

# University of Hawai'i Manoa

## *Solar Project Feasibility Analysis*

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# Background and Methodology

# Background

- Feasibility study undertaken to determine options, opportunities and constraints for implementing solar projects
- We are looking at three types of solar implementation:
  1. On-campus generation
  2. Large, ground-mounted systems in the Wa'ahila Valley
  3. Off-campus generation, likely to be implemented under a Feed-In Tariff (FIT)
- The initial focus of the study is on-campus generation, as it can be implemented more quickly than solar on the Wa'ahila Valley site or off-campus
- On-campus generation opportunities represent only a portion of the potential solar generation available to the University and should be considered to be the initial phase of a larger program
- All on-campus generation would be “behind the meter” and used to offset electricity purchased from HECO

# Methodology

- The Study includes
  - Review of energy use at the facilities
  - Site visits to determine possible locations for solar arrays and to determine roofing conditions through discussions with UHM staff
  - Research and review of current and developing legal, regulatory and program rules
  - Development of scenarios for analysis
  - Estimation of energy project costs and energy savings over a 25-year period

# Evaluation Scenarios and Assumptions

# Evaluation Scenarios

Three scenarios were developed for analysis:

## 1. No Project Alternative/Baseline

- Assumes no solar systems installed at UHM
- Forecasts electricity costs for the analysis period (25 years) based on historical utility escalation rates and changes to the cost of oil
- This scenario examines a range of utility escalation rates

## 2. Photovoltaic (PV) Ownership

- UHM purchase of PV system
- PV systems to be installed on campus facilities
- The project would be interconnected through a standard interconnection agreement with HECO and offset a portion of the Campus' base load
- This scenario examines a range of solar PV system costs

## Evaluation Scenarios (cont.)

### 3. Power Purchase Agreement (PPA)

- UHM enters into a PPA with a third-party and commits to purchasing power for a fixed duration (typically 20 years) at a fixed cost, which can include escalation
- The Third-party owns and maintains panels and related systems for the duration of the agreement and can take advantage of significant Federal Tax Credits that can enable competitive pricing
- This scenario examines a range of PPA rates

# Financial Assumptions and Sensitivity

- Several assumptions have a significant effect on the viability of each scenario. In particular, the models are very sensitive to the following assumptions:
  1. *The amount of energy consumed and the profile of that consumption*
- We assume historical load patterns are good indications of future load patterns
- The annual load is assumed to be constant over the life of the project

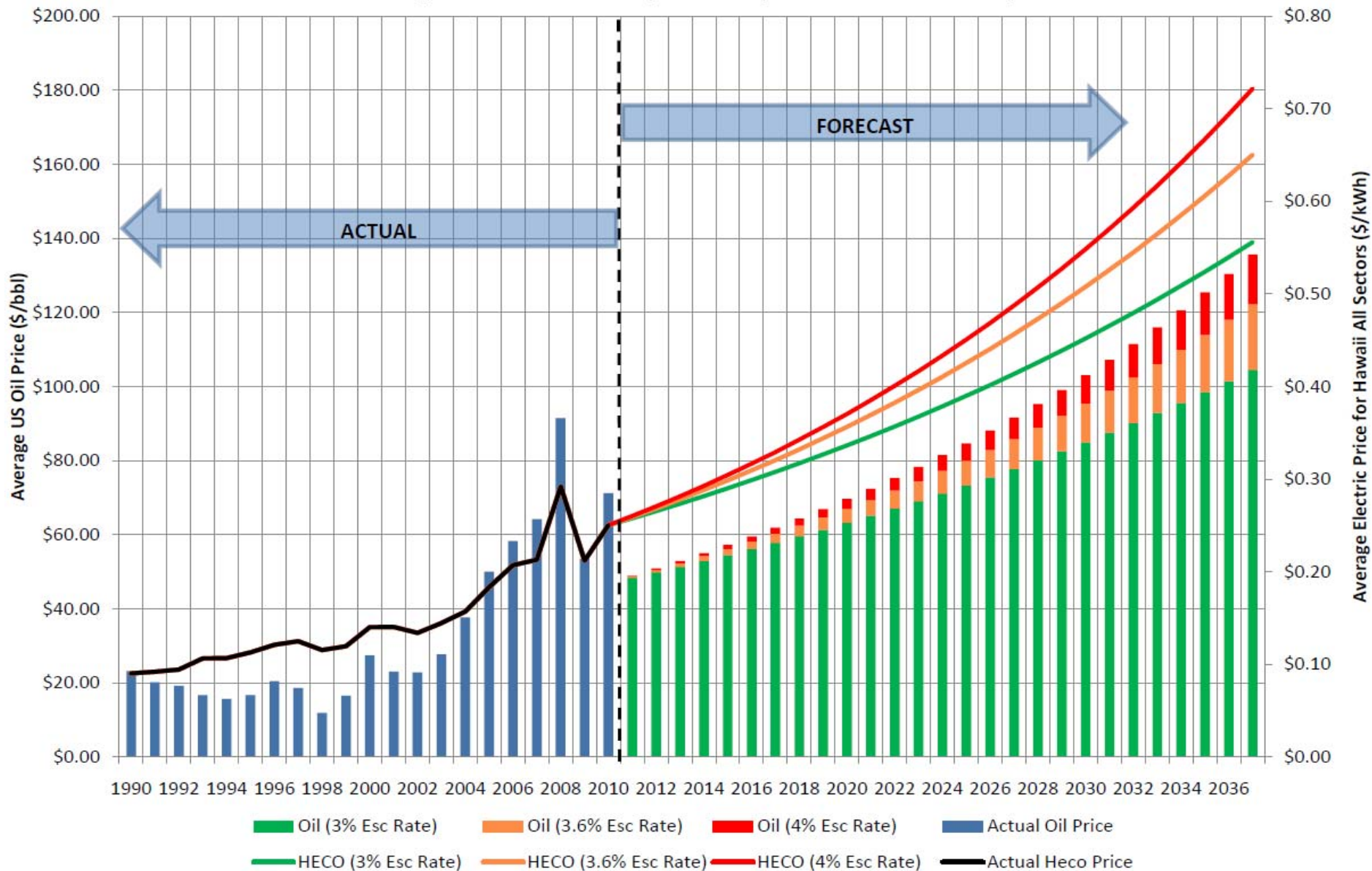
# Financial Assumptions and Sensitivity (cont.)

