

ACCESS Project Case Study: Orcas Power & Light Cooperative

Using Solar Energy and Hybrid Battery Technology to Address Grid Resiliency and Energy Affordability on a Remote Island Archipelago



ACCESS Program

NRECA Research's solar energy project, *Achieving Cooperative Community Equitable Solar Sources* ([ACCESS](#)), is the flagship project of NRECA's *Advancing Energy Access for All* initiative. This initiative spotlights the innovative ways cooperatives approach community development and support for their consumer-members, as technology advancements continue to transform our industry.

ACCESS will explore and amplify the use of innovative, cost-effective energy access programs to help increase solar affordability, with particular focus on assisting low and moderate income (LMI) consumers. ACCESS will research varying financing mechanisms and program designs to identify optimal solutions for small utilities, including field tests of diverse co-op solar projects around the country. Through this project, tools and resources will be developed to assist electric co-ops and the broader industry deploy solar projects to benefit LMI consumers.

This case study provides example of how one cooperative, Orcas Power & Light Cooperative, is working to provide solar affordability benefits to their archipelago through a suite of partnerships and an innovative hybrid battery energy storage system.

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Cooperative Profile

Orcas Power & Light Cooperative (OPALCO) is a member-owned cooperative serving the remote island archipelago of San Juan County off the northwestern coast of Washington since 1937. The total estimated population of San Juan County was estimated at 17,582 in 2019.¹ OPALCO serves around 15,235 meters

¹ <https://www.census.gov/quickfacts/fact/table/sanjuancountywashington/PST045219>

(approximately 87% residential and 13% commercial), covering around 173 square miles of land on 20 islands in the archipelago (see Figure 1). The co-op's unique geographical location has required them to use complex infrastructure, such as submarine cables, and additional staff members and co-op offices to fully support the county.

The county receives power from the mainland through submarine cables, with OPALCO owning 15 distribution and 11 transmission submarine lines. Pacific Northwest Generating Cooperative (PNGC) is OPALCO's electricity provider, and mainly provides energy generated and purchased from Bonneville Power Administration's (BPA) hydro-electric plants. OPALCO employs a staff of approximately 50 people, plus an additional 36 staff members working for the co-op's wholly owned subsidiary, Rock Island Communications, an internet service provider.



Figure 1: OPALCO Service Territory

OPALCO's Demographic Profile

While 10.2% of the population of the county is estimated to be living in poverty, lower than the U.S. poverty rate of 13%, San Juan County does experience high income inequality as defined by the GINI Index.² The median household income for San Juan County is \$60,711, lower than the statewide median of \$70,166.³ The average annual wage in San Juan County in 2019 was \$38,163, roughly half of the average wage of \$69,615 for Washington state. This large difference can be mainly attributed to the many seasonal and part-time wages that lower the annual average, with hourly wages not far below the state average.⁴ Approximately 16% of households in OPALCO's service area have incomes below 200% of the Federal Poverty Level (FPL).⁵

The racial composition of OPALCO's territory is 90.4% White, 3% Multiracial, 1.7% Asian or Pacific-Islander, with the remainder population identifying as Indian or Native American (0.9%), Black (0.5%), and Other (3.5%) 6.1% of all races within the territory identify as ethnically Hispanic. Educationally, only 4.6% of the population

² GINI Index is a statistical measure that denotes income inequality. The GINI Index for San Juan County from the 2018 American Community Survey 5-year estimate is .50. The Population Reference Bureau advises that GINI scores greater than 0.43 indicate high inequality. <https://www.prb.org/poverty-and-inequality-us-counties/>

³ <https://datausa.io/profile/geo/san-juan-county-wa#economy>

⁴ <https://esd.wa.gov/labormarketinfo/county-profiles/san-juan>

⁵ <https://aspe.hhs.gov/poverty-guidelines>: 200% of the FPL for the 48 contiguous states and DC is \$25,520

(25 years old and over) do not have a high school diploma, which is lower than the 9.4% statewide and 13.2% nationwide without a high school diploma. About 32.9% of the population is over the age of 65 in San Juan County, comparatively much larger than the 15.1% for Washington and 15.6% for the U.S due to the large retiree community on the islands.⁶

