**Special Meeting**

July 16, 2019

CONVENE SPECIAL MEETING – 8:00 a.m. – Commission Meeting Room

The Board of Commissioners of Public Utility District No. 1 of Snohomish County, Washington, will hold a SPECIAL MEETING on TUESDAY, July 16, 2019, in the Commission Meeting Room located in the District Headquarters Building, 2320 California Street, Everett, Washington. The SPECIAL MEETING will convene at 8:00 a.m. for a Workshop to Discuss Future Initiatives of the Utility. It is anticipated the SPECIAL MEETING will adjourn at approximately 5:00 p.m.

ADJOURNMENT

Agendas can be found in their entirety on the Snohomish County Public Utility District No. 1 web page at www.snopud.com. The public is invited to attend. Parking and meeting rooms are accessible for persons with disabilities. Contact the Commission Office at 425.783.8611 for special accommodations or additional information.
UTILITY OF THE FUTURE

Commission Workshop
7/16/19
Agenda

• Introduction
  – SnoPUD Utility of the Future
  – PUD Mission and our Vision of the Future
  – Customer + Grid of the Future
  – Why make changes?
  – Value to our Customers
  – Action Plan: How we’ll make it happen

• Initiatives & Programs
  – DER Initiative
  – EV Initiative
  – Solar
  – Customer-scale Battery Storage
  – Demand Management

• Enabling Technologies
  – Grid-scale Battery Storage
  – Smart Grid Controls & AMI

• Customer Experience
  – Customer Self-Serve
  – Customer Experience
Snohomish PUD Mission

We deliver affordable power and water to our customer-owners in a safe, environmentally sustainable and reliable manner while successfully navigating complex change in our industry.

We accomplish this by empowering our teams to provide quality service to our community, prudently managing costs while investing for the future, and striving to improve every day.
Energizing Life In Our Communities

In the PUD’s Vision of the Future, We...

- Address the evolving energy uses, distributed resource flexibility and optimization, and carbon reduction needs of our customers and the District amidst disruptive environmental, social, and technological change in the electric industry.
- Collaborate with District, customer, and community to evaluate strategic alternatives and drive policy, programmatic, and technical solutions that benefit all stakeholders.
- Support increased distributed generation, microgrids, and islanding capabilities.
- Enable more customers to achieve net-zero or participate in clean and renewable initiatives.
- Flexibly meet demand for electric vehicle load with low carbon electricity.
- Provide more customer options for energy savings and value for distributed and flexible generation and storage.
- Facilitate load shifting, peak mitigation in partnership with our customers.
Customer of the Future

Expectations

- Seamless customer experience (consistent, effortless, intuitive)
- Easy-button self-service
- Pro-active notifications
- Personalized products and services that:
  - Automate or streamline energy savings (mobile apps, smart devices)
  - Enable me to generate my own electricity (solar, storage)
  - Support my connected home through the latest technology
  - Enable me to collaborate with other customers (community solar, friendly competition)

[Links to additional resources]

Grid of the Future
Deloitte’s Future Utility Customer

Energy Consumer Segmentation

- Licensed from Acxiom as part of our residential customer demographics data package
- Assigns customers into one of 13 consumer segments based on critical household energy buyer capacities, attitudes, and behaviors
- Starting point for understanding how customers may respond to specific new programs and services based on:

**Means**
- How much capital and associated savings capacity does a household possess?
- How much of that capital might a consumer commit to “green”?

**Motives**
- How do behind-the-meter impacts align with consuming behaviors around energy-intensive household assets (houses, cars)?
- Will a household’s propensity to leverage technology play into their adoption decision?

**Opportunities**
- Will consumers have the time, money and focus to explore and act on new offers?
- Do their situations create other demands on these personal resources that crowd out new access?
Energy Consumer Segments at the PUD

**GREEN INVESTORS**
Upper income, middle-age families dominated by high-earners and growing new wealth with high economic stability. Capacity to invest, green minded, and technology early adopters. Most likely DER participants.

**PRAGMATISTS**
Savers, doers, tech adopters. Living the upper-middle class family life. Many in their core earning years, with dual incomes, or with elder parents in the home. Not the earliest of adopters, but will invest, participate, and be hands-on.

**PAYBACK INVESTORS**
Mature families and couples with accumulated wealth and sustained financial investment. Capacity to invest, green minded, but biased against new technology adoption.

