Strategic Planning Workshop

Future Power Supply Options & CETA

9/14/2020

Staff Participants

- CETA analysis, scoping and strategic planning
  - John Purvis, PE; Assistant General Manager
  - Sean Worthington: Finance Manager / Treasurer
- Subject Matter Experts
  - Colin Young, PE; Distribution Systems Supervisor
  - Tyler King, Power Analyst II
  - Mattias Jarvegren, Utility Services Supervisor

CETA Background

Background

- In January 2019 WPUDA brought attention to SB5116
- SB5116 was the initiation of CETA
- By March 2019, passage became probable
- In May, CETA became law
- Throughout 2019 staff worked closely with WPUDA and Dept. of Commerce
  - Interpretations
  - Rulemaking
  - Public comments
  - Analysis
  - Scope & potential solutions

Background

- By November 2019, staff largely completed scoping analysis of CETA impacts on the District
  - Power supply carbon neutral by 2030
  - Carbon free by 2045
  - Potential zero carbon solutions, costs and timing
- By January 2020 rulemaking progressed sufficiently to evaluate CETA Section 12 (low income)
  - Reduce Energy Assistance Need 60% by 2030
  - Reduce Energy Assistance Need 90% by 2050
  - Target or eventual requirement?
  - Competed Section 1200 District analysis in April

Background

- In view of future obligations we incorporated CETA into the Districts 2020 Strategic Plan last year
- Considering the consequences of CETA on future power procurement to the District:
  - Introduced compliance with the Carbon Neutral standard as a major focus in contract negotiations with BPA
  - BPA would have to ensure compliance for Load Following Customers subject to CETA
  - Conducted preliminary cost analysis of becoming a Slice/Block customer for renewable resources at some point in the future

Background

- Recent Commissioner inquiries and requests have touched on topics very close to:
  - Staff CETA analysis conducted over the last year.
  - Related analysis with respect to future power procurement and negotiation of the new BPA contract
- This presentation is based on an update to previous analysis, including:
  - Latest CETA rulemaking
  - Newly published 2020 system costing and estimation
  - Informal conversations with BPA in advance of 2028 contract discussions
  - Information from The Energy Authority (TEA) for managing BPA slice/block customers

Background

- Slice customers pay to BPA a percent of the cost for a percent of the output of the FCRPS.
- Slice clients are responsible for matching loads and resources over all time horizons.
- Slice customers responsible for selling excess power into wholesale markets and procuring shortfalls from other resources.
- Requires robust Risk Management Program:
  - Forward Hedging
  - Outsourcing or hiring additional personnel
  - Day ahead and real time trading capability including scheduling
  - Software systems
  - Increased reserves
  - No Carbon Free Market

CETA Obligations

Clean Energy

CETA Obligations

Pre 2045

- Coal supply eliminated 2025
- In 2030, Clallam PUD power supply must be carbon neutral
- Carbon sources are limited to 20% of total
- Renewable Energy Credits (RECs) required to offset any carbon supply
- A $60/MWh penalty can be paid for natural gas
- At least 80% of generation received must meet the zero carbon definition

CETA Obligations

Post 2045

- ➢In 2045, Clallam PUD power supply must be carbon free
- ➢No carbon sources are allowed
- ➢Renewable Energy Credits (RECs) can not be used to offset any carbon supply
- ➢Acceptable Generation Post 2044 sources include
  - Hydro
  - Wind
  - Solar
  - Nuclear
- ➢Excludes carbon capture technology
- ➢Long-term planning necessary

Current Power Supply and CETA Obligations

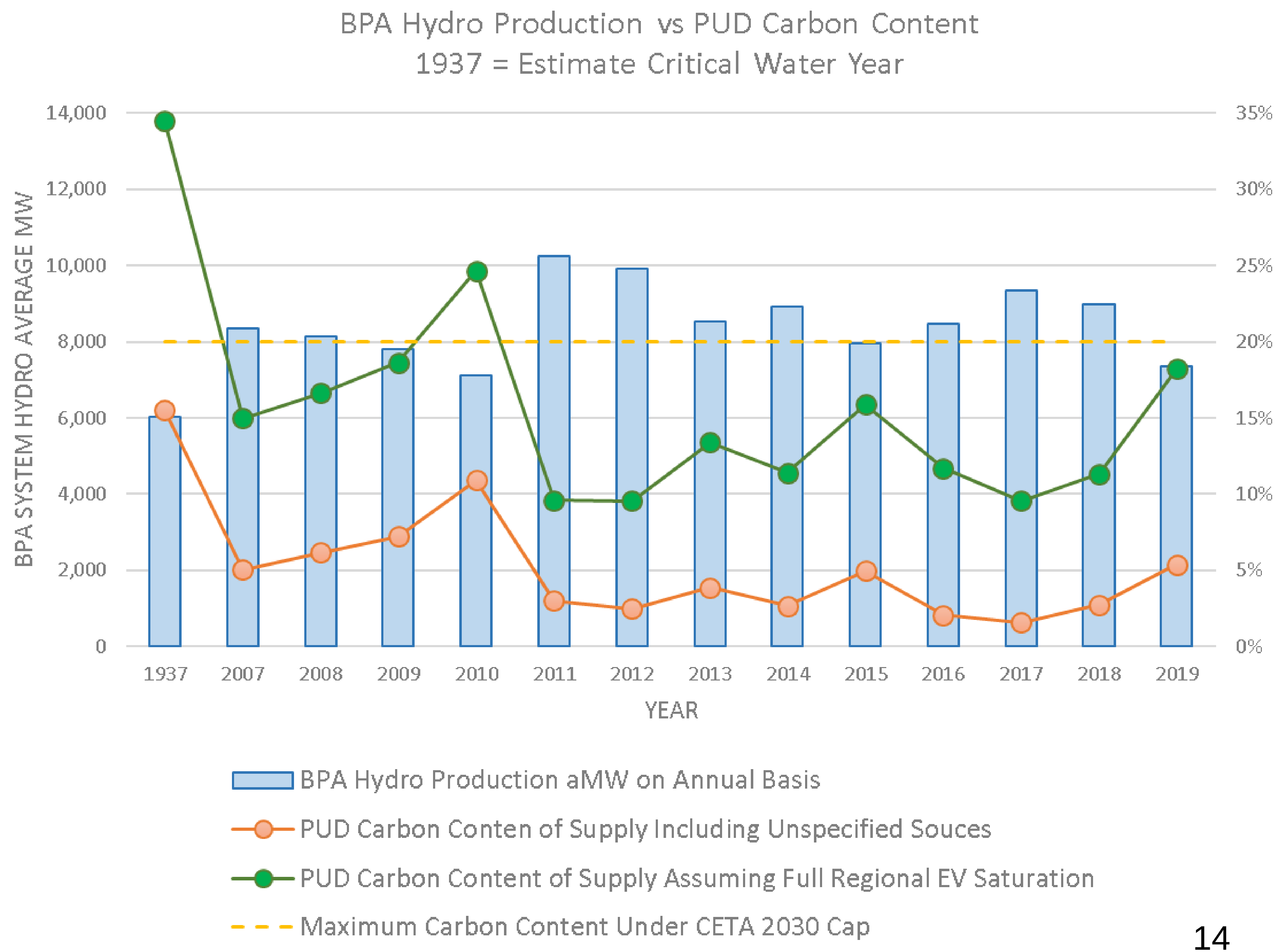
- In most years our carbon content is less than 5%
  - Typically 85% Hydro and 10% Nuclear
  - Carbon and unspecified sources < 5%
- But this may not always be the case!
- In a worst-case1937 critical water year, the carbon content can rise to as high as 16%
- Even so, I-937 RECs can be used for CETA and Clallam **now meets the 2030 requirement** of carbon neutral
- But there are risks and we may exceed 20% carbon at some point in the future, planning is required
  - To keep carbon below 20% through 2044
  - To achieve zero carbon after 2044

CETA Consequences?

CLALLAM COUNTY PUD #1

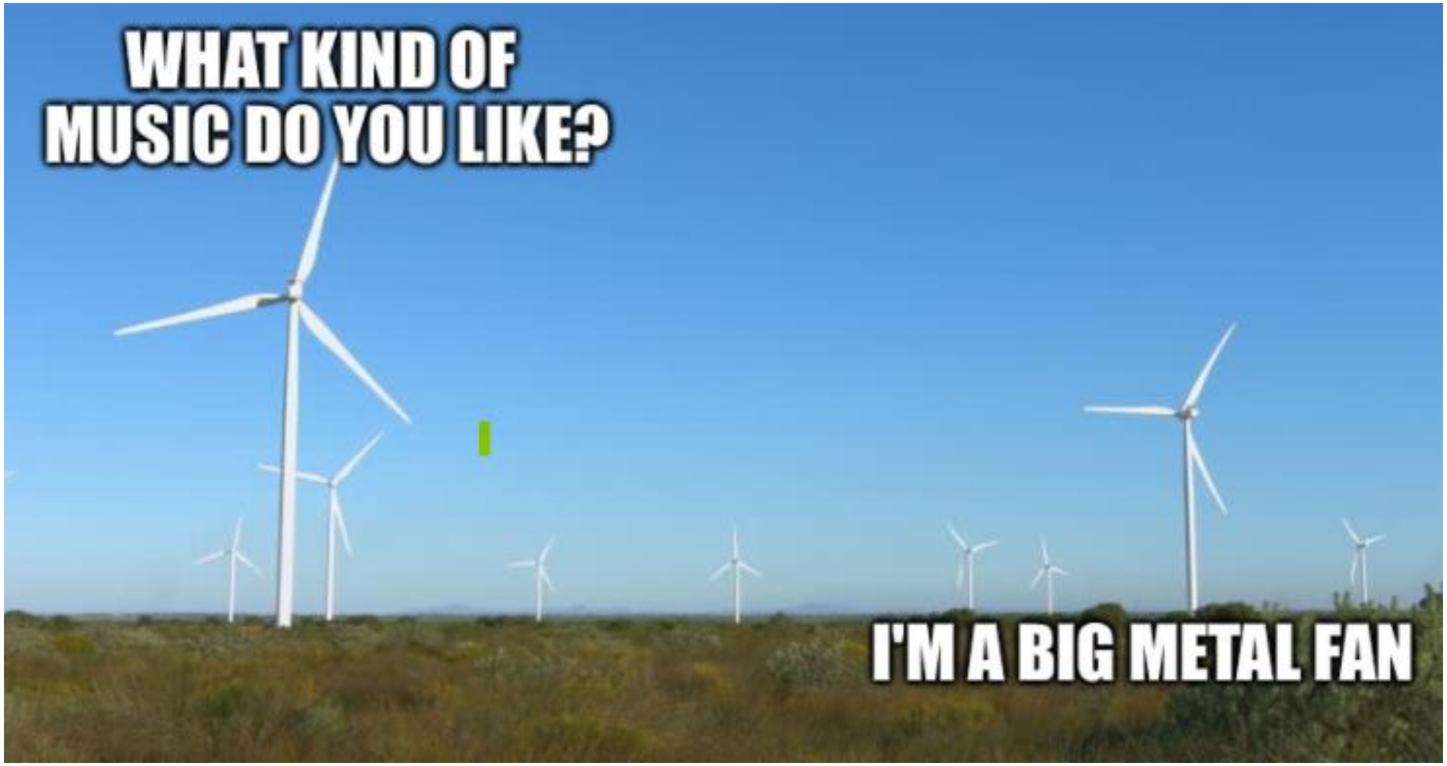
Bringing Energy To Life™

➢ What if our utility fails to meet either carbon neutral or zero carbon requirement?
  - If part of an emergency, the Governor may waive the requirements
  - **Otherwise we are obligated to make investment of 2% of annual sales every year to achieve the objective (2% cap)**
  - If in effect for 2020, the CETA "cap" for Clallam would cost about **$1.2 Million** in capital investments


BPA Hydro Production vs PUD Carbon Content
1937 = Estimate Critical Water Year
BPA SYSTEM HYDRO AVERAGE MW
REPORTED PUD CARBON CONTENT
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
35%
30%
25%
20%
15%
10%
5%
0%
1937
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
YEAR
BPA Hydro Production aMW on Annual Basis
PUD Carbon Conten of Supply Including Unspecified Souces
PUD Carbon Content of Supply Assuming Full Regional EV Saturation
Maximum Carbon Content Under CETA 2030 Cap

CETA Obligations

Section 12



CETA Section 12

Low Income/Vulnerable Populations

- Provided in your Board Packet is a copy of the District's Analysis of CETA Section 12 dated 4/23/20
- Energy Assistance Need (EAN) is the portion of a households energy costs that exceeds a 6% Energy Burden based on household income
- CETA Section 12 designates a target or goal:
  - Reduce EAN by 60% by 2030
  - Reduce EAN by 90% by 2050
- To make EAN reductions in way that does not negatively impact vulnerable or low income customers
- CETA Section 12 costs NOT capped at 2% of retail sales

CETA Section 12

Low Income/Vulnerable Populations

- Staff analysis estimates the District's Energy Assistance Need (EAN) is $4.1 million dollars per year
- This has a potential eventual rate impact of 7.3%
- Due to the potential rate impact, we contracted with the FCS Group to perform a similar analysis
- The contracted analysis corroborated staff results, and will be presented to the Board in the next few months.
- Potential Solutions:
  - Expand District funded direct monetary assistance
  - District funded weatherization projects
  - Other District funded conservation programs, such as heat pumps
  - District funded low-income community solar

