The Evolution of Our Grid

From 1935 to 2035

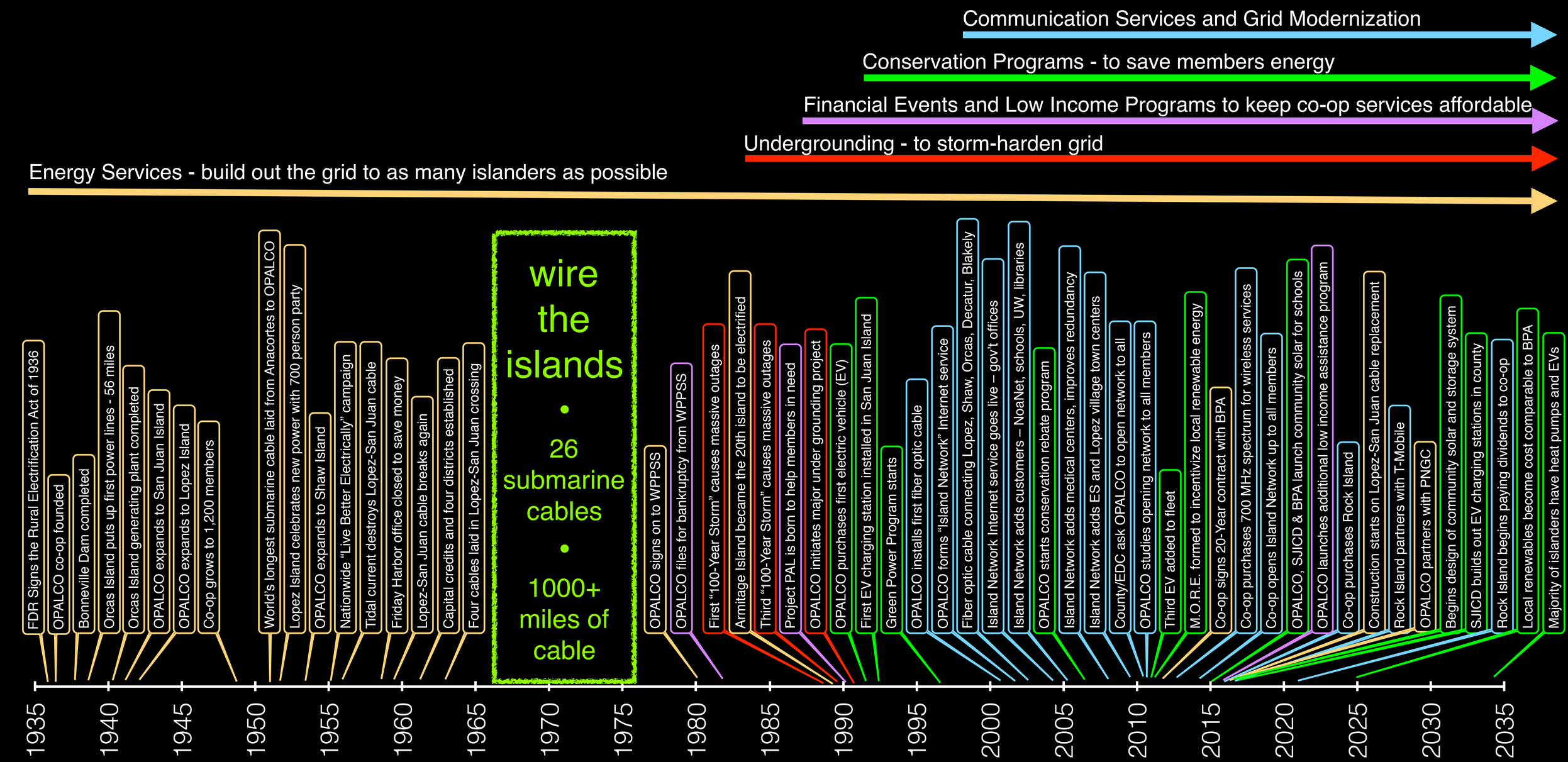
OPALCO Data Insights Series: Energy Services

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.”

