Eastsound, Washington

2020 – 2040
Integrated Resource Plan

The IRP is a "living document" updated periodically to catalyze constructive discussion on our energy future.

Orcas Power & Light Cooperative
183 Mt. Baker Road
Eastsound, WA 98245

September 13, 2019

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A Message to all Co-op Members

Benjamin Franklin said, "*When the well's dry, we know the worth of water.*" Like water, energy is a fundamental part of our daily life and economy.

There has never been a more important time to learn about the tremendous changes that are taking place with energy and climate change.

We are at a tipping point. Climate impact, risk and uncertainty are on the rise. These changes are unfolding as we speak and will accelerate over the next five years and beyond. We navigate those waters together and the more we understand about the trends, options, costs and benefits, the more informed our choices, and the better our solution will be. Things you can do to be informed and engaged:

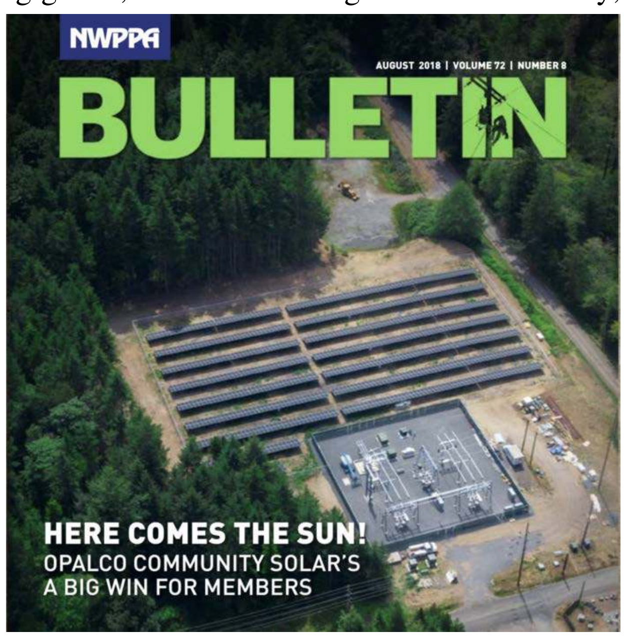
- **Read this IRP**. There is a lot of information here. You will have questions. Contact us to deepen the conversation. We are here to help and welcome opportunities to meet with members.
- **Explore questions and ideas with your co-op staff and board members**. Contact them to get to know them and deepen the conversation. They have a lot of industry experience, and value hearing your experience and thoughts.
- **Come to a co-op board meeting** now and then. They are packed with information and insight. Here's the calendar. We'd love to see you there.
- **Attend** co-op town halls and candidate forums. See the calendar link above.
- **Explore** the OPALCO website. It is loaded with helpful information and tools.
- **Check out the Switch it Up! Program**: low-interest, on-bill-financing to switch to low-cost electric heating and transportation. It can literally save you thousands of dollars a year in energy.
- **Share** this information and insights with your friends. We are all in this together.

OPALCO Nordine Jensen scholarship regional co-op ICUA Youth Rally in Idaho

I. Executive Summary

IRP Highlights

- **Climate impact is warming winters and summers**. At the current rate, winters will be summer-like by the end of the century. Summers will be much warmer. There is a rotation of load from winter-peaking to summer-peaking that will unfold over the coming decades. Heat load (our biggest source of revenue) will decrease, due to warming winters and steadily growing market share of super-efficient heat pumps replacing less efficient electric resistance heating. Air conditioning load will increase, but, being heat pump based, it is inherently efficient. Snowpack is receding (more rain, less snow fall) leading to a shift of hydro flow away from summer, toward winter. This will especially challenge mainland urban areas that depend on air conditioning to stay cool during more frequent climate changed heat waves. That said, trends in local warming, though moderated by the cool surrounding Salish Sea, will become uncomfortable in summers, especially challenging our vulnerable (larger than the mainland) elder population.
- **Mainland power will become more costly and less reliable** in the coming decade as demand for firm, clean, reliable affordable hydro increases, driven by the decommissioning of coal power plants. Capacity will go down, driving energy prices up. Demand will exceed supply, leading to regional rolling blackouts and demand rate inflation during periods of peak load demand. Much of this IRP looks at the trends, implications and potential solutions for ensuring continued safe reliable affordable service. Increasing local renewable energy resources will be an important part of the solution.
- **There is time to solve the problem, if we start now**. Gradual incremental deployment of cost-effective solutions reduces risk and saves money for the co-op and members. *An ounce of prevention is worth a pound of cure*. Delay would lead to unmanageable risk and rate shock. Near term focus is on building equity, winning grants, and incentivizing member efficiency, renewable energy and battery storage programs.
- We expect that **local renewable energy resources will become competitive with mainland power** wholesale electric rates around 2025 (grid parity). Solar + storage will be essential parts of our resource mix. Storage is the "Swiss Army knife" of the grid, helping firm the increasing contribution of intermittent resources like solar, helping reduce demand charges, keeping critical infrastructure and town-centers operating during outages, and much more.



- **Direct member investment** will be an essential part of growing our local energy resource mix. This is an especially important way to accelerate local energy resource deployment, before grid parity, without impacting rates. OPALCO's Switch it Up! program and RESP funds will be used to incentivize direct member investment in over 3 MW of member battery storage, and efficiency measures including heat pumps, dispatchable water heaters, dispatchable EV chargers, and smart inverters coupled with rooftop solar.
- **Mainland power will remain an essential part of our resource mix**, albeit less. As we increase local energy resilience with the addition of local energy resources (member and community solar, and utility-scale solar, storage, wind and tidal), mainland (BPA/PNGC) energy purchases will decline to about half of total kWh sales by 2040, depending on post grid parity investment levels. Yet, it will remain a vital resource for firming intermittent resources, powering us during cold snaps, at night and in long gray winters when solar production is limited – the ultimate "backup battery."
- **Load continues to be flat** but will change in the coming decade as more members use electricity for heating and transportation. EVs are projected to reach cost parity with fossil-fueled cars in 2022. EVs will be significant driver of load growth and revenue toward the end of the 2020s. Ferry electrification will add to load in the 2030s. The increasingly transactional grid helps load and resources become more dispatchable (home battery storage, smart water heaters). This will be an essential tool in avoiding peak demand charges.
- **We are in the early stages of a highly transactional grid**. We have an outstanding grid that has served us well for over 80 years, more reliable than ever. As communication protocols standardize, we will see increased two-way energy and information flow, members buying <u>and</u> selling energy, solar + batteries increasing local energy resilience, enabled by our fast reliable fiber and wireless internet. OPALCO will increasingly serve as a balancing exchange, keeping voltage stable as members buy and sell energy from each other, with BPA serving as a vital source of <u>firm</u> energy when local energy demand exceeds <u>local</u> generation capacity.
- **Efficiency continues to improve**, helped along by the "internet of things" (IoT) – enabled by the OPALCO/Rock Island fiber and LTE wireless broadband backbone. The automated home market exceeded $23 billion in 2018 and is expected to reach $75 billion by 2025, at an impressive compound annual growth rate of 18%. This presents encouraging impetus for helping OPALCO members make their energy use smarter and more efficient, including smart thermostats and appliances, better grid monitoring, grid control and crew information access. Heat pumps will be the largest reducer of load as members convert from resistance heat to super-efficient heat pumps. Bundling fiber with smart home systems helps incentivize uptake.
- **Excellent member communication is increasingly essential** as climate impact accelerates, effecting every aspect of our mission: Serving our membership with safe, reliable, sustainable and cost-effective essential utility services with a commitment to the use of renewable resources and carbon reduction. This is a big challenge! Members are busy. It takes time to comprehend the interconnected nature and implications of these issues. The challenges, risks, opportunities and possible solutions are complex and nuanced. Social media is filled with mis-

information. We have our work cut out for us and will use all available channels to reach out to our members.

- **Grants** will continue to help us do more with less. We expand our efforts to garner grants that help us modernize our grid, increase local energy resilience, and provide low income members access to renewable energy systems. Climate impact is accelerating the availability and variety of grant funds. This will help us reduce impact on rates as we adapt to a climate-changed energy landscape. We want to do everything we can to develop funding beyond rates - funding that minimizes raising rates. And grants help us to be a faster fast follower.
- **Strategic partnerships** amplify our reach and capability. One example, PNGC. Our industry is changing rapidly. The expertise we gain through PNGC's top-notch team is the most important long-term strategic cost-saving measure we could put in place for us and other Northwest co-ops. PNGC is an extension of OPALCO now to improve reliability, provide accelerated resource planning, more direct interaction with BPA for billing, project management and more accurate forecasting for power purchases. Joining forces with other energy co-ops, gives us the buying power of BPA's third largest power customer. With the advent of CETA, PNGC will coordinate much of the response to fully understanding and responding to CETA requirements. That helps OPALCO staff stay focused, work efficiently, and do more with less.

The table below summarizes the resources to be developed, the purpose of those new resources, and the investment source, before and after grid parity.

	Before Grid Parity	After Grid Parity
Resources	Deploy **moderate** amounts of local renewable energy resources: a combination of solar + storage + demand response, community solar, and utility-scale solar. Incentivize rooftop solar, dispatchable home storage, and demand response units.	**Accelerate** deployment of local renewable energy resources, as they become affordable, to significantly reduce our dependence on mainland power. Initially solar, eventually tidal energy, likely in the 2030s.
Purpose	Reduce vulnerability to mainland demand charges. Increase local energy resilience, especially for critical services in the county: first responders, town centers, government. Community solar helps members lower the cost of their electricity.	Cushion us against the increasing cost of mainland power. Increase local energy resilience.
Investment Source	Community solar is paid for by subscribers. Utility-scale solar is funded through grants and RESP program. Member storage and demand response is paid for through direct member investment, grants and RESP program.	Direct member investment, Grants, RESP program, and rates as a last resort.

Over the 20-year IRP planning horizon, we see four distinct themes playing out. We start with preparing for CETA, developing critical local energy resilience resources, especially dispatchable storage. We also prepare for grid parity, leveraging our local grid control backbone to manage the increasingly smart, dispatchable distributed local resource mix. And we begin negotiations with BPA on the 2028 contract. We expect that BPA mainland power will be in high demand regionally and all the way down to California, serving as the ultimate low carbon backup battery for the increased intermittent renewable resource mix.

In the later 20s, we navigate some troubled waters as CETA reduces near term regional power capacity, increasing demand spikes and risk of mainland power disruption. But we will get through that and by 2040, most transportation and heating will be clean electric, most of our energy will be local, with BPA as the ultimate backup battery. Our power will be more distributed, resilient and affordable than mainland alternatives. The transformation is funded with a mix of grants, RESP funds, direct member investment, and for large local utility-scale renewable generation projects, possibly with investor renewable energy credits (IRECS).

IRP Themes

2020–2025	2025–2030	2030–2035	2035–2040
Prepare for CETA and Grid Parity	**Regional Power Risk**	**Electrify Everything**	**Local Energy Takes Lead**
Increase… - critical infrastructure resilience - dispatchable load, storage - community solar Direct Member Investment (DMI)… - member storage - community solar	CETA Risk Multipliers - reduced capacity, reliability - increasing demand Grid Parity: ramp up… - utility-scale solar + storage	Most members drive EVs and heat with heat pumps Electric ferries ramp up Local renewables expand All town centers and critical infrastructure are resilient	Most energy generated locally BPA as "ultimate backup battery" Tidal energy grid parity - trial small system - ramp up at grid parity CETA transformation complete
CETA and BPA contract prep	CETA Compliance BPA contract negotiation	CETA Compliance	
Grants, RESP, DMI, build equity	Grants, RESP, DMI, build equity	Grants, RESP, DMI, build equity	Grants, RESP, IRECs, build equity

2020 2025 2030 2035 2040

About OPALCO and the IRP

For more than 82 years, OPALCO has been dedicated to providing safe, reliable, clean, affordable and sustainable energy to our members.

The Co-op is financially strong, navigating a path of innovation, as we adapt to a climate changing world.

We have a diverse membership that inspires us to be our best. We have staff and crews that endeavor to serve our members to the highest standards. We have community-minded partners that help us do more with less, honor us with grants, all in a spirit of cooperation.

OPALCO has one of the most complex rural grids in the nation. We serve 20 islands through thousands of miles of submarine cables, transmission lines, storm-hardened underground distribution, and fiber – connecting 11,300 member homes and businesses through eleven substations. Our grid is constantly evolving to meet the needs of our members and the changing world we live in.

This Integrated Resource Plan (IRP) is an energy roadmap for the next 20 years. It builds on the IRP Orcas Power & Light Cooperative (OPALCO) developed in 2014. It explores where our energy will come from in the future (it's changing rapidly), how members will use that energy (that's changing, too), and the investments needed to ensure safe, reliable, affordable and sustainable service well into the future.

It is the result of extensive research and analysis, exploration of energy topics at Board meetings, conversations with members, and discussions with community leaders and visiting experts. The IRP is a "living document" updated periodically to catalyze constructive discussion on our energy future. That conversation iteratively deepens and refines the IRP and the Co-op's service to the members.

The need for <u>this</u> update is driven by a number of compelling **challenges** <u>and</u> **opportunities** that are rapidly playing out regionally, nationally and globally:

- **Climate impact** – driving rapid regional shift to low carbon energy resources, away from coal, increasing reliance and value of clean, firm, affordable hydro and local energy resources.
- **Shifting energy resource landscape** that, if ignored, will likely lead to rate shock. Local energy resilience is increasingly essential and moving to the foreground, with mainland power ultimately becoming a backstop rather than the main event.
- **Beneficial electrification**, helping reduce climate impact and keep member rates (and TOTAL energy bills) lower
- **Increasing global risk <u>and</u> opportunity** that requires a smart, agile, fast follower approach to innovation. The next four to eight years will be particularly dynamic. Read on: this is important stuff to understand and think about.

For more on all this, see the Challenges and Opportunities chapter below.

IRP Time Line

Here is expected timeline – dates may vary as plan details are refined.

	Date	Activity
✔	February 2018	Strategic Long-Range Vision
✔	March 2018	Long-Range Capital Projects Work Session
✔	May 2018	Long-Range Financial Work Session equity, cash, debt
✔	August 2018	Cost of Service Analysis (COSA)
✔	September 2018	Rate Structure Review supporting COSA
✔	October 2018	Rate Structure Approval
✔	Q2 – Q3 2019	Update Integrated Resource Plan (IRP) to 2020 - 2040
✔	August 2019	Review draft IRP
	September 2019	Review final IRP
	Q1 2020	Review final Long Range Capital Plan (LRCP) capital projects
	Q2 2020	Review Long Range Financial Plan (LRFP)
	Q3 2020	Review Long Range Member Communications Plan (LRMCP)

OPALCO Mission

Orcas Power and Light Cooperative serves our membership with safe, reliable, sustainable and cost-effective essential utility services with a commitment to the utilization of renewable resources and carbon reduction.

OPALCO Values Statement

The OPALCO Board of Directors and Employees strive for excellence with a passion and determination that is founded on the following values. These values inspire, guide and determine our conduct in carrying out our mission:

- We are dedicated to the 7 Cooperative Principles
- We are committed to building, nurturing and preserving lasting relationships with our member-owners and among ourselves
- We hold ourselves accountable to the highest legal and ethical standards
- We are dedicated to financial stewardship of member resources through sound governance, management and operating practices
- We are a responsible member-owned organization; we strive to make a positive impact in our community
- We care deeply about our island communities and are dedicated to the protection of our sensitive environs
- We continually evolve our services, and offer programs to meet the needs of our membership
- We seek and implement innovative solutions and adopt technologies to improve and maintain our members' quality of life

OPALCO Strategic Directives

2. **Safety** - Safety is our highest priority. Safety programs will be implemented to engage all staff members and to promote OPALCO's high standards for safety with a goal of no accidents.
3. **Reliability of Electric Service** - Maintain reliability of electric service. Preserve our connection to the mainland power supply, support the federal hydro system and optimize locally generated power. Develop local resiliency for emergency conditions
4. **Sustainable Power Supply Strategy** - Maintain a long-term strategy to provide safe, adequate, reliable power, which balances source risk, economics, climate and energy policy uncertainties and environmental impact. Leverage collaboration to access cost-effective and environmentally sensitive generation in our service territory and beyond.
5. **Personnel** - Attract and retain top quality employees by actively cultivating a workplace culture based on mutual respect that embraces diversity, encourages high team functionality and harmony, promotes personal and professional development and maintains high employment satisfaction. Maintain wage rates that are competitive within the industry and for

our region. Include apprenticeship and training programs for all positions and succession planning for key positions.

6. **Member Satisfaction** - Sustain high levels of member satisfaction as evidenced through periodic member surveys.
7. **Communications with Members** - Provide regular communication outreach to inform members of relevant issues and to encourage member participation and engagement in co-op affairs. Maintain transparency for co-op governance and operations. Cultivate a culture of listening and provide opportunities for member feedback.
8. **Cash and Debt Fund Availability** - Ensure revenue and financial stability and have cash and debt availability to provide for foreseeable demands and to mitigate the impacts of potential significant damaging events including storm damage, loss of electric supply, equipment or cable failure.
9. **Debt & Equity** - Maintain appropriate levels of debt and equity that support the long-range financial strategic plans (power supply, capital projects and finances) while maintaining all loan covenants and meeting regulatory requirements.
10. **Guiding Documents** - Maintain and publish guiding documents.
11. **Communication Backbone** - Maintain fiber optic and wireless communications infrastructure to support grid operations for OPALCO and its subsidiary.
12. **Rock Island Communications** - Manage OPALCO's wholly-owned subsidiary to provide our membership high quality, reliable internet, voice and communications services. Prioritize communications to emergency responders and fiber to the home deployment while continually improving wireless services and maintaining key partnerships.

OPALCO Guiding Principals

Reliable Energy

Delivery of reliable and safe service is an essential goal for any electric utility. Reliability is especially important in rural, remote San Juan County due to the logistical challenges of acquiring replacement materials, ability to reach critical facilities, and gathering personnel resources needed for restoration during extreme weather events.

OPALCO has consistently strived for greater reliability through its programs to undergroung the system, starting in 1970s, installation of redundant submarine cables, installation of alternate feeds to critical areas and investments in communications to monitor, automate and control its electric distribution grid.

Use of industry statistical trends such as SAIDI (System Average Interruption Duration Index), SAIFI (System Average Interruption Frequency Index), and CAIDI (Consumer Average Interruption Duration Index) have allowed the continued monitoring of the reliability performance of the system and the measures. Through geographical outage tracking, staff has the ability to specifically determine the most economical reliability improvements needs throughout the system and prioritize them for inclusion in the Construction Work Plan (CWP).

Affordable Energy

OPALCO has delivered energy to its members at affordable rates since 1937. This is accomplished with the use of strategic planning, persistent and skillful financial oversight, use of low-interest federal loans via RUS, and evolving operational efficiency. The balance of keeping rates affordable while providing reliable and redundant service to 20 islands with a mix of submarine, buried, and overhead infrastructure is no small task.

OPALCO has provided energy efficiency programs to aid in reducing overall system load while minimizing the energy needs for its members. There are also fuel-switching programs which incentivize members to change their heating and vehicle fuel sources from higher cost fossil fuels to clean electric sources.

There are several programs in place for providing assistance to low- and fixed-income households. Project "Program for member Assistance funded Locally" (PAL) and Energy Assist are in place to support member households in need. Funding for Energy Assist is collected as a line item on all members' bills (based on kWh usage) and PAL is funded by members' voluntary donations and some Board support when required. OPALCO collaborates with local Family Resource Centers and the Opportunity Council to provide a further hand up for weatherization and energy bill assistance.

OPALCO continues to gauge affordability of it's services through review of the other local energy markets, like propane and local renewables, and also regional cost comparisons.

Clean Energy

OPALCO has some of the cleanest energy in the world due to our beneficial electrification initiative, energy efficiency programs, local renewables, and hydro power from Bonneville Power Administration (BPA) through Pacific Northwest Generating Cooperative (PNGC). In addition to affordability, OPALCO's low carbon footprint provides members with a compelling reason to utilize electricity for all their energy needs.

OPALCO realizes the far-reaching consequences of climate change and this IRP positions us to prepare for the potential of increased precipitation, reduced snowpack, increased run-off and risk of flooding, shifting hydro seasonal flow, warmer summers and increased use of air conditioning, warmer winter and decreasing use of heating, warming streams reducing fish spawning, increased summer fire threat, reduced summer water capacity, etc.

Sustainable Energy

Providing renewable resources to the membership is a large driver in the strategic planning process. As costs for installation and maintenance of renewable resource are reaching grid parity, OPALCO will incorporate more and more of these low-carbon resources to allow for local energy production and storage to allow for resource diversity and backup power for critical community load during outages.

Audience

- OPALCO Members The IRP is an essential resource for members to understand trends and drivers effecting their energy services, learn, and give feedback.
- OPALCO Board and PNGC To affirm and facilitate strategic planning and oversight.
- OPALCO Management and Staff Together with Mission and Strategic Directives, drives investment and project selection to meet objectives.

Purpose

This IRP lays out long-range goals for generation resources for the next 20 years: to 2040. This study projects load/resource balance and evaluates resources that could potentially benefit the utility and membership. The document includes a researched look into future conditions and trends and prepares the Co-op to thrive in a rapidly changing environment.

The IRP will inform our Long-range Plan (LRP) and assist OPALCO in providing the flexible and efficient infrastructure required to meet the evolving energy needs of our membership.

At the heart of this IRP are three chapters central to our commitment to providing safe, reliable sustainable and affordable energy to our members over the 20-year IRP planning horizon.

- **Load** - How will members use energy? What are the major loads and how is our load changing? How can OPALCO help members use energy efficiently, wisely, in ways that reduce co-op energy costs and lower member's TOTAL energy bill?
- **Resources** - What energy resources will we need to meet member load? How do we plan to increase local energy resilience? Emerging resources include community solar, member rooftop solar, utility-scale and member storage, demand response and tidal energy.
- **Grid** - How can the Co-op accommodate the needs of our members? How will the grid manage interconnections and the increasingly diverse distributed network of utility and member resources and load? With the growing uncertainty of our climate and economic future, and potential of major supply outages, the grid is an essential element in providing local energy resilience to our isolated island communities.

II. Challenges and Opportunities

Climate Impact

Climate impact is accelerating. A number of global and regional trends are emerging.

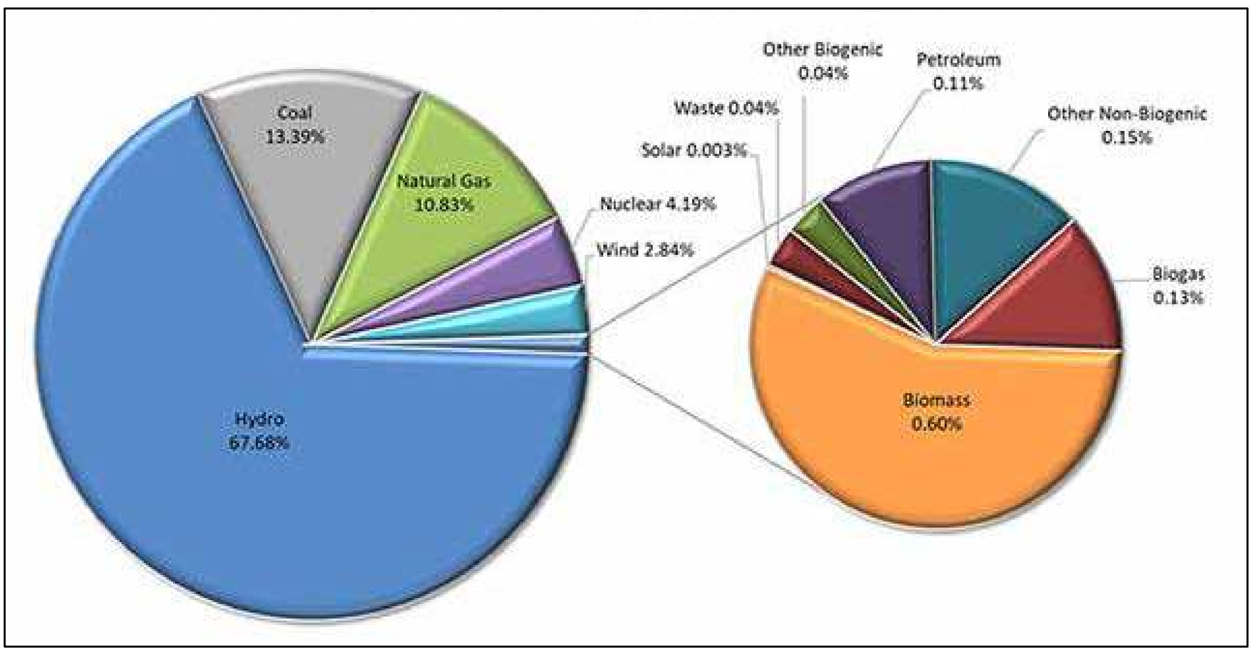
- **Extreme Weather Conditions -** Extreme heat, cold, wind, rain, flooding and fire danger are increasingly challenging the reliability, safety and cost of operations for electric utilities.
- **Increased Demand for Low Carbon Electricity -** To reduce carbon emissions, many states are vying for Northwest clean hydro power, putting upward pressure on wholesale power pricing and potentially reducing capacity for Northwest customers.
- **Coal Plant Decommissioning -** Coal generation in the Northwest is being decommissioned to speed the reduction of carbon emissions. Aside from the benefit of reduced carbon emissions, this removes significant firm capacity from the grid, which can increase cost of electricity, especially demand pricing.
- **Increased Regional Outages -** Increased demand coupled with reduced capacity increase the probability of major outages. "*We have a 30-50 percent chance of a major outage in the next 10 years.*" NW Power and Conservation Council

Shifting Energy Landscape

In 2019, Washington State passed historic legislation, Senate Bill 5116 (SB5116), *Washington Clean Energy Transformation Act* (CETA). This bill puts into motion a complex set of interdependent actions intended to speed a transition to clean energy but offers no plan or funding to get there.

CETA commits the state to a path for no coal generation by end of 2025 and 100% clean energy by 2045. This is a bold move, recognizing the need to reduce carbon emissions as fast as possible. But equally important is what Washington replaces that coal energy with. **Washington recognizes hydropower as a critical source of generation in order to meet this goal**. Similarly, the state of Oregon and many cities and electric utilities in the Northwest are all working towards carbon-free energy goals. To meet these goals, hydropower – with its energy storage firming capabilities and carbon-free attributes – will be especially important and it helps the region add even more renewable power to its resource mix. It is the go-to firm, clean, affordable energy resource. As western states decommission coal generation, the economics of supply and demand will put upward pressure on hydro pricing.

Referring to the chart below, coal generates about 13.4% of the energy currently used in Washington state. All of the renewable energy in Washington, built over the last two decades adds up to less than 3%.



Removing coal generation reduces the regions capacity headroom to handle extreme energy demand events. This will increase the likelihood of regional outages and rolling blackouts when the region is bumping up against the limits of capacity.

Recent Scarcity Events – A Wake-Up Call

Extreme Summer Heat Example

During July through September 2018, the Peak net load of the California Independent System Operator (CAISO) was 7% lower (46,000 to 50,000) than the peak load in 2017. Despite that, system marginal energy prices in the day-ahead market reached record highs on July 24, 2018, peaking at almost 98¢/kWh (or roughly 10x the typical retail energy rate members pay now) in hour ending 20 (more than double). The frequency of high day-ahead prices increased significantly during the third quarter, largely concentrated between July 23 and August 10, driven by extremely hot temperatures across the western region and limited natural gas availability.

Extreme Winter Cold Example

On March 1, 2019, the MidC index price for day ahead bilateral trades exceeded $900/MWh for heavy load hour energy and $160/MMbtu for natural gas. These prices were driven by a number of factors including very cold temperatures, a pro-longed cold period prior to March 1st resulting in depletion of hydro generation and natural gas in storage, a maintenance outage on the DC intertie, and limitations in supplies of natural gas impacting the ability of some natural gas generation to operate.

These high prices, and the capacity shortage that they reflected, occurred **despite all the soon-to-be retired PNW coal plants operating at maximum capacity**. It is important to note that wind and solar generation all but disappeared during this event. This reinforces why we cannot solely rely on wind or solar (or any single technology for that matter) to replace legacy firm resources. This occurrence should serve as a wake-up call to PNW entities.

The task ahead is enormous, and there is no plan or funding to replace that coal energy with clean energy. For that reason, the NW Power and Conservation Council recently wrote:

> *"The loss-of-load probability increases from 6 percent in 2021 to 7 percent in 2022, and to 8 percent in 2024. The analysis shows that the region will need about 800 megawatts of new capacity to maintain adequacy through 2024. If some of the coal-fired generators at the Jim Bridger plant in Wyoming and the two other generators at the Centralia plant retire by 2024, as currently planned,* ***the probability would increase to about 30 percent,*** *a situation similar to what happened in the 1990s that led to the West Coast energy crisis, when* ***the problem was not retiring existing plants but just not building enough new ones****."*

By loss of load, they mean an inability to meet demand on occasions when load exceeds generation resources. As load approaches the maximum supply, prices will increase sharply to curtail use. But if demand continues to rise, exceeding supply, outages can result.

Clean Energy Transformation Act (CETA) - The Fine Print

- Amends the Energy Independence Act (EIA) to include federal incremental hydro as an eligible renewable resource.
- An electric utility is in compliance with the Greenhouse Gas (GHG) neutral and 100% non-emitting standards if over four years the incremental cost of meeting the standards is **two percent or more** for each year.
- Amends retail tax RCWs to provide a **tax exemption** for machinery and equipment **for fuel cells, wind, sun, biomass energy, tidal or wave energy, geothermal resources** or heat recovery.
- State energy strategy - By 12-31-2020, and every eight years thereafter, Commerce will update the state energy strategy. **Membership of the energy strategy advisory committee must include one person recommended by rural electric cooperatives**.
- **Small Utilities** (Less than 25,000 consumers, or full-requirements customers). By December 31, 2020, and in every resource plan thereafter, identify how the utility plans over a 10-year period to implement this act. Plans must be presented at a public meeting and adopted by the governing board.

Preliminary PNGC Observations

Pacific Northwest Generation Cooperative (PNGC) staff is still completing its assessment of the impacts of CETA on its Washington members specifically and the entire PNGC membership in general. The following are preliminary conclusions that still need to be vetted fully. PNGC does not recommend any specific actions yet based on these preliminary conclusions as these are early general observations and they are still seeking clarification on aspects of CETA.

- It appears that first <u>direct</u> effect on Washington PNGC members will occur in 2030. We are not aware of any Washington Consumer Owned Utilities (COUs) that own coal so the coal phase-out by 2025 does not directly impact COUs in Washington.
- The BPA contract expires in 2028. **The largely carbon-free nature of our BPA power supply (i.e. about 88 to 98% carbon free depending on hydro conditions) will make BPA power more attractive in the short-term and particularly the long-term**. This must shape our thinking about a post-2028 BPA contract. One factor that could now change in a major way is that the Investor Owned Utilities (IOUs) that have access to BPA power under the 1980 Power Act may want direct access to BPA power rather than the "financial settlement" they now receive under the Residential Exchange settlement that goes through 2028.
- Once the 2030 provisions of CETA start, COUs that rely on BPA for power will likely still have compliance obligations. This could vary each year depending on hydro conditions. PNGC staff will seek more answers on how this particular issue (compliance obligations that vary based on hydro conditions) will be handled. Ideally, there would be some kind of multi-year smoothing similar to what it appears Oregon plans to adopt.

- Based solely on Renewable Energy Credit (REC) current prices, it appears that it would be far more economic to meet post 2030 compliance obligations with RECs rather than paying the high administrative/compliance fees for generation of GHG. It is likely even more economic to build carbon free resources than be subject to the high administrative/compliance fees for generation of GHG. However, REC prices could rise as a result of a new market demand to meet CETA requirements.
- CETA is a major policy shift that, along with carbon policy in California and likely Oregon, will have both direct and indirect impacts on power markets. California carbon policy, for example, influences market prices for power in the West. Carbon-free resources are now carrying a premium due to carbon pricing. While RPS tended to deflate power prices by causing oversupply, carbon pricing will likely have an opposite impact. This could have a positive impact on BPA secondary revenues which, in turn, helps BPA customers with additional revenue to offset costs we otherwise pay.
- CETA and other carbon policy in California and Oregon are going to accelerate the closure of coal plants. We are already seeing this play out. **This has already put upward pressure on power prices in short volatile periods** (for now). **We are also seeing an increase in extreme pricing events similar to this past March**. It is also setting up a **possible reliability situation as legacy firm dispatchable plants (i.e. gas and coal) are shuttered**. **It is not yet clear how the power system needs for this firm capacity to back up wind, solar and other intermittent power will be met**. California is pursuing a battery-based solution. That is expensive and it does not meet the unique winter needs of the Northwest. This need will ultimately have an impact on Washington utilities as well as all PNGC members and utilities in the entire region.
- Important clarifications are needed and rulemaking has yet to be started. PNGC will be participating in this to make sure we are prepared and that rules are reasonable.

The world is starting to take climate impact seriously and demand action from the leadership. CETA legislation is just one of what we expect will be a steady stream of climate impact related legislation.

Much of this IRP is focused on how to increase local energy resilience in preparation for the potential of increased outages and associated increased peak demand charges.

Further Reading

Future Northwest Capacity Shortages

Resource Adequacy in the Pacific Northwest

The intersection of Climate Impact, Energy and Salmon

Salmon Challenges are Complex

Regardless of whether rivers have dams, those rivers along the entire North Pacific Coast—from Alaska to southern Oregon, British Columbia and the Puget Sound – are experiencing similar or worse salmon return trends than the lower Columbia and lower Snake river basins.

This is true for rivers with dams and those without dams, and it includes rivers with nearly pristine habitat.

Scientists theorize the problem is occurring in the ocean. Some believe growing numbers of seals and sea lions, which feed on the fish, are behind the declines. Others say the warming and acidifying of the ocean is starting to affect the food web that the salmon depend on. There is strong evidence that ocean conditions, including ocean temperatures, form an important predictor of future adult salmon returns.

Scientists estimate that the oceans have absorbed more than 90 percent of the heat trapped by excess greenhouse gases since midcentury. Humans have added these gases to the atmosphere largely by burning fossil fuels, like coal and natural gas, for energy.

This excess heat is increasing not only baseline ocean temperatures but also the frequency and duration of marine heat waves.

An earlier study found that, from 1925 to 2016, marine heat waves became, on average, 34 percent more frequent and 17 percent longer. Over all, there were 54 percent more days per year with marine heat waves globally.

The most severe years tended to be El Niño years. Warmer ocean temperatures are one of the characteristics of an El Niño pattern.

There's also some indication that El Niños have been getting more extreme with climate change, but regional marine heat waves can happen even without an El Niño.

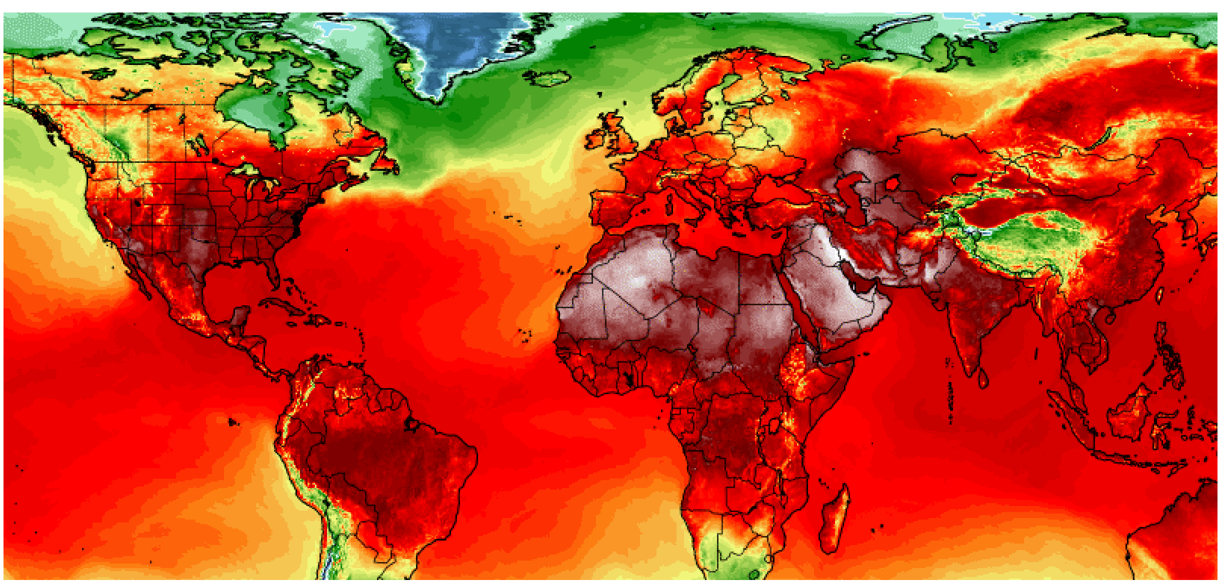
Climate is changing. There is a northward movement of many species on land and sea, toward cooler environs. In the *3rd Oregon Climate Assessment Report (2017)*, in a discussion of climate change impacts on fish and wildlife, **fish habitat is expected to degrade** due to increasing peak flows, earlier streamflow timing, reduced summer low flows, and warming summer stream temperatures that could shift preferred habitats, alter the timing of life history stages, and exacerbate current stressors for the Pacific Northwest's salmon, steelhead, and other aquatic wildlife.

Warmer temperatures, shift from snow to rain, and higher rainfall intensities increase risk of:

- Lethal stream temperatures
- Scouring of shallow-buried eggs from heavier winter streamflow
- Downstream migration timing of smolts desynchronized with spring freshet
- Upstream migration in summer/fall delayed by lower summer flow

Beyond the Northwest, in Rhode Island, Narragansett Bay has warmed as much as 1.6 degrees Celsius in the past 50 years, and for want of cooler water, the state's lobster catch has plummeted 75 percent in the past two decades.

During the summers of 2018 and 2019, the world experienced record heat waves. Though dams produce low-carbon climate-friendly energy, with or without dams, it is quite possible that salmon's northward movement to cooler waters is literally "baked in." As the world dithers on climate action, carbon emissions continue, the oceans will warm further and will likely take a century or more to return to the cooler temperatures of the last century.



Hydro Energy Reduces Climate Impact and Powers Our Economy

Hydro power is the single largest and cleanest source of energy in the Northwest. The Columbia and Snake river system traverses nearly 500 miles through four states, defining the lives of every person who relies on what they provide. It is a low-carbon, low-cost resource that is powerful enough to create jobs, sustain communities, and help us reach our clean energy goals. Through the Northwest hydropower system, massive salmon restoration projects have been made possible. These efforts are helping salmon recover despite poor ocean conditions and increased predation.

From 2017 to 2019, approximately 33% of the Bonneville Power Administration's wholesale power rate is associated with its Fish and Wildlife programs. For customers who buy power from a BPA-sourced utility, around 15% to 20% of their typical utility bill goes towards these programs.

Beneficial Electrification

On the positive side, **beneficial electrification** is helping members to save money while reducing their carbon emissions. Major trends include:

- **Electrification of Transportation** - About half of a typical San Juan County household's energy use is for transportation. Electric vehicles (EVs) cost about 80% less to drive. This cost advantage, coupled with the zero emission of EVs, is driving a remarkable global rapid transition to electric transportation. In 2018, the number of EVs in San Juan County grew by 63%. In the 20-year planning of horizon of this IRP, most vehicles will be electric. This will increase the demand for electricity, which can help keep rates lower and helps reduce the fixed cost share on utility bills.

- **Electrification of Heating -** After transportation, heating uses the second most energy in a home. Most OPALCO members heat with electricity. It is the lowest cost way to heat, especially using heat pumps. A recent survey shows OPALCO members continuing the trend of replacing fossil fuel heat (propane, fuel oil, wood) with electric heating. Typically, this replacement happens when their fossil fuel heater fails, and they look for better options. OPALCO recently introduced on-bill financing to help members make the switch to super-efficient heat pumps. Unlike electric transportation though, there is little new kWh sales, since many members are also upgrading from conventional resistance heat, which significantly reduces member energy use (heat pumps use about three times less energy compared to electric resistance heat). The net load change is forecast to be minimal. But, as with EVs, the carbon reduction is significant for members switching from fossil fuel heating. The chart below summarizes the benefits of electrification for energy and carbon footprint.

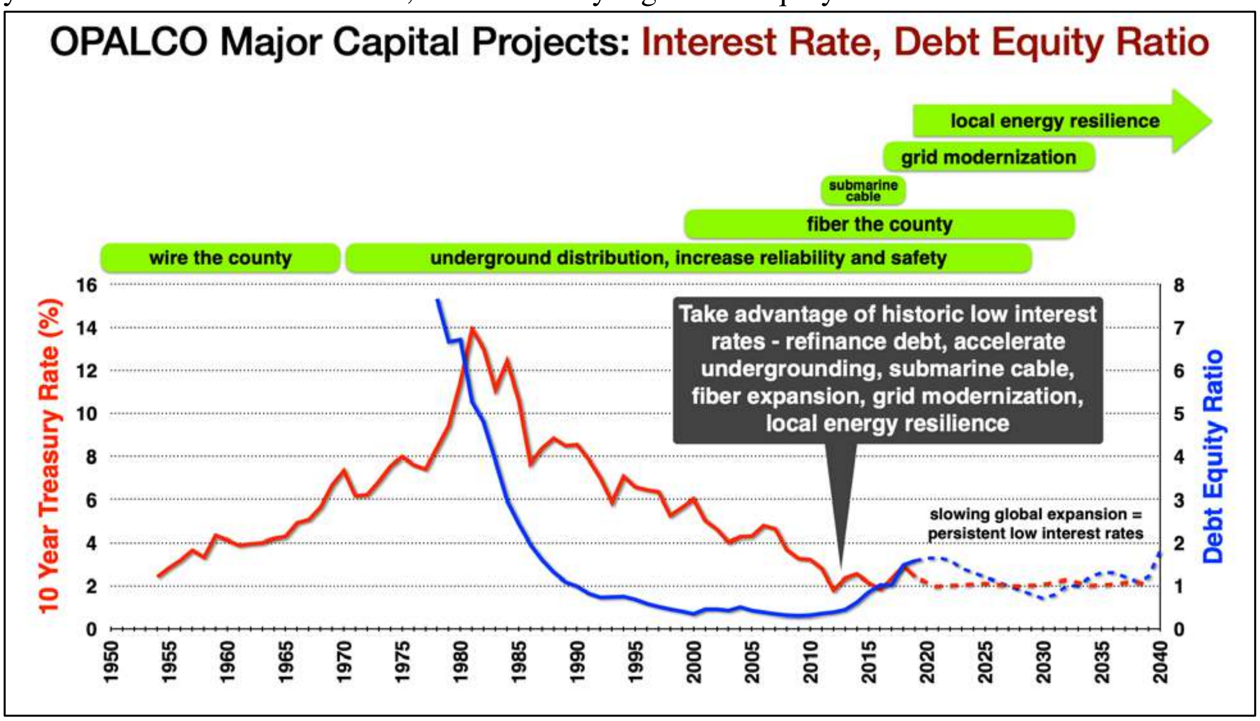
Global Risk and Opportunity

Risk

While **climate impact** and **beneficial electrification** trends are enormous, they are, to a large extent, predictable, and can therefore be planned for. But in an increasingly chaotic world, while we can hope for the best, we must prepare for the worst:

- **Unpredictable Events** - Major events such as a Cascadia Subduction Zone earthquake, associate tidal waves, cyber warfare, and proliferation of nuclear weapons, have the potential for extended outages of several months. BPA contract renewal and Columbia River Treaty negotiations, though less dramatic, present difficult to predict potential changes to business models, economics and the delivery of safe, reliable and affordable energy. There will be an increased need for local utility-scale and member generation resources (solar, storage, tidal), and adjustments to **grid transmission and distribution systems** to increase local energy resilience and reduce our dependency on mainland power.

