



Solar Feasibility Study

City Council

May 28, 2019

Keith Hormann-Director, Light & Power

Joel Peterson-Engineering Manager, Light & Power

Purpose

- Address City Council Objective 1.1: “Complete feasibility study for solar on Light and Power owned land.”

Study Partnerships

Bonneville Power Administration

Bonneville Environmental Foundation

Utility Financial Consultants

FCS Group Consulting

Presentation Objectives

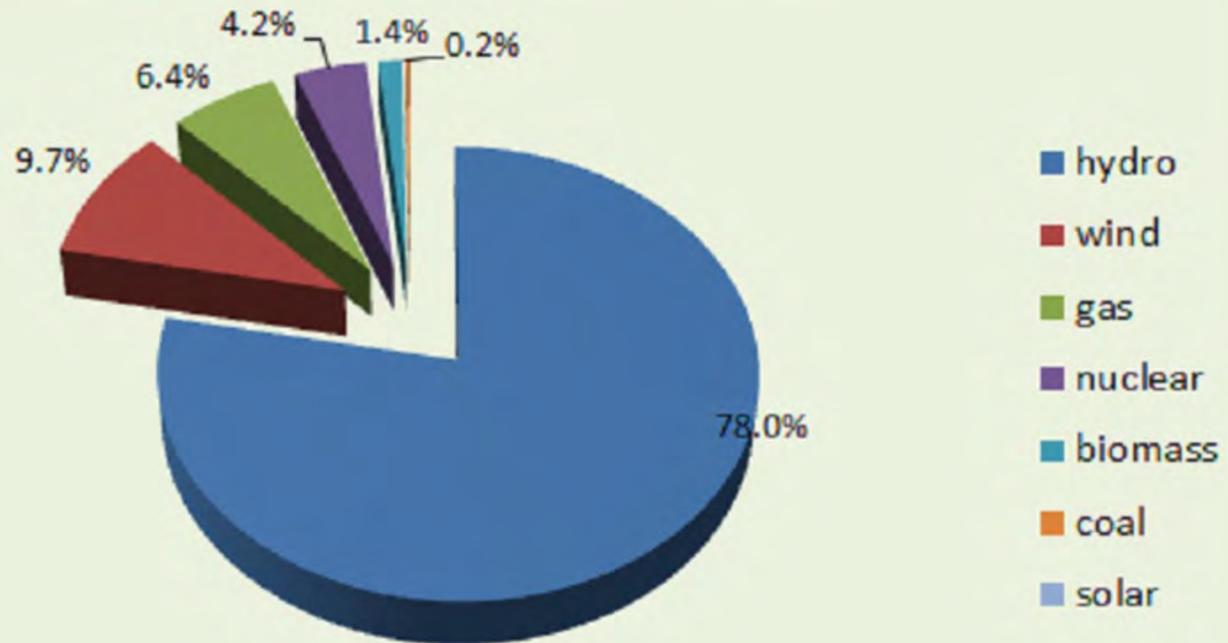
- Explain power purchase contracts & load forecasting methodology
- Discuss solar site and array options
- In-depth financial review of array options
- Review decision-making variables

Power Purchase Contracts

- We currently purchase power from three different providers: Bonneville Power Administration, Grant County PUD & Non-Federal market based power
- On an average day, our City is using approximately 31 MW of power every hour. Our highest recorded peak usage was in the winter of 2014 recorded at 62.3 MW
- In calendar year 2018 we consumed 246,903 MWh
- The hydro power we purchase from BPA & Grant County PUD is considered 90% efficient, 100% carbon free, and by most, 100% renewable. For comparison purposes, solar generation in the NW is considered 13% efficient, 100% carbon free and 100% renewable

