Orcas Power & Light Company

Resource Plan Update
September 23, 2015

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Agenda

- 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

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

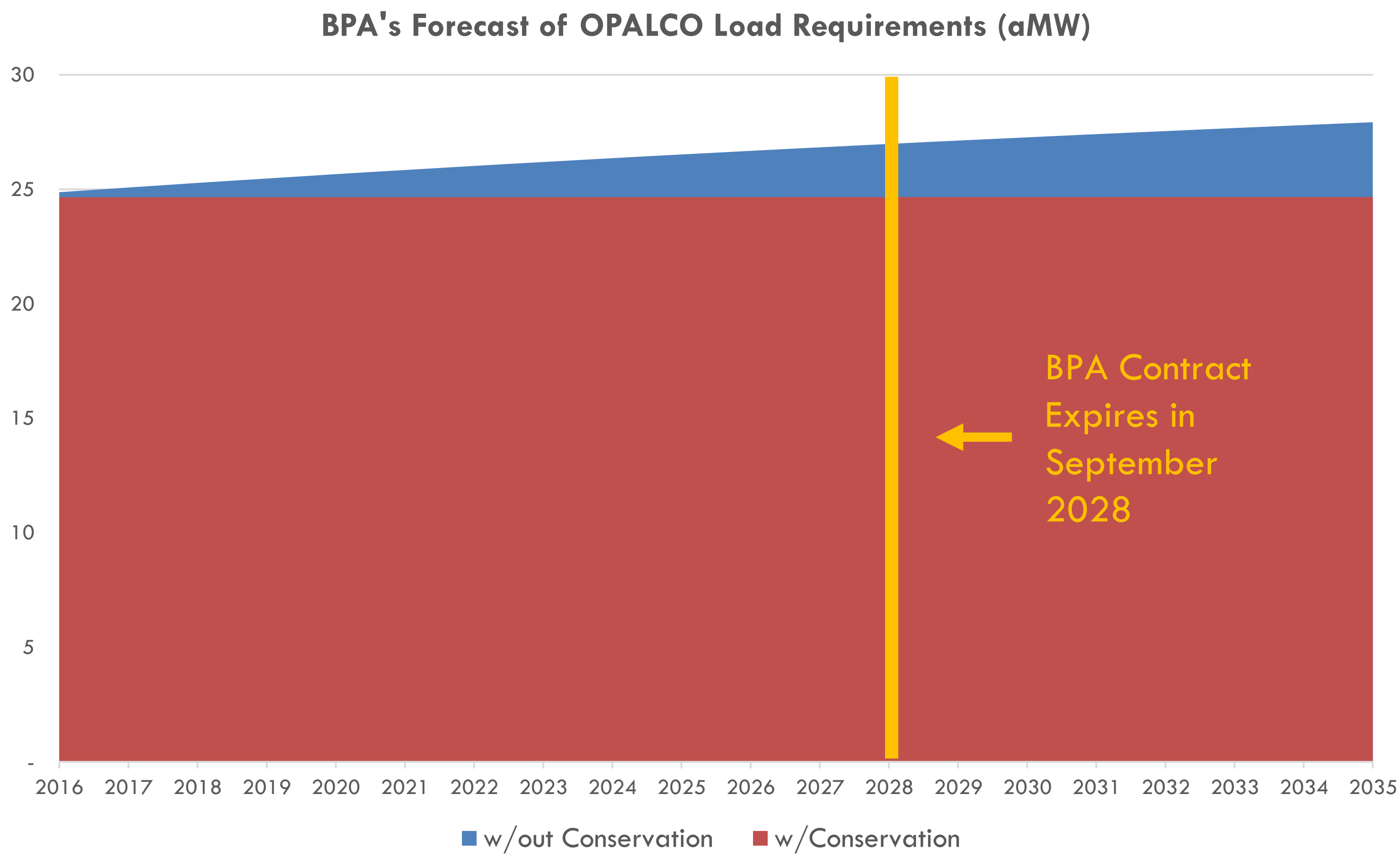
Review Resource Planning Objectives

- 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 <u>price</u> or <u>commodity</u> 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)

- 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



Conservation is the first resource deployed

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 it's HWM).

Conservation/EE Update (cont'd)

- 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

35 New or Revised Standards

WA State Energy Code

Market Transformation

New Data Developed by RTF

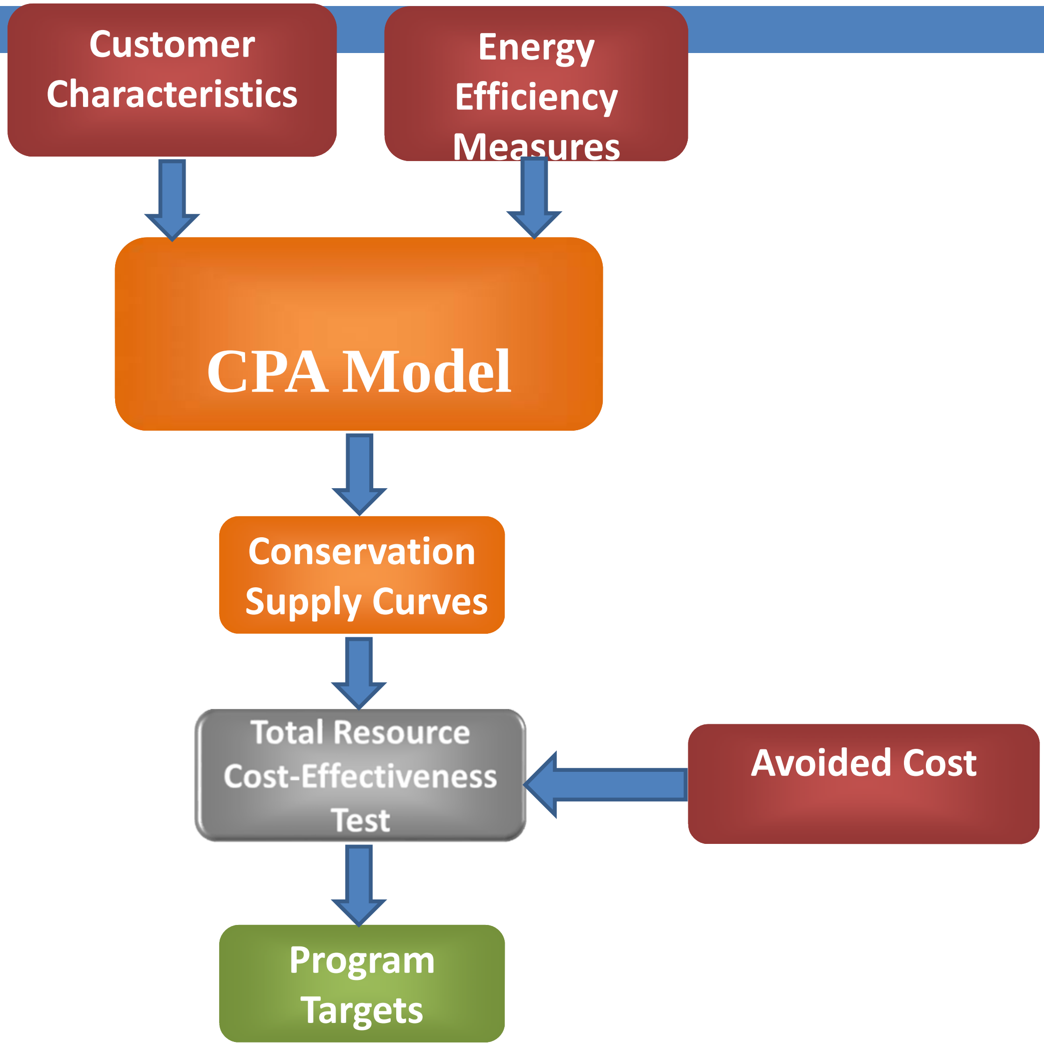
Updated Baselines

New Measures

Measure Removals

Regional C/E Potential 24% Lower

CPA Model


Customer Characteristics
Energy Efficiency Measures
CPA Model
Conservation Supply Curves
Total Resource Cost-Effectiveness Test
Avoided Cost
Program Targets

