

Orcas Power & Light Company

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Resource Plan Update September 23, 2015

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Agenda

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- Schedule
- Review Resource Planning Objectives
- Updated Conservation Potential Assessment
- Strategic Partners
- Update on Battery Storage
- Update on Smart Inverters/Grid
- Draft Resource Plan Strategies
- Next Steps

Schedule

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June Meeting:

- Planning Objectives
- Load Resource Balance
- Resources to consider
- Potential Portfolios

September Meeting:

- Review of objectives
- Strategic Partners
- Update on Conservation/EE
- Update on Battery Storage and Smart Inverters
- Draft Resource Plan Strategies

October/November Meeting:

- Present Summary of Draft Resource Plan
- Receive Board and Stakeholder Input

Review Resource Planning Objectives

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- Resource plans evaluate “portfolios” of resources in areas of:
 - Reliability
 - Cost stability
 - Environmental impact
- OPALCO currently purchases all of its power from BPA
 - Current contract expires at the end of September 2028
 - No guarantee of price or commodity from BPA after September 2028
 - BPA’s resources are relatively low cost and low carbon emitting
- OPALCO does not want to increase its carbon footprint
- OPALCO does not want to decrease its reliability

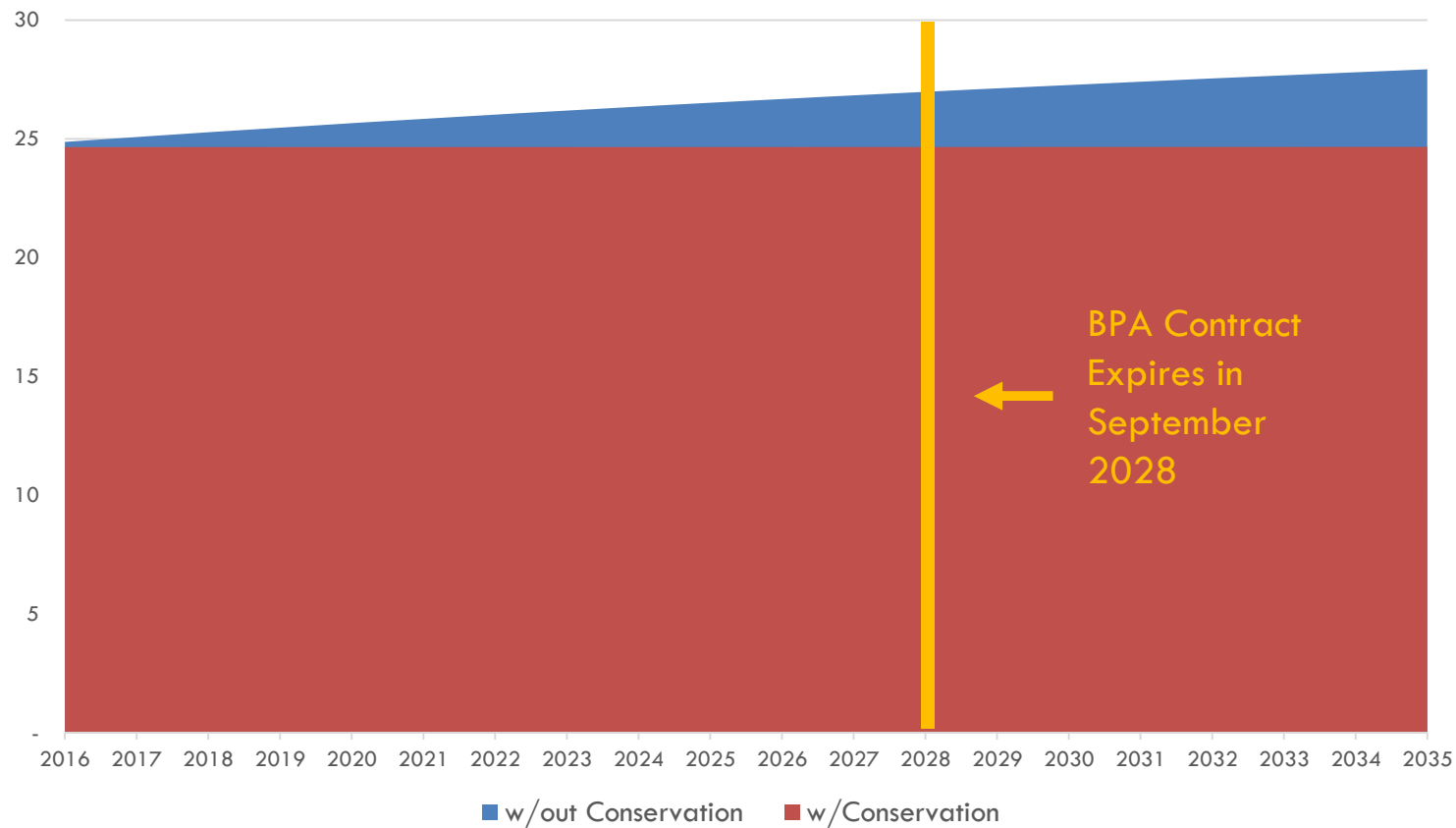
Review Resource Planning Objectives (cont'd)

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- OPALCO's Policy 28 states that OPALCO wants to encourage and increase the use of the following in its service area:
 - energy efficiency and conservation
 - renewable energy production
- OPALCO is dependent on generating resources located on the mainland and delivered via sub-transmission cables
- OPALCO would like to become less dependent on mainland generation and more self-sustainable
 - consider targeting a % of load

Conservation/EE Update

BPA's Forecast of OPALCO Load Requirements (aMW)



Conservation is the first resource deployed

BPA Contract Expires in September 2028

Projected loads net of conservation are flat at 24.7 aMW; which is less than OPALCO's contract high water mark of 25.1 aMW in all years (conservation is keeping OPALCO below its HWM).

Conservation/EE Update (cont'd)

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- Changes from the Seventh Power Plan
- Conservation Modeling Overview
- Comparison 2013 vs 2015 CPA Results
- 2015 Potential Detail/Programs
- Programs beyond BPA
- Summary