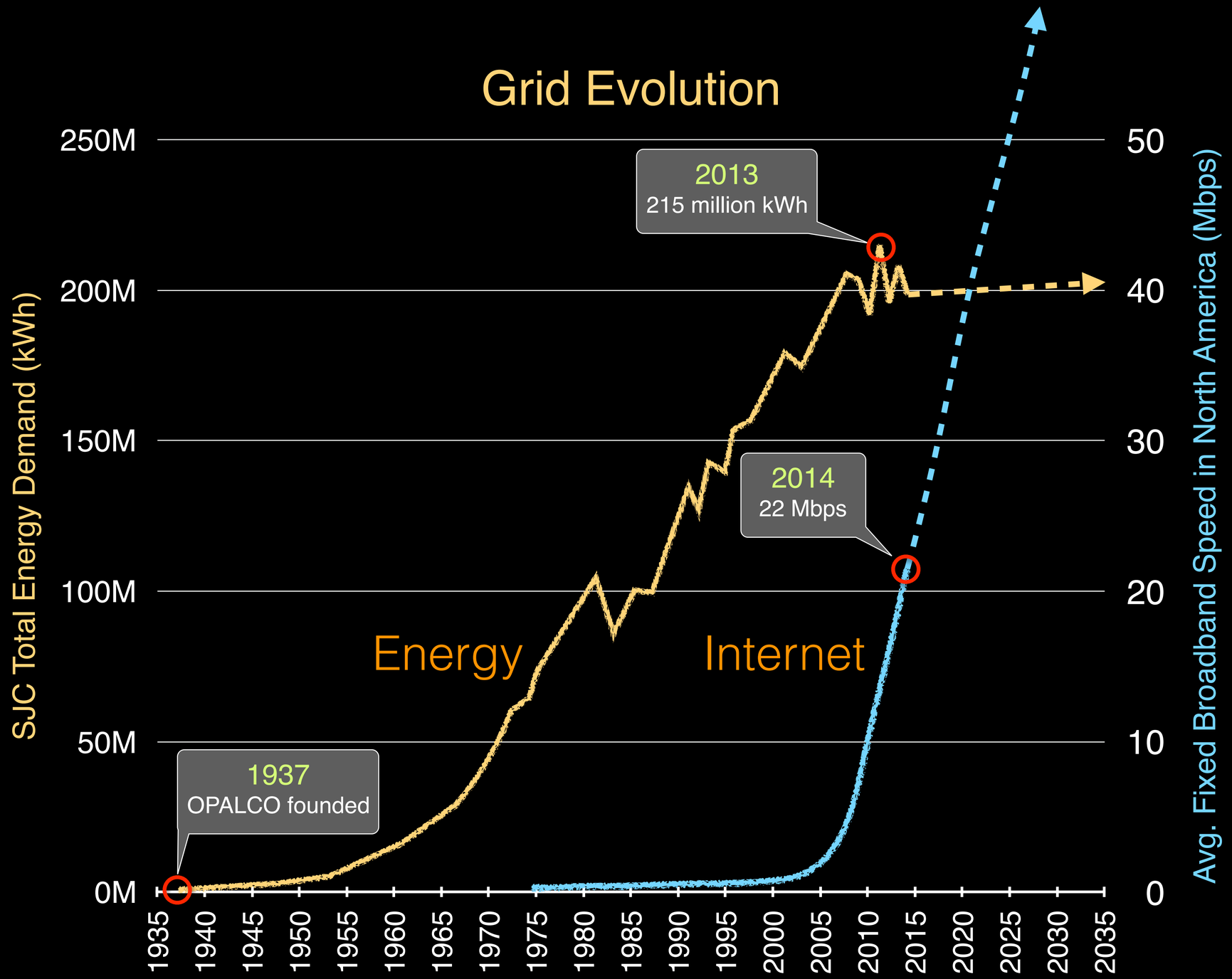
The history of power in our rural islands is steeped in the stories of the local people who dedicated their lives’ work to creating the electric cooperative, to building the system across twenty islands, and to continually maintaining and improving the power grid and friendly offices that serve us today.

The next slide lays out 100 years of innovation since OPALCO’s formation.