Conservation Potential Analysis Comparison

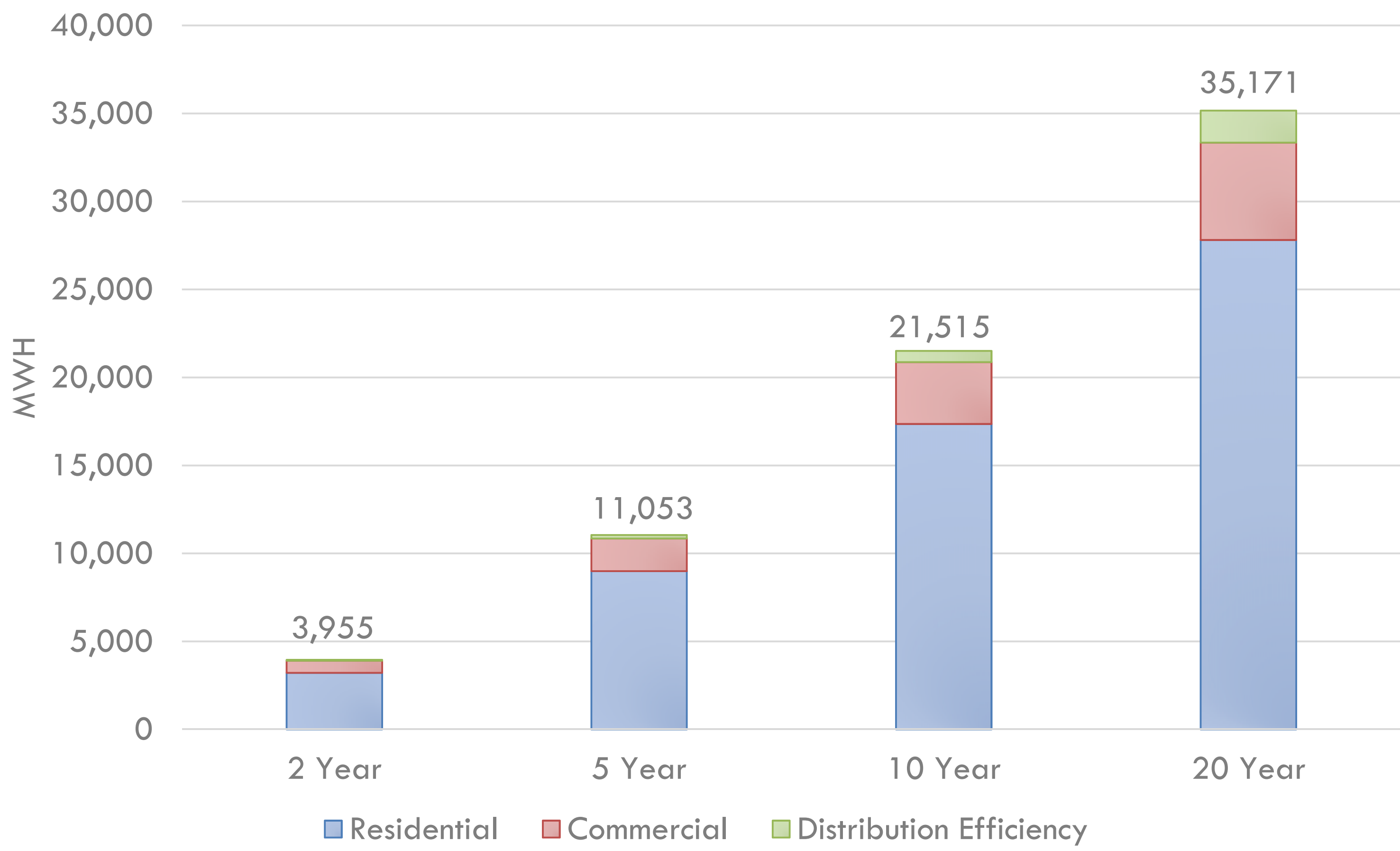
2013 CPA
67,000 MWh

48%

2015 CPA
35,200 MWh

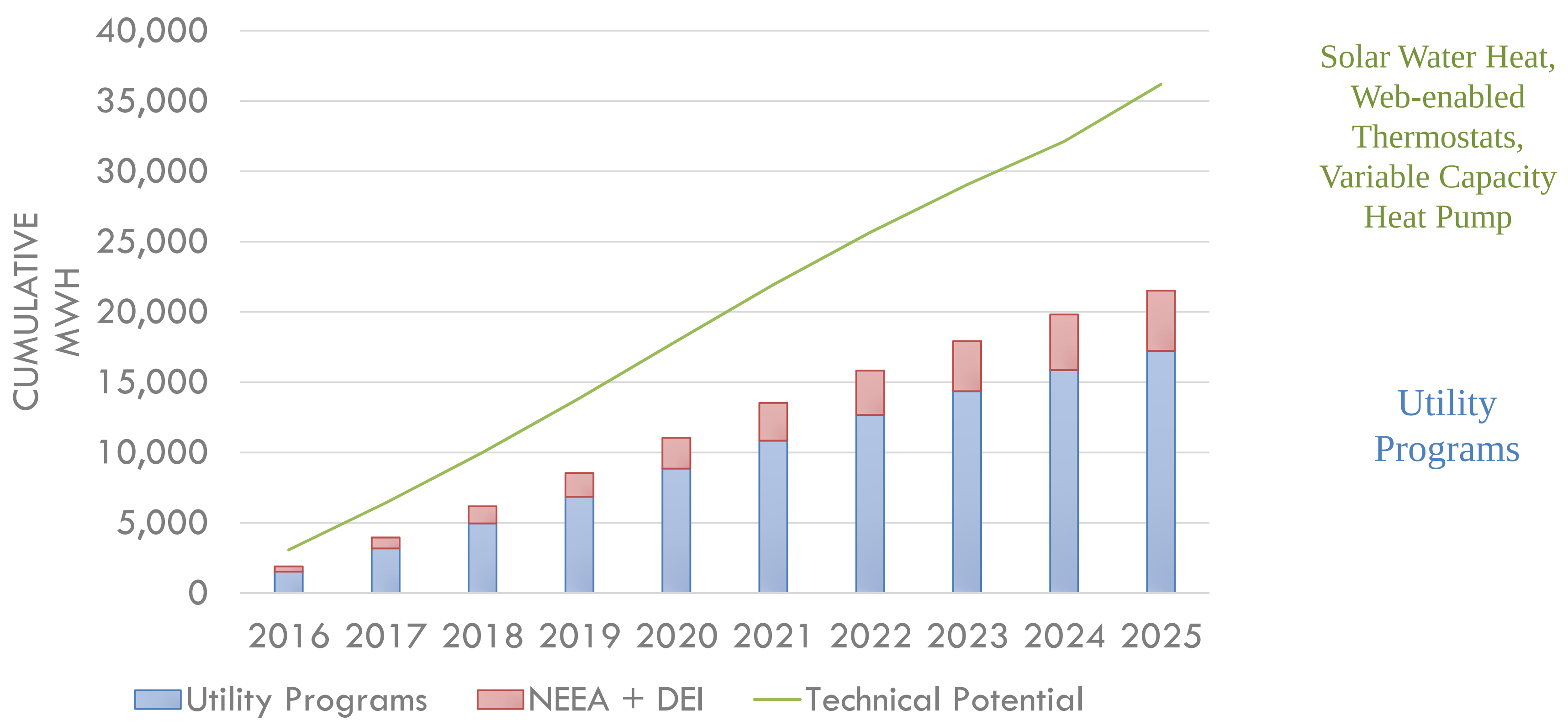
Decrease primarily due to change in code changes and appliance standards.