7th Power Plan Conservation Updates

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35 New or
Revised Standards

WA State Energy
Code

Market
Transformation

New Data
Developed by RTF

Updated Baselines

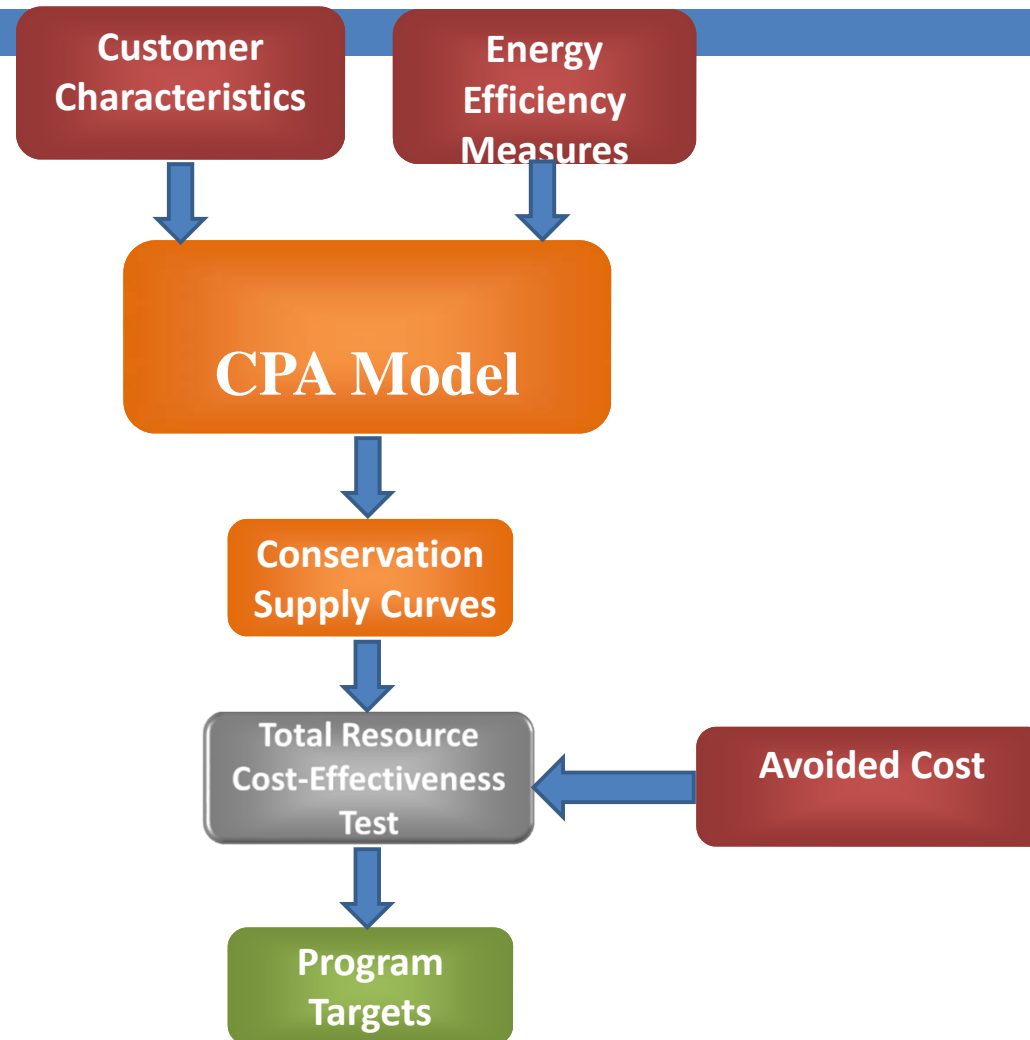
New Measures

Measure Removals

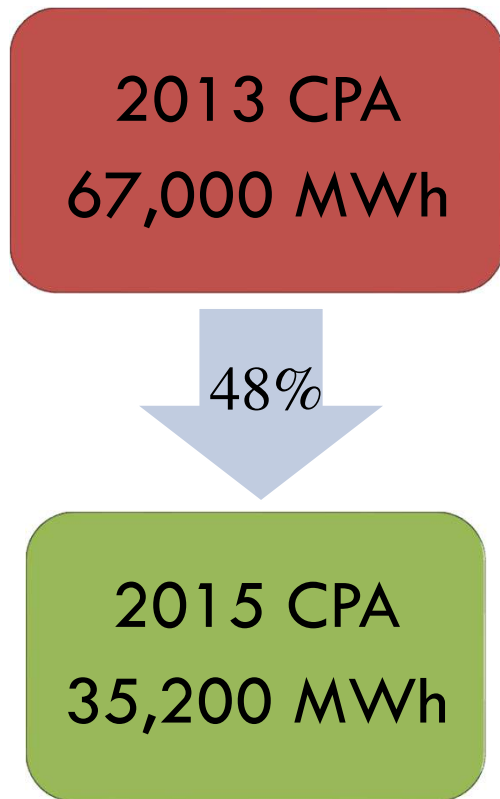
Regional C/E
Potential 24% Lower

CPA Model

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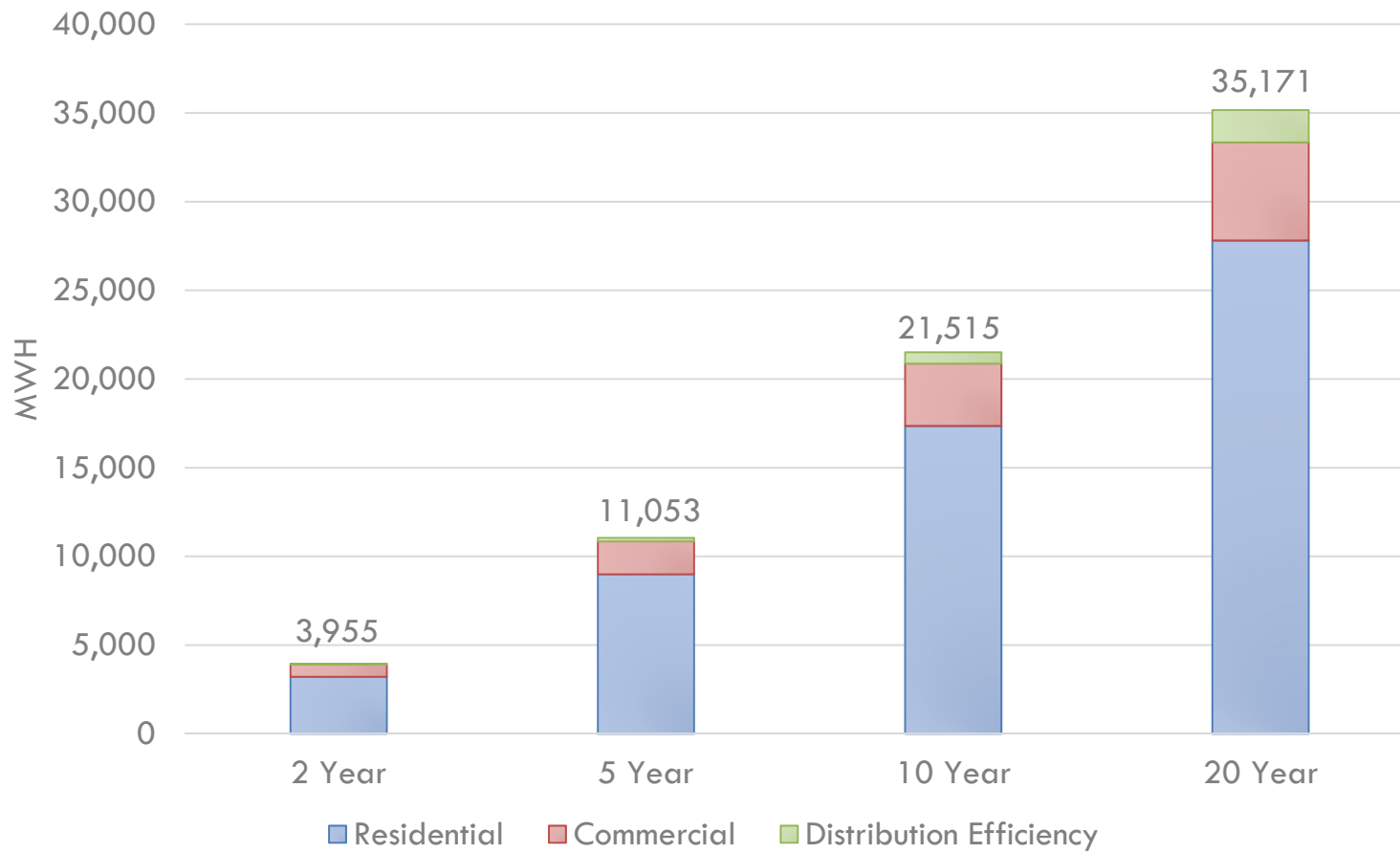


Conservation Potential Analysis Comparison



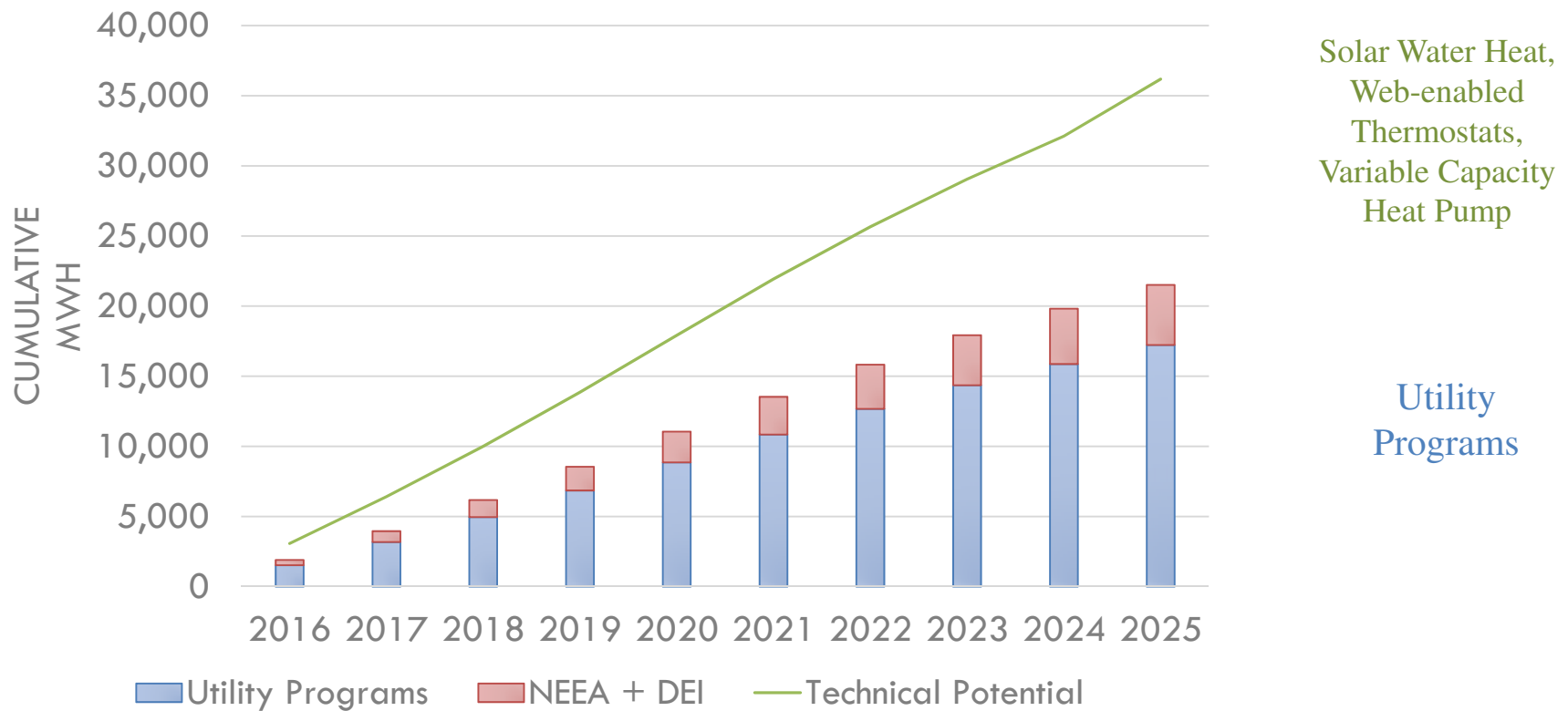
Decrease primarily due to change in code changes and appliance standards.