**CREATURES OF COMFORT**
Healthy and stable upper-middle class earnings. Living relatively larger on those paychecks than any other cluster. Biased against technology and green participation.
<table>
<thead>
<tr>
<th></th>
<th>Green Investors</th>
<th>Pragmatists</th>
<th>Payback Investors</th>
<th>Creatures of Comfort</th>
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<tbody>
<tr>
<td><strong>Age</strong></td>
<td>36-55</td>
<td>56-65</td>
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<tr>
<td><strong>Income</strong></td>
<td>$150,000+</td>
<td>$125,000 - $150,000</td>
<td>$150,000+</td>
<td>$60,000 - $70,000</td>
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<tr>
<td><strong>Net Worth</strong></td>
<td>$2,000,000+</td>
<td>$250,000 - $500,000</td>
<td>$2,000,000+</td>
<td>$50,000 - $100,000</td>
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<tr>
<td><strong>Education</strong></td>
<td>college or grad school</td>
<td>college</td>
<td>college or grad school</td>
<td>high school or college</td>
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<td><strong>Home Type</strong></td>
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<td>38% house w gas heat</td>
<td>52% house w gas heat</td>
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<tr>
<td></td>
<td>26% house w elec heat</td>
<td>31% house w elec heat</td>
<td>33% house w elec heat</td>
<td>28% house w elec heat</td>
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<tr>
<td></td>
<td>7% condo</td>
<td>12% apartment</td>
<td>11% condo</td>
<td>7% condo</td>
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<tr>
<td><strong>eBill</strong></td>
<td>33%</td>
<td>28%</td>
<td>25%</td>
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<tr>
<td><strong>Payment</strong></td>
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<td>●</td>
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<tr>
<td><strong>Investment Capacity</strong></td>
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<td><strong>Tech Propensity</strong></td>
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<tr>
<td><strong>Comfort Consumption</strong></td>
<td>●</td>
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</tbody>
</table>
Example: Propensity to Purchase an EV

23,000 customers most likely to purchase an electric vehicle this year

75% are Green Investors
• Income >$150,000
• Net worth >$2,000,000
• Highly educated
• Married with children
• Age 46-55
• 80% single family with gas heat
• 84% pay bill electronically
• 40% get an eBill

20% are Payback Investors
• Income >$150,000
• Net worth >$2,000,000
• Highly educated
• Married with no children at home
• Age 56-65
• 73% single family with gas heat
• 69% pay bill electronically
• 73% get a paper bill
## Current Electric Vehicle Registrations

<table>
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<th>Year</th>
<th>Growth</th>
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<td>2015</td>
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<tr>
<td>2016</td>
<td>2,150</td>
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<tr>
<td>2017</td>
<td>2,952</td>
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<tr>
<td>2018</td>
<td>4,486</td>
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<tr>
<td>2019</td>
<td>4,996</td>
</tr>
</tbody>
</table>
Most Likely to Purchase an EV

23,250 customers

Legend:
- Green Investors
- Payback Investors
Existing Solar Installations

1,970 customers

Legend:
- **Residential**
- **Commercial**

Sized by name plate capacity
Known Smart Thermostats

1,860 customers that have received a rebate
Known Battery Back-up Systems

41 battery + solar customers
Growth of Flexible Load - Nationwide

Cumulative potential for behind-the-meter residential flexibility

Source: Wood Mackenzie Power & Renewables, Residential Flexibility Potential in the U.S.
Value Proposition to the Customer

Reliability & Resiliency
- Reduced outage impacts to customers
- Resource and grid planning processes are strengthened
  - Distributed Energy Resources Planning Bill (HB 1126)

Environmental Sustainability
- Support the region’s transition toward renewable and zero-carbon energy
  - Clean Energy Transformation Act (SB 5116)
- Customer shift from NIMBY to YIMBY
- Electrification, EV adoption increasing
- PUD can develop pilots to meet customer interest in storage, net-zero energy, and carbon-free programs and rates

Affordability
- PUD can meet customers increasing interest in choice and flexibility at a low cost through rates, programs, renewable options
- Battery storage, solar, and EV costs are decreasing

Grid Integration to Increase Flexibility + Controllability
- Increase flexibility of loads, in partnership with customers, enables increased reliability and rewards customers for peak load shifting/energy usage
- Increase controllability, leveraging in-home intelligent appliances, such as Amazon voice assistance, to make energy management easier
Action Plan: How We’ll Make It Happen

1. Behind-the-meter solutions and smart grid that together enable and manage flexible and controllable loads
   - Distributed Energy Resources Initiative, Electric Vehicle Initiative, Solar, Customer-scale Battery Storage, Demand Response

2. Optimized processes and solutions that deliver reliable, clean power at the lowest cost by the best people
   - Grid-scale Battery Storage, Smart Grid Controls & AMI

3. Maximize Customer Experience by enabling choice and providing frictionless interactions with the PUD for energy and services
   - Customer Self-Serve, Customer Experience Initiative
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Kelly Strand

DISTRIBUTED ENERGY RESOURCES (DER) INITIATIVE
What are DERs?

- “Non-emitting resources that provide electric energy, capacity, or ancillary services to an electric utility and that are located on the distribution system....”
  - Clean Energy Standard ESSB 5116

- Used to provide power – ex: solar
- Or reduce/manage demand – ex: energy efficiency, managed electric vehicle charging
DER Initiative Objectives

1. Recognize the value and manage the impact of customer-sited DERs.

2. Build a cohesive plan to synchronize DER net impacts with power generation and acquisition decisions, capital and operational grid management, and conservation acquisition.