Background to OPALCO's Solar-Battery Microgrid Program

OPALCO has an existing microgrid project (see Figure 2), which includes a 500 kW (DC) solar array and a 1 MW/2.6 MWh lithium iron phosphate battery energy storage system (BESS), located on Decatur Island in the cooperative's service area.⁷ The solar array went online in July 2018, and is expected to produce around 570 MWh annually. The 3.6-acre solar project was made possible, in part, by the participation of approximately 270 members who purchased shares through OPALCO's community solar program. The battery system came online in February 2021 and the microgrid system will be able to provide backup power the island's 500 homes for around four hours. The microgrid project is expected to provide several cost-saving and efficiency benefits to OPALCO including:

- Reduction in demand charges and load shaping charges
- Deferral in submarine transmission cable replacement
- Energy cost reduction
- Transmission charge reduction
- Voltage regulation and outage mitigation
- Demonstration of islanding, Volt-VAR control, and other advanced control methods
- Integration of renewables onto the grid



Figure 2: Decatur Island Microgrid Project

PNNL: Economic Analysis and Benefits of PV Investments

Pacific Northwest National Laboratory (PNNL) helped OPALCO with initial economic analysis on the microgrid project and provided key lessons that helped to justify the microgrid project. The main takeaway from PNNL's analysis shows the microgrid project has a benefit-cost ratio of 1.13, meaning the project creates a positive net benefit for the co-op. The most valuable benefit was from submarine cable replacement deferral, creating almost \$2 million in present value benefits. Demand charge reduction was the next most valuable benefit, generating \$700,000 over the life of the system. This analysis has helped OPALCO to understand that multiple value streams are possible with just one project, and that more solar projects can potentially further benefit the cooperative and its members.

⁶ 2019 American Community Survey 5-year Estimates Detailed tables, Demographic and Housing Estimates, data.census.gov

⁷ <https://www.opalco.com/opalcos-first-local-microgrid-is-complete/2021/02/>

Creating new projects to generate local energy makes financial sense for OPALCO since the costs for hydro power from PNGC, flowing through from BPA, are increasing, while the costs for local distributed energy projects that use solar, wind, and storage are decreasing. Power costs are also anticipated to increase further by the end of the decade. The microgrid project is important, as it signals the start of OPALCO's plan to build a small, local power supply for resiliency to keep essential services running in their rural remote environment during mainland outages.

This microgrid project was supported through a combination of federal, state, non-profit, and private partnerships including:

- The [Bonneville Environmental Foundation](#) (BEF),⁸
- The U.S. Department of Agriculture (USDA) [Rural Energy for America Program](#) (REAP),⁹ and
- Local non-profit organizations, and financial institutions.¹⁰

OPALCO is currently working to develop a second solar and battery storage microgrid project on San Juan Island. PNNL will also develop an economic analysis and the new installation will likely see many similar benefits as the existing microgrid project on Decatur Island. Additionally, once the project is running, PNNL will be involved in monitoring the installation over time, which will help to determine the economic value the project brings to the cooperative. While the COVID-19 pandemic initially delayed the new project in capital spending and land acquisition, the project is now progressing again with the solar array on track to be completed by the end of 2021 and the battery component completed by 2023.

Program Design

Project Details

The entire new 1 MW solar photovoltaic array will be sited on a 19-acre parcel of land outside of the town center on San Juan Island and will be owned by OPALCO. The array will be paired with a 1 MW/4 MWh hybrid chemistry BESS to be connected through distributed switchgear.¹¹ The area of land also has room for future solar array expansion, as solar costs continue to decrease and member interest increases. The cooperative foresees building an additional 1 MW of solar every couple of years with up to a total of 5 MW of potential generation on this land. Project objectives include the following:

- Helping OPALCO with valuable cost-saving and efficiency benefits
- Expanding local energy independency & resiliency through renewables
- Improving LMI & overall membership renewable benefits
- Identifying additional energy storage value streams for the project, including specific values associated with the co-op location

⁸ BEF is a non-profit organization based in Oregon that markets renewable power to a variety of entities and offers grants for renewable energy projects.

⁹ The USDA REAP is a government program that supports small rural businesses by providing guaranteed loan financing and grant funding for renewable energy projects.

¹⁰ Spark NW and Sustainable Connections have helped with OPALCO's marketing, and different financial institutions have helped in navigating various project financing options in the early stages of the project.