2015 CPA Results



Note: MWhs shown above are cumulative.

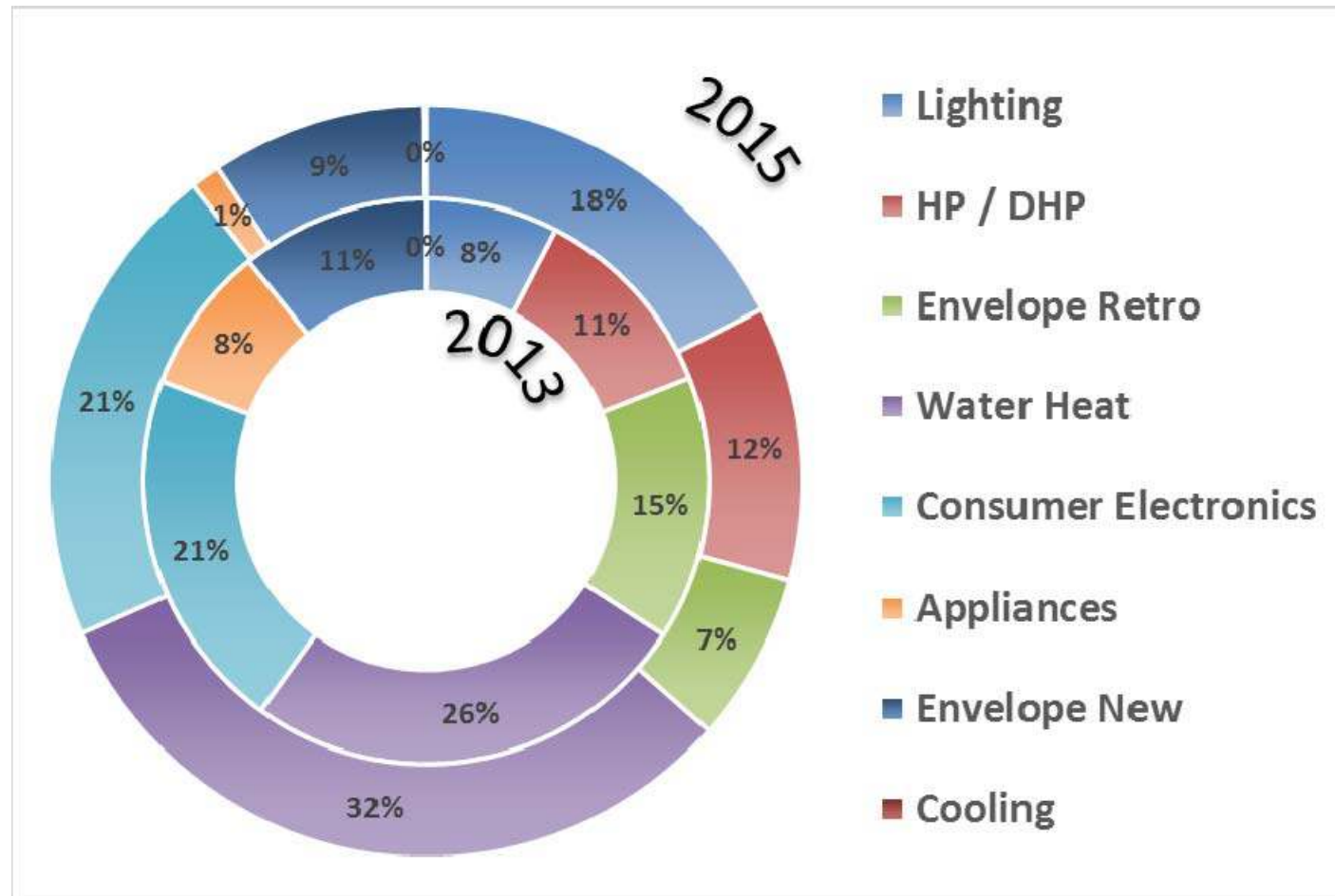
10-Year Program Potential



NEEA = Northwest Energy Efficiency Alliance
DEI = Distribution Efficiency

Residential Savings by End-Use

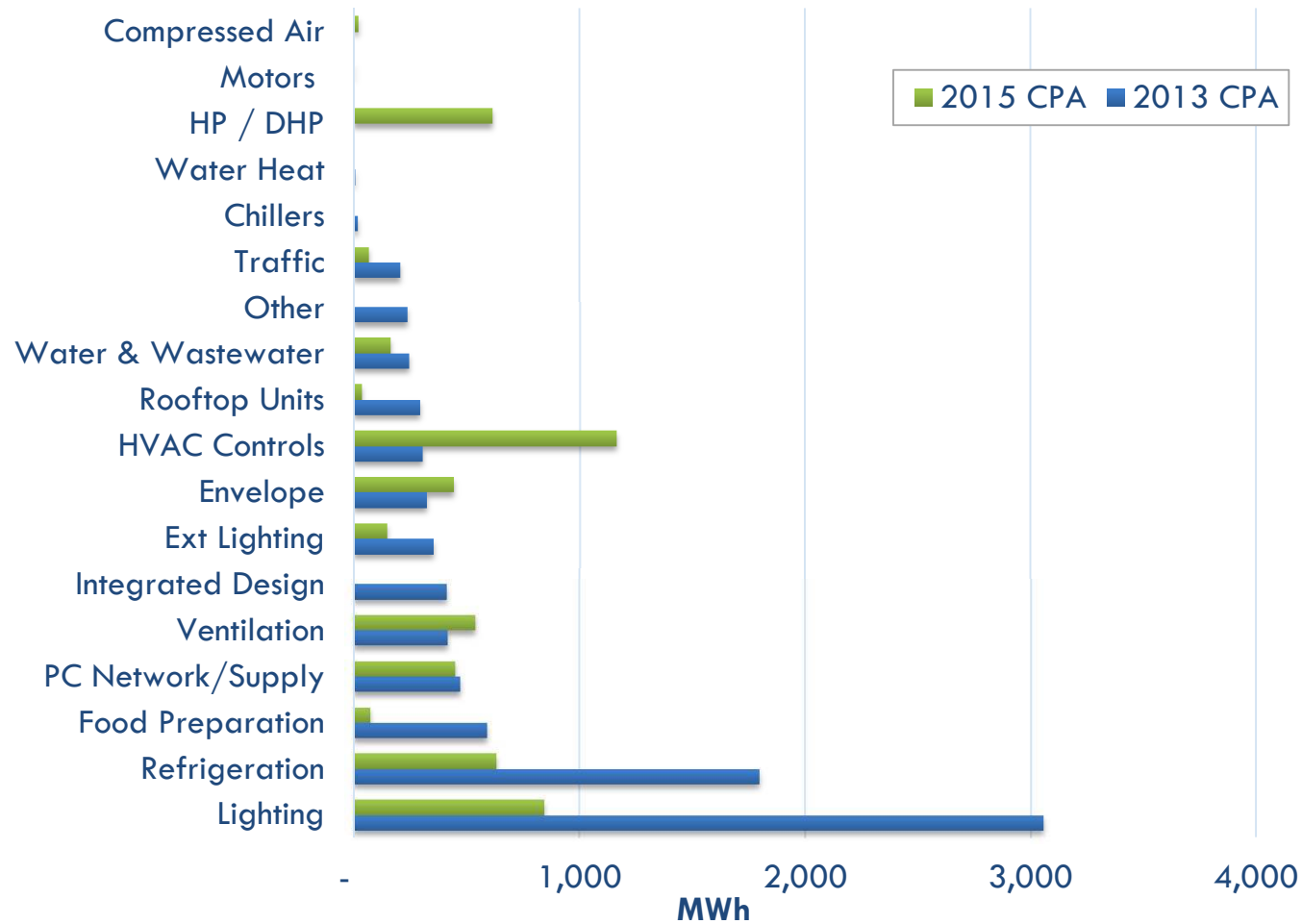
- Water Heating – HPWH, showerheads, faucet aerators
- Lighting – LEDs
- Consumer Electronics – Advanced Power Strips



Commercial Savings by End-Use

20-Year Potential

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New Cost-Effective Measures

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■ Commercial

- Solid-state lighting
- Ductless heat pumps
- Commercial rated efficient water tanks
- Web-enabled programmable thermostat
- Water cooler controls

■ Residential

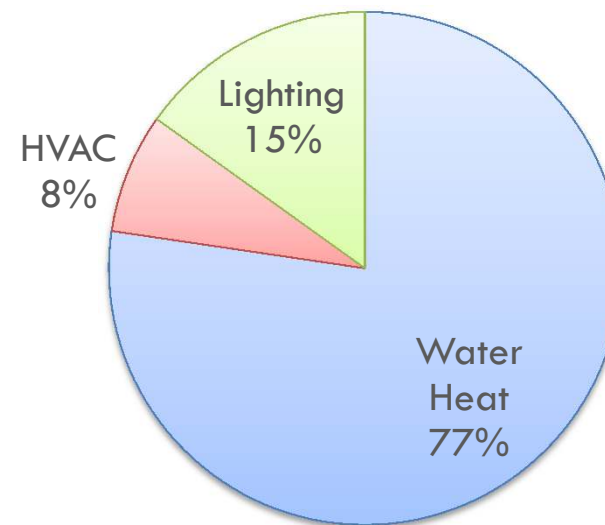
- Advanced power strips
- Variable speed heat pumps (12 HSPF/18 Seer)
- WiFi enabled thermostat

Utility Programs Beyond BPA

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- Behavioral Programs for Educational Outreach
 - Turn down water heat temperature
 - HVAC usage reduction
 - Reduction in lighting hours of use
 - Existing Single-Family Homes: 770 MWh potential

Behavioral Program Savings
172 kWh/year/home



Based on regional estimates.

