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Cost-Benefit Analysis of Energy Storage and Solar PV for a Tribal Community

A Case Study for the Pueblo of Picuris, NM

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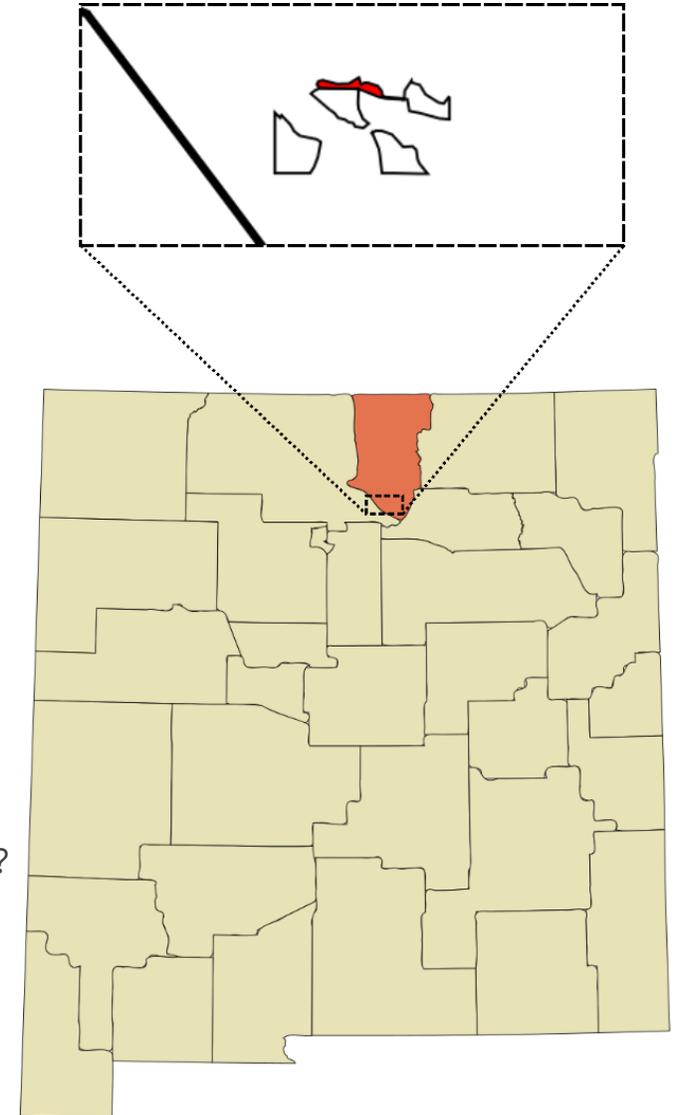
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Energy Storage Benefits to Picuris Pueblo



Background Information:

- Tribal members: ~300 enrolled members
- Located in Sangre de Cristo Mountains, Taos County, Northern New Mexico
- Above-average electricity rates
 - Electric heating is considered costly and gas infrastructure does not exist
 - Many members burn wood, with possible health consequences
- 1 MW solar PV operational since Jan. 2018
 - Funded through DoE grant and loan
 - Power Purchase Agreement (PPA) to sell power to the local utility
 - Revenue from PPA pays back loan and subsidizes tribal members' electric bills
- Funding secured for another project
 - Possible microgrid with another similar-sized solar PV array
- Evaluate alternative electrical service scenarios
 - How can a Battery Energy Storage System (BESS) support tribe's energy sovereignty?
- Evaluation of different solutions to couple large scale energy storage and solar
 - Analysis of reduction of electricity costs with energy storage and solar power