OPALCO: 100 Years of Innovation



Internet is the Energy of the 21st Century



Source: OPALCO, Cisco VNI

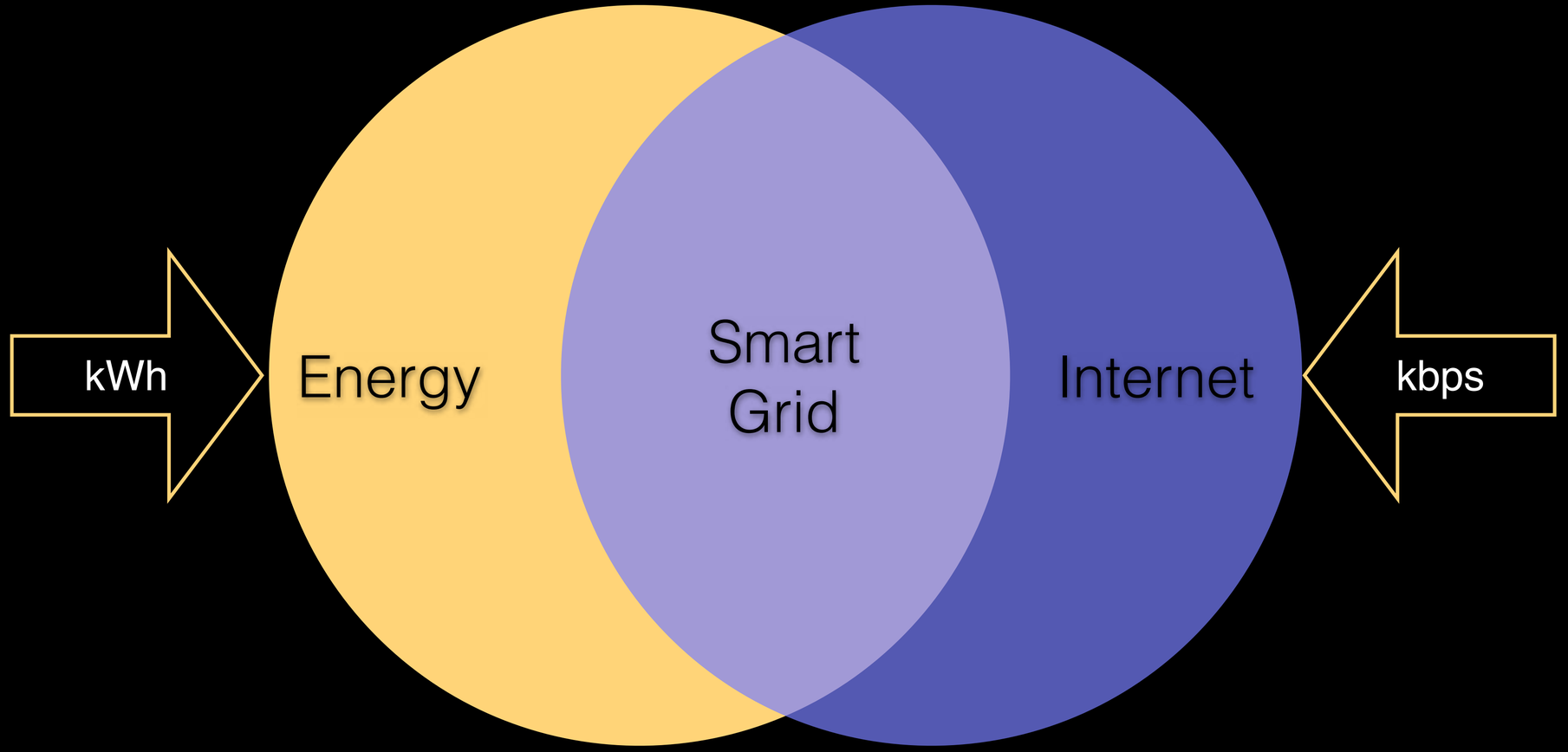
Founded in 1937, OPALCO built a grid that has supported an exponential growth in energy use by co-op members.

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 E*nergy* 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.