3. Overcome historical silos between planning and implementation functions.

Cross-functional Initiative

*DER Planning Initiative* knits together the utility’s program, system, and resource decisions to ensure we can create the best long-term outcomes for the customer and the PUD.

**Grid System Optimization: Grid/Capital focus**
- Optimize grid planning and capital expenditures, defer distribution system investment
- Identify areas of congestion and load growth opportunities
- Maximize geospatial generation resource additions and target appropriate capital/non-capital solutions in congested areas

**Power Resource Optimization: Resource focus**
- Manage peak load, mitigate capacity costs
- Defer long-term resource acquisition through demand and supply-side investments
- Reduce exposure to market volatility from short-term purchasing

**Customer Integration: Operations focus**
- Manage programmatic acquisition of capacity and other behind the meter resources
- Incentivize grid-optimal customer energy and demand behavior
- Provide value through DERs and DER optimization
DER Team

- **Customer & Energy Services**
  - New Energy Initiatives - Solar, DR, EV
  - Conservation
  - Customer Experience
  - Key Accounts

- **Distribution & Engineering**
  - System Planning & Protection
  - Distribution Planning

- **Power, Rates & Transmission**
  - Rates
  - Power Supply & Scheduling

- **ITS Project Management**
- **Corporate Communications**
- **Government & External Affairs**

- **Sponsors**
  - John Haarlow
  - Pam Baley
  - Guy Payne

- **5 Projects Leads**
DER Work Plan

- DER Launch
- DER Project Development
- DER Best Practice Research
- Develop Integrated DER tools
- Assess DERs
- Align Planning + Customer Programs
- Quick Wins & Pilots
- 10-Year DER Roadmap + Policy Decisions
DER Initiative Progress Update

Cross-functional research groups focused on 3-month research objectives

- Defining DERs at SnoPUD; Solar + Battery Storage; Demand Response Residential + C&I; Rates; System Planning Data Inventory; Electric Vehicles, in partnership with EV CFT; Interactive Grid Management

Research Phase Completed Deliverables

- Drafted C&I Demand Management & TOD Pilot
- Developed feeder characteristics analysis of 400 feeders categorized by load profile
- Learned how to model DERs into distribution planning software
- Built EV Forecaster Tool
- Formalized data collection
  - Customer battery installations
  - Developed a customer survey around DERs and pricing signals
- Completed legal analysis of variable incentives
- Peer utility connections, lessons learned
Peer Utilities

- **Portland General Electric**
  - Stacking values of DER technologies as a balancing authority
  - Evaluating DERs and distribution limitations as part of their resource planning process
  - Tying DER Planning to Smart Grid Test Beds
    - Testing DERs - Solar, Batteries, DR, using weather, location, constraints
Big, Quick Win: System Capacity “Heat Map”

Version 1: Substation-level detail

Version 2: Circuit-level detail
Big, Quick Win: 1st Non-wires Analysis

*Customer Focus in Woods Creek*

Distribution Planning provided **three** alternative peak reduction target and distribution system alternatives to building an $8M Woods Creek substation in 2022.

Energy Efficiency engineers looked at the **total achievable conservation potential in the area**.

Energy Efficiency Cost Effectiveness calculator built for each alternative to determine the PV Costs and PV Benefits of each scenario from a Distribution System AND Resource Portfolio perspective.

Comparing the Distribution Planning and Resource Portfolio values of each scenario **allows** the PUD to identify the best overall scenario and compare it with a reference case.
**Looking Ahead:**

**How DERs Enable the Utility of the Future**

- DERs offer customers choices and control over their energy future
- Heralds smart integration between platforms
- DER optimization enables and incentivizes grid-optimal behavior using programmatic capacity reduction and behind the meter approaches, rates, and smart grid/AMI infrastructure.
- DERs will facilitate new customer interactions with the utility
- Customers may transact with each other, via blockchain transactions

*DER Planning Initiative* knits together the utility’s program, system, and resource decisions to ensure we can create the best long-term outcomes for the customer and the PUD.
Suzanne Frew

ELECTRIC VEHICLE (EV) INITIATIVE
Electric Vehicles
Why an Electric Transportation Strategy?

- Millions in investments by vehicle manufacturers and number of models introduced by 2021
- British Columbia’s Zero Emissions Act will require all light duty vehicles sold in 2040 to be zero emissions
- Opportunity for increased long term load growth with electric vehicles as 55% of all cars sold in 2040
- Customer commitment to electrification of their fleets
- Potential grid benefits by influencing when customers charge vehicles
- Policy makers supporting growth of electric vehicles through building codes and state legislation (SB1512)
- Washington is third in the nation for EV adoption
- New entrants into the market including, vehicle manufacturers, charging networks, e-mobility and connected cars
Electric Vehicle Activity