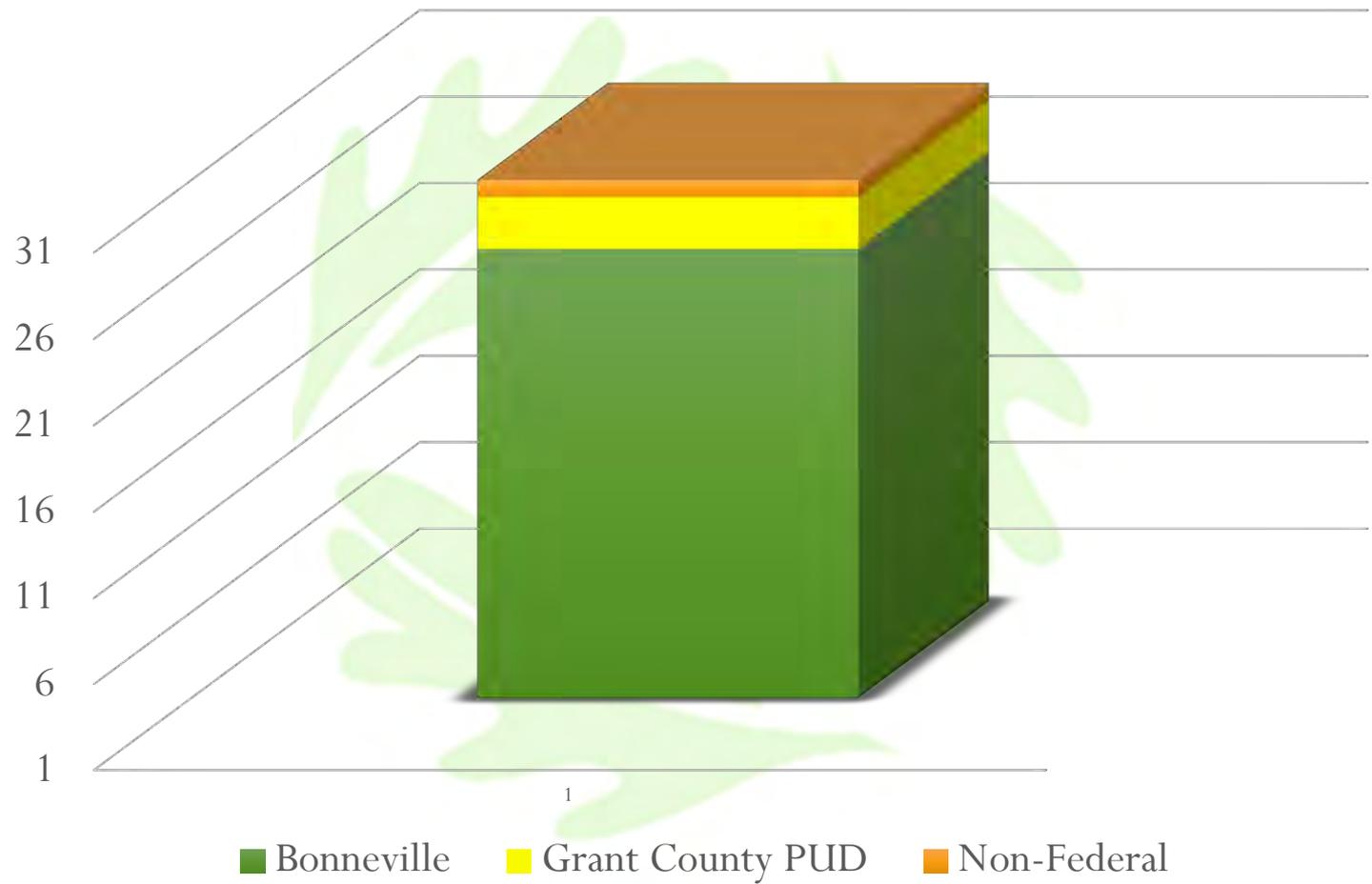
BPA Fuel Mix

**Generation Capacity Within The BPA
Balancing Authority Area, By Type**



Total Nameplate Generation = 28,443 MW, as of 18 September, 2018; BPA/Technical Operations/TOOC

Forest Grove Power Purchases (MW)



Power Purchase Contracts (Cont.)

