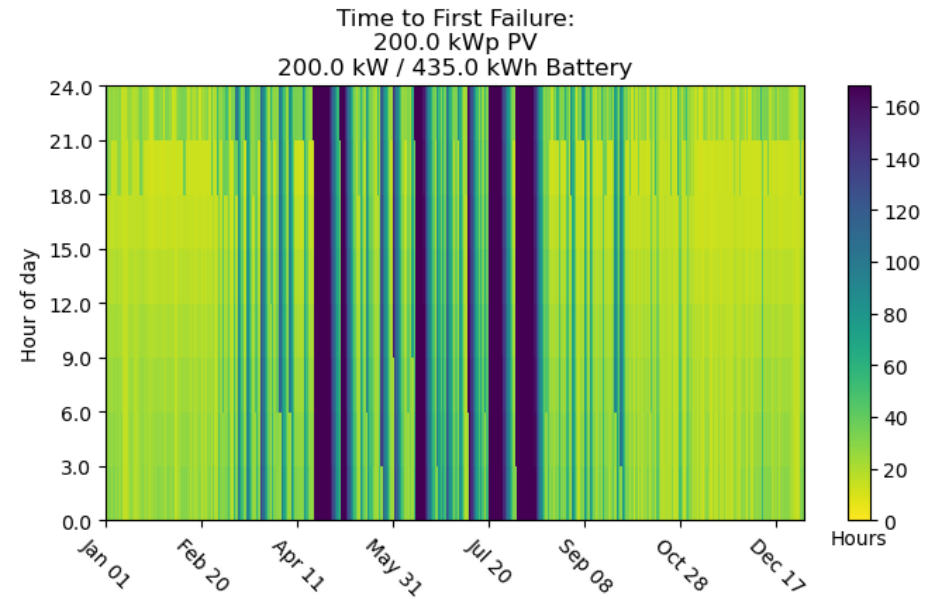
WWTP



Resilience Seasonality



Health Clinic



Waste Water Treatment Plant

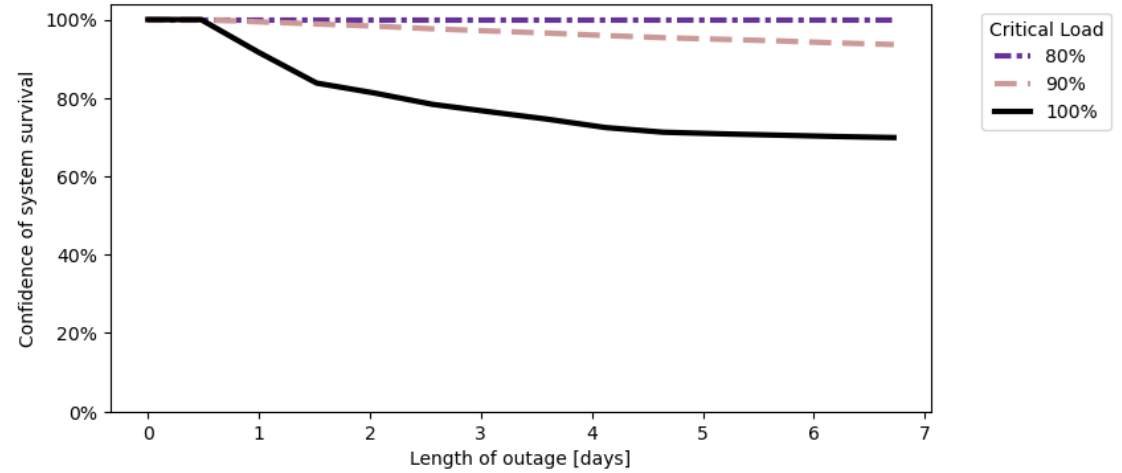
- At the health clinic, solar production creates sufficient generation to provide near indefinite resilience from March to November. During winter months, resilience may be supplemented by fuel-based generation
- At the waste-water treatment plant, due to flatter load, resilience durations provided by solar plus storage alone cover most nominal grid outages, while fuel-based generation supplements for longer durations.



