



Rhode Island Renewable Energy Growth Program:

2017 Ceiling Price Recommendations

October 2016

Sustainable Energy Advantage, LLC

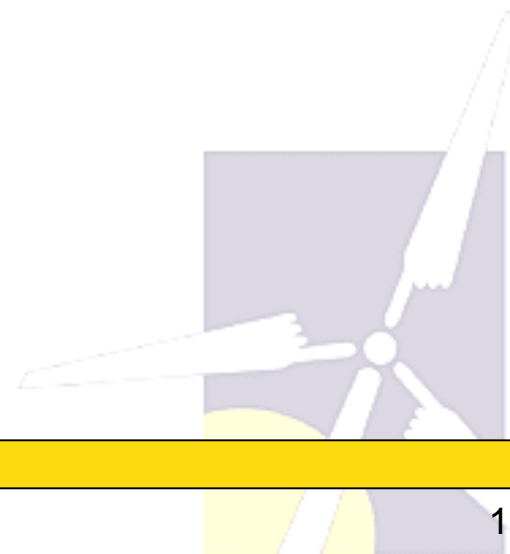
Meister Consultants Group, Inc.

Mondre Energy, Inc.

Changes from prior analyses, and supporting comments, marked in green text.



SUMMARY RESULTS



Final Draft Proposed Ceiling Prices, 2017 REG Program (1)

(cents/kWh)

Technology	Size Range (Modeled Size)	Analysis Run	15 year Tariff Duration	20 year Tariff Duration
Small Solar I, Host Owned, Residential	1 to 10 kW (5)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	37.65 28.15 (-25%) 29.65 (-21%) 34.75 (-8%)	33.45 25.45 (-24%) 27.65 (-16%) 30.85 (-8%)
Small Solar I, Host Owned, Non-Residential	1 to 10 kW (5)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	NA 28.65 29.15 34.75	NA 25.85 26.85 30.85
Small Solar I, TPO, Residential	1 to 10 kW (5)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	28.35 26.25 (-7%) 27.65 (-2%) 27.05 (-5%)	24.70 24.55 (-1%) 24.55 (-1%) 24.05 (-3%)
Small Solar I, TPO, Non-Residential	1 to 10 kW (5)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	NA 26.75 27.05 27.05	NA 23.75 24.25 24.05

When comparing Ceiling Prices, please note that property taxes were applied to residential projects for 2016 CPs and are not applied to residential projects for 2017 CPs.



Final Draft Proposed Ceiling Prices, 2017 REG Program (2)

(cents/kWh)

Technology	Size Range	Analysis Run	20-Yr Tariff
Small Solar II, Residential	11 to 25 kW (25)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	24.90 23.65 (-5%) 24.65 (-1%) 27.75 (11%)
Small Solar II, Non-Residential	11 to 25 kW (25)	2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	23.25 23.95 27.75
Medium Solar	26 to 250 kW (140)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	22.55 22.25 (-1%) 22.25 (-1%) 22.75 (1%)
Commercial Solar	251 to 999 kW (500)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	19.30 18.35 (-5%) 17.85 (-8%) 18.75 (-3%)
Commercial Solar, Community Remote DG	251 to 999 kW (500)	2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	18.45 20.50 21.60
Large Solar	1 to 5 MW (2)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	15.10 14.95 (-1%) 14.45 (-4%) 15.05 (-0.3%)
Large Solar, Community Remote DG	1 to 5 MW (2)	2017 2 nd Draft 2017 Final Draft	16.60 17.30



Final Draft Proposed Ceiling Prices, 2017 REG Program (3)

(cents/kWh)