2015 CPA Results



Note: MWhs shown above are cumulative.

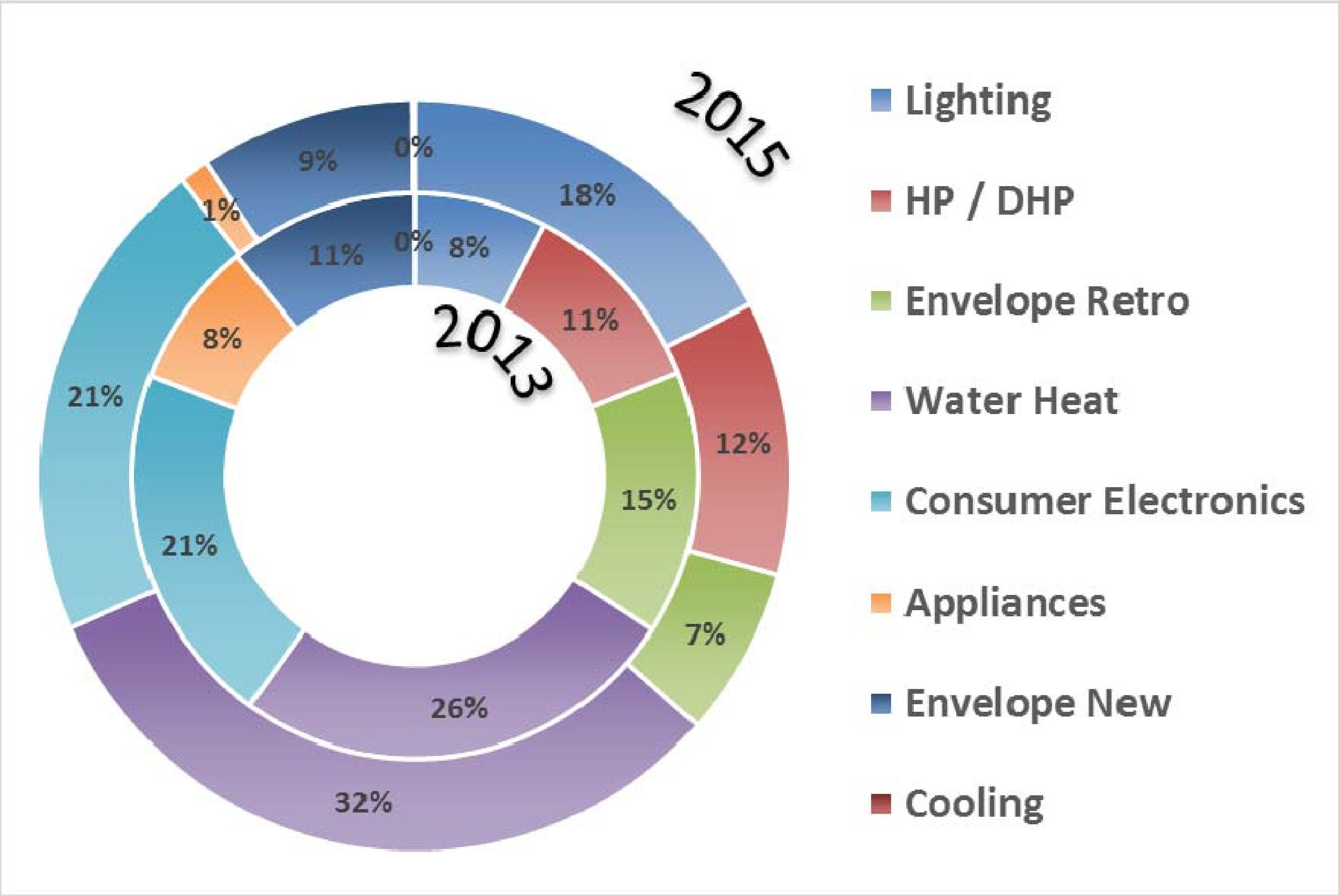
10-Year Program Potential



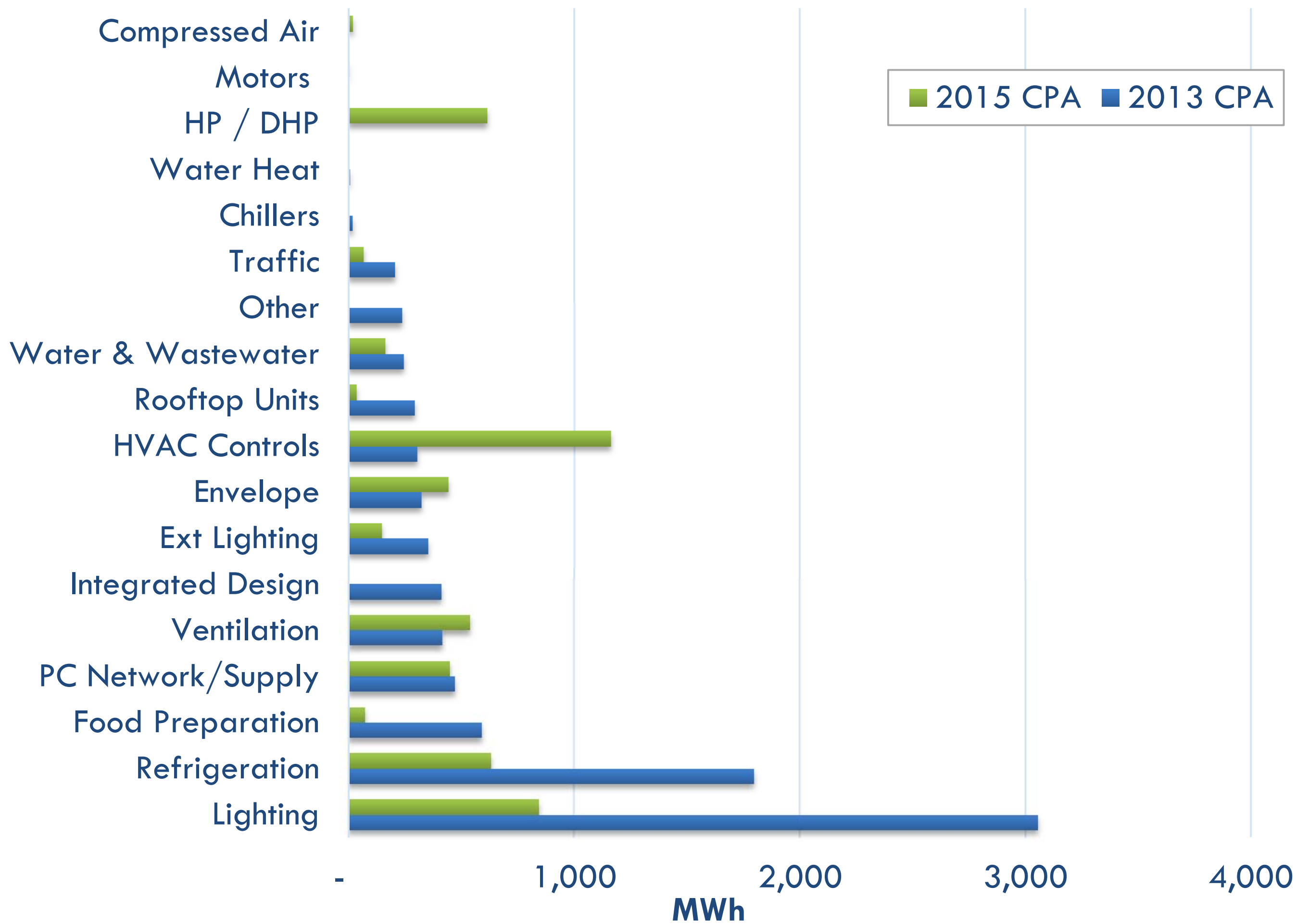
NEEA = Northwest Energy Efficiency Alliance
DEI = Distribution Efficiency