- Electric Vehicle Planning Report 2009
- Commission Presentations 2017 and 2018
- Short Term Plan (AUG – DEC 2018)
  - Customer education and awareness
  - Facilitate customer-owned infrastructure build-out
  - Pilot managed charging
- District Cross-functional Work Group
- Recent Legislation
  - HB 1512
  - Transportation Electrification Plan - approved by the Commission (tentative)
EV Work Group

AGM, Customer and Energy Services

New Energy Initiatives

Distribution Engineering Shared Services

System Planning and Protection

Distribution Engineering

Load Forecasting

Customer Programs

Government Affairs

Corporate Communications

Distribution Services

Rates

Legal

Key Accounts

Customer Experience
EV Work GROUP

• Quick Wins
  – Website updates
  – Call Center FAQs and basic information calls
  – EV Interest Form on website and at fairs
  – Team PUD EV community
  – New Service Questionnaire (NSQ) revision to include EV questions
  – Data collection from vehicle and all charging

• Longer Term
  – Infrastructure ownership
  – Connection policies
  – Rate structures
  – Incentives for customer segments – residential, fleet, off-road, charger networks
Fleetcarma Proposed Pilot

- Electrical vehicle driving and charging data collection
- District interest in vehicle and charging data
  - Customer programs, load forecasting, rates, system planning, engineering, fleet and microgrid
- Device plugs into vehicle OBD port – self install w/assistance for Tesla
- GPS based information from within and outside service territory
- Potential to extend the pilot and add managed charging rewards
- Other Fleetcarma Utility Pilots
  - Tacoma data collection from 100 customers
  - SRP/EPRI projects on data collection, rate schedules and charging profiles
  - Nashville/TVA data collection “Smart Charge Nashville”
  - Lincoln Electric data collection with APPA DEED grant
Latest From Neighboring Utilities

- Seattle City Light
  - Rocky Mountain Institute Transportation Plan
    - Public, residential, workplace and high mileage charging
    - Rates, business processes and fleet electrification support

- Puget Sound Energy
  - WUTC Filing
    - Education and Outreach
    - Public, residential, multifamily and workplace L2 charging
    - Investing in DCFC
Best Practices

• Portland General Electric Transportation
  Electrification Goals
  – Promote customer acquisition of electric vehicles
  – Efficiently integrating EVs into our system
• Salt River Project
  – Fleetcarma data collection and rate schedule pilots
  – EV Community
  – Utility wide collaboration
• Hawaiian Electric Transportation Plan
  – Boosting EV adoption
  – Accelerate build-out of EV chargers
  – Supporting electrification of heavy duty fleets
  – Creating grid services opportunities (DR and Rates)
  – Coordination with grid modernization
Road Map Components - Draft

• Outreach and Education
  – Customers, dealerships, charging provider, customer fleets
• Managed Charging
  – Smart charger incentives, education, rate schedules, flexibility in demand costs
• Promote Electric Vehicles
  – Utility EV fleet, investment in EV infrastructure, efficient customer processes
• Support Our Customers
  – Off road electrification, fleet and transit electrification, workplace charging, home charging, public charging
• Grid impacts and forecasting
  – Data collection, propensity to adopt, load management
Customer Activities

• Customer Engagement
  – Input on our strategy and offerings
  – Educate customer/District benefits

• Influence Customer Behavior
  – Charging habits
  – Load flexibility

• Partner with Customers
  – Collaborative build-out for transit and fleet operations
  – Mitigate distribution constraints
Opportunity for the PUD

- Increased revenue if managed charging is incorporated
- Customer education with technology adoption
- Influence charging location based on grid capacity and customer demand for a comprehensive charging network
- District fleet electrification
- Increased customer engagement (rates, DR, managed charging)
Customer Experience Opportunity

“Millennials will be 45% of the car-buying population in 2025”

• Their expectations will be set by best in class digital experience (Uber, Amazon)
  – Seamless and reliable service
  – Competent advisory functions
  – Personalized omni-channel communication
  – 24/7 support
  – Relevant social-media marketing

• For the next generation, failure to meet expectations may result in opting out of car ownership and opting into rideshare

• For charging, there is a need to match the Tesla car buying experience
Looking Ahead:

How EVs Fit into the Utility of the Future

- Source of added revenue if managed charging
- Wide adoption of EVs with multiple types of charging
  - L2 managed charging at home and work
  - DC Fast Charging with battery support
- Grid flexibility benefit with V2G
- Future homeowner with solar direct charge of EV and battery improving efficiency
Solar Landscape

- Enthusiastic customer base
- Diminishing state and federal incentives
- Equity and Access
- Technology advancements
  - More efficient equipment
  - Declining costs
  - BATTERIES
- Rate changes
Solar at PUD

- Net metering (renewable generation up to 100 kW)
  - Nearly 2000 interconnected customers
  - 15.5 MW of solar installed
- Community Solar
- Planet Power (sunset in 2019 – in process of awarding final projects)
Annual Installs (as of July 2019)
Customer-Sited Batteries