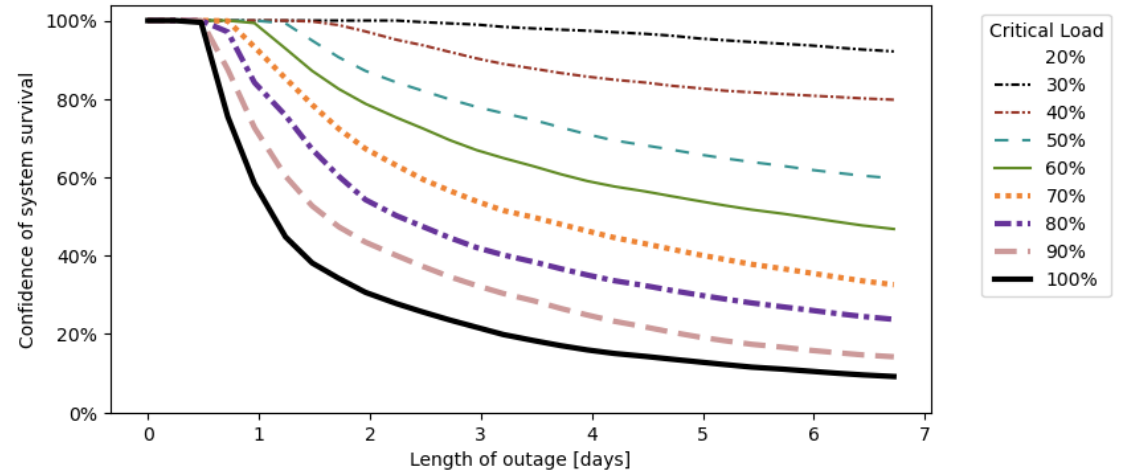
Load Reduction

- We assumed 100% critical load at both facilities
- If load is able to be reduced, resilience performance improves