- **Economic Uncertainty** - This IRP lays out a roadmap of capital investment to maintain and transform the grid over the next 20 years. The chart below shows a continuous stream of capital projects that blossomed with the laying of our first submarine cable in the 1950s: our connection to the mainland. Electric co-ops finance capital projects using debt. Those early years incurred tremendous debt, hence the very high Debt Equity Ratio.



What was less predictable in years past was the interest rate that the co-op could borrow at to fund capital projects. In the 1950s, interest rates where at historic lows. By the 1980s, interest rates had soared to over 14%. In the past decade, in response to the 2008 global financial crisis, interest rates plunged. OPALCO took advantage of those very low rates to refinance debt and accelerate capital-intensive projects. Economists are now suggesting that these low interest rates may prevail for decades as anemic growth, low inflation and high global debt set in. A kind of economic "Japanification" extended recession: once in, it's hard to get out, without significant investment. If this is the case, OPALCO's capital investments, can help support the local economy, in the same way that investment in fiber and LTE created jobs and provided a foundation for lifting the county above the low-wage tourist economy of the County.

- The Electric utility industry is faced with an aging workforce. OPALCO's need to attract and retain a young, smart team is both a challenge and an opportunity. There is a national shortage of qualified skilled utility staffers, driving up the range of salary packages. In our remote island communities, it can be difficult for spouses to find comparable jobs, and some find it difficult to fit into the island life. That said, new young candidates we see are often well versed in modern grid engineering methods and motivated to be part of a utility that has a track record for innovation and leadership in the industry. We must do all we can to build a workplace and compensation package that is attractive and rewarding for the long-term.

As mentioned above, capital projects are traditionally debt financed, generally provided by the Rural Utility Service (RUS). Over the past few years though, OPALCO has been applying for and winning a variety of grants from WA Clean Energy Fund, RUS, DOE, Commerce and others. These grants represent significant potential for funding grid modernization, local renewable energy, transportation electrification, and energy efficiency projects. OPALCO is seen by WA Clean Energy Fund, US DOE, and NRECA as an innovative leader, serving as a model for other co-ops across the nation.

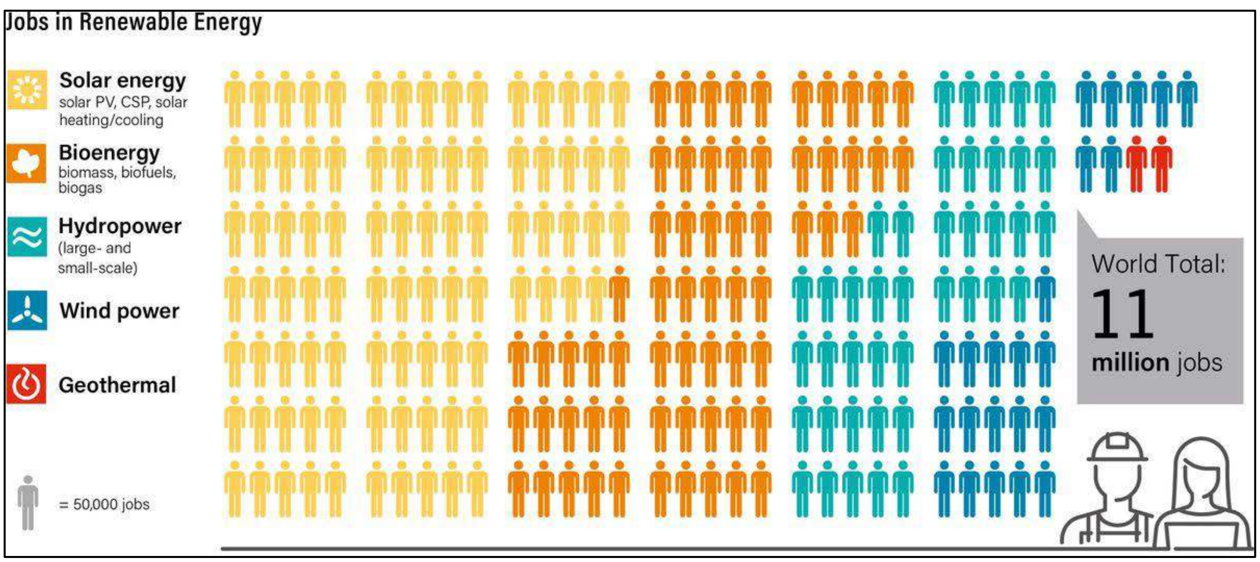
Opportunity

Clean tech energy and information services are among the fastest growing sectors of the economy.

As we have seen with county projects like community solar, accelerating rooftop solar member generators, grid modernization, Rock Island fiber and wireless service deployment – clean tech jobs are in demand. This lifts income for working people in the County above the low-wage tourist economy. The chart below provides a global perspective on the large role clean energy plays in job creation. Especially solar. There is tremendous opportunity to help reduce climate impact, while increasing clean energy resilience.

The San Juan County Economic Development Council (EDC) has a successful initiative to ramp up trades education in the local community. They have identified where there is a shortage of skilled tradespeople in the islands to meet the needs of our dynamic and growing community. Addressing this need, the EDC has partnered with local businesses and education institutions to provide well-paid career opportunities for island youth and residents.

The first major program under this initiative has been the Marine Education Program in which 17 students have already successfully completed the first stage of their education and are progressing to apprenticeships or further technical education. Other programs include welding, fiber optics, HVAC and a number of other programs relevant to the skill sets needed for developing the Co-op workforce . These clean tech skills are increasingly in demand as we build out local energy resources, including solar, storage, and tidal generation, deploy fiber to member homes and business, and improve the energy efficiency of home and business energy systems.



III. Load

Overview

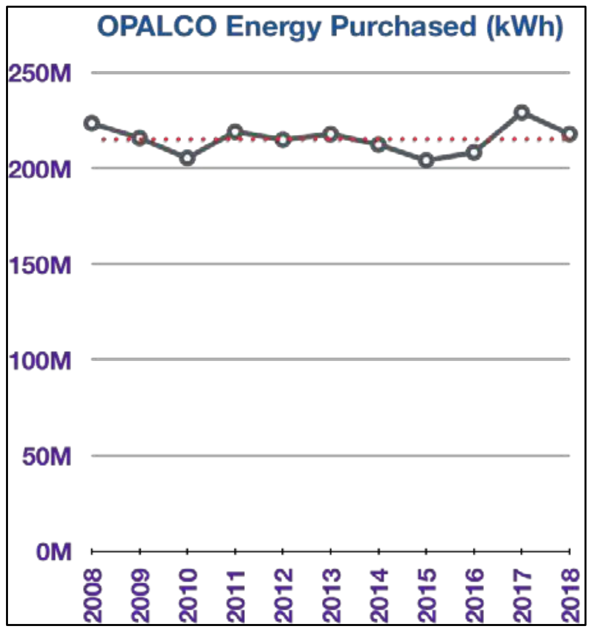
This section reviews current and projected load. We review trends that will drive load growth and reduction. Drawing on those trends, we present a simplified model of what the load will look like over the next 20 years. Later sections will explore low, nominal and high load scenarios to help evaluate optimal resource mix and grid evolution.

Load has three important measures:

- **Power** - the instantaneous amount of electricity being used by members expressed as megawatts (MW). Peak power demand typically happens in February and is 50 to 65 MW.
- **Energy** - the power used over time by members expressed as kilowatt-hours (kWh). Annual energy use typically ranges from 200 to 230 million kWh.
- **Demand** - Demand is the peak energy hour in a given month.

While annual total member energy use has a floor of about 200 million kWh, it can increase 15% depending on winter weather. Colder winters can pulse the load to 65 MW peaks when wind blows from the North and temperatures plummet below 20ºF. In a cold year, annual energy has approached 230 million kWh.

As the chart at right shows - weather driven variations aside - with slowing population growth and the success of energy efficiency programs, load has been essentially flat for the past 10 years.

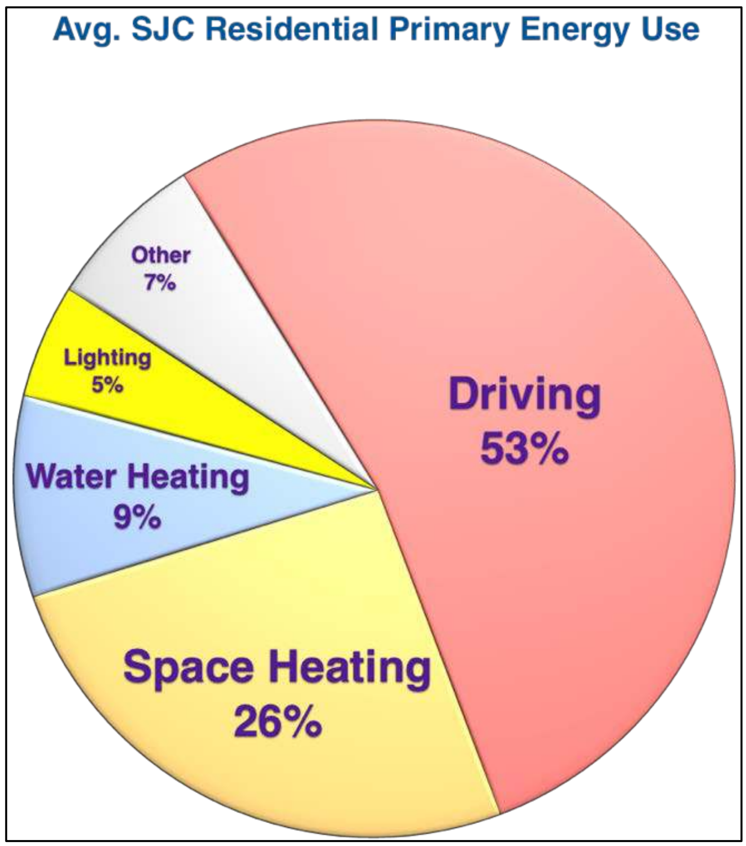


The Two Sides of Load

Load is a double-edged sword: it pays the bills, yet it costs money.

- **It pays the bills** – Load results from members using electricity for their homes and businesses. It is an essential part of a vibrant economy. Members pay the Co-op for the safe, reliable, affordable access to and delivery of that energy. So, increasing load increases co-op revenue, which helps keep rates lower by selling more electricity through our fixed-cost grid.
- **It costs money** – The energy OPALCO purchases to meet load has a cost. About one-third of co-op costs are for the energy we purchase from BPA/PNGC and member generators. We want to ensure that the load is efficient, to minimize waste. The less waste, the less requirement for generation resources, which means lower costs of service, which helps keep rates lower.

As the chart at right shows, the top ways islanders use energy include **transportation**, **heating**, **water heating** and **lighting** - accounting for over 80% of residential energy use. Some forms of energy are cleaner than others; OPALCO energy is very low carbon, while fossil fuels are high in carbon, exacerbating climate change. Transportation and heating that use fossil fuel energy are a major opportunity for combating climate change and saving members money on their TOTAL energy bill.



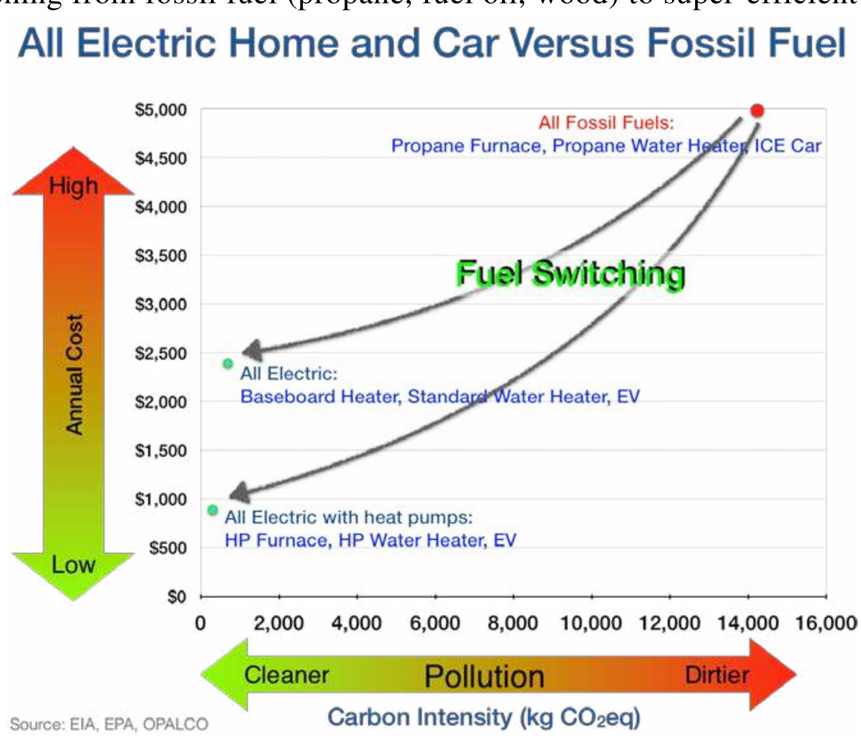
Beneficial Electrification

Shifting heating, cars, trucks and ferries from fossil fuels to electric, is referred to as *Beneficial Electrification*. It helps members in three important ways.

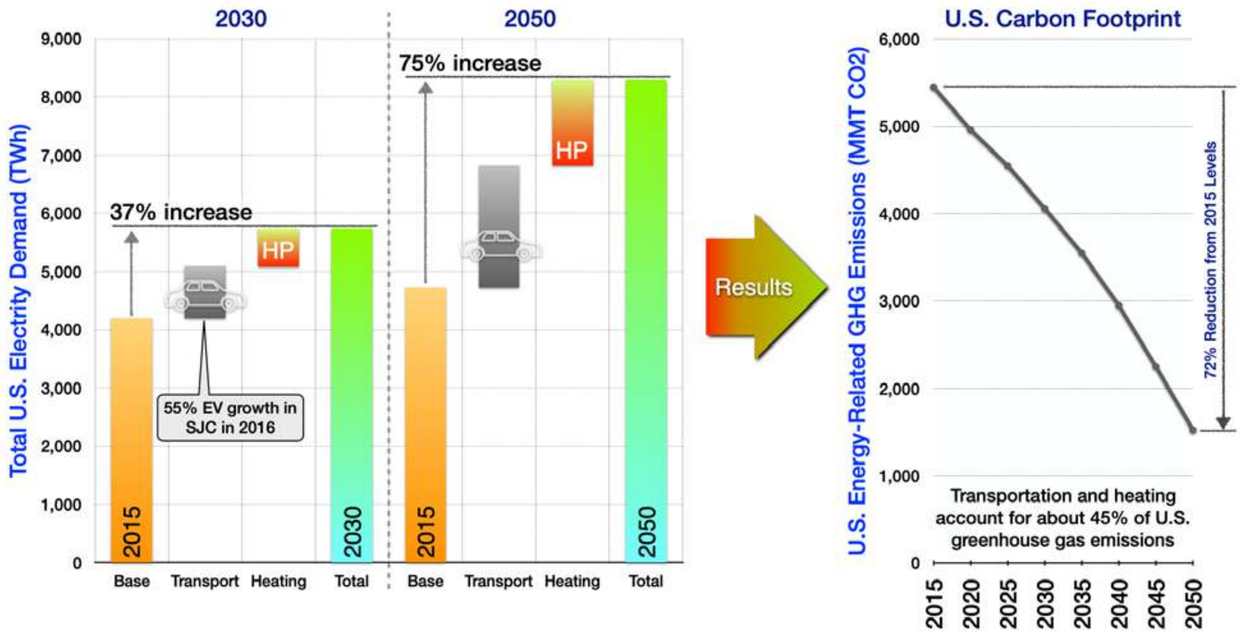
- **Much lower cost to operate** – Electric cars and heat pumps are super-efficient, use less energy, cost much less.
- **Less pollution** – Clean and quiet, environmentally friendly, reducing climate impact and carbon consumption.
- **Less maintenance** – EVs have fewer moving parts, no oil changes, no muffler – simpler.

For example: electric vehicles (EVs) replace fossil fuel gasoline with electricity. It's much lower cost and cleaner to drive on electricity than gasoline, typically saving members more than $1,000 per year and reducing pollution.

Similarly, with heating, switching from fossil fuel (propane, fuel oil, wood) to super-efficient electric heat pumps, typically saves members more than $1,000 per year, and reduces pollution. The chart at right shows a summary of the savings in cost and pollution, switching from fossil-fueled transportation and heating to electric. Assumptions: Car driving 10,000 miles per year. Internal combustion engine car gets 26 MPG. EV gets 4.5 miles per kWh. Heating is typical of a 70 million BTU island home.



Beneficial Electrification benefits the Co-op and the planet, too. By switching fossil-fueled heating and transportation to electric, electricity sales increase, maximizing the use of the fixed-cost grid, which helps keep rates lower. And, since transportation and heating account for about 45% of U.S. greenhouse gas emissions, it also helps reduce climate-changing pollution – an estimated 72% reduction by 2050, from 2015 levels (see chart below).



Beneficial electrification is one of the most effective forms of TOTAL energy efficiency. Electricity is more efficient that fossil fuels, when used for transportation and heating. Making the switch uses a little bit of electricity but saves a lot of fossil fuels. That's how energy efficiency saves members money in the long term. OPALCO has a new on-bill financing program to help members afford the upfront cost of energy efficiency measures (e.g. heat pumps, EV chargers), while reaping the rewards of reduced energy use and lower electric bills.

Trends Impacting Load

The following table summarizes trends that we expect will influence load in the 20-year IRP planning horizon.

Trend	Context	Implication
County Population	Late 20th century growth was exponential. Past decade has been less than 1% per year.	Steady small contribution to increase in new load.
Energy Efficiency	Energy efficiency continues to be the lowest cost "resource:" about 3¢ per kWh. Though many of the easy things – e.g. LED lighting – have been done, the remaining potential is substantial (see 7th Power Plan), particularly heating, water heating and transportation.	OPALCO should continue to fund effective energy efficiency programs, especially for heating, transportation, and smart appliances. The County should promote building standards that increase efficiency (e.g. insulation, passive solar, net-zero best practices).
Grid Efficiency	Just as efficiency makes sense for members, it makes sense for the Co-op's grid. It helps reduce system size, energy losses, and general wear and tear.	Continue upsizing distribution cable to reduce losses. Use grid control backbone and smart technology to monitor and control grid for optimal efficiency.
Peak Load	WA Legislation has essentially created an unfunded mandate to reduce carbon emitting energy sources. Coal plants are being decommissioned, but there is no plan or funding yet to replace coal with new cleaner resources. This leaves an ever-increasing gap between load and the generation resources needed to meet it. Extreme cold winter events will create unpredictable spikes in regional load demand. With fewer resources online, the NW Power and Conservation Council predicts a 30-50 % chance of a major outage in the next 10 years.	Demand spikes will create major regional outages and larger more frequent peak demand charges. Local storage, resilient grid, and local energy resources can help keep the power on for critical county functions and reduce demand charges. Rates and policy may need to be tuned to incentivize best practices that reduce demand spikes: DRUs, home storage, smart water heaters, etc.

Trend	Context	Implication
Battery Storage	Battery Storage System (BSS) costs are dropping. Batteries help reduce peak spikes in load and support critical systems during outages. Utilities are increasingly deploying utility-scale batteries and providing incentives for members to install their own dispatchable home/office batteries. This offers members the dual benefit of outage protection, while helping the Co-op avoid expensive BPA demand charges, by dispatching storage during times of peak demand.	Increase deployment of dispatchable utility-scale and member storage systems. Incentivize member storage systems with credits for dispatch of storage to reduce load. Take advantage of grants and low interest finance programs from WA CEF, DOE, and NRECA, to reduce cost. Storage helps with multiple use cases, including peak shaving demand spikes, outage mitigation, reducing transmission system wear and tear, meeting electric ferry charging demand spikes.
Electric Vehicles	SJC EV ownership grew 63% in 2018. The County has one of the highest per capita EV ownerships in the U.S. With battery costs dropping, it is estimated that EVs will be lower cost than comparable fossil fueled cars around 2022. This will lead to rapidly accelerating EV market share. Likely encouraged with a price on carbon (see discussion in Resource section).	EVs will significantly reduce member total energy cost and CO2 emissions. Over time, EVs will bring significant new revenue to the co-op. We expect more driving in summer than winter, contributing to a flattening of annual load in coming decades. Though EVs are very efficient, typically contributing less than 2,500 kWh per EV per year, as EV sales begin to go exponential in mid-2020's, rates should be designed to encourage charging at night when other demand is typically low. Dispatchable chargers should be offered and incentivized as soon as available.
Electric Ferries	WSF plans to convert their fleet to electric (hybrid) ferries starting in the later 2020s. Charging will be mostly during daytime hours, putting significant new load on the grid and bring substantial new revenue to the co-op. Electric ferries are lower cost to operate, and whale friendly, quieter, less polluting and lower emissions..	New revenue will help keep member rates lower. To mitigate spikes in demand during ferry charging, battery storage will be deployed starting in 2019, adding more every other year, for dispatch on demand during ferry charging cycles.

Trend	Context	Implication
Heat Pumps	Heat pumps are super-efficient and can cut member heating costs in half or better. More than 80% of heating in the County is electric, mostly resistance heating. Heat pumps will substantially reduce heating costs for members and heat load on the grid. Heat pumps pay back quickly. That, coupled with OPALCO's On Bill Financing (OBF) program, ensures most heating in the county will shift to heat pumps in the coming decades. Fossil fuel pricing is very volatile. When members switch to electric, they will find that they are not only saving money, their heating and driving bills are more stable and predictable.	Continue OBF program and deepen incentives to accelerate the shift from fossil fuel to electric. This helps members save on their TOTAL energy costs, while reducing climate impact. Converting resistance heat to heat pumps results in significant reduction of load and savings for members. Converting fossil fuel heating to heat pumps also saves members significant costs, with slight increase in winter load. Net load change is likely toward reduction of load.
Heating	Climate change is warming our winters. We have observed a steady reduction in Heating Degree Days (HDD). With our OBF program accelerating uptake of heat pump heaters and water heaters, we should expect heat load to decrease. It is slightly balanced by new load from members who are switching from fossil fuel to heat pump heaters. But heat pumps are so efficient, that the net load change is projected to be minimal and may actually result in a reduction of load.	Net heat load, even with beneficial electrification, is expected to decline, driven largely by climate impact on warming winters. Combined with increasingly warm summers and air conditioning (see next AC trend discussion), we expect a flattening of annual load in coming decades.
Air Conditioning	We are starting to see a slight increase in Cooling Degree Days (CDD). As climate impact warms our summers, and with increased market share of heat pumps – which include air conditioning – we expect this trend to accelerate. This will be new load, during summer, when load is traditionally at half of winter load.	The combination of AC, with EV and electric ferry load (higher in summer) will lead to new higher summer load. Climate change is reducing snowpack and shifting hydro toward winter, so one might expect summer wholesale BPA rates to increase. But new load can be met by the increase in local solar production – both community and rooftop solar.

Trend	Context	Implication
Lighting	Most members have converted to efficient LED lighting. Those that haven't will soon. Though winters are warming, they are still dark, and a part of winter load is the extended nighttime, with members turning their lights on earlier in the afternoon and keeping them on later in the morning.	Lighting contribution to load will remain flat, more in winter than summer. Expect that home supply shops will continue to trumpet the benefits of efficient LED lighting, further reducing lighting's share of the load.
Summer	In the coming decades, climate impact will generally increase summer temperatures, higher occurrence of extreme heat days. Being surrounded by the Salish Sea, with waters a tempering 55ºF in summer, will keep us cooler than the mainland. That said, on still days, in full summer heat, we project increased use of air conditioning. Shade trees are becoming an increasingly important form of passive cooling to reduce the need for AC. And, with increased summer hustle and bustle, EVs will be more of a presence around the islands, increasing summer load. With climate impact, summer droughts will likely increase, stressing water systems and aquifers. We expect to see an increase in desalination water systems, which are energy intensive. This will be a new contribution to load.	Climate change is reducing snowpack and shifting hydro toward winter, so we may expect higher summer BPA wholesale rates. But this may be balanced by more local community and rooftop solar production (and eventually tidal generation) – offsetting demand from BPA. The combination of AC, EV and ferry load (higher in summer), potential desalination system load, and reduced winter heating load, will lead to a net flatter annual load shape. Flat load is desirable. We should encourage members to plant deciduous trees around their homes and businesses to increase shade (passive cooling) and absorb CO2.
Winter	In the coming decades, climate impact will reduce cold winters. That said, climate impact brings increasing extreme weather – extreme rain, cold, wind – all things that will bring periods of extreme cold. Generally warmer winters may lead to less "snow bird" empty homes, leading to higher winter occupancy and higher energy consumption in what had been empty homes, with thermostats set to 50ºF.	Climate change is reducing snowpack and shifting hydro toward winter, with snow replaced by rain and runoff. So, we may expect lower winter BPA wholesale rates compared to summer. This will complement the dearth of solar production in winter – 80% less than summer. About 35% of member homes are unoccupied in the winter. Warmer winters may lead to increased occupancy and more load.

2018 Load Forecast

BPA, PNGC, and OPALCO completed the load forecast in October of 2018. This forecast includes a 0.53% increase to loads for the duration of the 20-year period excluding load growth due to fuel switching, energy efficiency and conservation programs. Factors which effect this growth are as follows:

- Economy
  - Commercial Activities
  - Residential Growth
  - Rate Based Load Shift
- Climate Change Impact: reduced heating load, increased cooling load
- Fuel Switching
  - Fossil fueled cars switched to EVs
  - Fossil fueled heating switched to heat pumps
  - Fossil fueled water heaters switched to heat pumps
- Conservation/Energy Efficiency
  - Long-term trends of residential use
  - Retail market electronics availability
  - Resistance heating switched to heat pumps
  - Resistance water heaters switched to heat pumps
- Distributed Generation
- Smart Grid Efficiencies

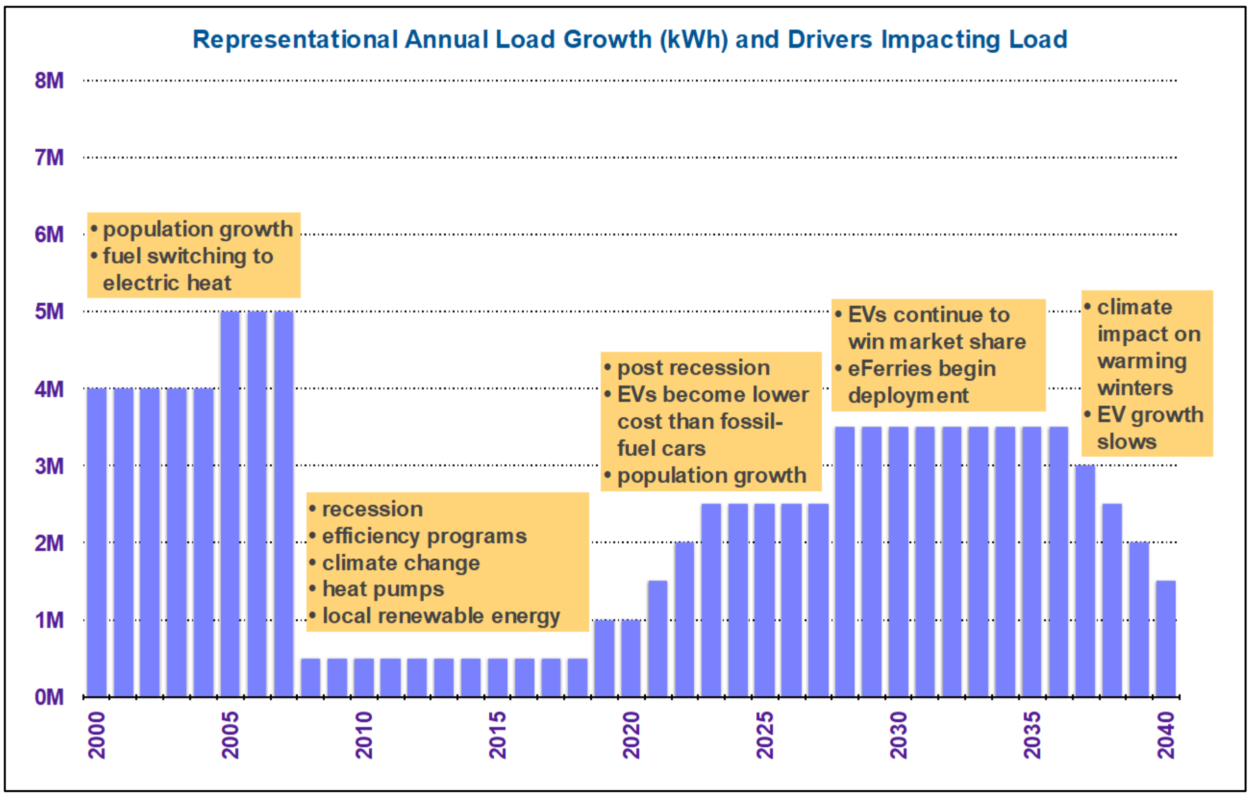
BPA Ten-Year Load Forecast for OPALCO

Each year BPA prepares a load forecast for OPALCO for the next 10 years. It uses a simple approach that only takes into account the past 10 years of load. There are no forward-looking considerations of trends, new load, and so forth. The most recent load forecast – November 2018 – projected annual load growth at a minimal .3%, with peak demand growing at .2%. OPALCO takes this and many other factors into consideration to forecast load.

Representational Long-Range Load Forecast

Load will continue be flat to slightly up, driven primarily by population, and members converting from fossil-fueled heating and transportation to electric – saving money and reducing carbon emissions. In 2023, load will gently start to increase as the market share for EVs, electric ferries, and air conditioning become mainstream in our territory. Summer load growth will outpace winter. The chart below shows how we project this will play out through 2040. Major drivers of load:

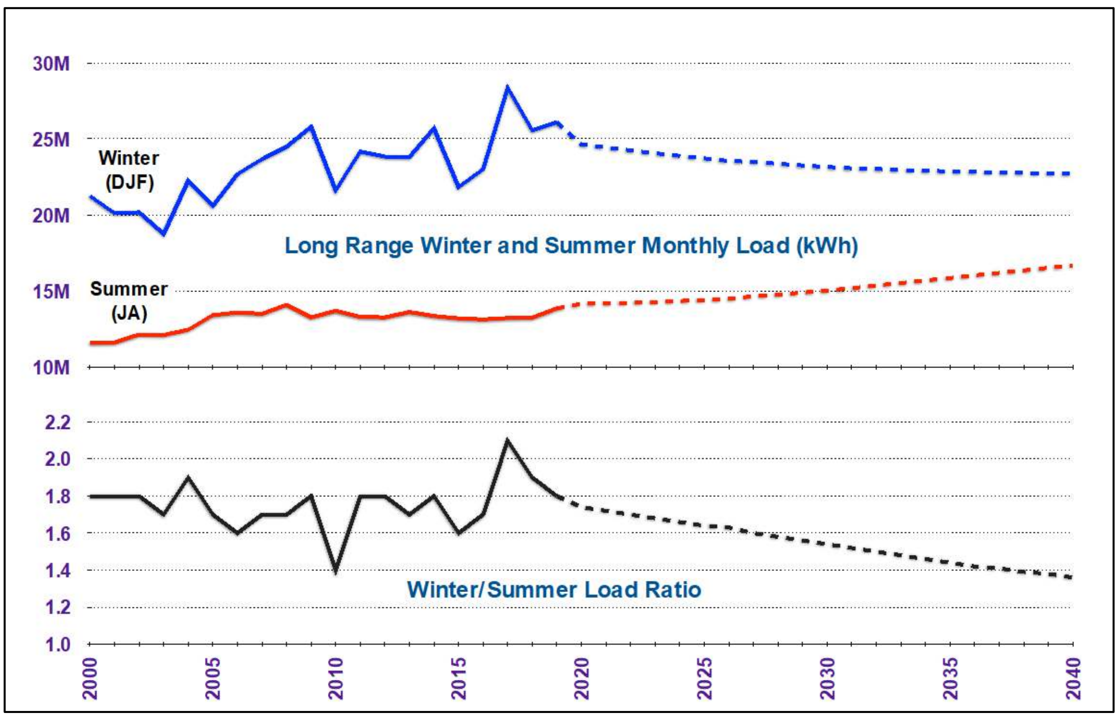
- **2000** - Load grows strongly, driven by strong population growth and members fuel switching to low cost electric heat from expensive fuel oil and propane.
- **2010** - Load flattens as recession hits, population growth flattens, OPALCO initiates energy efficiency programs and heat pump incentives, climate impacts warming winter, and rooftop solar accelerates.
- **2023** - Load grows as EVs hit price parity with gasoline cars, accelerating market share.
- **2028 -** Load growth accelerates as WSF begins deploying electric ferries.
- **2035 -** Load growth contracts as climate impact accelerates, reducing winter heating load. WSF eFerries deployment completes. EVs have displaced fossil-fueled cars and growth slows. There may be some added loads due to desalination ramping up due to climate impact on potable water availability.



Shifting Seasonal Load

Referring to the chart below, the upper section shows **monthly load** for winter of each year (blue line – December, January, February average), and summer (red line – July, August average). The lower section shows the **ratio of winter to summer load**. The **load ratio** has been fairly flat from 2000 through 2019, with winter load being about 1.8 times summer load. But our long-range forecast is for the ratio to trend downward. Primary drivers include:

- **Winter Load Decreasers**
  - Warming winters due to climate impact – reducing heat load
  - Increasing efficiency of winter heating – reducing winter load
  - Members continue to convert incandescent lighting to LED, reducing lighting load during long dark winters. About 5% of home energy use goes to lighting.
- **Summer Load Increasers**
  - Warming summers due to climate impact – increasing AC load
  - Increasing EV load, with more driving in summer than winter
  - Increasing eFerry load in the 2030s, with more stops in the summer
  - Desalination plants mostly run in the summer, and with climate change, are increasing their output as water becomes scarcer for a growing population. For example, six desalination plants in the county currently desalinate about a million gallons per year, using about 25,000 kWh.



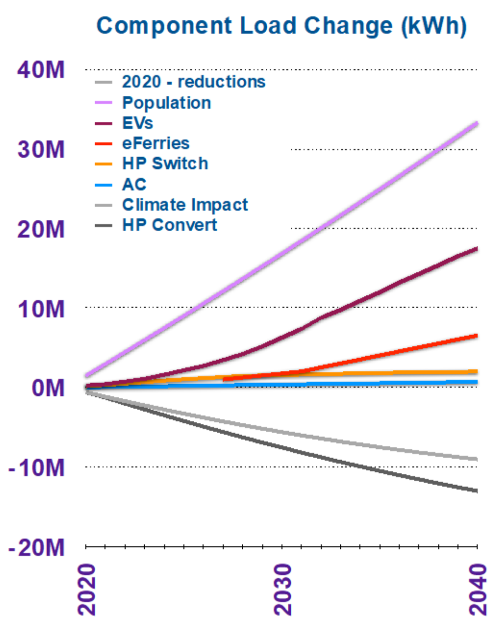
In general, having a Winter Summer Load Ratio closer to 1.0 improves Load Factor – less peak demand in winter – which helps keep winter bills lower for members, and more load in summer, when the economy is strongest, with more jobs and better wages and income.

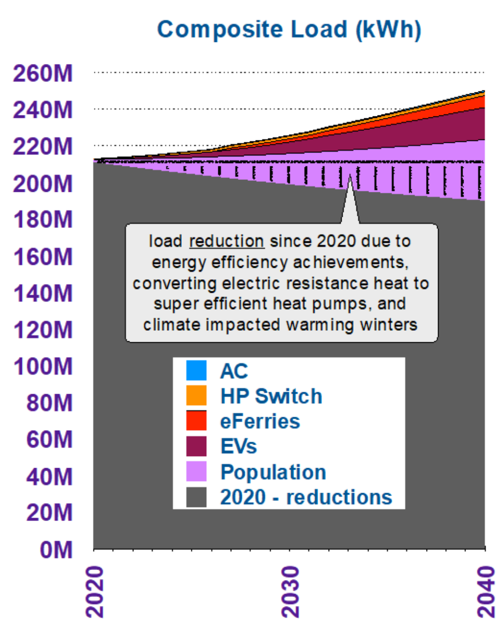
Load Components

From the load growth rates and drivers discussed above, the chart below provides a component and composite view of our 20-year load forecast.

- **Population growth**, even though it is less than 1%, it remains the most significant component of load growth. Each new member consumes an average of about 12,000 kWh per year.
- **EV charging** load starts softly, but ramps up in the mid-2020s as the price of EVs become less than fossil-fueled cars.
- **eFerries** start to come online in the 2030s.
- **Climate Impact** with warming winters significantly reduces load.
- **Heat Pump Conversions** from electric resistance heat also reduces load significantly.

population + EVs + eFerries + fuel switching + AC - efficiency - climate reduced heating





Key Concepts

Power

Power is the measurement of energy used be an electric device, appliance, or your total home or business at any given moment. If you buy a 10-watt LED light bulb, that's the power it consumes. If you run that 10-watt bulb for 100 hours, the **energy** (see below) it consumed was 10 watts X 100 hours = 1,000 watts, or 1 kilowatt hour (kWh).

With about 12,000 members in the co-op, we never know how much anyone will be consuming at any given moment, summer and winter, but we have a pretty good idea what the average will be, and we engineer the grid to make sure we can meet that highest possible demand for power, plus plenty of room for the unexpected. The peak power used by all OPALCO members typically occurs on a cold February morning or evening and is 50,000 to 65,000 kW or 50 to 65 MW.

Energy

Energy is a measure of how much power we consume, over time. Energy is expressed as kWh (kilowatts per hour = 1,000 watts/hour).

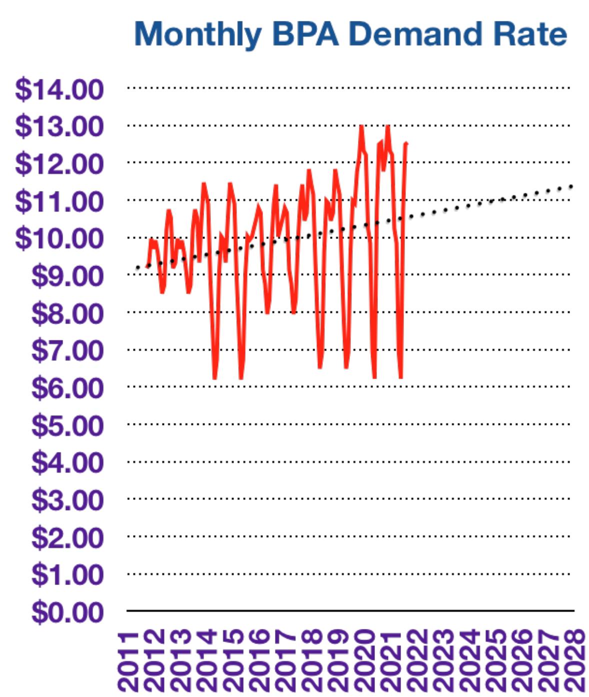
If you ran a 10-watt LED light bulb, it would take **100 hours** to rack up 1 kWh of energy. But if you ran 10,000-watt hot tub, it would rack up 1 kWh in **6 minutes**. They both consumed the same **energy**, but the hot tub consumes much more **power**, so that energy powers it for a shorter time.

Your monthly energy use is a basic part of your OPALCO bill. OPALCO residential member energy charges start at 10.57¢ per kWh. The typical OPALCO members consumes 700 to 2,500 kWh per month with the highest usage occurring in colder months.

Demand

Demand (expressed as kilowatts, or kW) is a measure of maximum average **power** usage over a 15-minute period during the billing cycle. While a kilowatt hour is a measure of the total **energy** we use over a specific billing cycle, **demand** is a measure of the fastest rate at which we consumed **energy** over a specific billing cycle. For example, when temperatures suddenly drop and a lot of members turn their heaters on at the same time – typically during high peak demand periods such as 8 AM and 6 PM – **demand** on the OPALCO system spikes.

The chart at right shows demand charge rate ($/kW-month). It fluctuates monthly, higher in winter, lower in summer.



Bonneville Power Administration (BPA) bills OPALCO more **when the rate at which we use energy unexpectedly increases.** For example, in February of 2014, the outside temperatures dropped suddenly. When everyone cranked up their heat, OPALCO drew more energy from BPA than we had projected to use. This sudden demand translated into a hit of $200,000 on the next bill from BPA, which became an unbudgeted expense. In keeping with the Co-op cost-of-service financial model, we pass that along to members as a **Demand Charge** when BPA use exceeds our contracted level.

Demand rates and managing demand are also important when EVs are charging. The best time to charge EVs is at night when demand is lower, OPALCO will work with members to EVs are charged during low demand times. Many utilities use Time of Use (TOU) rates to accomplish this. DC Fast chargers have much more demand than Level 1 or Level 2 chargers. All 3 kinds of chargers can deliver the same energy (kWh) to a EV battery but the main difference is the speed at which they charge and the kW of demand they impose.

Demand Response

Demand Charges from BPA have been one of the fastest growing costs of wholesale electricity. Demand Response Units (DRUs) are a proven effective way for utilities to peak shave spikes in load. Demand response could begin to play an ever-increasing role for our members. During peak usage times OPALCO will be incentivized to reduce load due to the regions peak demand. To accomplish this OPALCO will work with its member base to find creative ways to reduce load. This will likely result in a new time of use (TOU) rate structure as well as demand response units to control high kilowatt devices such as heating, water heater, and 240 V appliances. This would be an optional program and would not be considered the primary means of reducing load on our system.

Demand response costs from $50 to $120 per kW of load it is applied to, to implement and operate DRU programs, and install the DRUs.