<table>
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<th>Year</th>
<th>Battery Installs</th>
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<td>4</td>
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<td>2018</td>
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<td>2019</td>
<td>33</td>
</tr>
<tr>
<td>2020</td>
<td>41</td>
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</table>
Community Solar

- Over 500 customers participating. Approximately 100 people are on the waitlist.
- We received **over 100 applications within the first 20 minutes** of the program going live on Earth Day.
- By the end of our first day, over 50% of the units were reserved. **We were 100% reserved in less than a month!**
- Low-income pilot under development. Plan to be released in August.
- System certified by WSU on July 1\textsuperscript{st}. 
Participation Diversity

Solar Unit Purchase Amounts

Participants

Solar units

COMMISSION WORKSHOP | JULY 16, 2019
Solar Themes

REGIONAL
- Access
- Equity
- Community Energy Planning

CUSTOMER
- Energy "Independence"
- Environmental Stewardship
- Clean and Carbon Free
- Financial Return
- Societal Contribution
Community Solar Round Two and Beyond

Ideas for Round 2
• Stanwood or Camano Island
• WA State funds *may* be available. WSU interested in working with us.
• Corporate Sponsored Low-Income (e.g. Boeing)
• Developer model to utilize Federal Tax Credit

Beyond
• Absent incentives, move to subscription model
  – Track OPALCO developments
• Rooftop aggregation

15 acre Camano Island PUD site
Neighborhood-scale Microgrids – DRAFT CONCEPT

Support strategically customer-sited solar + storage projects to:

– Increase distributed grid resiliency
– Increase community resiliency
– Demonstrate technology

Identify sites in community where there is mutual benefit to District and the Community and leverage partner resources.

– Potential sites: schools, community centers, places of worship, libraries

Example programs:


Customer-sited Solar + Storage

- 41 existing storage customers; all are solar customers
- Paired with new rate structures (e.g. TOD), storage will be desirable for solar customers, and may be a key financial component
Looking Ahead:

How Solar Fits into the Utility of the Future

- Solar + Storage + TOD rates provide opportunity for the District to:
  - Increase resiliency (grid + community)
  - Smartly integrate renewables
  - Meet enthusiastic and growing customer interest

- Community Solar and Neighborhood-scale projects enable the District to continue to expand access to more customers
Kelly Strand

CUSTOMER-SCALE BATTERY STORAGE
PUD Customer Solar & Batteries

- Storage systems range in size from 5kW to 30 kW
- At least 41 PUD customers have home battery storage systems
- 6 customers (15%) have Tesla Powerwalls
- 32 customers (78%) have Outback brand batteries
Why Do Customers Want Battery Storage?

- Outage Protection – provide a backup power source during an outage
- Decrease utility bills
  - Via time of day energy use arbitrage for customers on TOD rates
  - By reducing demand for peak energy
  - By reducing T&D costs incurred by the utility
- Use solar generation effectively
- Enable electrification and decarbonization
- In the case of utility-owned batteries, get the benefit of battery backup, without having to own, manage, or maintain it

Tesla Powerwall (45.3” tall; 5kW)
Potential Utility Benefits

- Improve reliability
- Reduce T&D grid infrastructure investments to meet peak
- Create incentives to match the utility’s needs: kW vs kWh
- Increase flexible and controllable load
- Reduce generation investment
- Voltage Stabilization
- Frequency Stabilization
- Facilitate Demand Response
- Peak reduction and carbon emissions management
  - Lower Grid Stress
- Earn leasing revenue from utility-owned distributed battery storage systems

LG Chem RESU 10HV (35.7” tall, 5kW)
Utility Program Type: Utility-Owned Batteries

- Utilities charge and use the battery during high-peak times
- Utilities must predict peaks
- Utilities must communicate with site installed batteries, or 3rd party aggregators
- Require customers to switch to TOD rates
- Most operate on 10-year contracts
Utility Program Type: **BYOD (Bring your own device)**

- Some utilities communicate with site-installed batteries, or 3rd party aggregators, some do not
- Utilities must predict peaks
- Do not require customers to switch to TOD rates, but it’s one of the primary mechanisms to manage energy flow
- Most operate on 10 year contracts
- Most require that a customer has solar and do not allow customer to charge battery directly from grid
Barriers & Risks

- **Cost** – A barrier for the customer and the utility
- **Short Lifespan and Battery Degradation**
  - Useful life of 5 - 15 years (compare to solar at 25 - 30 years)
  - Battery will degrade as it cycles
- **Main competition for batteries are generators**
  - 5kW Portable Diesel Generators $2,100-5,300
  - 5kW Installed Battery $10,000-16,000
Opportunities for the PUD

- Capture insights from a PUD Customer Battery Survey
- As costs decline, offer customer programs
  - Reliability & Resiliency – provide backup power
  - Craft program to address customers with wells
- Alleviate infrastructure upgrades and T&D costs
- Pair battery programs with TOD rates when implemented
- Learn how to integrate small-scale distributed storage into our grid operations
- Reduce peak power purchases
- Opportunity to purchase energy management, grid services, and install/maintenance of batteries from 3rd party implementers
Looking Ahead:
How Batteries Fit into the Utility of the Future