## 2. *The price of energy purchased from HECO and annual escalation rate*

- The analysis utilizes HECO's TY2009 DS rate as the base rate, with an average electricity price of \$0.205/kWh
- A \$0.01/kWh increase in the initial utility prices results in about \$2 million additional avoided costs over 25 years, for system ownership
- We assume an annual utility escalation rate of 3.60%, which is based on the average escalation rate for the price of oil since 1990.

# Hawaii Electricity Costs (All Sectors) and Oil Prices from Energy Information Administration

[http://inflationdata.com/inflation/inflation\\_rate/historical\\_oil\\_prices\\_table.asp](http://inflationdata.com/inflation/inflation_rate/historical_oil_prices_table.asp)  
 Energy Information Administration, Form EIA-861, "Annual Electric Power Industry R"



## Financial Assumptions and Sensitivity (cont.)

3. *The cost of the solar system, for both Ownership and PPA Scenarios*
  - Within Scenarios 2 and 3, three sub-scenarios were analyzed
  - **Low PPA/Ownership Price:** Lowest proposal prices for PPA/Ownership from recent historical solar projects in Hawaii and California solar projects (adjusted for Hawaii construction costs)
  - **Medium PPA/Ownership Price:** Average proposal prices for PPA/Ownership from recent historical solar projects in Hawaii and California solar projects (adjusted for Hawaii construction costs)
  - **High PPA/Ownership Price:** Highest proposal prices for PPA/Ownership from recent historical solar projects in Hawaii and California solar projects (adjusted for Hawaii construction costs)

# Key Technical Assumptions

- Roof mounts and parking lot systems
  - Ground cover ratio (GCR) is area of panels per area of system
  - GCR of 0.8 for roofs and 0.5 for parking
- Fixed, tilted 10 degrees south
  - Typical tilt angle
  - Tracking is also an option
- Commonly implemented solar equipment
  - PV modules: Sharp 230W modules
  - Inverters: SMA Sunny Boy 500kW inverters

# Solar Systems in the Analysis

## Large Roof Systems

Name	Area (sqft)	Area Covered by Panels (sqft)	Number of Panels	System Capacity (kW)
<b>Roof Systems over 10,000 sqft</b>				
Athletic HPER Complex	34,426	27,541	1,570	361
Hamilton Library	32,255	25,804	1,471	338
Law Library	32,748	26,198	1,494	344
Wa'ahila Faculty Housing	22,735	18,188	1,037	238
Holmes Hall	22,605	18,084	1,031	237
Institute for Astronomy	21,073	16,858	961	221
Sakamaki Hall	18,575	14,860	847	195
PBRC	16,794	13,435	766	176
Sinclair Library	13,943	11,154	636	146
Campus Center	12,916	10,333	589	135
Music Buildings	12,356	9,885	564	130
Ag Sceince Facilities	11,630	9,304	530	122
Kennedy Theater	11,112	8,890	507	117
Webster Hall	10,340	8,272	472	108
<b>TOTAL ROOF over 10,000 sqft</b>	<b>273,508</b>	<b>218,806</b>	<b>12,475</b>	<b>2,869</b>
*Roof area accounts for a 5' wide access lane on the perimeter of each roof, and excludes any area significantly obstructed by other equipment.				

# Solar Systems in the Analysis (cont.)

## Small Roof Systems

Name	Area (sqft)	Area Covered by Panels (sqft)	Number of Panels	System Capacity (kW)
<b>Roof Systems under 10,000 sqft</b>				
Maintenance Shop	8,840	7,072	403	93
Hale Laulima	8,360	6,688	381	88
Hale Manoa	7,960	6,368	363	84
Student Services Center (QLC)	7,523	6,018	343	79
Hale Kuahine	7,240	5,792	330	76
Hale Kahawai	7,240	5,792	330	76
Hawaii Hall	7,162	5,730	327	75
Moore Hall	6,385	5,108	291	67
Spalding Hall	6,316	5,053	288	66
Hawaii Geophysics Institute	6,084	4,867	277	64
George Hall	5,947	4,758	271	62
Hamilton Library Annex	4,411	3,529	201	46
<b>TOTAL ROOF under 10,000 sqft</b>	<b>83,468</b>	<b>66,774</b>	<b>3,807</b>	<b>876</b>
*Roof area accounts for a 5' wide access lane on the perimeter of each roof, and excludes any area significantly obstructed by other equipment.				