Technology	Size Range	Analysis Run	20-Yr Tariff
Small Wind	1 – 999 kW (100 kW)	2017 1 st Draft	20.95
		2017 2 nd Draft	20.95
		2017 Final Draft	21.45
Wind I	1 – 3 MW (1.65 MW)	2016 Final CP	18.75
		2017 1 st Draft	17.55 (-6%)
		2017 2 nd Draft	17.55 (-6%)
		2017 Final Draft	19.45 (4%)
Wind I, Community Remote DG	1 – 3 MW (1.65 MW)	2017 2 nd Draft	20.20
		2017 Final Draft	22.40
Wind II	3 – 5 MW (3.3 MW)	2016 Final CP	18.00
		2017 1 st Draft	16.85 (-6%)
		2017 2 nd Draft	16.85 (-6%)
		2017 Final Draft	18.25 (1%)
Wind II, Community Remote DG	3 – 5 MW (3.3 MW)	2017 2 nd Draft	19.40
			21.00
Wind III	3 – 5 MW (4.95 MW)	2016 Final CP	17.40
		2017 1 st Draft	16.25 (-7%)
		2017 2 nd Draft	16.25 (-7%)
		2017 Final Draft	17.35 (-0.3%)
Wind III, Community Remote DG	3 – 5 MW (4.95 MW)	2017 2 nd Draft	18.70
		2017 Final Draft	20.00

The analysis assumes that wind projects qualify for 80% of the full ITC value.



Final Draft Proposed Ceiling Prices, 2017 REG Program (4)

(cents/kWh)

Technology	Size Range	Analysis Run	20-Yr Tariff
Hydro I	10 – 250 kW (150 kW)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	18.65 22.15 (19%) 22.15 (19%) 22.45 (20%)
Hydro II	251 kW – 5 MW (500 kW)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	17.45 20.75 (19%) 20.75 (19%) 22.45 (29%)
AD I	150 – 500 kW (325 kW)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	20.20 19.45 (-4%) 20.15 (-0.25%) 20.15 (-0.25%)
AD II	501 kW – 5 MW (750 kW)	2016 Final CP 2017 1 st Draft 2017 2 nd Draft 2017 Final Draft	20.20 20.15 (-0.25%) 20.15 (-0.25%) 20.15 (-0.25%)




Summary of Changes & Recommendations: Solar

- Inputs (detailed in next section) updated based on data from stakeholders
 - Interconnection costs assumed to increase compared to historic actuals.
- Modeling already aligned with stakeholder comment that ITC/5-year MACRS based on ~90% of project costs (current modeling ~89.5%); rest of cost basis depreciation as 15-year SL
- % of Total Tariff Value Assumed Taxable increased from 45% to 65%
- With respect to cost of capital, stakeholders recommended input increases. Stakeholders also commented that projects/portfolios are often back-levered after initial development, effectively reducing the cost of capital and liberating capital for future investment.
- Stakeholders recommended removing the non-res. small solar categories.
- CPs for both Res. and Non-Res. Host-Owned recommended at same value (Solar I & II).
- CPs for both Res. and Non-Res. 3rd-Party-Owned recommended at same value.



Summary of Changes & Recommendations: Solar CRDG

- 15% CP premium recommended;
- Stakeholders comment that this is insufficient; that actual premium is ~25%
- Taking “Large Solar” as an example, with weighted-average Round 2 project bids at 12.58 ¢/kWh, a CRDG project priced at the CRDG CP would be afforded a 37% premium over the “core” cost of solar at that scale.
 - Suggests that CRDG may be possible when paired with cost-effective projects.
- Taking “Commercial Solar” as an example, with weighted-average Round 2 project bids at 17.59 ¢/kWh, a CRDG project priced at the CRDG CP would be afforded a 27% premium over the “core” cost of solar at that scale.
 - Suggests that CRDG may be possible when paired with cost-effective projects.