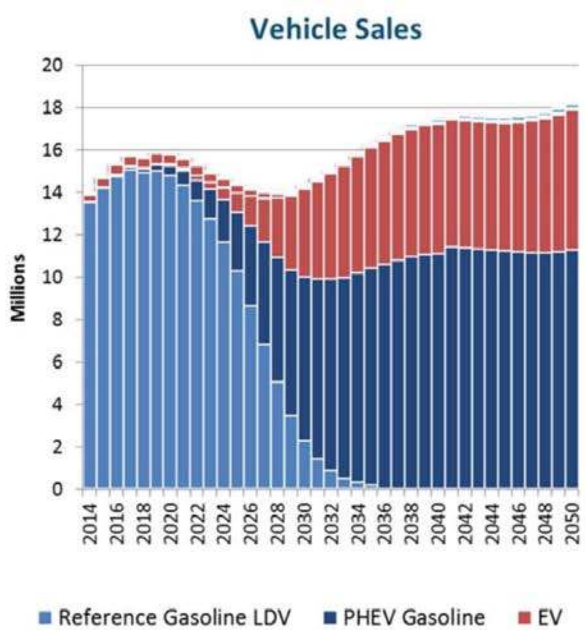
Switch it Up!

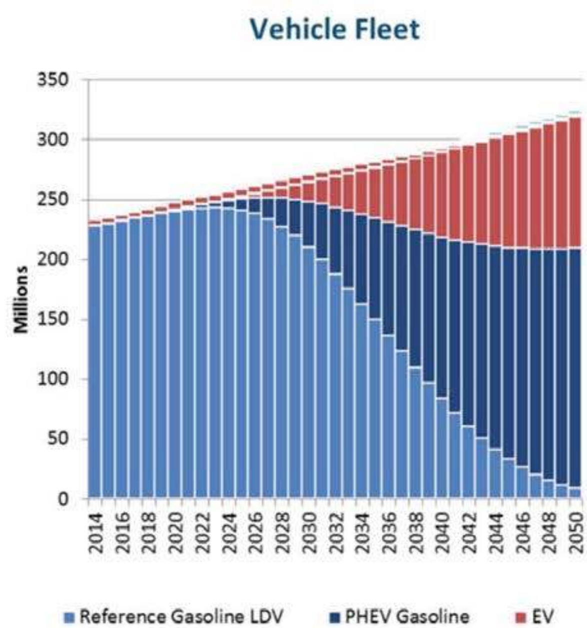
In 2019, OPALCO launched a program to accelerate energy efficiency and fuel switching. The goals were to increase efficiency, decrease member cost of <u>total</u> energy, and decrease use of carbon-based fuel use in the County. In its current form, the program is targeted to convert fossil fuel and electric resistance heating to heat pumps, convert fossil fuel and electric resistance water heaters to heat pump water heaters, and fossil fuel cars to electric vehicles (via installation of charging stations). This program uses USDA/RUS Rural Energy Savings Program (RESP) zero-interest loan funds to create a revolving fund for members to finance these projects at a low interest rate (2% to cover admin costs) on the member's electric bill. We expect to win a second round of RESP funds, about $10 million, to further accelerate the Switch it Up! program.

Members are showing strong interest in the program, with about $550,000 in financing in play (53 projects) in the second quarter of the program. About 30% of the projects are fuel switching related and will add new load. But that new load is more than balanced by efficiency gains as electric resistance heating members convert to heat pump heaters, significantly reducing their heating load.

EV Overview

There are several EV types that drive the transition all electric EVs, also known as Battery EVs (BEVs), and gasoline plugin hybrids EVs (PHEVs). Examples of PHEVs are the hybrid Toyota Prius, but with larger batteries, allowing electric only driving for 30 to 60 miles or more before the gasoline engine would turn on. Since the average commute is about 40 miles, PHEVs can give those who drive greater distance the assurance of not needing to recharge until they get back home to top off the battery. In our island county though, we see many more EVs, since the average driving distances in a typical day are well within the 100 to 200+ mile range of pure EVs. The chart below shows the projected U.S. mix of EVs and PHEVs in the coming decades. The chart at left shows electric vehicle sales displacing gasoline light duty vehicle (LDV) sales by the 2030s. The chart at right shows how that mix plays out in the total fleet, keeping in mind that cars last for about 16 years (scrappage), and it takes time for legacy gasoline cars to leave common use.

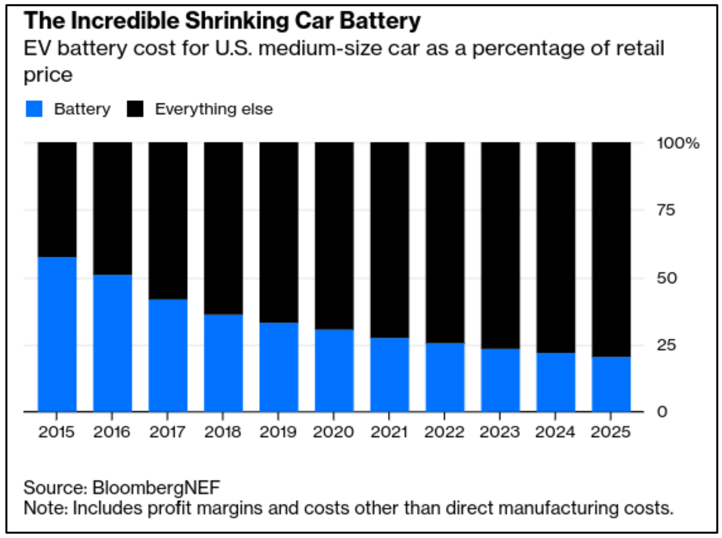




EVs are a small but rapidly growing component of our load. That load has been easily offset by our successful energy efficiency programs, local new generation, including community solar, and our recently launched Switch it Up! program which reduces load by converting resistance heating to super-efficient heat pumps.

But in the coming decade, EVs are on pace to reach price parity with internal combustion engine (ICE) cars in the early-2020s. Bloomberg New Energy Finance (BNEF) has been tracking the EV market for several years. In 2017, the team suggested EV parity would happen in 2026 — under a decade away at that time. In 2018, BNEF changed their forecast to 2024. Now they are projecting 2022.

Given the total cost of ownership of EVs is already superior to fossil vehicles today and price parity is important for many buyers, who want the clean emissions and low driving cost of EVs, but don't want to pay more up front.



EV prices are falling because battery prices are falling. Batteries are a major component of the EV (see chart at right). In addition, those batteries are becoming increasingly popular with utilities, for firming solar and mitigating outages, further accelerating manufacturing efficiencies and driving cost down.

Dr. Maximilian Holland, at CleanTechnica observed:

> *"The history of technology adoption shows that, once market penetration of a new technology passes a foothold of around 2.5% to 5%, it then quickly takes off. US household adoption of automobiles moved from 2.5% to 50% in around 12 years.*
>
> *For EVs, this 2.5% to 50% transition has already happened in Norway, taking around 7 years. Iceland is on track, with the move from 2.5% to >25% (expected this year) taking 5 years. Its 2.5% to 10% move took 3 years. Sweden is passing 10% this year, 4 years after passing 2.5%. China passed 2.5% in 2017–2018 and looks set to pass 10% in late 2019 or 2020 (around 2.5 years). Q1 2019 saw 7.5% EV market share in China."*

EV Highlights for Washington State

Transportation is the state's largest source of greenhouse gas emissions at 42.5%. Advancements in electric vehicle (EV) technology in conjunction with the state's abundant and inexpensive, low-emission electricity, enables the state to greatly reduce greenhouse gas emissions by dramatically increasing the number of electric vehicles on our roads. The continued electrification of the state's transportation system will be vital to meeting the state's long-term greenhouse gas emission goals.

With very clean, low cost electricity in the northwest, Washington state has become a leader in US EV market share, second only to California. The table below Shows 2018 EV market share and growth from 2017, for San Juan County, California, Washington, and Oregon. WA EV market share grew 71%, to just under 5% market share. This mirrors what we are seeing in San Juan County, where EVs grew at 63% in 2018.

State/County	2018 EV Market Share	2018 Growth
San Juan County	6.11%	63%
California	7.84%	56%

State/County	2018 EV Market Share	2018 Growth
Washington	4.28%	71%
Oregon	3.41%	44%

As of December 31, 2018, there were 42,542 plug-in electric vehicles registered in Washington State.

- Battery electric vehicles (BEV): 28,423
- Plug-in hybrid electric vehicles (PHEV):14,119
- The split between BEVs and PHEVs remains about two BEVs for every one PHEV.
- With the delivery of Tesla Model 3 vehicles, Tesla's registrations increased from 5,873 at the end of December 2017 to 12,298 in at the end of December 2018: a 109% increase. Of all the Teslas registered in WA, 5,117 are Model 3s.

EV Highlights for San Juan County

As of December 31, 2018, there were 428 plug-in electric vehicles registered in San Juan County – a 63% increase from 2017.

- Battery electric vehicles (BEV): 182
- Plug-in hybrid electric vehicles (PHEV):246

EVs are now an important component of our load forecast. As EV market share increases, it will help the co-op increase beneficial electrification load, helping keep rates lower through increased kWh sales.

Electric Ferries

Electric ferries (eFerries) are proliferating around the world, especially in Nordic countries in their island archipelagos, similar to the Salish Sea. Contribution to load will pale in comparison to EV load but will represent a notable new source of revenue none the less.

eFerries are whale-friendly, much less polluting and a smart economic choice over our current fleet of diesel-powered ferries:

- **Cleaner** – 95% less emissions means reduced ocean and river warming, which means less migration of salmon to cooler northern waters. Power to the ferries would use OPALCO's low carbon, clean hydro and local renewable energy – not "coal by wire" as provided by others in the region. Currently, 67% of all WA DOT vehicle emissions come from WA ferries.
- **Quieter and Reliable** – Electric motors are much quieter (better for whales and wildlife) easier to maintain, and more reliable than diesel engines.
- **Lower Cost to Operate** – 80% less operating cost. OPALCO energy is much lower cost than diesel, per mile. And OPALCO's grid modernization initiatives include storage to mitigate increasingly expensive demand charges, common when an eFerry is charging up.

OPALCO's hybrid fiber-wireless communication network supports high-speed real-time data flow between the new class of electric ferries and the ferry operations center. An example from the EV world: According to McKinsey, a typical connected EV generates about 25GB of data per hour.

Electric ferries will help increase use of OPALCO's grid, strengthening revenue, which helps keep rates lower for members. When an eFerry docks, it begins a rapid charging cycle – drawing an estimated 8 MW for about 15 minutes. OPALCO was awarded $1 million WA Clean Energy Fund grant for innovative grid-scale battery storage system. OPALCO's innovative approach to grid-storage may help WSF electric ferries avoid about $691,000 in annual demand charges that would typically be incurred during rapid ferry charging. That's over $40 million in savings over the life of the ferry.

In the Resource discussion below, a distributed mix of utility-scale and member storage will be used to avoid demand charges from BPA.

Demand load will be large, which OPALCO will manage using a mix of utility-scale and member storage, which offer a multi-use resource to firm local renewable energy intermittence, peak demand events on cold winter days, transmission congestion relief and asset deferral, and outage mitigation.

It is notable that though ferries use a lot of energy, there will be only a handful in the islands here, so their collective load is less than that of EVs, but there are many more EVs, which collectively use more kWh than eFerries, in a given year. See more in the Load Components discussion above.

eFerries are Whale Friendly

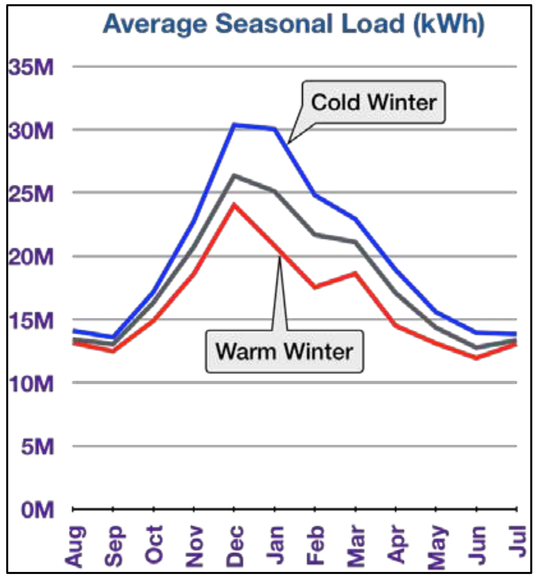
eFerries are emit significantly less air and noise pollution. According to WA Governor Inslee's Office "*A recent study found southern resident orcas lose up to 97 percent of their ability to communicate with each other due to noise pollution.*"

In a recent review of the Nordic electric ferry Elektra, Ship Technology magazine said: "*What's particularly noticeable about traveling on the Elektra is the complete lack of vibrations and engine noise.*"

Load Seasonality

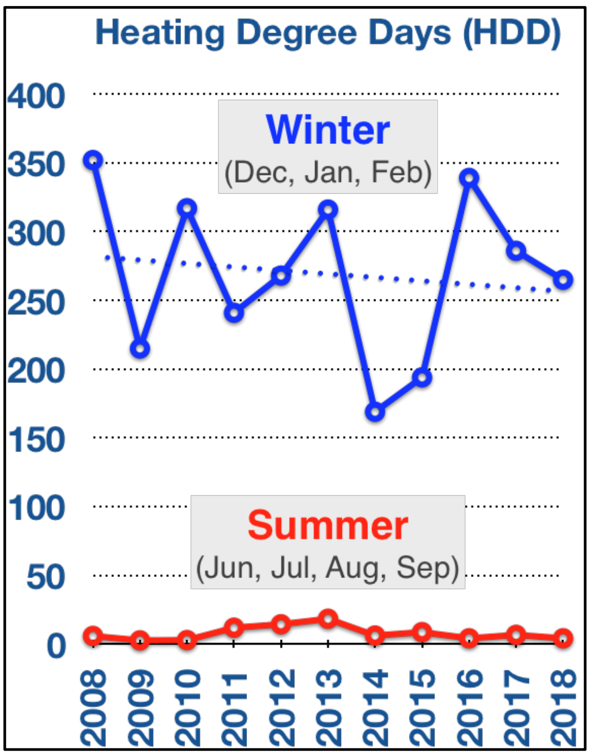
OPALCO load varies with the season – at its lowest in the summer, doubling in the winter.

- Summer averages about 14 million kWh per month.
- Winter averages about 25 million kWh per month.



Very cold winters can see loads above 30 million kWh per month, with power peaking at over 66 MW. Those cold spikes tend to be Nor'easters, with fast cold winds that increase heat loss from homes and businesses and increase heat load. The chart at right shows typical OPALCO load for average (gray line), warm, and cold winters.

Those wind-driven events are hard to predict. More predictable are warm El Niño and cold La Niña cycles, which tend to last for a year or two.



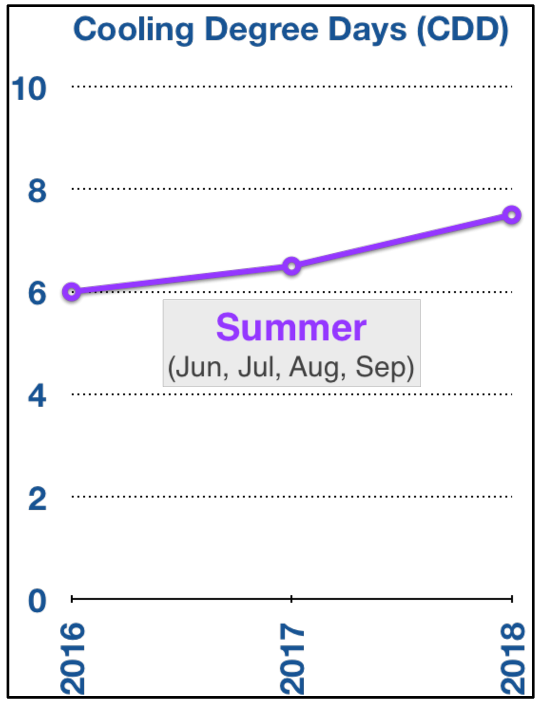
Referring to the chart at left, we can see these cold and warm winter cycles playing out. The chart shows Heating Degree Days (HDD) for winter and summer seasons. The higher the number, the more heating was required, and hence the larger the load. Cold winters have HDDs above 300, warm winters have HDD around 200.

It's also important to note the dotted trend line. We are seeing a general warming trend - about 25 HDD less each decade. **If that trend continues, winters will be summer-like at the end of this century.** Aside from the environmental consequences, this has enormous implications for reduced winter load, and kWh requirements.

The red line shows that in summer, there is minimal need for heating – mostly in the shoulder months of June and September. With climate impact, we expect summer heat load will reduce to near zero in coming decades.

Just as climate impact is driving a shift to warmer winters, it is warming our summers too. Though we are surrounded by the Salish Sea, which helps keep us warmer in the winter and cooler in the summer than our mainland neighbors, we would expect to see increased use of air conditioning.

To explore this, we are starting to track Cooling Degree Days (CDD), for summer season. The chart at right, shows a small CDD signal. We will continue to watch it and expect that it will be a harbinger of warmer summers ahead, indicating increased need for cooling in summer.



As more and more heat pumps are installed in homes and offices, we expect to see the use of the heat pumps integral air conditioning feature finding more and more use. This can be especially important to our more vulnerable elder population, as climate impact brings more frequent extreme heat periods in summer. San Juan County has a much larger elder population compared to mainland Washington.

Conservation and Energy Efficiency

Conservation and energy efficiency measures serve as a means to continue the same level of electric services and uses while reducing consumption. These measures ensure that new and existing facilities are cost effective, minimize or reduce load requirements, defer capital investment and maintenance, and reduce purchase requirements.

The major sources of conservation potential are heating, water heating, and lighting. Secondary potential comes from appliances and consumer electronics, which happen organically as manufacturers constantly improve the efficiency of their products, with incentives from public policy standards (e.g. FTC Energy Guide).

Based on OPALCO's service area, load profiles, and service mix, the majority of potential is in the residential sector. The measures used to achieve these figures include the following:

- Heat pump supplements and upgrades
- Lighting conversions
- Consumer electronic replacements and upgrades
- Water conservation and heating replacements and upgrades
- Home envelope upgrades

OPALCO's Switch it Up! program is helping members save money and energy. See the discussion above in the Key Concepts section.

Conservation Potential Energy Assessment (CPA)

In 2015, a Conservation Potential Assessment ("CPA") was prepared. This assessment provides estimates of energy savings by sector for the period 2016 to 2035. The assessment considers a wide range of conservation resources that are reliable, available and cost-effective within the 20-year planning period. The CPA informs our policies and efforts to help members save energy.

OPALCO offers programs for all customer classes aimed at meeting goals including full participation in BPA's Conservation Rate Credit program, consistency with the Northwest Power and Conservation Council methodologies, responsiveness to customer needs and meeting load in a cost-effective, customer-focused manner. In addition, OPALCO's Policy 28 states that OPALCO will strive to encourage and increase the use of energy efficiency and conservation in its service territory. Policy 28 goes on to say that OPALCO will encourage members "to seek other sources of funding to perform retrofits outside the scope of BPA's energy conservation programs". Increases in conservation and energy efficiency reduce OPALCO's dependence on mainland power generation and enhance the utility's self-sustainability.

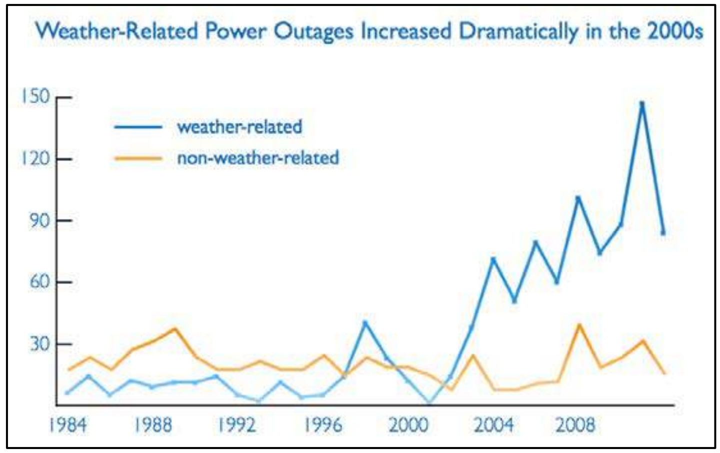
The benefits of conservation/energy efficiency include:

- Lowest cost resource option: about 3¢ per kWh
- Reduces load requirements
- Deferred capital investment and maintenance
- Reduced market price risk and reduces carbon footprint by reducing purchase requirements

A comparison of the 2013 and 2015 CPAs shows that cost-effective conservation is down 42 percent over the 20-year study period in the 2015 CPA. The change in conservation potential is the result of several changes to the input assumptions, including measure data, conservation achievement and avoided cost assumptions. Basically, homes are becoming more efficient due to programs, market transformation efforts, and code and standard updates. In addition, avoided costs, which are based on projected wholesale market prices are down due to the decrease in wholesale market prices.

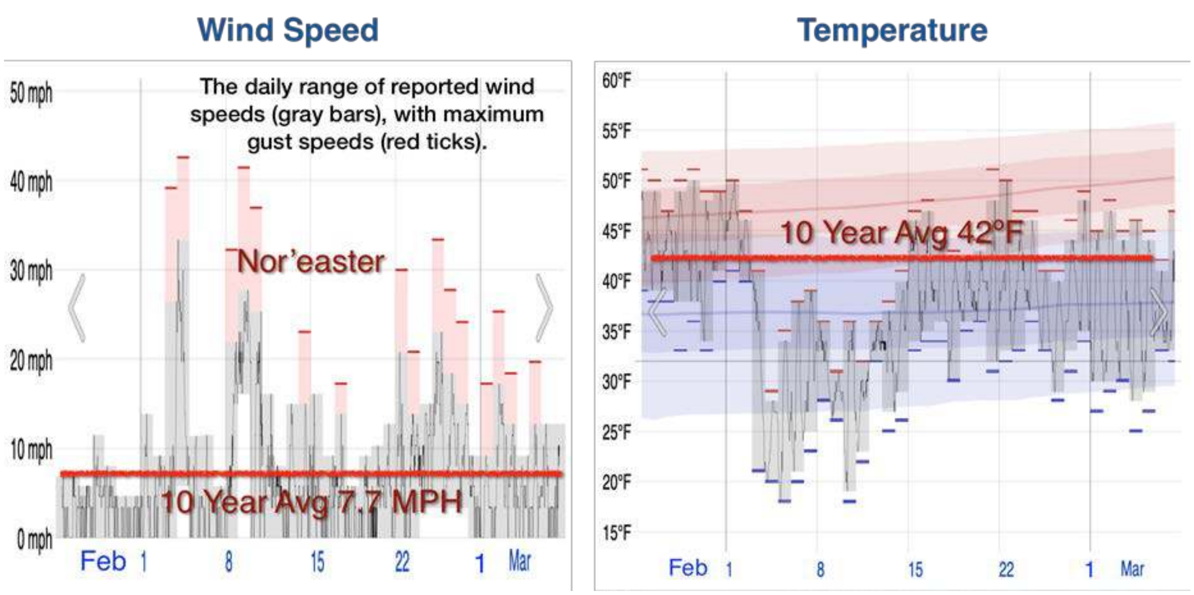
Load and the Impact of Weather

A massive 78% of the total U.S. power outages are related to **extreme weather events**, at a cost of $20 billion per year (source: Congressional Research Service).



SJC electricity outages cost the local economy about $3.5 million per year (source: Lawrence Berkeley Labs Interruption Cost Estimator (ICE)).

In OPALCO's service area most damage occurs during periods of high wind and extreme cold. A recent example occurred in February 2019 when a Nor'easter blew in for about a week, bringing extreme cold temperatures and very strong winds. See chart below.



While most of OPALCO's distribution system is storm-hardened by undergrounding, the high voltage transmission lines necessitate aerial deployment, on poles, which make them more vulnerable to tree fall, especially common on Shaw Island, where some of the oldest trees are located. Those old trees often have rotten cores that cause the tree to fail during periods of high wind. The chart below shows wind and temperature extremes for February 2019.

IV. Energy Resources

"Between now and 2040, the world will spend over $20 Trillion on Energy Infrastructure and $10 Trillion on Telecom Infrastructure"

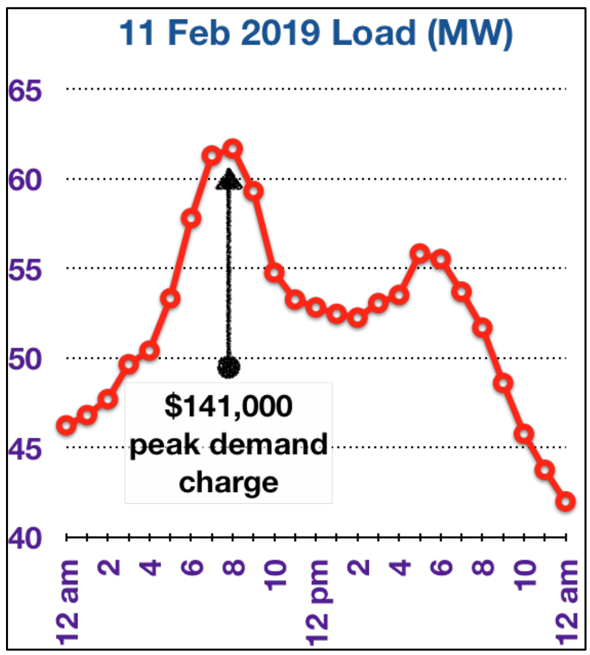
McKinsey & Company

The Peak is the Problem

As with many utilities, the number one problem the Co-op faces in the coming decade is the unintended consequences from CETA legislation: an unfunded state mandate removing significant WA generation resources by 2025. For more on that, see the CETA discussion in the Challenges and Opportunities chapter above. By reducing generation capacity in the state, it increases the probability of regional outages, rolling black outs, and more generally, following the laws of supply and demand, an increase in the cost of the energy, especially during times of peak demand.

The problem is the peak.

A Recent Example



On February 11, 2019, cold temperatures, driven by freezing Nor'easter winds, had members turning up the heat as they arose that morning. The morning load peaked at 63 MW, the mid-day trough was at 53 MW – a 10 MW peak demand spike. That peak cost us $141,000. That peak becomes very expensive if the region as a whole can't meet load.

To shave the peak above would require about 10 MW of storage. At $2 million per MW of storage, that is a $20 million-dollar problem that dwarfs the $16 million Lopez San Juan submarine cable.

Solutions could combine a distributed mix of storage and dispatchable load, for example:

- 3 MW of utility-scale storage. Distributed around the service area, at optimal locations to serve town centers and minimize degradation of power quality due to increasing intermittent resources like solar and wind. Deployed incrementally, before 2028.
- 3 MW, about 300 members with 10 kW, of dispatchable storage each (see storage discussion below). Incentivized starting in 2020, with full deployment by 2028.

- 2 MW of demand response units on water heaters and other substantial member load, incentivized with billing credits any time their load is dispatched. Incentivized starting in 2020, with full deployment by 2028.
- 2 MW of dispatchable commercial member standby generation, during peak demand periods, (not outages), including OPALCO, grocery stores, hospitals, government, incentivized with billing credits any time their generation resource is dispatched. Incentivized starting in 2021, with deployment by 2025.

This investment is similar to what OPALCO did following the storms of 1989 and 90 that knocked down major co-op infrastructure and required significant capital investment in undergrounding distribution cables. Unlike back then, the Co-op has now developed a strong set of financing options to minimize impact on rates. It will take a skillful steady investment that leverages a mix of grants, RESP funds and incentives for member generation/storage to tackle this.

Energy Resource Overview

OPALCO continues to monitor the Levelized Cost of Energy (LCoE) of local renewable energy resources and as those costs approach the slowly rising cost of BPA, and as those energy resources become viable for utility-scale application, they will be added to the grid reducing our dependency on mainland power, increasing local resilience and moderating the rising cost of mainland power.

In the near term, **before Grid Parity and CETA**, OPALCO will:

- Focus on keeping retail rates low by leveraging the low cost (4.1¢ per kWh) of BPA energy.
- Balance usage rates to encourage fuel switching to build revenue to help reduce rate increases.
- Secure as many grants as possible for solar, storage and dispatchable load, keeping it modest until grid parity.
- Invest in energy efficiency and beneficial electrification.
- Build as much community solar as members want – probably another 1 MW.
- Improve high-value local energy resilience with microgrids around town centers.
- Evaluate and implement new programs to offer dispatchable storage and DRUs to help mitigate peak load conditions.

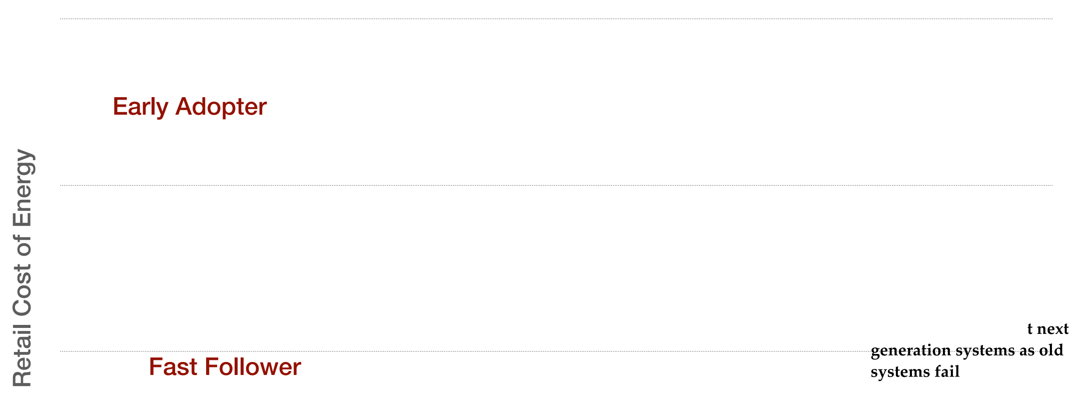
We expect that local renewable energy resources will become competitive with BPA wholesale electric rates around 2025 (Grid Parity). See analysis and definition below. **After Grid Parity**:

- Ramp up a transition to viable lower cost local energy resources, using BPA as backup and firming. This will bend the arc of rising BPA energy costs through application of falling local energy resource costs.
- When tidal energy resources hit grid parity, and with community support, add that into the local mix to fill the winter low solar production gap (see Winter Problem discussion below).

The table below summarizes the recommended resources to be developed, the purpose of those new resources, and the investment source, before and after grid parity.

	Before Grid Parity	After Grid Parity
Resources	Deploy **moderate** amounts of local renewable energy resources: a combination of solar + storage + demand response, community solar, and utility-scale solar. Incentivize rooftop solar, dispatchable home storage, and demand response units.	**Accelerate** deployment of local renewable energy resources, as they become affordable, to significantly reduce our dependence on mainland power. Initially solar, eventually tidal energy, likely in the 2030s.
Purpose	Increase local energy resilience, especially for critical services in the county: first responders, town centers, government. Community solar helps members lower the cost of their electricity. Reduce vulnerability to demand charges.	Cushion against the increasing cost of mainland power. Increase local energy resilience.
Investment Source	Community solar is paid for by subscribers. Utility-scale solar is funded through grants and rates. Demand response paid for through grants and rates.	Grants, rates.

Referring to the chart below, OPALCO has been employing a **Fast Follower strategy**, generally waiting for **Early Adopters** to prove out emerging technologies and letting the price point of viable systems improve.



Being a **Fast Follower** has important advantages and benefits for the co-op. We benefit from the **Early Adopter** experience – revealing the actual costs for emerging technologies, and the best practices needed to get the most out of them. We can make better economic and technical decisions. This results in better ROI and reduced risk for the co-op.

Before grid parity, we use grants to be a faster fast follower by reducing the cost of the new resource, and trialing the technology in preparation for grid parity.

As the LCoE of local renewables approaches grid-parity, OPALCO will begin ramping up local renewable resources, meeting demand with the lowest cost, cleanest sources. As with **Early Adopters**, this investment is paid for with a combination of grants and debt, but the debt financed is smaller for **Fast Followers**, since the capital cost of the systems is smaller, and the system size needed is less, thanks to the energy efficiency achievements that preceded the build-out of local renewables. In addition to lower cost of capital, there is also the added benefit from delaying build-out until grid-parity – systems being acquired are state of the art, being 10 to 20 years newer than systems put in place by **Early Adopters**.

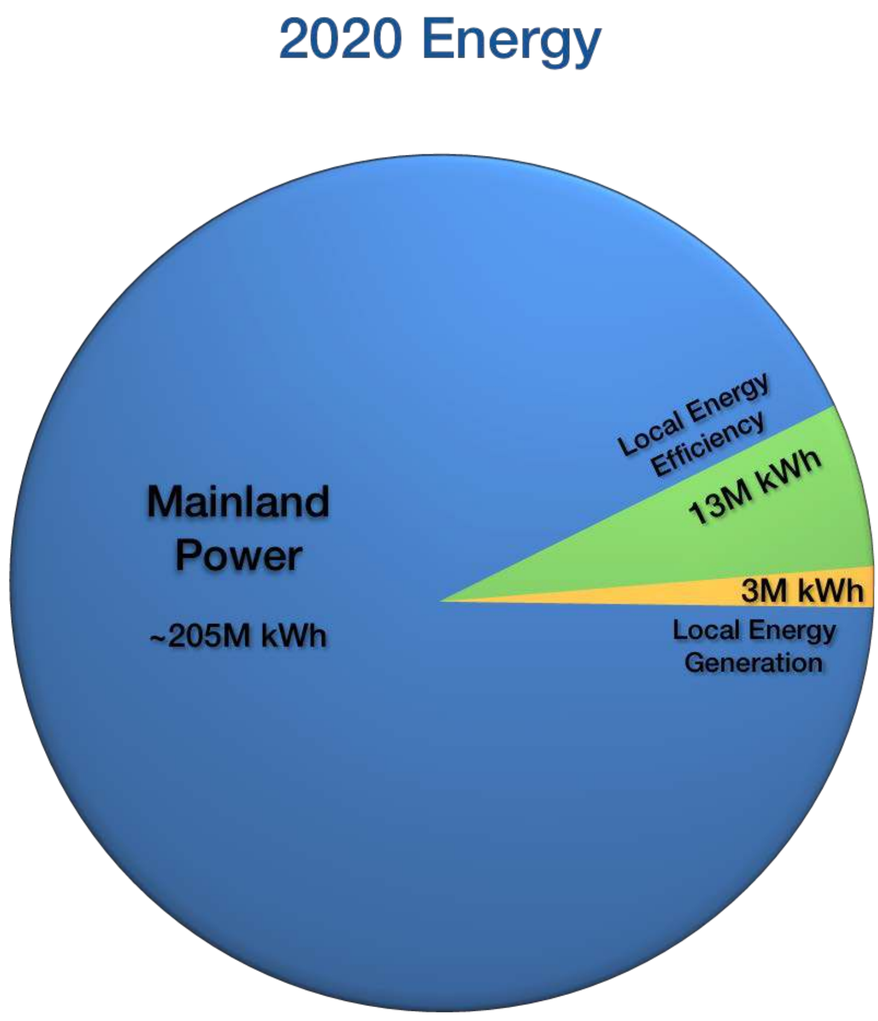
We want to be Smart Fast Followers, monitoring LCoE trends and viability of solutions, and erring on the side timely investment that gets the most bang for the buck for the co-op and members.

Current Resource Mix

Most our energy comes from BPA. Over the past decade though, local energy resources have made significant advance. Local renewables – mostly solar, with some wind and micro-hydro – now contribute about 3 million kWh a year, and cumulative energy efficiency has contributed about 14 million kWh.

In 2018, OPALCO built its first community solar array, about 500 kW DC, one of the largest in the state. That increased local solar production by over 30%. Member interest in subscribing was strong, and we estimate there is subscriber potential for an additional 1 MW of capacity.

OPALCO will continue to ramp up local renewable energy resources, increasing local energy resilience, moderating rates as local renewables become more cost effective than BPA, and reducing dependence on mainland power. The chart below shows the current resource mix.



Clean Energy Transformation Act (CETA)

As stated above, Washington State passed historic legislation in 2019, Senate Bill 5116 (SB5116), *Washington Clean Energy Transformation Act* (CETA). This bill puts into motion a complex set of interdependent actions intended to speed a transition to clean energy but offers no plan or funding to get there.

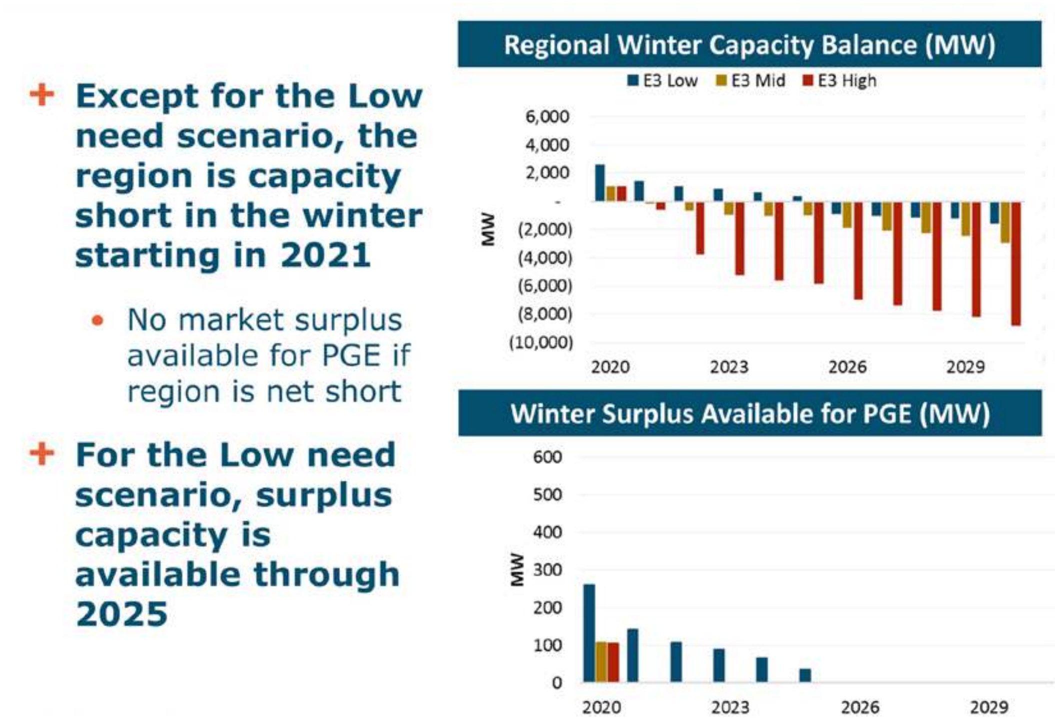
CETA dialog is just starting, with anticipated implementation in January 2021. OPALCO and PNGC participated in a July 2019 CETA conference call with WA Department of Commerce DOC and Department of Ecology (Ecology). Here are the highlights from that call:

- DOC and Ecology have just 15 months to figure out how to implement CETA. It will be a fast and potentially messy process. DOC has set the expectation that it will be a highly interactive process, and they want to seek utility input along the way. We welcome that. There are big questions remain: How to budget for CETA and what are the Admin requirements?
- Public interest includes equitable distribution of energy benefits, reduction of burdens on vulnerable, highly impacted communities. This may suggest support for our Energy Assistance Programs, and possible grants for to mitigate burdens CETA may place on our community.
- Administrative penalty of $150 per MWh of non-renewable energy.
- Non-emitting electric generation and electricity from renewable resources supply 100% of all sales of electricity to Washington retail electric customers by Jan. 1, 2045.
- Utilities must incorporate this standard in planning, resource acquisition, and electric service to retail customers.
- Each utility must submit a Clean Energy Implementation Plan (CEIP) every four years, starting 1/1/2022. To include targets for energy efficiency, demand response, renewable energy, and specific actions identified.
- Subject to a rate impact limit.
- Each utility must calculate and report GHGs from electricity delivered to retail customers. We will need to develop a tracking methodology.
- Utilities must offer energy assistance. We do and expect we will be in compliance. Adequacy is to be determined.
- Utilities must include social cost of carbon in resource evaluation.
- Allows incremental hydro RECs, starting in 2020.

Given the above highlights, OPALCO feels we are more prepared than most utilities for CETA compliance.

On the one hand, we are in a strong position with 97% carbon-free – a great place to start, as we plan for the next BPA contract. Many other utilities will struggle to define their resource mix, prove how clean it is, and how to control carbon attributes. BPA contracts we now operate under are too simplistic for the CETA future. Todays contract is not just going to roll over, as is, in 2028. In the CETA future, BPA power products will need to be either extremely simple, or very diverse to meet different state's needs. Regarding CETA and reduced mainland capacity driven outages, BPA customers are in a good position in near term. They are in a good position to meet current customer loads. But we must recognize that the mainland feed is party of a highly interconnected transmission highway that has limits to isolating (and protecting) the BPA customer endpoints from regional rolling blackouts.

The chart below provides an analysis of the net capacity of the Northwest region, in winter. This analysis was developed by E3 consulting for PGE, before CETA was enacted. Even without CETA mandated coal plant decommissioning, E3 is forecasting capacity shortfall as soon as 2021. Hence the increased priority to ramping up local battery storage capacity and other dispatchable load systems.



This section is a work in progress and will be developed as CETA discussions continue. There may be some GHG emitting generations (e.g. natural gas peakers) in the BPA non-specified resources (see table below) and we may need to get some RECs to offset. Here's the 2018 BPA fuel mix:

Resource	Share	Notes
Hydro	85.82%	
Natural Gas	.01%	
Nuclear	10.60%	
Non-specified	2.74%	Non-specified purchases are purchases made from another system without knowledge of specific fuel type. Reporting agencies in Washington assign their generic fuel mix to the BPA purchase amount based on their determination of the Northwest power pool region resources.
Wind	2.74%	Without RECs - BPA conveys its RECs to other parties and does not retire them

BPA non-specified purchase is assumed to be GHG emitting. We will work with PNGC on how to get numbers out of BPA.

We need to have a plan for implementing CETA requirements. Future IRPs are required to layout a clean energy transition plan to meet CETA requirements.