CETA Section 12

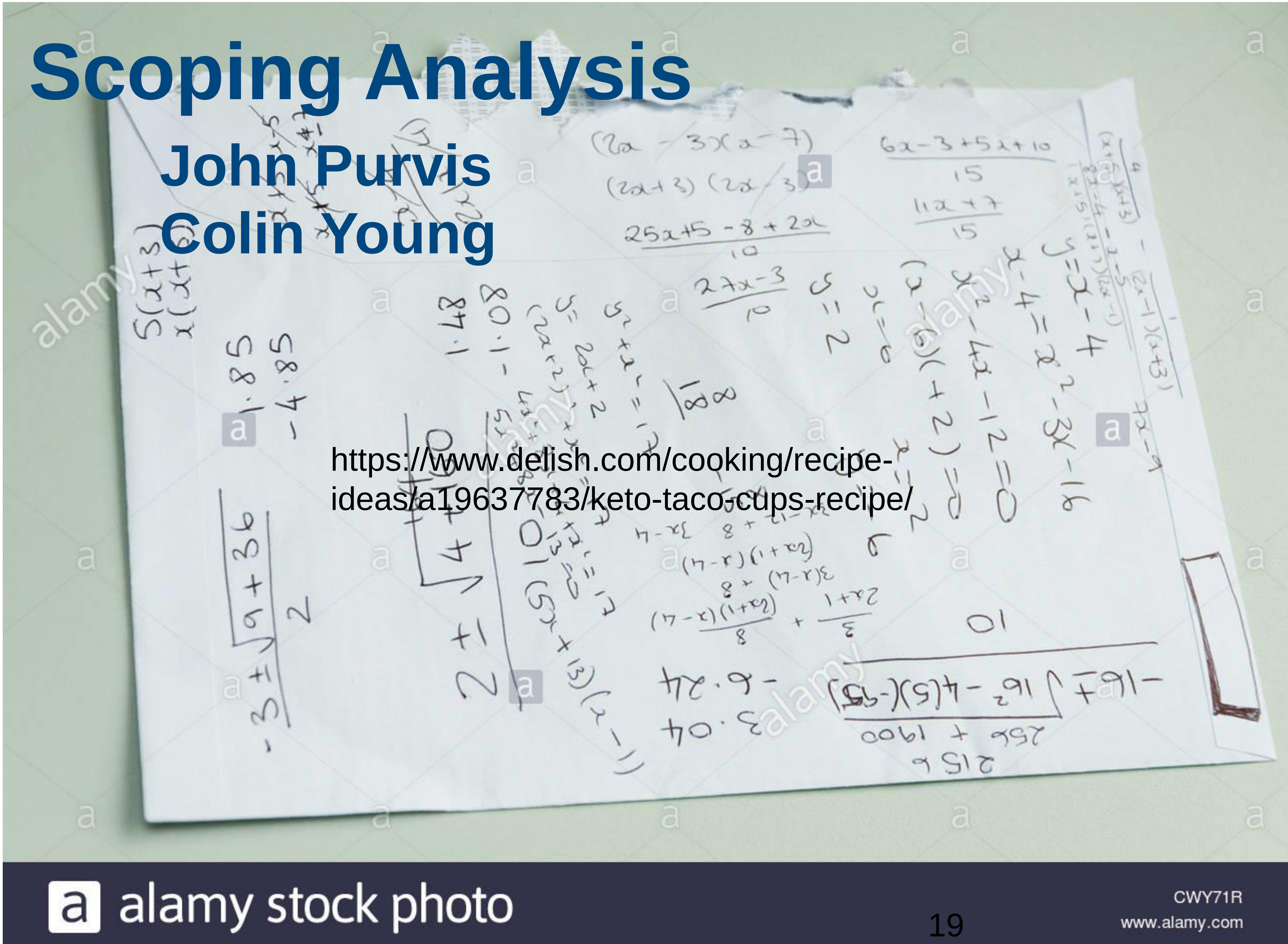
Low Income/Vulnerable Populations

- How do we fund this?
  - Rate increase? (7.3%)
  - Can’t charge low income or vulnerable populations
  - Line item on the bill
- Line item on the bill
  - Most Cost effective
  - No compounding for 2% rate cap
  - Work through OlyCAP
  - Customers would apply for exemption
  - Current District program eliminated

Scoping Analysis

John Purvis
Colin Young

https://www.delish.com/cooking/recipe-ideas/a19637783/keto-taco-cups-recipe/



The PUD Challenge

- CETA has significantly affected 3 of 11 strategic planning objectives
  - Provide stable rates
  - Manage our resource portfolio
  - Be financially responsible
- Nationally, many utilities see similar challenges, most recently outlined in a highly publicized comprehensive review by Duke Energy
  - Presented as 6 roadmaps to reduce GHG 70% over 15 years, and as choices for the public
  - Replace all coal with a varying mixes of natural gas, nuclear, wind, solar and batteries with rate impacts between $21 and $58 per month
- In some respects, Washington utilities have the greater challenge
- Even if Duke is successful over a 15 year period:
  - They will only meet the equivalent of our 2030 CETA requirement
  - And still have several times the carbon content as our PUD supply has today

Scoped Projects
2018-2020 (Updated Analysis)

CLALLAM COUNTY PUD
Bringing Energy To Life™

- Large solar with and without battery backup or energy storage
- Small Modular Reactor (SMR)
  - NuScale
  - Natrium
- Potential CETA Section 12 projects to lower EAN
  - Direct bill subsidy
  - Community solar with and without battery backup
  - Home weatherization
- Research and development
  - Solar-Battery-Micro Grid Project
  - Emergent Technologies & Trends
- Distribution scale battery

Current BPA Power Supply Costs

- Power supply costs derived from BPA-20 and estimates
  - Tier 1 Power = $36.55/MWh (BPA Hydro & ENW Nuclear)
  - Tier 2 Power = $30.32/MWh (Unspecified Market Purchase)
  - Transmission = $4.57/MWh
  - RECs = $8.17/MWh (applied to 15% of load per EIA)
  - Financial Reserve Charges = $0.66/MWh
  - Total Composite = $42.91/MWh
- Cost by function of all BPA sources and RECs – PUD staff estimate
  - Generation all sources with RECs and charges = $32.34/MWh
  - Transmission = $4.57/MWh
  - Power Services = $6.00/MWh

Consistent Financial Analysis (equal basis)

- A common basis needed to evaluate significantly differing projects
- Levelized Cost of Electricity (LCOE):
  - Does not satisfactorily measure cost for non-profit public utility projects (not-for-profit, taxes, property, and financing options)
  - Does not adequately address variable project life – often biased
  - Does not consider the inherent experience, technologies and technical capabilities within public power organizations
- The District has a long established financial analysis technique to evaluate Strategic Projects that are within the experience of staff
- Constrained by revenue requirements and/or bonding limitations at a particular rate

Consistent Financial Assumptions (equal basis)

- 2020 Project year initiation, unless otherwise stated
- Inflation and cost escalations = 2.5% per year
  - Annual Fixed O&M
  - Annual Variable O&M
  - Expected future rebuild and capital replacement costs
- Project life – variable, 15 to 60 years
- Cost of capital = 4% for 15 or 30 year term
  - Initial project cost financed or bonded
  - Future capital cost finance or bonded, if applicable
- Power generation value necessary to achieve a designated return on investment (ROI) over project life
  - ROI generally 4% for low risk projects, can be higher for speculative projects
  - In this case the required current dollar value to generate a Megawatt*hour ($/MWh) over project life

Large Solar Farm

Solar Farm - Assumptions

- National Renewable Energy Laboratory (NREL) Solar PV System Cost Benchmark, 2018
  - Adjusted by NREL quarterly updates through 2^{nd} quarter 2020
- NREL PV Watts Calculator for select locations
- Size 100 MWdc, 77 MWac (Utility Scale)
- Required land = 650 Acres, about one square mile
- 30 Year project life
- 0.7%/year annual panel degradation
- 8% I2R conversion and shading losses
- 96% Inverter efficiency
- 1 Axis tracking (current lowest cost for MWh)
- Ground cover ratio = 0.4

Solar Farm - Assumptions

- DC to AC inverter size ratio = 1.3 : 1.0
  - Typical for large solar farms.
  - The reduction in inverter cost more than makes up for the “clipping” effect when near maximum dc rating
  - Lessens the comparable benefit of 2 axis tracking
- Optimum tilt for latitude to maximize annual production
- Estimated 2020 Project costs
  - Initial Capital = $1.18/Wdc ($118 million)
  - O&M = $16/kW/year
  - PUD could own a fractional share (gross revenue $63 million)
- Evaluated locations
  - Harper Lake Road, CA (Mojave Desert)
  - Ritzville, WA (Optimum location in Eastern Washington)
  - Sequim, WA

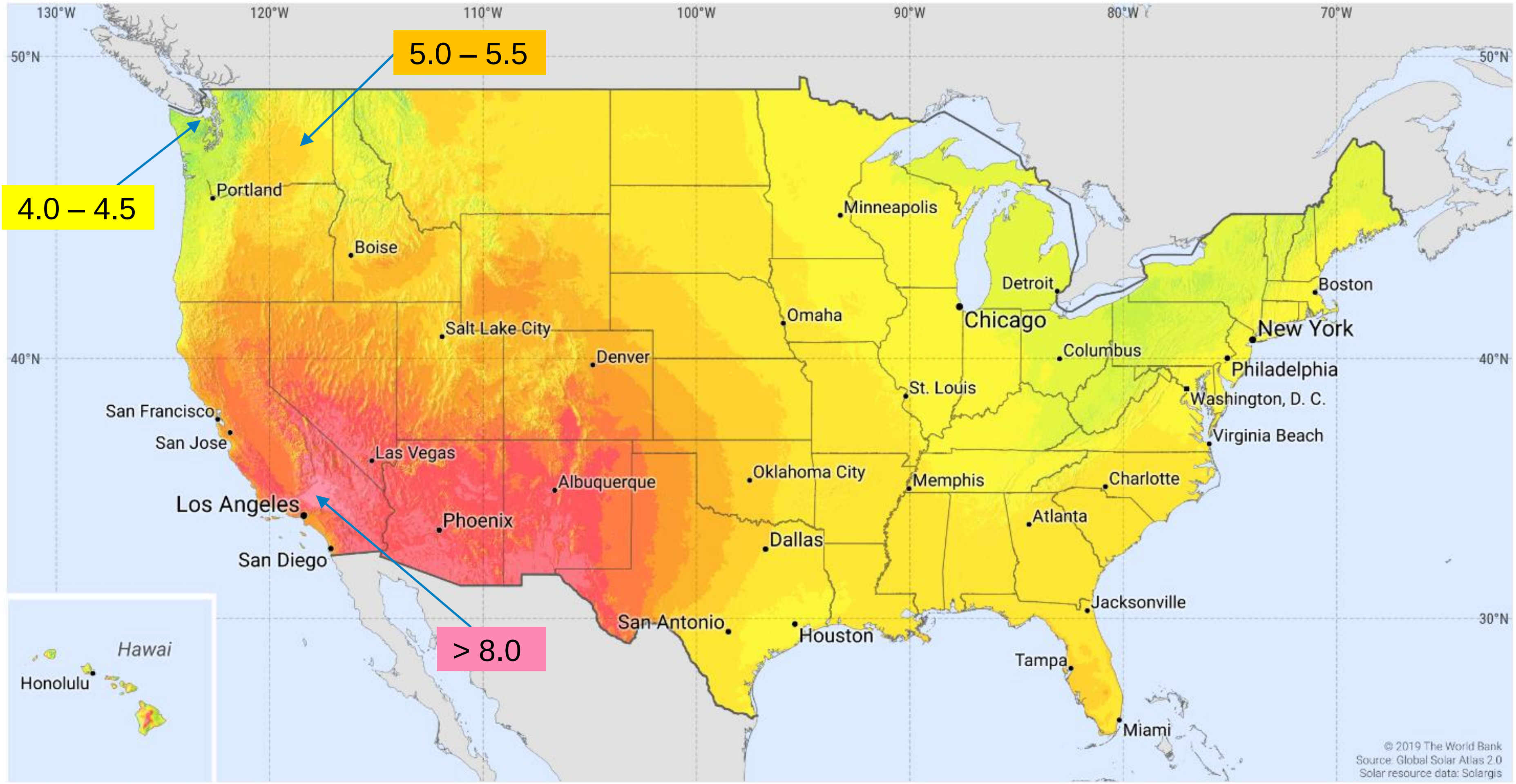
SOLAR RESOURCE MAP

DIRECT NORMAL IRRADIATION

UNITED STATES OF AMERICA

WORLD BANK GROUP

ESMAP SOLARGIS



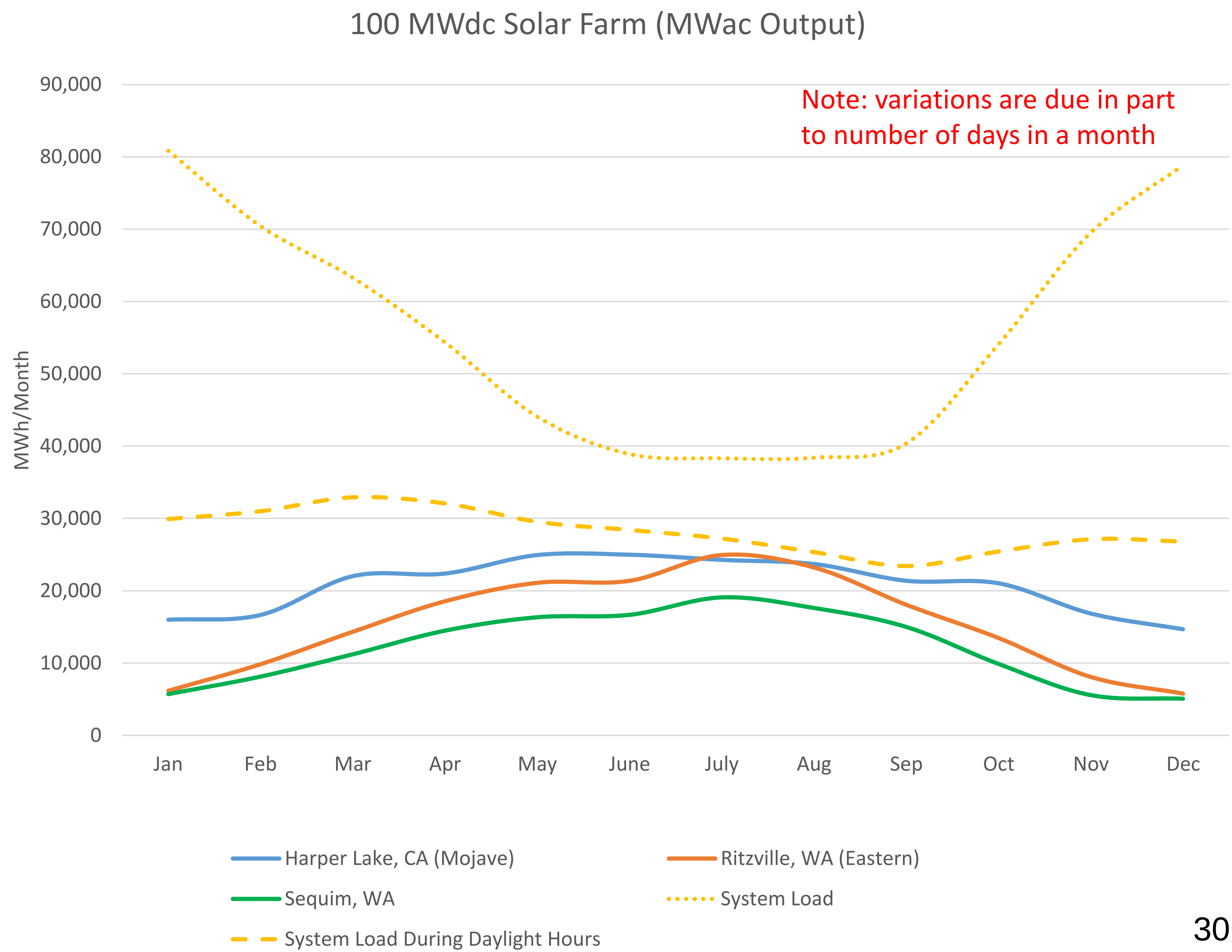
500 km

Long term average of DNI, period 1999-2018

Daily totals:	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	kWh/m²
Yearly totals:	365	730	1095	1461	1826	2191	2556	2922	

Location	Expected Annual Production (kWh)	Estimated Energy Compared to Cloudless Potential (Reliability)	Generation Costs ($ / MWh)
Harper Lake Rd, CA, (Mojave Desert)	248,724,596	98.20%	28.6
Ritzville, WA	184,773,742	73.32%	38.5
Sequim, WA	144,722,419	57.43%	49.2

- Average PUD annual requirement is 671,000,000 kWh
- $28.6 / MWh in-line with recent published projects


100 MWdc Solar Farm (MWac Output)
Note: variations are due in part to number of days in a month
MWh/Month
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Jan
Feb
Mar
Apr
May
June
July
Aug
Sep
Oct
Nov
Dec
Harper Lake, CA (Mojave)
Ritzville, WA (Eastern)
Sequim, WA
System Load
System Load During Daylight Hours

Solar Farm

- Reminder - The District is under contract through 2027 but a large solar farm is scoped for post 2027 options, as well as consideration for future CETA obligations
- Any large solar addition under the current contract would ultimately increase the incremental cost of BPA energy through 2027
- Note that a 100 MWdc solar farm located in the Mojave Desert, in theory, could meet almost 90% of our Summer daylight hour needs
- Solar generation in Washington would be limited in Winter
  - Significantly higher energy consumption
  - Frequent overcast conditions
  - Relative shortness of daylight

Solar Farm
Additional Power Costs

- The Western Interconnect transmission system has bottlenecks
- But we can utilize theoretical cost recovery analysis to estimate an idealized unconstrained transmission system (Energy Institute, University of Austin)
  - $2400 per MW-mile (staff optimistic estimate based on W Texas)
  - 5% ROI
  - 40 year life
  - No additional charges based on resource capacity factor
- We can also estimate the power services cost for Load Following BPA customers, $6/MWh

Solar Farm
Theoretical End User Costs

Location	Generation	Transmission to Clallam[1]	Balancing and Services	Total Cost ($ / MWh)
Harper Lake Rd, CA, (Mojave Desert)	28.6	13.8	6.0	48.4
Ritzville, WA	38.5	3.1	6.0	47.6
Sequim, WA	49.2	0	?	49.2 ?