Summary

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- **Updated baselines, and measure costs and savings result in lower conservation potential savings estimates**
 - 2-year estimates are 32% lower compared with 2013 CPA

Strategic Partners - PNGC

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- Joint Operating Entity (JOE) – the only JOE in BPA’s service territory
 - PNGC is a preference customer of BPA
- Advantages for resource delivery – JOE is one customer with multiple points of delivery
- Aggregate members’ loads and resources
 - Demand pooling (savings due to load diversity among members)
- Aggregate wholesale power purchases to serve above-HWM load
 - Large enough to do deals
- Generating resource ownership
- Energy efficiency pooling, demand response and solar PV committees
 - Take advantage of diversity of resource potential of members (e.g. solar potential)
- BPA watchdog (rate case party)

Strategic Partners - NRU

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- Trade association serving 52 member utilities (BPA watchdog)
- Purchase non-federal power to serve above-HWM load (capturing economies of scale)
 - Northwest Energy Management Services (NEMS) – 21 utilities (all load following customers of BPA)
- Fees are roughly 10 to 15 percent of PNGC's fees

Strategic Partners - Other

- Don't need to join a group
- Reduced risk and economies of scale with a group
- Provides a plan for when/if above-HWM loads materials
- Value in issuing Requests for Proposals for larger quantities of power
 - Economies of scale when evaluating power purchases and generating resource ownership options
- Could partner with neighboring or like-minded utilities when issuing RFPs for non-federal power
- Need to consider potential services needed in the future
 - Uncertainties include BPA rates, BPA supply in post-2028 and potential for renewable portfolio standard requirements

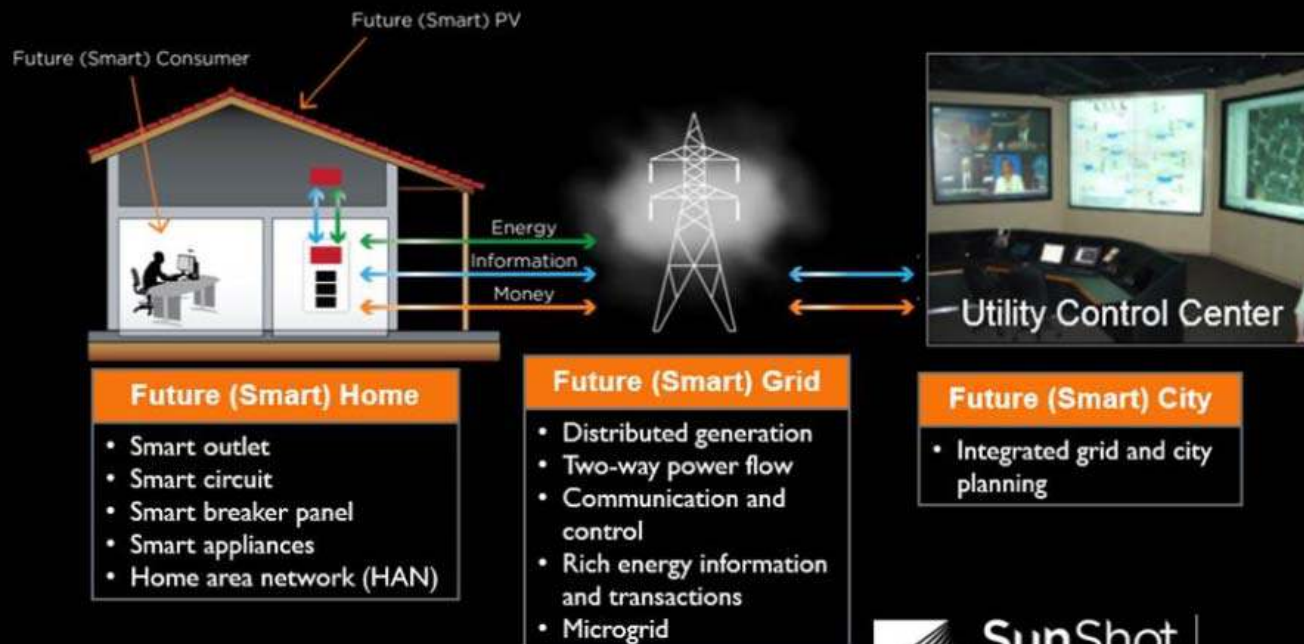
Smart Inverters/Grid

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Grid Integration : Plug-and-Play Solar

Vision : PV as an Appliance

No permitting Easy installation Seamless grid integration



Smart Inverters/Grid (cont'd)

- Current inverter performance standards force inverters to disconnect at the first sign of a grid disturbance
- **Need to modify existing inverter standards** to allow them to:
 - stay connected to the grid during minor grid disturbances
 - change their output to assist the grid remain stable
 - help the grid stay at the correct voltage and frequency
 - if a smart inverter detects voltage exceeding 1 percent of normal, it will absorb additional reactive power
 - if line voltage drops below normal—as can occur when passing clouds suddenly squelch PV power—the smart inverters will bolster it by injecting reactive power.

Smart Inverters/Grid (cont'd)

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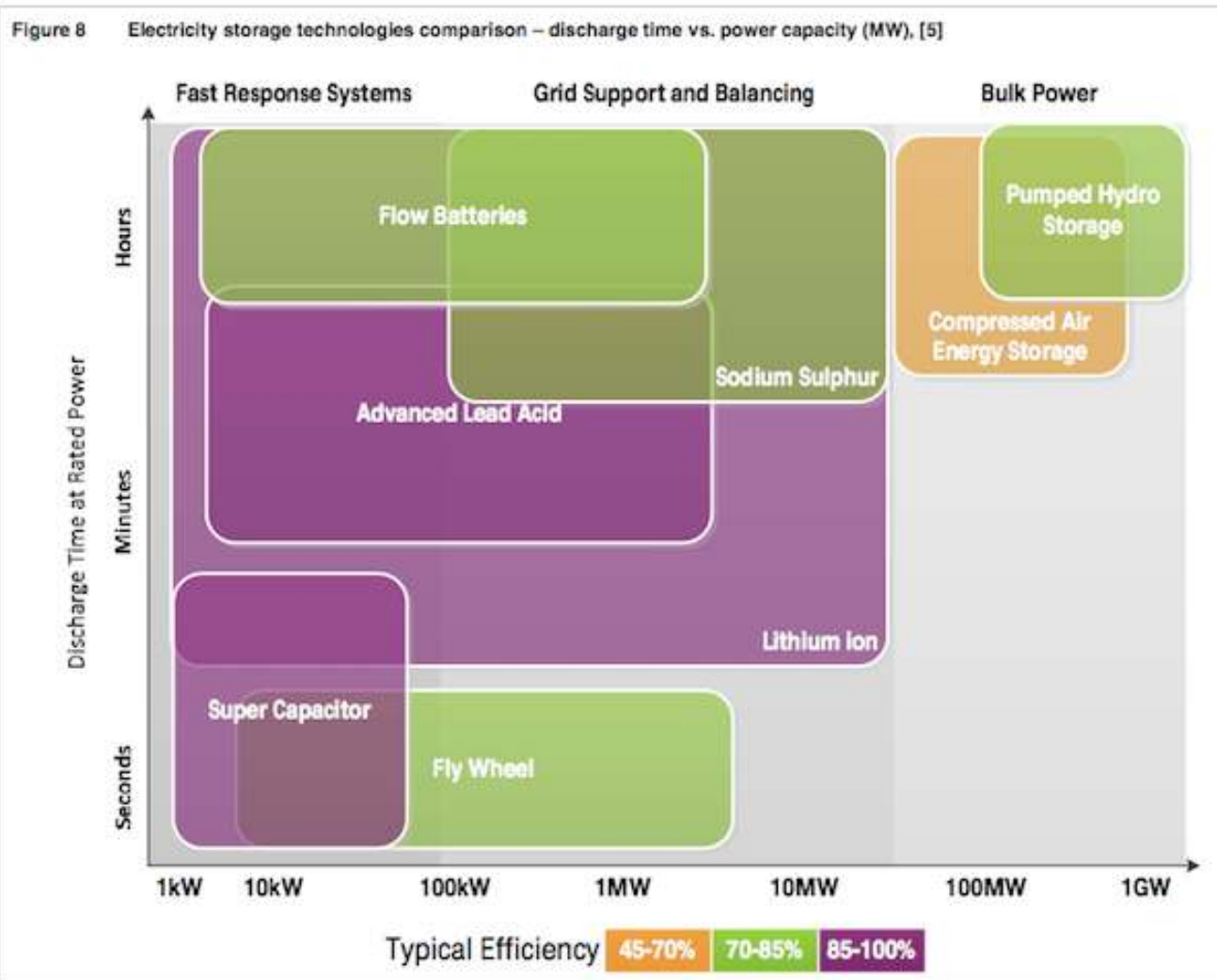
- At night, when their PV panels are silent, the inverters can keep running on grid power
- **Inverter standards (mainly IEEE 1547) must be updated** to allow smart inverters
 - process has already started, but standards development is slow
- Added cost for a smart inverter is low
- To incorporate all the features of a smart inverter adds only \$150 to the cost of a residential size inverter
- Retrofitting existing inverters with smart inverter technology in Germany (more expensive to retrofit)
- A push in the US to use smart inverters now in anticipation of future need

Smart Inverters/Grid (cont'd)

- California utilities already pushing for all new PV sites to use smart inverters
- Development in California is the result of a state-specific standard, approved by the CPUC in December
 - not mandatory until mid-2016
- Distributed inverters could be a fully integrated component of utilities' distribution control systems within five years
 - Before then CPUC hopes to address whether inverter owners should be compensated for providing grid-regulation services.