For further reading, The National Law Review has a good overview of CETA. Here are some highlights:

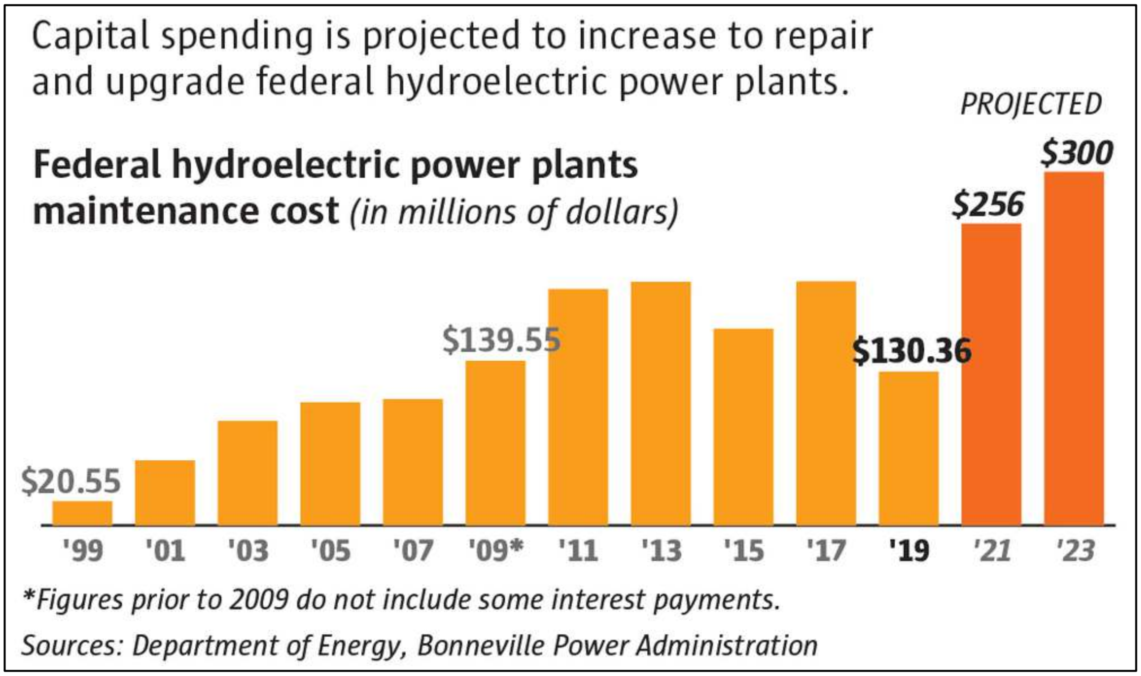
- The mandate to eliminate coal from the utility generation portfolios by the end of 2025 primarily affects Washington's investor-owned utilities (IOUs), which are regulated by the Utilities & Transportation Commission (UTC). Because the only coal-fired generation in Washington, the Centralia Steam Plant, is already slated to shut down by 2025, the legislation affects imported coal-fired electricity. In particular, CETA is likely to drive the early retirement of Units 3 and 4 of the Colstrip Plant in Montana (in which each of the Washington IOUs has an ownership share – Units 1 and 2 will close at the end of this year) and several other PacifiCorp coal plants scattered across the interior west.
- The UTC is also permitted to accelerate depreciation for the transmission lines associated with the retired plants if the UTC determines those lines are no longer used and useful and there is no likelihood they will be used in the future. **There is, however, a good chance some or all of this transmission capacity will be repurposed to transmit power generated from the interior west's abundant wind, solar and geothermal resources to West Coast markets**.
- CETA requires all electricity delivered to Washington consumers to be GHG-neutral by 2030. Utilities can achieve this goal using a combination of non-emitting resources, renewable resources, and "alternative compliance options" that produce GHG reductions equivalent to what would be achieved by the use of non-emitting resources. Utilities may use alternative compliance options to satisfy up to 20% of the GHG neutrality requirement.

- The legislation allows for a variety of alternative compliance options. The simplest are to make an "alternative compliance payment" ($84 per MWh for gas peaking plants, $60 per MWh for combined-cycle plants) or to use unbundled Renewable Energy Credits (RECs), a compliance option that has long been used to meet Washington's Renewable Portfolio Standard, Initiative 937. **Utilities may also invest in "energy transformation projects," which include energy conservation programs that would achieve conservation above targets required under Initiative 937, support for electrification of the transportation sector** and for hydrogen as a transportation fuel, **investments in distributed energy resources such as small rooftop solar systems**, investments in renewable natural gas systems, and projects to improve efficiency and achieve emissions reductions in the agricultural sector.
- CETA defines "non-emitting" resources to include any generation resource that does not emit GHGs and that is not defined as a "renewable" resource. **Washington's abundant hydroelectric resources, which already provide much of the electricity consumed in the state, will provide the lion's share of non-emitting resources** to meet CETA obligations, **along with nuclear power from Columbia Generating Station**. However, **the legislation strongly discourages construction of new hydroelectric projects**, allowing new hydropower projects to count toward CETA compliance only if it is constructed on irrigation canals or other artificial waterways. **On the other hand, the legislation implicitly acknowledges that a carbon-free grid will require large additions of new energy storage and balancing capacity by permitting new pumped storage to count toward the non-emitting goal**. **The legislation also adds limitations on RECs produced from hydro projects that are stricter than RECs produced from other renewable resources.**
- **Utilities may obtain compliance relief if compliance threatens to create a violation of electric reliability standards established by the North American Electric Reliability Corporation**, or if the utility is unable to obtain access to renewable or non-emitting resources because of unavailability of transmission, mechanical failure, failure of a third-party supplier to meet its contractual obligations or similar uncontrollable forces. In addition, **CETA empowers the governor to invoke emergency powers to suspend CETA compliance obligations if the Department of Commerce reports that compliance is creating systematic problems with electric reliability**.
- CETA adds considerably to the long-term planning obligations already applied to Washington utilities through the state's **integrated resource planning** statute. That statute requires utilities to develop and update integrated resource plans every two years. CETA adds several new requirements to the integrated planning process. Most notably, **utilities must now include a ten-year "clean energy action plan" documenting the utility's long-term path to comply with CETA and utilities must use the social cost of carbon calculation developed by the Obama Administration in the planning process**. That calculation, published in August 2016, was intended for use in planning and review of federal regulations under Executive Order 12866. This provision should help clarify how GHG emissions are treated in the IRP process, an issue that has bedeviled many Washington utilities as well as regulators.

- Washington joins California, Nevada, Hawaii, and New Mexico in mandating that 100% of electricity be produced without GHG emissions by mid-century, and Colorado and Oregon appear likely to follow suit. These western states join several eastern states, most recently New York, in adopting similar legislative goals. In addition, more than 100 cities and hundreds of corporations have adopted policies requiring that they transition to renewable energy. The trend even extends to utilities like Xcel Energy and Idaho Power. Thus, while the federal government has largely stepped away from GHG regulation, states and local governments have stepped into the breach and adopted aggressive GHG mandates, and corporate action has followed that trend. Taken together, **these actions may represent the most significant development in energy policy this century**. **The new legislation, of course, augurs continued strong growth in the renewable energy sector**. **The decline of coal generation in the West, already well underway, is likely to accelerate. Together, these trends will create strong demand for both new energy capacity and energy storage resources and may challenge the ability of system operators to maintain system reliability as the West's energy generation mix rapidly evolves**.

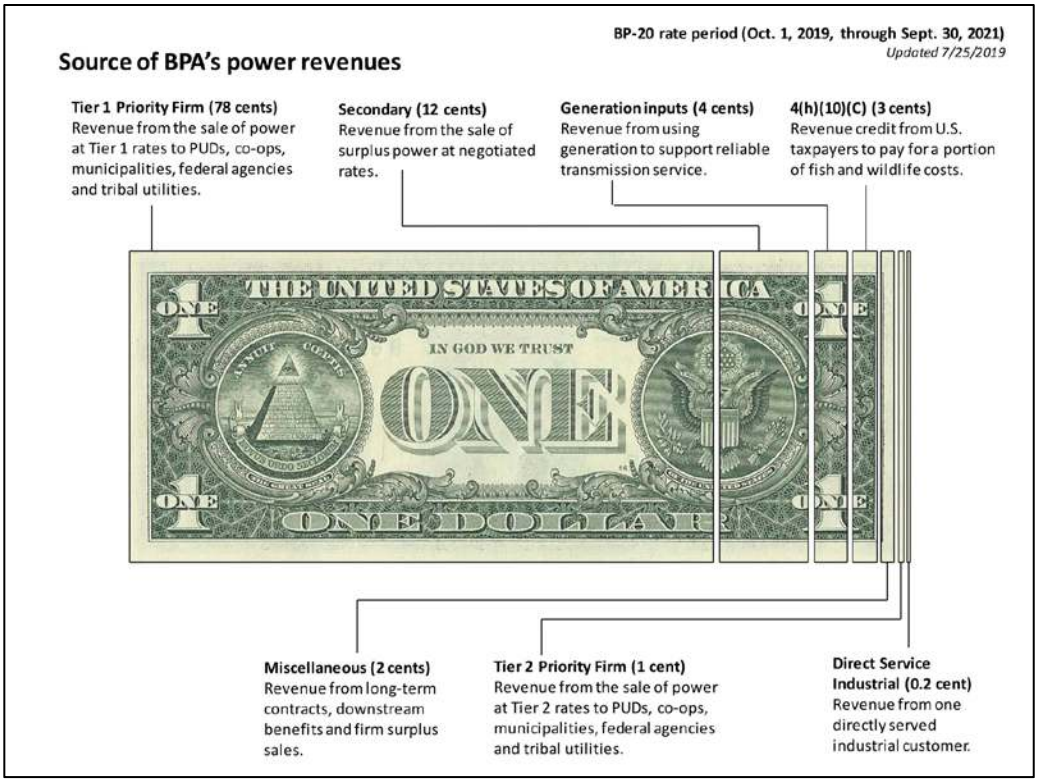
BPA Resource Overview

BPA has supplied power to OPALCO since the 1950s, when they deployed the first submarine cable to the islands. While it currently costs less and is lower carbon than solar, wind and tidal energy, BPA costs have been increasing above inflation while solar, wind, tidal, and storage costs have been decreasing steadily. We expect BPA Levelized Cost of Energy (LCoE), which is currently at about 4¢ per kWh, to exceed the LCoE of solar around 2025 (see more below under Solar Resource Overview). A substantial contribution to the rising cost of BPA is maintenance of aging dams and infrastructure. The chart below shows the growth in BPA maintenance costs.

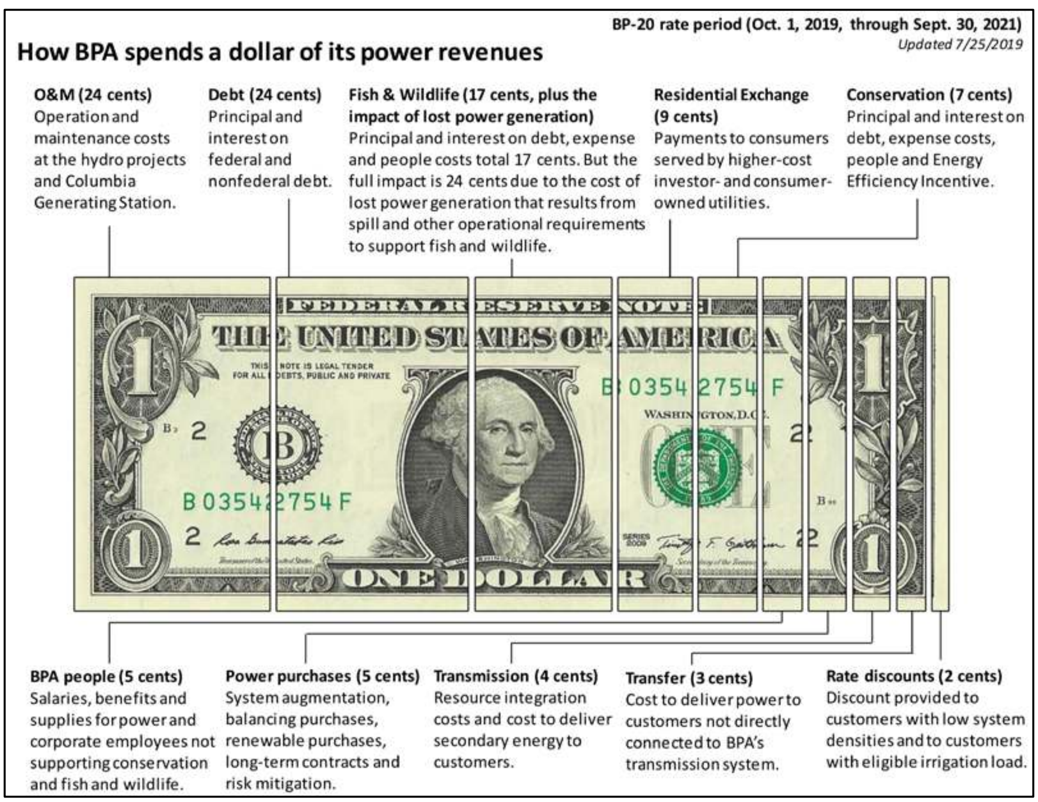


We currently purchase between 200-230 million kWh form BPA annually, depending on how cold our winters are. Unlike solar and other renewables, BPA hydro energy is "firm" and is used to firm up intermittent resources like solar and wind. This is especially so for California, which depends on Northwest hydro to firm up their substantial solar resource mix, especially as evening approaches, the sun sets, and demand is rising (see discussion below in Solar Overview).

BPA Revenue Sources

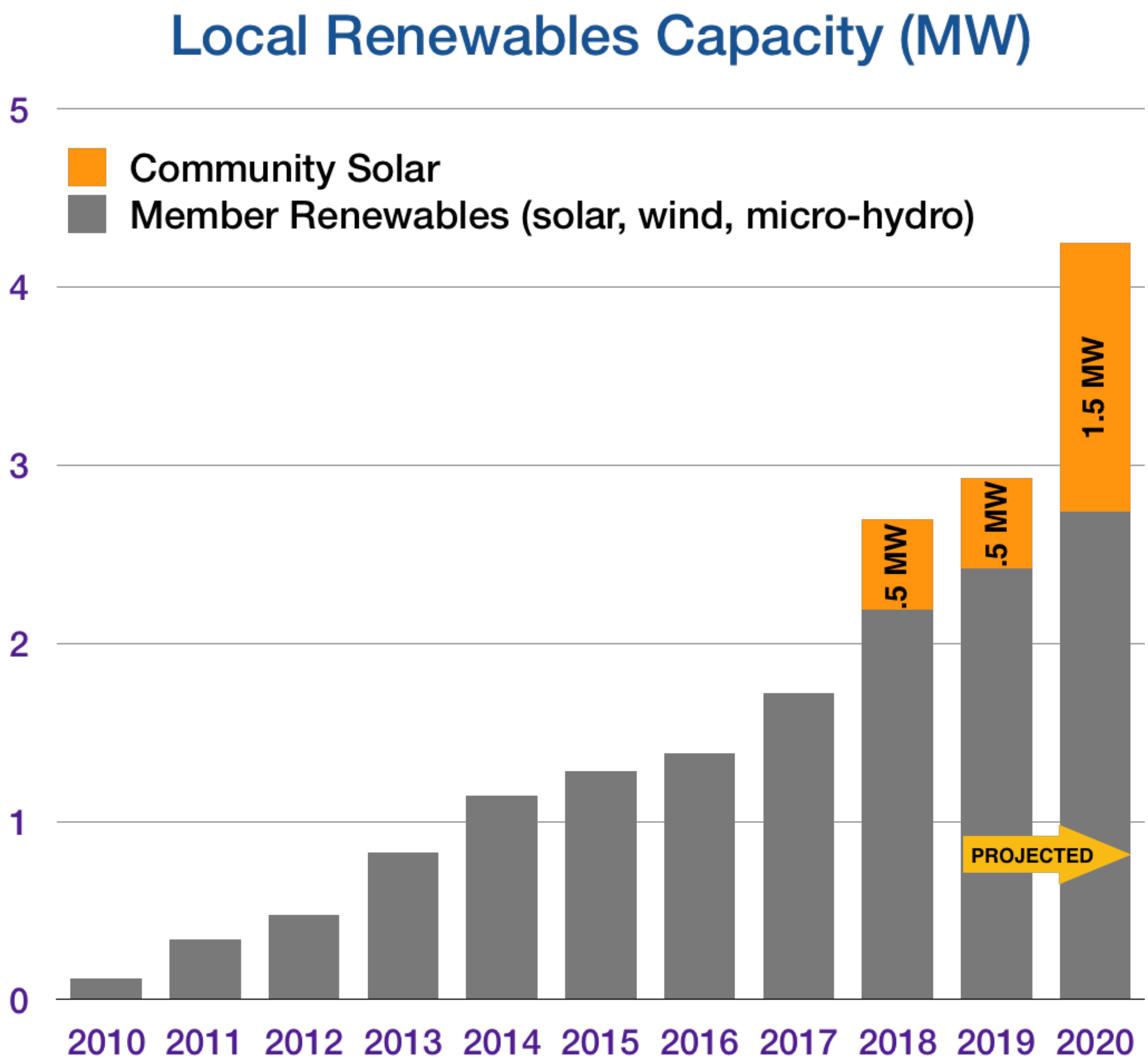


BPA Revenue Spending



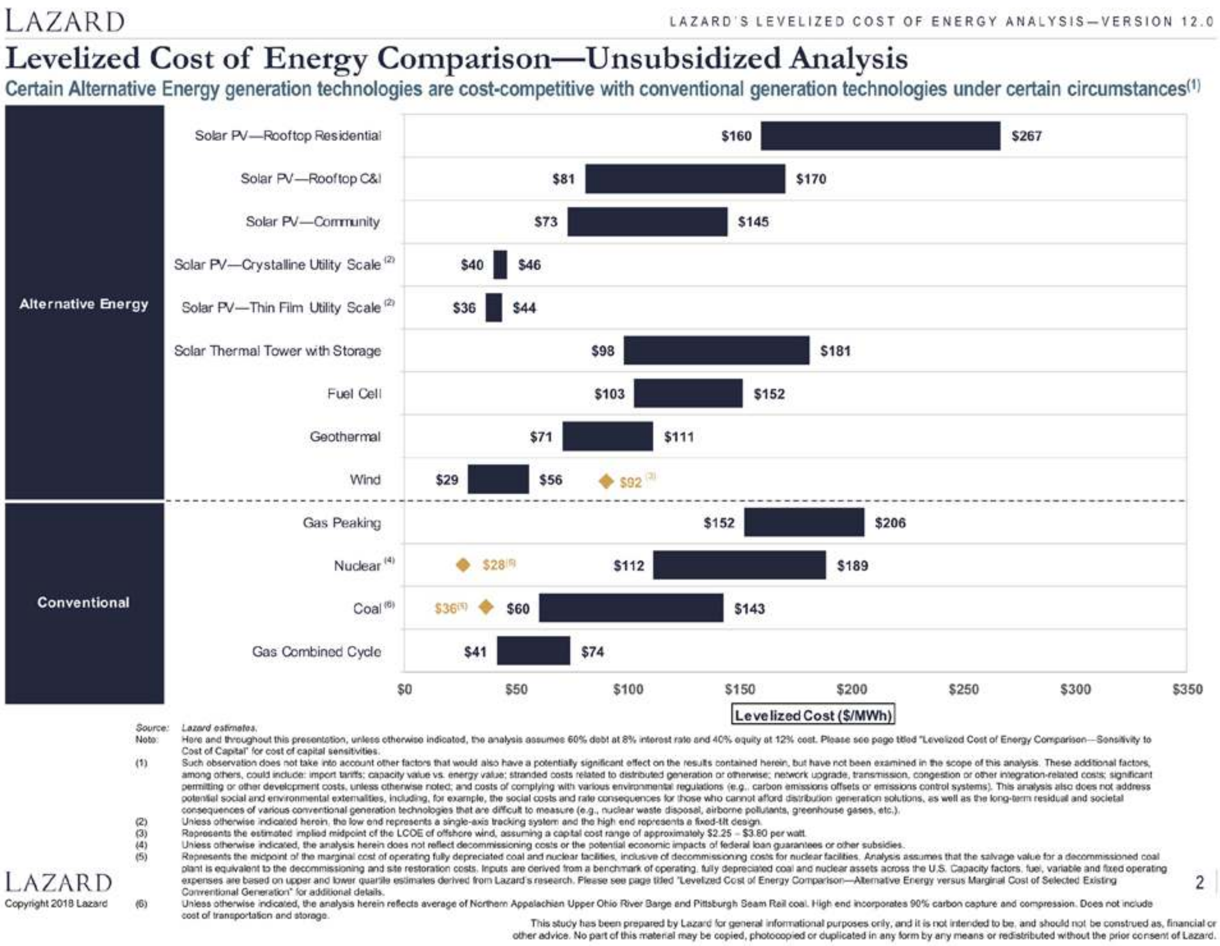
Solar Resource Overview

Solar LCoE has been falling steadily for the past decade and is beginning to flatten out. A 2018 increase in WA renewable energy production incentives accelerated solar rooftop deployments by members, and OPALCO built a .5 MW community solar array on Decatur Island. The chart below shows local renewable energy capacity by year with projected capacity for 2019 and 2020.



The following charts provide updated perspective on the cost of various resources, including generation and storage. This information factors into Long Range Financial Planning.

Energy Resource LCoE and Capital Costs

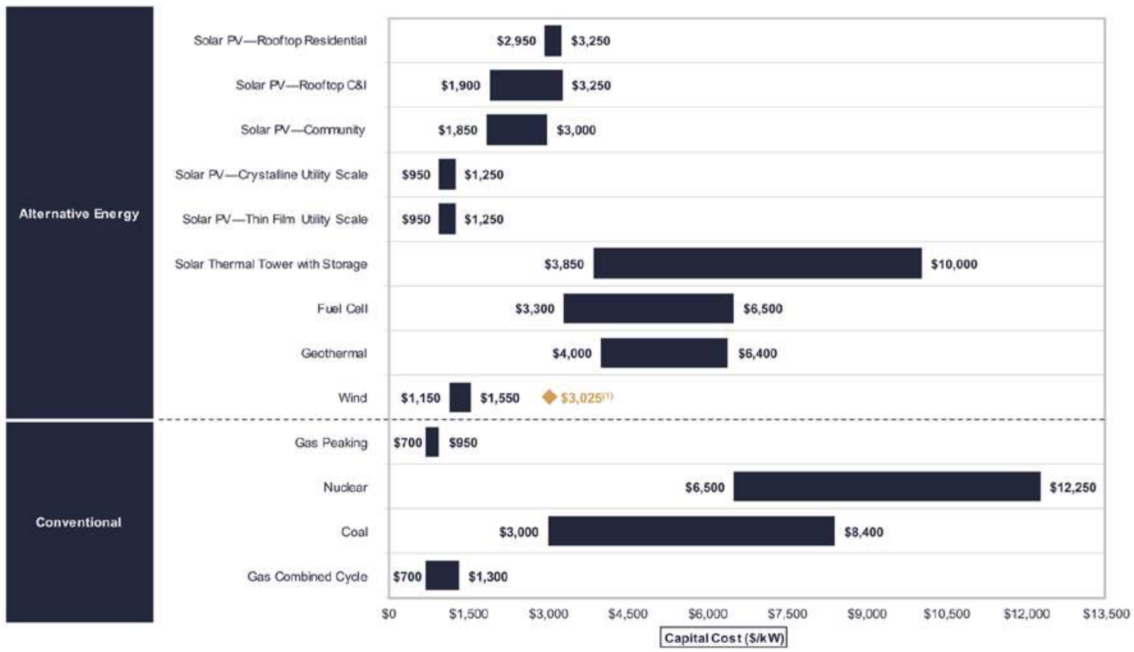


LAZARD

LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS—VERSION 12.0

Capital Cost Comparison

While capital costs for a number of Alternative Energy generation technologies are currently in excess of some conventional generation technologies, declining costs for many Alternative Energy generation technologies, coupled with uncertain long-term fuel costs for conventional generation technologies, are working to close formerly wide gaps in LCOE values



LAZARD

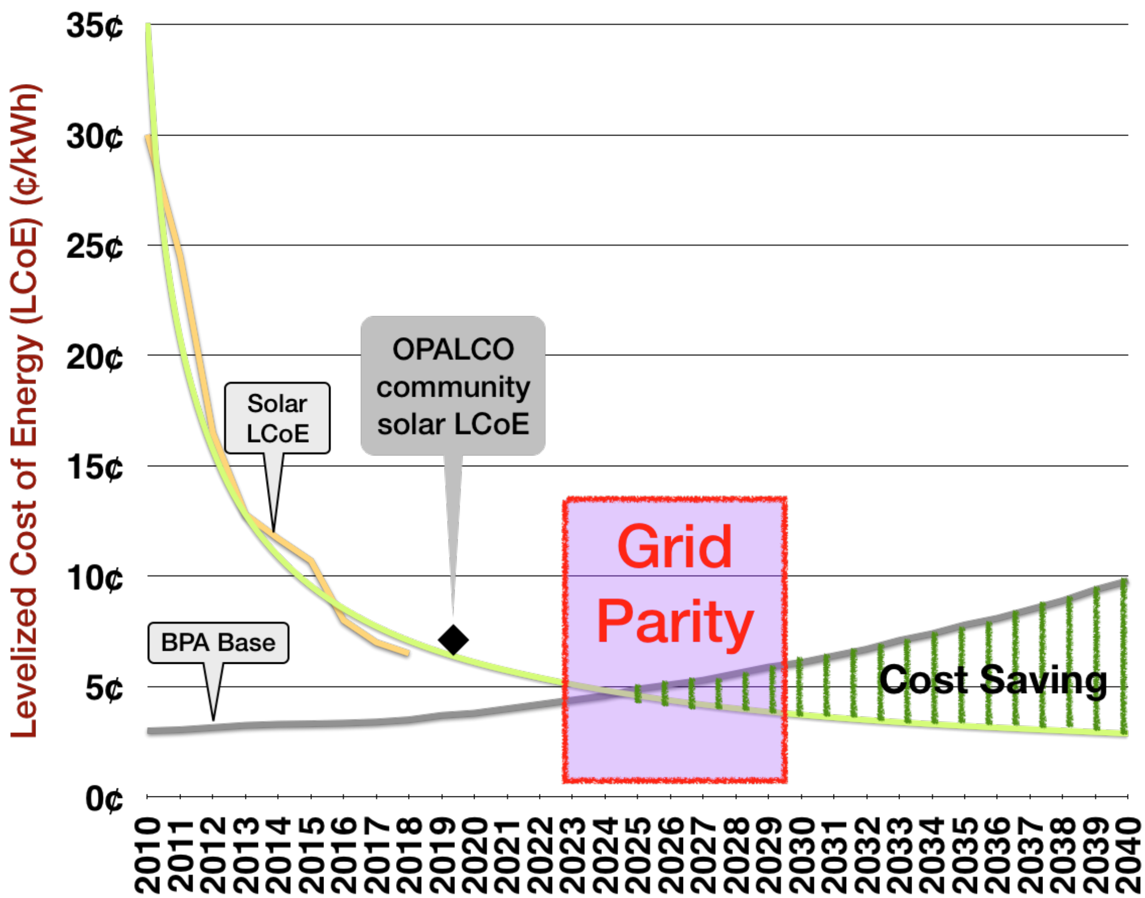
Source: Lazard estimates.

(1) Represents the estimated midpoint of the total capital cost for offshore wind.

10

Northwest Solar LCoE and Grid Parity

Renewable energy resource costs have been falling, while BPA pricing has been slowly rising. The point at which they cross is called **Grid Parity**. In other words, Grid Parity is the point at which an emerging technology becomes economically viable. At that point, the emerging technology has increasing cost savings compared to the legacy technology (see slide below).

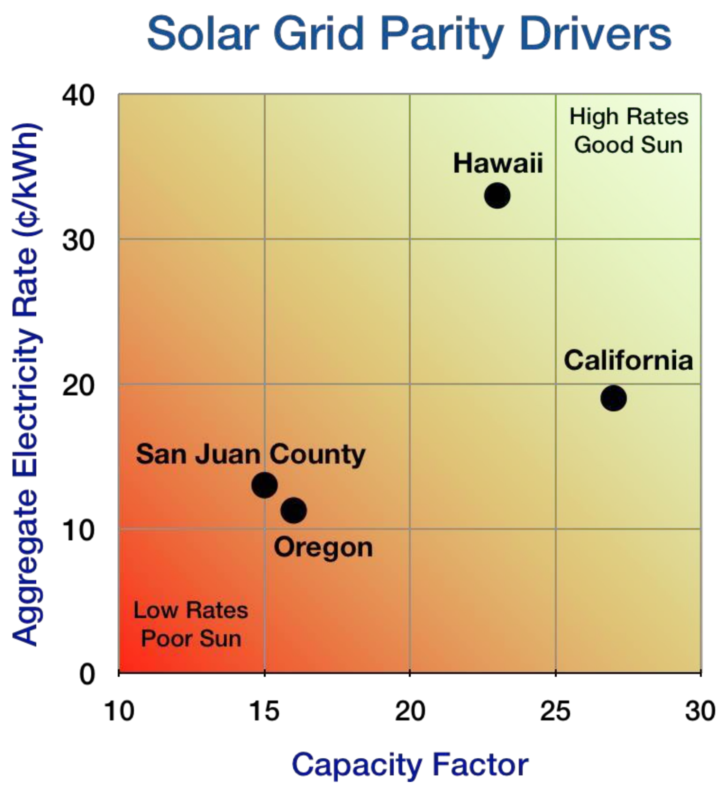


Once a resource is at grid parity or better, it can be added into the energy portfolio to replace or moderate the cost of legacy energy sources. When evaluating renewable resources, there are two factors that tend to drive economic viability:

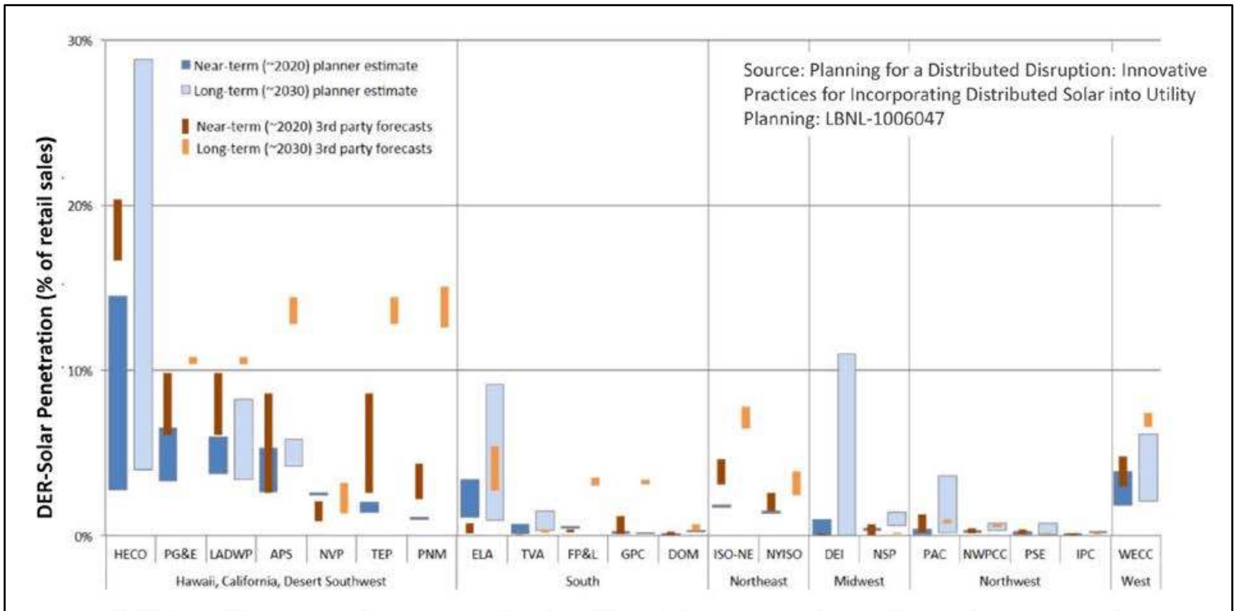
- **Location** – Does the location have good energy potential? For example, the Southwest has excellent sun, the Northwest has excellent tidal, Texas has excellent wind energy. The better the potential, the higher the **Capacity Factor** for that renewable resource.
- **Electric rates** – Does the renewable resource have rates that are lower than the legacy electric rates. For example, Hawaii imports diesel fuel to run generators, so the rates are more than 30¢/kWh. That makes lower cost alternatives attractive.

The chart at right shows how Hawaii and southern California have expensive electricity, and good sun, making them excellent candidates for solar. Here we see that the San Juan County capacity factor (15) is about 45% less than California (27). So, for example, a 1 MW array in San Juan County will put out 45% less energy than the same array in California.

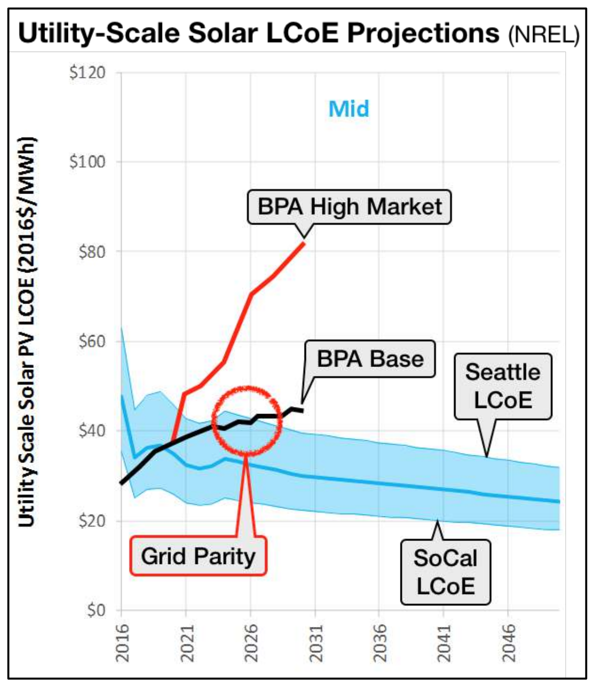
With that understanding, the chart below shows utility-scale solar market share for various regions of the U.S. – note that the Northwest region (lower right side of chart) has the lowest market share for solar – we are not at grid parity yet. With low Northwest electric rates and poor sun, grid parity is still a few years off.



- **High electric rates** and **good sun** drive solar market share up. Hawaii, followed by California – both with very high electric rates (25¢ to 35¢ per kWh) and good sun – have the most to gain. Grid parity happened for them years ago; they are rapidly adding solar into their energy mix.
- The Pacific Northwest has some of the lowest market share. **Sun is modest** here, especially in winter, and **electric rates are some of the lowest in the country** (8¢ to 11¢ per kWh – half of the rates in California and Hawaii). Poor sun reduces the capacity factor of solar, increasing the LCoE. See grid parity discussion below for when we expect solar LCoE to reach grid parity with BPA wholesale pricing.



Utility DER-Solar Forecasts in the Near Term and Long Term Compared with Third-Party DER-Solar Forecasts



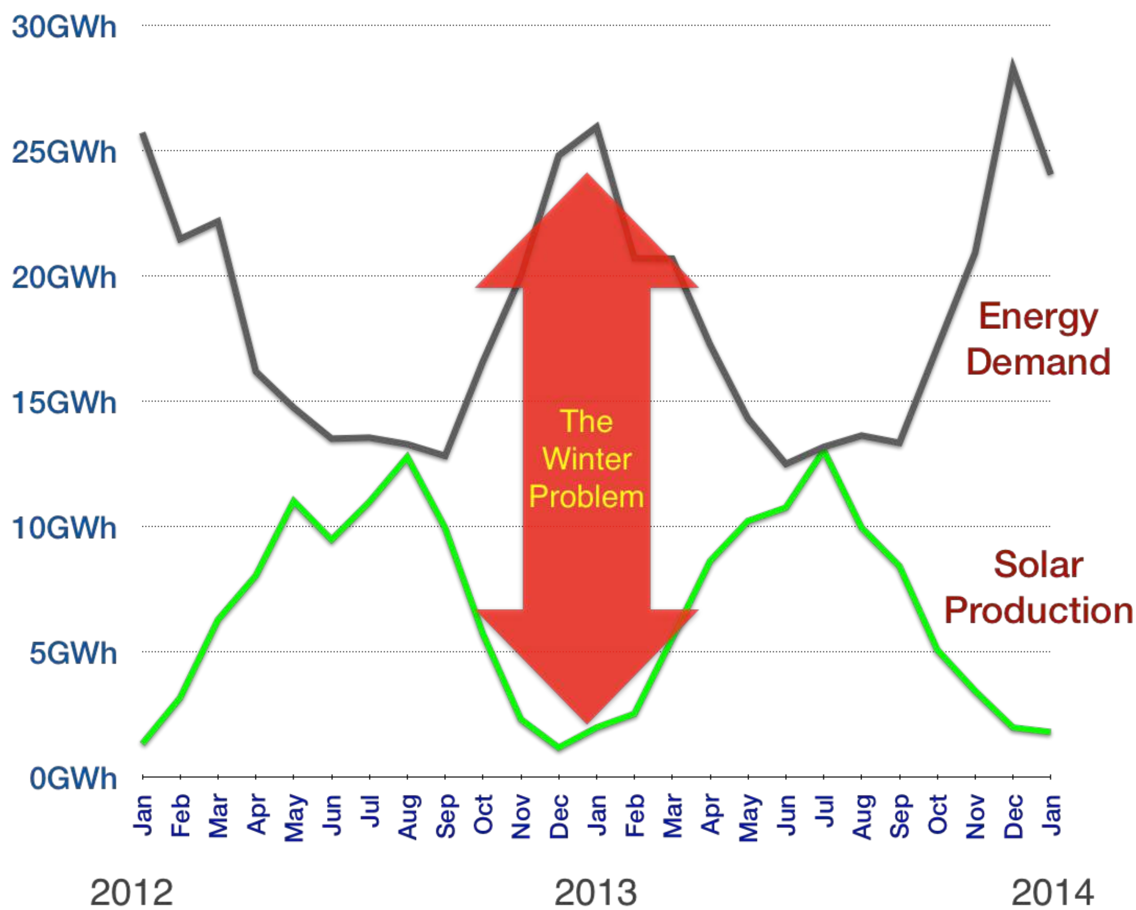
Given that 15% capacity factor, NREL has forecast the LCoE for solar in our region. The chart at right shows mid-level pricing (for the solar equipment), through 2050. The upper bound of the blue range is Northwest (Seattle) price point. We have overlaid the BPA base and high market forecast. Having just completed a 500 kW community solar array, the NREL pricing is more representative of larger arrays, with their efficiencies of scale. And, BPA pricing has been running a bit above base. Given that, we project that utility-scale solar pricing will cross BPA pricing around 2025 (grid parity).

CETA injects additional uncertainty that can impact the LCoE calculus, changing the path the cost of mainland power will follow – base, or high market. For example, CETA may require purchase of Renewable Energy Credits (RECs), increase administrative process to track and meet emerging new clean energy requirements, and penalties for non-compliance to as yet undefined rules. This may prematurely increase the cost of mainland power.

The Winter Problem

San Juan County solar in summer is quite good, but in winter, output drops to one-fifth of summer output. We call that the winter problem. The best year-round resource for our region is tidal energy, but it is an emerging technology, and we don't expect it to be affordable until the 2030s.

OPALCO rooftop solar members use the grid as their battery, generating energy in the summer, selling excess to the grid, using net metering, and buying it back in the winter when solar output is minimal. The chart below offers an example of the winter problem. Assuming each home had good sun, and had a 7.5 kW array, solar would only meet about 38% of the county electric load, due to limitations of sun in the Northwest. In winter, load doubles, but solar decreases by 80%. But, with climate change… Winters are warming and summers are too. There will be reduced need for winter heat and increased need for summer air conditioning. Snowpack is decreasing, which means less hydro flow in summer, which could mean lower hydro production and higher hydro costs in summer when big cities have increased air conditioning load. Solar can help fill the gap from reduced summer hydro. And, increasing local renewable energy such as solar, wind and tidal helps increase local energy and economic resilience.



The Duck Curve

Referring to the chart below (California utility solar example), high solar adoption creates a challenge for utilities to balance supply and demand on the grid. This is due to the increased need for electricity generators to quickly ramp up energy production when the sun sets and the contribution from solar falls. At OPALCO, where peak demand occurs in the morning, the duck curve is reversed, but the dynamics are essentially the same.

Another challenge with high solar adoption is the potential for solar to produce more energy than can be used at one time, called over-generation. This leads system operators to curtail solar generation, reducing its economic and environmental benefits. While curtailment does not have a major impact on the benefits of solar when it occurs occasionally throughout the year, it could have a potentially significant impact at greater PV penetration levels.

Rather than reduce peak demand, solar can exacerbate peak demand, requiring careful engineering to reap the benefits of solar, without compromising the quality of energy to members.

Utilities are increasingly turning to battery storage to mitigate the duck curve. For more on that, see Peak Shaving and Load Shifting, in the **Grid** chapter.

Solar Intermittence

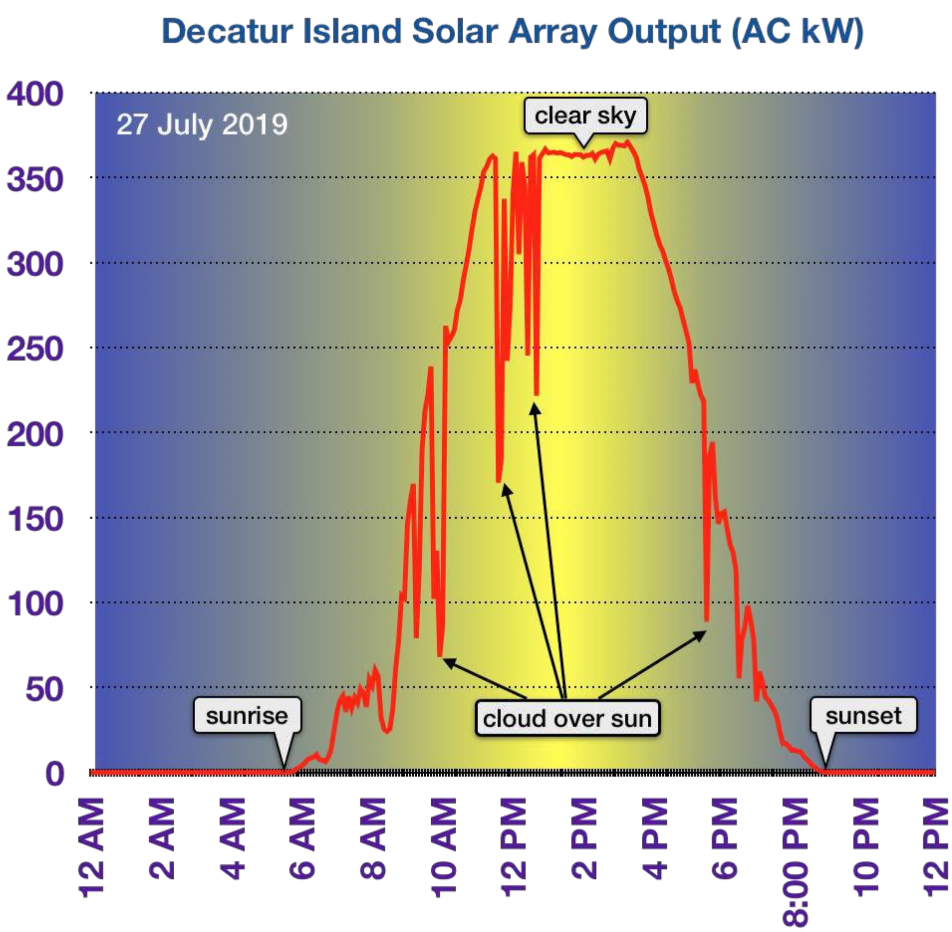
California has an ambitious goal of 33% renewables by 2020 and has seen substantial additions of residential solar over the past few years. CAISO, which oversees grid reliability in California, has enthusiastically embraced renewable integration. But it has no illusions about what that means.