(1) Based on unconstrained transmission, $2,400 MW-mile

Solar Farm
Future Considerations

Bringing Energy To Life™

- Large solar can generate power at well under $30/MWh in certain areas
  - But not on a firm schedule
- The more optimum locations will be subject to significant transmission costs to reach Clallam PUD
- Unlike EIA, CETA implies a need to be carbon free, and perhaps carbon neutral, for all periods of time
  - Rules are still being drafted
  - Export credit during peak production - doubtful
  - Offset from peak production applied to carbon supply - doubtful
- Enablers for reliance on solar power, at additional costs
  - Integration of substantial energy storage, such as batteries
  - Energy storage at the point of use may avoid transmission costs, but full storage utilization may be limited, unless exports to meet outside needs are practicable
  - Excess solar production capacity across a wide geography
  - Elimination of transmission bottlenecks

Solar Farm with Battery Backup

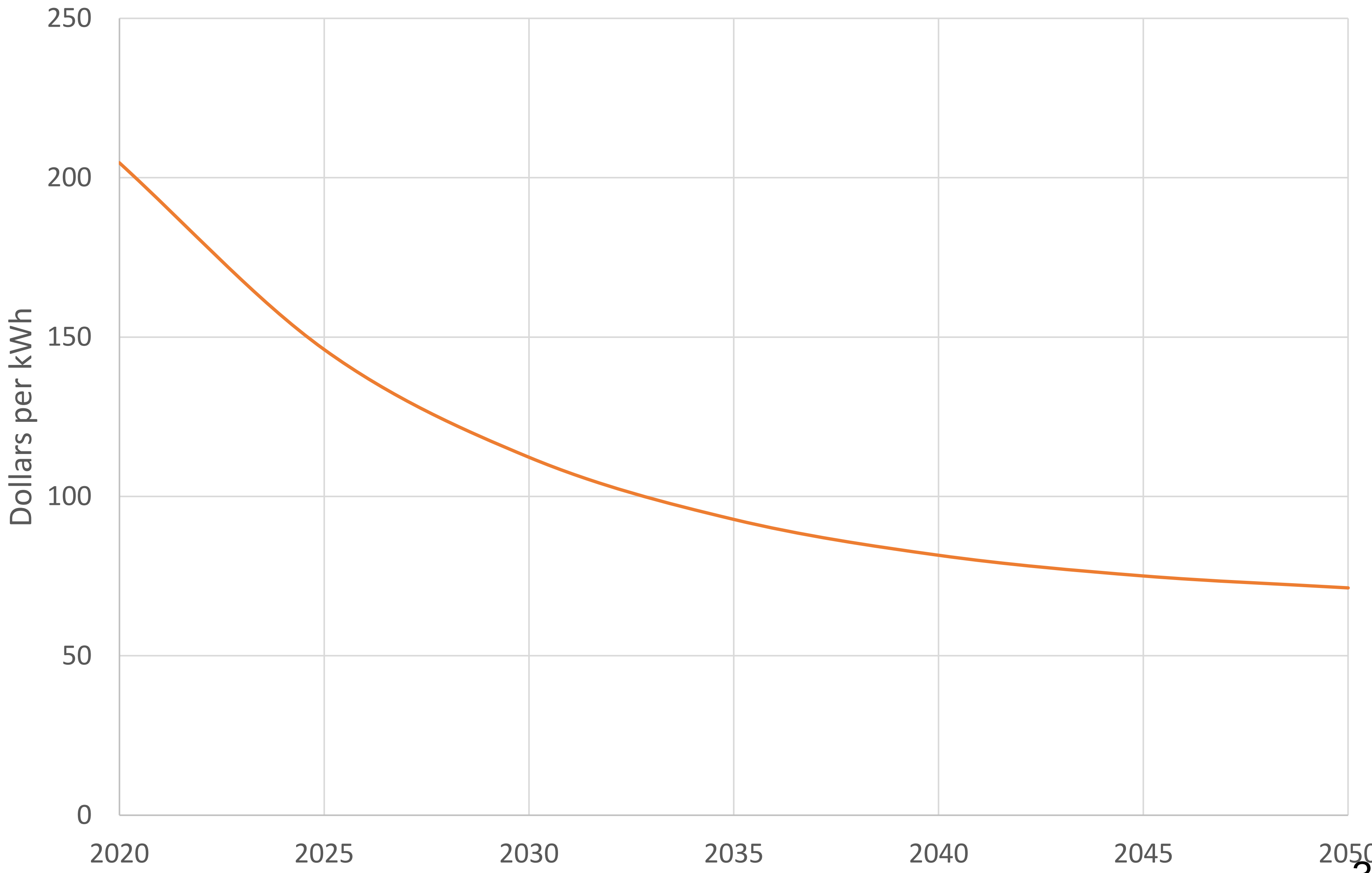
Solar Farm with Battery Backup

- Solar farms can be made more reliable with the introduction of batteries
  - For areas with high solar reliability, a two hour battery can generally make the production 24-hour firm during daylight hours
  - At a level close to system design rating, for daylight hours
  - Lower solar reliability requires larger batteries to achieve the same effect, usually at a level less than design rating
  - For Washington, daylight 24-hour firm would be at best seasonal, unless systems are significantly oversized
- Batteries can also advantageously shift production to match demand, especially for summer evening peaking loads

Solar Farm with Battery Backup - Assumptions

- Previous 100 MWdc solar farm analysis
- 2018 NREL U.S. Utility-Scale Photovoltaics Plus-Energy Storage System Cost Benchmark
- 2020 NREL Cost Projections for Utility Scale Battery Storage Update
- 60 MW 120 MWh battery (2 hour battery)
- 15 Year battery life, 2 X 15 system life
- 85% Discharge cycle
- 120 MWh Battery system capital cost = $49,695,000 (2020)
- Li-Ion capital replacement cost in 2035 = $12,279,000
- Battery O&M = 0.75% of original capital cost

Li-Ion Battery Cost, 60MW 120MWh $/kwh
Cost Projections (NREL – mean case)



100 MWdc Solar Farm with 60 MW 120 MWh Battery - Costs

Location	Generation	Transmission to Clallam(1)	Balancing and Services	Total Cost ($ / MWh)
Harper Lake Rd, CA, (Mojave Desert)	41.8(2)	13.8	6.0	61.6(3)
Ritzville, WA	56.3	3.1	6.0	65.4(4)
Sequim, WA	71.8	0	?	71.8(5) ?

(1) Based on unconstrained transmission, 2,400 MW-mile

(2) $41.8 / MWh in-line with recent publicized projects

(3) 24 hour firm at or near capacity

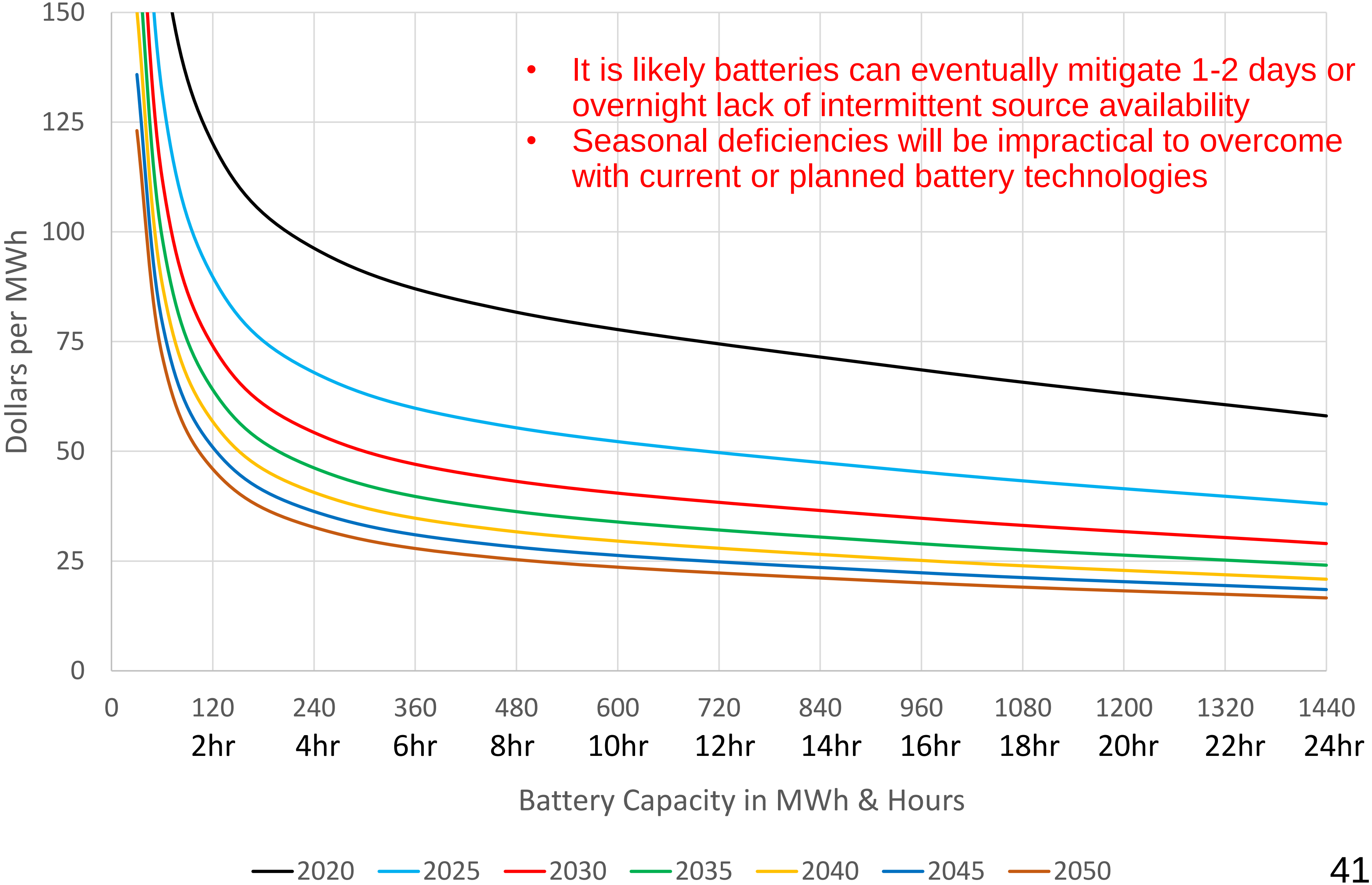
(4) 24 hour firm seasonally ?

(5) Not firm near capacity, battery largely ineffective for this purpose

Solar Farm & Battery Future

- Further cost reductions expected from:
  - PV thin film technologies, including shaping & building materials
  - Lower capital and O&M cost for two axis tracking systems
  - Substantial reduction in Li-Ion Battery costs over the next three decades
  - Longer Li-Ion battery life and charge retention
  - Battery repurposing? (old electric vehicle batteries)
  - Thermal or liquid salt batteries
  - Long-term energy storage utilizing hydrogen
- Solar with batteries are unlikely to match current power supply costs, but over time these sources may offer the lowest cost option to meet CETA obligations
- Staff intends to update this analysis periodically

Total Cost to Charge & Discharge 1 MWh for 60 MW Battery System
Projected Li-Ion Cost Reduction, Charge Life and Discharge Cycle



- It is likely batteries can eventually mitigate 1-2 days or overnight lack of intermittent source availability
- Seasonal deficiencies will be impractical to overcome with current or planned battery technologies

Long Term Energy Storage Hydrogen Gas

- Combustion of hydrogen and oxygen generates H_2O as opposed to CO_2
- Large scale hydrogen generation from water is in advanced developed as a non-carbon source of electricity
  - Production of hydrogen during periods of renewable energy abundance
  - Stored hydrogen is used to generate electricity during energy deficit
  - Feasible solution to long-term or seasonal energy deficiency
  - Numerous technological challenges to overcome
  - Douglas PUD has initiated a renewable hydrogen project
- Practical constraints
  - The efficiency to convert energy to hydrogen is about 65%
  - The conversion of hydrogen to electricity by combined cycle turbine or fuel cell is on the order of 55%

Long Term Energy Storage Hydrogen Gas

- Infrastructure cost for generation based on hydrogen combustion is somewhat similar to natural gas, with additional technological challenges, including liquid storage
  - Generation perhaps ≈ $50 / MWh when technology is mature ?
- Hydrogen generation will be comparatively expensive
  - Cost of Hydrogen = $Energy Source Cost / (0.65 x 0.55) + $50 per MWh
  - Low cost source: $20 / (0.65 x 0.55) + $50 = **$106 / MWh**
  - Moderate cost source: $40 / (0.65 x 0.55) + $50 = **$162 / MWh**
- Renewable hydrogen provides a strong argument for a more robust electric transmission system between regions of optimum generation and regions where energy is used, or used to produce hydrogen