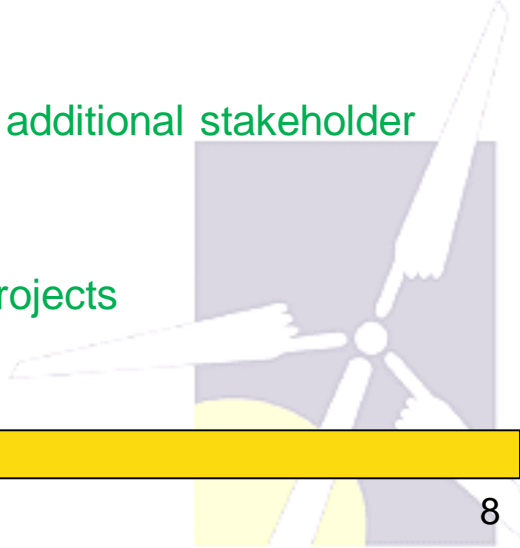


Summary of Changes & Recommendations: Wind & Hydro

- Wind

- Turbine size adjusted from 1,650 to 1,500 for Wind I, II & III.
- Interconnection costs: updates based on NGrid estimate for proposed wind project in RI
- Other cost data based on data from stakeholders and comparison to other markets
 - O&M costs disaggregated
 - Major equipment repairs and replacements added
- Changes detailed in next section

- Hydro

- Cost and performance assumptions updated based on additional stakeholder feedback
 - Dam maintenance expense added
 - CP intended to provide price-signal to long lead-time projects
 - Stakeholder recommends removing Hydro I category
- 



MODELED PARAMETERS: SOLAR






SOLAR: Cost & Production Inputs

Modeled Parameters

		Small Solar I Resi (1-10 kW)	Small Solar I Comm (1-10 kW)	Small Solar II (11-25 kW)	Medium Solar (26-250 kW)	Commercial Solar (251-1,000 kW)	Large Solar (1-5 MW)
Nameplate Capacity	kW	5		25	140	500	2,000
Capacity Factor		13.49%	13.49%	13.49%	14.00% [13.45%]	14.40% [13.59%]	15.30% [14.18%]
Annual Degradation	%	0.5%					
Cost, Less Interconnection	\$/kW	\$3,800 (+ \$161 inverter warrantee) [\$3,839 + \$161 inverter warrantee]		\$3,541 [\$3,680]	\$2,724 [\$2,799]	\$2,240* \$2,293 [\$1,939]	\$2,091* \$2,150 [\$1,784]
Interconnection	\$/kW	\$0			\$129 [\$128]	\$150* \$97 [\$513]	\$150* \$91 [\$237]
Total Cost	\$/kW	\$3,961 [\$4,000]		\$3,541 [\$3,680]	\$2,853 [\$2,927]	\$2,390 [\$2,452]	\$2,241 [\$2,021]

* This is a reallocation of costs among categories, per stakeholder recommendation.



Ongoing Cost Assumptions

Modeled Parameters

		Small Solar I Resi (1-10 kW)	Small Solar I Comm (1-10 kW)	Small Solar II (11-25 kW)	Medium Solar (26-250 kW)	Commercial Solar (251-1,000 kW)	Large Solar (1-5 MW)
Fixed O&M Expense, Yr 1	\$/kW -yr	\$50 [\$15]	\$50 [\$15]	\$50 [\$15]	\$34 [\$15]	\$24 [\$15]	\$15
O&M Cost Inflation	%	2%					
Insurance, Yr 1 (% of Total Cost)	%	0.00%			0.27% [0.25%]		
Management Yr 1	\$/yr	Included in O&M. [\$150]			\$750 [\$500]	\$3,000 [\$3,300]	\$7,700 [\$10,000]
Land Lease	\$/yr	\$0			\$3,500 [\$0]	\$12,500 [\$6,000]	\$50,000 [\$24,000]
Inverter Replacement, in year 13	\$/kW	Covered by warranty; see previous slide			\$150	\$150	\$100