# Solar Systems in the Analysis

## Parking Structure Systems

Name	Area (sqft)	Area Covered by Panels (sqft)	Number of Panels	System Capacity (kW)
<b>Parking Lot Systems</b>				
Parking Structure Phase 1	91,085	45,543	2,596	597
Parking Structure Phase 2	60,100	30,050	1,713	394
Dole Street Parking	20,165	10,083	575	132
<b>TOTAL PARKING</b>	<b>171,350</b>	<b>85,675</b>	<b>4,885</b>	<b>1,123</b>
<b>GRAND TOTAL</b>	<b>528,326</b>	<b>371,256</b>	<b>21,166</b>	<b>4,868</b>

- Potential systems identified in our analysis total **4.9 MW** of solar capacity
- This capacity is likely to decrease as we perform additional roofing and structural due-diligence as part of developing procurement specifications

# Results

## Results – Scenario 1: Baseline/No Solar

- This scenario estimates the cost for purchasing electricity from HECO for the next 25 years without implementing solar (3.6% escalation, TY2009 DS base rate)

Metric	25 Year Sum	25 Year NPV
<b>UTILITY COST W/O SOLAR</b>	<b>(\$879,060,627)</b>	<b>(\$698,532,058)</b>

- This Scenario serves as a point of comparison for Scenarios 2 and 3
- Our utility bill estimates are subject to revision, which would be based on a comparison to UHM's March utility bill

# Results – Scenario 2: PV System Ownership

- A range of potential system costs (in \$/Watt) were used to develop the analysis

<b>Effects of Solar Cost on Benefits of Ownership</b>			
	Low Solar Cost	Medium Solar Cost	High Solar Cost
<b>Model Inputs</b>			
Roof Capital Cost (\$/W)	\$4.17	\$5.25	\$6.72
Parking Capital Cost (\$/W)	\$4.40	\$5.71	\$7.93
<b>Results of Analysis</b>			
Net Benefits (Ownership)	\$17,657,467	\$11,505,480	\$2,578,408

- The table above shows the Net Present Value (NPV) of the 25-year net benefits resulting from PV system purchase
- We selected the medium scenario for our analysis, a reasonable estimate given the scale of the UHM project

**Note: Financing costs are included in this analysis.**

## Results – Scenario 2: PV System Ownership

Metric	25 Year Sum	25 Year NPV
<b>UTILITY COST W/O SOLAR</b>	<b>(\$879,060,627)</b>	<b>(\$698,532,058)</b>
Electric Bill Savings w/ Solar	\$56,502,229	\$45,243,375
<b>TOTAL ONGOING COST</b>	<b>(\$862,346,609)</b>	<b>(\$687,026,578)</b>
<i>M&amp;O Costs</i>	<i>(\$5,784,086)</i>	<i>(\$4,647,159)</i>
<i>PPA Cost</i>	\$0	\$0
<i>Utility Cost w/Solar</i>	<i>(\$822,558,398)</i>	<i>(\$653,288,683)</i>
<i>Bond Principal Payment</i>	<i>(\$26,462,365)</i>	<i>(\$22,380,433)</i>
<i>Bond Interest Payment</i>	<i>(\$7,541,774)</i>	<i>(\$6,710,313)</i>
<b>NET BENEFIT</b>	<b>\$16,714,019</b>	<b>\$11,505,480</b>

- At an NPV rate of 1.5%, bond interest rate of 3%, and a bond issuance rate of 1.5% of capital costs, UHM will accrue a 25-year net benefit of \$11.5 million (NPV).

# Results – Scenario 3: Power Purchase Agreement

- A range of potential PPA prices (in \$/kWh) were used to develop the analysis
- PPA prices are escalated at 3.4% per year (average escalation rate for Hawaii DOT project)

<b>Effects of Solar Cost on Benefits of PPA</b>			
	Low PPA Rate	Medium PPA Rate	High PPA Rate
<b>Model Inputs</b>			
Roof Price (\$/kWh)	\$0.120	\$0.185	\$0.300
Parking Lot Price (\$/kWh)	\$0.150	\$0.198	\$0.230
<b>Results of Analysis</b>			
Nat Benefits (PPA)	\$17,864,218	\$4,656,198	(\$15,984,867)

- The table above shows the NPV of the 25-year net benefit resulting from PPA
- We selected the medium scenario for our analysis, a reasonable estimate given the scale of the UHM project

## Results – Scenario 3: Power Purchase Agreement

Metric	25 Year Sum	25 Year NPV
<b>UTILITY COST W/O SOLAR</b>	<b>(\$879,060,627)</b>	<b>(\$698,532,058)</b>
Electric Bill Savings w/ Solar	\$56,502,229	\$45,243,375
<b>TOTAL ONGOING COST</b>	<b>(\$873,170,672)</b>	<b>(\$693,875,860)</b>
<i>M&amp;O Costs</i>	\$0	\$0
<i>PPA Cost</i>	(\$50,612,273)	(\$40,587,177)
<i>Utility Cost w/Solar</i>	(\$822,558,398)	(\$653,288,683)
<i>Bond Principal Payment</i>	\$0	\$0
<i>Bond Interest Payment</i>	\$0	\$0
<b>NET BENEFIT</b>	<b>\$5,889,956</b>	<b>\$4,656,198</b>

- At an NPV rate of 1.5% and a PPA escalation rate of 3.4% annually, UHM will experience a 25-year net benefit of over \$4.6 million (NPV).