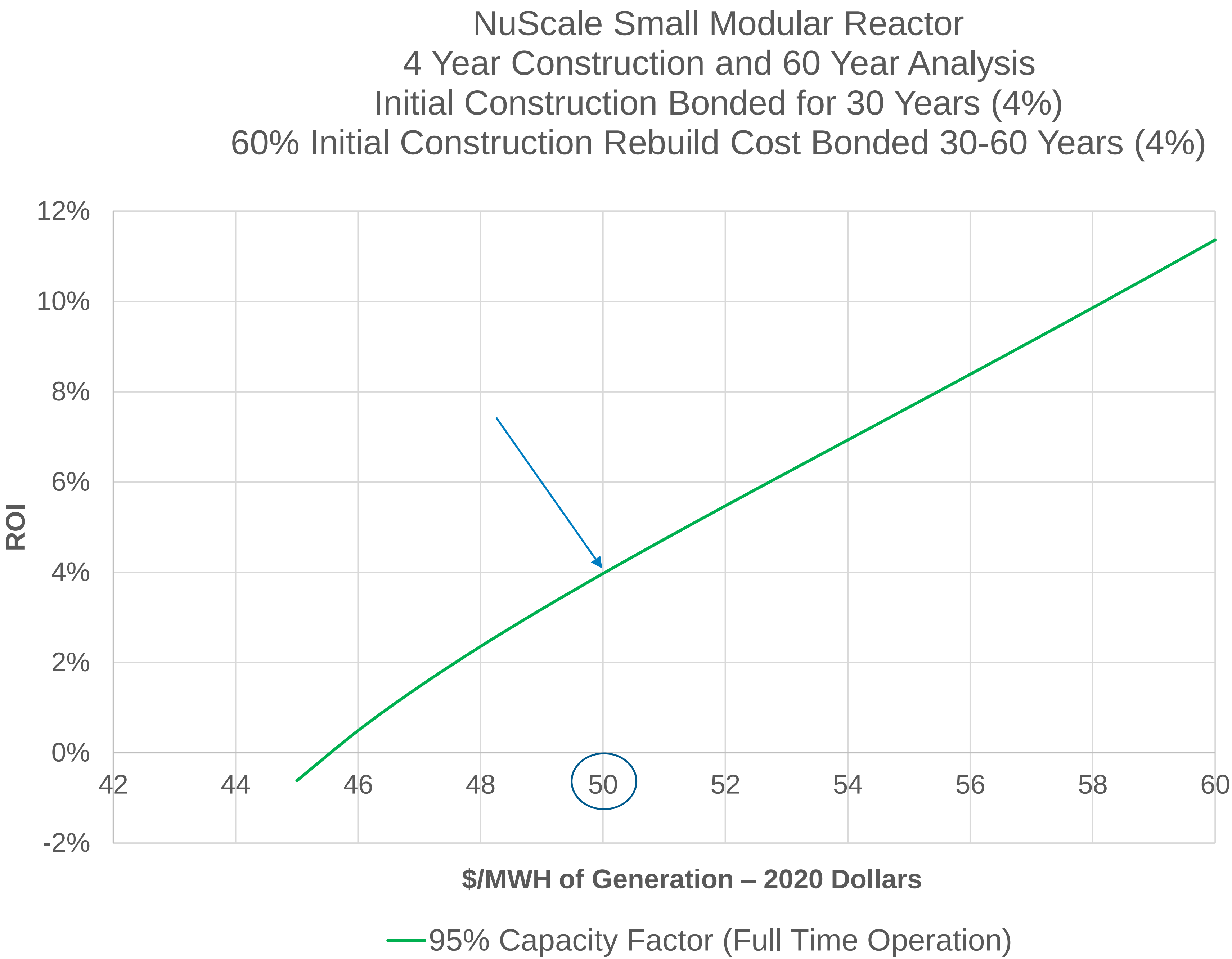
Small Modular Reactor
SMR (NuScale)
SMR (Natrium?)

NuScale SMR Primary Sources

- Economic Impact Report for Construction and Operation of a Small Modular Reactor Generation Facility at the Idaho National Laboratory, Butte County Idaho; Jan 29, 2019
- SMR Start, The Economics of Small Modular Reactors; Sep 14, 2017
- A techno-economic assessment of NuScale and DHR-400 reactors in a district heating and cooling grid; Mar 27, 2019
- Economic viability of light water small modular nuclear reactors: General methodology and vendor data; accepted Dec 18, 2018

NuScale SMR - Assumptions

- Nominal rating = 720 MW
- Electric rating = 685 MWe
- Initial Capital cost = $4,200 per kWe ($3.02 Billion)
- Fixed O&M cost = $150 per kWe per year
- Variable O&M costs = $13 per MWh
- Capacity Factor 0.95
- Four year construction period
- Replacement of 60% initial capital at 30 years
  - Largely for non-nuclear secondary steam generation systems
  - Financed at 30 years of age through the 60th year
  - 60 Year service life


NuScale Small Modular Reactor
4 Year Construction and 60 Year Analysis
Initial Construction Bonded for 30 Years (4%)
60% Initial Construction Rebuild Cost Bonded 30-60 Years (4%)
ROI
12%
10%
8%
6%
4%
2%
0%
-2%
42
44
46
48
50
52
54
56
58
60
$/MWH of Generation – 2020 Dollars
95% Capacity Factor (Full Time Operation)

NuScale SMR - Costs

Location	Generation	Transmission to Clallam	Balancing and Services	Total Cost ($ / MWh)
SMR, Idaho	50.04	3.56(1) 4.57(2)	6.0	59.96(1) 60.91(2)
Current BPA Tier 1	32.44	4.57(2)	6.0	43.01
Current BPA Tier 2 or Carbon	26.21	4.57(2)	6.0	36.78

(1) Based on unconstrained transmission, $2,400 MW-mile

(2) Based on actual transmission

NuScale SMR - Costs

- A PUD 1% share in a SMR = 6.5 aMWe
- $30 Million initial investment
- 8.5% of annual District power needs
- SMR cost above carbon alternative, $24 / MWh
- Roughly 2% retail sales long term costs
- Will approximately meet the CETA 2% cap over life
- Probably not needed prior to the 2045 zero carbon requirement, but requires 10-15 year planning horizon

Natrium SMR ?

- Founded by Bill Gates (Terra Power LLC)
- 345 MWe Reactor with 500 MWe peaking capability
- Includes liquid sodium thermal energy storage to integrate with intermittent renewables
- Commercial viability late 2020s ?
- Coincidental to Clallam CETA obligations ?
- Insufficient literature to conduct economic analysis or otherwise scope.
- Potentially promising technology

SMR Future

- Until SMRs are actually constructed, cost analysis is speculative
- Further cost reductions are likely if multiple projects of a particular design occur nationally
- SMR will not match current power supply costs, but the source is the only base-load resource currently feasible to meet CETA Requirements
- Staff intends to update this analysis periodically

CETA Section 12

Direct Assistance
Community Solar
Weatherization

Direct Assistance
Low Income Customers

- The value of direct assistance to a customer for energy assistance is simply the residential cost of a MWh
  - $74 / MWh in 2020
- Advantage, relatively low cost and easy to administer
- Disadvantage, no conservation, health or societal benefit
  - Not included in CETA 2% cost cap
- Rate impact based on proportional monetary target
  - 4.63% by 2030
  - 6.95% by 2050
- Rate impact to achieve a customer count target
  - 5.54% by 2030
  - 7.29% by 2050

Low Income Community Solar - Assumptions

- NREL Literature & Watts Calculator
- Sequim Location
  - No land costs (existing Windy Way or other PUD property – 158’ X 94’)
- Solar 100 kWdc; 30 year life
  - Significantly larger systems requires BPA interconnect and probably procurement of land
  - Until thin film PV technology and systems are more fully developed, ground mounted systems offer the lowest cost option.
- Battery 50 kW, 100 kWh; 2 X 15 year life
- 0.7%/year annual panel degradation
- 8% I2R, conversion and shading losses
- 96% Inverter efficiency
- Fixed rack, southward facing

Low Income Community Solar - Assumptions

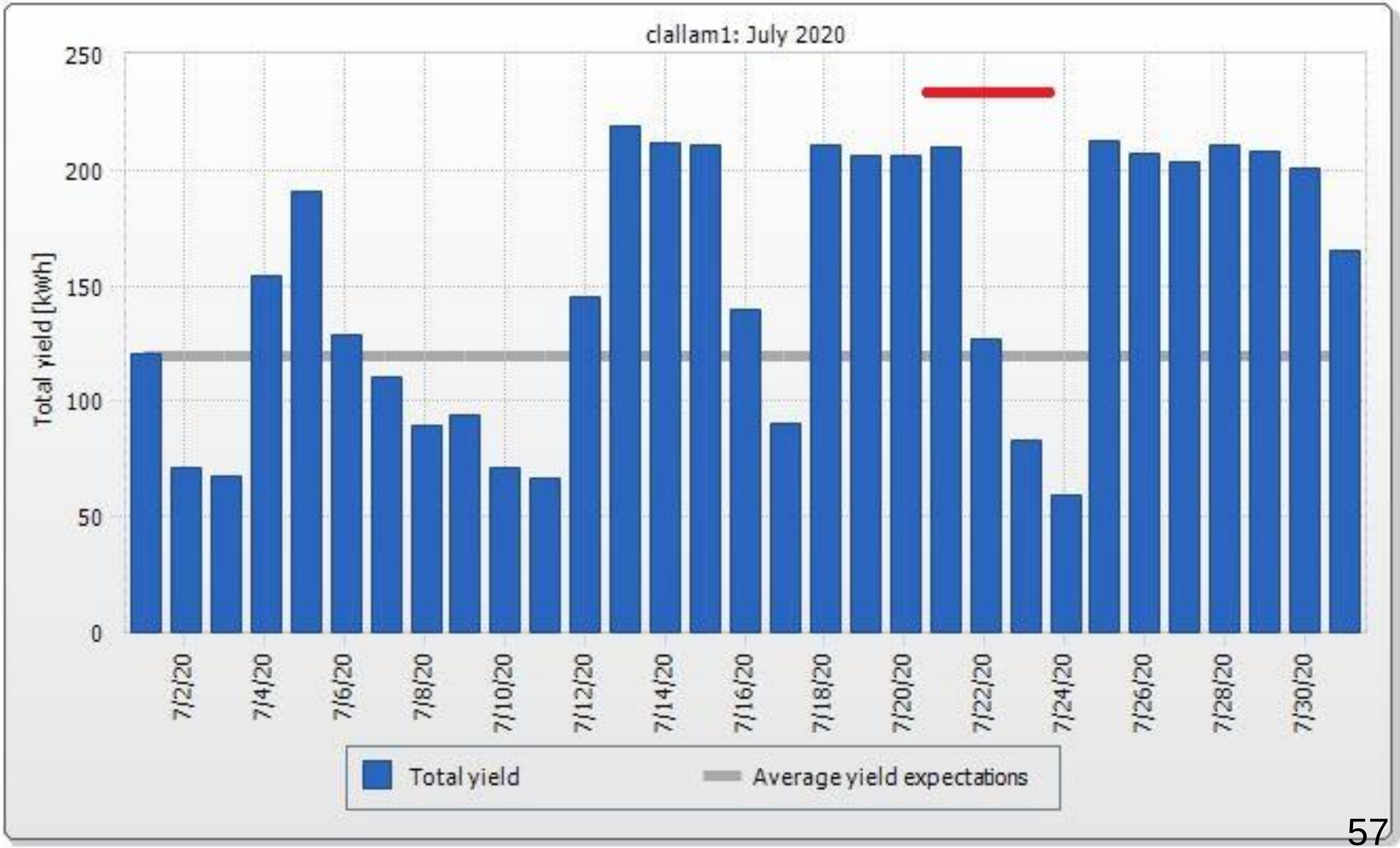
- Funded by PUD customers
- Shares directed to low income customers to offset utility bill cost
- Solar Cost
  - Capital - $2.00 / Watt (Sequim Solar was $3.60 / Watt)
  - O & M - $14 / kW / year
  - Existing PUD property available
- Battery system cost, if included
  - Capital in 2020 = $122,000
  - Battery replacement 2035 = $48,800
- Estimated first year annual production = 121,085 kWh
  - EAN assistance value = $8,960 / year average over 30 years
  - Note the 2030 EAN target = $2,460,000 / year

Community Solar Cost of Production

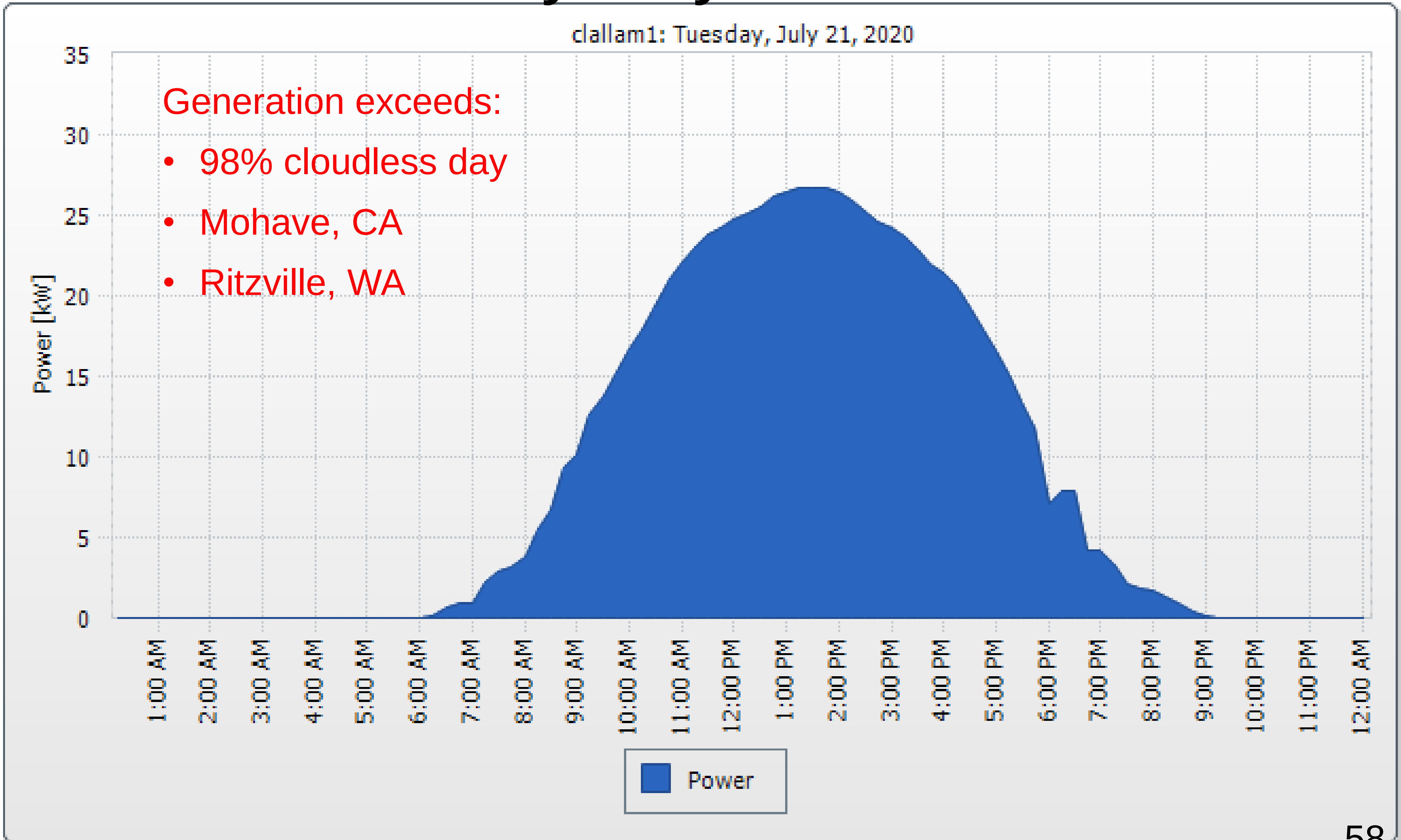
	100 kWdc Facility Location	Generation Value(1) ($ / MWh)	Grant Funding Needed(1)	Grant Eligible WA
No Battery	Sequim E Washington S California	87.5 72.1 54.8	16% 0% 0%	No No No
With Battery	Sequim E Washington S California	160.0 131.8 98.7	54% 44% 25%	Yes Yes No
	Clallam Retail Rate	74		