One of the challenges: they must match supply second-to-second to the net load to maintain system balance and reliability. Output from renewables can drop dramatically, by hundreds of megawatts, in as short a period as 30 minutes.

As OPALCO increases the proportion of generation resources that are intermittent, we will have the same challenges. The chart below shows the output from OPALCO's community solar array on Decatur Island. Note the periodic cloud hits that can cut output over 80% in a matter of minutes.

CAISO has devoted substantial resources to advanced forecasting capabilities and increased incentives for flexible, fast-start gas generation resources.

At OPALCO, to avoid fossil generation resources, we would mitigate intermittence with local battery storage and BPA firm power. Our analytics partner PNNL advises that for every 1 MW of solar, we should balance with about 200 kW of storage.

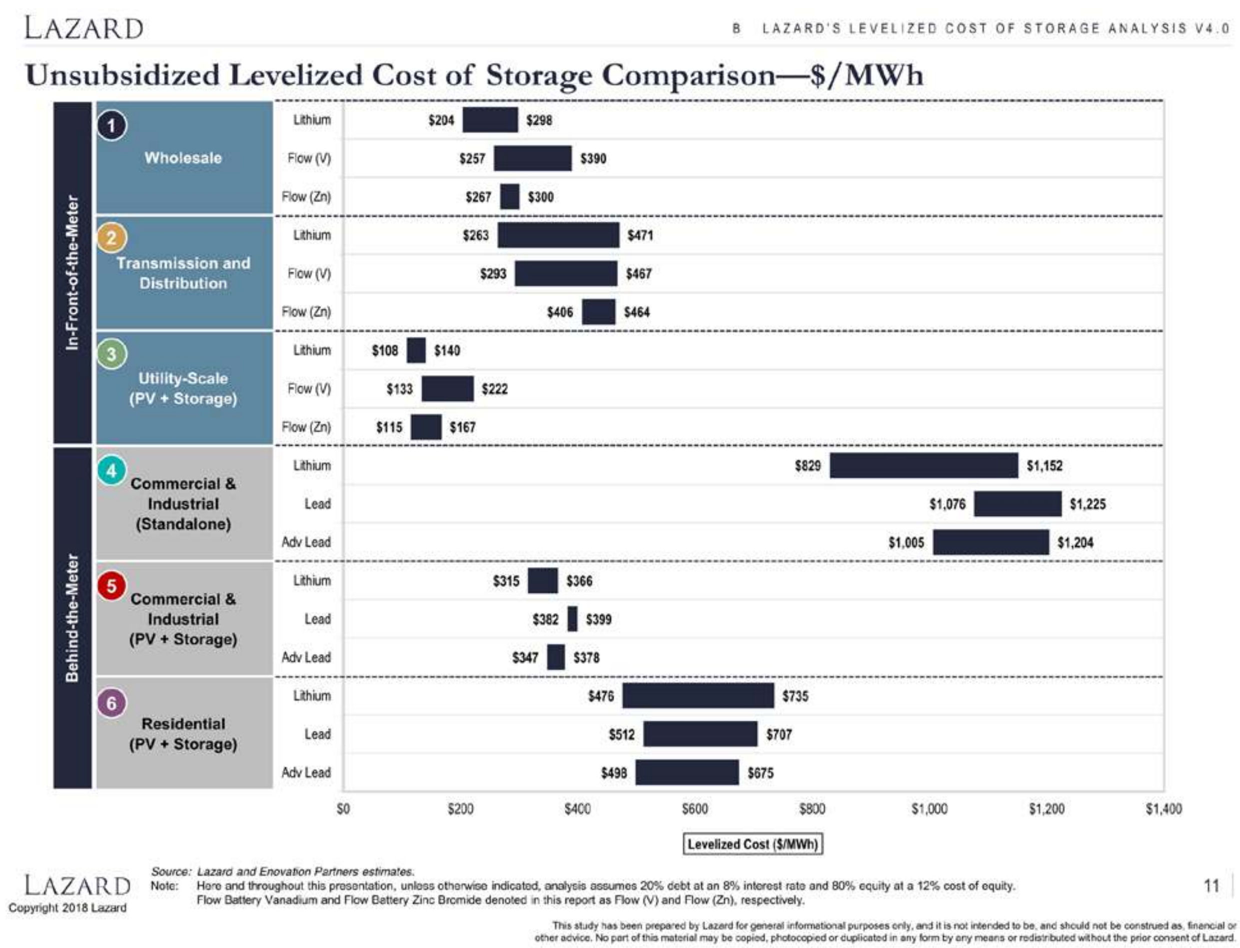


Storage Resource Overview

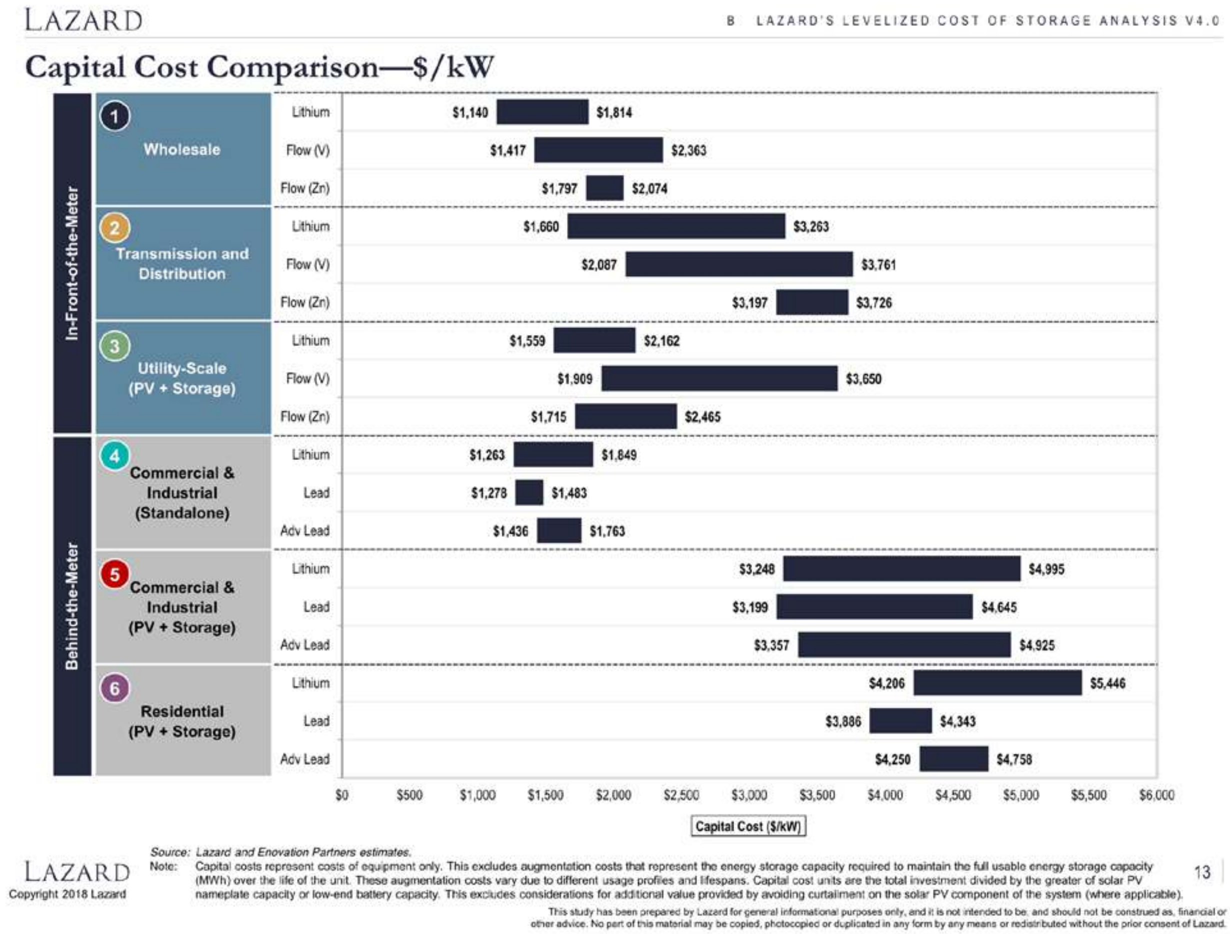
Storage prices are dropping much faster than anyone expected (about 10-20% per year), due to the growing market for consumer electronics and demand for electric vehicles (EVs). Major players in Asia, Europe, and the United States are all scaling up lithium-ion manufacturing to serve EV and other power applications.

Still more uses will become attractive for utilities, industrial customers and households, because lower system costs, combined with developments such as the rollback of solar incentives, will make it financially sensible to store power rather than export it to the grid.

The chart below shows Lazard's latest survey of Levelized Cost of Energy (LCoE) for various storage systems.



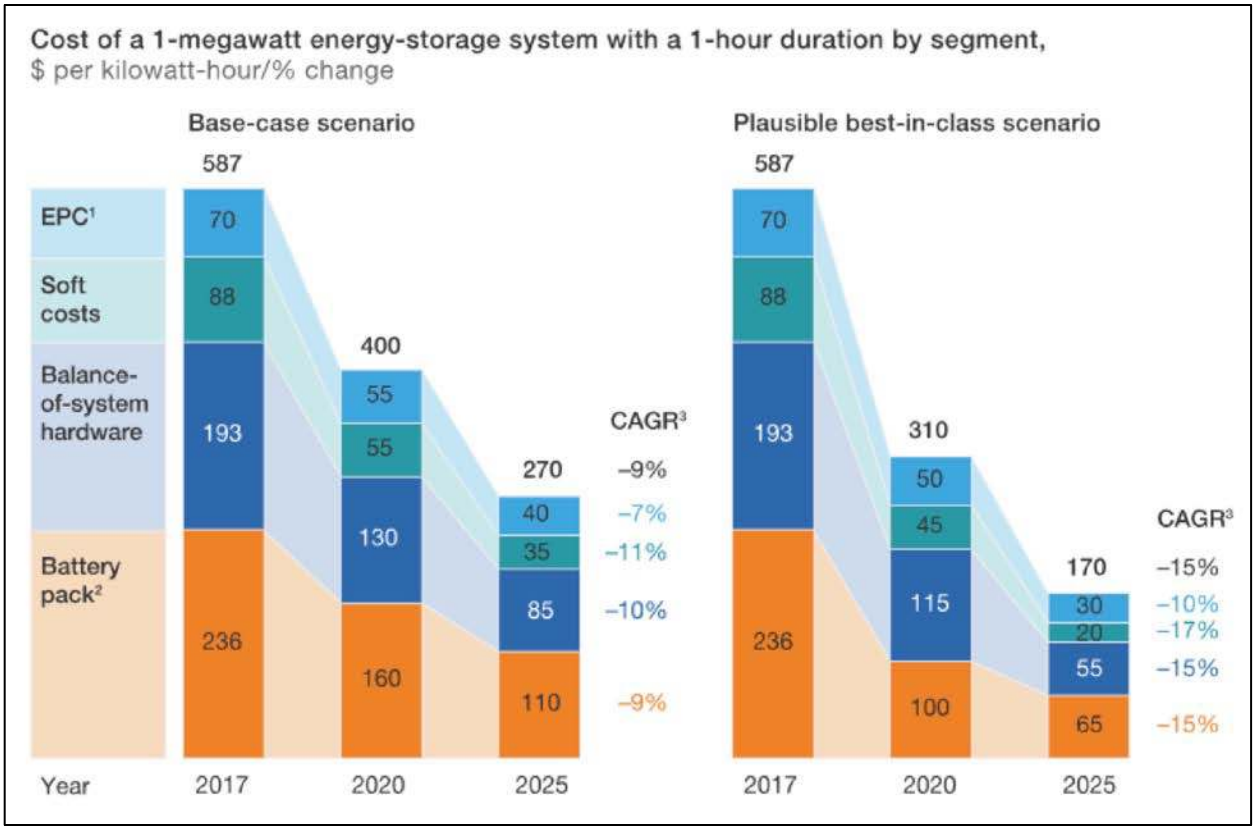
The chart below shows Lazard's latest survey of capital cost for various storage systems.



Trends in Storage Pricing

The Lazard data above gives us a snapshot of current pricing. The next few pages are from work done by McKinsey on trends in storage.

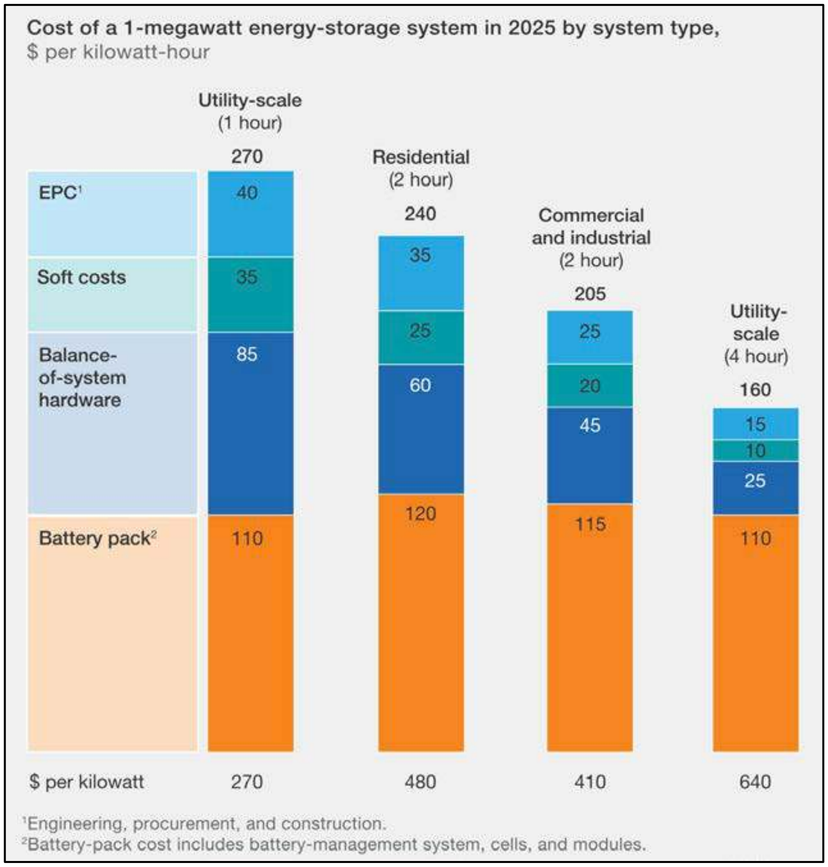
Referring to the chart below, energy storage pricing is decreasing exponentially and finding rapid adoption by electric utilities. The pricing includes battery cost, balance of system costs (BOS), soft costs, and engineering, procurement, and construction costs (EPC).



In the base case, the installed per-kilowatt-hour cost of an energy-storage system would decrease roughly 55 percent by 2025, thanks to continued advances in manufacturing scale and technology as well as improvements in storage-system engineering and design. There is also a plausible best-in-class scenario in which market-leading energy-storage manufacturers and developers deliver a step change in cost improvement: additional process-efficiency gains and hardware innovations could reduce the cost of an installed system by more than 70 percent. At that point, each kilowatt-hour of storage capacity would cost about $170 in 2025—less than one-tenth of what it did in 2012. In this scenario, battery packs could break through the $100 per-kilowatt-hour mark by 2020.

How Costs Compare by Type of System

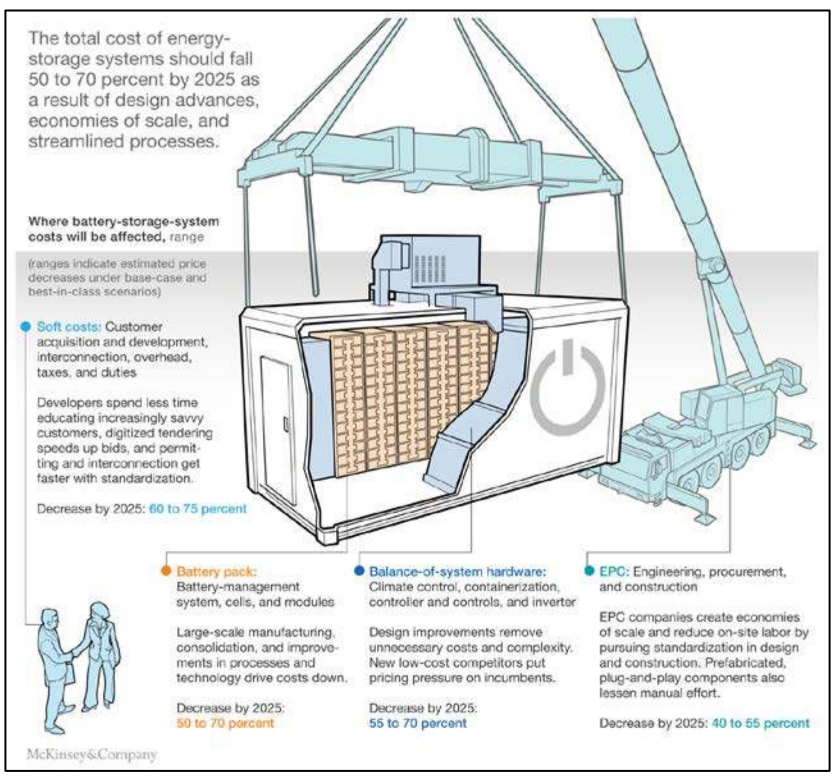
Installed system costs vary among different types of storage systems. Battery-pack costs vary slightly across system sizes, primarily driven by the ability to use purchasing volumes and more efficient battery-management system scaling for larger systems. Balance-of-system costs for a storage system, however, are heavily influenced by the ratio of power (maximum output) to energy (duration of capacity) and the market segment that it is suited to (utility, commercial and industrial, or residential).



Note the utility-scale one-hour and four-hour BOS difference. BOS costs generally increase in proportion to a system's power output, because more powerful systems require additional hardware, mostly in the form of power electronics, and tend to be more complex, which leads to higher engineering, procurement, and construction (EPC) and soft costs. The market segment matters because commercial, industrial, and residential systems generally carry higher customer-acquisition and EPC costs per unit. The estimated costs we present here are primarily indicative, as the specific requirements of each system will ultimately determine its installed cost.

These developments might play out in the four main categories of system costs:

- Battery-pack costs decline by more than 50 percent by 2025 in the base case as global competition intensifies, leading to larger-scale manufacturing, consolidation, improvements in manufacturing processes and technology, and commoditization of products. The best-in-class scenario envisions that battery makers will incorporate multiple chemistries and formats (for example, reduced cobalt cathodes and solid-state batteries), gain more efficiencies from automation and added scale, integrate their supply chains and streamline their manufacturing. All these advances can be financed inexpensively as the cost of capital comes down.
- BOS hardware costs drop by more than 50 percent in the base case. Design improvements remove unnecessary costs and complexity from inverters, wiring, containerization, climate controls, and other components. Further competition from incumbents and new low-cost manufacturers will also pressure pricing for storage hardware. In the best-in-class scenario, the use of new materials and technologies (such as silicon carbide for inverters), the accelerated growth of low-cost manufacturers, and innovations in design (such as the development of prefabricated, modular components) enable additional cost savings.
- Soft costs drop 60 percent in the base case. As utilities optimize the use of battery storage, they streamline their procurement processes and require less time and effort from developers. The additional cost reductions expected under the best-in-class scenario stem from developers' efforts to digitize tendering and the emergence of standard approaches to permitting and interconnection.
- EPC costs fall in the base case because efficient, experienced EPC firms achieve economies of scale and reduce on-site labor by pursuing standardization in design and construction. Alliances with committed developers also provide EPCs with the confidence to invest in capabilities and resources that improve efficiency. The best-in-class scenario accounts for larger-scale EPC enterprises, and the development of hardware and software with plug-and-play compatibility, and prefabricated components that reduce manual installation steps on-site.



Storage – Utility-Scale and Member-Owned

While there are a number of approaches to energy storage, in this section we focus on two:

- Utility-scale Storage
- Member-owned Storage

Storage: Utility-Scale

Energy storage is the Swiss Army knife of a 21st century grid. It provides OPALCO with the ability to store energy for a variety of use cases including:

- Bulk energy – arbitrage and capacity
- Outage mitigation, support microgrids
- Peak shaving and load shifting – reduces demand charges
- Transmission congestion relief and asset deferral
- Firming intermittent renewable resources
- Ancillary services – regulation, spin and non-spin reserve, load following, frequency response, flexible ramping, voltage support, black start
- Distribution deferral, voltage support, conservation voltage regulation

Energy storage will be a critical part of our efforts to reduce peak load on OPALCO's system.

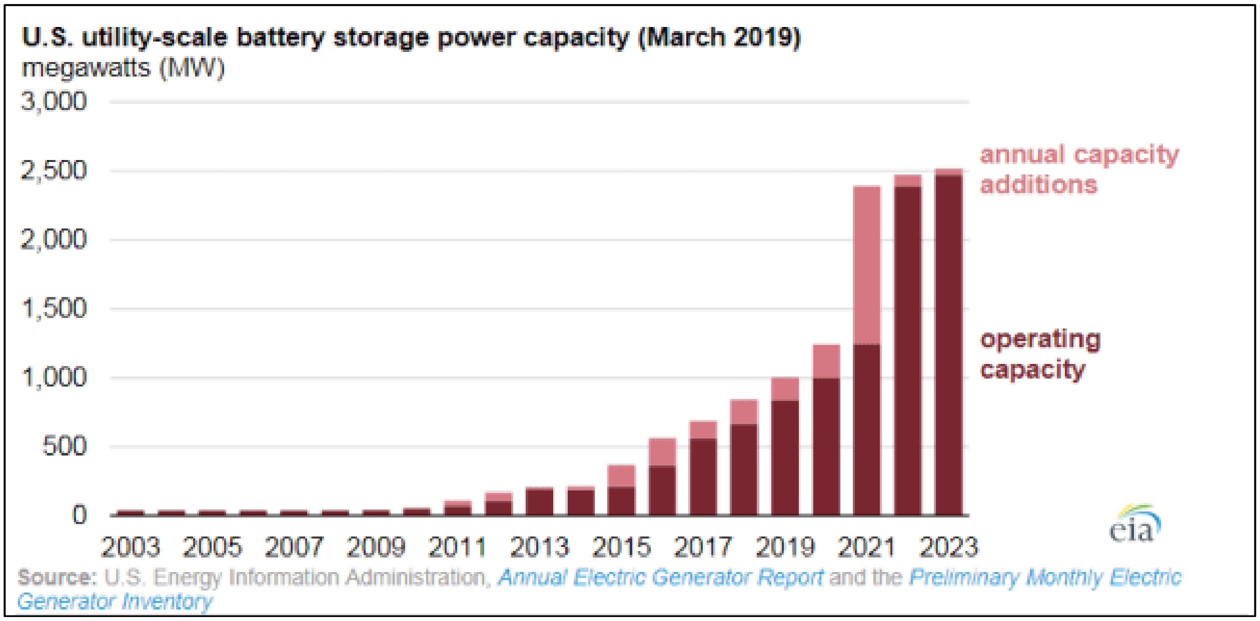
PNNL advises that for every 1 MW of solar, we should balance with about 200 kW of storage.

Storage will be an essential tool to help us increase local energy resilience and keep rates lower as peak demand charges for mainland power increase. Energy industry analyst Gregor Macdonald recently observed:

> *According to the EIA, solid annual growth in 2019 and 2020* ***will be followed by a disruptive high growth year in 2021****, followed by a resumption of much lower growth in years 2022 and 2023 (see chart below). As wind and solar costs continue to fall, that makes the cost of whole-system projects fall entirely, even if cost decline rates for storage are lagging. Moreover,* ***utilities from Arizona to Florida are deciding that not only does it not make sense to build new natural gas generation****, but in some cases it now makes sense to build storage, instead of new wind and solar. Why? Because everyone else is already busy deploying new wind and solar: so why not be a market-maker in electricity supply via storage-capacity versatility, in addition to being an electricity generator? In order to have exposure to everything coming in the grid ecosystem, utilities have discovered there's not only a new profit center to*

> *exploit around storage, but* ***storage itself is the gateway to surviving a very disruptive transition****.*

The jump in 2021 is largely being driven by the expiring Investment Tax Credit (ITC), with investors wanting to maximize their renewable energy credit ROI.



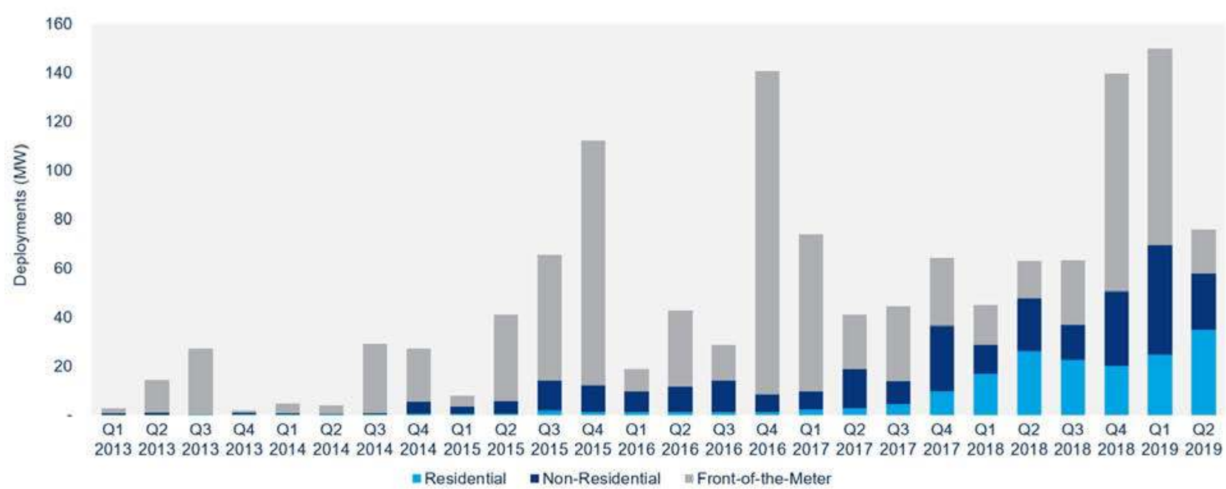
Storage: Member-owned

Members are starting to install energy storage systems in their homes and businesses. The most common applications are for:

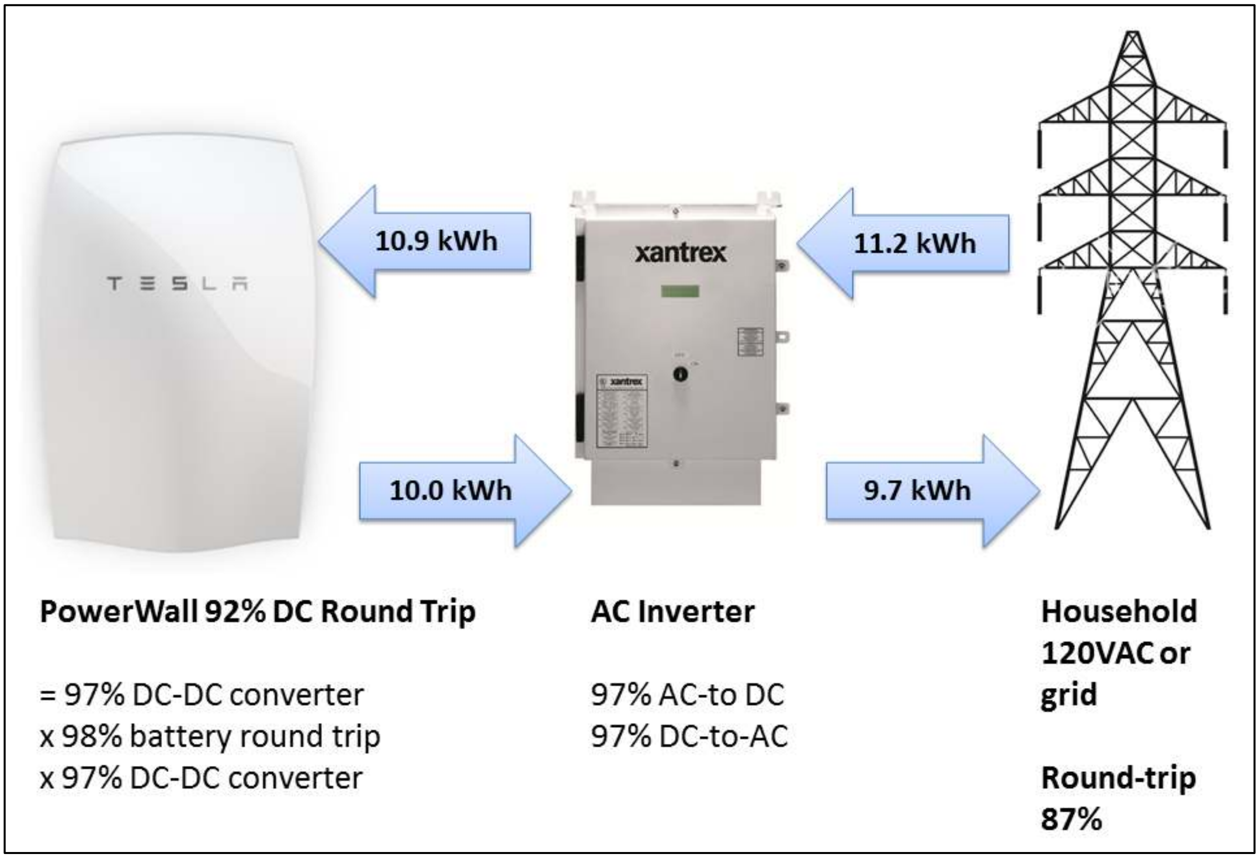
- Outage protection
- Outage protection with solar to ride through more extended outages and smooth solar intermittency
- Dispatchable storage – Charging the home storage system at night, during low use time, and selling it back during peak demand times on signal from OPALCO. The storage can still be used for outage protection.

Member storage can be configured to be dispatchable by the utility, during periods of high demand. This helps the utility save on BPA demand-charges, passing the savings on to the member through billing credits. An electric co-op in the east has a pilot program up and running. OPALCO is monitoring their program for possible replication.

The chart below shows the significant increase in U.S. Residential battery storage (light blue), and business storage (dark blue). New data finds that at a record-breaking 35 megawatts deployed in 2019 Q2, the United States residential storage market climbed 41 percent quarter-over-quarter in megawatt terms. Q2's strong performance was the result of rising customer interest and support incentives in more state markets. We are seeing this mirrored in OPALCO's service area, with increasing member interest in battery storage for both home and office.



Like solar, member-owned batteries are typically connected to the home and the grid through and inverter. Efficiency is important. In the example below, the graphic shows a Tesla Powerwall charging and discharging through a Xantrex inverter. Round-trip efficiency is about 87%.



Pairing member storage with solar has some important benefits. The *Northwest Power and Conservation Council* developed a model simulation to gauge the impact of aggregating installations of behind-the-meter solar + battery systems to smooth out the regional electricity load and, as a result, reduce peaks.

The results were interesting. For instance, on a typical spring day, the regional peak load might occur at around 8 am and another slightly lower peak might occur around 8 pm (at OPALCO it is around 11 am and 7 pm). In this case, the grid charges the battery in the very early morning hours when load is low and then dispatches electricity at the 8 am hour to smooth out the morning peak. Once the sun is up and the PV system is generating, some of the electricity is diverted to the battery to be stored and used later that night during the 8 pm peak. The overall daily system load shape is flattened, which makes it easier to serve. A few other observations from the simulation:

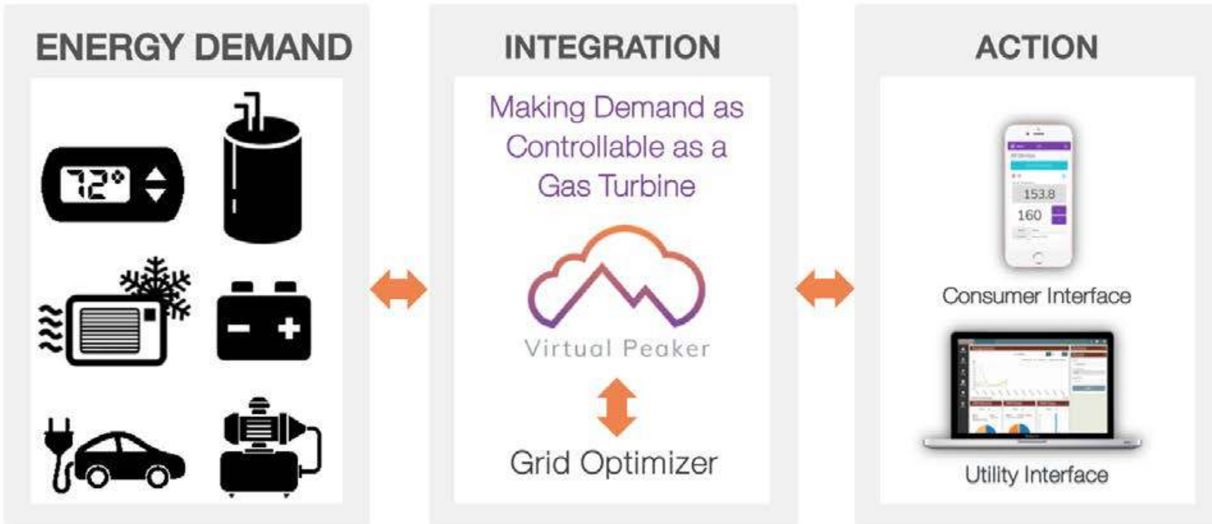
- In some situations, adding battery storage can provide nearly four times the peak load reduction when compared to solar alone
- The amount of peak load reduction varies from month-to-month, but the greatest benefit from adding batteries to solar occurs in the winter and spring months when there is an early morning and/or later evening peak
- In the summer when the sun shines longer, PV systems can produce electricity late in the day and early evening to meet peak demand, relying less on the battery storage

The synergistic combination of utility-scale and member-owned storage provides a much higher return on investment for the member and the co-op. Since outages are infrequent, the battery has few opportunities to deliver value. Members can realize more value by making it dispatchable:

- Provides outage backup power for the member
- Helps the member earn bill-credits to pay off the battery
- Saves the Co-op money by reducing peak demand charges
- Improves grid load factor
- Reduces the amount of utility-scale storage the co-op needs to invest in

OPALCO is in conversation with another electric co-op that has launched some innovative on-bill financing programs to deploy dispatchable storage (and water heaters) into member homes and businesses. In this model:

- 2,000 battery systems are being deployed to residential customers
- Customers pay $15 per month or a one-time payment of $1,500 per 5 kW home storage module
- Approximately 70% of participating customers signed up for the monthly charge option, while 30% opted to make the one-time up-front payment
- Used for utility peak demand reduction – 10MW of dispatchable storage capacity.
- There about 5 to 10 peak events per month, requiring about 3 hours of constant rate discharge from the distributed storage network
- Customer have access for outage resiliency
- This project is estimated to generate approximately $2 million of NPV value over the 15- year life of the project
- The storage network is managed using Virtual Peaker which interfaces the utilities grid control system with the 2,000 batteries, as well as EV chargers, smart water heaters and DRUs, to manage dispatchable load reduction on demand (see below). It also gives the member control of their connected devices – e.g. storage, water heaters, EVs, thermostats, etc.
- Virtual Peaker can serve as an IoT alternative, removing the need for a separate EV electric meter, to control time of use of EV chargers to mitigate increased demand charge. Virtual Peaker empowers the member and the co-op shift load to off-peak hours.



While large utilities concentrate on utility-scale solutions, Virtual Peaker is an ideal solution for co-ops, to help members adopt right-sized solutions for their needs, while helping the co-op increase local energy resilience and ability to manage a distributed network of co-op, home and business member systems.

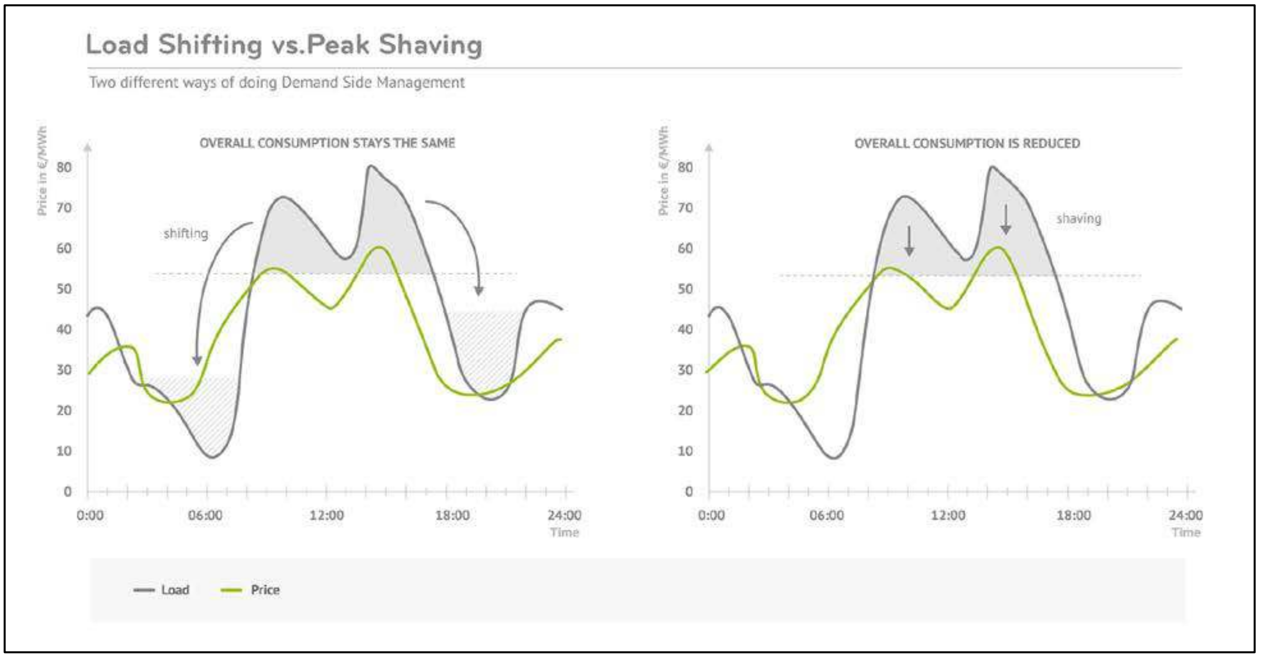
Storage: Peak Shaving and Load Shifting

As the utility industry changes to a time-of-use model, it will become more and more important to have peak shaving programs, peaking capacity and advanced voltage regulation to optimize circuit voltages to reduce load during peak times of the day.

Peak shaving refers to leveling out peaks in electricity use. Power consumption peaks are important in terms of grid stability, but they also affect power procurement costs: BPA demand pricing is set with reference to maximum peak-load in a given hour of the month. The reason is simple: the grid load and the necessary amount of power production need to be designed to accommodate these peak loads. Anything we can do to reduce that peak can save the co-op cost of power. A typical year may have about $250,000 in demand charges.

Load shifting refers to a short-term reduction in electricity consumption followed by an increase in production at a later time when power prices or grid demand is lower (see chart, below left). Solar or storage facilities can be used to bridge high-price or high-load phases but play less of a role if production will eventually catch up again.

In contrast, with peak shaving, we reduce power consumption ("load shedding") quickly and for a short period of time to avoid a spike in consumption (see chart, below right). This is accomplished by temporarily scaling down load with demand response units (DRUs), installed on heavy loads at customer homes and business, or using energy storage to source energy in place of BPA.



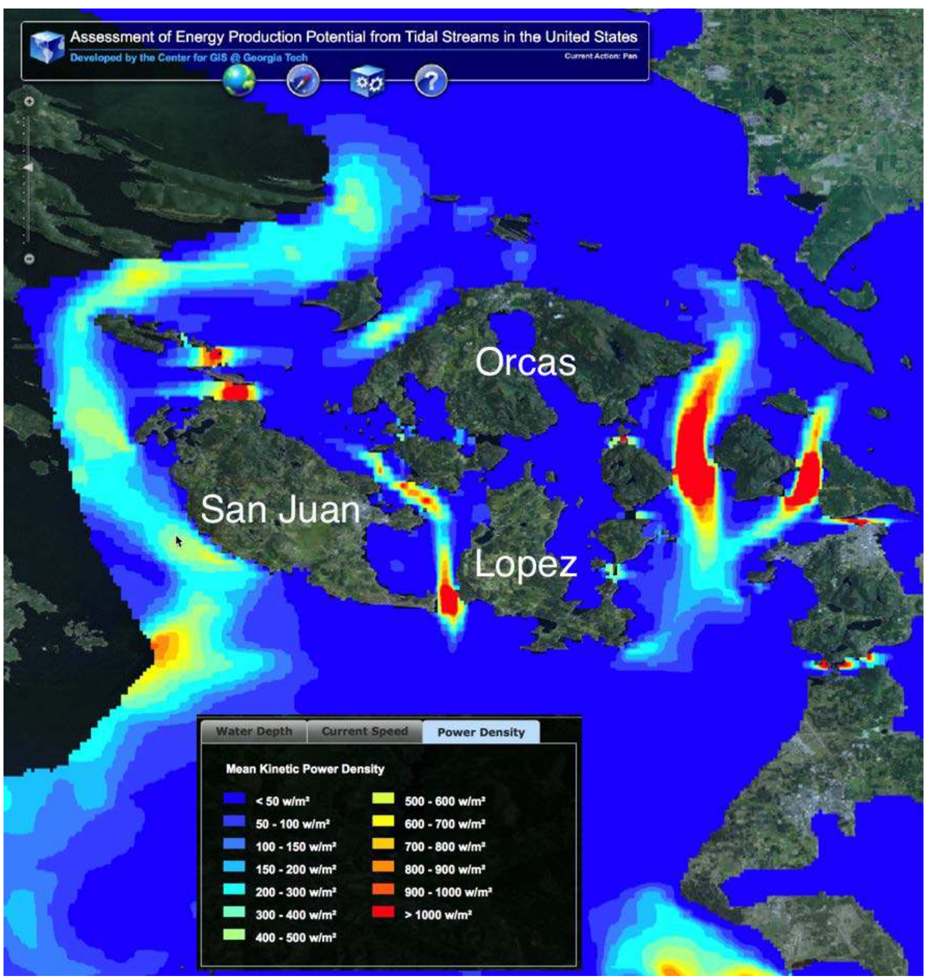
Tidal Resource Overview

Tidal energy potential in San Juan County is enormous.

It has several features suited to our island service area:

- In the US, just as sun is better in southern states, tidal energy is best in the northern latitudes, where tidal flows along coastal waters move massive amounts of water back and forth about four times each day. The chart below shows areas of strong tidal flow in red.
- It is predictable energy. This predictability makes the management of tidal energy much simpler than the highly intermittent nature of solar and wind energy.
- Tidal energy is year-round energy, with minimal seasonality. It can help fill the solar winter gap.