- The bulk of our power comes from BPA under a long term contract that will expire in 2028. The billing is broken into numerous categories including: Tier 1, Tier 2, load shaping heavy load and light load hours, demand, transmission and numerous other miscellaneous fees
- The power we purchase from Grant County PUD is produced by two dams, Priest Rapids and Wanapum. We purchase slightly under 3 MW from this contract and it is in place thru 2052
- We also purchase 1 MW Non Federal market power to cover some of our contracted above rate high water mark load. The rest of our above rate high water mark load is covered by BPA under load shaping rates

Load Forecasting

- Our power purchase amount and price is determined on a two year basis
- These amounts are determined by load forecasting, which is done almost three years in advance of the actual purchase
- Many factors go into the load forecasting modeling including; our history of loading, long range weather forecasts, our known load increases or decreases based on 60% certainty and numerous other factors

Load Forecasting

- Included in this two year process of determining rates and prices, each of the 135 public power utilities share of the Tier 1 allocation, (contracted high water mark) is also determined
- Once this number is known and the amount of power we are purchasing from elsewhere is added in, we then know how much extra power we need, or do not need, to purchase

Load Forecasting

- Through the load forecasting process, our purchase amounts have already been determined for the two year period from October 2019 thru September 2021.
- This is extremely important since we are on a **take or pay basis**

SNEER Policy

- BPA has a policy in place regarding small non-dispatchable new resources treated equivalently to an existing resource (SNEER)
- This policy gives utilities the ability to add a renewable energy resource up to 1 MW to their resource portfolio replacing power already committed to
- This policy would allow us to add up to a 1 MW array with no negative financial impact to our current contracts. An array less than 200 KW can be added at any time with no impacts to BPA due to the negligible effect it would have

Any Contract Questions?



Solar Site Options

- Filbert Substation – Will accommodate up to a 609 KW array
- Forest Grove Substation – Will accommodate up to a 664 KW array

Filbert Substation – 609kW



Forest Grove Substation-664 kW



Solar Array Options

- 1 MW Power Purchase Agreement (PPA)
 - Requires long term contract
 - Owned and operated by contractor
- 1 MW Utility owned resource
 - Requires two L&P sites to reach capacity
 - Additional BPA monitoring necessary
 - Financed
- 200 KW community owned solar array
 - No additional BPA monitoring required
 - Financed
- 50 KW community owned solar array
 - Modular design for future expansion
 - Self-funded

Financial Review: Assumptions

| | | |
|----|--------------|--|
| \$ | 1.50 | Assume \$1.50/watt DC for 1 MW DC system |
| \$ | 1,500,000.00 | Calculated base installation cost for 1 MW DC system |
| \$ | 2.10 | Assume \$/watt DC for Scenario 200 KW DC system |
| \$ | 370,000.00 | Calculated base installation cost for 200 KW DC system |
| \$ | - | Assume no land costs, FG owns a few parcels |
| \$ | - | Assume no property taxes, I don't think a municipal entity pays them |
| \$ | 0.10 | Assume an additional \$.10/w DC for interconnection costs |
| \$ | 25.00 | Assume community solar costs for admin, legal, and O&M at \$25/kW/year built into upfront offering |
| \$ | 15.00 | For utility owned solar assume \$15/kW/year for O&M |
| | 2.50% | Annual Inflationary Increase on O&M |
| | 6.00% | Assume 6% interest for cost of capital for all arrays, or other rate if FG has an opinion |
| | 15 | Assumption for financing years |
| | 0.50% | Annual solar production degradation |
| | 25 | Depreciation Years / PPA Years |
| | | typical range (250 to 335 watts per panel) |
| | 335 | watt per panel = 2.99 panels per KW DC |
| | 2.99 | number of panels per KW DC |
| | 5 | KW DC typical residential rooftop solar install |
| | 14.95 | number of panels per typical residential rooftop solar install |
| | 2,990 | number of panels per 1 MW DC solar |
| | 598 | number of panels per 200 KW DC solar |