Financing Assumptions

Modeled Parameters

		Small Solar I, Host, Residential (1-10 kW) (15 / 20 yrs)	Small Solar I, Host, Non-Residential (1-10 kW) (15 / 20 yrs)	Small Solar I, TPO, Residential (1-10 kW) (15 / 20 yrs)	Small Solar I, TPO, Non-Res. (1-10 kW) (15 / 20 yrs)
% Debt	%	0% 100% [0%]	0%	55% 50%	55%
Debt Term	yrs	[N/A]	[N/A]	12/15 [13/18]	10/12
Interest Rate on Term Debt	%	[N/A]	[N/A]	6.0%/6.25% 5.5%/5.75% [6.5%]	5.5%/5.75%
Lender's Fee (% of total borrowing)	%	2.0% [2.25%, N/A for Small Solar I Resi (1-10 kW)]			
Required Minimum Annual DSCR		1.00			
Required Average DSCR		1.35			
Target After-Tax Equity IRR	%	5.0% [5.0%]	7.5%	8.0%	8.0%



Financing Assumptions

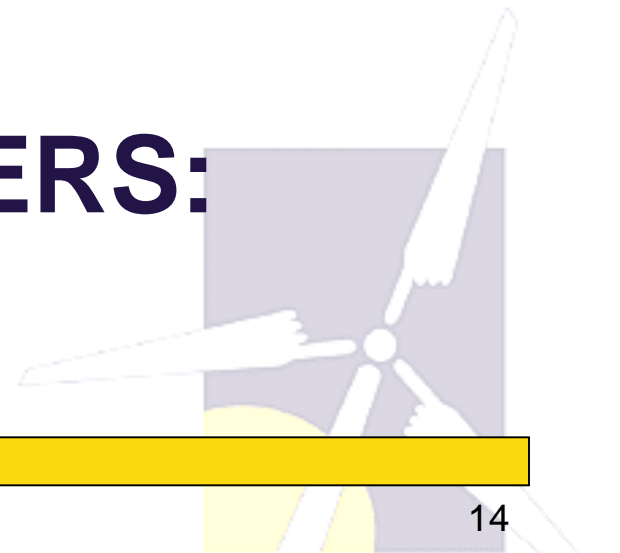
Modeled Parameters

		Small Solar II, Residential (11-25 kW)	Small Solar II, Non-Res. (11-25 kW)	Medium Solar (26-250 kW)	Commercial Solar (251-1,000 kW)	Large Solar (1-5 MW)
% Debt	%	0% 100%	0% 45% [50%]	50% 45% [50%]	50% 40% [50%]	40% [50%]
Debt Term	yrs	[N/A]	N/A, 12, 12 [18, 10, 15]			15
Interest Rate on Term Debt	%	[N/A]	N/A, 6.5%, 6.5% 5.5% [6.5%, 6.5%, 6.0%]			5.75% [6.0%]
Lender's Fee (% of total borrowing)	%	2.0% [2.25%, N/A for Small Solar I Resi (1-10 kW)]				
Required Minimum Annual DSCR		1.00				
Required Average DSCR		1.35				
Target After-Tax Equity IRR	%	5.0%, 7.5%, 7.5%, 7.5%, 7.0% 8.0% [5.0%, 8.0%, 7.5%, 7.0%, 7.0%]				

Green = change from 1st draft **Blue** = change from 2016 value. **[Bracketed]** values show 2016 CP inputs, where different




MODELED PARAMETERS: WIND



Production and Capital Cost Assumptions

Modeled Parameters

		Small Wind	Wind I	Wind II	Wind III
Nameplate Capacity	kW	100	1,500 1,650	3,000 3,300	4,500 4,950
Capacity Factor	%	21%	21%		
Annual Degradation	%	0.0%	0.0%		
Generation Equipment	\$/kW	\$4,000	\$3,500 \$3,200	\$3,325 \$3,025 [\$3,100]	\$3,159 \$2,850 [\$3,000]
Interconnection	\$/kW	\$54	\$292 \$102 [\$241]	\$240 \$100 [\$181]	\$213 \$100 [\$160]



Ongoing Cost Assumptions

Modeled Parameters

		Small Wind	Wind I	Wind II	Wind III
Fixed O&M Expense, Yr 1	\$/kW-yr	\$30.00		\$23.00* \$45.00 [\$25.00]	
O&M Cost Inflation	%	2%		2%	
Insurance, Yr 1 (% of Total Cost)	%	0.25%		0.43%* 0.45% [0.60%]	
Management Yr 1	\$/yr	Incl.		\$15,000 Included in O&M	
Land Lease	\$/yr	\$5,000	\$54K [\$52.5K]	\$108K [\$105K]	\$162K [\$157.5K]

* Per stakeholder data response; O&M now disaggregated.