Possible Energy Storage Benefits to Picuris Pueblo

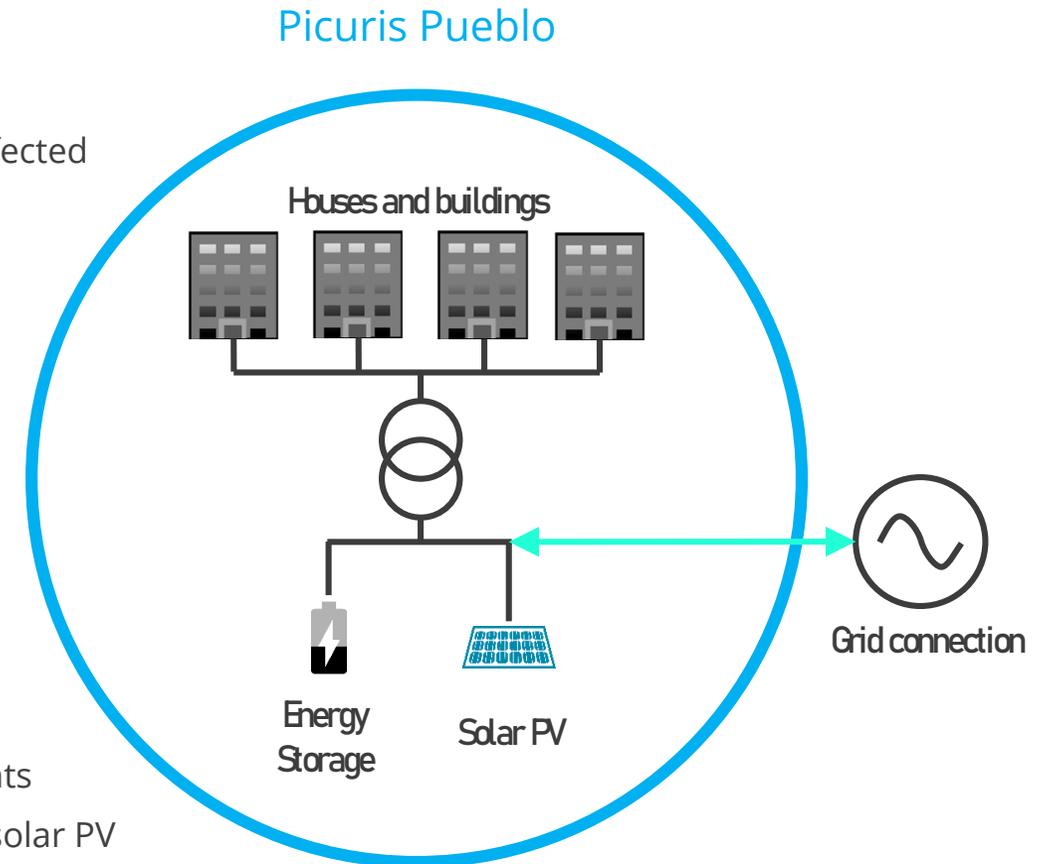


Reliability:

- Problem: restoration time is relatively long due to location
 - Power interruptions of over 1 hour are common
 - Communications, local economy and well-being of people are affected
 - Local sensitive loads need backup power
 - Buildings are scattered throughout the Pueblo
 - Distributed BESS probably too costly

Energy arbitrage:

- Could the Pueblo trade energy with the local utility?
- PPAs for *buying and selling* power with BESS?
 - Sell and store power when there is excess solar
 - Buy and discharge BESS when no solar power is available
- What are the best sizes of new PV array and BESS?
- Maximize net present value of investment
 - Capital costs: purchase new PV and BESS under budget constraints
 - Revenue stream: cost-savings from arbitrage and revenue from solar PV