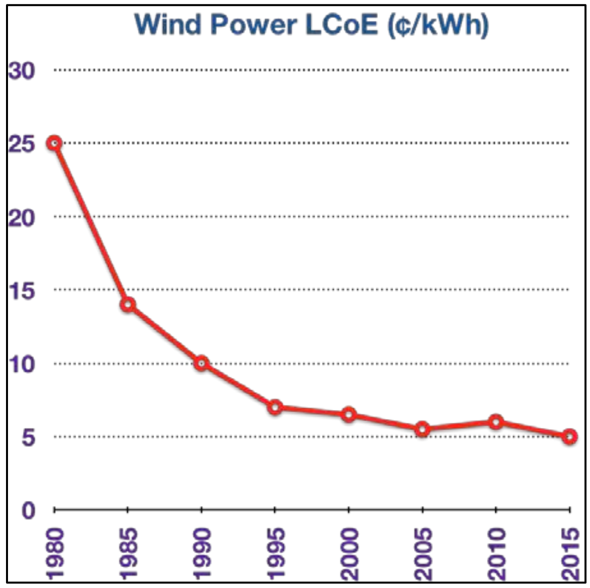
That said, we recognize that just because a resource is being used elsewhere doesn't mean that the community will support it in our territory. OPALCO has a long track record of care for our environment. Any development of tidal resources needs to be done with community support, and engagement with stakeholders, including those most involved with our sensitive marine environments such as the Friends of the San Juans and SeaDoc Society.



Tidal LCoE

Tidal energy generation is in its infancy - more research than development. Its LCoE and capital cost is high, with projections on future cost difficult to rely upon. During OPALCO's March 2018 LRP work session, an LCoE of 10¢ per kWh around 2030 or later was discussed. But as long as the tidal energy industry is in prototyping phase, reliable forecasts will remain difficult.

In discussions with University of Washington Pacific Marine Energy Center, and with PNNL, the consensus was that until a viable tidal energy platform rises to the top and garners committed state/nation incentives to drive scaling up, costs will remain high, beyond grid parity. NREL likens it to the early days of wind turbine development. Once California embraced large-scale rollout of wind power, and incentivized it, that drove production scale up and costs down. The chart at right shows that it took 15 to 20 years for Wind power LCoE to become economic. Perhaps climate imperatives will accelerate tidal power to scale, but the market for tidal solutions may be smaller than wind power.



To get a present-day benchmark for the state of tidal power R&D and pricing, OPALCO has been in discussion with a European developer of a floating tidal generation systems. They estimate a 2 MW system would costs $5,000 per kW, with and LCoE of 25¢ per /kWh and a capacity factor of 20%-45%. Their forecast for LCoE by 2030 is 15¢ per kWh. Just as solar's capacity factor varies with solar insolation (e.g. San Juan County insolation is 45% less than southern California), Tidal power capacity factor varies with tidal energy. A system in upper latitudes like Scotland would have a higher capacity factor than a system in lower latitude such as Hawaii. European systems might conceivably be manufactured locally, in Anacortes for example, to reduce cost and import logistics of large marine energy systems.

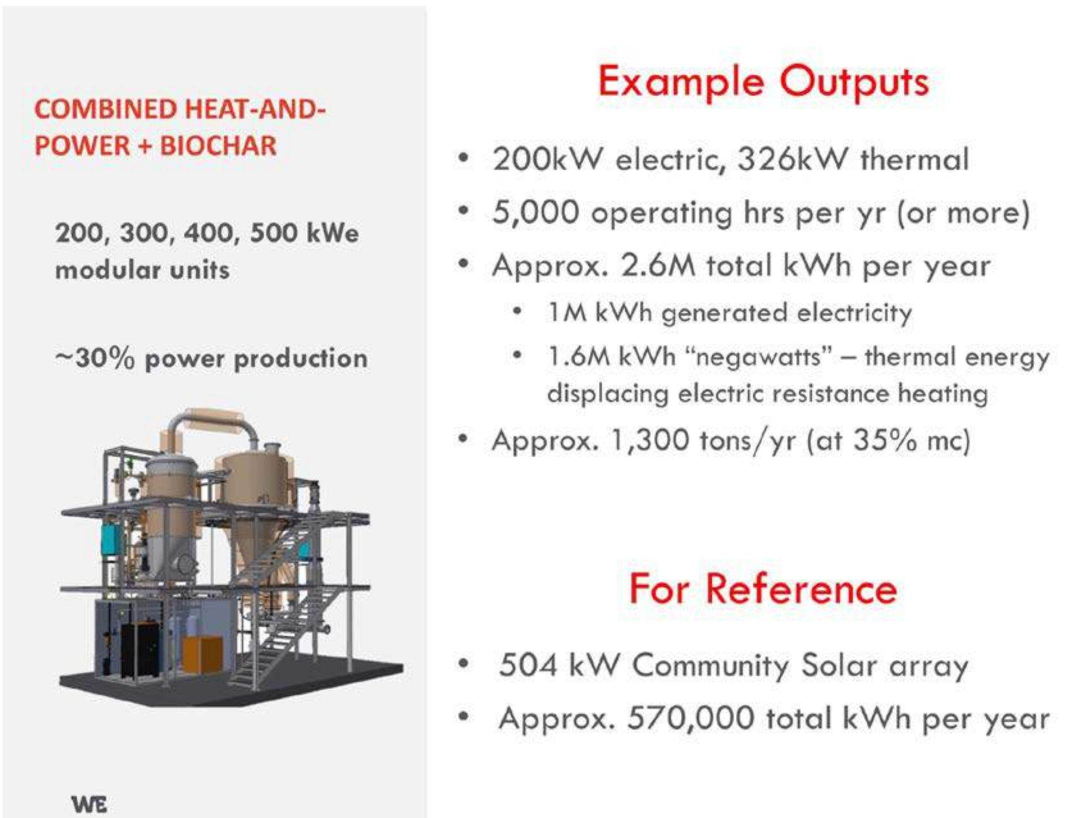
OPALCO will continue to monitor tidal power developments and is in discussion with UW, PNNL and DOE exploring potential grant opportunities as they develop.

Biomass Resource Overview

We are seeing positive developments and interest in the county toward biomass and biochar carbon sequestration and Combined Heat and Power (CHP) production. The Orcas exchange and Conservation District are exploring grants and emerging biogassification technology to process woody biomass. This can have the beneficial side effects of:

- **Reduced fire risk** in a climate impacted world. Increased proactive stewardship of county forests, removing wood fall and woody biomass "fuel" from forest floors, and using it to generate energy.
- **Energy production**, perhaps purchased by the co-op through a Power Purchase Agreement (PPA).

The chart below offers an example of how biomass compares with solar.



San Juan County biologist and forestry guru Tom Schroeder, researches and writes extensively on our county forests. As many have observed, and Tom notes:

> *Trees in our local forests grow more slowly, are much shorter at every age, and experience challenging conditions that derive from peculiarities of local geology and climate.*
>
> *Low timber productivity in San Juan County means that, even at culmination, the rate of volume growth is low. Culmination - the age at maximum timber growth - is also relatively delayed compared to more productive areas. In this*

> *county's forests culmination is at 100-120 years, whereas in forests on "good" land of grade II culmination is at about 50 years. For sustainability, age at culmination should be matched to rotation of timber harvesting, so it follows that* ***San Juan's forests are being harvested 2 to 3 times too rapidly*** *(turning over every 45 years vs 100-120 years).*

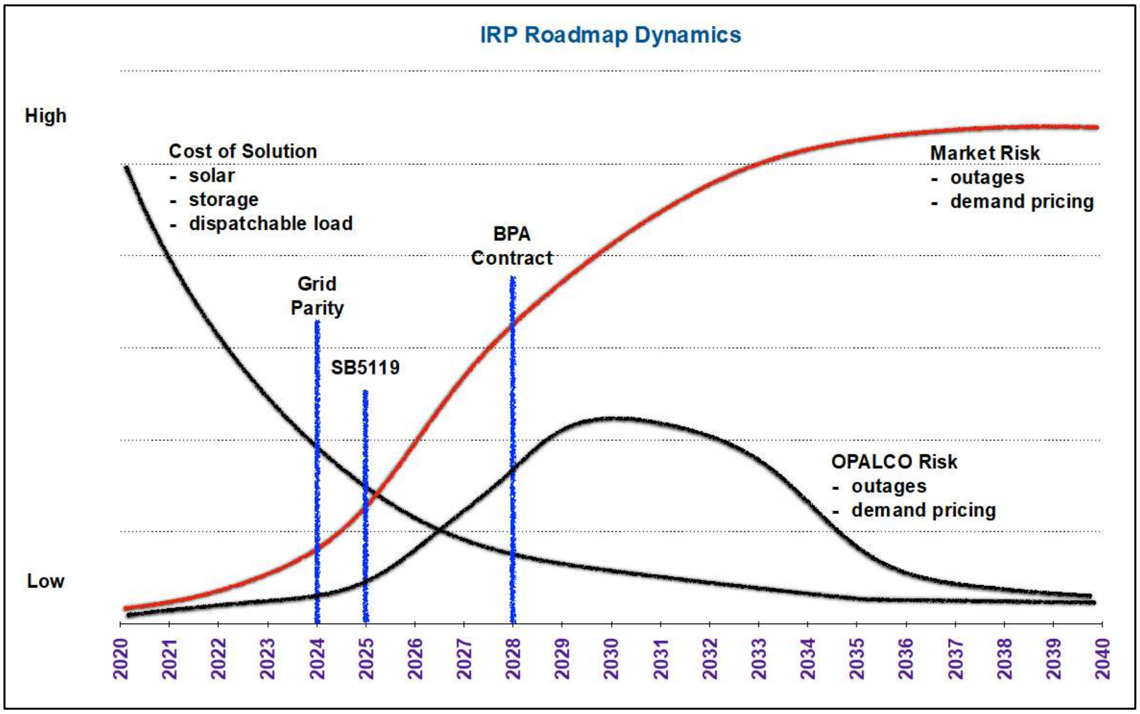
One estimate suggests that only about 320 to 500 of the total 70,000 acres of County forest could be harvested annually in a sustainable fashion. In the Pacific Northwest, hybrid poplar grown for saw-log production is estimated to yield up to 12 dry tons per acre of chips for energy production at the time of harvest (Stanton et al. 2002). So, 320-500 acres x 12 ODT (one dry ton) = 3,840 to 6,000 tons/yr of burnable biomass. It takes from 5,600 to 8,600 ODT to generate 1 MW of power. So, about 1MW, or 5,600 tons of woody mass/yr. At best, this gives about 8,760MWh, or 4.4% of our annual 200,000 MWh demand, and more likely only 3% if you assume a 70-80% capacity factor.

And at the end of the day, you are releasing all that carbon, comparable to coal, into the atmosphere. Just as it has been said that much of the remaining oil and coal should be left in the ground, when it comes to burning wood, to paraphrase, “leave it on the ground” for a slower release of carbon, and nutritive benefit of the soil.

That said, though biomass emits carbon, when burned for energy, and is considered by many a problematic source of renewable energy, biogassification systems are becoming increasingly efficient, and carbon neutral holding promise as a potential source for local energy production and fire risk mitigation.

Resource Roadmap

OPALCO's resource roadmap unfolds over a very dynamic decade ahead, with grid parity expected around 2024, CETA legislation decommissioning coal plants by 2025, and negotiation of a new BPA contract by 2028. The chart below shows how trends in **local renewable energy resource cost**, and **mainland power reliability and cost risk** playout against these important markers.



Initially, OPALCO's risk is lower than market risk, thanks to the contract guarantees for BPA power. But we and BPA co-exist in a complex shared transmission system, making it difficult to know how buffered we will be from CETA effects. As we increase our local generation resource portfolio, especially in winter-strong tidal capacity, we expect to see that risk reduce.

Given the above dynamics, the table below summarizes a recommended roadmap for OPALCO resource development, in four-year Capital Work Plan (CWP) increments.

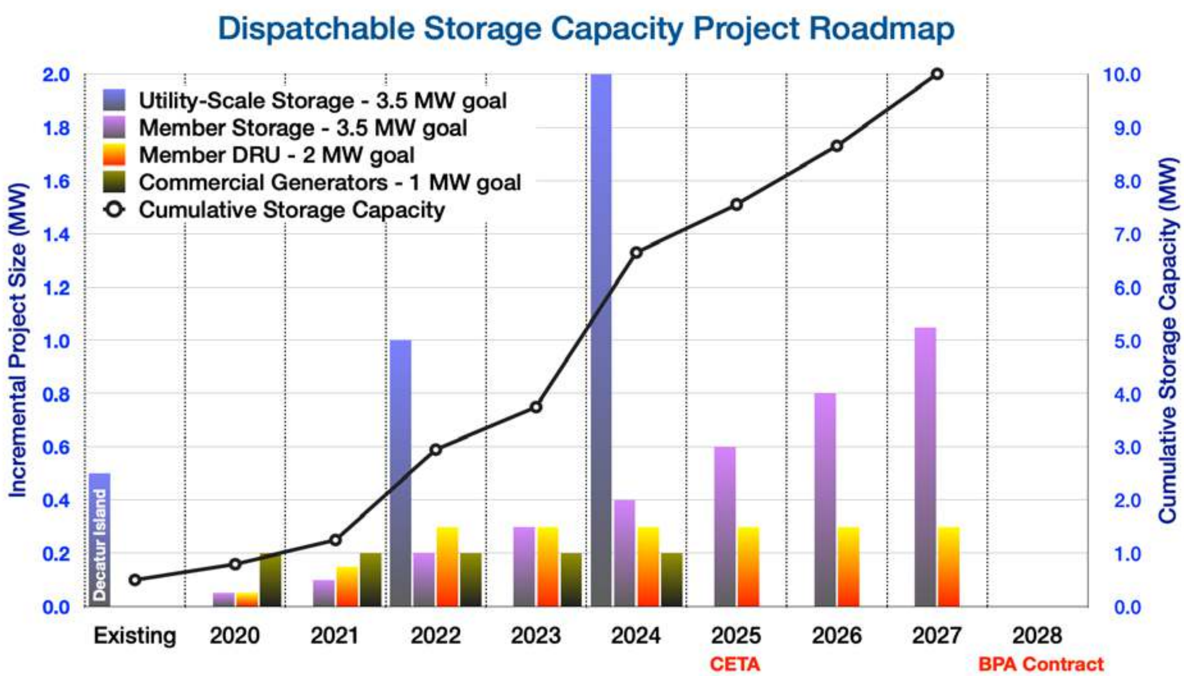
Each of the following Themes, Benefits, and Actions tie back to our Mission and Strategic Directives – safe, clean, cost-effective, reliable and sustainable energy, with a commitment to the use of renewable resources and carbon reduction.

Schedule	Theme and Benefits	Actions
2020 – 2024 **CWP 1**	**Before Grid Parity + CETA Preparation** Increase local energy resilience at minimum cost to members through community solar subscriptions, grants and RESP funds. This helps increase local energy resilience, especially for critical services in the County: first responders, town centers, government. Community solar helps members lower the cost of their electricity Continue beneficial electrification programs.	Deploy as much community solar as members want (at least 1 MW) – funded by subscribers. Create incentives and OBF program for 3 MW dispatchable home storage - funded by grants and RESP funds. Create incentives and OBF program for 2 MW dispatchable load (water heaters) for home and business - funded by grants and RESP funds. Create incentives for dispatchable commercial member generation for peak demand mitigation. Cooperate with partners on grant-funded tidal projects that help assess potential solutions. Continue grid modernization projects (see Grid chapter below).
2024 – 2028 **CWP 2**	**At utility-scale solar Grid Parity and CETA** Increase local energy resilience by ramping up utility-scale solar. Cushion against the increasing cost of mainland power. Rate inflation should start to flatten. Continue beneficial electrification programs. More revenue helps moderate rate increases.	Deploy all cost-effective local energy resources, including solar, storage and dispatchable load solutions, funded by grants, RESP and rates. Continue grid modernization projects (see Grid chapter below). Continue tidal power collaborations, through grant funded projects.
2028 - 2032 **CWP 3**	**New BPA Contract** Continue deploying local energy solutions. Optimize mix of local generation with BPA as firming and gap filling. Continue beneficial electrification programs.	Continue deploying all cost-effective local energy resources, including solar, storage and dispatchable load solutions, funded by grants, RESP and rates. Continue grid modernization projects (see Grid chapter below). As tidal approaches grid parity, prepare for deployment when cost effective.

Schedule	Theme and Benefits	Actions
2032 – 2036 **CWP 4**	**Ramp up Tidal Power at Grid Parity** Switch from solar to tidal investment to strengthen winter generation resource portfolio. Further reducing dependence on mainland power and pricing. Continue beneficial electrification programs.	Funded through grants, RESP program, rates.
2036 – 2040 **CWP 5**	**Build Equity** In preparation for forthcoming submarine cable replacement projects. Continue beneficial electrification programs.	Grants, RESP program, rates.

Storage Project Roadmap

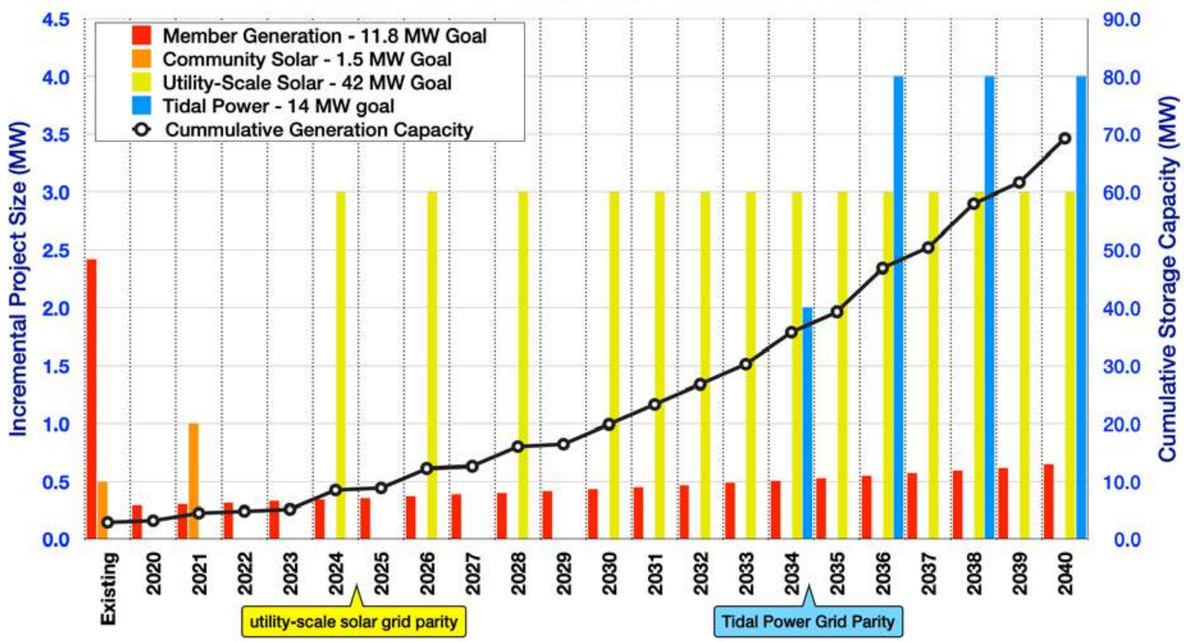
The roadmap below lays out a mix of dispatchable storage resources between now and 2028, with a goal of having 10 MW of capacity by 2028. As mentioned in discussion throughout this IRP, storage helps with demand cost control, outage mitigation, intermittent resource smoothing, and other valuable functions.



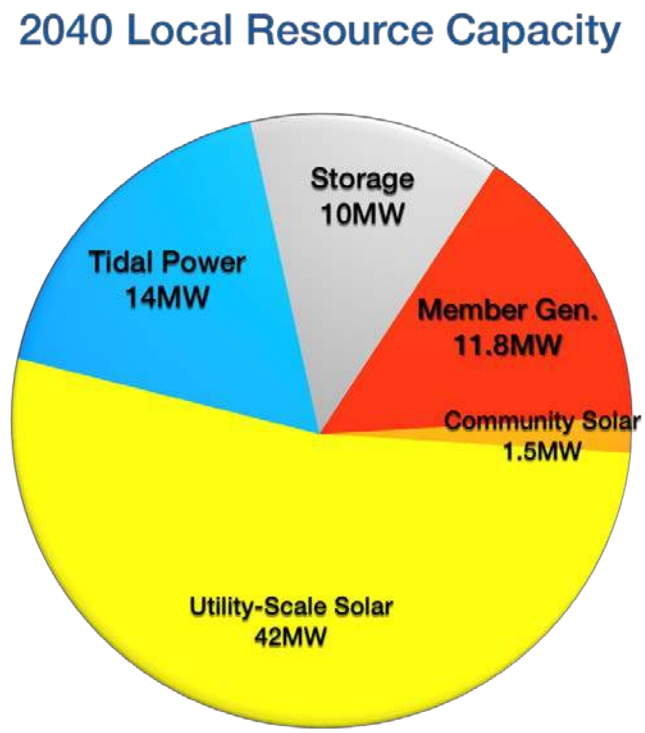
Local Renewable Generation Project Roadmap

The roadmap below lays out a mix of local renewable energy resources between now and 2040, with a goal of building capacity at a steady rate once utility-scale solar hits grid parity. In the example below, we are adding 3 MW of solar every other year, in the 2020s, and every year in the 2030s. Once tidal LCoE hits grid parity, we start with 2 MW of tidal for the first project, ramping to 3 MW every other year, which, in this example takes us to 2040. As mentioned in discussion throughout this IRP, local renewable energy resources help moderate the rising cost of mainland energy and improve local energy resilience. With climate impact accelerating, it is possible that deployment of local renewables might accelerate, if grant funding rises, allowing us to build more for less.

Local Generation Capacity Project Roadmap



The chart at right shows the resulting local resource capacity mix in 2040. It's worth remembering that as we ramp up local generation, the load on the mainland cables is reduced, extending the life of the transmission and submarine cables through congestion relief and asset deferral. That improves the cost benefit equation.

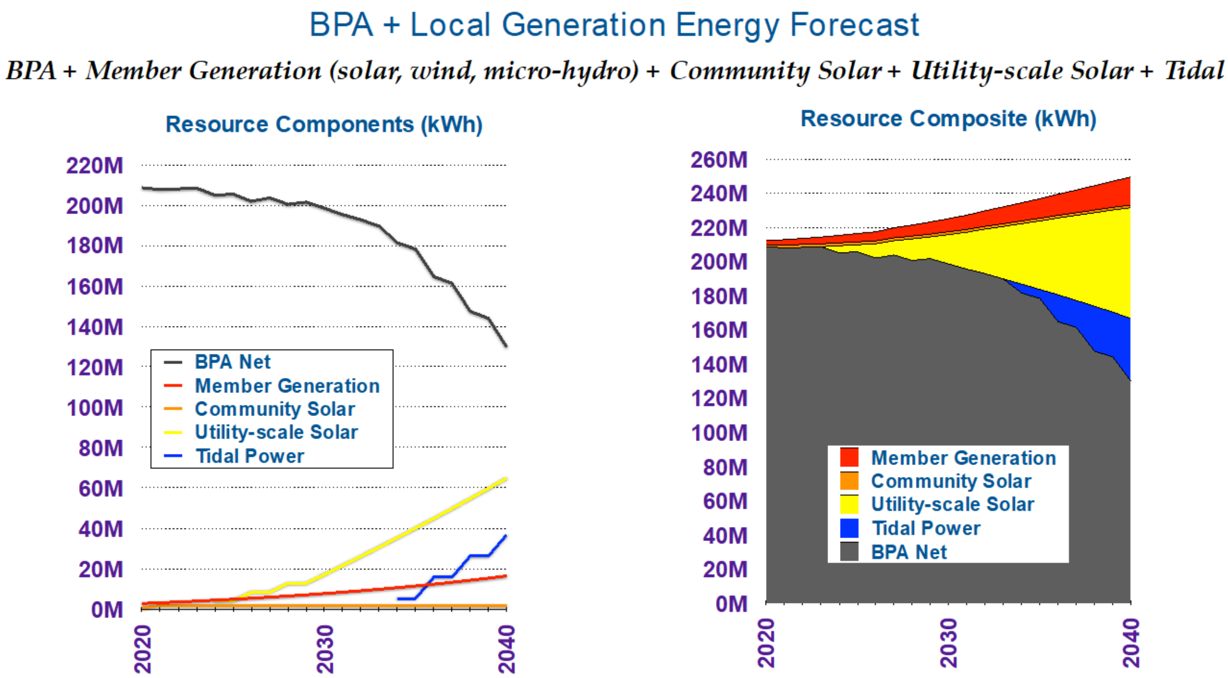


Winter, Summer, Night, Day

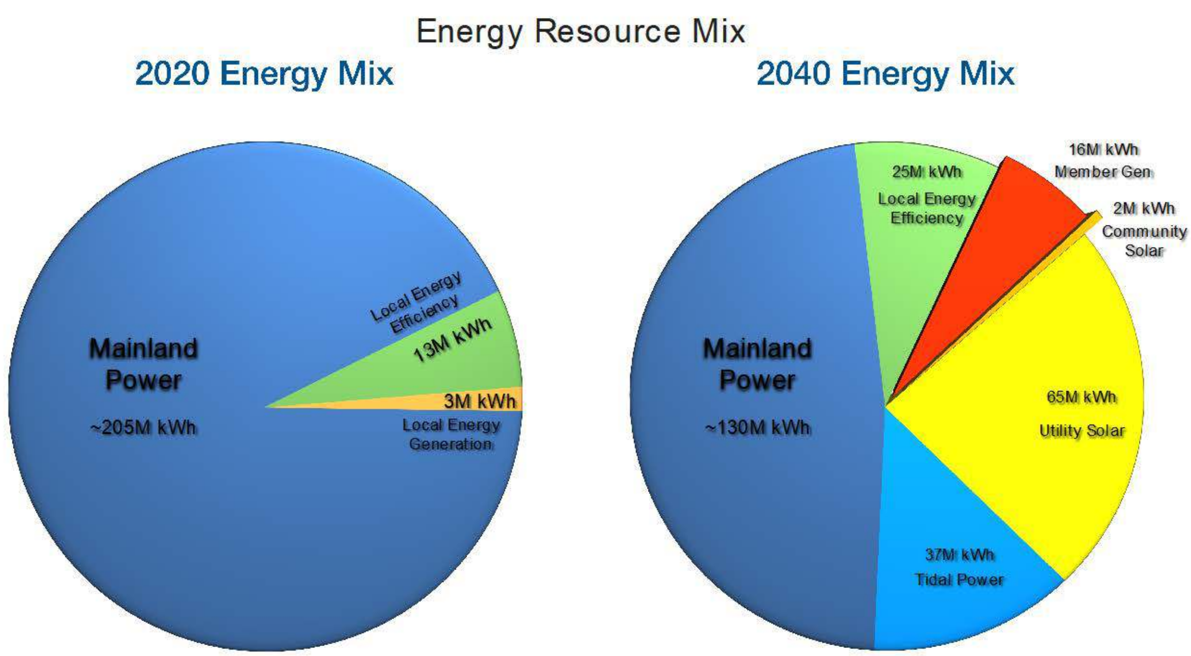
This emerging mix of local renewable energy, each resource with its own seasonal and daily productions patterns, has some remarkable implications for when we draw on mainland power. We are in the early stages of modeling this, but here are a few preliminary implications to consider:

- 14 MW of tidal power yields 4 MW of power (30% Capacity Factor). That is day and night, winter and summer.
- 55 MW of local solar (member + community + utility), yields 8 MW of power (15% Capacity Factor). That is daytime only in summer. In winter solar is daytime only, and 20% of summer – 1.6 MW.
- Summer load in 2040 is forecast to typically be 17 MW. So, summer daytime load will be mostly met by local generation. Summer nights tidal is still generating, but we will need more mainland power. In summer, mainland power daytime rates may be expensive due to climate heating, increased demand for air conditioning, and reduced hydro flow due to reduced snowpack.
- Winter load in 2040 is forecast to typically be 23 MW. So, winter daytime load will be mostly met by mainland generation. Daytime will have about 1.6 MW of solar on the occasional sunny day. Day and night will have will about 4 MW of tidal. That gives us about 5.6 MW of local energy, leaving about 17 MW need from the mainland. In winter, mainland power daytime, and especially nighttime rates may be less expensive than summer, with warming winters, reduced heat load, and a shift in hydro from summer to winter as snow decreases, and winter rains increase, increasing winter hydro flow.

Given the roadmap above, the chart below shows the energy production over time as we ramp up the local energy resource mix. The left chart breaks out the component energy resources in the mix. The right chart shows the combination of the components.



The chart below shows the energy production mix for 2040 compared to 2020. It is worth noting that 52% of the energy is still coming from the mainland in this example. The 2040 resource mix requires a steady aggressive resource development commitment. There are a number of challenges behind this, including securing and permitting adequate siting for local solar, tidal, wind and other resources.



We will be exploring low and high cases in the LRP, early next year. There are two dials we want to explore as we model high and low business cases.

- **CETA** drives investment in storage to mitigate demand and outages – a form of insurance. How much storage do we want to roll out to mitigate CETA exposure? And there are beneficial side-effects of have that storage for the many use cases storage offers?
- **EVs** load increases revenue using existing infrastructure – no new capital needed to handle the increasing load. That new revenue helps moderate rates. EV market share has been accelerating. Will it continue, especially given the current political climate in Washington, DC aimed at slowing climate action, clean energy incentives, etc?

Key Concepts

Decarbonization

The passage of CETA legislation accelerates the closing of coal plants by 2025, in an effort to slow down climate impact. This is an important step. As we mentioned in discussion above, the problem is, there is no plan or funding to replace that coal energy (13% of WA energy use comes from coal) with clean energy. The task ahead is enormous, and the state and utilities will be scrambling to figure out what to replace the coal power with and how much will it cost?

Natural gas has often been viewed as coal's cleaner alternative low-cost alternative. But natural gas is still a carbon intense fossil fuel. And, the economic energy calculus is changing rapidly.

Coal's market share of U.S. electric power generation has decreased from 57% 30 years ago to 27% in 2018. During the same 30 years, natural gas' share has leapt from 9% to 35%. The shale gas revolution has made gas the fuel many utilities have embraced as an alternative to coal, and a firming resource for the growing portfolio of intermittent solar and wind resources.

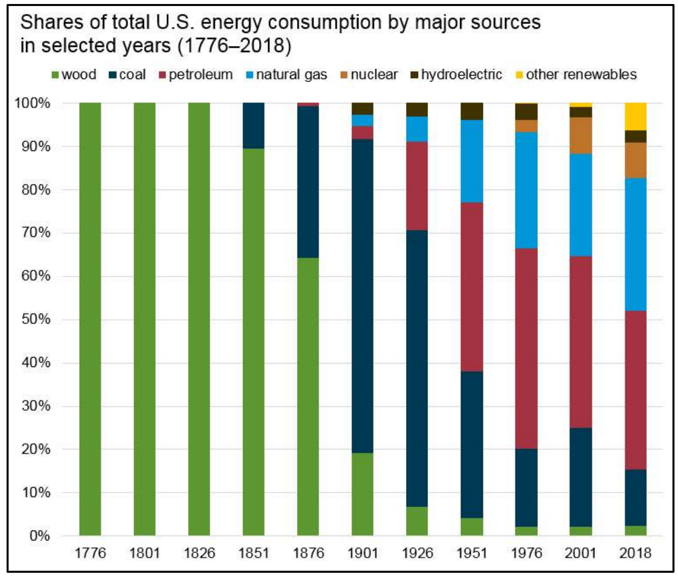
New research at Tepper School of Business at Carnegie Mellon University, demonstrates that, compared to mid-merit gas plants, the combination of solar plus storage (S+S) can be a better value, operationally and financially, at least in sunny regions of the world.

For example, in the California, the net levelized cost of energy (see LCoE discussion above) for S+S runs from 3.9¢ to 4.8¢ per kWh, with a mid-point of 4.32¢. A comparable mid-merit natural gas plant would have a net LCoE of 6¢ to 11.6¢ per kWh.

The writing is on the wall. Even without a carbon price, fossil fueled energy days are numbered. That's great climate impact news, and challenging utility managment news. For the Northwest, our winter solar is one-fifth of summer production, so the economics don't work. But, perhaps with wind on the mainland (and possibly offshore), and tidal, as it becomes cost effective, fossil fueled energy resources decline will be as swift as stable economics allow.

As Washington State tries to figure out its next move on how to replace the 13% of state energy that comes from coal, it has new emerging options. And, if a price on carbon gets added to the mix, then that speeds the transition to renewables. But remember, making fossil fuels more expensive doesn't mean renewables are inexpensive. Either way, replacing 13% of WA coal energy will be expensive and take time. The good news is that renewable and storage costs continue to fall – scaling projects up over time (rather than doing it all up front) reduces the TOTAL capital investment.

Renewable Energy



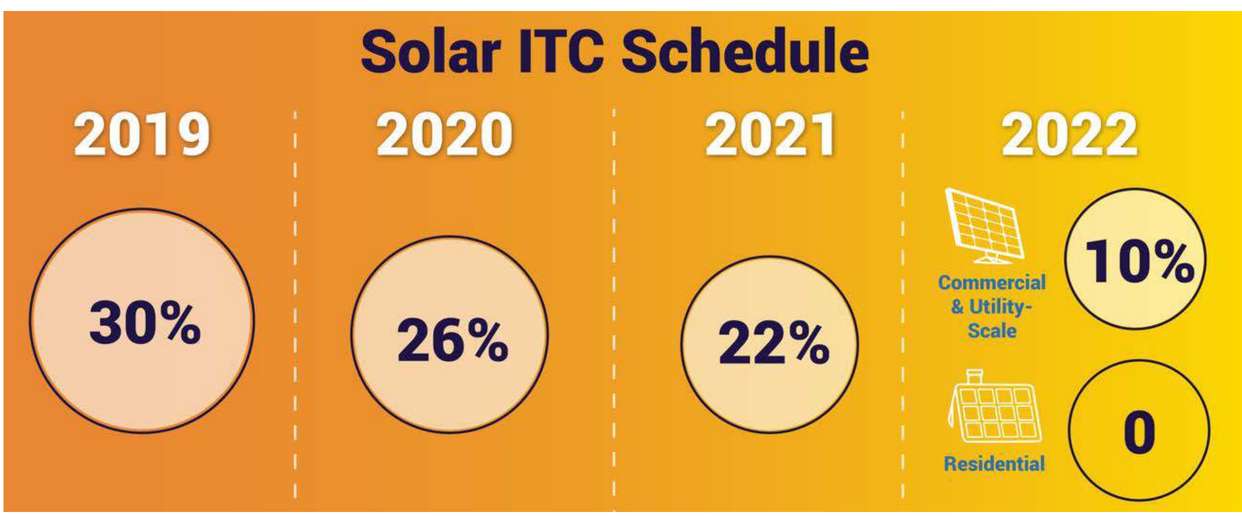
Renewable energy is energy from sources that are naturally replenishing but flow-limited; renewable resources are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. This includes sunlight, wind, geothermal heat, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed.

As the chart on the right shows, U.S. energy mix is increasingly diverse, and shifting rapidly to low carbon renewable forms.

In the Pacific Northwest, most of our energy is renewable hydro. BPA's fuel mix is 98% greenhouse gas free. It is some of the cleanest, lowest cost energy in the world.

Renewable Energy: Federal Income Tax Credit

The renewable energy Investment Tax Credit ("ITC") is a Federal tax credit for renewable energy systems (e.g. solar, wind) placed on residential and commercial properties. In December 2015, Congress acted to extend the 30% tax credit through 2019 with a step down in subsequent years: to 26% in 2020, to 22% in 2021, and thereafter it is 0 (zero) for homeowners and 10% for businesses.



Renewable Energy: WA Net Metering

The 2019 Washington State Legislature updated Washington State's renewable energy net metering statute via E2SSB 5223. In summary, an electric utility must offer to continue to make net metering available to eligible member-generators on a first-come, first-served basis until the earlier of either June 30, 2029; or the first date upon which the cumulative generating capacity of net metering systems equals 4 percent of the utility's peak demand during 1996.

Net metering allows grid-connected renewable energy system owners to receive credit for excess electricity produced by their system. Net-metered systems that produce more electricity than needed are credited for the excess production at retail electric rates on the next month's utility bill. Credits carry forward month to month but NOT year to year. Credits zero out on March 31 and a new net metering year begins. Therefore annually, a customer does not earn credits for more energy than they use that year. Monthly minimums or basic fees are not offset by net metering credits; credits offset per kilowatt hour usage.

Renewable Energy: WA Sales Tax Exemption

Starts July 1, 2019 for system sizes under 100 KW. Different rules apply for systems 100 KW to 500 KW. Sales tax exemption will continue through December 31, 2029.

Renewable Energy: WA State Production Incentives

OPALCO has been notified by Washington State University, on behalf of the State of WA, that they will no longer be processing any new applications that were received after 3/28/2018 for certification for the Renewable Energy System Incentive Program. Information about the program is displayed below, and we hope future programs will emerge from the legislature. **Contact your local State congress representatives**, and learn about the legislative committees to influence new renewable incentive legislation.

V. The Grid

The combination of energy + internet enables a local collaborative commons, powered by local renewable energy resources, whose lower marginal cost enables a more robust resilient local economy.

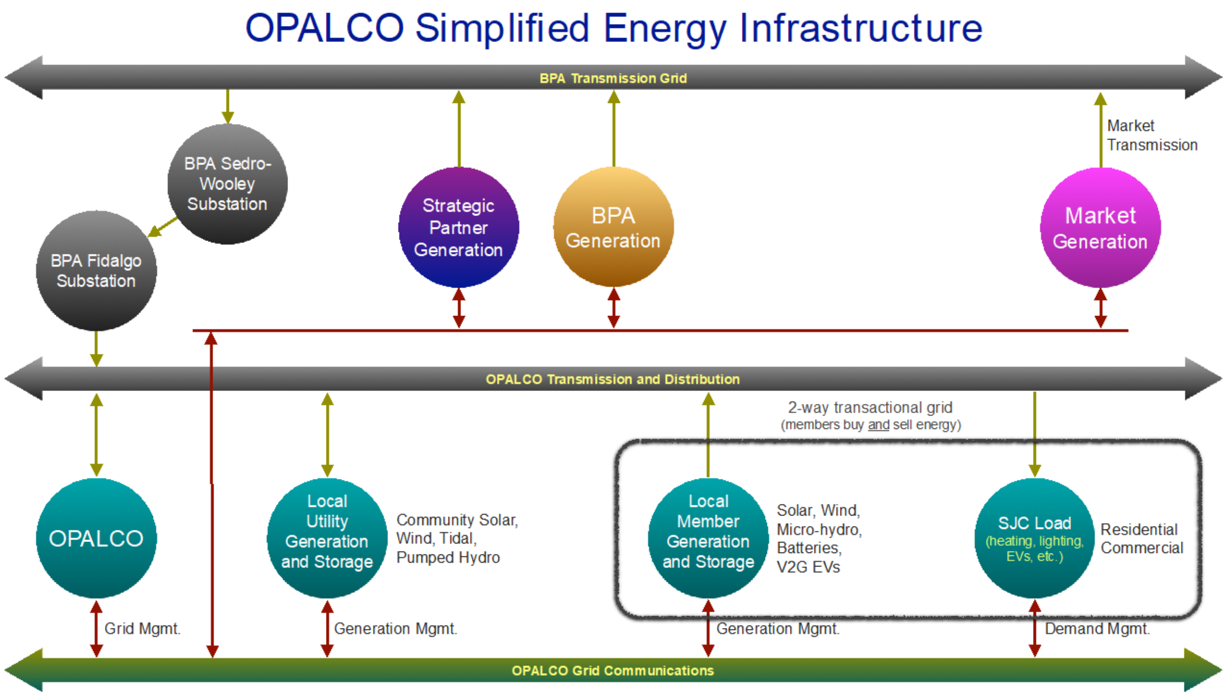
paraphrasing Jeremy Rifkin, discussing the Internet of Things (IoT), energy + internet, collaborative commons

Overview

We are in the early stages of a highly transactional grid. As communication protocols standardize, we will see increased two-way energy and information flow, members buying and selling energy, solar + batteries increasing local energy resilience, a reliable fiber and wireless internet. OPALCO will increasingly serve as a balancing exchange for members as they buy and sell energy from each other, with BPA serving as a vital source of firm energy when local energy demand exceeds local generation capacity.

OPALCO serves Co-op members on 20 islands by routing energy from BPA and local renewable resources through the **Grid** to member's homes and businesses. The grid is composed of submarine, aerial and buried cables interconnecting substations, switches, voltage regulators, and managed through a network of fiber, interconnecting all the elements, and connecting them to a control system designed to keep energy flowing reliably and safely.

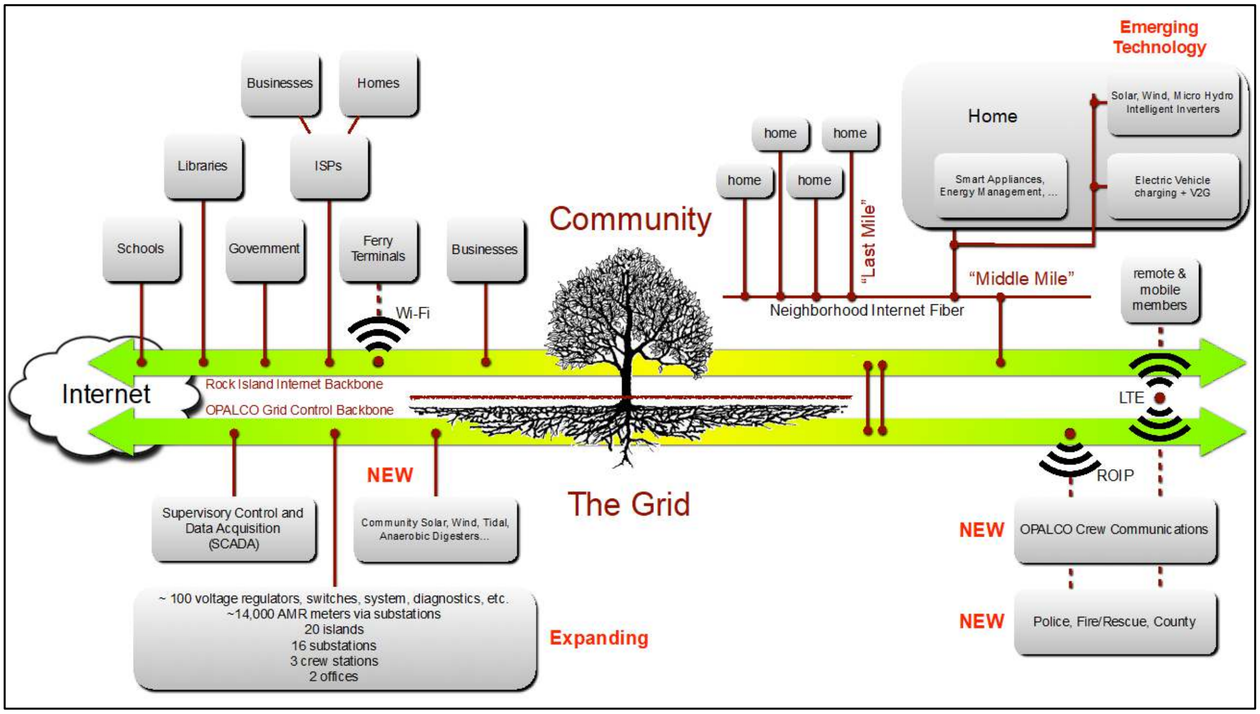
The diagram below shows the major components of the grid, including BPA, strategic partners and market energy providers routing power through the Sedro-Wooley and Fidalgo stations to OPALCO's local transmission and distribution system that connects the islands. Energy can be routed to members. And it can be routed from members who generate electricity from solar, wind, and micro-hydro resources, and sell what they don't use back to OPALCO, for sharing with other Co-op members.