Utility-Scale Storage Systems

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OPALCO Demand Notes:

- Historic Peak \approx 75 MW
- BPA Monthly Billing Determinants \approx 1 to 11 MW
- No savings for peak shaving beyond BPA billing determinants
- BPA Monthly Demand Rates = \$6.57/kW to \$12.16/kW
- 1 MW decrease in all months = \$120K in annual savings

Utility-Scale Battery Systems

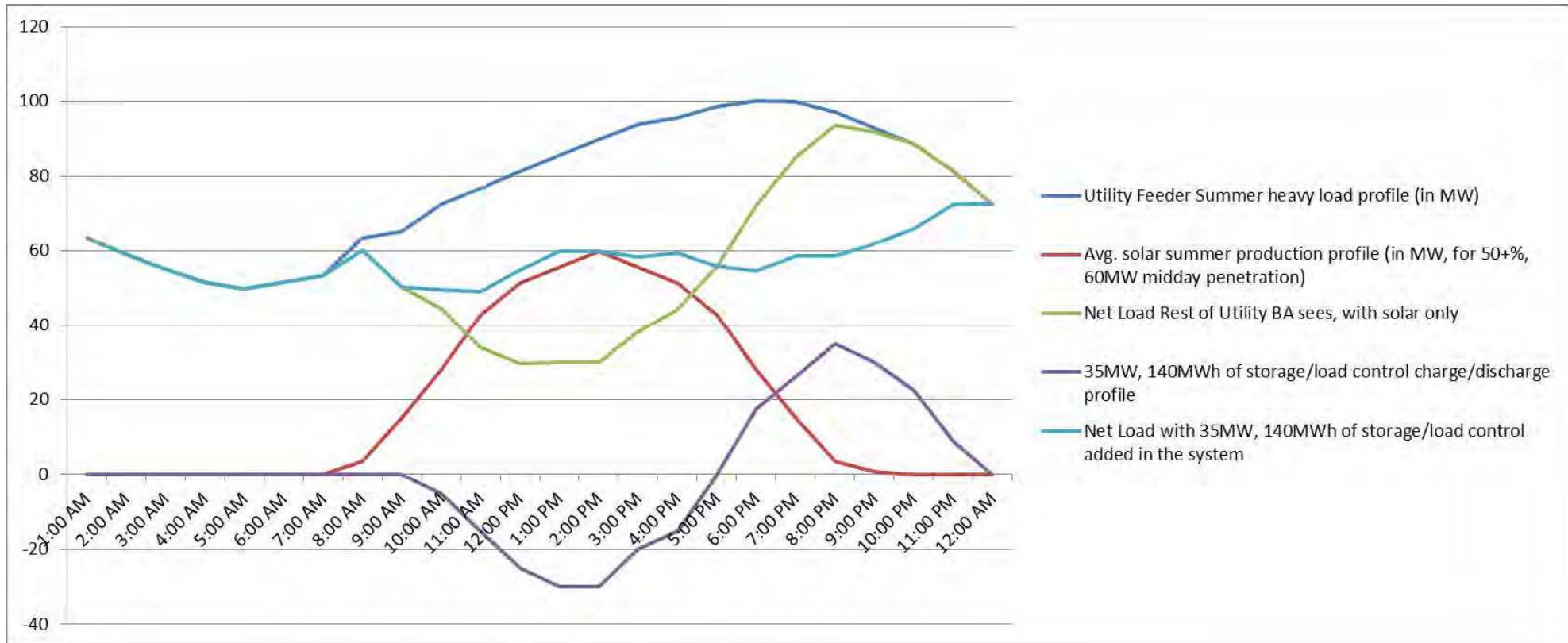
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- Storage systems currently not cost effective (utility-scale and smaller)
 - BPA demand rate \approx \$10/kW-mo
 - Lifecycle costs of pumped storage \approx \$30/kW-mo
 - Lifecycle cost of flow battery \approx \$50/kW-mo
- Battery system costs expected to decrease over next 5 to 10 years
- Estimated cost of storage systems
 - Pumped hydro and gas peakers = \$100 - \$300/MWh
 - 1 MW lithium ion = \$550/MWh (projected 2020 = \$200/kWh)
 - 1 MW vanadium redox flow batteries = \$680/MWh (projected 2020 = \$350/MWh)
 - Smaller systems = > higher costs
- Lithium-ion
 - greatest potential storage capability and efficiency (e.g. solar and wind integration)

Utility-Scale Battery Systems (cont'd)

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- Extreme example of 50+% solar penetration, storage energy content of about 50% of solar energy content (daily average over course of year)



Note: Load shape reflects a typical California load; not Northwest wherein daily peak loads are typically in the morning.

Cost Effectiveness of Rooftop Solar/Battery

SOLAR-PLUS-BATTERY LEVELIZED COST OF ELECTRICITY (LCOE)
 VS. UTILITY RETAIL PRICE PROJECTIONS
 COMMERCIAL - BASE CASE [Y-AXIS \$/kWh]



Northwest has:

- 1) Low cost hydro power
- 2) Low retail rates
- 3) Poor solar potential

NW most resembles Kentucky

Is There A Need for New Resources?

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- Lowest cost resources are conservation/EE and BPA
 - Continue to maximize these resources
 - All other resource options are greater in cost
- Current resource portfolio is low risk in the short-term
 - Loads are flat and less than BPA contract HWM (see slide 6)
 - Adding resources that displace BPA would result in higher power costs
 - Should look for opportunities to reduce BPA demand costs (peak shaving)
- Risks in current resource portfolio are more long-term
 - BPA contract expires September 2028
 - Renewable Portfolio Standard compliance (currently exempt under WA law)
 - Self-sustainability: promote/incentivize up to 5 or 10% target?
 - Resource diversity

Draft Resource Plan Strategies

- **Energy Efficiency:** OPALCO should continue to participate in BPA's Energy Efficiency Incentive ("EEI") rate funded programs
 - BPA-Funded: OPALCO should continue to encourage customers to take advantage of incentives/rebates available for converting to heat pump technologies (within existing BPA programs)
 - Self-Funded: OPALCO should self-fund energy efficiency if:
 - membership says "do it"
 - Conservation Potential Assessment shows measure is cost effective

Draft Resource Plan Strategies (cont'd)

■ Fuel Switching

- Heating: OPALCO should encourage customers to take advantage of incentives/rebates available for converting from propane or wood heating to heat pumps
 - Provide information on carbon footprint implications of fuel switching
- Electric Vehicles: OPALCO should provide rebates and/or rate designs that encourage switching from fossil fuel to electric:
 - Encourage off-peak charging via rate schedules
 - Consider rebates for customers that convert to EV
 - rebate funded by additional revenue generated by EV rate schedule
 - 131 electric vehicles registered in San Juan county as of December 2014

Draft Resource Plan Strategies (cont'd)

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- **Educational Outreach:** OPALCO expand its educational outreach efforts with respect to the energy efficiency incentives/rebates available to its customers
 - Note: Consideration should be given with respect to how to best optimize resources

Draft Resource Plan Strategies (cont'd)

- **Demand Response Units:** OPALCO should install DRUs if customers are interested
 - Can help reduce BPA demand costs (see slide 25)
 - Provide incentives based on potential BPA savings
 - Candidates include: space heating, space cooling, water heating, commercial lighting and refrigerated warehouses
 - 7th Power Plan shows the following program costs:

\$/kW-month	2020	2025	2030
All Customer Classes	\$8.4 to \$9.3	\$5.7 to \$6.3	\$5.6 to \$6.2
Residential Only	\$9.1 to \$13.5	\$3.0 to \$4.4	\$2.9 to \$4.3

* Average Monthly BPA Demand rate is currently \$9.98/kW-mo. In most cases DRU is less expensive than BPA demand product.