HWC



WWTP





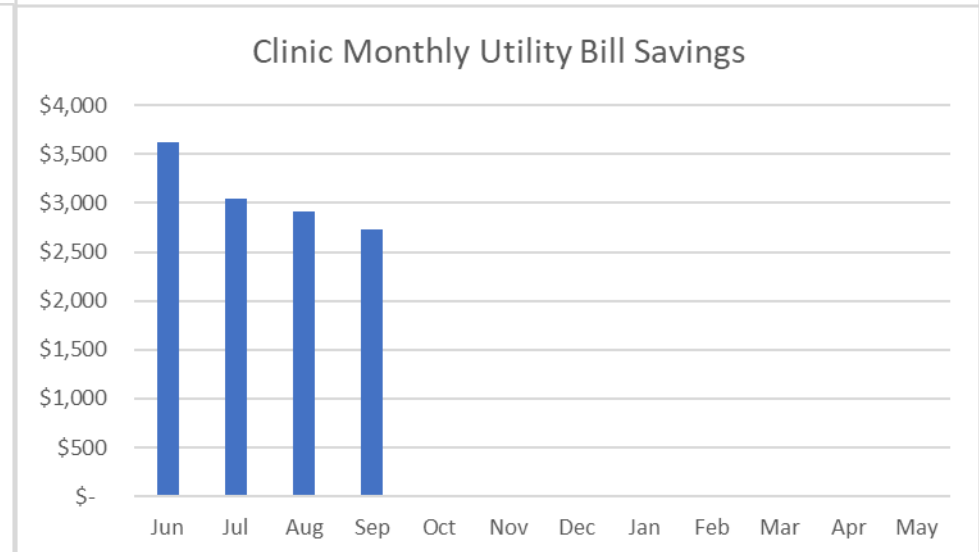
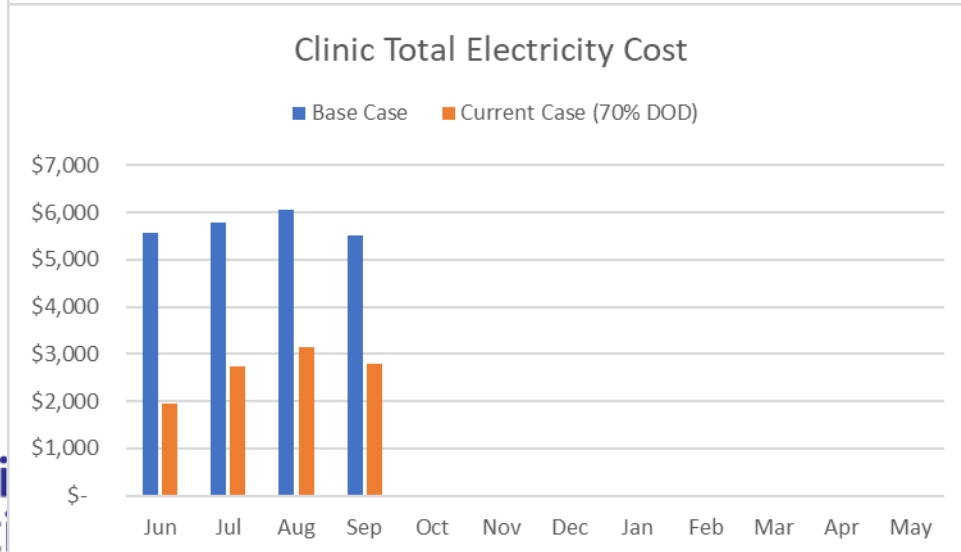
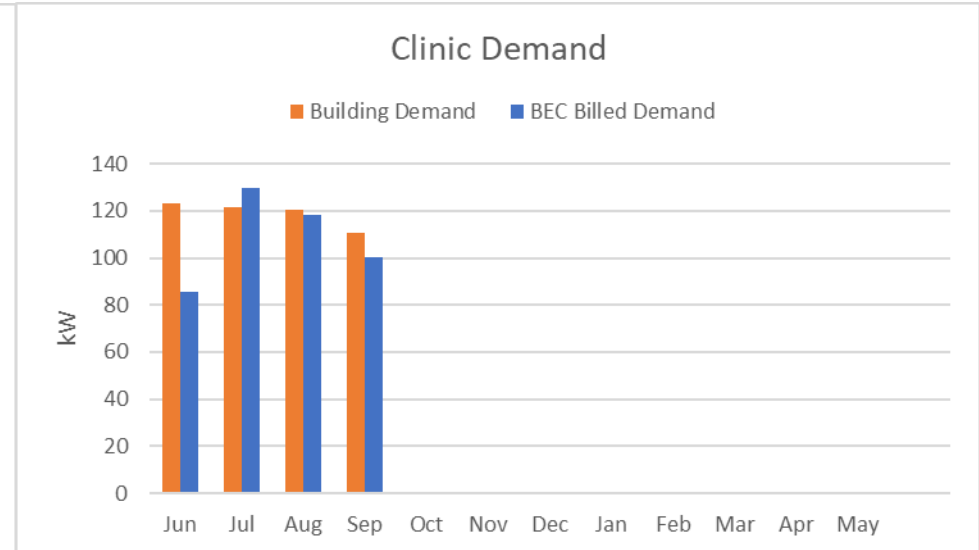
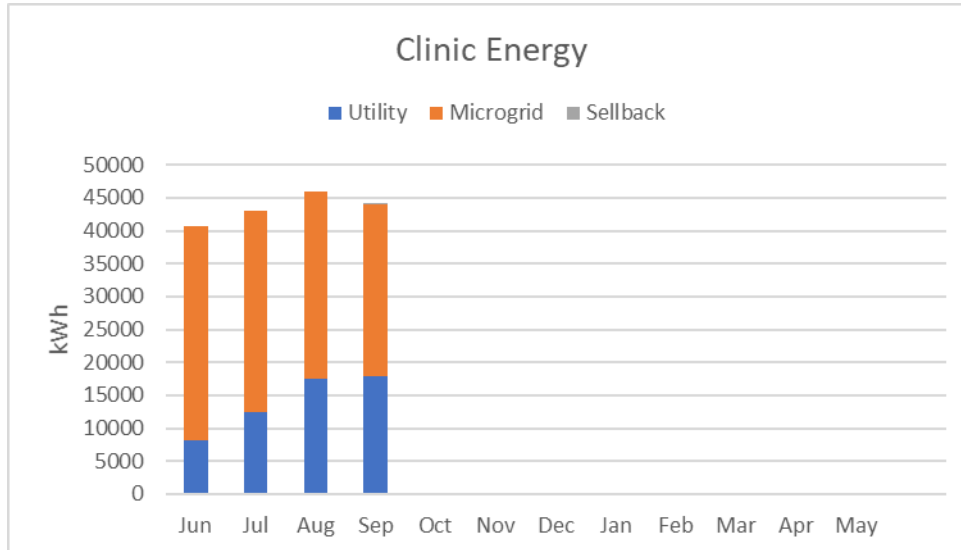
Rate Tariff Summary & Operating Strategy