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

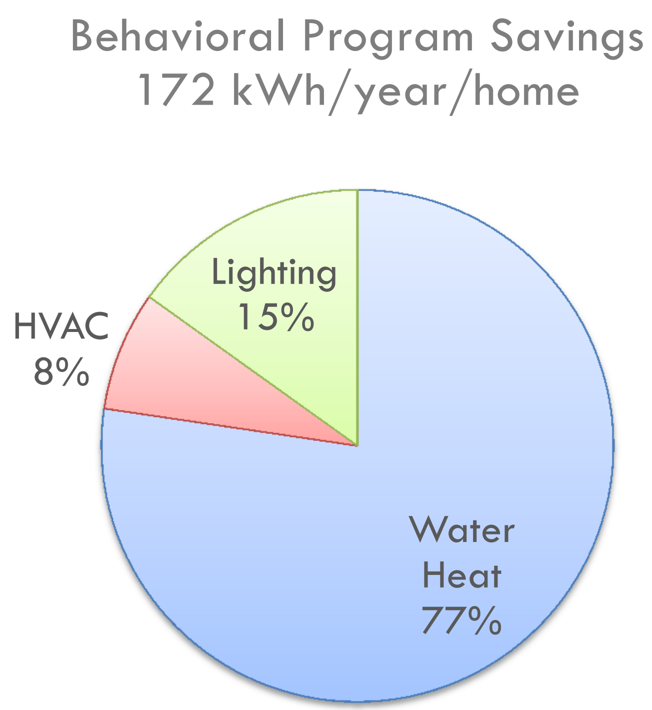


New Cost-Effective Measures

- **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

- 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



Based on regional estimates.

Summary

- **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

- 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)

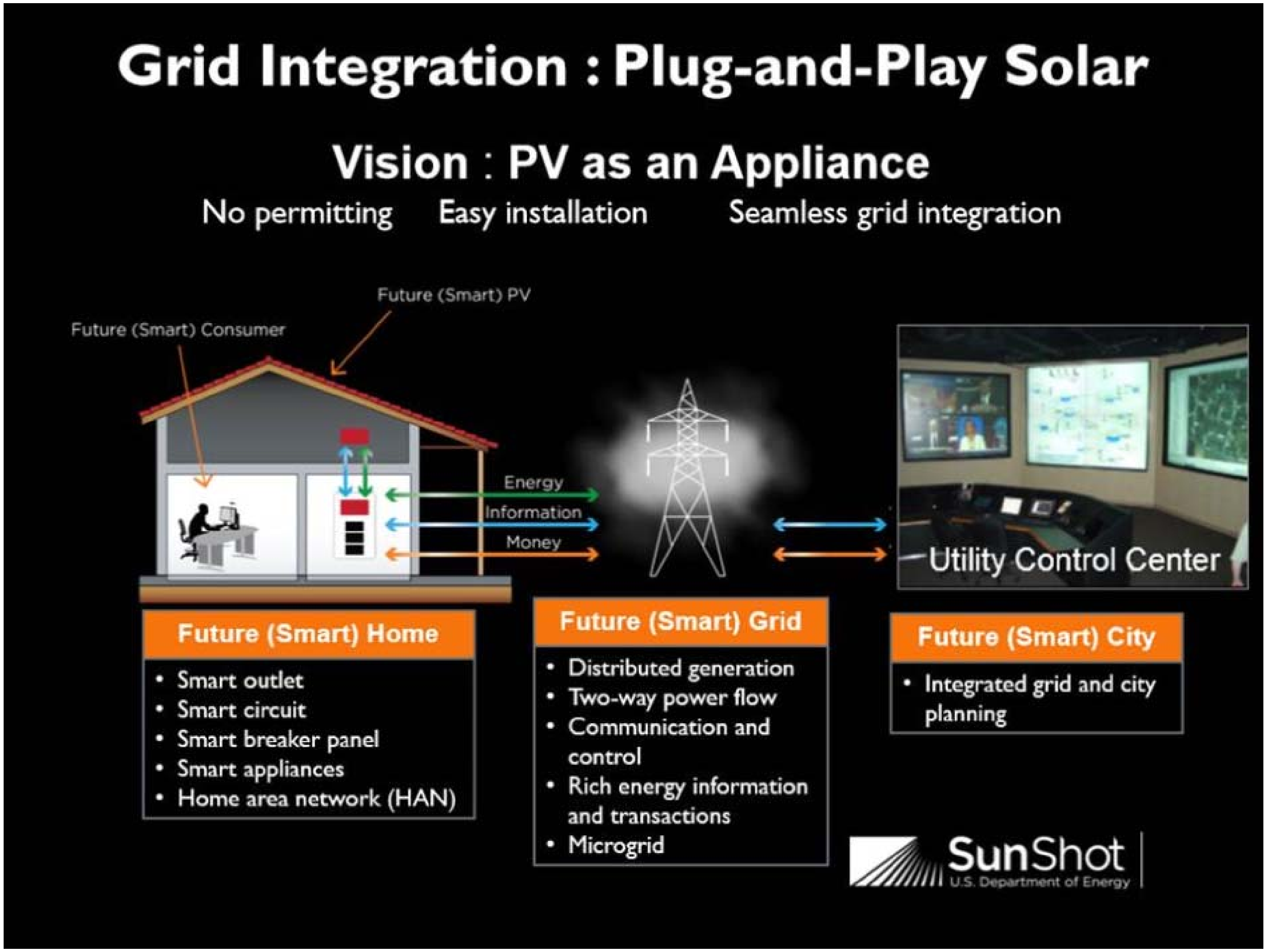
Strategic Partners - NRU

- 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



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.