- Note: 400 demand response units installed on Orcas Island as part of pilot program

Draft Resource Plan Strategies (cont'd)

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- **Pre-Pay:** OPALCO should provide residential customers with pre-pay option
 - Increases customers' awareness of how much energy they are using
 - Allows customers to control their usage and costs
 - Encourages conservation
- **Time-of-Use Rates:** OPALCO should provide all customers with time-of-use rate options
 - 4 time periods like existing Residential TOU rates, or
 - 2 time periods (on-peak = 6 am to 10 pm Mon-Sat)
 - BPA rates only include incentives to shift loads from on- to off-peak (load shaping rates)

Draft Resource Plan Strategies (cont'd)

- **Renewable Resources:** OPALCO should provide Time-of-Generation (TOG) incentives for distributed renewable generating projects that:
 - a) assist OPALCO in meeting loads during peak demand periods,
 - b) assist OPALCO in meeting loads during periods in which supplies are constrained due to resource outages or other unplanned events (i.e. emergency use), and/or
 - c) improve OPALCO's system load factor (i.e. flatten OPALCO's loads across all hours)

Draft Resource Plan Strategies (cont'd)

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- **Strategic Partners:** OPALCO should continue to explore PNGC and NRU membership
 - Projected annual cost of membership
 - Financial benefits to OPALCO absent HWM load
 - Risk management/insurance
 - Demand pooling
 - Full Time Employees
 - PNGC and NRU staff = utilities sharing FTEs
 - Stability of resources & BPA post-2028 uncertainty
 - BPA rates continue to increase (greater than market today)
 - BPA supply uncertain beyond 2028
 - Potential for RPS requirements in the future

Draft Resource Plan Strategies (cont'd)

- **Future Resources:** In the interest of self-sustainability and resource diversity OPALCO should consider:
 - Utility-scale solar
 - Battery storage system
 - Complement utility-scale solar and provide backup in the event of a transmission contingency
 - Cogeneration at wastewater treatment plants
 - Pumped storage at state park
 - 2nd Tier resource options: smart inverters (when codes updated), anaerobic digesters (farm manure), biomass-woody debris, small hydro (gravity-fed water pipes), distributed storage (EV/Tesla) and landfill gas projects

Next Steps – Draft Resource Plan

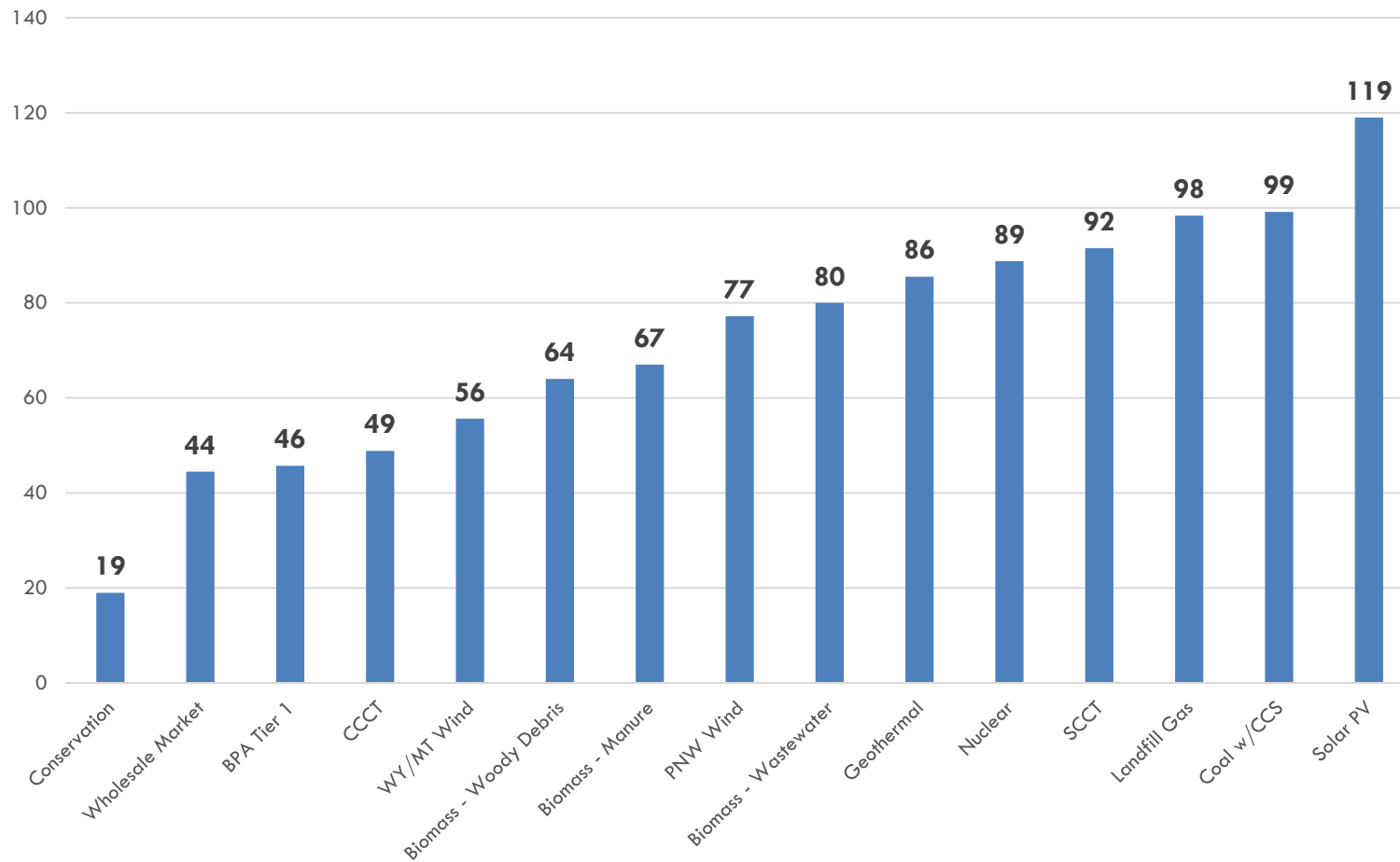
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- **Resource plan strategies on previous slides**
- **Portfolios:**
 - Low load forecast: BPA load forecast, high conservation, high net metering growth, low electric vehicle growth
 - High load forecast: OPALCO load forecast, low conservation, low net metering growth, high fuel switching (EV and heating)
 - High sustainability: High growth in net metering, conservation, demand response and local resource development (“behind the meter resources”)
- **Action Plan – timing of resource plan strategies**
 - Short-term (1 to 5 years)
 - Long-term (6 to 20 years)

Appendix – Backup Slides

Resource Screening

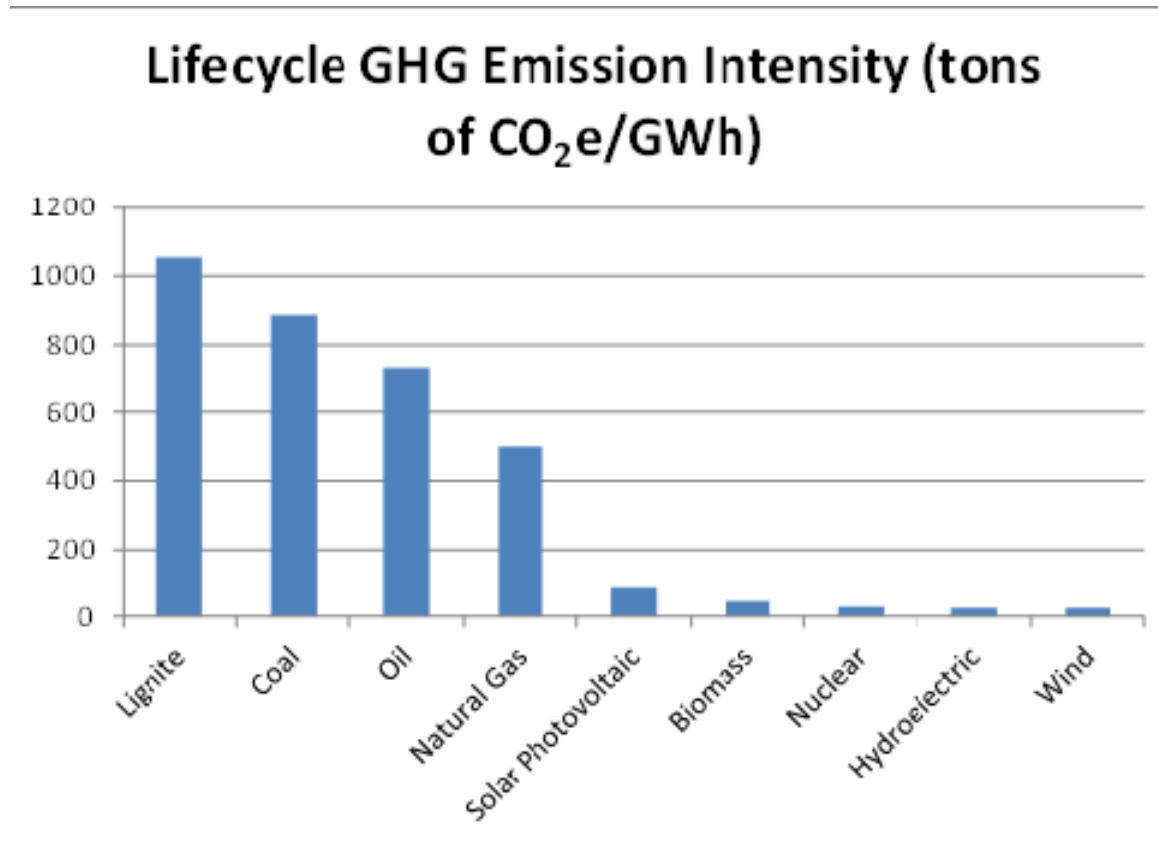
Estimated 20-year Levelized Costs (\$/MWh)