- Energy
 - \$0.10 / kWh
- Demand
 - \$10 / kW Winter
 - \$12 / kW Summer
- Sellback
 - Utility avoided cost (no net metering)
 - About $\frac{1}{4}$ to $\frac{1}{2}$ of the retail rate

- Grid-connected (normal) mode operating strategy
- Increase solar self-consumption
 - Reduce demand charges

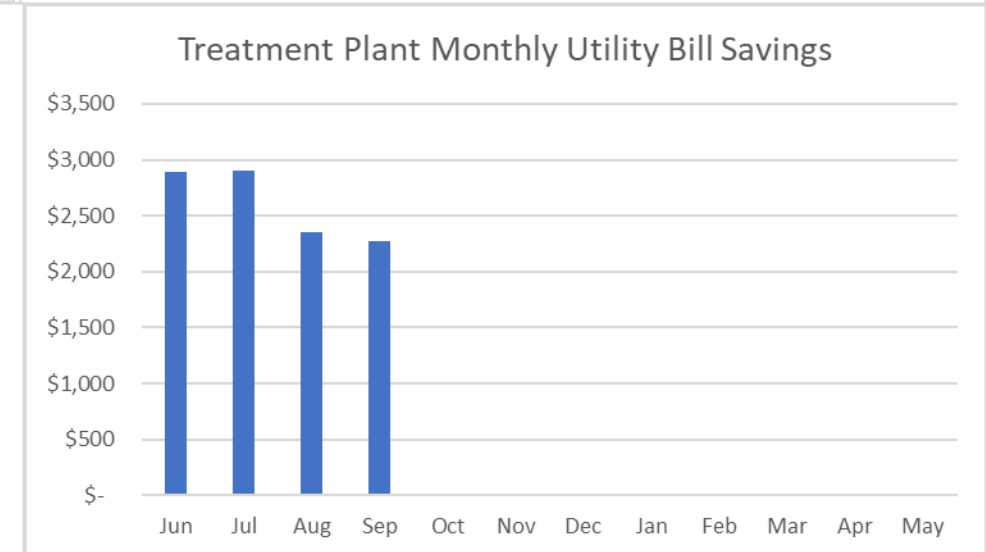
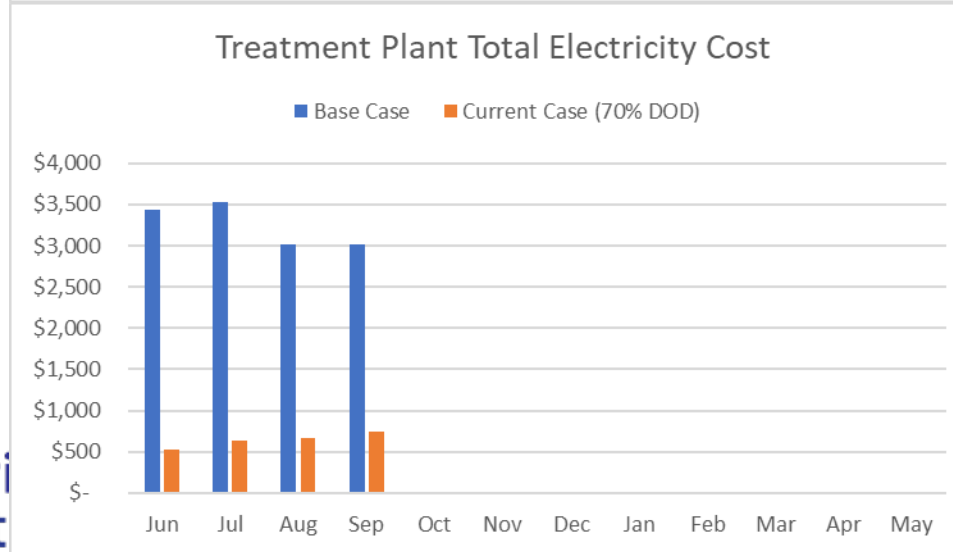
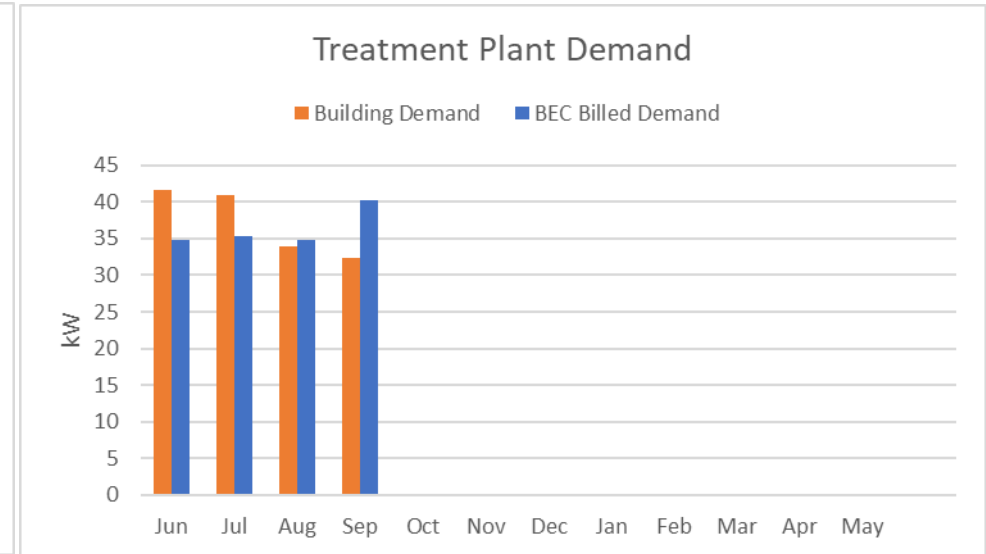
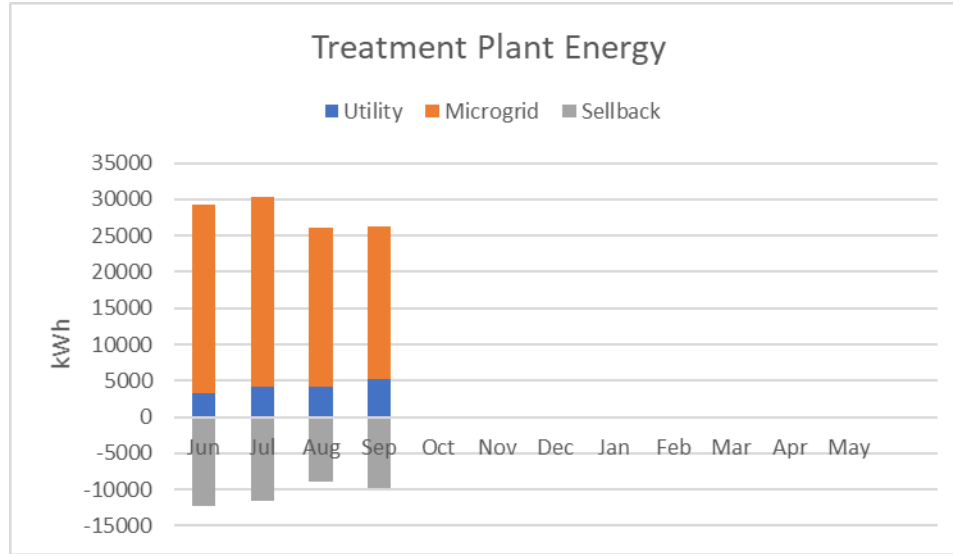