Financial Review: 1 MW

Utility Installed 1 MW DC array

| Year | Interest Expense | Principal Payment | Remaining Principal Balance | Annual Depreciation | Annual O&M | Affect on rates on a utility basis | 1 MW DC Production in AC kWh | Average \$ per kWh produced |
|-----------|-------------------|---------------------|-----------------------------|---------------------|----------------------|------------------------------------|------------------------------|-----------------------------|
| 1 | \$ 96,000.00 | \$ 68,740.42 | \$ 1,531,259.58 | \$ 64,000.00 | \$ 15,000.00 | \$ 175,000.00 | 1,145,009 | \$ 0.15284 |
| 2 | \$ 91,875.57 | \$ 72,864.85 | \$ 1,458,394.73 | \$ 64,000.00 | \$ 15,375.00 | \$ 171,250.57 | 1,139,284 | \$ 0.15031 |
| 3 | \$ 87,503.68 | \$ 77,236.74 | \$ 1,381,157.98 | \$ 64,000.00 | \$ 15,759.38 | \$ 167,263.06 | 1,133,587 | \$ 0.14755 |
| 4 | \$ 82,869.48 | \$ 81,870.94 | \$ 1,299,287.04 | \$ 64,000.00 | \$ 16,153.36 | \$ 163,022.84 | 1,127,920 | \$ 0.14453 |
| 5 | \$ 77,957.22 | \$ 86,783.20 | \$ 1,212,503.84 | \$ 64,000.00 | \$ 16,557.19 | \$ 158,514.41 | 1,122,280 | \$ 0.14124 |
| 6 | \$ 72,750.23 | \$ 91,990.19 | \$ 1,120,513.65 | \$ 64,000.00 | \$ 16,971.12 | \$ 153,721.35 | 1,116,669 | \$ 0.13766 |
| 7 | \$ 67,230.82 | \$ 97,509.60 | \$ 1,023,004.04 | \$ 64,000.00 | \$ 17,395.40 | \$ 148,626.22 | 1,111,085 | \$ 0.13377 |
| 8 | \$ 61,380.24 | \$ 103,360.18 | \$ 919,643.86 | \$ 64,000.00 | \$ 17,830.29 | \$ 143,210.53 | 1,105,530 | \$ 0.12954 |
| 9 | \$ 55,178.63 | \$ 109,561.79 | \$ 810,082.07 | \$ 64,000.00 | \$ 18,276.04 | \$ 137,454.67 | 1,100,002 | \$ 0.12496 |
| 10 | \$ 48,604.92 | \$ 116,135.50 | \$ 693,946.57 | \$ 64,000.00 | \$ 18,732.94 | \$ 131,337.86 | 1,094,502 | \$ 0.12000 |
| 11 | \$ 41,636.79 | \$ 123,103.63 | \$ 570,842.93 | \$ 64,000.00 | \$ 19,201.27 | \$ 124,838.06 | 1,089,030 | \$ 0.11463 |
| 12 | \$ 34,250.58 | \$ 130,489.84 | \$ 440,353.09 | \$ 64,000.00 | \$ 19,681.30 | \$ 117,931.88 | 1,083,584 | \$ 0.10883 |
| 13 | \$ 26,421.19 | \$ 138,319.23 | \$ 302,033.86 | \$ 64,000.00 | \$ 20,173.33 | \$ 110,594.52 | 1,078,167 | \$ 0.10258 |
| 14 | \$ 18,122.03 | \$ 146,618.39 | \$ 155,415.47 | \$ 64,000.00 | \$ 20,677.67 | \$ 102,799.70 | 1,072,776 | \$ 0.09583 |
| 15 | \$ 9,324.93 | \$ 155,415.49 | \$ (0.02) | \$ 64,000.00 | \$ 21,194.61 | \$ 94,519.54 | 1,067,412 | \$ 0.08855 |
| 16 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 21,724.47 | \$ 85,724.47 | 1,062,075 | \$ 0.08071 |
| 17 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 22,267.58 | \$ 86,267.58 | 1,056,764 | \$ 0.08163 |
| 18 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 22,824.27 | \$ 86,824.27 | 1,051,481 | \$ 0.08257 |
| 19 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 23,394.88 | \$ 87,394.88 | 1,046,223 | \$ 0.08353 |
| 20 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 23,979.75 | \$ 87,979.75 | 1,040,992 | \$ 0.08452 |
| 21 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 24,579.25 | \$ 88,579.25 | 1,035,787 | \$ 0.08552 |
| 22 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 25,193.73 | \$ 89,193.73 | 1,030,608 | \$ 0.08654 |
| 23 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 25,823.57 | \$ 89,823.57 | 1,025,455 | \$ 0.08759 |
| 24 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 26,469.16 | \$ 90,469.16 | 1,020,328 | \$ 0.08867 |
| 25 | \$ - | \$ - | \$ (0.02) | \$ 64,000.00 | \$ 27,130.89 | \$ 91,130.89 | 1,015,226 | \$ 0.08976 |
| \$ | 871,106.31 | 1,600,000.02 | \$ | 1,600,000.00 | \$ 512,366.46 | \$ 2,983,472.77 | 26,971,775 | |