(1) From investor standpoint a positive return requires cost of production to be below the retail net meter retail rate, or the availability of offsetting funds

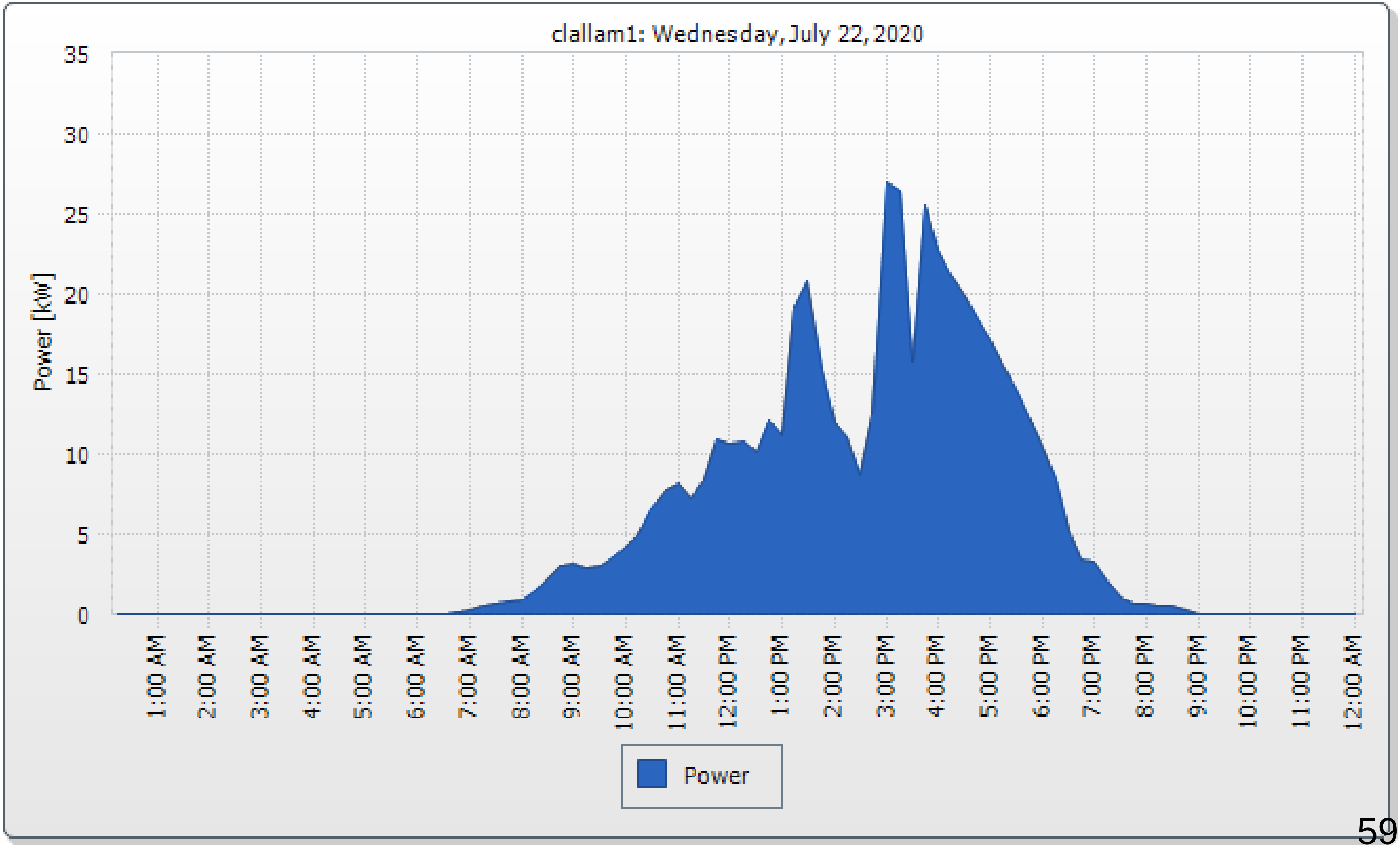
Community Solar Challenges for Clallam



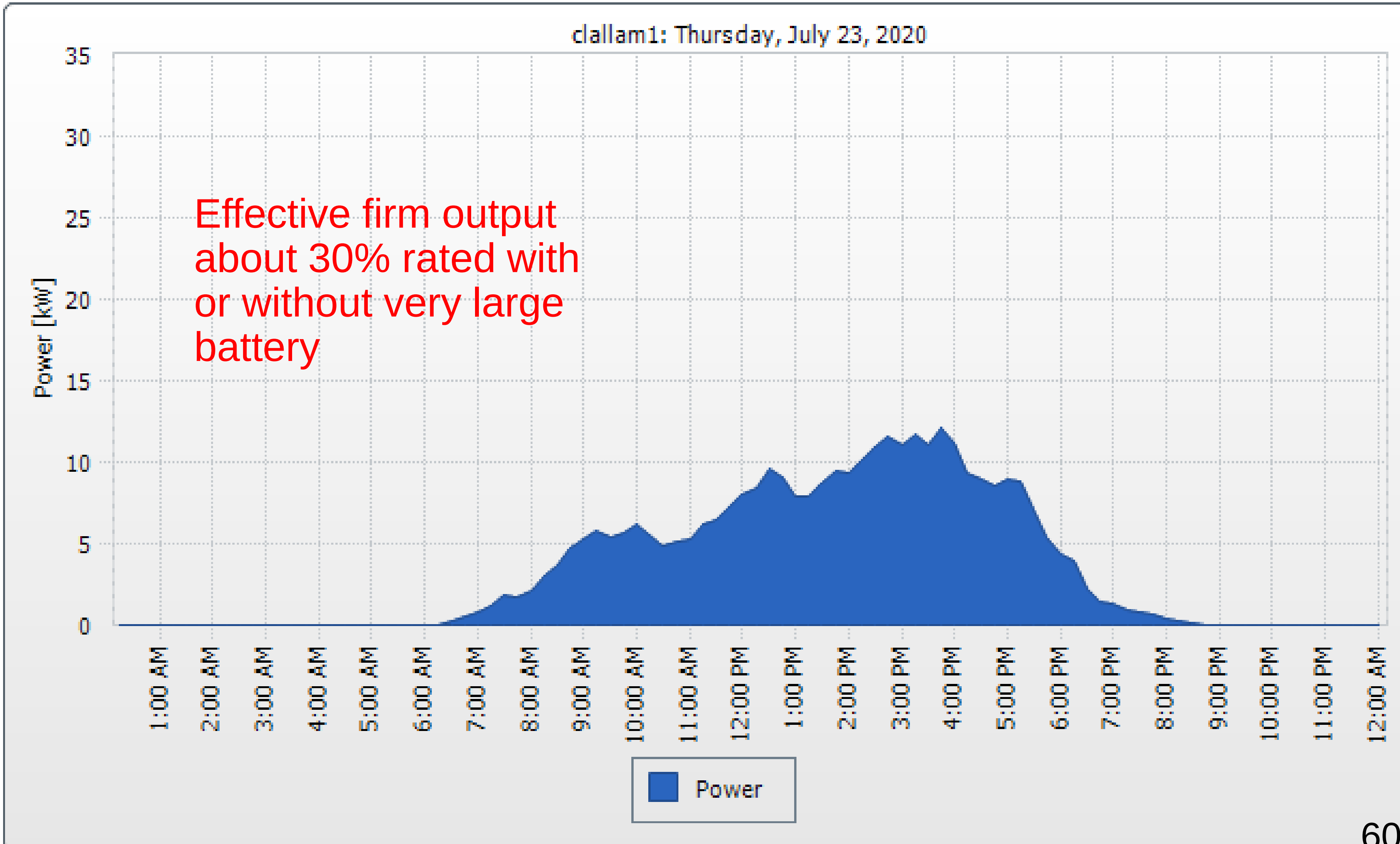
Community Solar 7/21/20, Sunny Day



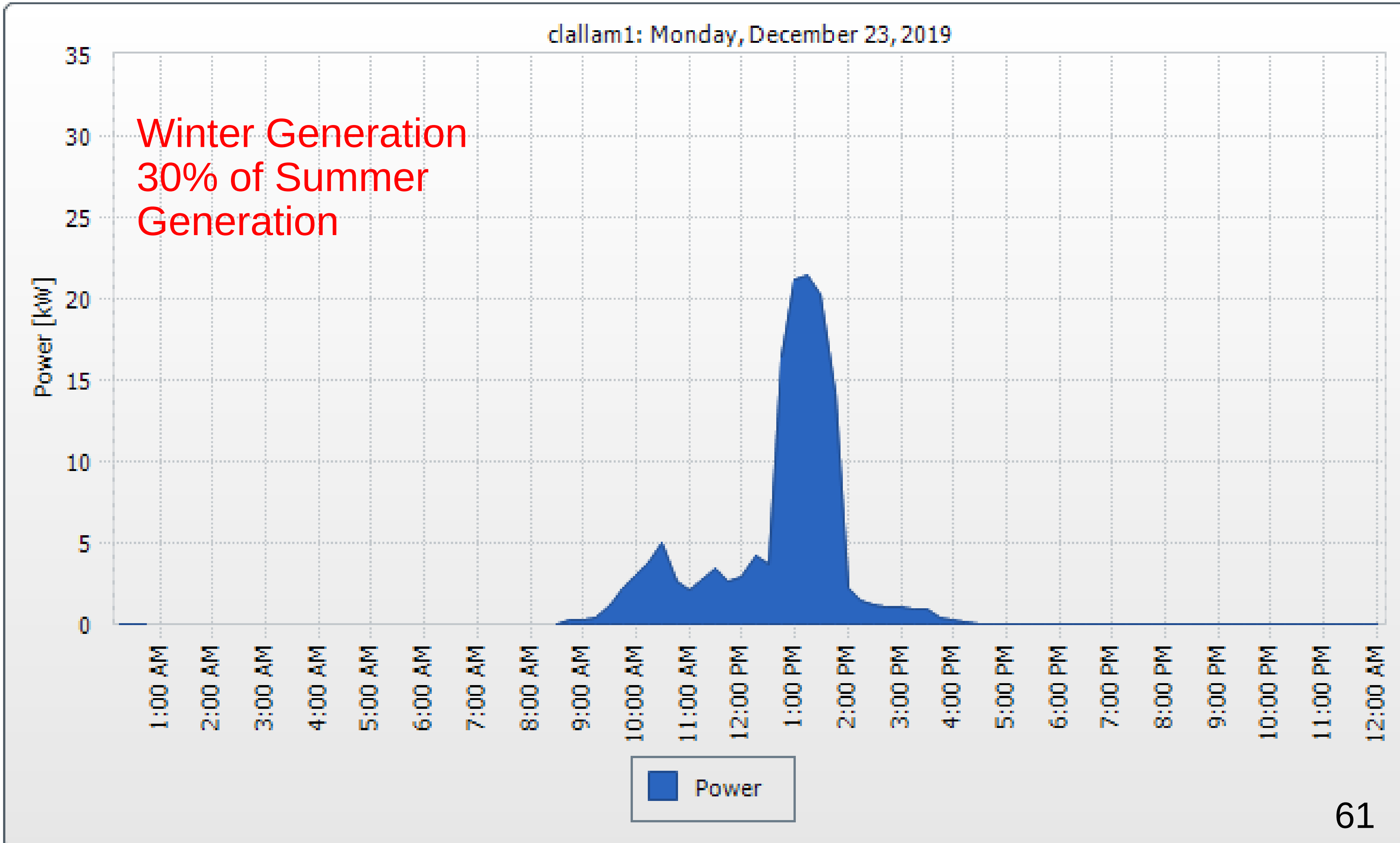
Community Solar
7/22/20, Partly Cloudy



Community Solar
7/23/20, Overcast



Community Solar 12/23/19, Partly Cloudy

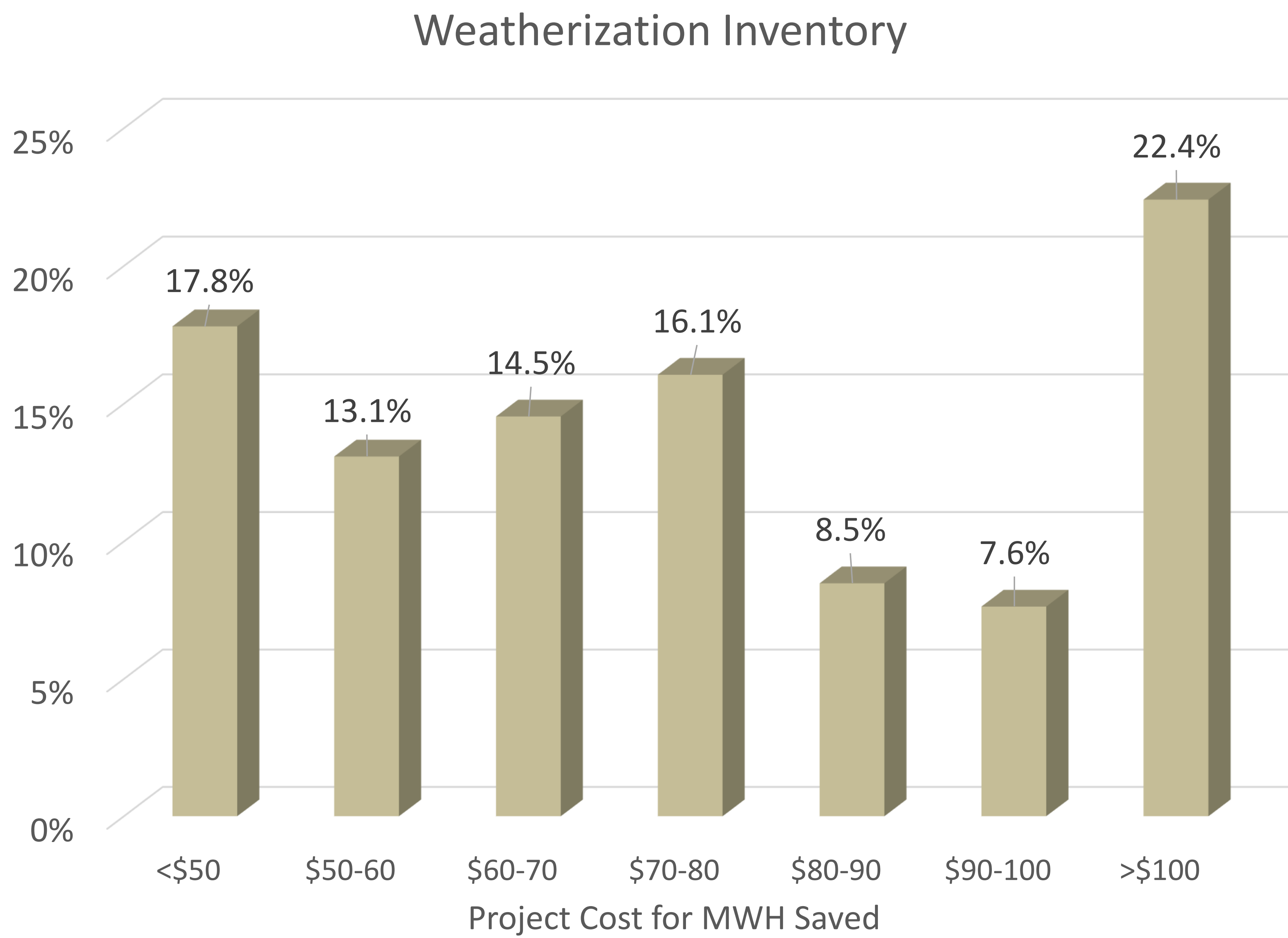


Weatherization

- Sources and references
  - BPA Low Income Programs
  - Past PUD Conservation Programs
  - City of Port Angeles Low Income Program
  - Clark PUD Low Income Program with CAP Agency
  - OlyCAP
- Assumptions (very speculative and preliminary)
  - OlyCAP funds administration & related repair not associated with kWh reduction using State and/or Federal funds
  - PUD funds the entirety of the conservation project cost
  - Target the more cost effective weatherization programs
  - 30 to 40 year life depending on program specifics
  - No credit for non-financial health or societal benefits of weatherization (not referenced in CETA)