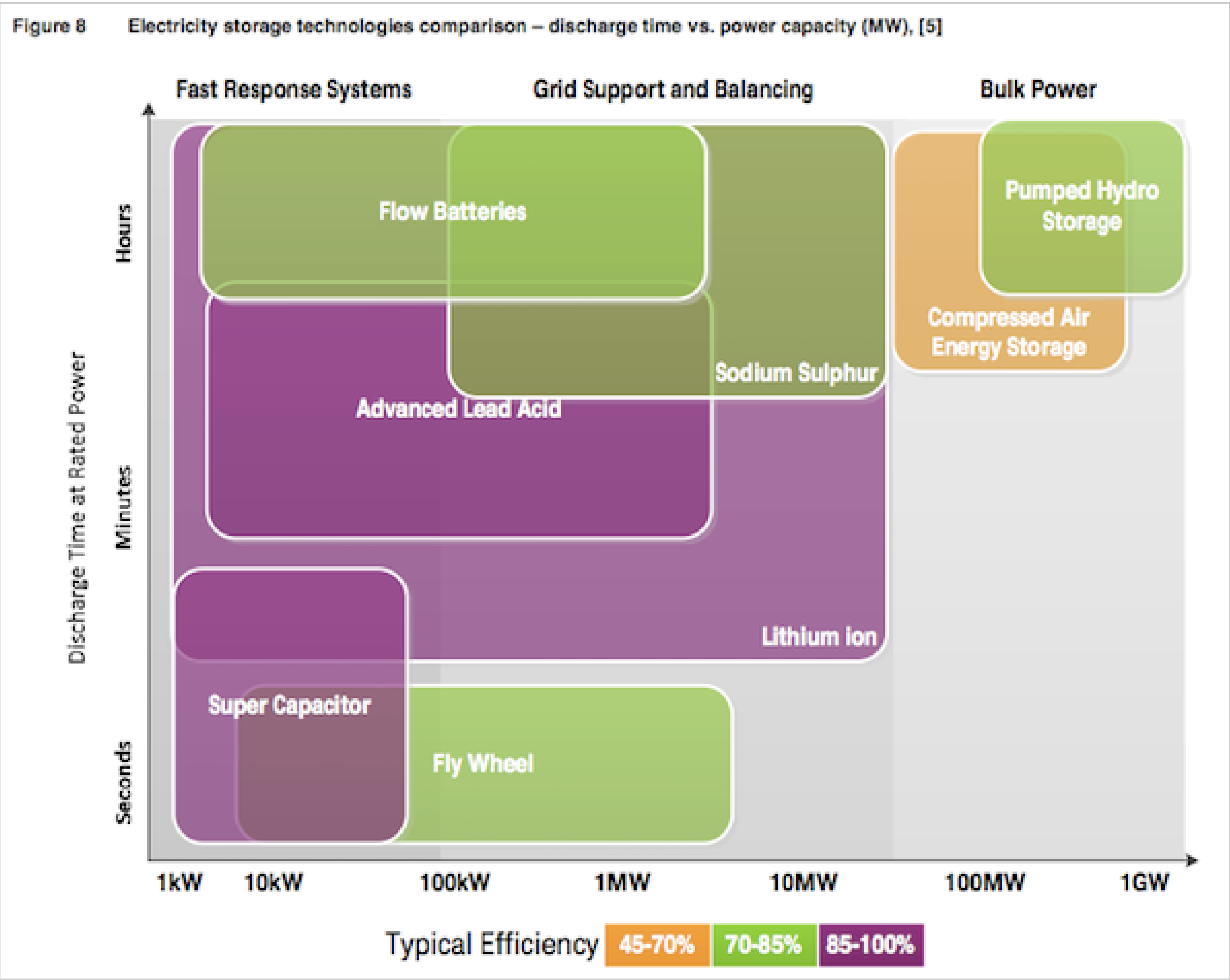
Smart Inverters/Grid (cont'd)

- 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



<u>OPALCO Demand Notes:</u>

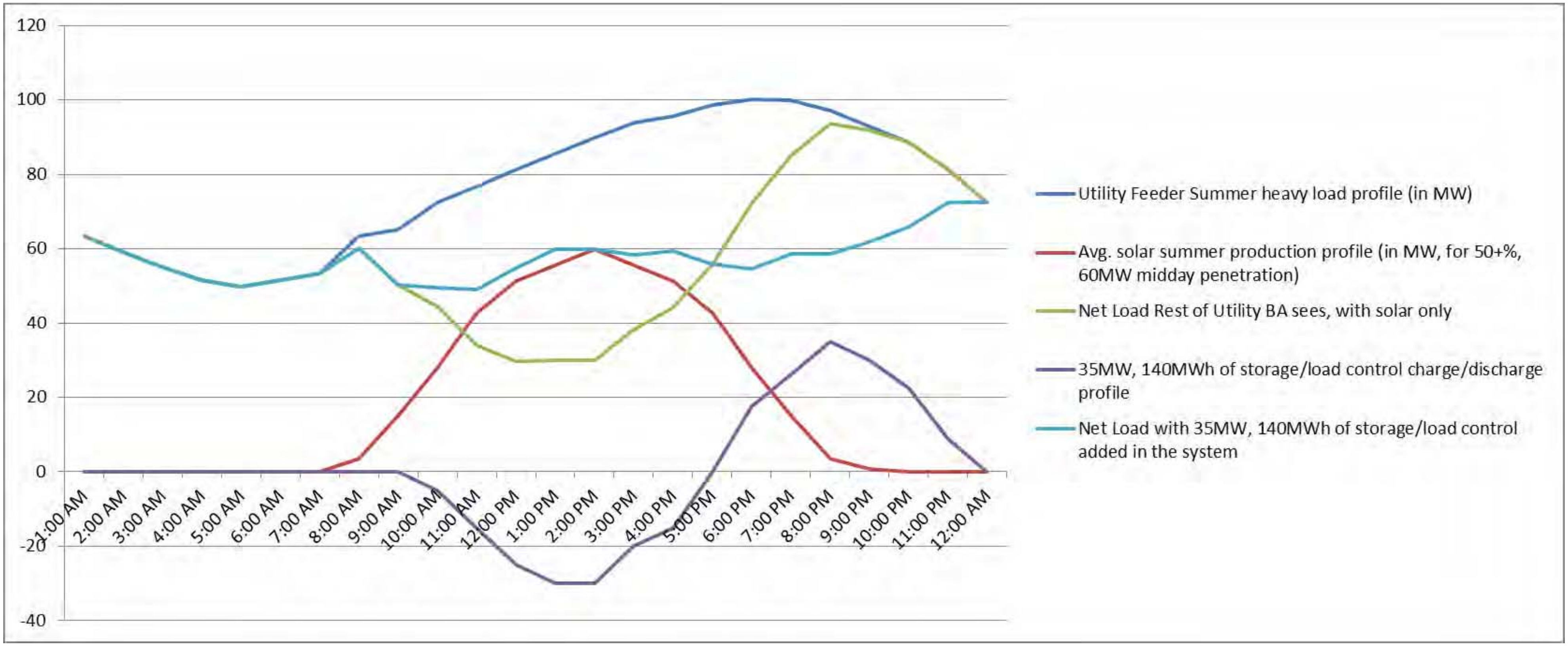
- Historic Peak ≈ 75 MW
- BPA Monthly Billing Determinants ≈ 1 to 11 MW
- No savings for peak shaving beyond BPA billing determinants
- BPA Monthly Demand Rates = \$6.57/kW to \$12.16/kW
- 1 MW decrease in all months = \$120K in annual savings

Utility-Scale Battery Systems

- Storage systems currently not cost effective (utility-scale and smaller)
  - BPA demand rate ≈ \$10/kW-mo
  - Lifecycle costs of pumped storage ≈ \$30/kW-mo
  - Lifecycle cost of flow battery ≈ \$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)