| | | |
|---|-----------|---------------------|
| Average per kWh AC Solar Produced before BPA Savings | \$ | 0.11061 |
| Total 25 Year Cost before BPA Savings | \$ | 2,983,472.77 |

| | | |
|--|-----------|---------------------|
| Without VOS Escalator | | |
| Average per kWh AC Solar Produced after BPA Savings | \$ | 0.09062 |
| BPA Savings over life at fixed \$ 0.02 per kWh | \$ | 539,384.18 |
| Net Cost over life | \$ | 2,444,088.59 |

Financial Review: 200 kW

Community Solar 200 KW DC array

| Year | Interest Expense | Principal Payment | Remaining Principal Balance | Annual Depreciation | Annual O&M | Affect on rates on a utility basis | Solar Production Scenario for 200 KW DC Array | Average \$ per kWh produced |
|------|------------------|-------------------|-----------------------------|---------------------|---------------|------------------------------------|---|-----------------------------|
| 1 | \$ 23,400.00 | \$ 16,755.48 | \$ 373,244.52 | \$ 15,600.00 | \$ 5,000.00 | \$ 44,000.00 | 228,596 | \$ 0.19248 |
| 2 | \$ 22,394.67 | \$ 17,760.81 | \$ 355,483.71 | \$ 15,600.00 | \$ 5,125.00 | \$ 43,119.67 | 227,453 | \$ 0.18958 |
| 3 | \$ 21,329.02 | \$ 18,826.46 | \$ 336,657.26 | \$ 15,600.00 | \$ 5,253.13 | \$ 42,182.15 | 226,316 | \$ 0.18639 |
| 4 | \$ 20,199.44 | \$ 19,956.04 | \$ 316,701.22 | \$ 15,600.00 | \$ 5,384.45 | \$ 41,183.89 | 225,184 | \$ 0.18289 |
| 5 | \$ 19,002.07 | \$ 21,153.41 | \$ 295,547.81 | \$ 15,600.00 | \$ 5,519.06 | \$ 40,121.13 | 224,058 | \$ 0.17907 |
| 6 | \$ 17,732.87 | \$ 22,422.61 | \$ 273,125.20 | \$ 15,600.00 | \$ 5,657.04 | \$ 38,989.91 | 222,938 | \$ 0.17489 |
| 7 | \$ 16,387.51 | \$ 23,767.97 | \$ 249,357.23 | \$ 15,600.00 | \$ 5,798.47 | \$ 37,785.98 | 221,823 | \$ 0.17034 |
| 8 | \$ 14,961.43 | \$ 25,194.05 | \$ 224,163.19 | \$ 15,600.00 | \$ 5,943.43 | \$ 36,504.86 | 220,714 | \$ 0.16539 |
| 9 | \$ 13,449.79 | \$ 26,705.69 | \$ 197,457.50 | \$ 15,600.00 | \$ 6,092.01 | \$ 35,141.80 | 219,611 | \$ 0.16002 |
| 10 | \$ 11,847.45 | \$ 28,308.03 | \$ 169,149.47 | \$ 15,600.00 | \$ 6,244.31 | \$ 33,691.76 | 218,512 | \$ 0.15419 |