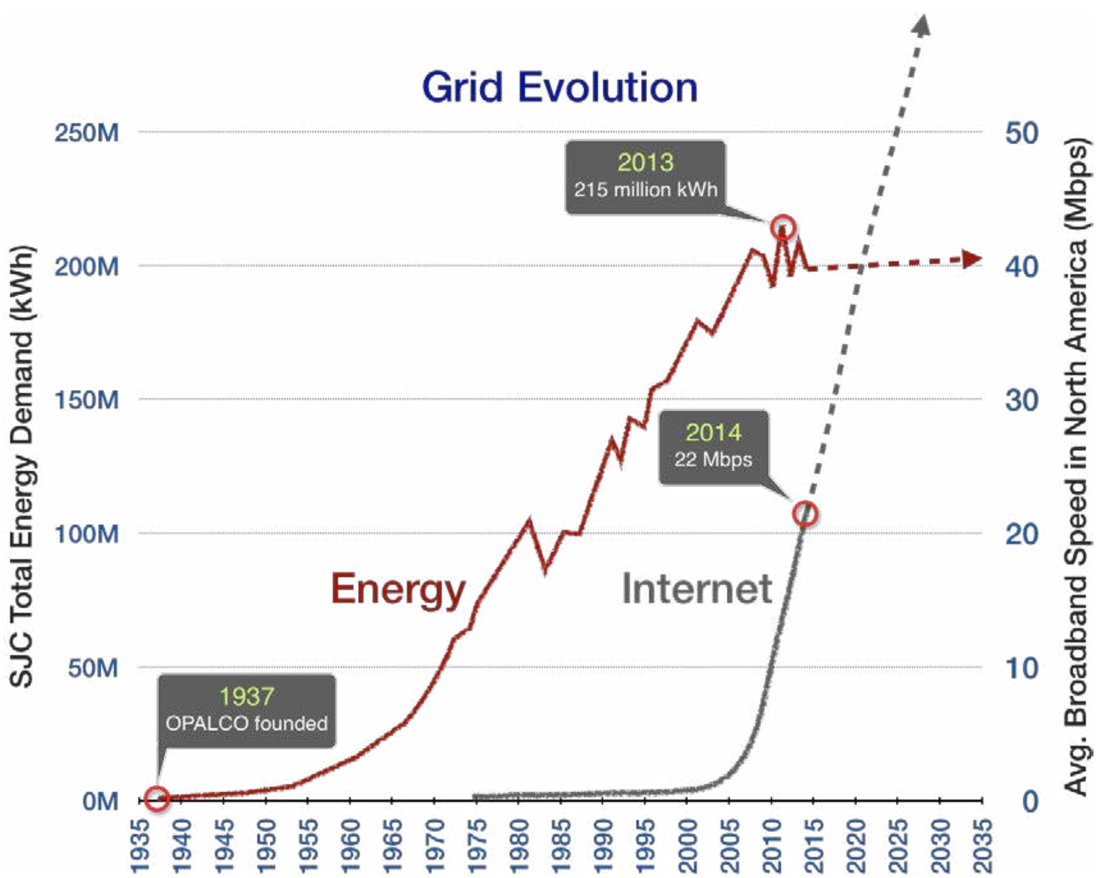
The grid will increasingly carry more of this 2-way energy flow, as more and more local renewable generation is added to the grid. This flow of energy is managed using the grid control backbone for grid communications via optical fiber network. This network supports:

- very fast efficient and reliable grid operations
- smooth interconnection with local renewable energy resources – e.g. solar, wind, storage
- increased energy efficiency
- better customer service

The grid control backbone also provides a layer of communications system for communicating between OPALCO offices and with field crews. This communications capability is expanding to fill communication holes throughout the county that have limited first responder communications. This will improve public safety and the reliable reach of county communication systems. The wireless component of the grid communication system employs LTE wireless radio spectrum purchased by the Co-op and configured to provide wireless radio and phone capability.



While demand for energy has flattened, internet demand has been growing exponentially.



This intersection of energy and internet is often referred to as the Smart Grid. This integrative whole-systems approach is synergistic, taking the grid the Co-op developed starting in 1937, and transforming it into the grid of the 21st century:

- more local
- more distributed
- two-way (consuming and generating, buying and selling energy)
- sourced from increasingly intermittent generators such as solar and wind

At a recent energy Roundtable meeting with OPALCO, Dan Kammen said:

> *"In order to make renewable energy into a stable energy resource, it is necessary to monitor power supply and demand in real time and to obtain a balance between supply and demand by integrating conventional electric grid with up-to-date information and communication technologies. The internet-enabled Smart Grid will foster a well-managed local energy generation portfolio of solar, wind, tidal, hydro and energy storage resources."*

To date, most grid communication is between OPALCO's grid control elements – e.g. substations, switches, voltage regulators, meters. As open Smart Grid interface standards for home solar and wind inverters and electric vehicles, and smart appliances solidify, grid communications will extend to those devices, too. This enables reliable connection of many member generators to the grid, maintaining voltage and frequency quality, and facilitating a vibrant energy sharing economy, where member generators and storage systems sell energy back to the grid, when they have a surplus and demand is high. On the demand side appliances and consumer devices can be managed to reduce load during peak demand periods, holding energy costs down. Co-op members reduce energy, saving money, and increase energy generation, making money by sharing energy.

As Lena Hansen, a principal in RMI's electricity practice noted:

> *The "distributed system platform" places the customer at the center of the grid equation as never before. This is not by any means incremental…[utilities are] taking a very whole-systems transformative approach.*

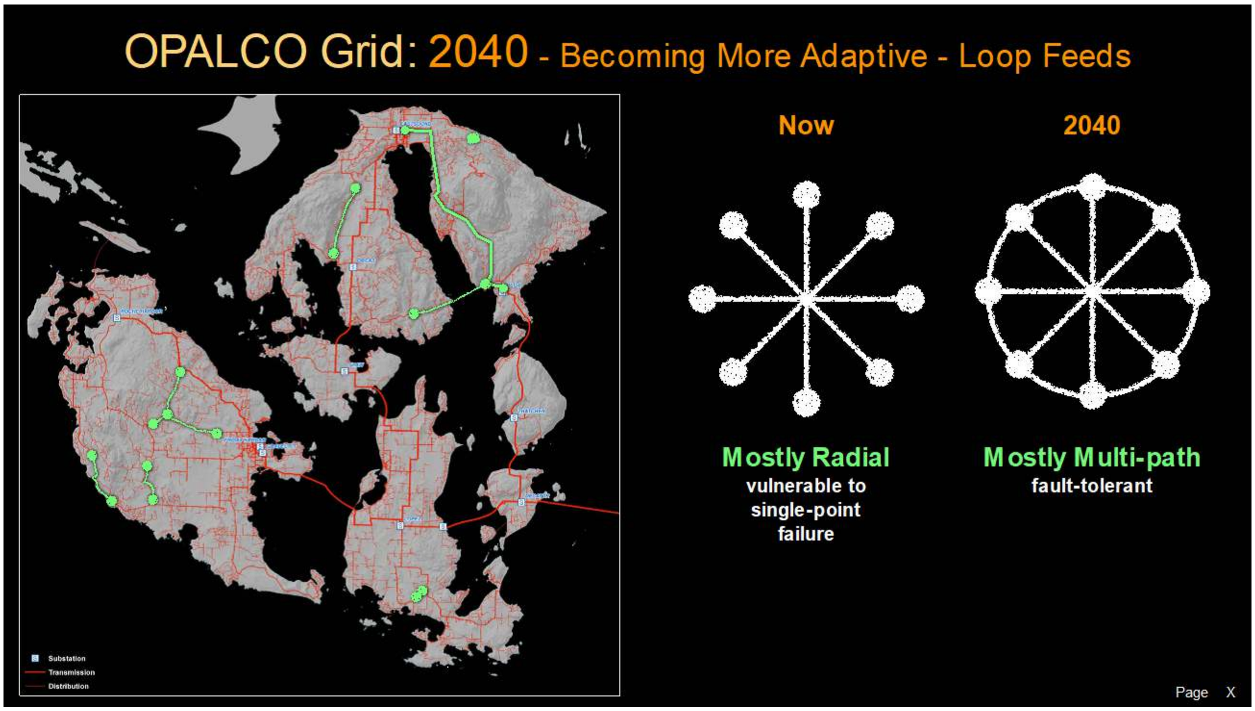
Dan Cross-Call, a senior associate in Rocky Mountain Institute's (RMI) electricity practice noted:

> *This two-way flow of electrons, services, and values won't happen without the communications infrastructure to relay all that data and decision making. Adding a layer of IT to the grid is essential.*
>
> *Smart Grid is a term you could interpret many different ways and means many different things, but at the most basic level, it's a question of how you make the grid intelligent using IT.*

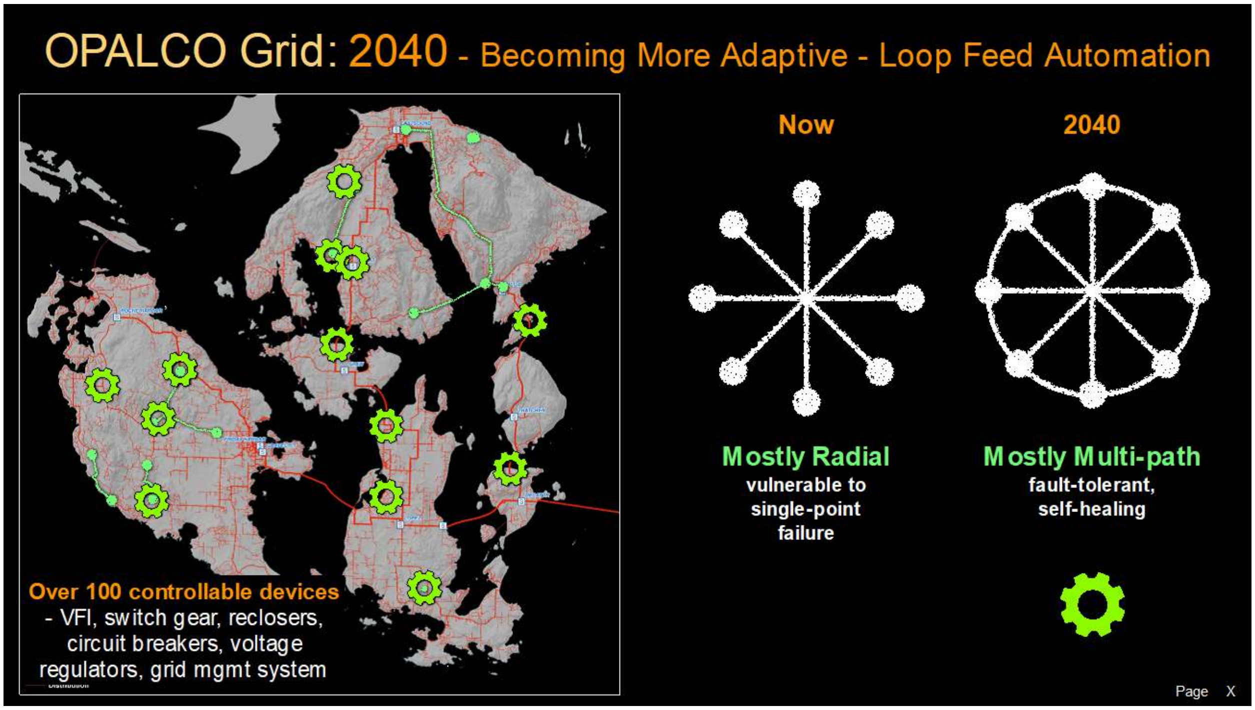
Which way are electrons flowing? Who is providing or consuming what energy services, at what times, in what places?"

Key Grid Modernization Initiatives

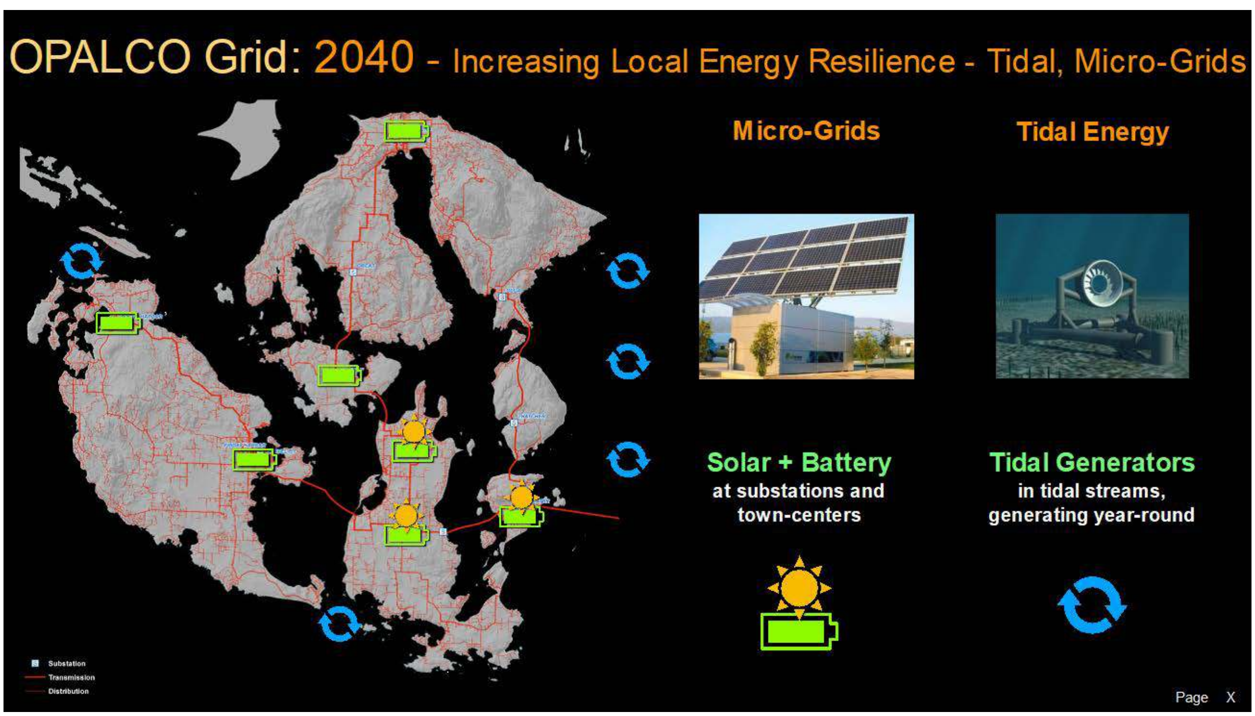
OPALCO is making the grid more multi-path – creating multiple ways for transmission and distribution to get energy to members. If a tree takes out one path, we want an alternative to reroute energy to members. The chart below shows planned new paths in green.



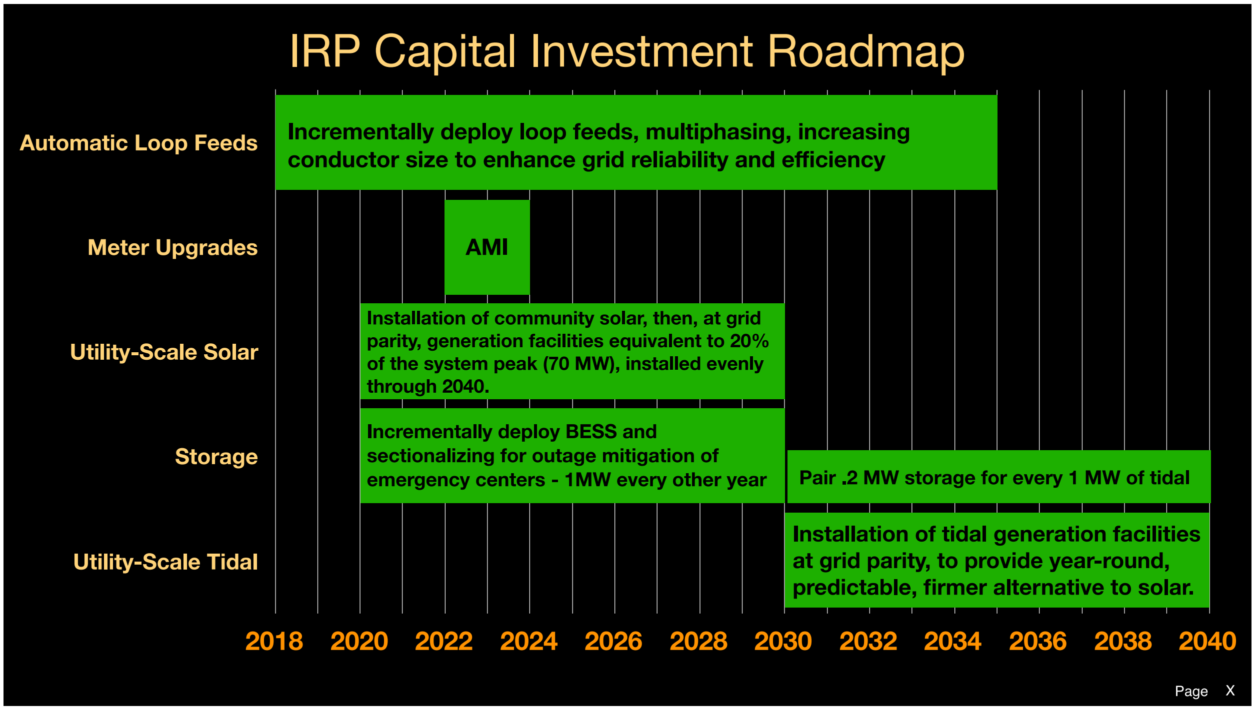
To reroute energy on those redundant paths, OPALCO plans on adding a variety of loop-feed automation, controlled by our fiber grid control backbone, to quickly route around failures using a mix of switches, reclosers, and smart device. See chart below. OPALCO's grid modernization investment now allows crew, using iPads to access grid status information and control features, which improves insight on problems and solutions, and safety.



The expanded reach of the grid allows for better integration of local energy resources, including member generation (solar, wind, micro-hydro), member storage, utility-scale storage, and town-center micro-grids. See chart below. This will increase local energy resilience and help moderate rate inflation, keeping rates lower than if we depended solely on mainland power. We expect BPA to always be part of the mix, using it to firm local intermittent resources, and supply extra capacity during days of peak demand, beyond the capacity of our local energy resource portfolio.



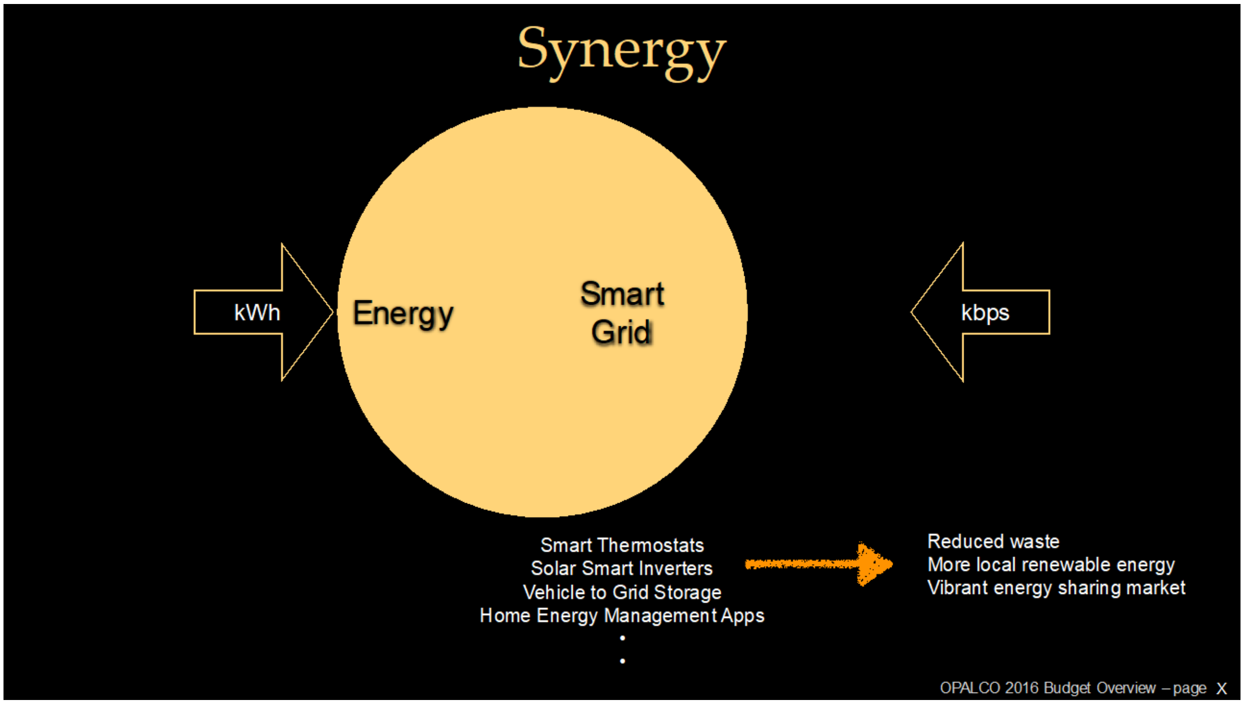
Grid Modernization Roadmap



Key Concepts

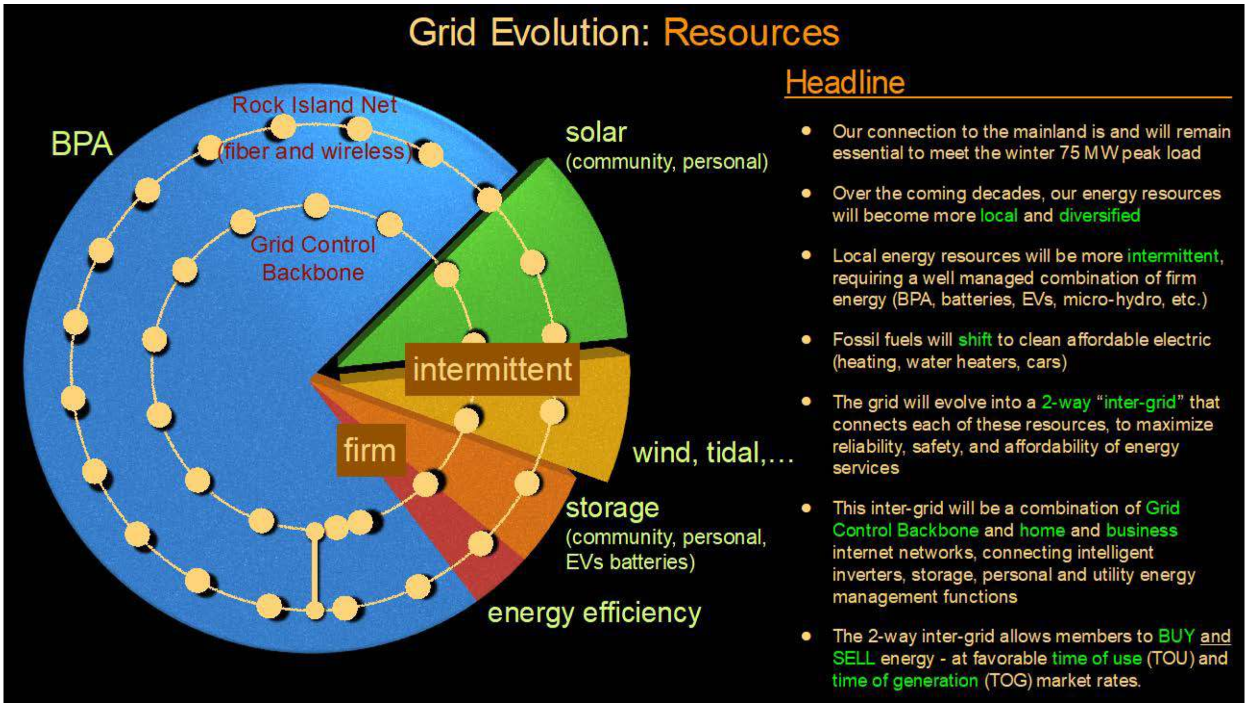
Smart Grid

Smart grid is a widely used term across the industry and can mean a whole host of things to the utility and or the end customer. In general, smart grid employs advanced metering, control, communications, and technologies to improve the efficiency for the customer. This can result in reduced outage times due to fault location precision, automated controls, as well as providing the tools necessary to proactively prevent outages in the first place.



Member connections to the grid control backbone will be through the Rock Island fiber and wireless internet network, which is being built-out now, and over time will be available to every Co-op member in the county.

The build-out of the grid control backbone, and Rock Island networks are timed to be largely in place as inverter and EV grid control interface standards deploy. The chart below shows how the various energy resources are joined together on the smart grid.



Distributed Energy Resources (DERs)

DERs are physical and virtual assets that are deployed across the distribution grid, typically close to load, and usually behind the member meter, which can be used individually or in aggregate to provide value to the grid, individual customers or both.

DERs can include:

- renewable and non-renewable generation (e.g. rooftop solar, wind turbines, micro hydro, biogas and biomass generators, inverters)
- battery storage, fuel cells
- electric vehicles (EV) and EV chargers
- demand response applications, other controlled loads and, smart appliances
- smart meters and data services

The energy industry's focus on DERs is a function of how important it's become to understand the potential capabilities they have to offer. In 2015, U.S. electric utilities spent $103 billion in capital expenditures to maintain and upgrade the grid — and they now expect average annual spending of around $100 billion through 2018. And yet, we are also investing in ways to help members reduce their energy use and save money.

These two trends – **growing grid modernization investment** and **reduced energy sales** – combined could raise retail rates significantly for electricity customers, as much as 15-30% through 2030, according to one study. To modernize the grid for two-way energy flows and incorporate new, connected technologies, while maintaining minimal rate impacts, all available resources– including DERs– need to be put to best use.

Combined, DERs are the key to our local energy resilience. But as with any transition as fundamental as this, the capital investment can be daunting. Many of the DERS are member owned, and they take on the cost of investment themselves. But the co-op invests in incentives, as do the Fed and State, to speed the transition. Those investments take the form of production credits, sales tax credits, net metering credits, etc. These are the economic tools that accelerate the uptake of renewable energy systems, while softening the expense for members and the Co-op.

Reactive Power, Frequency Ride-Through, Dispatch

Currently, most DERs are not required to provide **reactive support**, **frequency ride-through**, or **dispatch** to help ensure local voltage quality. Modern technologies, including inverters for new rooftop solar PV installations, should have the capability to support voltage and ride-through voltage excursions and dispatch. As DERs generate a larger percentage of our energy, use of these capabilities will be increasingly important to support the reliability of both the transmission and distribution systems. The industry is rapidly converging on grid control standards that will allow utilities to maintain high-quality power for its members. As those standards propagate into next-generation DERs, policies should set a standard of performance for member DER systems.

Blockchain

Rocky Mountain Institute (RMI) recently announced the launch of the Energy Web (EW) Chain, the energy sector's first open-source, tailor-made blockchain.

In early 2017, RMI partnered with European blockchain developer Grid Singularity to co-found the Energy Web Foundation (EWF). Since then, EWF has unwaveringly focused on two major outcomes: 1) build a blockchain platform specifically tailored to the performance and regulatory requirements of the energy sector, and 2) foster a global ecosystem of utilities, grid operators, startups, regulators and other energy companies that would establish the network and serve as its early adopters.

RMI believes blockchain technology is a crucial enabler for accelerating the low-carbon, distributed electricity future.

Our grid is becoming more decentralized. And, with the coming potential of increasingly unreliable mainland energy, decentralization is a good thing. Beyond drawing energy from the mainland, we are rapidly ramping up a variety of local distributed energy resources (DERs) – community solar, rooftop solar, wind, micro-hydro. Decentralized power generation is generally intermittent, therefore and increasingly firmed with energy storage systems. This leads to a reduction in demand on the power grid, while also providing a source of backup power when necessary. However, the DERs mentioned above are usually not owned by power system operators, but by end consumers. This has resulted in the transformation of consumers into prosumers, who can buy and sell energy to and from the grid. But, this in itself presents its own challenges.

Shared Responsibility

Grid decentralization means the responsibility of improving grid reliability is the shared responsibility of all stakeholders in the energy sector, not just the power system operator.

Management and coordination of DERs connected to the grid-edge cannot be handled by legacy control room software that is centralized and outdated. Furthermore, unilateral control is not possible because the DERs are owned and operated to satisfy consumer objectives and not those of the power system. This means that for power systems to embrace DERs, a decentralized, non-discriminatory, and incentive-based system needs to be implemented.

Main Problems in Modern Energy Systems

- No common control/communication infrastructure at the grid-edge (intersection between the distribution/utility grid and where prosumer DERs interconnect) exists yet.
- Consumer owned DERs, when left uncontrolled, can cause damage to grid resources and interfere with legacy power system operation.

Need for Coordination

The system, although decentralized, needs to be highly coordinated so that aggregated DERs (virtual power plants) can trade both energy and services with the grid and other virtual power plants. The result of this is an ultra-modern power system that is capable of organizing service-oriented, local energy trading markets that seek to optimize power flow and provide grid reliability services. This requires trust and automation, which is challenging because present stakeholders take the most economically profitable course of action for themselves. However, there is a new technology on the block that has emerged as a candidate for the implementation of transactive energy systems (TES).

TES are a "combination of economic and control techniques to improve grid reliability and efficiency." They provide a framework for the coordinated control of all DERs such that their actions can be controlled to optimize the overall grid, including the local optimization of customer owned DERs.

Blockchain

Blockchain uses a shared, distributed ledger that requires consensus to ensure that all peers accessing the ledger have a single, consistent version of truth. Smart contracts can be used to automate grid services and energy trading, meaning the system does not need a centralized service provider. As such, the implementation of blockchain can create a service-oriented power system that is auditable, accountable, and automated — as is required by TES.

Benefits of a Blockchain-Based Transactive Energy System

- Increases renewable energy usage via peer-to-peer (P2P) electricity markets in which green energy is produced and consumed locally.

- Aggregates prosumers into virtual power plants which provide ancillary services to the grid, meaning power system operators don't have to invest in new infrastructure.
- Provides auditable information on the source of electricity.
- Provides multiple sources of backup power for energy security and resiliency.
- Acts as a transactive layer that all service providers can use to provide charging services to EV owners.

Blockchain Example

Let's look at an important function we've discussed above, to manage load to reduce peak demand charges – smart demand response, which allows prosumer owned DERs to provide ancillary services to energy stakeholders. In this case, incentives may be awarded for delivering services such as voltage regulation, peak shaving, and load shifting. The use of ancillary services provided by DERs allows the co-op to **defer capital investment**, for building new substations and upgrading critical infrastructure in order to keep pace with the growing demand, potentially saving millions of dollars.

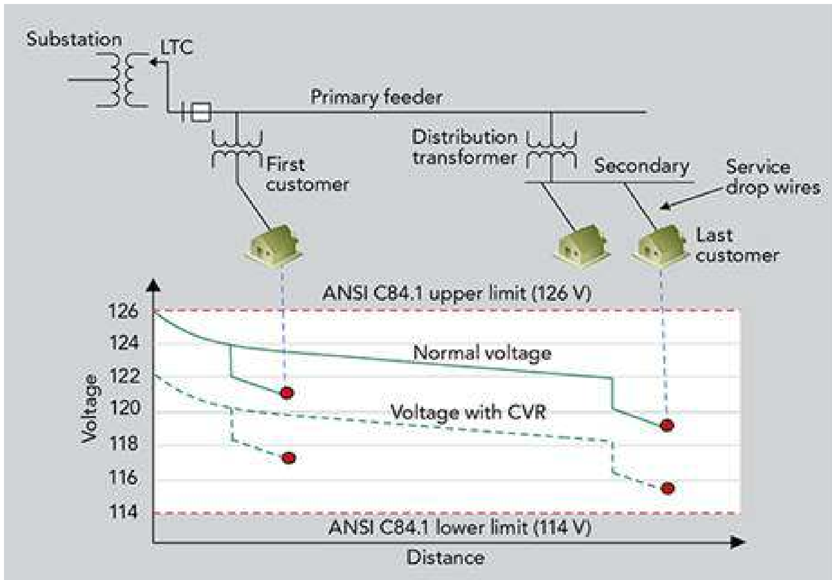
In practice: It is an especially cold winter day and portions of the main grid are experiencing peak demand and insufficient supply because of member heating running at maximum, day and night. This leads to excessive BPA demand charges, heat building up in the transmission lines and thus, to power losses and outages. To avoid system failure, utilities would typically spend millions of dollars upgrading infrastructure — building new substations and storage systems to satisfy peak demand.

While these events typically occur for only a few hours on a few days per year, equipping the congested areas with a combination of utility and member energy storage mechanisms that discharge energy at peak times replaces the need to build and upgrade infrastructure. Moreover, dispatchable grid-tied energy storage systems can also offer additional services to stabilize voltage and frequency when there is a high penetration of renewable energy output.

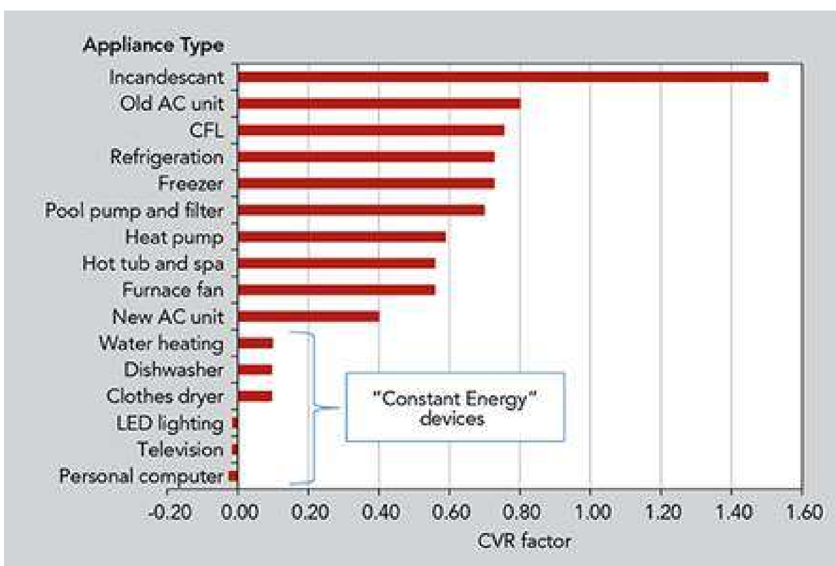
Blockchain integration is an emerging technology that we believe had promise and will benefit the co-ops commitment to increasing local energy resilience.

Conservation Voltage Reduction

Conservation voltage reduction (CVR) is a means to reduce energy usage by reducing the voltage across the grid. By optimizing the voltage during peak times this method can be used as a means of peak shaving. CVR would be intentionally lowering the voltage served to our members to the minimal acceptable band as defined by industry practices (American National Standards Institute).



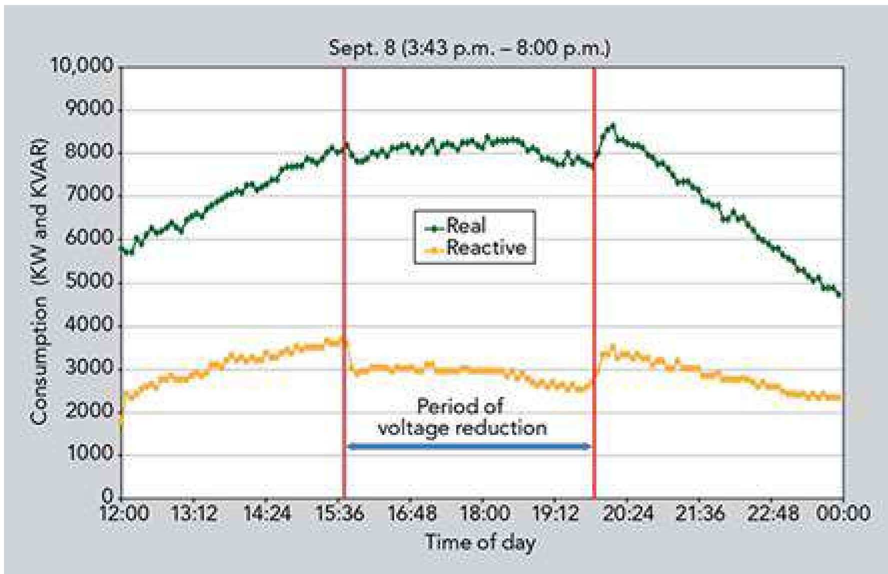
The risk with operating at such a low voltage is that during heavily loaded times or during a temporary fault on an adjacent feeder (or even a distant transmission line) could cause service disruptions to our members. CVR has little effect on power electronic based devices, while resistive and inductive type devices consume less power at lower voltages. OPALCO can currently implement expanded voltage optimization with minimal cost.



Based on all studies performed by OPALCO, the co-op's CVR factor is close to 1.0. Typical target voltages during peak periods range from 118 V to 123 V, depending on how much the feeder or bus can tolerate. The Co-op estimates it saved between $500,000 and $600,000 on demand charges in 2014 alone. The SCADA system has paid for itself many times over in the past 30 years.

The chart below shows how real and reactive power consumption clearly drop off when voltage is reduced and return to normal values when full voltage is restored.

OPALCO will be evaluating voltage optimization for peak shaving, battery storage, and circuit optimization so that our members will be as minimally impacted by future industry changes.



VI. Investment and Funding

OPALCO has active programs seeking and winning grants for grid modernization, beneficial electrification, and renewable energy projects. We generally try to fund with grants and RESP programs first and backfill with RUS funding.

OPALCO actively works with WA legislators to enact legislation and public policy in alignment with co-op initiatives. One example - increasing funding for WA solar production incentives.

The table below summarizes the resources to be developed, and the investment source, before and after grid parity.

	Before Grid Parity	After Grid Parity
Community Solar	Subscribers subscriptions	**TBD** depends on member interest.
Utility-Scale Solar	Grants, RUS funding.	Grants, RUS funding.
Dispatchable Resources	Grants, RUS funding.	Grants, RUS funding.

See Strategic Partnerships below for discussion on grant partners – WA Department of Commerce, PNNL, DOE, NRECA.

VII. Strategic Partners

PNGC

PNGC Power is a Portland-based electric generation and transmission (G&T) cooperative owned by 15 Northwest electric distribution cooperative utilities (including OPALCO) with service territory in seven western states (Oregon, Washington, Idaho, Montana, Utah, Nevada and Wyoming).

PNGC creates value for its member systems by providing power supply and other management services. PNGC Power is a top aggregator of geographically diverse loads in the region and became the first electric cooperative in the country to receive a power marketing license from the Federal Energy Regulatory Commission (FERC).

Our industry is changing rapidly. The expertise we gain through PNGC's top-notch team is the most important long-term strategic cost-saving measure we could put in place. PNGC is an extension of OPALCO now to improve reliability, provide accelerated resource planning, more direct interaction with BPA for billing, project management and more accurate forecasting for power purchases. Joining forces with other energy co-ops, gives us the buying power of BPA's third largest power customer.

With the advent of CETA, PNGC will coordinate much of the response to fully understanding and responding to CETA requirements. That saves OPALCO staff, and will be a compelling benefit to other co-ops not currently PNGC members, who don't have the resources to grapple with CETA challenges.

PNGC Power offers members a competitive advantage despite significant weather and market-related challenges. With the benefit of having some of the most experienced professionals in the energy industry and by offering advanced tools, technology and policy leadership, they are able to serve their members' load requirements reliably and cost-effectively. By coming together as PNGC Power, their member co-op utilities have more options than any one of them could have alone. Member benefits include:

- More buying leverage
- Access to advanced technical capabilities
- Financial strength; backed by $964 million in assets of member-owners
- Risk management capability and increased control
- Ability to meet customers' power needs in the new era of public power

PNGC member utilities have the collective clout to offer their customers reliable, low-cost power options at stable prices, now, and in the future thanks to the intense planning and forward-thinking vision of the PNGC Power Board and staff.

In December 2008, PNGC Power signed a new 20-year contract with BPA. This contract, which began October 1, 2011, secures long-term, cost-based power from the Federal Base System. It also sets the stage for PNGC to acquire additional resources to meet member cooperatives' future energy needs in the most efficient manner and at the highest level of wholesale rate stability possible.

That 20-year contract with BPA provides a long-term commitment to cost-based power supply. It also gives PNGC Power's members the opportunity to be directly involved in future resource decisions, build equity in generating assets, better manage power supply risk and keep future wholesale energy costs as low as possible.

PNGC is the only active Joint Operating Entity (JOE) in BPA's service territory. As a JOE, PNGC is a preference customer of BPA. The loads of PNGC's 15 member utilities are pooled together and billed as one load. The JOE is one customer with multiple points of delivery. PNGC bills each member utility as if it were a stand-alone utility.

PNGC is a vital partner as we search for new resources to grapple with the challenges of CETA legislation, 2028 BPA contract negotiations, and development of alternative assured resource partners.

PNGC also bills its member utilities service/membership fees that pay PNGC's operating costs (including staff). PNGC's member utilities have diverse load shapes. The diversity results in lower load shaping and demand charges for PNGC. The sum of the member utilities load shaping and demand charges is greater than those charged by BPA to PNGC. The power supply cost savings stay with PNGC and result in lower PNGC service/membership fees.

Aggregate wholesale power purchases serve above-High-Water-Mark (HWM) loads. PNGC has the ability to use BPA Tier 2 and nonfederal power purchases as well as owned generating resources to serve the aggregated above-HWM loads of its member utilities. Member utilities that, on a stand-alone basis, have above-HWM load pay their share of above-HWM resource costs. As a relatively large preference customer PNGC is large enough to purchase power more economically than its members would otherwise be capable of on their own. Through economies of scale PNGC is able to reduce its members' above-HWM power costs.