¹¹ "Electrical switchgear is a centralized assortment of circuit protection devices that serve to protect, control, and isolate electrical equipment in case of faults in the power system"

<https://www.tdworld.com/substations/article/20973426/the-role-of-switchgear-in-us-grid-advancements>

Hybrid Chemistry Battery Energy Storage System

OPALCO chose to pair two different battery technologies in this new project. While the chemistries have not been decided upon yet, they could be, for example, a combination of lithium-ion (Li-ion) battery technology and flow battery technology. Each of the two battery technologies will make up roughly half of the total hybrid BESS size of 1 MW/4 MWh. There are distinct benefits for different technologies. For instance, flow batteries allow for a longer discharge duration, although they have a slower discharge rate. In the case of outage mitigation, flow batteries can provide greater benefits than Li-ion batteries by helping to control the distribution line during a stressful voltage time.

On the other hand, Li-ion batteries are better suited for black start events and can instantly reduce the energy peak. Li-ion batteries are the most common large-scale battery technology in the U.S., while flow battery technology makes up less than 1% of the installed power and energy capacity of large-scale battery storage, as shown in Figure 3.¹² This innovative approach of using two battery technologies will help to demonstrate how combining two different technologies can provide a variety of benefits while still at a moderate cost.

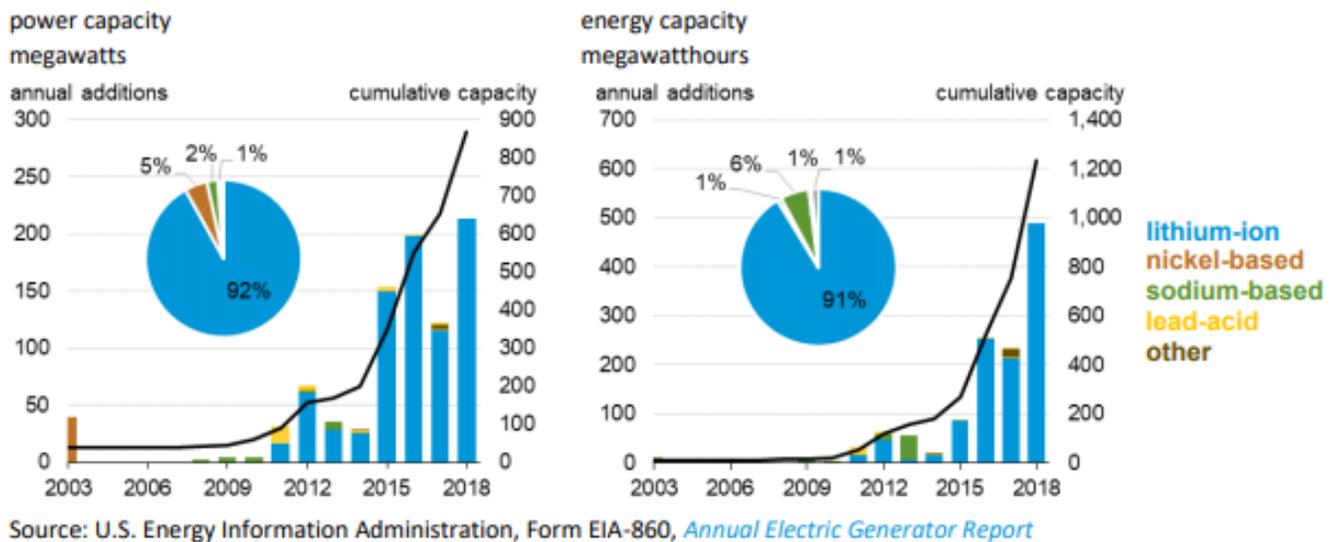


Figure 3: Large-scale Battery Storage Capacity by Chemistry (2003-2018)

Partnerships

This project is supported through the [Washington State Department of Commerce](https://www.wa.gov/department-of-commerce). The WA State Department of Commerce has a Low-Income Solar Deployment Program that is part of the Washington Clean Energy Fund (CEF), and has awarded OPALCO \$1 million in LMI solar funding towards the San Juan project.¹³ The Washington CEF also awarded OPALCO with \$2.4 million towards the battery storage component of the project. Both the BEF and the USDA REAP may still be considered for additional LMI grant funding to further support the project economics.