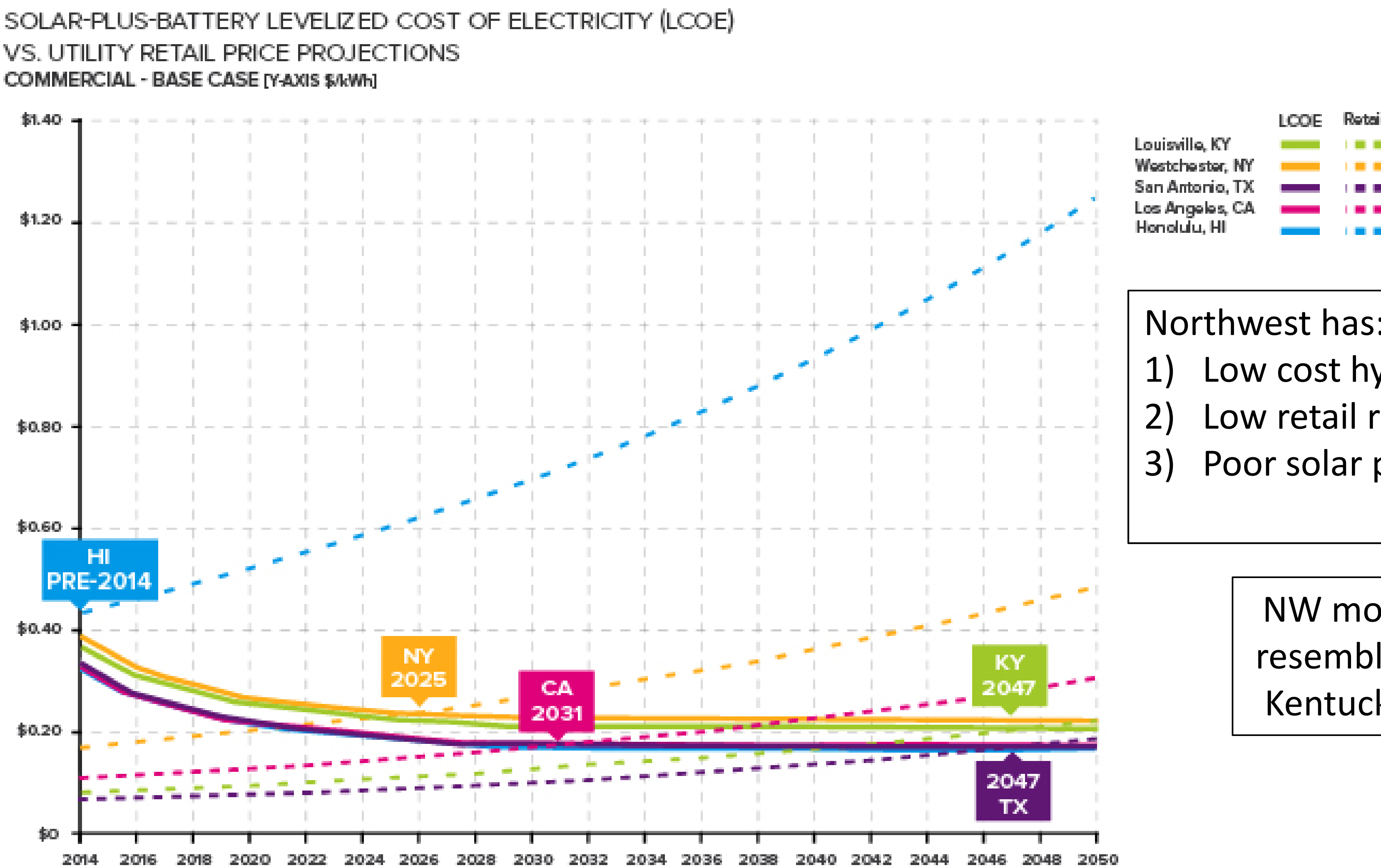
Utility-Scale Battery Systems (cont'd)

- 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



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?

- 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)

- **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
  - 7^{th} 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)

- **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)

- **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)

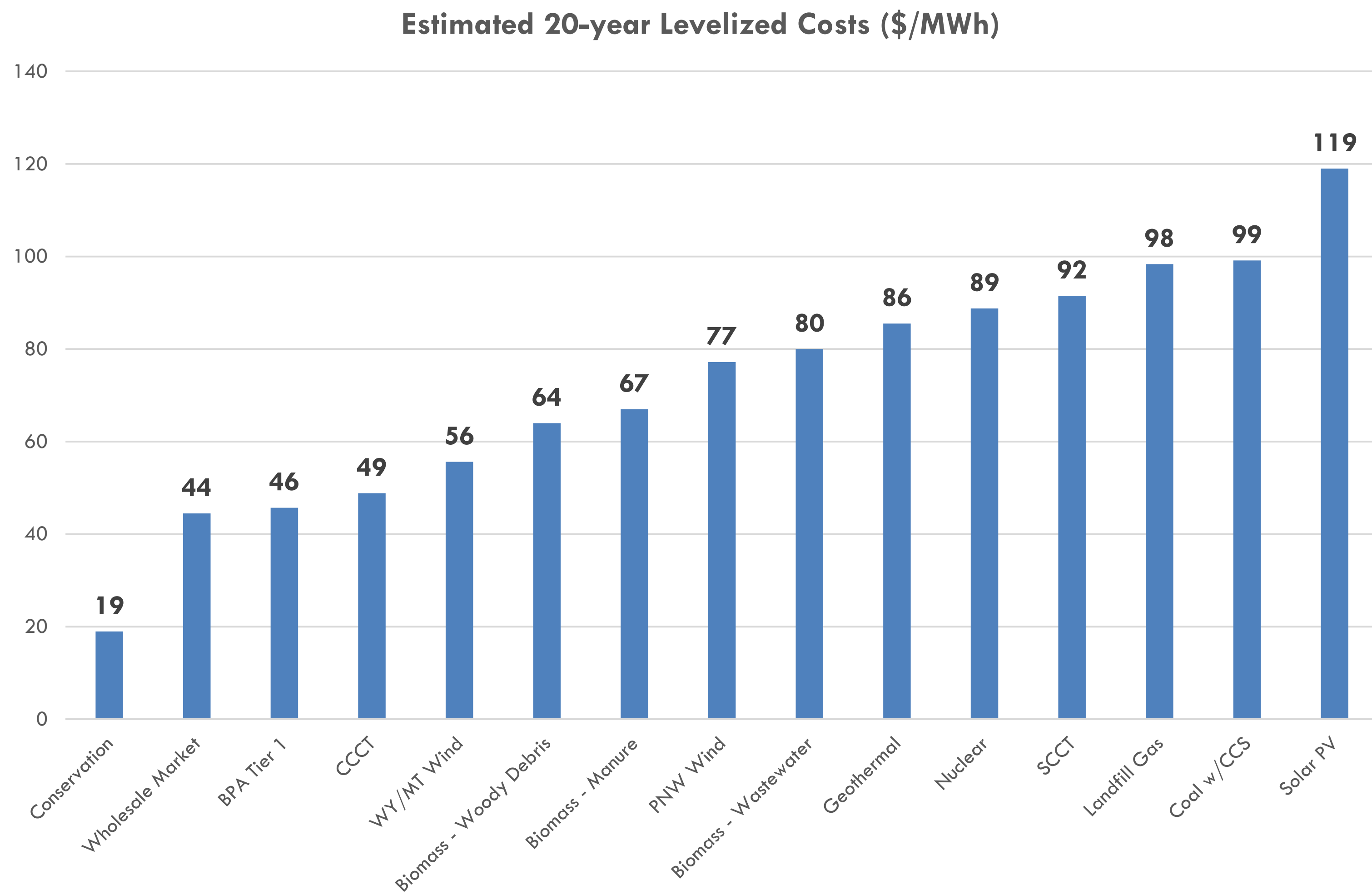
- **Future Resources:** In the interest of self-sustainability and resource diversity OPALCO should consider:
  - Utility-scale solar
  - Battery storage system
    - Complement utility-scale solar and provide backup in the event of a transmission contingency
  - Cogeneration at wastewater treatment 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

- **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)