# Benefits of Solar Production

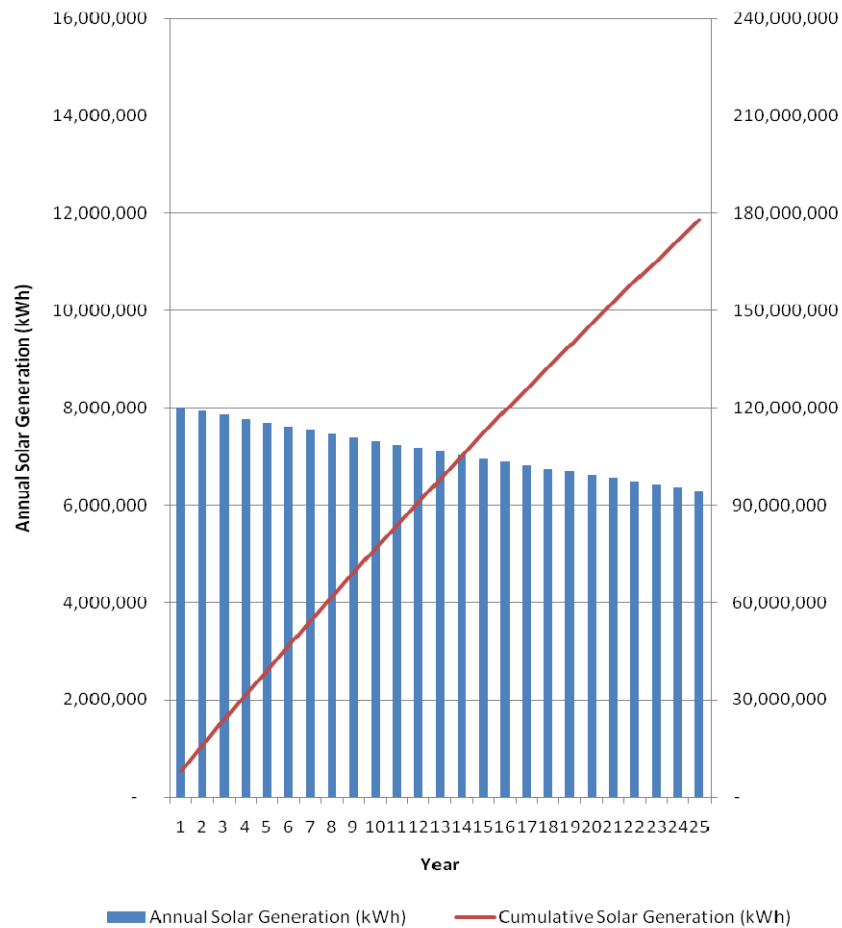
***In either of the “build” scenarios (ownership or PPA), solar implementation would result in the following benefits:***

- The project would offset about 7% of the campus’ energy consumption over 25 years, resulting in both financial and environmental benefits
- Generating 146 million kWh over 25 years is equivalent to avoiding:<sup>1</sup>
  - 123,000 Metric Tons of CO<sub>2</sub>
  - CO<sub>2</sub> emissions from 286,000 barrels of oil
  - CO<sub>2</sub> emissions of 24,000 passenger vehicles
  - Carbon sequestered by 3.2 million tree seedlings grown for 10 years

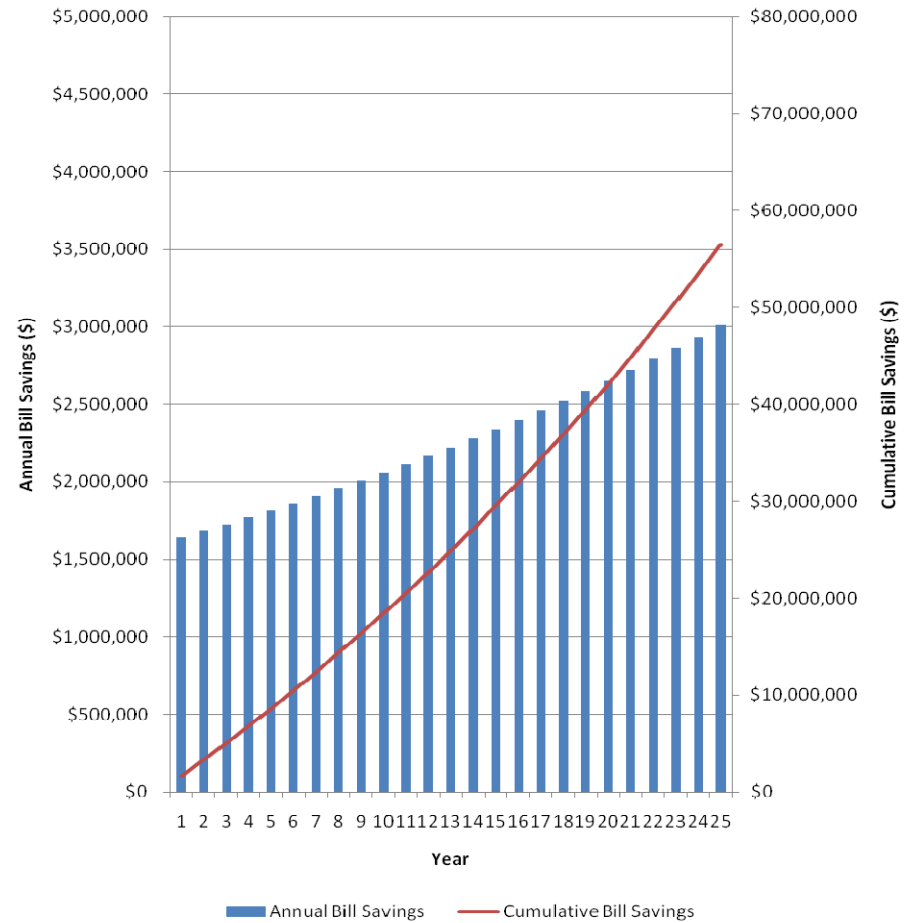
<sup>1</sup> <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