Life-cycle costs

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- Our screening includes on-going fixed and variable costs but not full life-cycle costs (cradle to grave)



Local Resource Opportunities

- Relatively small local generating resource opportunities
- Some of the resource options could provide synergies with other county operations
- Local resource options considered include:
 - Landfill gas project (currently no landfills in San Juan county)
 - Anaerobic digesters (farm manure)
 - Cogeneration at wastewater treatment plants
 - Utility-scale batteries
 - Utility-scale solar
 - Pumped storage
- Resources not considered due to lack of proven technology (no practical applications as of yet):
 - Wave
 - Tidal
 - Off-shore Wind

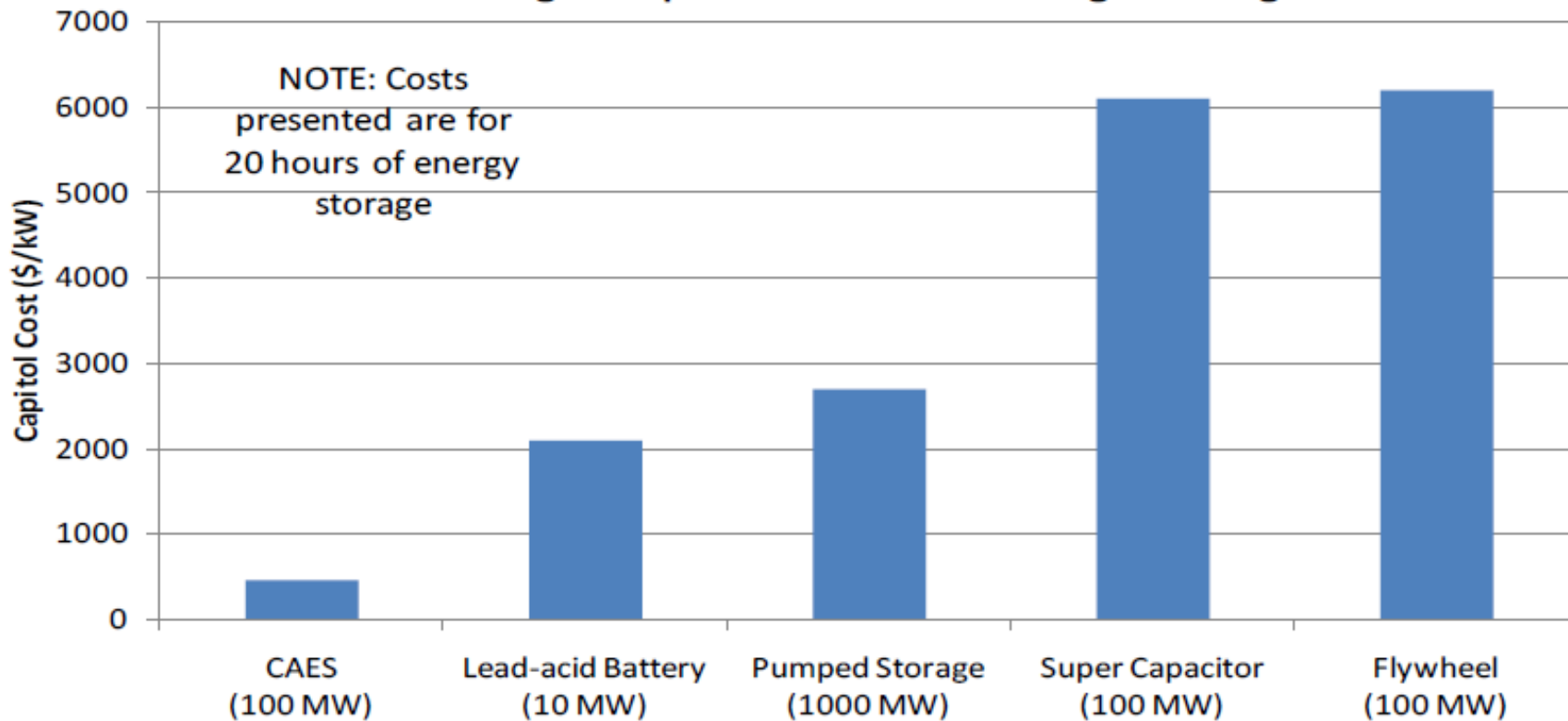
Storage Projects

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- California state law requires utilities to invest heavily in storage projects
- California's big three investor-owned utilities required to add 1.3 gigawatts of energy storage to the grid by 2020
- CA law designed to encourage the development of an unprecedented number of
 - Batteries,
 - thermal energy storage, and
 - other forms of grid power and energy capture-and-release technologies;
 - all while adhering to the mandate's requirement that they be "cost-effective"
- Utilities may own no more than half of the storage assets they procure
- Bottom line: Expect growth in deployment of storage devices (mainly batteries – utility scale and residential) and declining costs

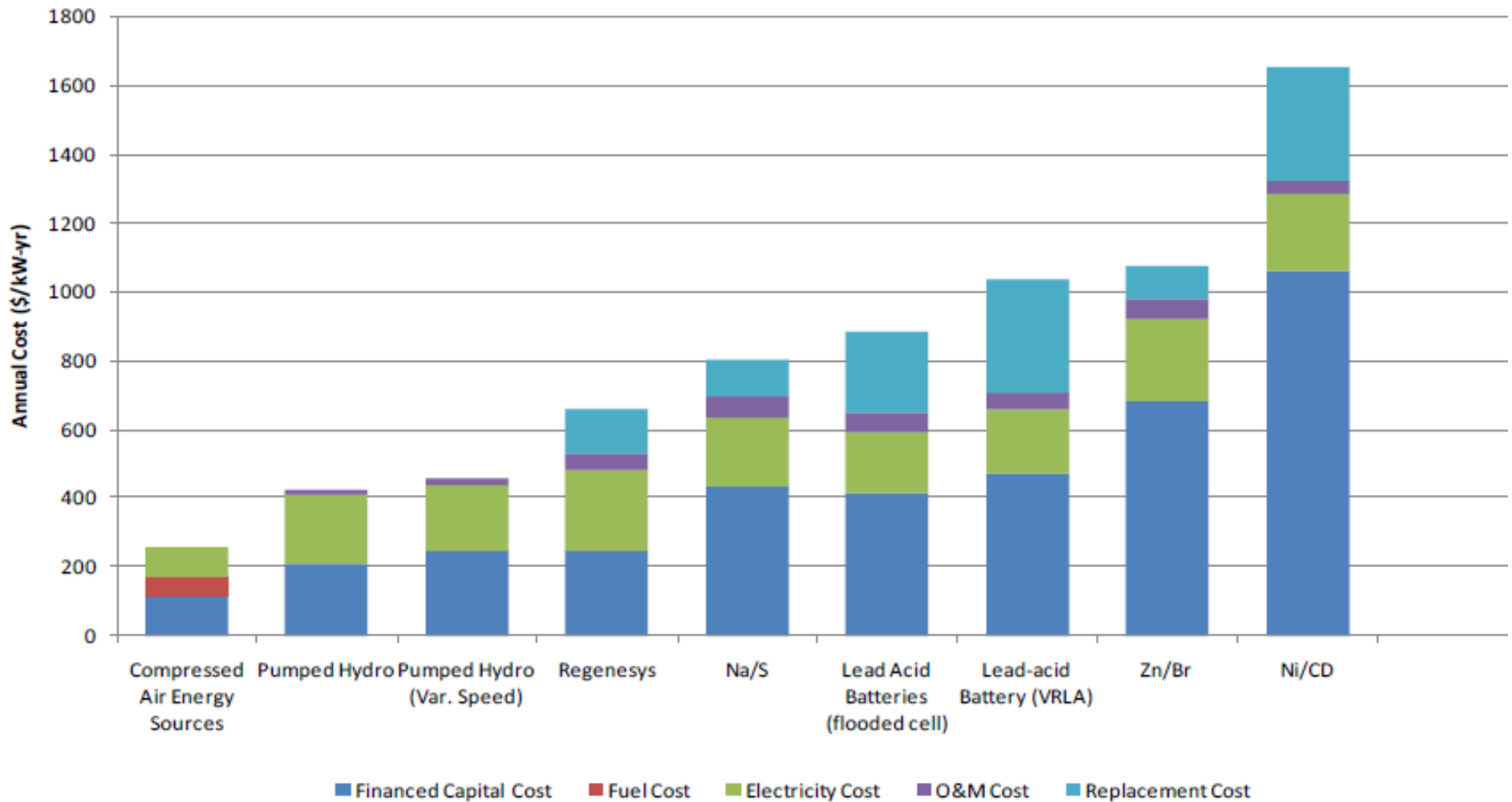
Storage Systems – Capital Cost Comparison

Comparison of Estimated Capital Cost in 2010 US \$/kW- for Technologies Capable of 20 hrs of Storage or Longer