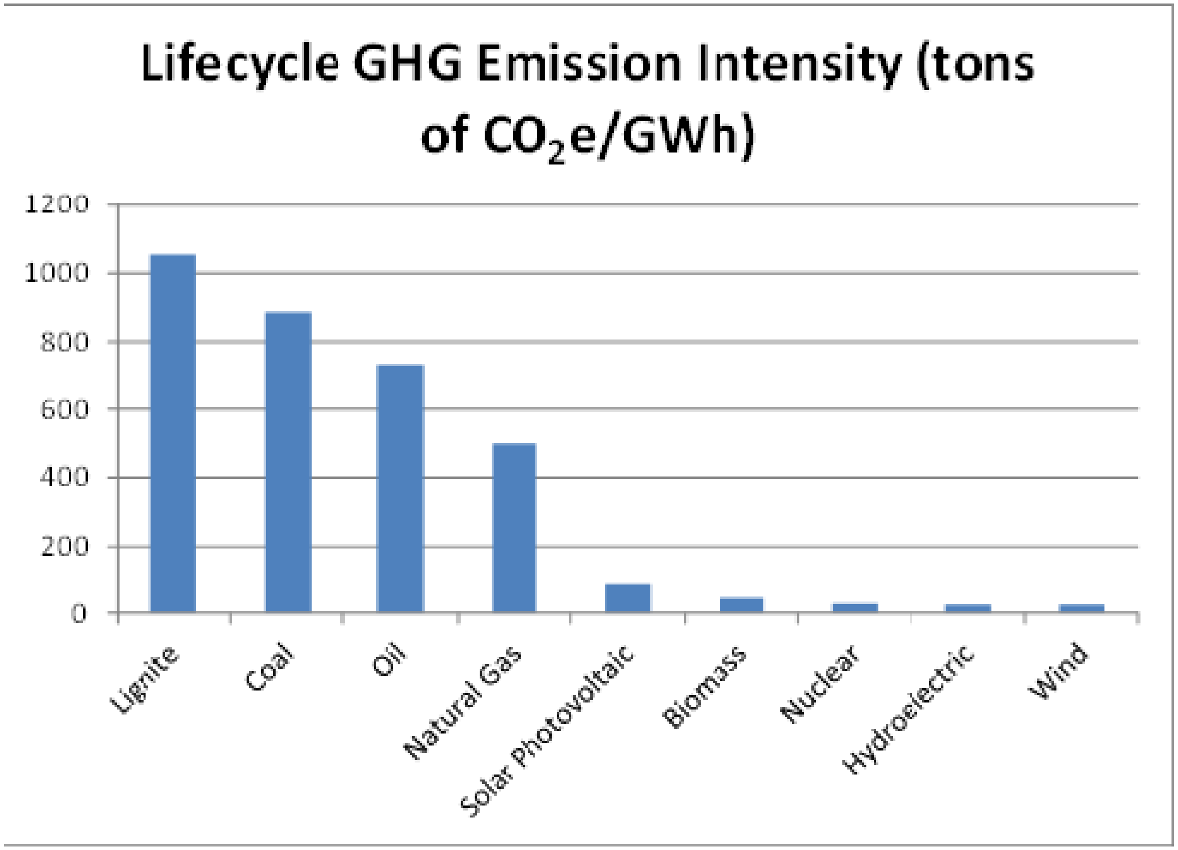
Appendix – Backup Slides

Resource Screening



Life-cycle costs

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



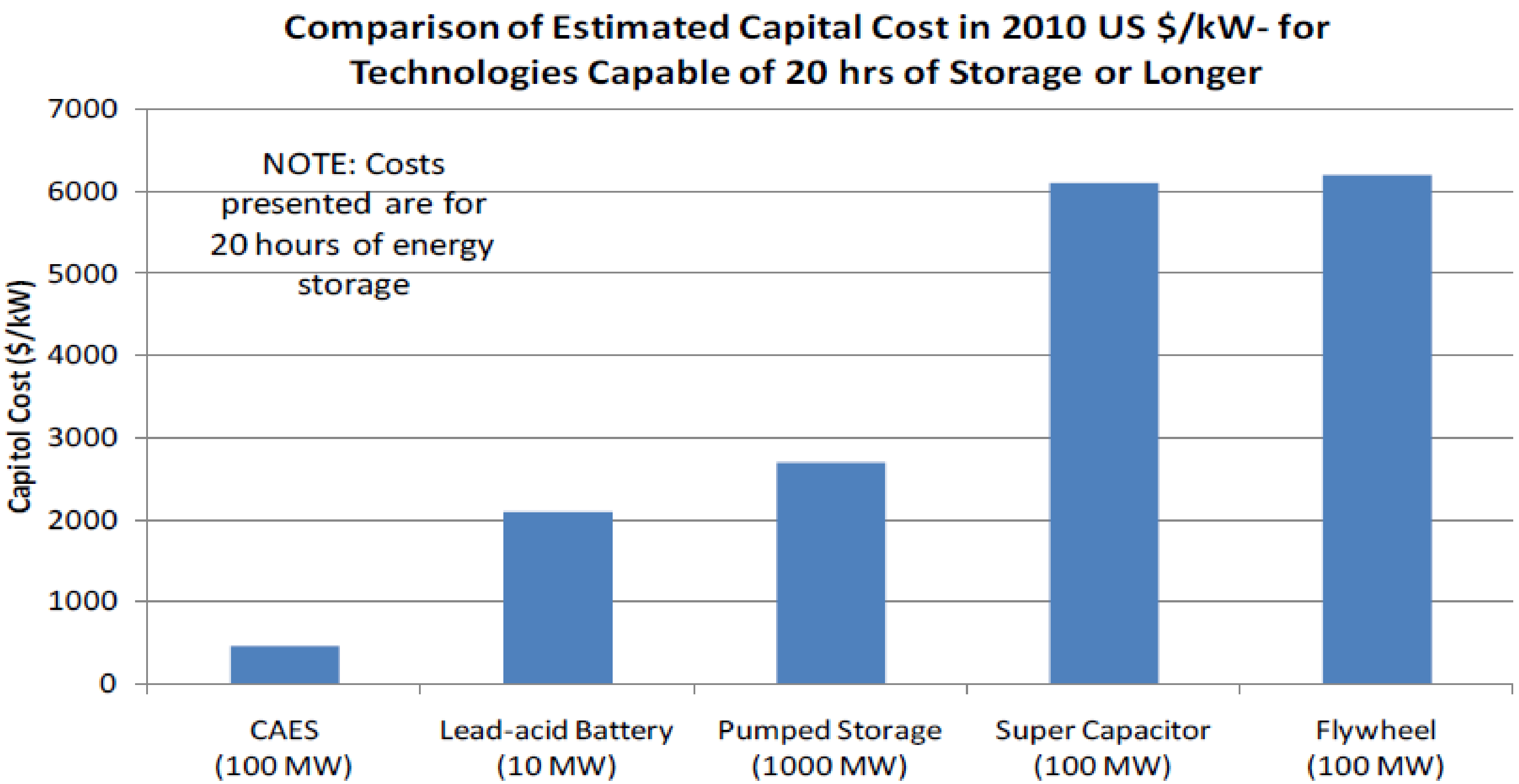
Local Resource Opportunities

- 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

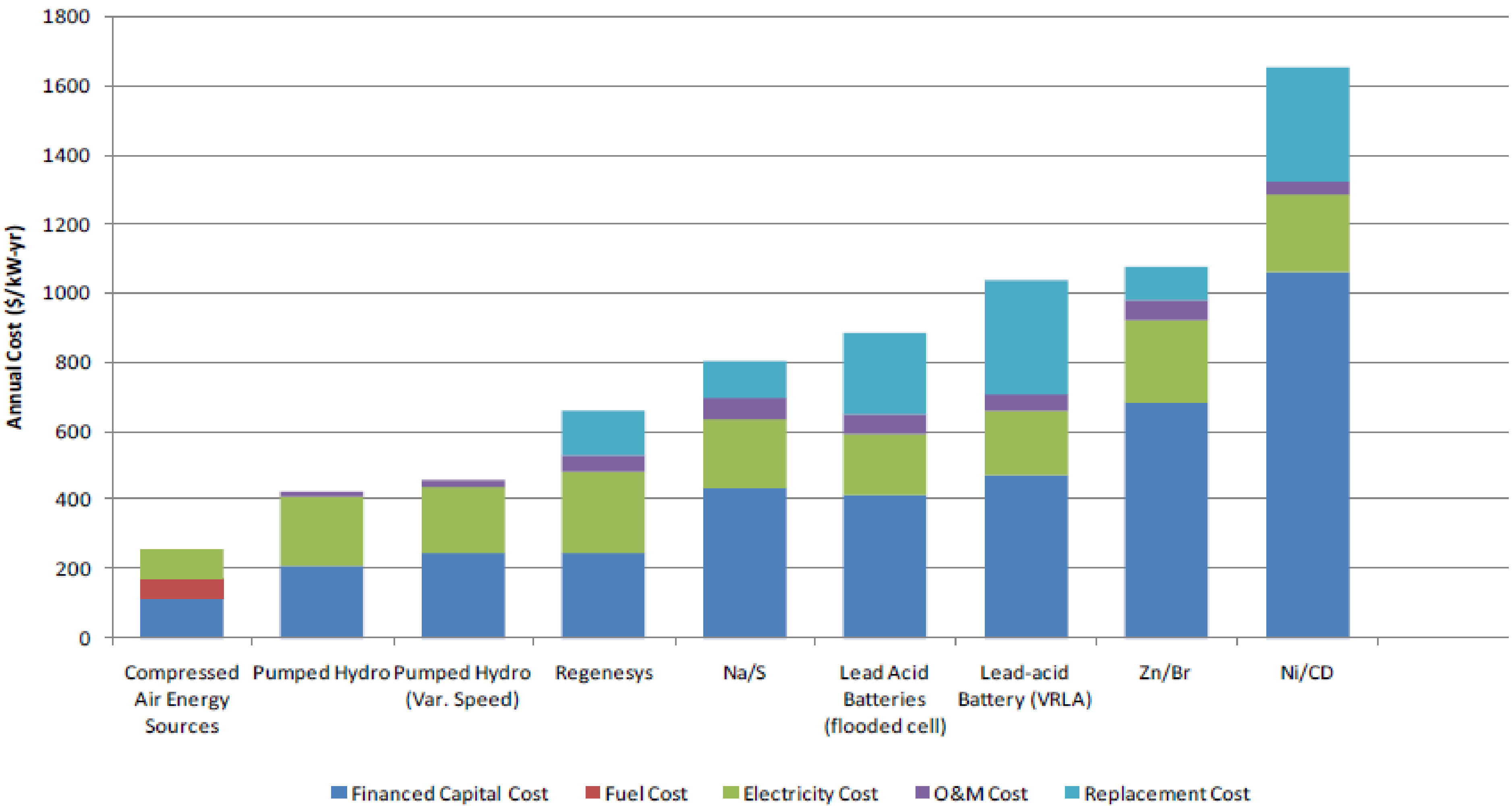
Storage Projects

- 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



Storage Systems - Life Cycle Cost Comparison



Batteries Can Help Better Match Load and Solar Profiles

- 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

- 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

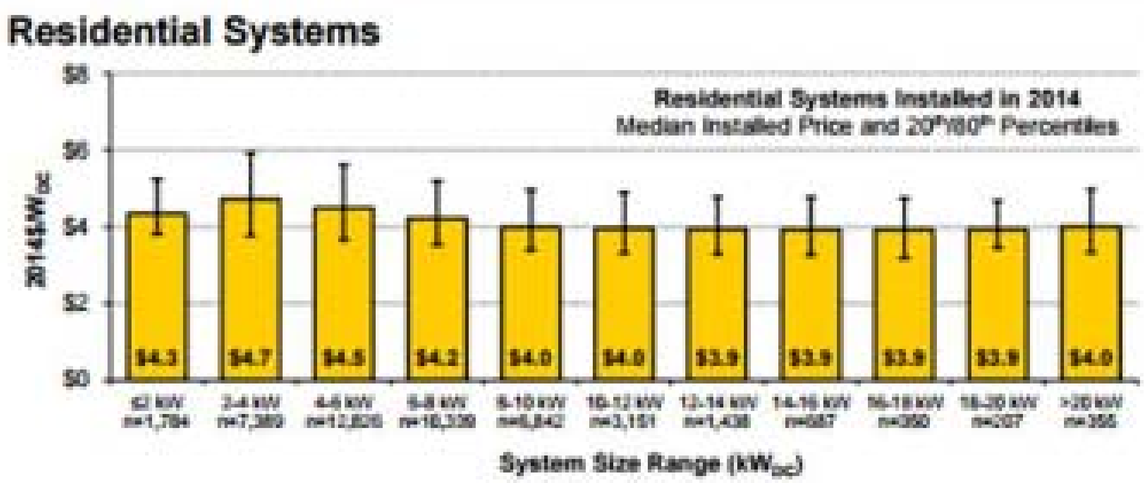
Utility-Scale Battery Systems Example: Avista

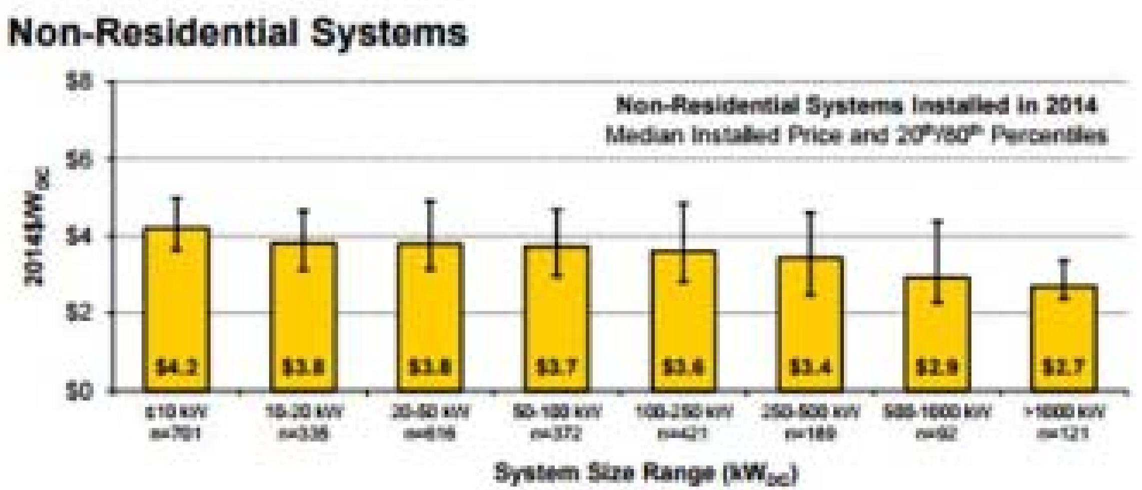
- 1 MW Vanadium Redox Flow batteries being used at a $7 million test project at Schweitzer Engineering in Pullman, WA
- Electricity from the batteries is available almost instantly
- Batteries housed in two rows of metal shipping containers in Pullman's industrial park
- DOE funded research for the batteries 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

- 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





- 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

- 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 plan 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)

- 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 CO_2 emissions associated with transporting garbage to mainland
- Estimated 20-year Levelized Costs: $98/MWh

Biomass – Woody Debris

- 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

- 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