Synergy



Smart Thermostats
Solar Smart Inverters
Vehicle to Grid Storage
Home Energy Management Apps
Improved Grid Operations and Safety
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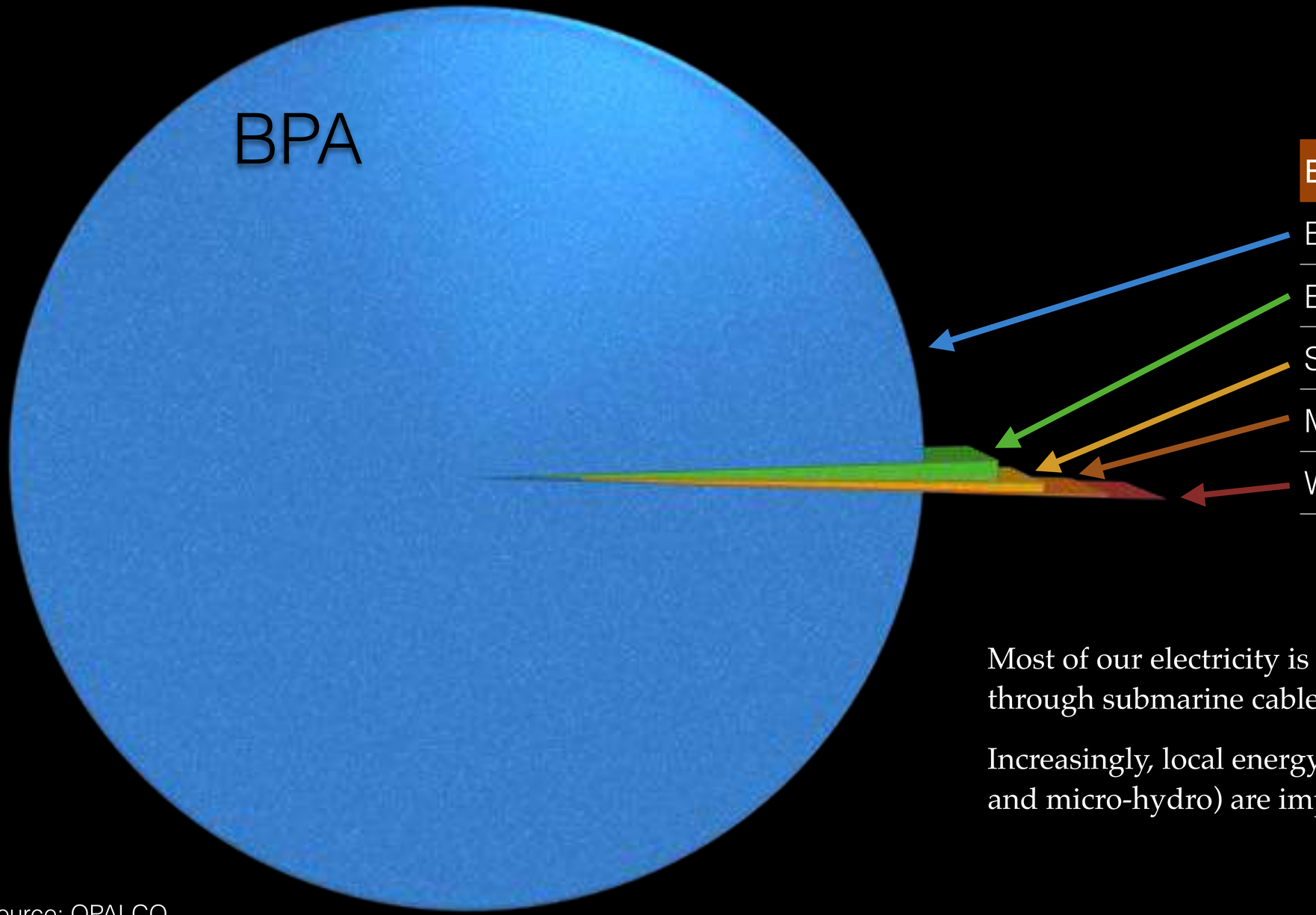
✔ Reduced waste
✔ More local renewable energy
✔ Vibrant energy sharing market

OPALCO Energy Sources: 2014



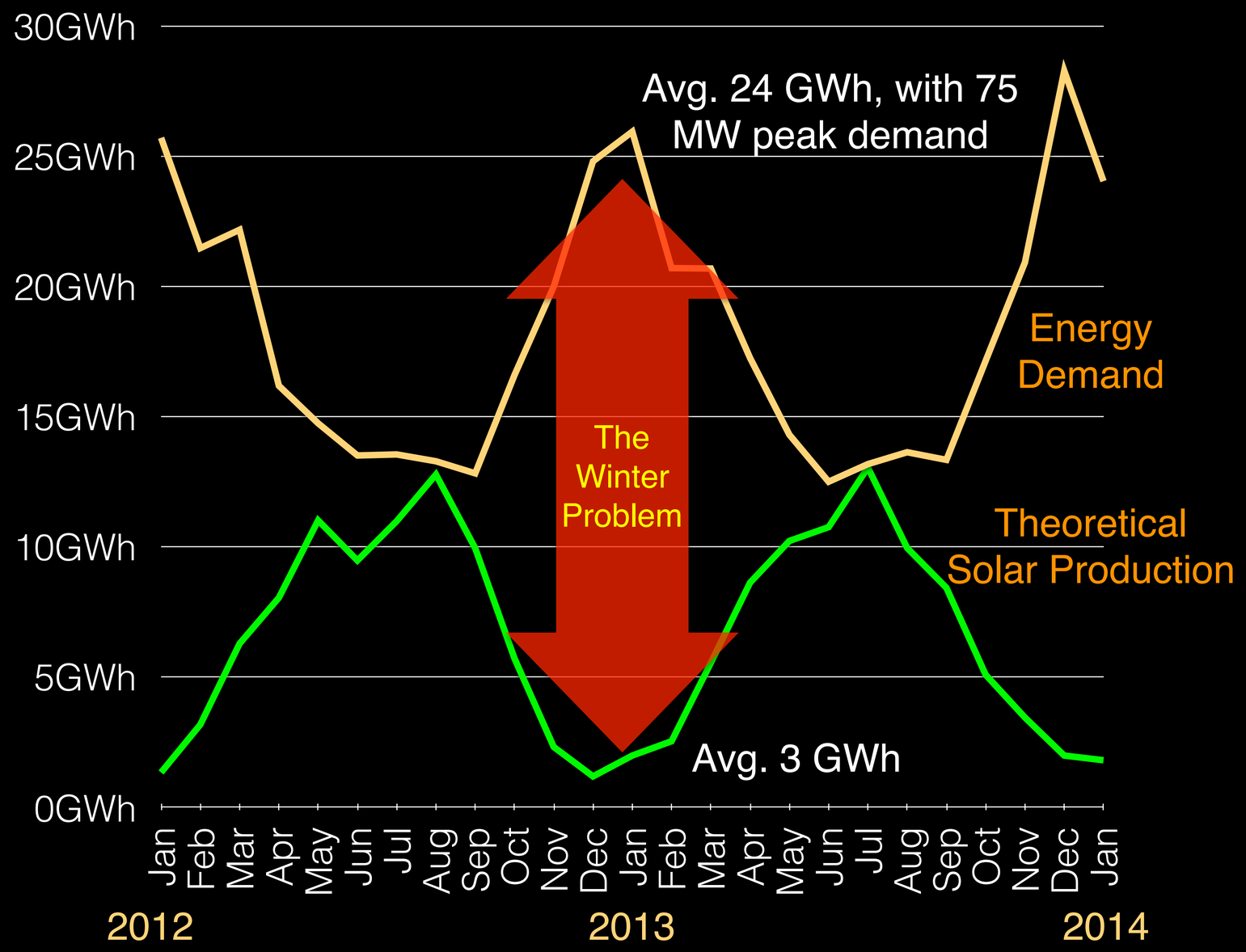
Energy Source	Production (kWh)
BPA	205,000,000
Energy Efficiency	1,418,000
Solar	624,723
Micro-Hydro	142,027
Wind	5,167
Total	207,189,917