Green = change from 1st draft Blue = change from 2016 value. [Bracketed] values show 2016 CP inputs, where different



Financing Assumptions

Modeled Parameters

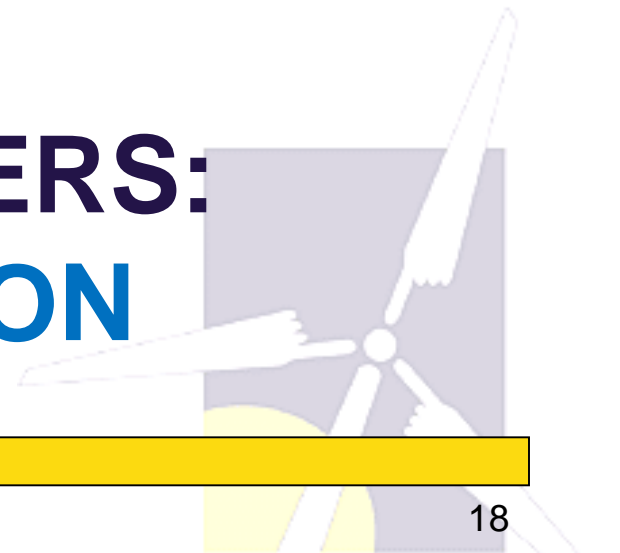
		Small Wind	Wind I	Wind II	Wind III
% Debt	%	45%	60% [70%]		
Debt Term	yrs	15	15 [18]		
Interest Rate on Term Debt	%	6.25%	6.25% [6.50%]		
Lender's Fee (% of total borrowing)	%	2.00%	2.00% [2.25%]		
Required Minimum Annual DSCR		1.00	1.00		
Required Average DSCR		1.45	1.45		
Target After-Tax Equity IRR	%	10%	10%		
Reserve Requirement	\$	Incl.	6 mos of debt service		
Major Equipment Replacements*		Incl.	Yr 15 = \$45K	Yr 15 = \$90K	Yr 15 = \$135K
			Yr 19 = \$45K	Yr 19 = \$90K	Yr 19 = \$135K
			Yrs 12, 15, 18, 19, \$30/kW		
			[\$0/kW]		

* Per stakeholder data response; O&M now disaggregated.

Green = change from 1st draft Blue = change from 2016 value. [Bracketed] values show 2016 CP inputs, where different



MODELED PARAMETERS: ANAEROBIC DIGESTION



PROJECT PERFORMANCE ASSUMPTIONS

Modeled Parameters

**No changes
to this set of
inputs.**

		Anaerobic Digestion I	Anaerobic Digestion II
Generator Nameplate Capacity	<i>kW</i>	325	725
Biogas Consumption per Day	<i>cubic feet/day</i>	131,729 157,911 [120,066]	293,856 [267,840]
Energy Content per Cubic Foot	<i>BTU/cubic foot</i>	550 [600]	
Heat Rate	<i>BTU/kWh</i>	8,979 10,339 [8,928]	8,979 [8,928]
Availability	%	92%	
Station Service (Parasitic Load)	%	20%	
Annual Production Degradation	%	0%	
Project Useful Life	<i>years</i>	20	



CAPITAL, INTERCONNECTION AND O&M COSTS

No changes to this set of inputs.