# Estimated Solar Generation and Bill Savings

## Solar Generation



## Bill Savings



# Summary and Recommendations

# Summary of Analysis

- Both the ownership and PPA scenarios result in a net financial benefit to UHM
  - The most beneficial approach depends on the cost and price assumptions in the model
  - SolarCity's aggressive pricing in the DOT procurement has a significant effect on the relative benefit of the scenarios
- There is no easy means for the University to take advantage of tax credits without entering into a PPA or lease arrangement
- While the system cost and utility cost assumptions in the model have high sensitivity, the project still results in financial benefits to the University using conservative values
- The University also needs to consider non-financial benefits of solar in their decision-making:
  - Predictability of utility prices (for the portion of electricity generated through solar)
  - Environmental benefits
  - Achieving progress toward the University's sustainability goals
  - Educational benefits

# Recommendations

## 1. Phased Approach

- Based on our field-work and analysis, we recommend adoption of a phased implementation approach
  - Phase 1: On-campus systems
  - Phase 2: Wa'ahila Valley
  - Phase 3: Off-campus FIT systems
- A phased implementation would allow UHM to quickly procure solar power, potentially taking advantage of beneficial pricing recently seen in the SDOT procurement, while continuing to pursue generation in the Wa'ahila Valley and off-campus FIT opportunities

## 2. RFP

- Go to market with RFP to test pricing assumptions in the analysis, confirm benefits stream, and potentially implement projects
- Next steps
  - Confirm approach with UHM procurement department
  - Perform due-diligence on roofing and structural issues
  - Further investigation of financial options
  - Develop specifications and procurement documents

# Appendix A

## *25-Year Financial Analysis*

# Appendix A: 25-Year Financial Analysis

#	Option	Metric	20 Years	Year 20 Yr NPV	2012	2013	2014	2015	2016	2017
					0	1	2	3	4	5
1	PPA	Load w/out solar			-	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
1	PPA	Load w/solar			-	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
1	PPA	Cost w/out Solar (\$/kWh)			\$0	\$ 0.21	\$ 0.21	\$ 0.22	\$ 0.23	\$ 0.24
1	PPA	Cost w/Solar (\$/kWh)			\$0	\$ 0.21	\$ 0.21	\$ 0.22	\$ 0.23	\$ 0.24
1	PPA	Avoided Cost (\$/kWh)			\$0	\$ 0.20	\$ 0.21	\$ 0.22	\$ 0.23	\$ 0.24
1	PPA	<b>UTILITY COST W/O SOLAR</b>	<b>(\$879,060,627)</b>	<b>(\$698,532,058)</b>	<b>\$0</b>	<b>(\$22,270,440)</b>	<b>(\$23,072,176)</b>	<b>(\$23,902,774)</b>	<b>(\$24,763,274)</b>	<b>(\$25,654,752)</b>
1	PPA	PPA Cost	(\$50,612,273)	(\$40,587,177)	\$0	(\$1,507,613)	(\$1,543,283)	(\$1,579,797)	(\$1,617,175)	(\$1,655,438)
1	PPA	Electric Bill Savings w/ Solar	\$56,502,229	\$45,243,375	\$0	\$1,640,488	\$1,682,550	\$1,725,690	\$1,769,937	\$1,815,318
1	PPA	Utility Cost w/Solar	(\$822,558,398)	(\$653,288,683)	\$0	(\$20,629,952)	(\$21,389,626)	(\$22,177,084)	(\$22,993,337)	(\$23,839,433)
1	PPA	M&O Costs	N/A	N/A	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Balance	N/A	N/A	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Payment	N/A	N/A	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Interest Payment	N/A	N/A	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	<b>TOTAL ONGOING COST</b>	<b>(\$873,170,672)</b>	<b>(\$693,875,860)</b>	<b>\$0</b>	<b>(\$22,137,565)</b>	<b>(\$22,932,909)</b>	<b>(\$23,756,881)</b>	<b>(\$24,610,512)</b>	<b>(\$25,494,871)</b>
1	PPA	<b>NET BENEFIT</b>	<b>\$5,889,956</b>	<b>\$4,656,198</b>	<b>\$0</b>	<b>\$132,874</b>	<b>\$139,266</b>	<b>\$145,893</b>	<b>\$152,762</b>	<b>\$159,880</b>
2	Ownership	Load w/out solar			-	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
2	Ownership	Load w/solar			-	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
2	Ownership	Cost w/out Solar (\$/kWh)			\$0	\$ 0.21	\$ 0.21	\$ 0.22	\$ 0.23	\$ 0.24
2	Ownership	Cost w/Solar (\$/kWh)			\$0	\$ 0.21	\$ 0.21	\$ 0.22	\$ 0.23	\$ 0.24
2	Ownership	Avoided Cost (\$/kWh)			\$0	\$ 0.20	\$ 0.21	\$ 0.22	\$ 0.23	\$ 0.24
2	Ownership	<b>UTILITY COST W/O SOLAR</b>	<b>(\$879,060,627)</b>	<b>(\$698,532,058)</b>	<b>\$0</b>	<b>(\$22,270,440)</b>	<b>(\$23,072,176)</b>	<b>(\$23,902,774)</b>	<b>(\$24,763,274)</b>	<b>(\$25,654,752)</b>
2	Ownership	PPA Cost	N/A	N/A	\$0	\$0	\$0	\$0	\$0	\$0
2	Ownership	Electric Bill Savings w/ Solar	\$56,502,229	\$45,243,375	\$0	\$1,640,488	\$1,682,550	\$1,725,690	\$1,769,937	\$1,815,318
2	Ownership	Utility Cost w/Solar	(\$822,558,398)	(\$653,288,683)	\$0	(\$20,629,952)	(\$21,389,626)	(\$22,177,084)	(\$22,993,337)	(\$23,839,433)
2	Ownership	M&O Costs	(\$5,784,086)	(\$4,647,159)	\$0	(\$97,360)	(\$100,281)	(\$103,289)	(\$106,388)	(\$109,580)
2	Ownership	Bond Principal Balance	N/A	N/A	\$26,462,365	\$25,139,247	\$23,816,129	\$22,493,011	\$21,169,892	\$19,846,774
2	Ownership	Bond Principal Payment	(\$26,462,365)	(\$22,380,433)	\$0	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)
2	Ownership	Bond Interest Payment	(\$7,541,774)	(\$6,710,313)	\$0	(\$754,177)	(\$714,484)	(\$674,790)	(\$635,097)	(\$595,403)
2	Ownership	<b>TOTAL ONGOING COST</b>	<b>(\$862,346,609)</b>	<b>(\$687,026,578)</b>	<b>\$0</b>	<b>(\$22,804,608)</b>	<b>(\$23,527,509)</b>	<b>(\$24,278,281)</b>	<b>(\$25,057,940)</b>	<b>(\$25,867,535)</b>
2	Ownership	<b>NET BENEFIT</b>	<b>\$16,714,019</b>	<b>\$11,505,480</b>	<b>\$0</b>	<b>(\$534,168)</b>	<b>(\$455,333)</b>	<b>(\$375,508)</b>	<b>(\$294,666)</b>	<b>(\$212,783)</b>