- Provide customer greater reliability and autonomy of choice
- Enable flexible and controllable distributed load
- Reduce distribution grid infrastructure and peak demand
- Manage load at peak, including EV charging and other electrification load
- Pair batteries with solar to make efficient use of customer generation
- Pair with new rates
- Facilitate distributed micro-grids
Suzanne Frew

DEMAND RESPONSE
Demand Response or Load Flexibility?
Demand Response is the Largest DER in the US
Past and Present Demand Response Projects

- Demand Response Pilot Enernoc/BPA with MESA 1 and 2
- Commercial Industrial Demand Response BPA Pilot 2015-2017
- BPA/PGE Residential Water Heater Pilot 2018
- Water and Wastewater Customers Peak Load Shifting – 2018-2020
Types of Demand Response

- Shed or load up – power consumption is increased or decreased over a period of time
- Shift – power consumption shifts earlier or later than it typically would occur
- Modulate – reduce or increase power consumption in short term increments
Demand Response

- **Economic**
  - Day ahead market
  - Hourly reductions for scheduling

- **Grid Reliability**
  - Regulation
  - Feeder/system peaks
  - Power mix (generation source)
  - Resiliency
Utility Demand Response Programs

SHARED INTEGRATED GRID

Imagine a future when customers’ energy assets become shared energy solutions that enhance grid reliability, resiliency, and value for all.

An electricity customer is in the market for a new water heater. The customer uses a mobile app connected to the network operator platform to purchase and install a smart water heater with a single click.

Peace of mind and selection support
The app connects the customer to a list of trusted service providers, detailing economics and customer reviews.

Incentives
The customer opts in and instantly qualifies for incentives based on the expected value of grid services.

Seamless integration
The energy asset automatically integrates with the electric grid.

Direct benefits
The water heater automatically adjusts to off-peak use, and the app delivers energy-saving tips, performance diagnostics, and service alerts—cost-effectively enhancing comfort, choice, convenience, and control.

Customer Value Stream

Network Operator Value Stream

Bridging customer resources and the grid
The app connecting customers to the electricity network operator platform can be developed by:
- Transmission and distribution system owners and operators
- Retail energy service companies
- Aggregators or third-party service providers
- Appliance and device vendors
- Energy solution providers

Network operator platform
Secure interfaces connect customers’ assets to utility planning and distribution operation systems and link to aggregated services for the bulk power system.

Grid services from customers’ assets
The “connected” water heater is optimized to use energy based on grid needs, coordinating load with grid and generation constraints without impacting comfort.

A new type of grid investment
The definition of grid investments expands to include grid services delivering value to customers and all levels of the grid.

Societal benefits
The shared integrated grid delivers greater reliability, resiliency, and value for the grid and all customers.
Best Practices

• Green Mountain Power
  – BYOD includes batteries, chargers and water heaters
  – Tesla Powerwall for shaving peaks and leverage as a smart meter

• Portland General Electric
  – Peak time rebates
  – PGE/BPA water heater demand response
  – Time of Use Rates

• CA IOUs
  – AC programs for more than 20 years
  – Flex Alert campaign
  – Resiliency adders to battery incentive programs
Looking Ahead:
How DR Fits into the Utility of the Future

- Behavioral demand response potential from all customer segments
- Grid Interactive strategies for all customers
- Leverage technology to simplify customer engagement
- Partnerships with customers for increased load flexibility
- DR automation with customer setting up parameters
Action Plan: How We’ll Make It Happen

1. Behind-the-meter solutions and smart grid that together enable and manage flexible and controllable loads
   - Distributed Energy Resources Initiative, Electric Vehicle Initiative, Solar, Customer-scale Battery Storage, Demand Response

2. Optimized processes and solutions that deliver reliable, clean power at the lowest cost by the best people
   - Grid-scale Battery Storage, Smart Grid Controls & AMI

3. Maximize Customer Experience by enabling choice and providing frictionless interactions with the PUD for energy and services
   - Customer Self-Serve, Customer Experience Initiative
Grid-scale Energy Storage and Solar

• Installed energy storage power capacity has nearly doubled every two years since 2011, and by the end of 2017, 708 MW was in operation; potential for 2500MW+ by 2023

• April 2019 US monthly electricity generation from renewable sources exceeded coal-fired generation for the first time based on Energy Information Administration data
  – Renewable sources provided 23% and coal provided 20% of total electricity generation
  – Renewable includes hydropower, wind, solar, geothermal and biomass

• In 2018 about 15 gigawatts of wind and solar generating capacity came online

Citation: U.S. Battery Storage Market Trends, U.S. Energy Information Administration, May 2018
Grid-scale Energy Storage and Solar (cont’d.)