PNGC's members can also take advantage of the memberships' geographical diversity. For example, instead of building utility-scale solar in OPALCO's service territory where solar potential is fairly low, if OPALCO were a member it could purchase the output of a solar project in a fellow member's service territory with greater solar potential (such as eastern Oregon or Washington).

As a pseudo-single-utility PNGC is also able to pool energy efficiency efforts. This pooling takes advantage of the diversity of PNGC's members' load characteristics and energy efficiency potentials. Another advantage to PNGC membership is that PNGC has the staff to take on large issues like demand response pilot programs and community solar and provide guidance to member utilities.

PNGC also participates in BPA's rate cases and relevant workshops and processes. Since all of its members are cooperatives, the members' interests are typically well aligned. As such, PNGC staff does not have to deal with nearly as many of the conflicts of interest that arise in large public power groups that are also BPA watch dogs (e.g. the Public Power Council).

PNGC staff has a good working relationship with BPA. As such, if a PNGC member has an issue it would like to take up with BPA it has a strong voice that can speak on its behalf. This will be even more important as the end of the current BPA power and transmission contracts nears. Having a strong voice in influencing the decisions that will go into the terms and conditions of the next BPA contracts will be invaluable. In addition, OPALCO is in the unique position of being reliant on a submarine transmission cable to deliver power to its service territory. Having a strong voice like PNGC that can address BPA transmission issues could also be invaluable.

PNGC's member utilities are essentially sharing staff that they would otherwise have to hire inhouse to track power supply issues, work with BPA, project future power supply requirements and execute power purchases when necessary. If it were assumed that a member utility would need two full time employees to do the same amount of labor that each utility receives from PNGC, the cost would be somewhere in the $300,000 range (salary and benefits for two full time employees). However, two FTE are not likely to be able to recreate the range of expertise and skillsets that PNGC provides. The other issue with staffing is that PNGC's member utilities are, like OPALCO, remotely located in very rural areas. Attracting high-caliber staff, comparable to PNGC's staff, to live and work in each of the member utilities service territories would be a daunting task.

BPA

Although the PNGC relationship has reduced the BPA day to day interactions, BPA remains an essential partner for things like load forecasting, Northwest energy policy, and contract discussions.

Rural Utility Service (RUS)

USDA's Rural Utilities Service provides much-needed infrastructure and infrastructure improvements to rural communities. These include electric power and telecommunications services. All of these services help to expand economic opportunities and improve the quality of life for rural residents.

The Electric Program provides capital and leadership to maintain, expand, upgrade and modernize America's vast rural electric infrastructure. The loans and loan guarantees finance the construction or improvement of electric distribution, transmission and generation facilities in rural areas. The Electric Program also provides funding to support demand-side management, energy efficiency and conservation programs, and on-and off-grid renewable energy systems.

OPALCO funds major capital projects with RUS very low interest loans – near treasury interest rates. They do that on terms that demand the highest standards of financial and business management.

National Rural Utilities Cooperative Finance Corporation (CFC)

CFC provides exceptional services that go beyond the balance sheet to meet the ever-changing needs of our member-owners in a dynamic environment, including; long-term shelf financing for electric infrastructure, such as distribution lines and power generation projects; emergency lines of credit so power can be restored quickly after natural disasters; specialized financing including loan syndications and loan resales through Farmer Mac and other partners, strategic planning and financial analysis; and financial education and training.

Each year OPLACO participates in and benefits from the CFC Key Ratio Trend Analysis (KRTA) survey that measures how our co-op is performing compared to over 500 other rural electric co-ops. It is an essential management tool for electric co-ops. For more on that, see the KRTA discussion in the Rates chapter above.

WA Department of Commerce (WA DOC)

WA DOC is a leader in the nation in accelerating the transition to clean energy and grid modernization. We continue to apply for and win substantial grants for grid modernization, storage and transportation initiatives. This helps us reduce the overall expense of strategic projects, especial those aimed at increasing local renewables, energy resilience, and decarbonization of transportation.

Pacific Northwest National Labs (PNNL)

PNNL continues to be a very engaged partner, source of matching grants, and ROI analysis on grid modernization and renewable energy initiatives. They have good access into the U.S. Department of Energy (DOE).

U.S. Department of Energy (DOE)

The DOE invests billions dollars in renewable energy resource development. OPALCO will be deepening grant outreach, including to the DOE.

National Rural Electric Cooperative (NRECA)

NRECA represents more than 900 consumer-owned, not-for-profit electric cooperatives, public power districts, and public utility districts across America. They have been a great partner on so many levels. They are innovating and partnering with DOE, securing major grants for local renewable energy and rural-friendly low income renewable energy programs.

T-Mobile

As a key strategic partner, T-Mobile has helped OPALCO and their subsidiary, Rock Island, solve the internet crisis in San Juan County by accelerating deployment of fast reliable broadband communication services to its members and OPALCO operations. It takes years to deploy fiber to our 20-island community. With T-Mobile fixed wireless, we have been able to get fast internet service to thousands of members so that don't need to wait. T-Mobile invested more than $10 million in state-of-the-art LTE wireless system, yielding over 90% coverage of the county, with both fixed wireless as well as cell phone services. In addition to helping homes and business, it has improved first responder, emergency services and government communications systems, improving public safety and day to day communications. Rock Island and T-Mobile worked together to pioneer a new way to help rural areas, who suffer with inadequate internet service, by using fixed wireless to reach more people at reasonable cost, in advance of fiber.

Cobank

CoBank is a major provider of credit and financial services to the nation's rural energy sector. Their customer-owners include hundreds of rural electric generation, transmission and distribution cooperatives that deliver power to millions of people in rural communities around the country. They also supply financing to independent power producers that are developing and building power facilities.

Like us, many of their rural electric distribution cooperative customers are investing in next-generation renewable energy projects, and helping to create a cleaner, more sustainable world. They also have access to investment community that has tax appetite for funding renewable energy projects.

Bonneville Environmental Foundation (BEF)

Funded in part by BPA, BEF has been a great partner, helping us first with a grant and expertise for our *Solar for Schools* program that put about 10 kW of solar on each of the ferry served island public schools. They also provided expertise, analysis and design, and grants for our first Community Solar array on Decatur Island.

They have a keen focus on reducing CO2 emissions. Working with OPLACO and their other partners, they estimate saving a combined total of more than 9.5 million metric tons of carbon from the atmosphere, generated more than 6 million-Megawatt-hours of clean energy, launched more than 250 renewable energy education projects across 20 states, restored 13.5 billion gallons of water to critically dewatered rivers and streams, and have supported the revitalization of 20 river ecosystems in 7 western states and Mexico.

VIII. Appendix

Rates

While this IRP focuses on project roadmap, funding options – including grants and rates – will be explored in depth on the Long-Range Financial Plan, this chapter offers a good overview of rates, how they work, and the interdependencies that we try to balance to keep energy affordable and keep the co-op financially sound.

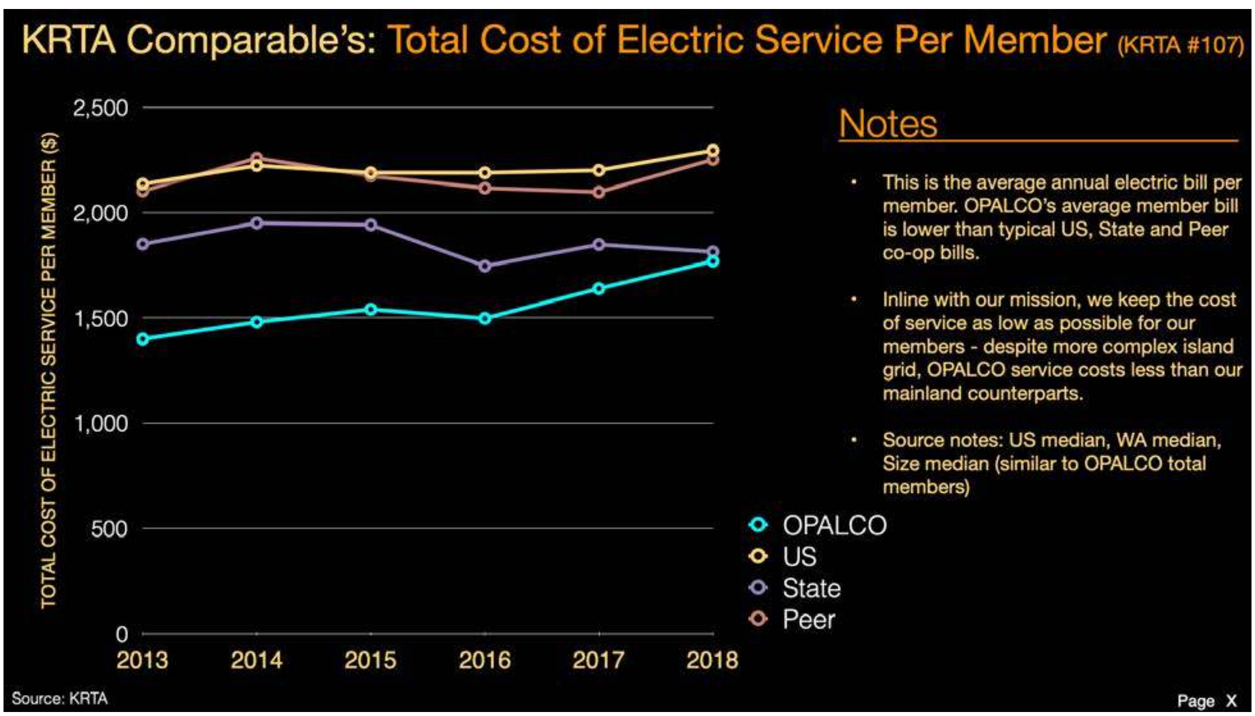
Overview

More electric utilities filed rate cases with their state regulators last year than at any other time in the previous 35 years.

EIA data shows that 83 utilities–more than half of all major U.S. electric utilities–sought rate changes in 2018. This was the highest number since 1983.

The dominant factor, according to the EIA, was higher spending for transmission and delivery, as opposed to generation costs. Spending on U.S. electric distribution systems had risen 54 percent over the past two decades, from $31 billion to $51 billion annually. Transmission had similar capital needs as utilities focus on grid modernization to deal with the growth in renewable energy resources and fears of dealing with outages from weather disasters.

We are seeing this in the Key Ratio Trend Analysis (KRTA) co-ops use to understand how their costs and business compare to other rural electric co-ops. In the chart below, OPALCO continues to offer electric service below national and peer co-ops, and on par with WA electric co-ops.



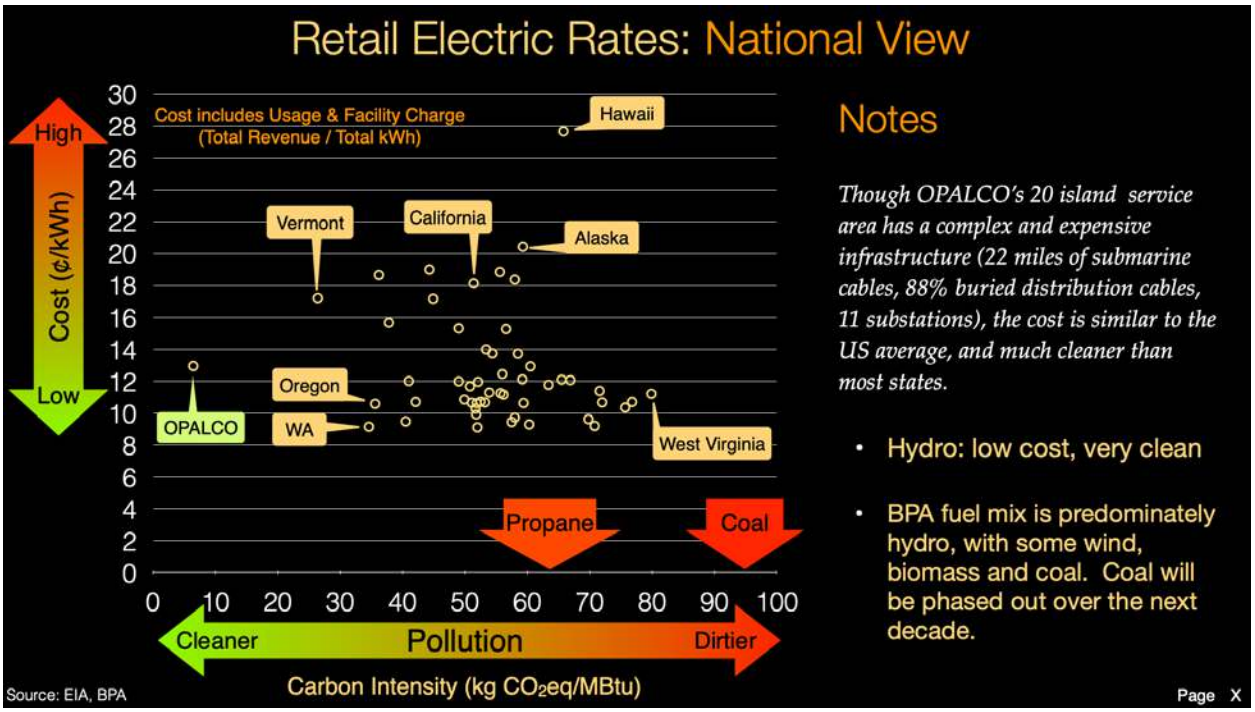
About KRTA

National Rural Utilities Cooperative Finance Corporation (CFC) has analyzed preliminary data for its 2018 Key Ratio Trend Analysis, an annual assessment of financial trends among electric distribution cooperatives nationwide.

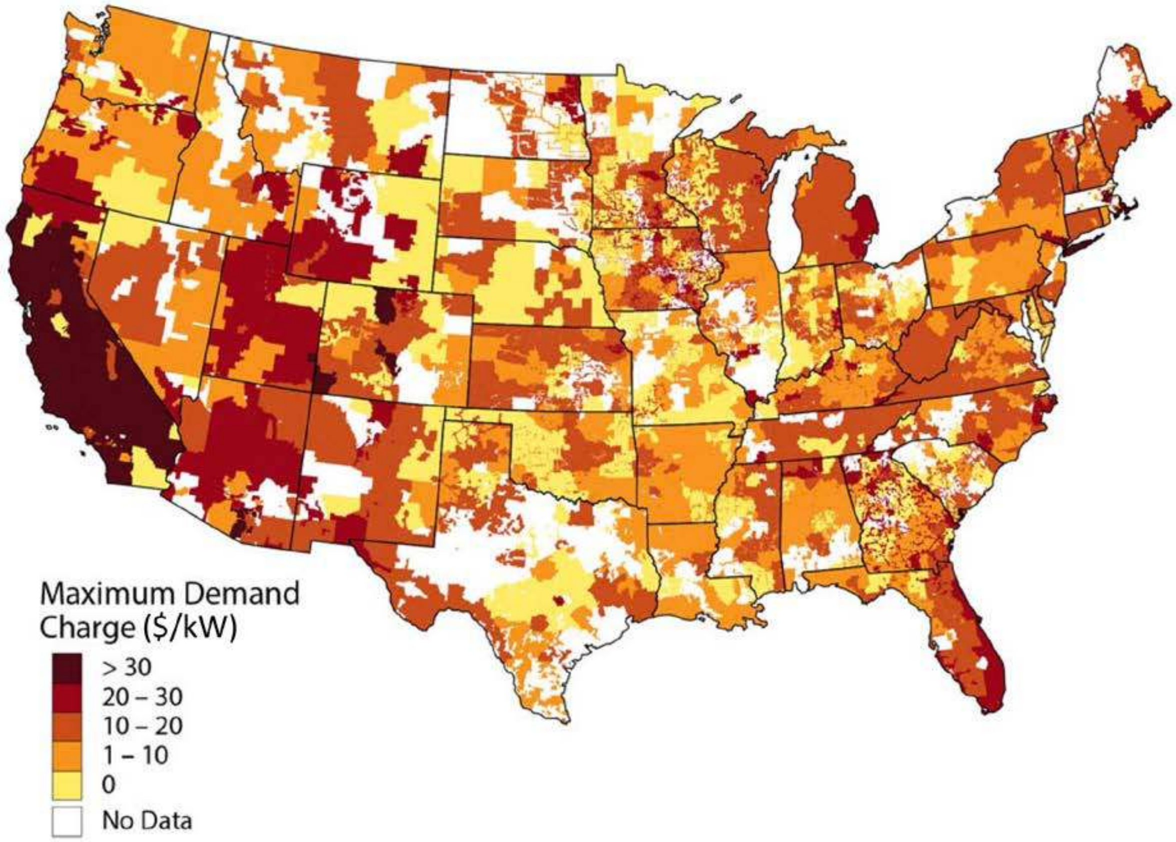
KRTA results are based on data submitted by 596 electric distribution cooperatives for the year ending Dec. 31, 2018. Notable trends include a 6.68 percent increase in kilowatt-hour (kWh) sales for the typical cooperative—that compares with a median 1.02 percent decline posted in 2017.

National Rates Perspective

While OPALCO members pay less than the national average, thanks in large part to the low cost of hydro power, they also benefit from much lower carbon emissions compared to almost all other states. Hydro has about the lowest carbon emissions of any energy resource – less even than solar.

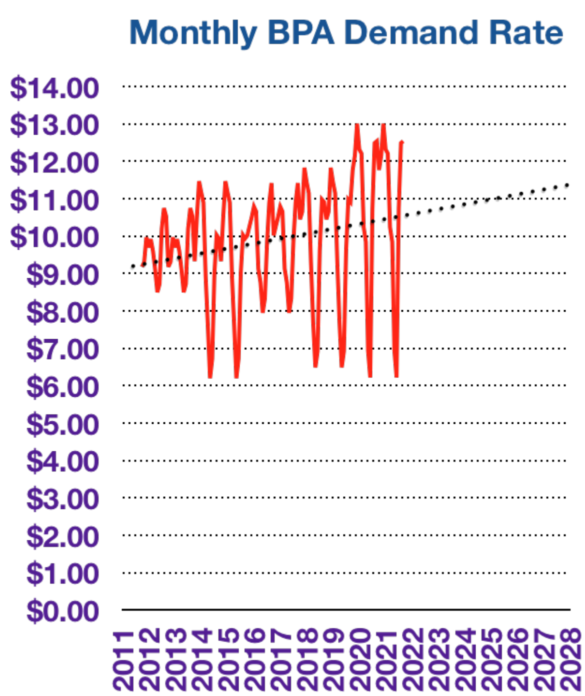


Demand charges are an increasingly important part of the rates. The chart below shows a national perspective on demand charges. Demand charges in the Northwest are fairly low, but with CETA, we expect that demand charges to increase significantly in the coming decade.



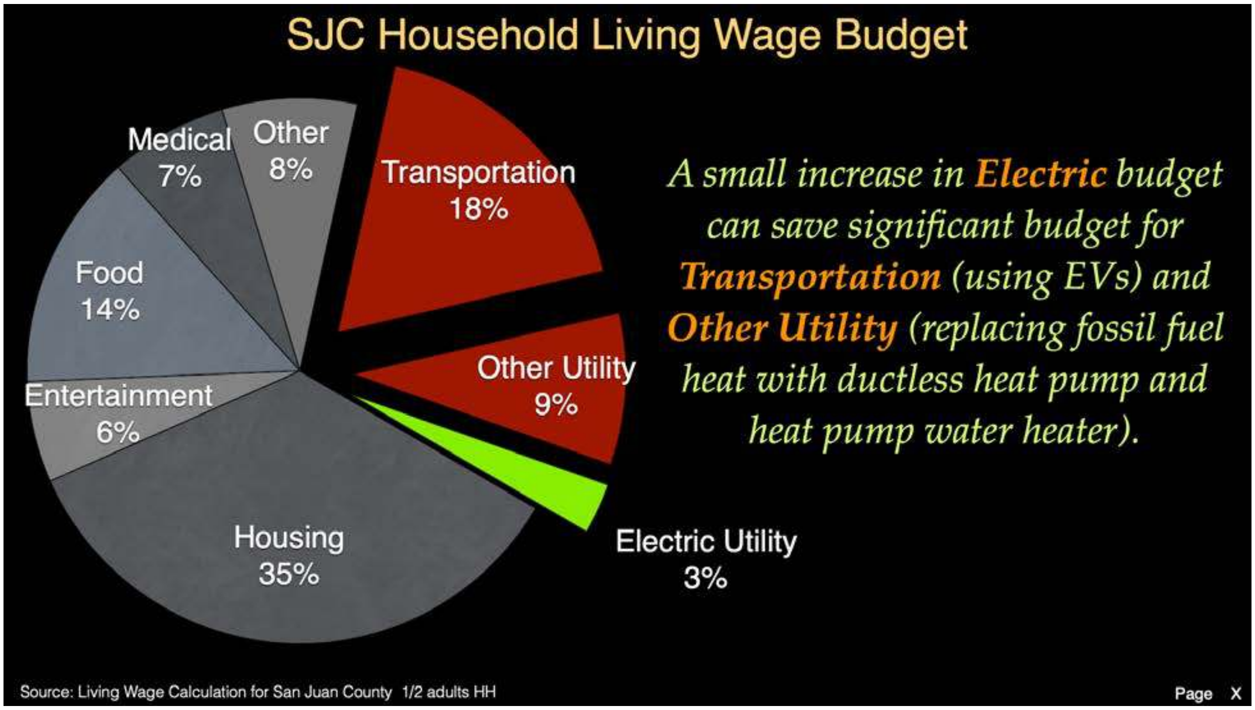
Source: NREL. 2017. *Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges*. Golden, CO: National Renewable Energy Laboratory.

The chart at right shows the steadily increasing PBA demand charge. We expect that upward trend to accelerate, as CETA reduces regional power production capacity.



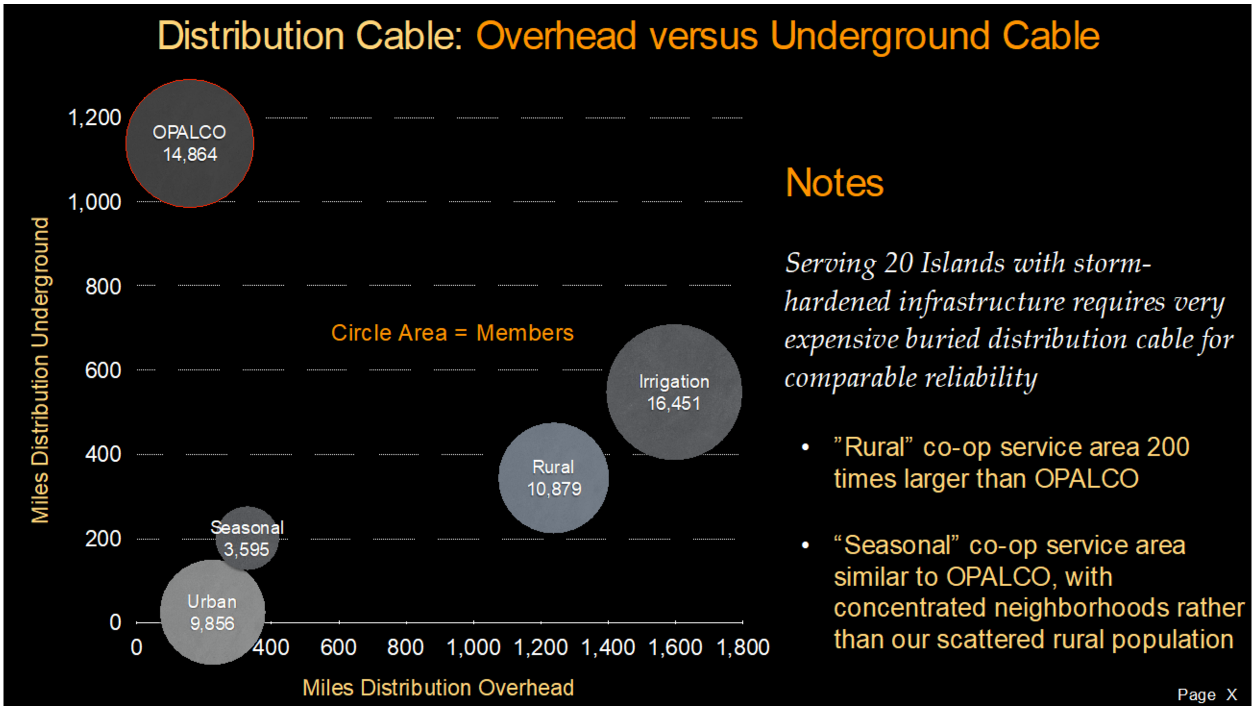
Living Wage Budget

In 2015 OPALCO worked with a variety of family resource centers and stakeholders on a county low income needs assessment. During that work, a living wage budget was developed. The chart below shows that the co-op accounts for about 3% of the living wage budget.



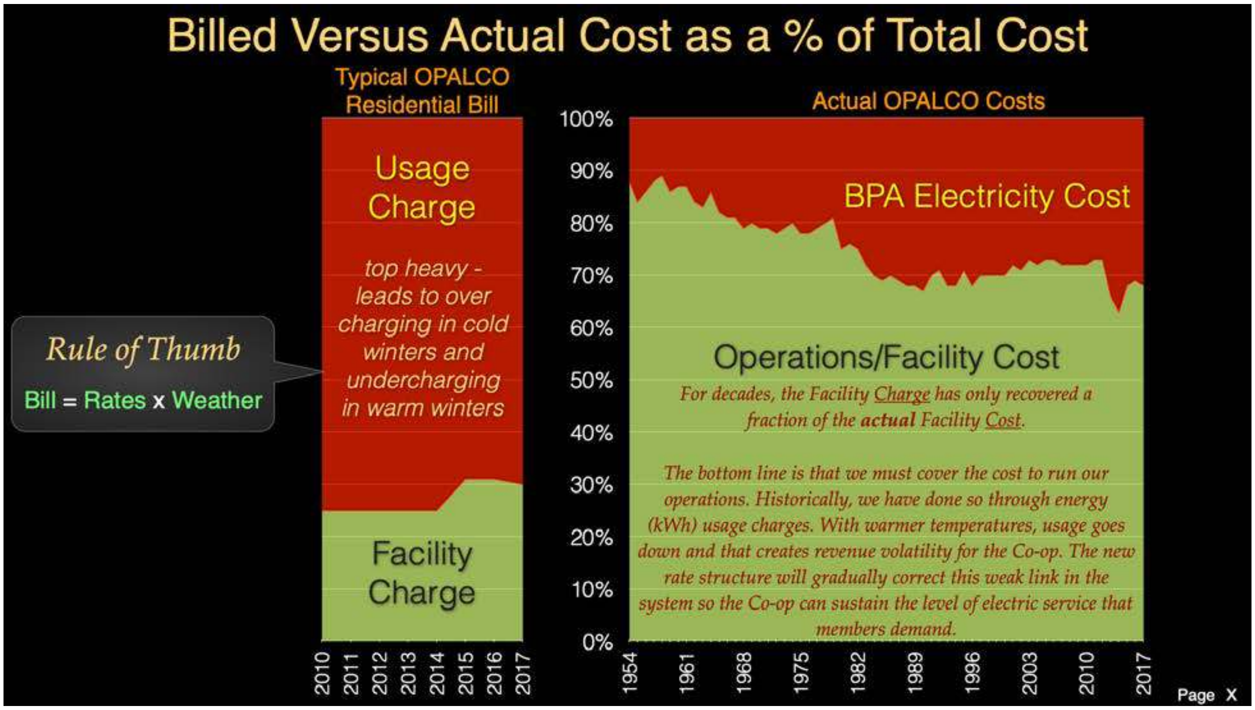
The Cost of Serving 20 Islands

Though OPALCO does a good job managing costs, it is more expensive to deliver electric service in the islands. On the mainland, most utilities prefer to distribute electricity via aerial cables on poles and towers. This is a fraction of the cost of submarine and buried cables that OPALCO members depend on for safe reliable service. The powerful storms in the 1980s lead to the co-op undertaking a massive undergrounding initiative. Each year, at great expense, above ground cables were replaced with underground versions. This was done in an incremental way, the most vulnerable cables first. It has been ongoing for decades now, and we are approaching 90% of our distribution being underground. This has made for a significant improvement in overall reliability, but it comes at a price. While most mainland utilities pay one third to one half their revenue for operations and capital projects, OPALCO pays about two-thirds of revenue. The chart below shows how OPALCO compares to northwest co-ops on the mainland with regard to overhead versus underground distribution.



Facility and Usage Charges – the Pros and Cons

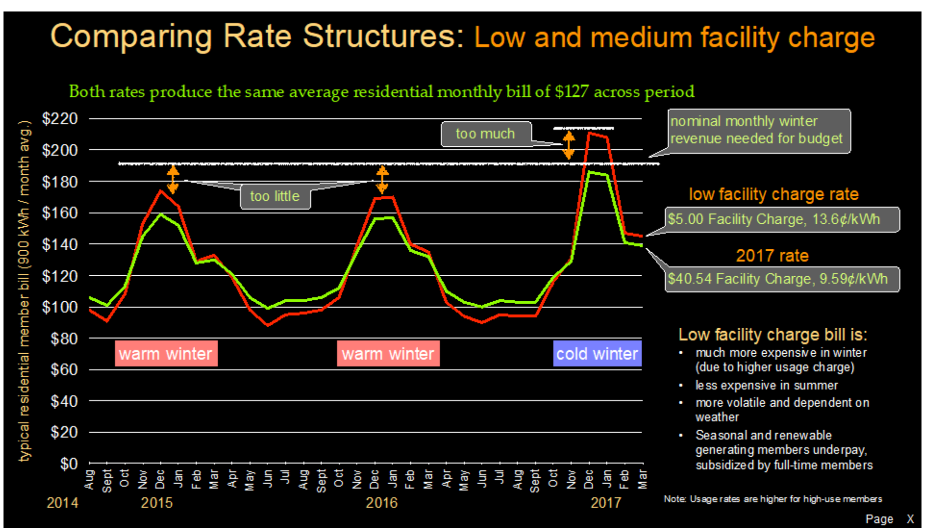
As mentioned above, two-thirds of OPALCO's costs go to operations and facility cost (see right side of chart below). But, as is common with many utilities, the facility **COST** is only partially recovered by the **Facility Charge** (see left half of chart below). The remainder is made up for in the **Usage Charge**, which is dependent on weather. A warm year produces too little revenue, a cold year too much – for a nonprofit co-op. In 2015, we increased the facility charge to get closer to the actual cost and reduce weather related volatility of revenue.



The chart below illustrates the pros and cons of low and high facility charges. In the example below, the average member pays about $127 per month. That's the average – in actuality, the member pays more in winter, less in summer. Referring to the chart below, to raise the $127 revenue, we can go with a:

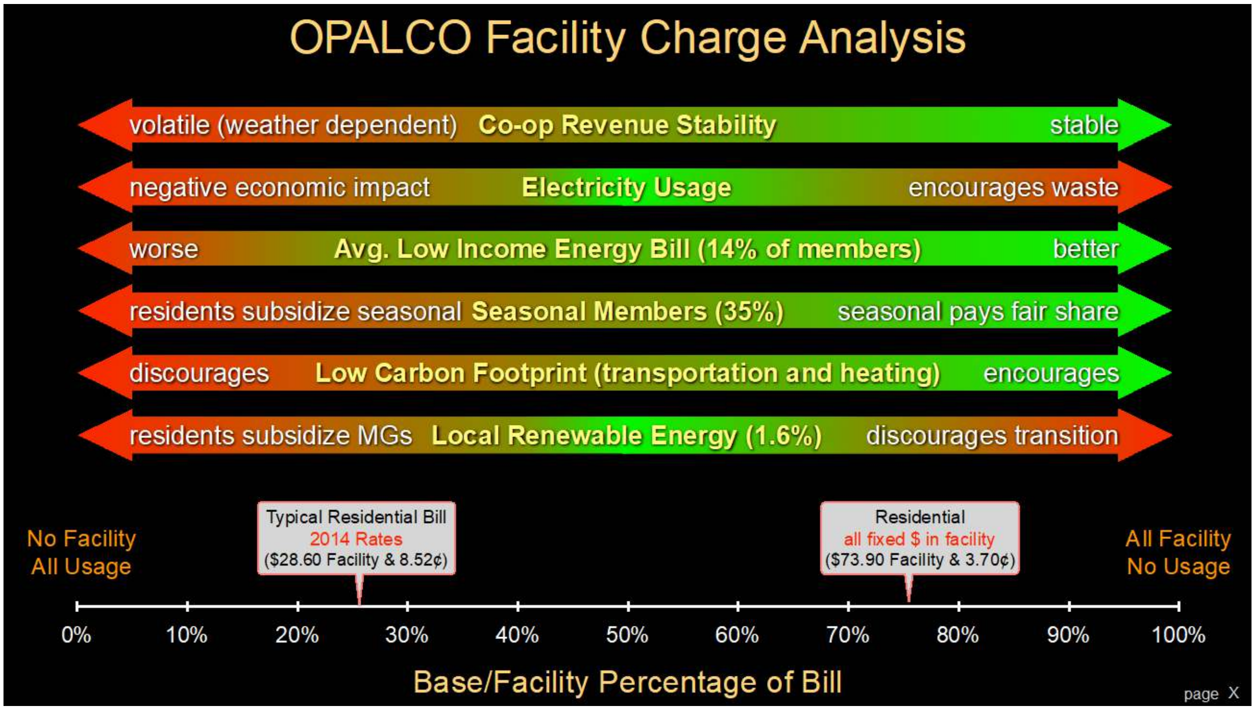
- **low facility charge** and make it up with a higher usage rate. That makes winter electric bills much larger than summer bills, at a time when residents are in the slow economic season.
- **higher facility charge** and go with a lower usage rate. That makes for less of a difference between summer and winter bills, and less weather dependent revenue volatility.

Either way, on an annual basis, the average member pays the same amount, just in a different seasonal pattern.



The balance between facility charge and usage rate is complex, with a mix of side-effects if we go too far one way or the other. The chart below shows some of those considerations, including:

- **Co-op Revenue Stability** - We want to keep the facility charge as high as we can to pay for the ACTUAL cost of operating and maintaining the grid.
- **Electricity Usage** - We want to keep the usage rate lower than fossil fuels to save members money and carbon emissions compared to fossil-fueled heating and driving, but not so low that it encourages waste. Energy is precious, to be used wisely.
- **Low Income** – Low income households typically use more energy. Keeping the usage rate lower helps keep winter heating bills down. And a higher facility charge allows a lower usage rate, which tends to help keep bills from rising in the winter when low income workers have less work to pay the bills compared to busy warm season months.
- **Seasonal Members** – Over 35% of OPALCO members are seasonal. They don't pay much to in the winter since they are not heating their homes. A higher facility charge helps them pay their fair share of the facility cost, rather than putting it on the backs of local year-round members, with higher usage rates.
- **Low Carbon Footprint** - We want to keep the usage rate lower than fossil fuels to save members money and carbon emissions compared to fossil-fueled heating and driving.
- **Local Renewable Energy** – Member generators use the grid more, consuming and generating electricity. That takes a modern grid and systems for our increasingly transactive electric economy. OPALCO buys electricity from members at RETAIL rates, about three times higher than wholesale BPA rates. That is a subsidy on the backs of the other co-op members. We want to strike a balance between a fair Facility Charge for the use of the facility to sell electricity to the co-op, and the Usage Charge, which many member generators would like to see higher, to help them make more money from the sale of their electricity to the co-op. We thread the needle to encourage local generation, but not at too much of an expense to co-op members.

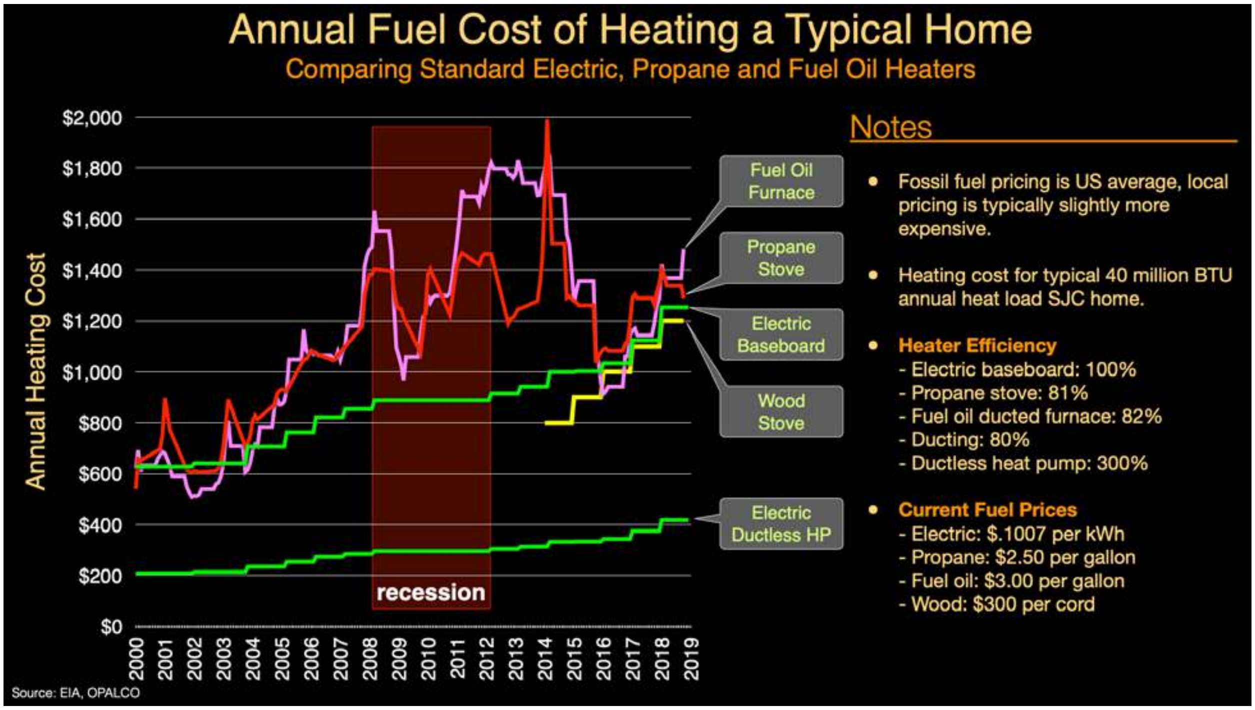


Some people think of the co-op as a monopoly. But in many respects, it is in a competitive environment where members have other options for their energy, especially propane, fuel oil and wood for heating and gasoline for driving. Though members care about the climate-friendly clean energy OPALCO offers, at the end of the day, members want their electricity to be the lowest cost option, too. OPALCO has the lowest cost energy for heating and driving, compared to fossil-fueled options. During each rate adjustment, we endeavored to keep the usage rate competitive with fossil fuels.

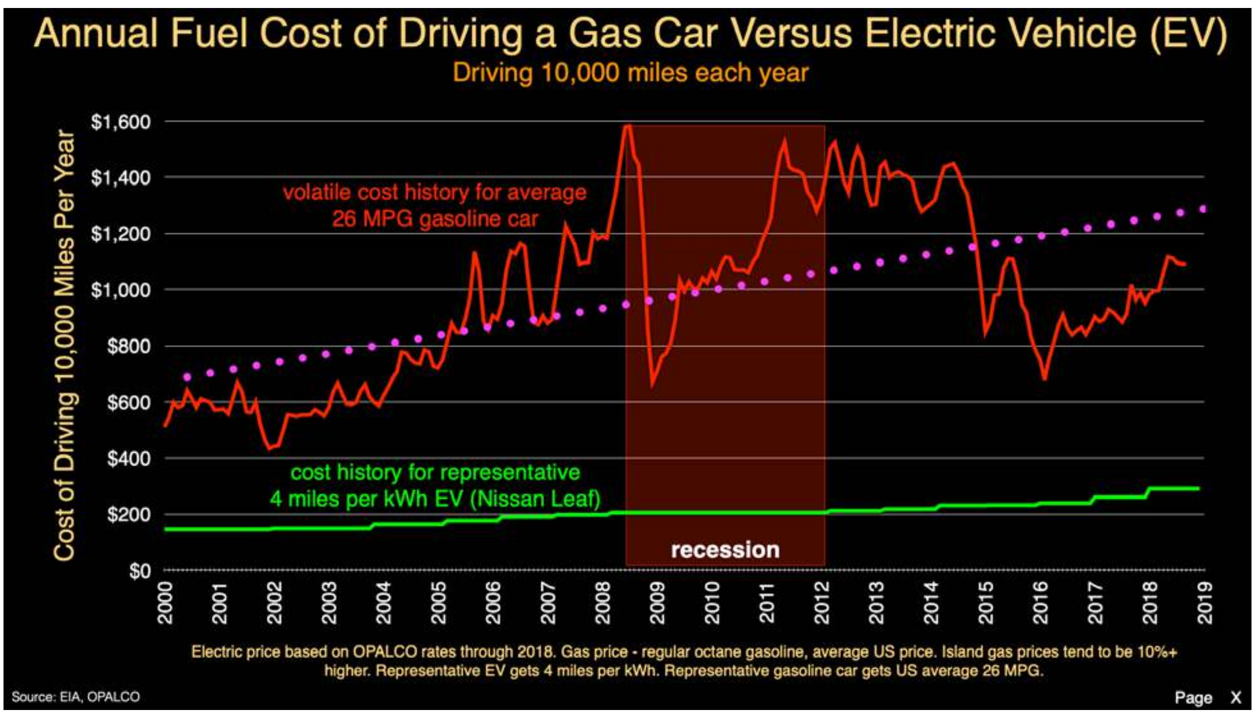
For that reason, OPALCO has been winning market share for heating and driving, year after year. Over 80% of members heat their homes with electricity.

Keeping the Usage Charge lower than fossil-fueled heating and transportation not only helps the environment, it helps co-op members save thousands of dollars in annual heating and driving costs. The chart below compares the annual cost of various forms of fossil-fueled heating with electric heating. Two notable things:

- Fossil fuel pricing is **very volatile**, subject to enormous changes in a given month. OPALCO rates change one per year.
- Fossil fuel heating is generally **more expensive**, especially compared to heat pumps.



Similarly, with cars, EVs are much lower cost to drive and maintain compared to fossil-fueled cars. And as the chart shows, gasoline price volatility is enormous.



Cost of Service Analysis (COSA)

COSAs are an important tool for rate design. The basic goals of rate design include:

- The utility's ability to collect the appropriate revenue requirement
- Utility revenues and customer rates are stable and predictable
- Proper price signals are sent to create efficiency of resources
- Rates are fair and equitable among customers and avoid undue discrimination
- Rates are simple, easy to understand and feasible for the utility to implement

OPALCO periodically reviews the cost of service to supply electric service to members. We use consulting engineering firms that are independent and have expertise in evaluating the underlying elements that contribute to electric co-op service costs. The most recent COSA was performed in 2018 by engineering consulting firm Guernsey – who also authored the *2017 National Rural Cooperative Rate Guide* – and have substantial experience in service cost assessments.

To learn more about the COSA, see OPALCO's website. Here are links to the 2018 COSA, along with the previous 2014 COSA.