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.

Source: OPALCO

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



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

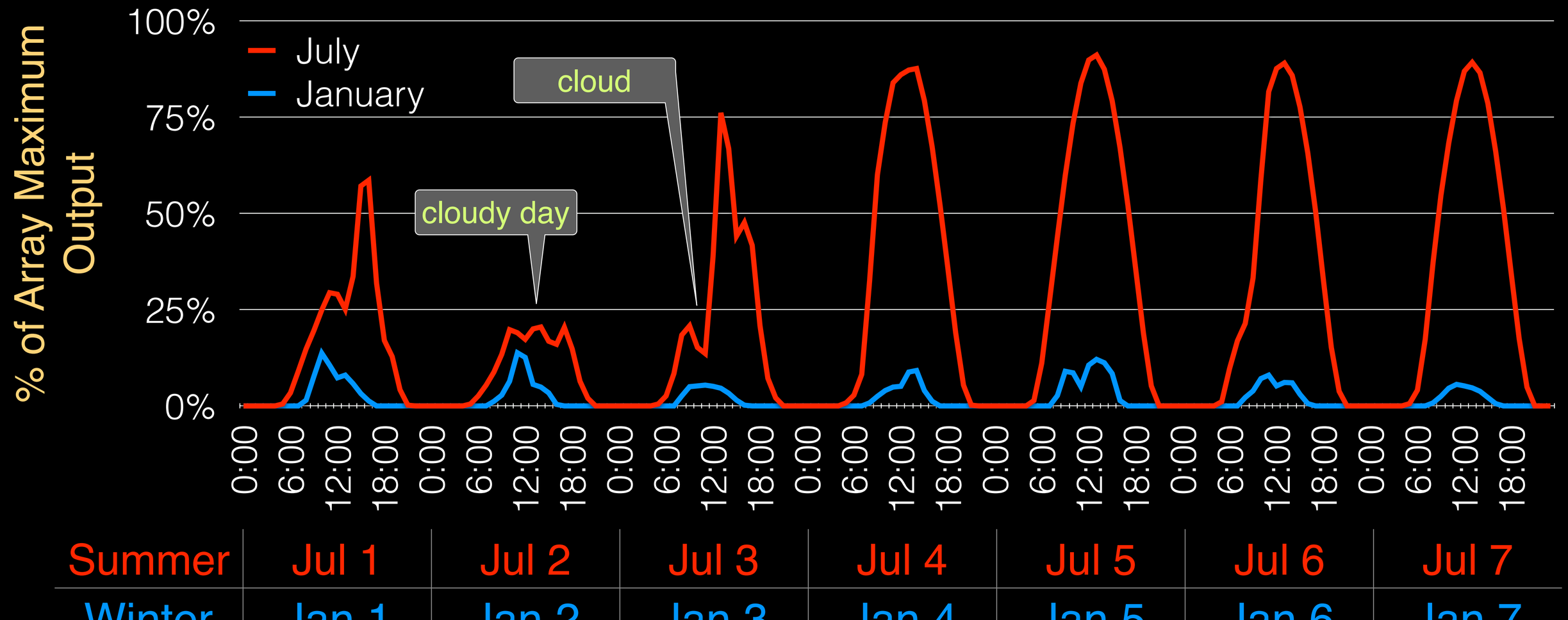
- OPALCO load 2012 to 2014
- Theoretical solar production from 10,000 rooftop arrays of 7.5 kW each = 75 MW, costing about $150 million (not including financing and grid integration)
- Solar production is 180 degrees out of phase with load, needing winter sources like hydro, wind, tidal, pumped hydro,…