# Appendix A: 25-Year Financial Analysis

			2018	2019	2020	2021	2022	2023	2024	2025
#	Option	Metric	6	7	8	9	10	11	12	13
1	PPA	Load w/out solar	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
1	PPA	Load w/solar	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
1	PPA	Cost w/out Solar (\$/kWh)	\$ 0.24	\$ 0.25	\$ 0.26	\$ 0.27	\$ 0.28	\$ 0.29	\$ 0.30	\$ 0.31
1	PPA	Cost w/Solar (\$/kWh)	\$ 0.25	\$ 0.25	\$ 0.26	\$ 0.27	\$ 0.28	\$ 0.29	\$ 0.31	\$ 0.32
1	PPA	Avoided Cost (\$/kWh)	\$ 0.24	\$ 0.25	\$ 0.26	\$ 0.27	\$ 0.28	\$ 0.29	\$ 0.30	\$ 0.31
1	PPA	<b>UTILITY COST W/O SOLAR</b>	<b>(\$26,578,323)</b>	<b>(\$27,535,142)</b>	<b>(\$28,526,407)</b>	<b>(\$29,553,358)</b>	<b>(\$30,617,279)</b>	<b>(\$31,719,501)</b>	<b>(\$32,861,403)</b>	<b>(\$34,044,414)</b>
1	PPA	PPA Cost	(\$1,694,605)	(\$1,734,700)	(\$1,775,743)	(\$1,817,757)	(\$1,860,765)	(\$1,904,791)	(\$1,949,858)	(\$1,995,992)
1	PPA	Electric Bill Savings w/ Solar	\$1,861,863	\$1,909,601	\$1,958,563	\$2,008,781	\$2,060,286	\$2,113,112	\$2,167,292	\$2,222,861
1	PPA	Utility Cost w/Solar	(\$24,716,460)	(\$25,625,541)	(\$26,567,844)	(\$27,544,577)	(\$28,556,993)	(\$29,606,389)	(\$30,694,111)	(\$31,821,552)
1	PPA	M&O Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Balance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Interest Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	<b>TOTAL ONGOING COST</b>	<b>(\$26,411,065)</b>	<b>(\$27,360,241)</b>	<b>(\$28,343,587)</b>	<b>(\$29,362,334)</b>	<b>(\$30,417,758)</b>	<b>(\$31,511,180)</b>	<b>(\$32,643,969)</b>	<b>(\$33,817,544)</b>
1	PPA	<b>NET BENEFIT</b>	<b>\$167,257</b>	<b>\$174,901</b>	<b>\$182,820</b>	<b>\$191,024</b>	<b>\$199,521</b>	<b>\$208,321</b>	<b>\$217,434</b>	<b>\$226,870</b>
2	Ownership	Load w/out solar	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
2	Ownership	Load w/solar	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
2	Ownership	Cost w/out Solar (\$/kWh)	\$ 0.24	\$ 0.25	\$ 0.26	\$ 0.27	\$ 0.28	\$ 0.29	\$ 0.30	\$ 0.31
2	Ownership	Cost w/Solar (\$/kWh)	\$ 0.25	\$ 0.25	\$ 0.26	\$ 0.27	\$ 0.28	\$ 0.29	\$ 0.31	\$ 0.32
2	Ownership	Avoided Cost (\$/kWh)	\$ 0.24	\$ 0.25	\$ 0.26	\$ 0.27	\$ 0.28	\$ 0.29	\$ 0.30	\$ 0.31
2	Ownership	<b>UTILITY COST W/O SOLAR</b>	<b>(\$26,578,323)</b>	<b>(\$27,535,142)</b>	<b>(\$28,526,407)</b>	<b>(\$29,553,358)</b>	<b>(\$30,617,279)</b>	<b>(\$31,719,501)</b>	<b>(\$32,861,403)</b>	<b>(\$34,044,414)</b>
2	Ownership	PPA Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2	Ownership	Electric Bill Savings w/ Solar	\$1,861,863	\$1,909,601	\$1,958,563	\$2,008,781	\$2,060,286	\$2,113,112	\$2,167,292	\$2,222,861
2	Ownership	Utility Cost w/Solar	(\$24,716,460)	(\$25,625,541)	(\$26,567,844)	(\$27,544,577)	(\$28,556,993)	(\$29,606,389)	(\$30,694,111)	(\$31,821,552)
2	Ownership	M&O Costs	(\$112,867)	(\$116,253)	(\$119,741)	(\$123,333)	(\$127,033)	(\$130,844)	(\$134,769)	(\$2,373,224)
2	Ownership	Bond Principal Balance	\$18,523,656	\$17,200,537	\$15,877,419	\$14,554,301	\$13,231,183	\$11,908,064	\$10,584,946	\$9,261,828
2	Ownership	Bond Principal Payment	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)
2	Ownership	Bond Interest Payment	(\$555,710)	(\$516,016)	(\$476,323)	(\$436,629)	(\$396,935)	(\$357,242)	(\$317,548)	(\$277,855)
2	Ownership	<b>TOTAL ONGOING COST</b>	<b>(\$26,708,155)</b>	<b>(\$27,580,929)</b>	<b>(\$28,487,026)</b>	<b>(\$29,427,657)</b>	<b>(\$30,404,080)</b>	<b>(\$31,417,593)</b>	<b>(\$32,469,547)</b>	<b>(\$35,795,750)</b>
2	Ownership	<b>NET BENEFIT</b>	<b>(\$129,832)</b>	<b>(\$45,786)</b>	<b>\$39,382</b>	<b>\$125,701</b>	<b>\$213,199</b>	<b>\$301,908</b>	<b>\$391,856</b>	<b>(\$1,751,336)</b>

