The Evolution of Our Grid From 1935 to 2035

OPALCO Data Insights Series: Energy Services

In the mid-thirties, President Roosevelt signed the Rural Electrification Act, fueling the creation of rural electric cooperatives with \$410 million for a 10-year program to "light up the countryside."

The history of power in our rural islands is steeped in the stories of the local people who dedicated their lives' work to creating the electric cooperative, to building the system across twenty islands, and to continually maintaining and improving the power grid and friendly offices that serve us today.









OPALCO: 100 Years of Innovation

Energy Services - build out the grid to as many islanders as possible



Communication Services and Grid Modernization

Conservation Programs - to save members energy

Financial Events and Low Income Programs to keep co-op services affordable

Undergrounding - to storm-harden grid

1985		I hird "100-Year Storm" causes massive outages
		Project PAL is born to help members in need
		OPALCO initiates major under grounding project
1990		OPALCO purchases first electric vehicle (EV)
		First EV charging station installed in San Juan Island
		Green Power Program starts
1995 -		OPALCO installs first fiber optic cable
		OPALCO forms "Island Network" Internet service
		Fiber optic cable connecting Lopez, Shaw, Orcas, Decatur, Blakely
2000 -		Island Network Internet service goes live – gov't offices
		Island Network adds customers – NoaNet, schools, UW, libraries
		OPALCO starts conservation rebate program
2005		Island Network adds medical centers, improves redundancy
		Island Network adds ES and Lopez village town centers
		County/EDC ask OPALCO to open network to all
- 0102		OPALCO studies opening network to all members
		Third EV added to fleet
		M.O.R.E. formed to incentivize local renewable energy
		Co-op signs 20-Year contract with BPA
		Co-op purchases 700 MHz spectrum for wireless services
		Co-op opens Island Network up to all members
N202		OPALCO, SJICD & BPA launch community solar for schools
		OPALCO launches additional low income assistance program
2025		Co-op purchases Rock Island
		Construction starts on Lopez-San Juan cable replacement
		Rock Island partners with T-Mobile
2030		OPALCO partners with PNGC
		Begins design of community solar and storage system
		SJICD builds out EV charging stations in county
2035	/	Rock Island begins paying dividends to co-op









Source: OPALCO, Cisco VNI

(kWh) mand Ð ergy

En

Total

SJ

250M

Grid Evolution



Internet is the Energy of the 21st Century

Founded in 1937, OPALCO built a grid that has supported an exponential growth in energy use by co-op members.

In the 21st Century, thanks to slowing growth and enormous achievements in efficiency, energy use is flattening.

Rural electric co-ops are transitioning to a hybrid model - providing Energy and very fast reliable *Internet* services.

This Internet backbone has been in development at OPALCO since 2000. It helps control the grid more efficiently and speeds the integration of local renewable energy resources and smart appliances by our members. In 2014, OPALCO began opening up that fiber backbone so members could have access to state of the art Internet services.





page 4



Energy kWh

Smart Thermostats Solar Smart Inverters - - Jaharak Kindidan Sakarak in Bata a Sag Vehicle to Grid Storage Home Energy Management Apps Improved Grid Operations and Safety





Reduced waste

- More local renewable energy
- Vibrant energy sharing market





OPALCO Energy Sources: 2014



Energy Source	Production (kV
BPA	205,000,0
Energy Efficiency	1,418,0
Solar	624,7
Micro-Hydro	142,0
Wind	5,1
Total	207,189,9

Most of our electricity is purchased from BPA and delivered through submarine cables from the mainland.

Increasingly, local energy efficiency and production (solar, wind and micro-hydro) are important contributors to our energy pie.







SJC Electric Consumption and Solar Example: Seasonal Load and Solar Production



Source: OPALCO, PVWatts

OPALCO members use twice as much energy in the winter as in the summer.

But solar production in the winter is a small fraction of summer. Other resources will be needed to meet winter loads if we wish to reduce our dependance on mainland energy.

Emerging wind, tidal and energy storage systems are possible resources that can help solve "the winter problem."

Notes

- OPALCO load 2012 to 2014
- Theoretical solar production from 10,000 rooftop arrays of 7.5 kW each = 75 MW, costing about \$150 million (not including financing and grid integration)
- Solar production is 180 degrees out of phase with load, needing winter sources like hydro, wind, tidal, pumped hydro,...









page 7

Solar: Hourly Solar Irradiance Data kW/m² for 2012

aximum

%



Grid Evolution: The Emerging Inter-Grid Electric Grid + Internet



solar (community, personal)



wind, tidal,...

storage (community, personal, EVs batteries)

energy efficiency

- Our connection to the mainland is and will remain essential to meet the winter 75 MW peak load
- Over the coming decades, our energy resources will become more local and diversified
- Local energy resources will be more intermittent, requiring a well managed combination of firm energy (BPA, batteries, EVs, micro-hydro, etc.)
- Fossil fuels will shift to clean affordable electric (heating, water heaters, cars)
- The grid will evolve into a 2-way "inter-grid" that connects each of these resources, to maximize reliability, safety, and affordability of energy services
- This inter-grid will be a combination of Grid Control Backbone and home and business Internet networks, connecting intelligent inverters, storage, personal and utility energy management functions
- The 2-way inter-grid allows members to BUY and SELL energy - at favorable time of use (TOU) and time of generation (TOG) market rates.



On Internet and Renewable Energy

"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."

Beyond local renewable energy, the next few slides show how the marriage of the grid and Internet tie the whole community together, for a mix of energy and communication services.

Dan Kammen: Director of Renewable and Appropriate Energy Laboratory





Grid Evolution: The Next 20 Years

	2015	2016	2017	2018	2019	2020
Energy Demand	Reduce (more efficient • Energy E • Fuel Switt • Keep ele	Total Ene ent, clean, a Efficiency tching (Elect ctricity cost	ergy Dema ffordable) rify everythin less than for	and ng) ssil fuels		
Energy Resources	Diversify (more reliab • Optimize • Build Cor • Commur • Strategic	Resourc ole, affordab BPA mmunity sol hity dialog or partners (P	es le, local) lar, storage r n tidal and w NGC)	esources rind energy		Ra \ (m Div loca up v
	Continue	e Upgrad	ing Grid			

ICIEITI, TEIIADIE, TEAUY IUI IUCAI distributed intermittent energy)

- Submarine cable replacements
- Grid Control Backbone
- Robust feeders

Grid

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• Smart Grid interface for Solar, EVs, home



Eventually local renewable energy cost will be comparable to the cost of energy brought in from the mainland. We call this point Grid Parity.

To facilitate a robust transition, the slide at left shows three areas of steady activity by OPALCO aimed at managing: *Energy* Demand, Energy Resources, and *The Grid*, which ties it all together.











The following slide provides a bit more granularity into the grid evolution roadmap for:

Energy and Communication Grid

Distributed Energy Resources

Transactive Services

Appendix



OPALCO: Grid Modernization Roadmap



Community-scale Tidal, Wind,...

Expand resources for year-round local generation

Community Solar Expansion

Expand community solar throughout grid

Expand Member DER (Distributed Energy Resources)

Grow residential and business solar and storage resources throughout grid

SmartHub+

Enhanced member energy information application

Demand Response

Expand enhanced DR systems throughout county

DER "Market"

Incorporate bi-directional energy flow between grid and member owned DER's (solar, battery, EV's, etc.)

2022

2023

2019

2020

2021