Source: OPALCO, PVWatts

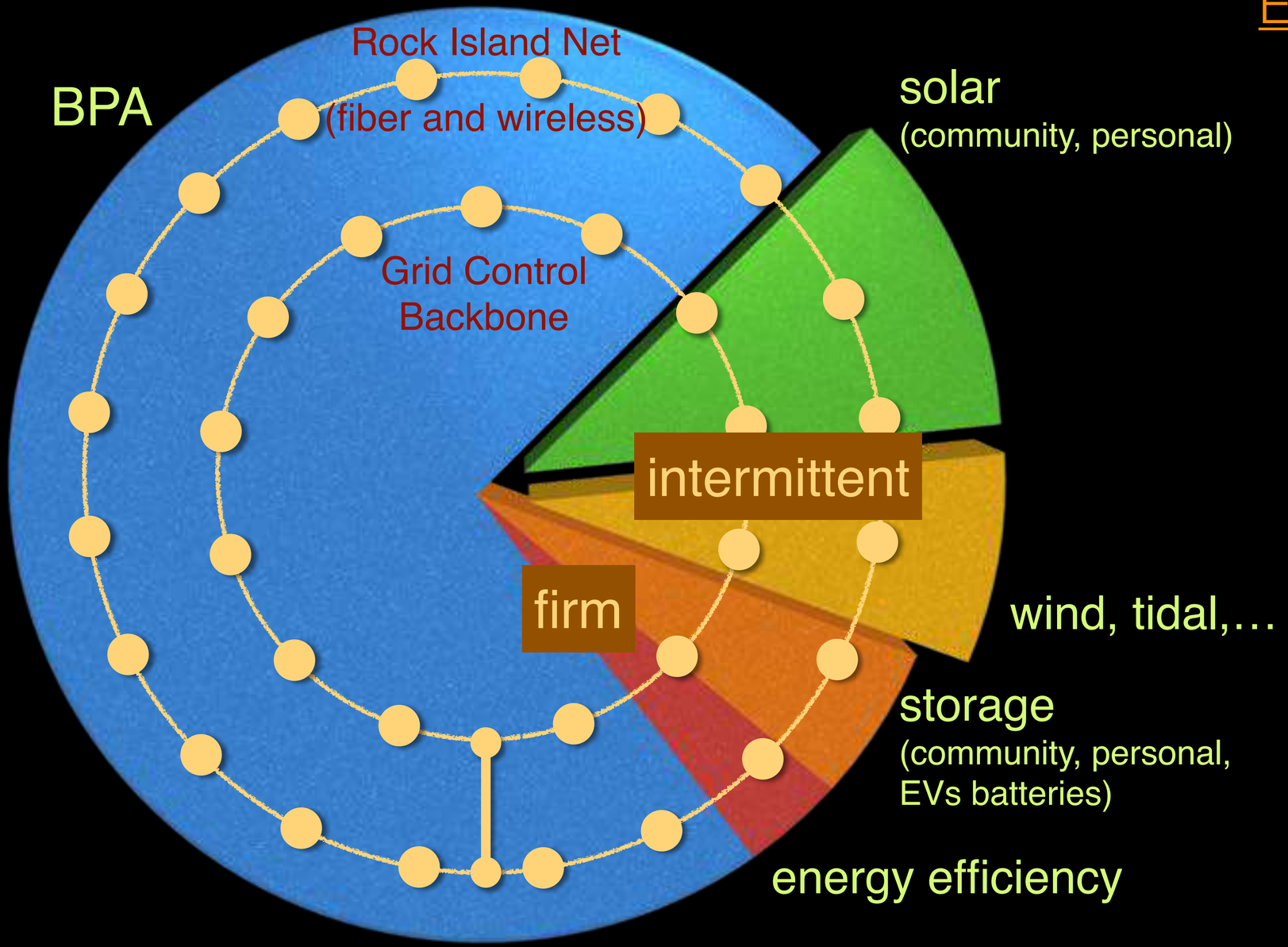
Solar: Hourly Solar Irradiance Data kW/m² for 2012

Local renewables are intermittent and require an agile grid to balance fluctuations in output, to maintain reliable high quality energy to co-op members.

The marriage of the electric grid and Internet are part of the evolving "inter-grid."