# Appendix A: 25-Year Financial Analysis

			2026	2027	2028	2029	2030	2031	2032
#	Option	Metric	14	15	16	17	18	19	20
1	PPA	Load w/out solar	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
1	PPA	Load w/solar	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
1	PPA	Cost w/out Solar (\$/kWh)	\$ 0.32	\$ 0.34	\$ 0.35	\$ 0.36	\$ 0.37	\$ 0.39	\$ 0.40
1	PPA	Cost w/Solar (\$/kWh)	\$ 0.33	\$ 0.34	\$ 0.35	\$ 0.37	\$ 0.38	\$ 0.39	\$ 0.41
1	PPA	Avoided Cost (\$/kWh)	\$ 0.32	\$ 0.34	\$ 0.35	\$ 0.36	\$ 0.37	\$ 0.39	\$ 0.40
<b>1</b>	<b>PPA</b>	<b>UTILITY COST W/O SOLAR</b>	<b>(\$35,270,012)</b>	<b>(\$36,539,733)</b>	<b>(\$37,855,163)</b>	<b>(\$39,217,949)</b>	<b>(\$40,629,795)</b>	<b>(\$42,092,468)</b>	<b>(\$43,607,797)</b>
1	PPA	PPA Cost	(\$2,043,217)	(\$2,091,559)	(\$2,141,046)	(\$2,191,703)	(\$2,243,558)	(\$2,296,641)	(\$2,350,980)
1	PPA	Electric Bill Savings w/ Solar	\$2,279,855	\$2,338,311	\$2,398,265	\$2,459,757	\$2,522,825	\$2,587,510	\$2,653,854
1	PPA	Utility Cost w/Solar	(\$32,990,157)	(\$34,201,422)	(\$35,456,898)	(\$36,758,193)	(\$38,106,971)	(\$39,504,958)	(\$40,953,943)
1	PPA	M&O Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Balance	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Interest Payment	\$0	\$0	\$0	\$0	\$0	\$0	\$0
<b>1</b>	<b>PPA</b>	<b>TOTAL ONGOING COST</b>	<b>(\$35,033,374)</b>	<b>(\$36,292,981)</b>	<b>(\$37,597,944)</b>	<b>(\$38,949,895)</b>	<b>(\$40,350,529)</b>	<b>(\$41,801,599)</b>	<b>(\$43,304,923)</b>
<b>1</b>	<b>PPA</b>	<b>NET BENEFIT</b>	<b>\$236,639</b>	<b>\$246,752</b>	<b>\$257,220</b>	<b>\$268,054</b>	<b>\$279,266</b>	<b>\$290,869</b>	<b>\$302,874</b>
2	Ownership	Load w/out solar	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
2	Ownership	Load w/solar	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
2	Ownership	Cost w/out Solar (\$/kWh)	\$ 0.32	\$ 0.34	\$ 0.35	\$ 0.36	\$ 0.37	\$ 0.39	\$ 0.40
2	Ownership	Cost w/Solar (\$/kWh)	\$ 0.33	\$ 0.34	\$ 0.35	\$ 0.37	\$ 0.38	\$ 0.39	\$ 0.41
2	Ownership	Avoided Cost (\$/kWh)	\$ 0.32	\$ 0.34	\$ 0.35	\$ 0.36	\$ 0.37	\$ 0.39	\$ 0.40
<b>2</b>	<b>Ownership</b>	<b>UTILITY COST W/O SOLAR</b>	<b>(\$35,270,012)</b>	<b>(\$36,539,733)</b>	<b>(\$37,855,163)</b>	<b>(\$39,217,949)</b>	<b>(\$40,629,795)</b>	<b>(\$42,092,468)</b>	<b>(\$43,607,797)</b>
2	Ownership	PPA Cost	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2	Ownership	Electric Bill Savings w/ Solar	\$2,279,855	\$2,338,311	\$2,398,265	\$2,459,757	\$2,522,825	\$2,587,510	\$2,653,854
2	Ownership	Utility Cost w/Solar	(\$32,990,157)	(\$34,201,422)	(\$35,456,898)	(\$36,758,193)	(\$38,106,971)	(\$39,504,958)	(\$40,953,943)
2	Ownership	M&O Costs	(\$142,976)	(\$147,266)	(\$151,684)	(\$156,234)	(\$160,921)	(\$165,749)	(\$170,721)
2	Ownership	Bond Principal Balance	\$7,938,710	\$6,615,591	\$5,292,473	\$3,969,355	\$2,646,237	\$1,323,118	\$0
2	Ownership	Bond Principal Payment	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)	(\$1,323,118)
2	Ownership	Bond Interest Payment	(\$238,161)	(\$198,468)	(\$158,774)	(\$119,081)	(\$79,387)	(\$39,694)	(\$0)
<b>2</b>	<b>Ownership</b>	<b>TOTAL ONGOING COST</b>	<b>(\$34,694,413)</b>	<b>(\$35,870,274)</b>	<b>(\$37,090,474)</b>	<b>(\$38,356,626)</b>	<b>(\$39,670,397)</b>	<b>(\$41,033,519)</b>	<b>(\$42,447,783)</b>
<b>2</b>	<b>Ownership</b>	<b>NET BENEFIT</b>	<b>\$575,599</b>	<b>\$669,459</b>	<b>\$764,689</b>	<b>\$861,323</b>	<b>\$959,398</b>	<b>\$1,058,949</b>	<b>\$1,160,014</b>