Weatherization Targeting Programs

- Examples of more cost-effective programs
  - Air sealing
  - Attic, wall and floor with existing insulation less than R19
  - Low emissivity storm windows
  - Upgrade of very high U-factor single pane windows to 0.30
- Examples of less cost-effective programs
  - Attic, wall and floor insulation already over R19
  - Insulated doors
  - Upgrade of widows with existing relatively low U factor



Weatherization Inventory
25%
20%
15%
10%
5%
0%
17.8%
13.1%
14.5%
16.1%
8.5%
7.6%
22.4%
<$50
$50-60
$60-70
$70-80
$80-90
$90-100
>$100
Project Cost for MWH Saved

CETA Section 12 Project Comparison

Facility & Location	Effective "Cost" Energy Basis ($ / MWh)	Annual Cost to Meet 2030 CETA EAN(1) Target
Direct Monetary Assistance Based on Retail Rate	74.0	$2,460,000
Community Solar without Battery	87.5	$2,909,000
Median Weatherization Project – PUD Cost	71.1	$2,364,000
Targeted Weatherization	50.0 60.0 70.0	$1,662,000 $1,995,000 $2,337,000

(1) EAN = Energy Assistance Need

CETA 1200 Projects

- Current District low income programs are based on direct assistance applied to the monthly charge
  - Not fully CETA compliant
  - Potential to address only a fraction of District EAN
  - No conservation (energy), health or societal benefits
- Weatherization conservation targeted to high energy burden households is likely the lowest cost remedy to meet 2030 EAN target
- In many cases, conservation kits consisting of the following are comparable to the most cost effective weatherization inventory
  - Low flow showerheads
  - Basic air sealing materials for DIY projects
  - Low flow aerators
  - Smart thermostats
  - Energy use literature and education materials

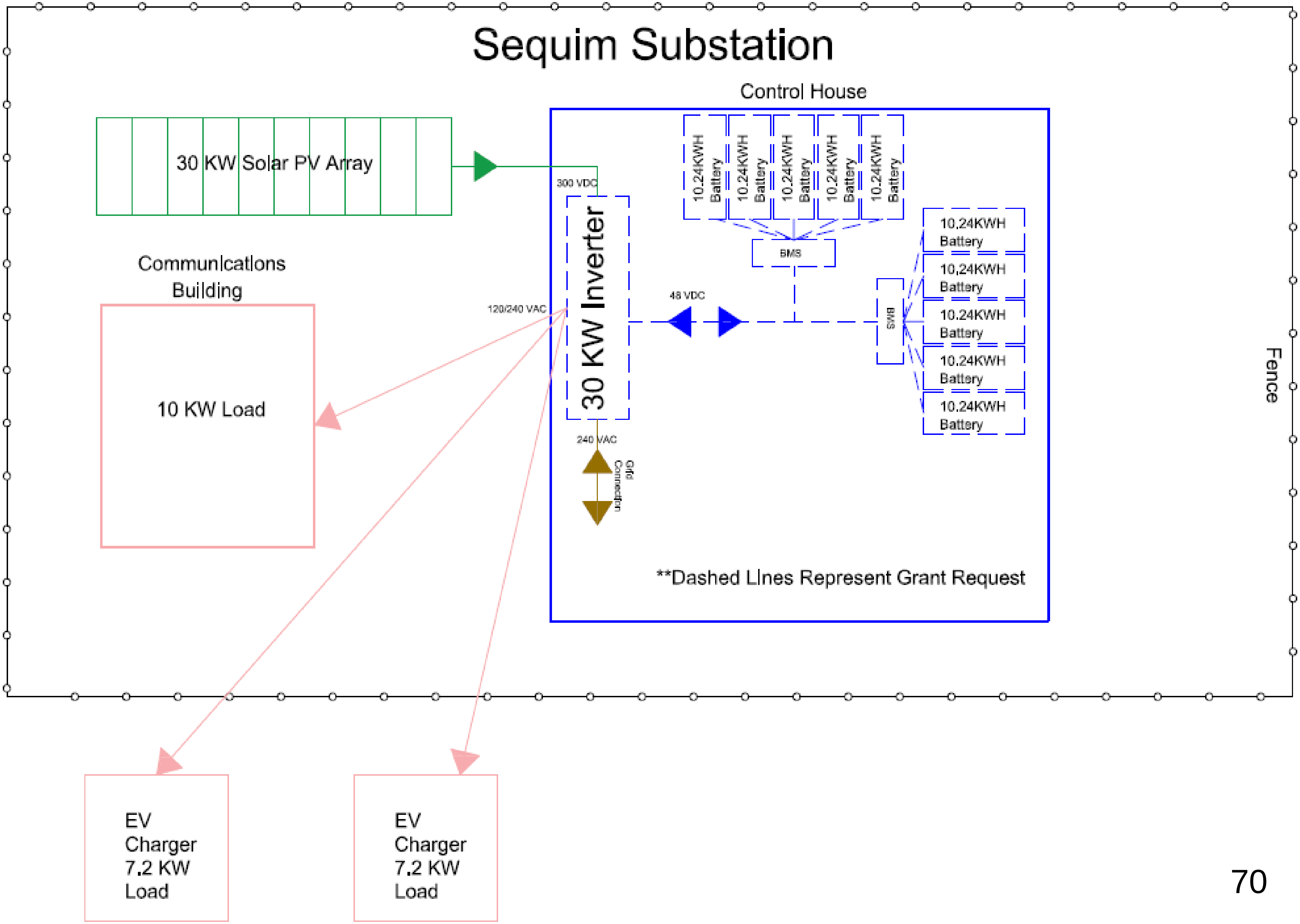
CETA 1200 Projects

- Low-income community solar may become the lowest cost effective way to meet the 2050 EAN target
    - Potential future reduction in generation costs below the cost of direct assistance, as is already the case in parts of Eastern Washington
    - Exhaust the more cost effective weatherization inventory and conservation kits
- CETA does not address if our PUD could participate in a more cost effective community solar project, or even in a shared large solar farm project in Eastern Washington
    - Administration, energy accounting, or transmission may add additional cost to such a project
    - A significant share in a solar farm may not be possible under the current BPA contract without negatively affecting cost of our BPA power

Research and Development

Solar-Battery-Micro Grid

- Project approved under the 2020 Budget
- Conditional on substantial grant funding
- Research and development project
- Reinforces the District's as well as regional broadband networks
- Reliability enhancement, no financial ROI
- Located at the old Sequim substation site
- Cost might fall under CETA "2% Cap"


Sequim Substation
Control House
30 KW Solar PV Array
300 VDC
10.24KWH Battery
10.24KWH Battery
10.24KWH Battery
10.24KWH Battery
10.24KWH Battery
BMS
10.24KWH Battery
10.24KWH Battery
10.24KWH Battery
10.24KWH Battery
10.24KWH Battery
BMS
48 VDC
30 KW Inverter
120/240 VAC
240 VAC
Grid Connection
Communications Building
10 KW Load
**Dashed Lines Represent Grant Request
Fence
EV Charger 7.2 KW Load
EV Charger 7.2 KW Load

Solar-Battery-Micro Grid Proposed Funding

- District - $150,000
- PNNL – $125,000
- Grants - $275,000
  - Washington State
  - APPA Deed
- Speculative
- Project delayed and grants may not be forthcoming
  - COVID-19, primarily at the State level

Emergent Technologies
Significant PUD Participation

- 2008-2011 Worked with Energy Northwest and 5 PUDs in an unsuccessful attempt to develop an 80 MW wind farm at Radar Ridge in Pacific County
  - Endangered Species, Marbled Murrelet
  - $304,132 Clallam PUD Investment, largely on Environmental Impact and Interconnect Studies.
- 2013-2020 Worked with BPA & Leidos Engineering to develop the region's first successful SCADA & line monitoring Voltage Optimization Program
- 2017-2019 partnered with the City of Sequim to develop a level 2 charging station on District property
- 2018-2019 worked with PNNL, APPA and the Department of Commerce to developed the Sequim Micro-grid concept and project
- 2018-2020 Partnered with Landis & Gyr to initiated the highest benefit to cost AMI conversion of any regional utility with comparable terrain and vegetation
- 2018-2020 Commenced planning with Energy Northwest & Department of Commerce to establish level 3 EV charging corridor for Hwy 101

Emergent Technologies

Cursorily Staff Review and Analysis

- 2007-2008, Sea Breeze Pacific Juan de Fuca HVDC Cable
  - Project canceled, permitting and environmental issues
- 2007-2009 British Columbia-based Finavera Renewables, Neah Bay Wave Energy
  - Project canceled, permitting and environmental issues
- 2010-2011 Energy Northwest & Energetics Renewables Christmas Valley OR Solar Project
  - Project constructed 2014 without ENW or District participation
- 2018 Contracted BEF Community Solar Project
  - The District elected to manage an in-house alternative
- 2020 Discussion & analysis of proposed PNNL Marine Renewable Energy (MRE) project for 3 X 5kW tidal generators in Sequim Bay
  - Currently scoping

Wind Farm
Not Recently Scoped

2018 NREL
Mean LCOE = $42 / MWh
Relatively Mature Technology

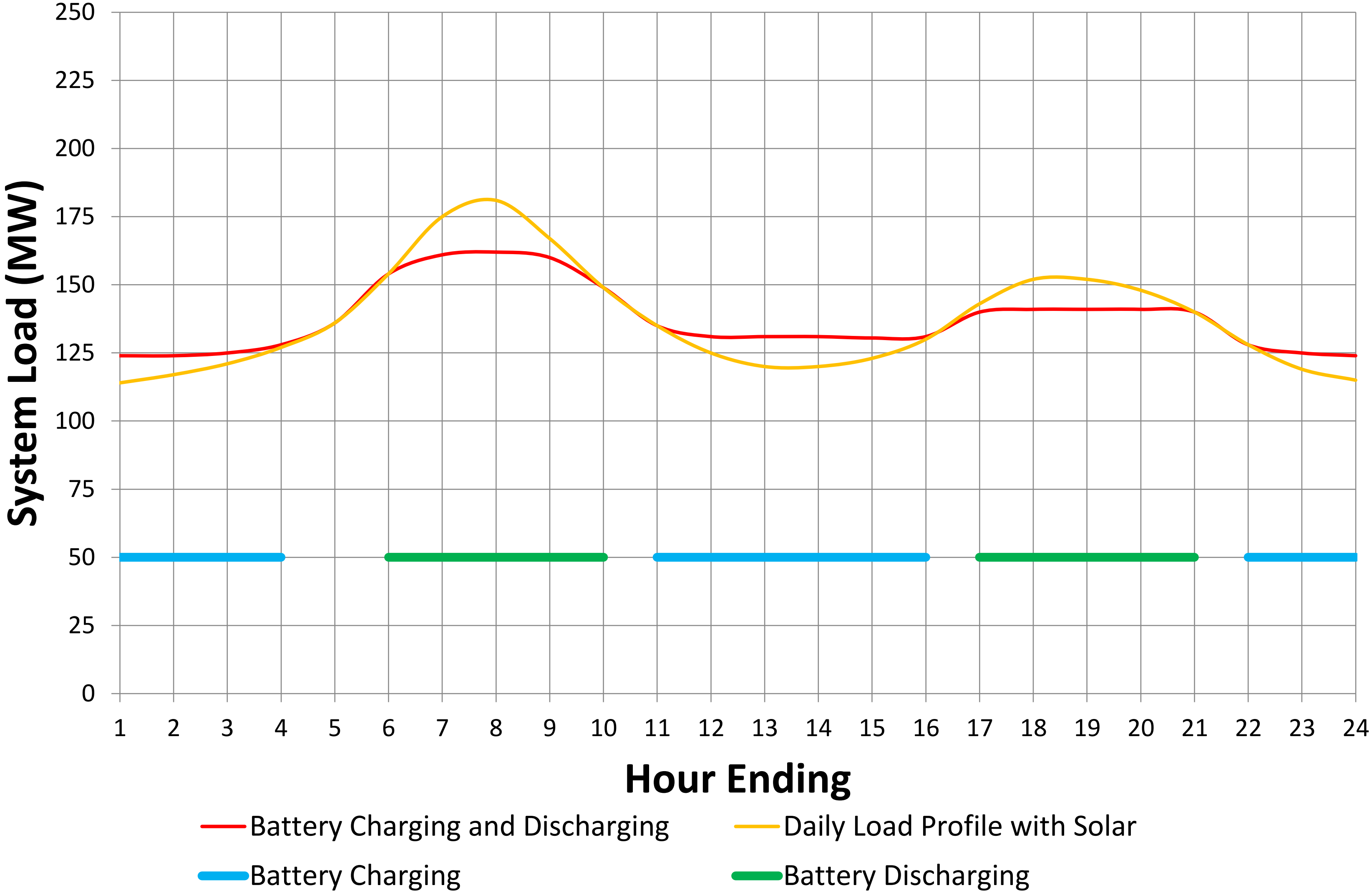
Marbled Murrelet
…..Not a Big Fan, of Wind