Grid Evolution: The Emerging Inter-Grid



Electric Grid + Internet

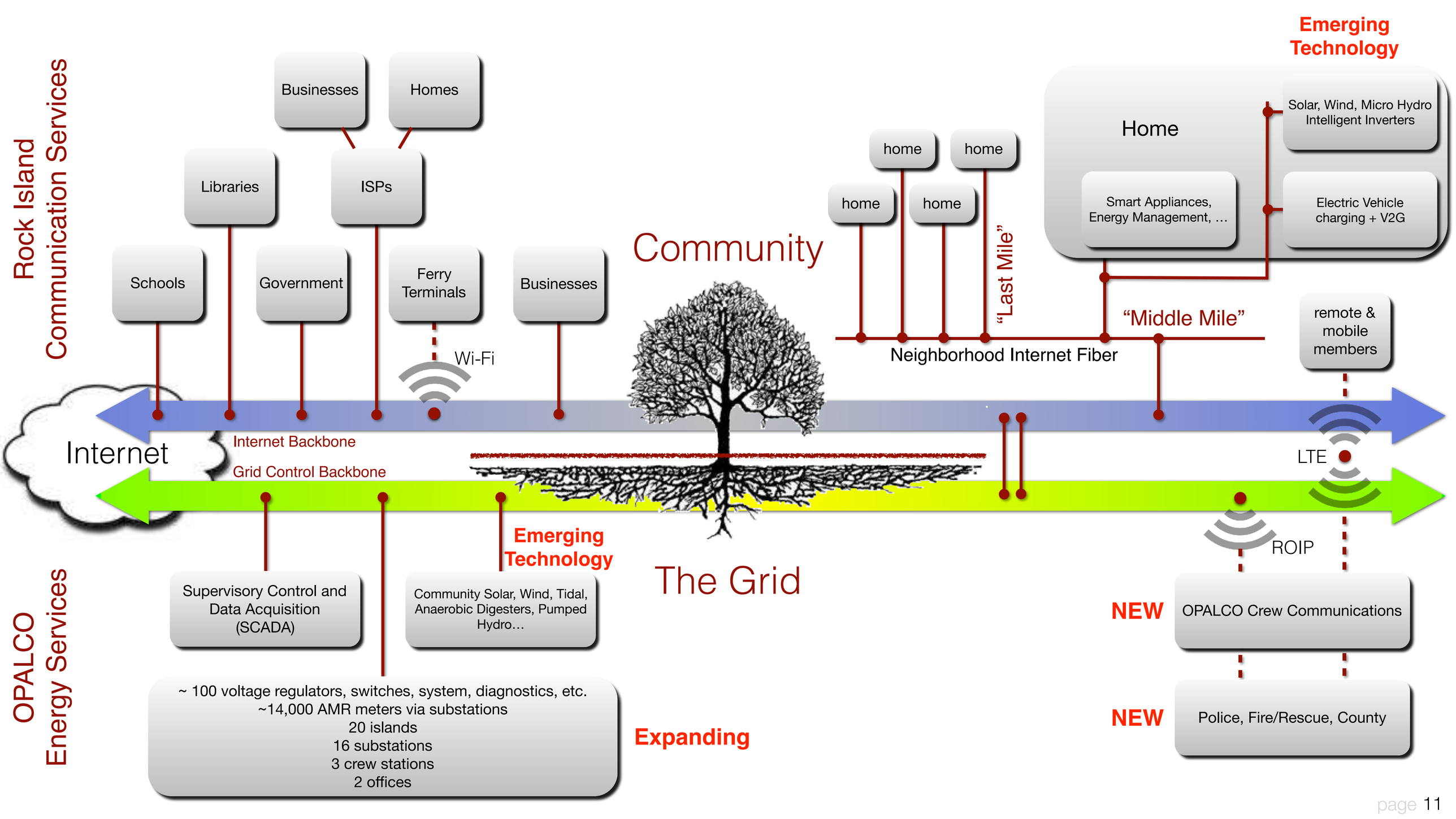
- Our connection to the mainland is and will remain essential to meet the winter 75 MW peak load
- Over the coming decades, our energy resources will become more local and diversified
- Local energy resources will be more intermittent, requiring a well managed combination of firm energy (BPA, batteries, 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.