Modeled Parameters

		Anaerobic Digestion I	Anaerobic Digestion II
Generation Equipment	\$/kW	\$10,000	\$10,000
Interconnection Costs	\$/kW	\$150	
Fixed O&M Expense	\$/kW-yr	\$600	
Variable O&M Expense	¢/kWh	2.00	
O&M Cost Inflation	%	2%	



ONGOING EXPENSE ASSUMPTIONS

Modeled Parameters

**No changes
to this set of
inputs.**

		Anaerobic Digestion I	Anaerobic Digestion II
Insurance, Yr 1 (% of Total Cost)	%	1.0%	
Project Management Yr 1	\$/yr	\$33,621	\$75,000
Water & Sewer Expenses	\$/yr	\$0	
Digestate Disposal Cost (if handled as an expense)	\$/ton	\$0.00	
Land Lease	\$/yr	\$15,690	\$35,000

FINANCING ASSUMPTIONS

Modeled Parameters

**No changes
to this set of
inputs.**

		Anaerobic Digestion I	Anaerobic Digestion II
% Debt (% of hard costs) (mortgage-style amort.)	%		60%
Debt Term	<i>years</i>		15 [18]
Interest Rate on Term Debt	%		6.25% [6.50%]
Lender's Fee (% of total borrowing)	%		0%
Required Minimum Annual DSCR	<i>Ratio</i>		1.00
Required Average DSCR	<i>Ratio</i>		1.50
Target After-Tax Equity IRR	%		10%
Other Closing Costs	\$		\$0
Reserve Requirement	\$		\$0



SUPPLEMENTAL REVENUE ASSUMPTIONS

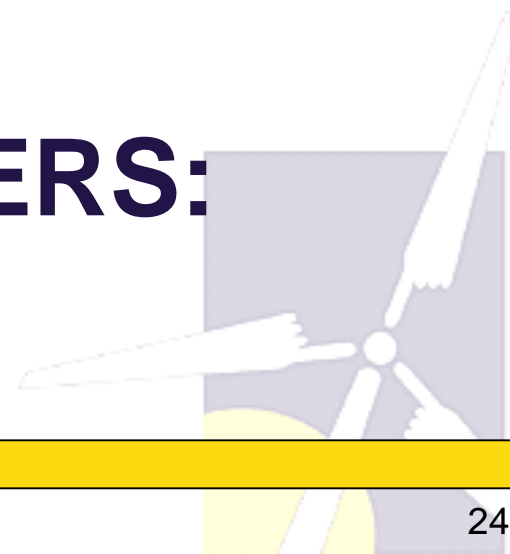
Modeled Parameters

**No changes
to this set of
inputs.**

		Anaerobic Digestion I	Anaerobic Digestion II
Tipping Fee	<i>\$/ton</i>	\$25.00 [\$22.50]	
Quantity Received Each Year	<i>tons per year</i>	10,000	22,308
Digestate (if merchantable for additional revenue)	<i>\$/gallon</i>		\$0



MODELED PARAMETERS: HYDRO





Production and Capital Cost Assumptions

Modeled Parameters

		Hydro I	Hydro II
Nameplate Capacity	kW	150	500
Capacity Factor	%	55%	40%
Annual Degradation	%	0.0%	
Cost Excluding Interconnection	\$/kW	\$8,750 \$6,000 [\$4,500, \$4,200]	
Interconnection	\$/kW	\$500 \$100	



ONGOING EXPENSES

Modeled Parameters

		Hydro I	Hydro II
Variable O&M – Power Generation Expense, Yr 1	¢/kWh	2.00	
Variable O&M – Dam Maintenance Expense, Yr 1	¢/kWh	2.00	
O&M Cost Inflation	%	2.00% [3.00%]	
Insurance, Yr 1 (% of Total Cost)	%	0.50%	
Management Yr 1	\$/yr	\$15,000 \$10,000 [\$5,000]	\$15,000
Land Lease	\$/yr	\$3,750 [\$3,000]	\$12,500 [\$10,000]