¹² https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf

¹³ <https://wastatecommerce.medium.com/commerce-awards-3-7-million-for-solar-installations-benefitting-low-income-communities-bbc06bc62601>

Program Design and Innovations

As the project currently stands, the financing structure and program design are still open for discussion. OPALCO plans to fully develop the program design after construction of the second solar array is complete in late 2021. The cooperative is exploring how different program design structures can be best combined to lower costs for members. One thing to consider is that there is a great deal of interest in renewable energy among its members. Program design structures under consideration include the following:

- **Community Solar:** The previous community solar program for the Decatur Island array was completely sold out in less than a month, leaving surplus demand from members still interested in participating. This unmet interest in member participation in community solar could lead to OPALCO creating a new community solar component in the San Juan project. Whichever design is ultimately constructed, the solar array will serve any OPALCO member who subscribes.
- **LMI Solar Carveout:** OPALCO is also considering an LMI carveout within this community solar offering. The goal is to dedicate about 40-50% of the array to LMI members. OPALCO anticipates finalizing the LMI program design and the benefit delivery by the end of Q2 2021, before the solar installation is complete.
- **Use of On-Bill Financing to Eliminate Cost Barriers:** Another option under consideration is the potential of using on-bill financing (OBF) to remove cost barriers to member participation. OPALCO has an OBF program offered using Rural Energy Savings Program (RESP) funding offered through the USDA Rural Utilities Service (RUS). Using OBF will help LMI members to participate in the community solar program by eliminating any upfront costs and spreading the costs out over time.

OPALCO already has a robust suite of Energy Assistance Programs¹⁴ targeted at low-income members, which will help the co-op to identify individuals and households that will be eligible for the LMI portion of this project. A portion of the funds dedicated to LMI members will flow directly towards bill credits and feed into OPALCO's existing 'Energy Assist' program.¹⁵ Energy Assist is a monthly bill credit for qualified low-income households that apply. It is funded through a non-voluntary line item on every members' bill and helps to bridge the income inequality gap within the co-op's territory. The monthly bill credit normally ranges between \$30 to \$60 per qualifying household.

Through this new LMI solar project, bill credits will go towards more than 300 LMI members and solar production credits may give the co-op the capacity to increase the monthly bill credits up to an additional \$10 per household. These funds would also be able to cover the average energy bills of certain low-income service providers (LISPs) in the area, such as food banks, affordable housing providers, and community resource centers. This further helps LMI members by providing indirect benefits to those members who access these LISPs and expanding benefits to the whole LMI community.

¹⁵ <https://www.opalco.com/about-your-account/energy-assistance-program/energy-assist-faq/>

Program Economics

Project Financing

The financing for this project includes a \$1 million grant from the Washington CEF allowing almost half of the array to be dedicated to LMI members, and a \$2.4 million grant that will go towards half battery system costs. OPALCO may also consider applying for a USDA REAP grant and a Bonneville Environmental Foundation grant to contribute towards the financing of this project. The potential community solar portion of the array will likely be funded through the participants of the community solar program, after any LMI-specific grants are applied.

Challenges and Opportunities

Challenges

COVID-19 Pandemic Impacts

The San Juan project was scheduled to begin at the start of 2020; however, pandemic-related delays pushed the start date of the project later into the year. Due to uncertainties around the pandemic in March 2020, the cooperative's Board was hesitant to spend any money on large capital projects that were not critical to delivering power - the co-op's primary function. However, after waiting for a few cautious months, the Board approved capital spending for this project. The project is now back on track with the solar array to be completed by the end of 2021 and the battery storage to be completed by the end of 2023 with post-install analytics occurring in 2024.

Diminished State Incentives

Washington state solar production incentives played a large part in increasing the financial benefits transferred to LMI and participating members in their previous Decatur Island project. However, OPALCO has fully taken advantage of its allocation of state incentive funds due to the large amount of solar installed in their service area. As a result, state incentives are unapplicable to the San Juan project, limiting the potential benefits that can be transferred to their members. These state incentives are separate from the grants OPALCO has received from the WA State Department of Commerce CEF.¹⁶

Project Size Affecting Economies of Scale

Since the size of the solar array and battery in this project are relatively small for a utility-scale project, the benefits from economies of scale may not be applicable in this project. Although this made it initially harder to reduce project costs, OPALCO has worked to find ways to reduce their costs through their partnerships and different financial structures. Additionally, this project has an initial 1 MW starting point with room for growth up to 5 MW over time, ten times larger than their first project of only 0.5 MW, which may allow them to see relatively more opportunities to leverage economies of scale as the project progresses.

¹⁶ For more information on Washington state solar incentives, see https://www.solarwa.org/solar_incentives.