Distribution Scale Battery

Distribution Scale Battery

- Periodically evaluated since 2014 (SnoPUD)
- Why do this?
  - Charge during low energy cost periods
  - Discharge during high energy cost periods
- 2018 NREL U.S. Utility-Scale Photovoltaics Plus-Energy Storage System Cost Benchmark
- 2020 NREL Cost Projections for Utility Scale Battery Storage Update
- District Cost Estimate, market conditions and recent quotes
- Battery integrated into the main 12.5 kV bus at one of our two largest load substations

Battery Peak Shaving Concept



Distribution Scale Battery
5MW 20 MWh – if in 2020

Description	Unit	Cost	Total Cost	% Taxable	
20 MWH Lithium Ion Battery	$222.50	/kwh	$4,450,003	100%	
(4) 40' Insulated Containers w/ 4 MWH each & (4) 30' Insulated Containers w/1 MWH each (Includes custom design for wiring, HVAC, Fire Suppression, foundations)	$1,000.00	/sq ft	$2,240,000	100%	(contractor)
(4) 1.5 MVA inverters	$140.00	/Kwatt	$840,000	100%	(contractor)
(4) 1.5 MVA transformers (Use $50,000/unit from 2006 PUD purchase price($40,912) + 2% inflation)	$50,000.00	/ea	$200,000	100%	
Site Preparation	$100,000.00	/ea	$100,000	100%	(contractor)
Substation Breaker (Use spare feeder bay in Prairie Sub)	$40,000.00	/ea	$40,000	50%	
Fencing cost (550 ft Chainlink)	$65.00	/ft	$35,750	100%	(contractor)
Transformer installation 4 total (Material not including transformer/labor)	$8,158.00	/ea	$32,635	80%	
Transformer vault instllation 4 total (material/labor)	$6,630.00	/ea	$26,520	80%	
Trenching cabling primary (330', $17.95 + $8.20 trench/ft)	$26.15	/ft	$8,629.50	10%	
JBOX installation (material/labor; $4400 for JBOX+$4620 for vault)	$8,020.00	/ea	$8,020	75%	
Secondary cabling and trenching (200') $26.26/ft	$26.15	/ft	$5,230	100%	(contractor)
PUD site prep (vault site prep, other work)			$5,000	0	
Permitting			$90,000		
Engineering (10%)			$808,179		
Sales Tax (8.8%)			$699,176		
Total Cost			**$9,589,142**		

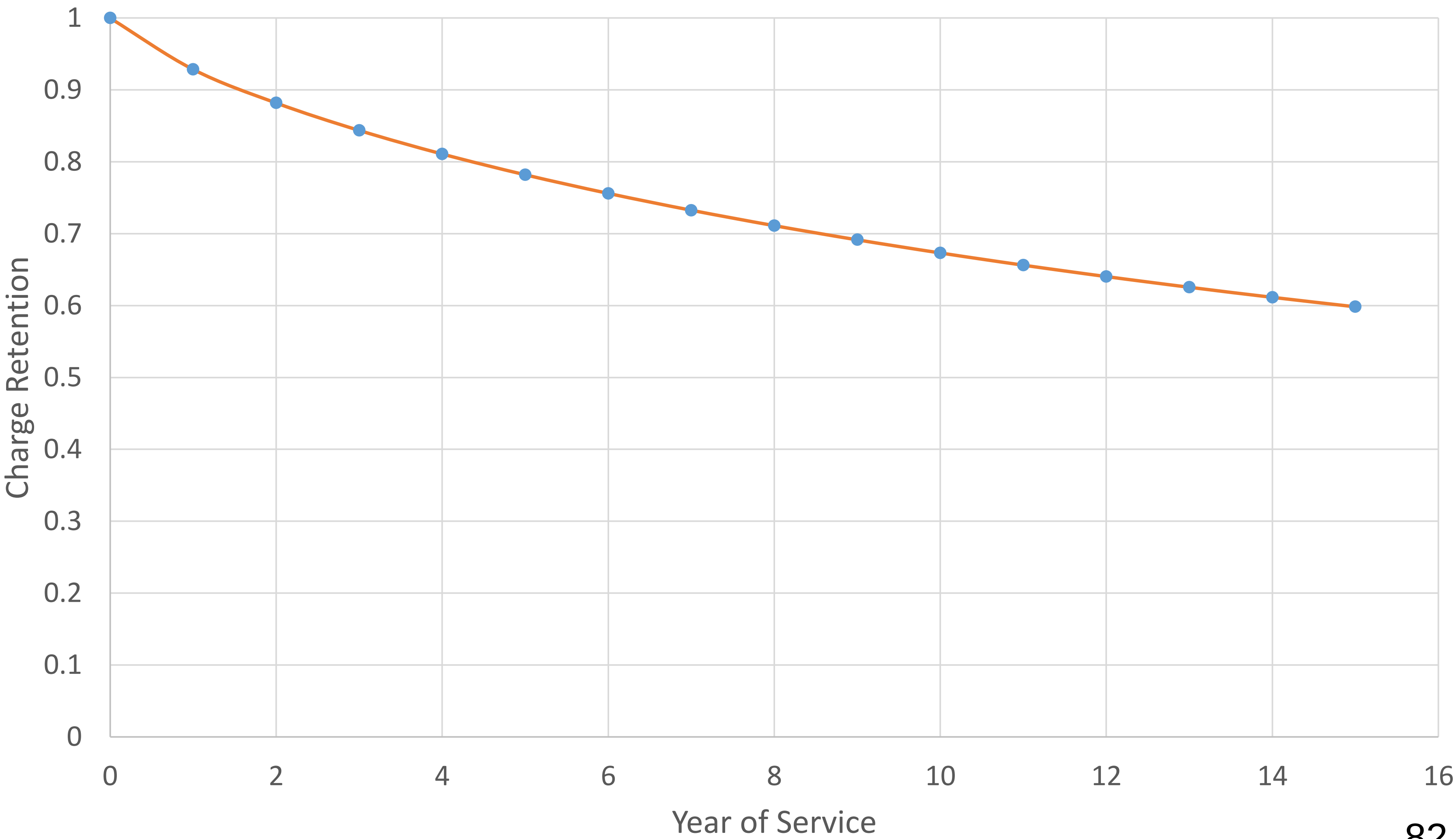
Distribution Scale Battery Assumptions

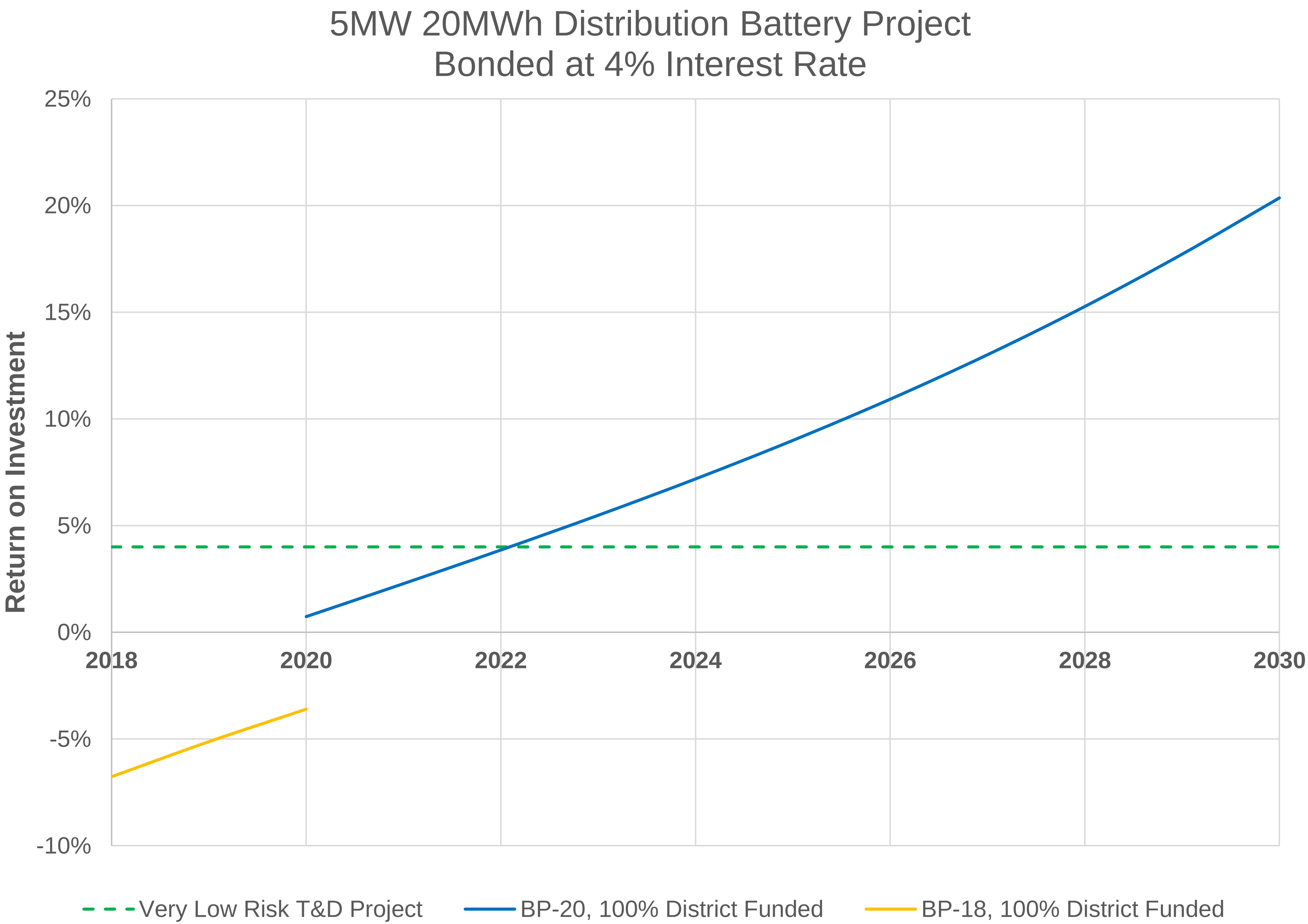
- Nominal rating = 5 MW, 20 MWh
- System life = 30 years
- Battery life = 2 X 15 years
- 85% Discharge cycle
- Initial cost = $9,589,000 (if 2020, less if in future years)
- Annual O&M 0.75% of initial costs
- With and without grants
- Project year – variable between 2020 and 2030

Distribution Scale Battery Assumptions

- Wholesale cost reductions based on BP-20
  - Reduced demand charges
  - Charge LLH, Discharge HLH
- Avoided BPA demand charge = $546,000 / year
- LLH to HLH > $15,000 / year
- Limit to 180 Cycles per year to retain battery life
- Battery degradation modeled

Distribution Scale Battery
Assumed Battery Degradation

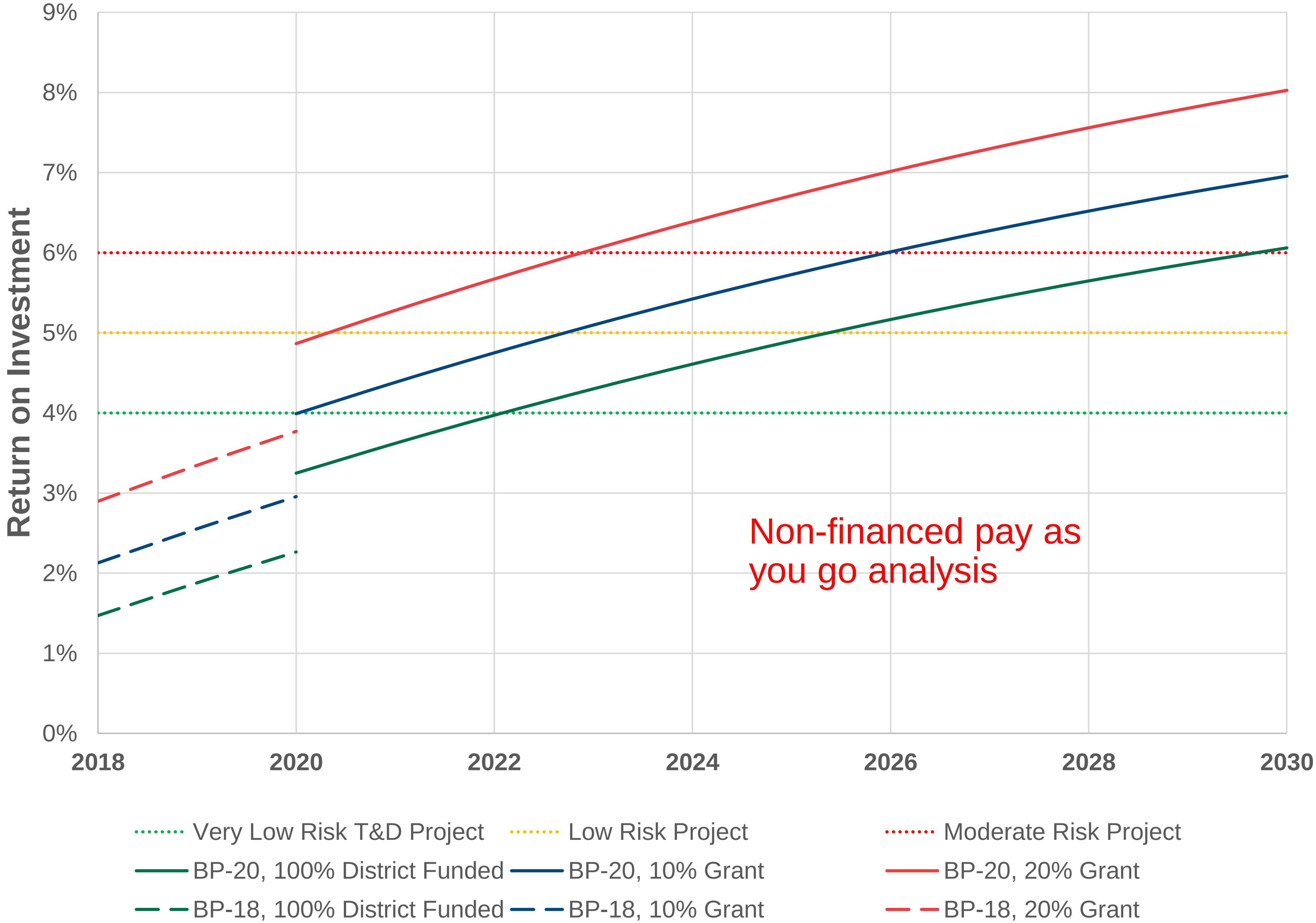



5MW 20MWh Distribution Battery Project
Bonded at 4% Interest Rate
Return on Investment
25%
20%
15%
10%
5%
0%
-5%
-10%
2018
2020
2022
2024
2026
2028
2030
Very Low Risk T&D Project
BP-20, 100% District Funded
BP-18, 100% District Funded

Distribution Scale Battery

- Really?
- A Battery project might actually make financial sense in the near future?
- Maybe, some risks
- Similar projects elsewhere in the last 10 years have generally failed
- But cost and performance are becoming more predictable and advantageous over time

5MW 20MWh Distribution Battery Project
Conventional ROI Analysis – Simple Cash Flow



Distribution Scale Battery Future

- Financial viability likely within next 5 years, independent of CETA
- Depending on State interpretations, the project has the potential to contribute 31% towards the CETA 2% cost cap.
- Analysis could be profoundly impacted by upcoming BPA BP-22 rate case and future contract terms (risk)
- Requires a BPA interconnect study ($200,000)
- Initially used for load shaping of BPA supply
- Has the potential to load shape eventual local or remote renewable or other non-carbon sources

CETA Finance Options

How do we pay for all this?