Dan Kammen: Director of Renewable and Appropriate Energy Laboratory

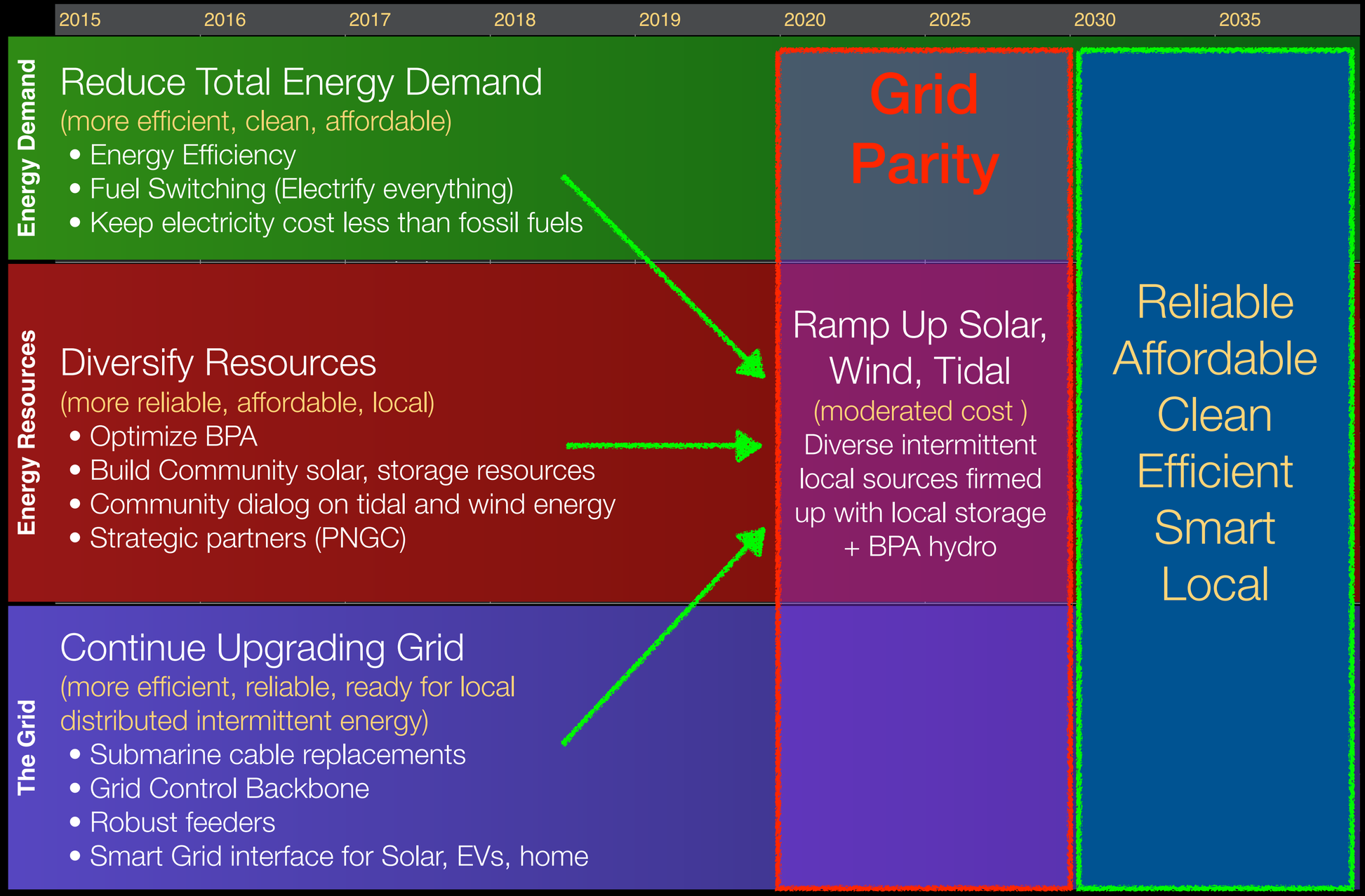
On Internet and Renewable Energy

"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.


Rock Island
Communication Services
Businesses
Homes
Libraries
ISPs
Schools
Government
Ferry Terminals
Businesses
Wi-Fi
Community
home
home
home
home
"Last Mile"
Neighborhood Internet Fiber
Emerging Technology
Home
Solar, Wind, Micro Hydro Intelligent Inverters
Smart Appliances, Energy Management, …
Electric Vehicle charging + V2G
"Middle Mile"
remote & mobile members
Internet
Internet Backbone
Grid Control Backbone
LTE
ROIP
Emerging Technology
The Grid
Supervisory Control and Data Acquisition (SCADA)
Community Solar, Wind, Tidal, Anaerobic Digesters, Pumped Hydro…
NEW
OPALCO Crew Communications
NEW
Police, Fire/Rescue, County
OPALCO
Energy Services
~ 100 voltage regulators, switches, system, diagnostics, etc.
~14,000 AMR meters via substations
20 islands
16 substations
3 crew stations
2 offices
Expanding

Grid Evolution: The Next 20 Years



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.

Appendix

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

Energy and Communication Grid

Distributed Energy Resources

Transactive Services

OPALCO: Grid Modernization Roadmap