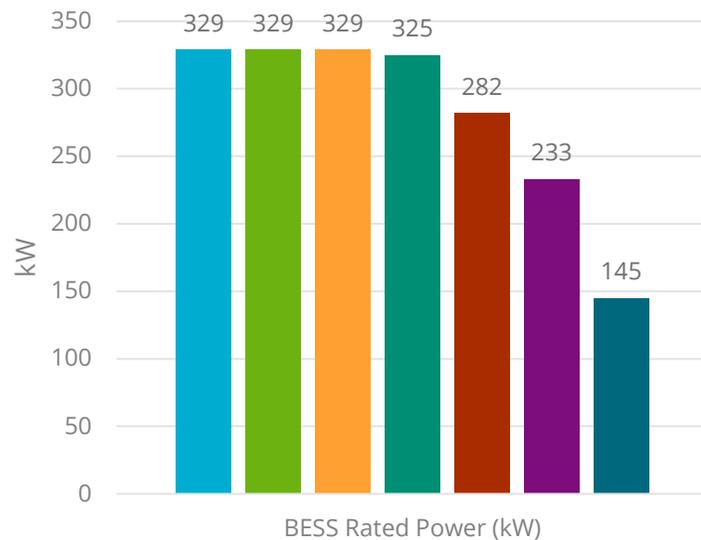
Results – Energy Arbitrage



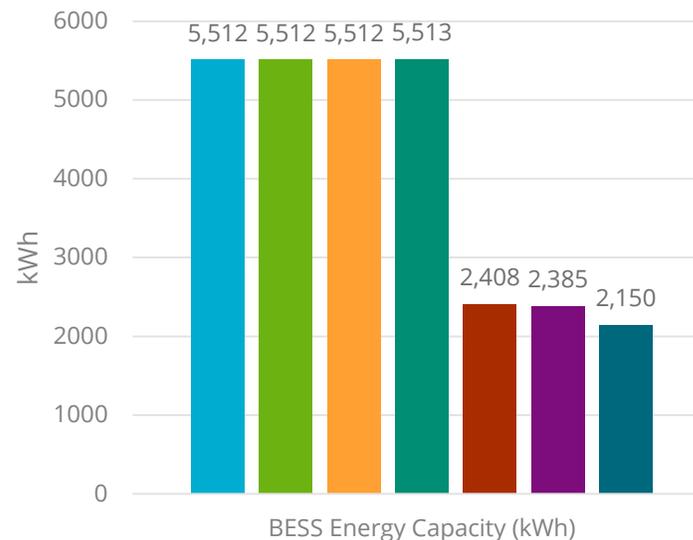
PPAs are yet to be negotiated

- Sizing of BESS and PV is highly dependent on difference between cost of buying (higher) or selling (lower) energy
- Sensitivity analysis for variable selling prices
 - Solve optimization problem assuming perfect forecast of load and solar
 - Assuming no significant load growth,
 - BESS and PV average prices from publicly available market surveys

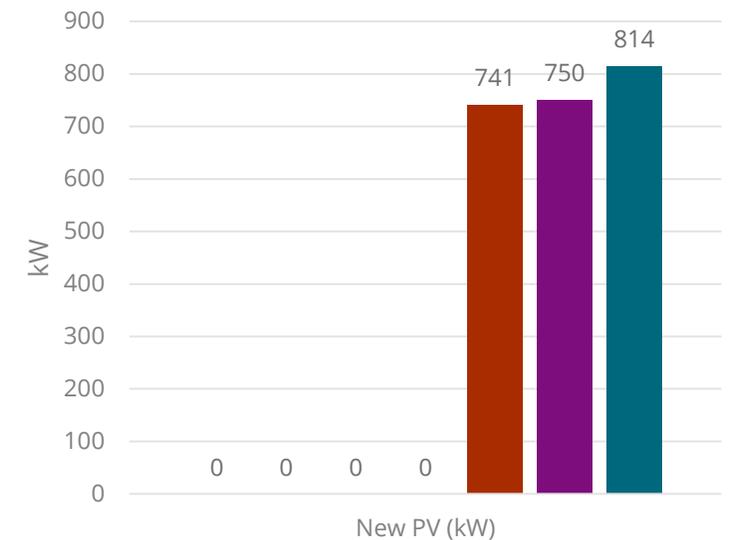
Energy Storage Power Sizing



Energy Storage Capacity Sizing



PV Sizing



Price of selling energy increases



Conclusion



- Integration of BESS to a PV system has potential to be economical project with significant reduction in cost of energy to Pueblo
- Project financial success is dependent on grants
 - Optimal results suggest that no additional costs should be added beyond grant
 - Price of selling solar energy expected to be much lower than price of buying energy
 - Cost of BESS is still relatively high for this application
- Optimum operation and sizing of modern, cost effective and efficient BESS, it is possible to obtain positive Net Present Value for a BESS investment for a time horizon of 10 years
- Payback of investment is obtained and electricity cost-savings and selling excess solar PV power
- By deploying renewables plus storage on tribal lands, the tribe can secure **greater tribal and economic sovereignty** through energy independence and economic development

Project Deliverables

- R.D. Trevizan and S. Atcitty, "Energy Storage Benefits to Picuris Pueblo" *presented to Picuris Pueblo, January 2021.*
- R.D. Trevizan and S. Atcitty, "Energy Storage Benefits to Picuris Pueblo - Update" *presented to Picuris Pueblo, April 2021.*

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