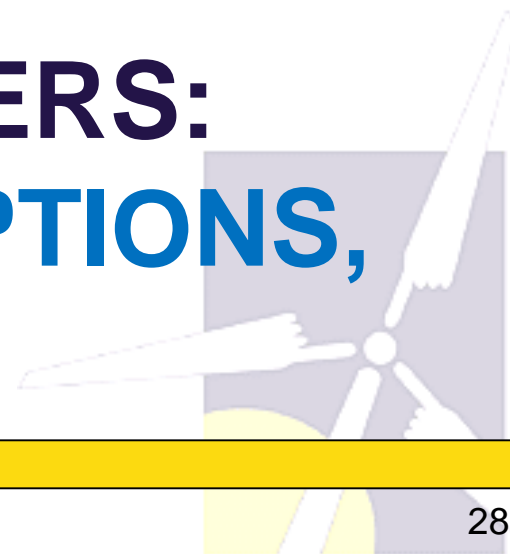
FINANCING ASSUMPTIONS

Modeled Parameters

		Hydro I	Hydro II
% Debt	%	65% 60% [50%]	
Debt Term	yrs	20 15 [18]	
Interest Rate on Term Debt	%	6.25% [6.50%]	
Lender's Fee (% of total borrowing)	%	2.00% [2.25%]	
Required Minimum Annual DSCR		1.00	
Required Average DSCR		1.45	
Target After-Tax Equity IRR	%	10%	
Reserve Requirement	\$	\$0	



MODELED PARAMETERS: ADDITIONAL ASSUMPTIONS, ALL TECHNOLOGIES





Property Taxes

- Methodology Supporting 2016 Ceiling Price
 - Start at 80% of cost basis
 - Reduce by 5% per year to floor of 30%
 - Multiply by Mill rate.
 - Effect: Tax expense starts high, decreases over time
- Methodology supporting 2017 Ceiling Price
 - Fixed rate, \$5.00 per kWac installed
 - Rate ultimately subject to regulatory approval
 - Effect: Tax expense is fixed and flat
 - Installations on residential and manufacturing facilities are exempt
 - Hydroelectric facilities are exempt from property tax per Title 44, [§ 44-3-3](#)



Incentives: Tax Credits

- Solar:
 - 30% ITC for projects commencing construction on or before 12/31/2019.
 - Assumed to apply to all projects selected in 2017 solicitations.
 - “Discount” on ITC of 7.5% taken into account to ensure reasonable equity rate of return. [7.5% based on stakeholder input that a 5% to 10% discount is appropriate.]
- Wind
 - Wind facilities participating in the 2017 REG Program are assumed to qualify for 80% of the face value of the ITC.
 - “Discount” on ITC of 7.5% taken into account to ensure reasonable equity rate of return. [7.5% based on stakeholder input that a 5% to 10% discount is appropriate.]
- AD & Hydro
 - No PTC (or ITC in lieu thereof) for facilities commencing construction after 12/31/2016.
 - Given REG eligibility criteria that facilities not be under construction, PTC/ITC assumed not available to facilities participating in 2017 solicitations.



Incentives: NOL Carryforward

- MACRS depreciation creates deduction benefit by reducing taxable income.
- Where depreciation expense is $>$ operating income, the project will most likely experience a net operating loss (NOL) for the specified year.
- This NOL is passed through to the facility owner, creating a benefit by reducing that entity's eligible taxable income.
- NOL benefits are assumed to be applied "as generated" to both state and federal tax liabilities

- No federal, state, local or other grants assumed.

- Policy Objective: Encourage projects able to make most effective use of tax benefits



Additional Assumptions: Forecast of Market Value of Production

Project Year	Calendar Year	Market Value of Production (incl. energy, capacity & RECs) (cents/kWh)	
		<u>Solar</u>	<u>Hydro</u>
21	2037	11.96	11.30
22	2038	12.57	11.88
23	2039	13.22	12.49
24	2040	13.90	13.14
25	2041	14.61	13.81
26	2042		14.52
27	2043		15.27
28	2044		16.05
29	2045		16.87
30	2046		17.74