Storage Systems - Life Cycle Cost Comparison

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Batteries Can Help Better Match Load and Solar Profiles

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- Two options for batteries
- Option #1: Put a battery in every home with rooftop solar (e.g. Tesla's Powerwall)
- Option #2: Put larger batteries in neighborhoods
 - Transformers provide a contemporary example
 - 25 kilovolt-amp distribution transformer used to serve about 5 homes
 - Multiple homes share one distribution transformer and benefit from diversity in loads
 - Same concept could be applied to batteries installed to backup rooftop solar
 - Economies of scale
 - Diversity of loads at individual homes

Utility-Scale Battery Systems Example: Snohomish PUD

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- Installed a 1 MW battery storage system built on Modular Energy Storage Architecture (MESA)
- Includes two lithium ion batteries
- Located at a utility substation near the PUD's operations center
- Designed to improve reliability and the integration of renewable energy sources
- \$7.3 million investment from the Washington State Clean Energy Fund
- Additional \$1 million from the Clean Energy Fund
 - partnership with BPA and the UW to optimize the use of energy storage and demand response

Utility-Scale Battery Systems Example: Avista

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- 1 MW Vanadium Redox Flow batteries being used at a \$7 million test project at Schweitzer Engineering in Pullman, WA
- Electricity from the batteries is available almost instantly
- Batteries housed in two rows of metal shipping containers in Pullman's industrial park
- DOE funded research for the batteries at the Pacific Northwest National Laboratory in Richland
- Avista = \$3.8 million investment
- Washington State Clean Energy Fund = \$3.2 million investment
- Avista will call on energy stored in the batteries to level out spikes in demand
 - Batteries will provide backup power to Schweitzer during power outages
 - Replacing backup diesel-fired generators (take 15 min to fire up)

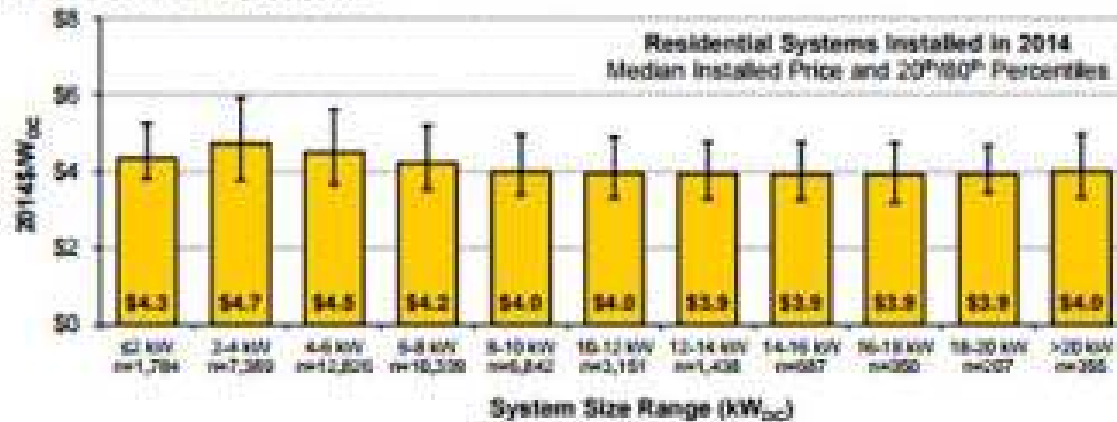
Utility-Scale Solar

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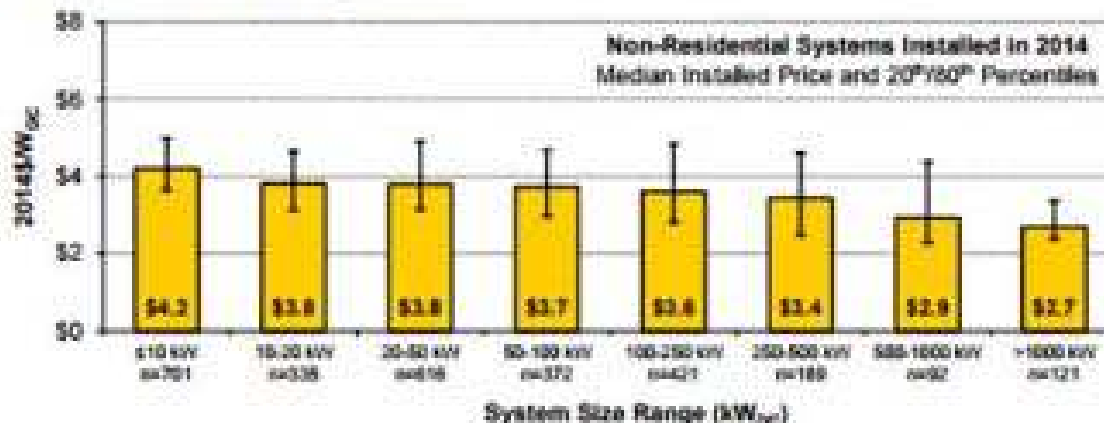
- Utility-scale Solar Example
 - Capacity = 5 MW
 - Capacity Factor = 20%
 - Energy = 1 aMW
 - Capital cost = \$3,100/kW
 - O&M = \$22/MWh (escalates after year 1)
 - Estimated 20-year levelized cost = \$155/MWh

Utility-Scale Solar – Economies of Scale

Residential Systems



Non-Residential Systems



- For residential systems installed in 2014, median prices were roughly 15% lower for 8-10 kW systems than for 2-4 kW systems
- Among non-res. systems installed in 2014, median installed prices were 36% lower for the largest (>1,000 kW) than for the smallest (≤10 kW) non-res. systems
- Even greater economies of scale may arise when progressing to utility-scale systems, which are outside the scope of this report

Wastewater Treatment Plants

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- Wastewater treatment facilities are very energy intensive
- On-site cogeneration engines can be fueled by two biogas fuels:
 - biogas produced from the anaerobic digestion of wastewater sludge and
 - biogas produced from the co-digestion of fats, oils and grease (FOG).
- Cogeneration also provides heat for treatment plant operations
- Investment in a FOG receiving and processing facility required in order to access second source of biogas
- FOG benefits
 - Diverts fats, oils and grease at their source (e.g. restaurant and food processors) before they get flushed into the wastewater collection system
 - County could avoid significant collection system cleanout costs
 - Tipping fees FOG haulers pay to the county could result in a significant revenue stream
- Combining biogas-fueled generation with energy efficiency investments can result in net-zero energy consumption for treatment plants
- San Juan County: Friday Harbor wastewater treatment plant and 5 sewage plants
- Estimated 20-year Levelized Cost = \$80/MWh

Anaerobic Digesters (Farm Manure)

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- Animal waste management is crucial factor in protecting water quality
- Animal waste has high levels of nitrogen, phosphorous, potassium, and bacteria
- Collecting manure and transporting to a generating plant would help farmers adhere to regulations and could reduce farmers overall compliance costs
- An estimated 50,000 lbs of manure is produced each year by livestock (llamas, sheep, horses and cattle) in San Juan county
- A project would protect water quality and provide local renewable generation
- Generation would use reciprocating engines
- Capital costs
 - \$3,200 to \$3,700/kW for 500 kW and greater systems
 - Higher costs for smaller systems: \$4,300 for 250-500 kW and \$7,000 for 50-250 kW
- Estimated 20-year Levelized Costs
 - \$60/MWh for 500 kW and greater systems
 - Smaller systems: \$67/MWh for 250-500 kW and \$95/MWh for 50-250 kW

Landfill Gas Projects

- There are currently no landfills in San Juan county
- The last of the landfills in the county was closed in the mid 1990s due to new regulations that would have required costly upgrades
- All solid waste/garbage is currently shipped to the mainland
- The county should re-consider locating landfills in the county
- Retired landfills would have to be upgraded in order to meet current regulations
- Cost of upgrades should be weighed against the benefits
- Benefits would include
 - local landfill gas generation that would help the county become more sustainable
 - reduced costs and CO2 emissions associated with transporting garbage to mainland
- Estimated 20-year Levelized Costs: \$98/MWh

Biomass – Woody Debris

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- Biomass generating projects fueled by woody debris typically
 - Burn forest waste
 - Sell the heat (e.g. manufacturing process, greenhouses)
 - Sell the electricity to local utility
- Dead woody debris is moderately high in places in the county and would carry a fire if left unattended (per 2012 county wildfire risk assessment)
- Generating projects can be relatively small (1 to 2MW)
 - BPA power contract allows up to 1 MW “behind the meter”
- Can be ramped up and down
 - can be used to serve peak loads and reduce BPA demand costs (akin to demand response)
- Concerns that woody biomass generation results in increased GHG emissions
 - EPA says impact is likely minimal to no net atmospheric contributions of biogenic CO₂ emissions or even reduce impacts compared to alternate fate of disposal
- Estimated 20-year Levelized Cost = \$64/MWh

Small Hydro: Gravity-Fed Water Pipes

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- Lucid Energy has designed the first hydroelectric system designed to harness the energy in gravity-fed drinking water pipes
 - Energy generated as water flows through turbines integrated into water pipes
- High capacity factor: generates energy 24 hours a day
- No environmental impact
- Pilot program with the city of Portland and PGE
- The company is currently negotiating agreements with several cities