| 11 | \$ 10,148.97 | \$ 30,006.51 | \$ 139,142.96 | \$ 15,600.00 | \$ 6,400.42 | \$ 32,149.39 | 217,420 | \$ 0.14787 |
| 12 | \$ 8,348.58 | \$ 31,806.90 | \$ 107,336.06 | \$ 15,600.00 | \$ 6,560.43 | \$ 30,509.01 | 216,333 | \$ 0.14103 |
| 13 | \$ 6,440.16 | \$ 33,715.32 | \$ 73,620.75 | \$ 15,600.00 | \$ 6,724.44 | \$ 28,764.60 | 215,251 | \$ 0.13363 |
| 14 | \$ 4,417.24 | \$ 35,738.24 | \$ 37,882.51 | \$ 15,600.00 | \$ 6,892.56 | \$ 26,909.80 | 214,175 | \$ 0.12564 |
| 15 | \$ 2,272.95 | \$ 37,882.53 | \$(0.02) | \$ 15,600.00 | \$ 7,064.87 | \$ 24,937.82 | 213,104 | \$ 0.11702 |
| 16 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 7,241.49 | \$ 22,841.49 | 212,039 | \$ 0.10772 |
| 17 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 7,422.53 | \$ 23,022.53 | 210,978 | \$ 0.10912 |
| 18 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 7,608.09 | \$ 23,208.09 | 209,923 | \$ 0.11056 |
| 19 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 7,798.29 | \$ 23,398.29 | 208,874 | \$ 0.11202 |
| 20 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 7,993.25 | \$ 23,593.25 | 207,829 | \$ 0.11352 |
| 21 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 8,193.08 | \$ 23,793.08 | 206,790 | \$ 0.11506 |
| 22 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 8,397.91 | \$ 23,997.91 | 205,756 | \$ 0.11663 |
| 23 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 8,607.86 | \$ 24,207.86 | 204,728 | \$ 0.11824 |
| 24 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 8,823.05 | \$ 24,423.05 | 203,704 | \$ 0.11989 |
| 25 | \$ - | \$ - | \$(0.02) | \$ 15,600.00 | \$ 9,043.63 | \$ 24,643.63 | 202,685 | \$ 0.12159 |
| 26 | \$ 212,332.15 | \$ 390,000.02 | \$ - | \$ 390,000.00 | \$ 170,788.82 | \$ 773,120.97 | 5,384,795 | \$ 0.14357 |
| | | | | | | | | \$ 773,120.97 |

| | |
|---|---------------|
| Without VOS Escalator | |
| Average per kWh AC Solar Produced after BPA Savings | \$ 0.12358 |
| BPA Savings over life at \$ 0.02 per kWh escalated annually by 0.0% | \$ 107,685.66 |
| Net Cost over life | \$ 665,435.31 |