Clinic Economic Performance





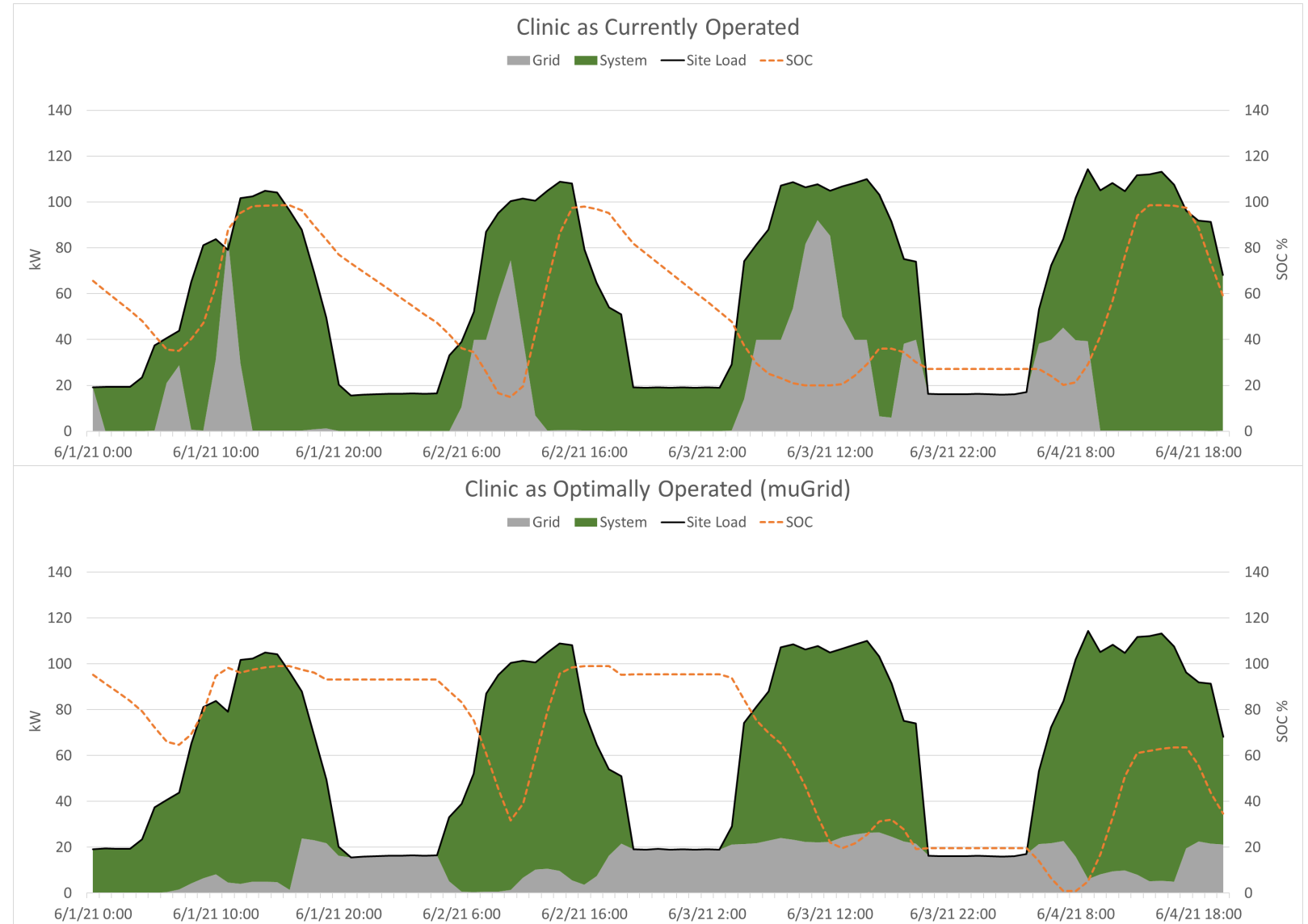
Treatment Plant Economic Performance





Dispatch Optimization

- Demand charge reduction requires an *intelligent* energy management system





Take-aways

- There is always a trade-off between resilience and economics which should be carefully thought through and analyzed during the planning and design phase – and even during the operational phase.
- Third-party ownership allows tax benefits and incentives to be realized, but can complicate operations since objectives may not be perfectly aligned as more data comes in.
- Many microgrid control systems are not that intelligent yet, and don't achieve economically optimal operation



Conclusions / Next Steps

- 3 building-level microgrids successfully commissioned in May 2021
- Resilience at the critical infrastructure (treatment plant, health clinic) has been significantly increased
- The Tribe is saving about \$5,000 per month on utility bills, making progress toward their sustainability goals, and increasing their energy sovereignty
- We look forward to continuing working with the Bad River Tribe to monitor and continually improve the system performance



Miigwech!