# Appendix A: 25-Year Financial Analysis

#	Option	Metric	2033	2034	2035	2036	2037
			21	22	23	24	25
1	PPA	Load w/out solar	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
1	PPA	Load w/solar	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
1	PPA	Cost w/out Solar (\$/kWh)	\$ 0.42	\$ 0.43	\$ 0.45	\$ 0.46	\$ 0.48
1	PPA	Cost w/Solar (\$/kWh)	\$ 0.42	\$ 0.44	\$ 0.45	\$ 0.47	\$ 0.49
1	PPA	Avoided Cost (\$/kWh)	\$ 0.42	\$ 0.43	\$ 0.45	\$ 0.46	\$ 0.48
1	PPA	<b>UTILITY COST W/O SOLAR</b>	<b>(\$45,177,677)</b>	<b>(\$46,804,074)</b>	<b>(\$48,489,020)</b>	<b>(\$50,234,625)</b>	<b>(\$52,043,072)</b>
1	PPA	PPA Cost	(\$2,406,604)	(\$2,463,544)	(\$2,521,831)	(\$2,581,498)	(\$2,642,576)
1	PPA	Electric Bill Savings w/ Solar	\$2,721,899	\$2,791,688	\$2,863,267	\$2,936,681	\$3,011,978
1	PPA	Utility Cost w/Solar	(\$42,455,779)	(\$44,012,386)	(\$45,625,754)	(\$47,297,944)	(\$49,031,094)
1	PPA	M&O Costs	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Balance	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Principal Payment	\$0	\$0	\$0	\$0	\$0
1	PPA	Bond Interest Payment	\$0	\$0	\$0	\$0	\$0
1	PPA	<b>TOTAL ONGOING COST</b>	<b>(\$44,862,383)</b>	<b>(\$46,475,930)</b>	<b>(\$48,147,585)</b>	<b>(\$49,879,442)</b>	<b>(\$51,673,670)</b>
1	PPA	<b>NET BENEFIT</b>	<b>\$315,295</b>	<b>\$328,144</b>	<b>\$341,436</b>	<b>\$355,183</b>	<b>\$369,401</b>
2	Ownership	Load w/out solar	108,544,411	108,544,411	108,544,411	108,544,411	108,544,411
2	Ownership	Load w/solar	100,531,777	100,531,777	100,531,777	100,531,777	100,531,777
2	Ownership	Cost w/out Solar (\$/kWh)	\$ 0.42	\$ 0.43	\$ 0.45	\$ 0.46	\$ 0.48
2	Ownership	Cost w/Solar (\$/kWh)	\$ 0.42	\$ 0.44	\$ 0.45	\$ 0.47	\$ 0.49
2	Ownership	Avoided Cost (\$/kWh)	\$ 0.42	\$ 0.43	\$ 0.45	\$ 0.46	\$ 0.48
2	Ownership	<b>UTILITY COST W/O SOLAR</b>	<b>(\$45,177,677)</b>	<b>(\$46,804,074)</b>	<b>(\$48,489,020)</b>	<b>(\$50,234,625)</b>	<b>(\$52,043,072)</b>
2	Ownership	PPA Cost	\$1	\$2	\$3	\$4	\$5
2	Ownership	Electric Bill Savings w/ Solar	\$2,721,899	\$2,791,688	\$2,863,267	\$2,936,681	\$3,011,978
2	Ownership	Utility Cost w/Solar	(\$42,455,779)	(\$44,012,386)	(\$45,625,754)	(\$47,297,944)	(\$49,031,094)
2	Ownership	M&O Costs	(\$175,843)	(\$181,118)	(\$186,552)	(\$192,148)	(\$197,913)
2	Ownership	Bond Principal Balance	\$0	\$0	\$0	\$0	\$0
2	Ownership	Bond Principal Payment	\$0	\$0	\$0	\$0	\$0
2	Ownership	Bond Interest Payment	(\$0)	(\$0)	(\$0)	(\$0)	(\$0)
2	Ownership	<b>TOTAL ONGOING COST</b>	<b>(\$42,631,621)</b>	<b>(\$44,193,502)</b>	<b>(\$45,812,302)</b>	<b>(\$47,490,089)</b>	<b>(\$49,229,002)</b>
2	Ownership	<b>NET BENEFIT</b>	<b>\$2,546,057</b>	<b>\$2,610,572</b>	<b>\$2,676,718</b>	<b>\$2,744,537</b>	<b>\$2,814,070</b>