Opportunities

Expand Grid Benefits

By integrating solar and storage onto the grid, there are several grid benefits that OPALCO can expect to gain. The different benefits include:

- Renewable capacity firming,
- Load shifting,
- Time-of-use energy charge reduction,
- Potential applications in outage mitigation and transmission upgrade deferral,

Grid resiliency overall is very important to OPALCO. This is especially important in cases when the power goes out on the mainland, cutting off power for the entire county, something that is completely out of OPALCO's control. During a recent storm in early 2021, the mainland lost power, leaving San Juan County without power for about 20 hours. These types of incidents remind the co-op how important resiliency is, even when not necessarily included in project economics. According to Foster Hildreth, General Manager at OPALCO, "This is an important step forward on the path of resiliency and energy storage. We are starting slow, and learning, so that when the cost and benefit equations are right, we'll be ready to replicate these projects throughout our territory." With this project, the cooperative is one step closer to still being able to provide some portion of energy to members during mainland outages.

Reducing Costs Through Financial Mechanisms/Partnerships

OPALCO explored several different types of financial mechanism opportunities that could help to best reduce the costs of the array. Several were dependent on the ultimate ownership of the array. The cooperative could own the entire array, enter a third-party equity ownership, create a community solar pre-purchase ownership structure, or develop a combination of various ownership structures. With the award of a \$1M Clean Energy Fund grant to OPALCO for the array, it is now likely that OPALCO will retain ownership of the array in order to leverage these funds.

New Program Design Elements

OPALCO is looking to incorporate new ways to provide the greatest reduction in cost and energy burden, so that solar can be accessible to the greatest possible number of LMI members. This includes using its on-bill financing program offered through USDA Rural Utilities Services (RUS) Rural Energy Savings Program (RESP) funding, helping LMI members to pay as they save. Another new element will be to help cover electricity bills for local LISPs, further expanding LMI member benefits. OPALCO will continue to research and look to the ACCESS program for additional ideas.

Project Demonstration

OPALCO plans to use this project for education and training opportunities for high school students in the islands. The cooperative will use various methods for community engagement, including marketing, a website page, and open houses. For future community engagement, OPALCO expects this project will be highly visible because of its location on San Juan Island, the second biggest and most populous island of the archipelago. Additionally, simply showing that this innovative LMI solar project can indeed work

could help to engage more cooperatives to work on similar projects and bring solar benefits to their own LMI members.

Key Lessons and Insights

This project contributes towards OPALCO's overall innovative approach, as with its microgrid on Decatur Island, to demonstrate a variety of benefits for the cooperative and its members. These include the benefits from integrating renewables on the grid, benefits of storage on load shaping, capital deferral and outage mitigation, and extending renewable energy to its LMI members.

One of the most valuable contributions of this project for OPALCO has been working with their project partners and continuing to build those long-term relationships. As Travis Neal, Head Accountant of OPALCO, describes it, "It's been a slow, but natural process over the years." Since their first grant with the WA State Department of Commerce, OPALCO has continued to work with the state government through applying for smaller grants for electric vehicles and energy efficiency, which has led to frequent communication between the two entities and having regular bi-weekly meetings. This relationship led to the introduction of OPALCO to BEF, helping to begin a new relationship and create a wider network for OPALCO. To build a network of project partners, Neal suggests to "look at who you are partners with already, and then ask them. They can help to point you in the right direction". OPALCO also partially benefits from working with their local agencies in Washington, a state that has ambitious clean energy goals.

Through this project, OPALCO aims to help their LMI members by reducing their participation costs and assisting the LMI community overall. As Hildreth puts it, "OPALCO is committed to our mission of providing affordable power and will continue to do all we can to meet the need." OPALCO already has a history of supporting their LMI members through their Energy Assistance Programs, and by developing this solar project the co-op will be able to assist those members even more.

As a "leader" cooperative of the ACCESS project, OPALCO has benefitted from listening to and sharing project ideas with the rest of the ACCESS team. As the co-op looks toward developing their program design structure for this project, they will continue to look towards the ACCESS team for new ideas and support.

Additional Resources on NRECA's ACCESS Project

- [Access Website](#)
- [Advisory: ACCESS Project Explores Use of Federal Assistance Funds to Provide Affordable Solar Energy for Low-Income Households](#)
- [PNNL Report on the Valuation of DER Resources to Demonstrate the Range of Potential Benefits](#)

Join the ACCESS Project as an Affiliate Member

Want to stay informed of our progress with the ACCESS project, and provide your input and feedback? We welcome all NRECA members to join the project as Affiliate member. Contact our team at: SolarAccessProject@nreca.coop.

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