- California mandate for 1,325MW by 2020
  - PG&E installing 567MW/2270MWh of energy storage to replace planned natural gas plants
- LADWP plans to replace gas peakers with solar and storage
  - Current plans include 400MW of solar and 300MW of energy storage
  - Combined price is just under $40/MWh
- PNM plans to retire San Juan coal plant
  - Replace with 280MW of natural gas peakers, 350MW of solar, 130MW of energy storage
Clean Energy Transformation Act

Washington State Legislation

• 100% clean energy by 2045
• Coal phase-out by 2025
• In 2017 WA resource mix included
  – 68% hydro
  – 24% coal and natural gas
  – 4% nuclear
  – 3% wind
  – 1% other
• This legislation will most likely drive more solar, wind and energy storage installation in the NW
Distribution Utility-Scale Energy Storage

- Eversource - Martha's Vineyard 14.7MW
  - Replace diesel generation peakers and integrate solar
  - Power supplied by 4 undersea cables
- Eversource - Provincetown, northern tip of Cape Cod, 25MW/38MWh Li-Ion
  - Purpose is to increase reliability to three towns fed by a single feeder that has low reliability due to storms
  - Other option was build a second 3 phase distribution feeder
  - Cost of $40M, several $M more than feeder; utility believes battery will be cheaper over time
  - Provides 3 hours of backup during summer, 10 hours during winter; reliability could be improved by as much as 50%
Distribution Utility- and Customer-Scale Energy Storage

- Eversource - Westmoreland, New Hampshire, 1.7MW/7.1MWh Li-Ion
  - Purpose is to increase reliability, manage peak demand and reduce greenhouse gas emission
  - 450 customers fed by single power line
  - $6M for new feeder, $7M for energy storage, mix of utility and customer owned
  - Estimate additional $2M in saving from peak cost reduction
  - Statewide incentives for batteries, vehicle chargers, smart thermostats
  - Statewide demand response program part of energy efficiency program
  - Estimate they will save 50kW through residential batteries in Westmoreland and 15kW through thermostats
Chemistry Trends

Figure 6. U.S. Large-Scale Battery Storage Capacity by Chemistry (2003–2016)

Citation: U.S. Battery Storage Market Trends, U.S. Energy Information Administration, May 2018
Application Trends

Figure 7. Applications Served by U.S. Large-Scale Battery Storage (2016)

Note: The figure does not include a 10 MW/7.5 MWh battery storage unit located in Maui, Hawaii, which did not report any applications in 2016.

Source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report

Citation: U.S. Battery Storage Market Trends, U.S. Energy Information Administration, May 2018
Battery Storage Ownership Trends

Figure 5. U.S. Large-Scale Battery Storage Capacity by Region and Ownership Type (2016)

Source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report

Citation: U.S. Battery Storage Market Trends, U.S. Energy Information Administration, May 2018
Future Outlook

Figure 11. U.S. Large-Scale Wind, Solar, and Battery Storage Capacity Projections (2020–2050)

Citation: U.S. Battery Storage Market Trends, U.S. Energy Information Administration, May 2018
Looking Ahead:
How Grid-scale Utility Storage Fits into the Utility of the Future

- Distributed storage for the purposes of:
  - Non-wires distribution solutions - capital investment deferral for distribution capacity constraints
  - Demand response and peak shifting
  - Reliability Improvements
- Storage paired with Community Solar or other large scale solar installations
- Customer owned storage incentivized through rates
- Procurement of clean power from others (solar, wind, energy storage)
Jason Zyskowski

SMART GRID CONTROLS & AMI
Reliability, Resiliency, Grid Operation and Integration

- According to JD Power reliability of electric service is the #1 thing our customers care about
- Future grid will consist of:
  - Advanced Meter Infrastructure (AMI)
  - Distribution Management System (DMS)
  - Outage Management System (OMS)
  - Distribution Automation (DA)
- These systems will work together to improve reliability, resiliency and operation of the grid
- Grid integration with customer owned devices
Advanced Meter Infrastructure (AMI)

• Allows for immediate notification to PUD of power outage
  – No longer relying on customer phone calls for outage notification
  – Information feeds into DMS/OMS to provide accurate outage data for more timely restoration
  – Provides up-to-date situational awareness during major storms
    • Quicker and more accurate prioritization of outage restoration
      – Major storm accurate outage restoration times
    – Up-to-date outage map and customer outage messaging
• Provides load flow data to DMS to allow for informed automated switching
AMI customer and utility benefits

- Customer options to proactively view detail, interact, and receive alerts regarding electrical energy usage
- Customer pre-pay options
- Rate structures that support and allow for the following:
  - Association of cost causation with customer cost of service
  - Price signals that promote cost effective use of electricity
  - Options for customers to reduce bills
  - Revenue stability
  - Incentivize technology investment and community objectives
- Remote disconnect/reconnect
- Interaction with building automation, smart inverters and demand response
Distribution Management System (DMS)