CETA Financing Challenge

- Cost required to meet CETA low income goals & the zero carbon requirement will be significant & truly transformative
- A new & unavoidable regulatory cost pressure
- Recognition that lower cost solutions will depend on future technology and innovation
- High risk of rate shock if not planned for well in advance
- Strategic objective is to meet requirements with the minimum impact on future rates
- Our queries suggest Clallam is more forward thinking in this regard than other Washington PUDs

Option 1:
Pay Down Debt

- Move up to $7 Million to Escrow Account held by US Bank.
- Monies can be used to pay down the 2014 series revenue bonds when they become callable.
- Call Date not until 2024.
- Using Escrow now allows us to remove the debt from our books lowering our debt ratio.
- De-leverage the utility to free up borrowing capacity for future CETA capital projects including Distribution Scale Battery Project.

Option 2:
Rate Stabilization

- Move up to $7 million to the rate stabilization fund.
- Lower future rate increases to 2.75% - 3.00%.
- Revenue shortfalls will be pulled from this account.
- Long term debt stays on the books.
- Limits future borrowing potential for CETA related expenses.
- Potential for downgrade in Moody's rating due to higher debt ratio and debt service coverage ratio.
- High potential for future rate shock due to CETA investments, including a prospective distribution battery project.

Option 3: Rate Stabilization

- Move up to $7 million to the rate stabilization fund.
- 0% rate increase for 1 year due to COVID impacts (2021)
- 4.00% (2022-2023)
- 3.75% (2024-2027)
- 0.5% to 0.75% higher each year (2022-2027)
- Long term debt stays on the books.
- Limits future borrowing potential for CETA related expenses.
- Potential for downgrade in Moody's rating due to higher debt ratio and debt service coverage ratio.
- High potential for future rate shock due to CETA investments, including a prospective distribution battery project.
- This COVID Mitigation is not targeted to need

Option 4:
CETA Compliance

Staff Recommended 5MW Distribution Battery Project (2024)

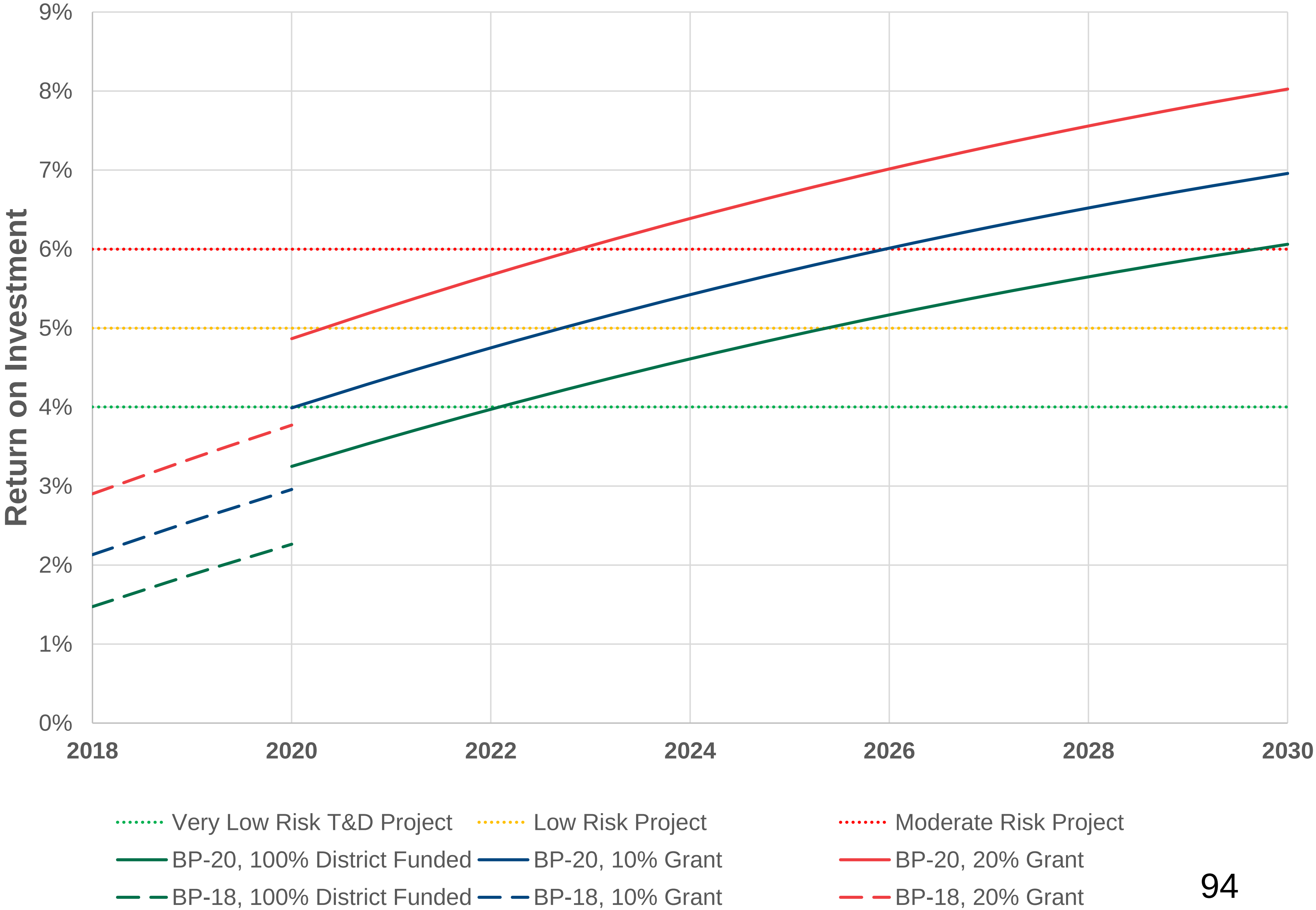
- Move up to $7 million to the CETA Capital Fund
- Rate Fund additional $575,000 per year (2021-2024)
- Rate Fund additional $200,000 per year (2024 – 2039)
    - For Battery replacement in 2039
    - Funded through Demand reduction and shaping
    - Already accounted for in projected O&M figures
- Qualifying CETA project
- Battery Project lowers current rate trajectory of power procurement costs by 2% post 2024.
    - Potential 0.90% rate reduction per year post 2024
    - Rate increase 2024 could be between 2.50% and 2.75%

Preferred Alternative: CETA Compliance

5MW Distribution Battery (2024)

- 20 MWH Lithium Ion Battery - $3,729,289
- (4) 40’ Insulated Containers @ 1MWH Each - $2,472,541
- (4) 1.5 MVA Inverters - $927,203
- (4) 1.5 MVA Transformers - $220,763
- Site Work - $110,381
- Substation Breaker - $44,153
- Fencing - $35,750
- Permitting - $99,343
- Engineering - $772,546
- Misc. Expenses - $86,035
- Sales Tax - $666,814
- BPA Interconnect - $220,763
- **Total Initial Cost - $9,385,579**

5MW 20MWh Distribution Battery Project
Conventional ROI Analysis – Simple Cash Flow



Staff Plan

- Fund CETA Capital Account with existing balances and future revenues
- Evaluate project based on
  - BP-22 rate case
  - Final CETA rules and eligibility
- Tentatively plan on a 2024 project
- Obtain formal approval via normal 2023 & 2024 budget process
- Rate Fund battery replacement in 2039
- Conditional upon no impact to current rate trajectory.

2021 Strategic Plan Changes for Consideration

2021 STRATEGIC PLAN

STRATEGIC OBJECTIVE:
PROVIDE STABLE RATES

Direct Report Lead
Sean Worthington, Finance Manager/Treasurer

Bringing Energy To Life™

Definition
Minimal budget fluctuations to support rate stability for District customers.

Picture of Excellence (POE)
- Provide stable rates to customers with no more than a 1% rate adjustment over the previous 5-year average rate adjustment.
- Over 10 years, capital costs should be within 85% of depreciation.

Identified Big Gaps To POE
a. Cost pressures (BPA and conservation) require efficiency measures be identified and implemented to control other costs.
b. Environmental and other regulatory as the Energy Information Admin. (EIA) & Clean Energy Transformation Act (CETA) upward rate pressures.
c. Declining KWH sales and decreasing system load factor due to conservation and distributed generation.
d. Aging infrastructure requires capital improvements and replacement.
e. Weather effects on water and power usage affecting cost recovery.
f. Maintain supporting 10-year staffing plan.

Strategic Initiatives
(How do we close Big Gaps and get to POE?)
1. Maintain and use the 10-year projection model to forecast rates, personnel, capital and financing needs.
2. Conduct regular Cost of Service studies and implement appropriate rate structures
3. Active participation in WPAG, WPUDA, PPC.
4. Model and track monthly rate revenues.
5. Managers track budgets monthly to assure in line with budget.
6. Review of budgets quarterly in Direct Reports meeting.
7. Plan, design and implement engineering projects and technology to reduce future O&M and energy procurement costs, while enhancing system efficiency.
8. Maintain sufficient cash reserves to address pandemic, weather and disaster effects.
9. Create Restricted Capital Account to Proactively Plan for CETA Compliance.

Key Performance Indicators (KPI)
(How are we doing? - measurement)

Electric
Revenues/expenses within % of budget
- Green = Within 5% of budget
- Yellow = Within 5% to 8% of budget
- Red = >8% of budget

Water
Revenues/expenses within % of budget
- Green = Within 5% of budget
- Yellow = within 5% to 8% of budget
- Red = >8% of budget

Electric and Water
- Green = Capital +/- 15% of Depreciation
- Yellow = Capital +/- 20% of Depreciation
- Red = Capital > +/- 20% of Depreciation

2021 STRATEGIC PLAN

STRATEGIC OBJECTIVE:
MANAGE OUR RESOURCE PORTFOLIO

Direct Report Leads
John Purvis, Assistant GM
Tom Martin, Water Superintendent
Sean Worthington, Finance Manager/Treasurer

Definition
Optimizing between the supply and demand requirements, over both short and long-term allows us to improve efficiency, meet regulatory requirements, and meet customer needs and expectations.

Picture of Excellence (POE)
Continually optimized portfolio meeting all resource requirements at the lowest cost.

Identified Big Gaps To POE
a. Legislative uncertainty with respect to renewable and other mandates.
b. Lack of corporate knowledge / familiarity with emerging power distribution technologies.
c. Need to acquire additional water rights for near term needs and full build out of water system service areas.
d. Need for optimized mix of conservation and Tier 2 resource mix.
e. Water losses due to aging infrastructure.
f. Need conservation rate structure that encourages conservation and offsets rate impacts (ex. Time of Use (TOU) rates).
g. Need to meet developing Clean Energy Transformation Act (CETA)

Strategic Initiatives
(How do we close Big Gaps and get to POE?)

Electric
1. Monitor CETA rulemaking, develop compliant Integrated Resource Plan (IRP), and conduct associated feasibility study .
2. Acquire conservation with a program cost that is less than our avoided cost of power in keeping with stable rates.
3. Implement a distribution upgrade program that optimizes energy savings and system reliability.
4. Plan, design and implement engineering projects that cost effectively reduce or optimize line losses and customer conservation
5. Develop and revise net revenue model on a monthly basis using NISC month end reporting.
6. Develop capability to meter time of use (TOU) for electricity.
7. Monitor emergent technologies and conduct periodic financial feasibility analysis necessary to decarbonize the power supply, including: EV charging, battery storage, SMR, solar and micro-grid technologies.
8. Active participation in WPAG, WPUDA and PPC to ensure procurement of a cost competitive power supply.
9. Long term full service power acquisitions made at most competitive regional rates.
10. Mitigate rate pressure through consistent & innovative enhancements in productivity.

Water
1. Identify strategies to secure water rights for full buildout. Utilize the Dungeness Water Exchange where appropriate, or develop independent mitigation projects.

Water (Con't)
1. Continually optimized portfolio meeting all resource requirements at the lowest cost.
2. Identify appropriate rate structure to encourage conservation without significant revenue impacts.
3. Evaluate full buildout demand for each water system.

Key Performance Indicators (KPI)
(How are we doing? - measurement)

Conservation
- Green =< $43 per MWh Conservation & Tier 2 resources
- Yellow = $43 to $46 per MWh Conservation & Tier 2 resources
- Red = >$46 MWh Conservation & Tier 2 resources

Water (per system)
Rolling 12 mos. loss rates are within DOH Standards.
- Green = all w/s below 10% loss rate
- Yellow = all w/s between 10% - 15% loss rate
- Red = all w/s greater than 15% loss rate

Ratio of water right supply to full buildout demand
- Green = >=100%
- Yellow = 80-100%

2021 STRATEGIC PLAN

STRATEGIC OBJECTIVE:
BE FINANCIALLY RESPONSIBLE

Direct Report Lead
Sean Worthington, Finance Manager/Treasurer

Bringing Energy To Life™

Definition
Manage costs and utilize assets in an efficient and effective way to ensure financial health and stability of the District.

Picture of Excellence (POE)
Maintain at least a Aa3 rating with Moody's Investors Service and achieve the objectives of the Strategic Plan. Manage expenditures within budgeted levels and meet revenue requirements.

Identified Big Gaps To POE
a. Need to evaluate cash reserve policy and related recommendation for 150-180 day reserve.
b. Lack of asset management program for replacement of aging water infrastructure.
c. Revenue variations due to weather.
d. No integration of budget process into enterprise software system.
e. Variable storm related expenses.
f. Limited resources to acquire failing water systems.

Strategic Initiatives
(How do we close Big Gaps and get to POE?)

1. Develop budget monitoring process to better and more timely react to areas of cost concerns
2. Provide asset management training and develop an asset management plan. (life cycle cost, etc.)
3. Provide regular progress updates on major projects and contracts.
4. Plan, design and implement projects and technology to reduce future O&M and energy procurement costs.
5. Establish Cash Reserve and Debt Service Ratio Policy
6. Evaluate potential acquisitions of existing water systems to determine financial feasibility.
7. Create Low Income CETA Program to mitigate rate impacts.
8. Scoping plan for utility scale qualifying CETA project and corresponding restricted cash account.

Key Performance Indicators (KPI)
(How are we doing? - measurement)

Cash Balance
- **Green** = Cash balance within $500,000 of budget
- **Yellow** = Cash balance within $500,001 - $1,000,000 of budget
- **Red** = Cash balance within >$1,000,000 of budget

Cash Reserves
***moving from 90 days to new 150**
- **Green** = >120 days
- **Yellow** = 90-120 days
- **Red** = <90 days