Financial Review: 50 kW

Community Solar 50 kW DC array

| Year | Interest Expense | Principal Payment | Remaining Principal Balance | Annual Depreciation | Annual O&M | Affect on rates on a utility basis | Solar Production Scenario for 50 kW DC Array | Average \$ per kWh produced |
|------|------------------|-------------------|-----------------------------|---------------------|--------------|------------------------------------|--|-----------------------------------|
| 1 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,250.00 | \$ 4,650.00 | \$ 57,149 | 0.08137 |
| 2 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,281.25 | \$ 4,681.25 | \$ 56,863 | 0.08232 |
| 3 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,313.28 | \$ 4,713.28 | \$ 56,579 | 0.08330 |
| 4 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,346.11 | \$ 4,746.11 | \$ 56,296 | 0.08431 |
| 5 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,379.77 | \$ 4,779.77 | \$ 56,015 | 0.08533 |
| 6 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,414.26 | \$ 4,814.26 | \$ 55,734 | 0.08638 |
| 7 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,449.62 | \$ 4,849.62 | \$ 55,456 | 0.08745 |
| 8 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,485.86 | \$ 4,885.86 | \$ 55,179 | 0.08855 |
| 9 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,523.00 | \$ 4,923.00 | \$ 54,903 | 0.08967 |
| 10 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,561.08 | \$ 4,961.08 | \$ 54,628 | 0.09082 |
| 11 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,600.11 | \$ 5,000.11 | \$ 54,355 | 0.09199 |
| 12 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,640.11 | \$ 5,040.11 | \$ 54,083 | 0.09319 |
| 13 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,681.11 | \$ 5,081.11 | \$ 53,813 | 0.09442 |
| 14 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,723.14 | \$ 5,123.14 | \$ 53,544 | 0.09568 |
| 15 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,766.22 | \$ 5,166.22 | \$ 53,276 | 0.09697 |
| 16 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,810.37 | \$ 5,210.37 | \$ 53,010 | 0.09829 |
| 17 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,855.63 | \$ 5,255.63 | \$ 52,745 | 0.09964 |
| 18 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,902.02 | \$ 5,302.02 | \$ 52,481 | 0.10103 |
| 19 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,949.57 | \$ 5,349.57 | \$ 52,218 | 0.10245 |
| 20 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 1,998.31 | \$ 5,398.31 | \$ 51,957 | 0.10390 |
| 21 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 2,048.27 | \$ 5,448.27 | \$ 51,698 | 0.10539 |
| 22 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 2,099.48 | \$ 5,499.48 | \$ 51,439 | 0.10691 |
| 23 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 2,151.96 | \$ 5,551.96 | \$ 51,182 | 0.10848 |
| 24 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 2,205.76 | \$ 5,605.76 | \$ 50,926 | 0.11008 |
| 25 | \$ - | \$ - | \$ 85,000.00 | \$ 3,400.00 | \$ 2,260.91 | \$ 5,660.91 | \$ 50,671 | 0.11172 |
| 26 | \$ - | \$ - | \$ - | \$ 85,000.00 | \$ 42,697.20 | \$ 127,697.20 | \$ 1,346,199 | 0.09486 |
| | | | | | | | \$ 127,697.20 | Average per kWh AC Solar Produced |
| | | | | | | | \$ 127,697.20 | Total 25 Year Cost |

| | |
|---|---------------|
| Without VOS Escalator | |
| Average per kWh AC Solar Produced after BPA Savings | \$ 0.07486 |
| BPA Savings over life at \$ 0.02 per kWh escalated annually by 0.0% | \$ 26,921.42 |
| Net Cost over life | \$ 100,775.79 |

Financial Review: Summary

| Size | Upfront Cost | Net Cost | Payback Period (yrs) | Average \$/kWh |
|-------------------|-----------------|-----------------|----------------------|----------------|
| 1 MW PPA | --- | --- | --- | \$ 0.110 |
| 1 MW | \$ 1,600,000.00 | \$ 2,444,089.00 | 106 | \$ 0.091 |
| 200 kW | \$ 390,000.00 | \$ 665,244.00 | 145 | \$ 0.124 |
| 50 kW | \$ 85,000.00 | \$ 100,776.00 | 88 | \$ 0.075 |
| Pure Power | --- | --- | --- | \$ 0.085 |
| BPA Rate | --- | --- | --- | \$ 0.045 |

Decision Making Variables

- Consider what may happen post-2028 when BPA contracts expire
- Solar installations will affect future expansion at our substations
- Does the Pure Power Program already accomplish Objective 1.1
- Would a community solar project fill a desire we think our customers have
- Under our current net metering program, we have 23 customers who have rooftop solar panels and we credit their accounts for the production at our full retail rate. We would have to decide if we want to do that for customers who purchase panels under a community solar project

ANY QUESTIONS?