- Takes data from field devices and creates up-to-date picture of the distribution grid
- Integration with customer-owned devices
  - Allows for customer devices to play a role in optimizing grid operation
- Takes actions based on data to restore outages, avoid overloads and manage the system in the most efficient way possible
  - Automatic Fault Restoration – Fault Location Isolation and Service Restoration
  - Conservation Voltage Reduction (CVR) – managing distribution system voltage
  - Automatic Switching or suggested switching to improve grid operation/efficiency
- Outage Management System
Distribution Automation

- Installation of reclosers, regulators, capacitors and other line equipment with communications to improve reliability and reduce customer energy costs
- Allows devices with advanced controls in the field to communicate back to the DMS
- Without these devices fault isolation, restoration and voltage management are not possible
Distribution Grid of the Future
Distribution Automation (DA) Demo Area

- Total load served in DA area: 51MW
- Around 10,000 customers across 5 substations
- 10 distribution circuits from 5 substations
- 200 circuit miles of service territory
- Low reliability circuits in Lake Goodwin area
- 31 switching devices (Reclosers and M.O. switches)
- 13x 3-phase regulators
- 6 end of line voltage meters
DA Future - Expansion

- SnoPUD is expanding its DA territory to the Arlington area
- Expanded area will have 66 switches, 17 reclosers, and 17 voltage regulators with several end-of-line voltage sensors
- This area was selected due to its:
  - Reliability opportunities
  - Proximity to planned microgrid/energy demonstration center
  - Proximity to new substation infrastructure
- Different communications infrastructure – optimized for the location, bandwidth needs, and physical layout of territory
Looking Ahead:

How Smart Grid and AMI Fit into the Utility of the Future

- Customers have detailed picture of energy usage, are billed in a way that reflects cost of services provided and have options to reduce bills
- Utility has real time picture of grid and improved ability to respond to outages
- Grid is managed in the most efficient way possible, including the use of customer devices for operational efficiencies
Action Plan: How We’ll Make It Happen

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   - Customer Self-Serve, Customer Experience Initiative
Cathy Patterson

CUSTOMER SELF-SERVICE
MySnoPUD.com

Customer Self Service

• Meet the customers where they are
  – Interactions at the customer’s convenience and on their preferred device
• Provide seamless customer experiences across digital channels
• Easy-button self-service
• Pro-active notifications
• Personalized products and services that:
  – Automate or streamline energy savings
  – Enable customers to generate their own electricity
  – Support my connected home through the latest technology
# CSS & EBPP Project Release Plan

**Customer Self-Service (CSS) / Electronic Bill Payment & Presentment (EBPP)**

<table>
<thead>
<tr>
<th>Q3 2019</th>
<th>Q1 2020</th>
<th>Q2 2020</th>
<th>Q3 2020</th>
<th>Q4 2020</th>
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<tr>
<td>Point of Sale Terminals</td>
<td>My SnoPUD Go Live!</td>
<td>Outage Center</td>
<td>Transfer and Move Out</td>
<td>Budget Payment Plan</td>
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<td>Real-Time Payments</td>
<td>User Management</td>
<td>Outage Preference Management</td>
<td>Two-way Texting for Outages</td>
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<td>Pledge Improvements</td>
<td>Billing &amp; Payment</td>
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<td>Combo Button</td>
<td>Billing &amp; Payment Preference Management</td>
<td>Expanded Admin Console</td>
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<td>Expanded Admin Console</td>
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Cyndy Nance
CUSTOMER EXPERIENCE
Customer Experience

• EV
  – Customer engagement
  – Partner with customers
• Solar
  – Enthusiastic customer base
• Demand Response
  – Leverage technology to simplify customer engagement
• Distribution Automation
  – Reduce customer outage time and increase reliability
• DERs and enabling technologies offer customers choices, flexibility and control
• Not just an action or interaction, it’s a culture
• Journey Mapping
Analysis of findings from previous customer experience-focused initiatives, operational data as well as multiple primary and secondary data sources provided a holistic and realistic assessment of our customers’ experience.
Customer experience exists as a SnoPUD strategic priority. The opportunity exists to weave this into decision-making by elevating customer centricity as a value.
Putting it all together...
Utility Best Practices Discussion

Key Features
- Innovative Electric Vehicle Initiatives
- Customer Storage Program
- Unique rate structures

Key Features
- Rebates on eBikes, EVs, and heat pumps
- BYOD Battery Storage, Water Heater, and EV Charger Program
- Demand Response Program
- Energy Innovation Center
- Rutland Solar Energy Trail

Key Features
- Demand based rebates on EVs, heat pumps, smart thermostats, and weatherization
- Peak Time customer controlled demand response program
- Time of Day Rates
- Test Beds
- Subscription Based Community Solar

Key Features
- Time of Day Rates
- Blockchain for EVs and Renewables
- EV charging discounts and purchase incentives
- Customer Storage Incentives
Where we’re headed

98% Carbon-Free Energy

What do DERs mean for our customers?
Utility of the Future

July 16, 2019
Commission Workshop