Rhode Island Distributed Generation Standard Offer:

Preliminary Input Assumptions & Modeling Results for 2013 Ceiling Price Review

October 2012

Sustainable Energy Advantage, LLC
(with support from Meister Consultants Group)

2013 Ceiling Prices to be established for 9 Classes…

- 4 Solar
- 3 Wind
- 1 Anaerobic Digestion
- 1 Hydro benchmark (*not official CP for 2013*), to be included for 2nd Public Meeting
- 'standard' installations will be modeled to inform setting of ceiling rates for each class

Technology, sub class	Eligible Size Range	Standard Size for Modeling Ceiling Price
Solar, Large	500 kW and above	1.5 MW
Solar, Medium 2	251 – 499 kW	500 kW
Solar, Medium 1	101 – 250 kW	250 kW
Solar, Small	50 – 100 kW	100 kW
Wind, Large	1.0 MW – 1.5 MW	1.5 MW
Wind, Medium	400 kW – 999 kW	750 kW
Wind, Small	90 – 100 kW	100 kW
Anaerobic Digestion	400 – 500 kW	500 kW
Hydroelectric	500 kW – 1.0 MW	1.0 MW

SOLAR

Capital Cost, Installed: Details, Sources

(Includes soft costs & construction financing; excludes Interconnection)

- Industry Databases Polled

  Usable data extracted from:

  - MA SREC Database [installed cost data analyzed from projects installed within the last 3, 6, and 9 months]
  - NREL July 2012 distributed generation cost estimates

  Database reviewed; data of limited direct usefulness, from:

  - NYSERDA PowerClerks Database (Only systems <100 kW; access to raw data not available)
  - California Solar Initiative Database (Data concerns, inconsistency with more relevant databases)
  - Mass CEC Commonwealth Solar Database (Not updated since 3/12; likely redundant with SREC Database)
  - Delaware SREC Long-term Contract Auction Results (No installed cost data available, only auction results)
  - New Jersey EDC Long-term Contract Auction Results (No installed cost data available, only auction results, last auction was in 2011)

- Stakeholder Data Request
  - Responses received from stakeholders: solar (10), wind (7), anaerobic digestion (4) and hydro (5)
- Follow up Interviews; Data available to SEA through other recent engagements

Costs embedded in total installed cost estimates include:

Soft Costs: *development, permitting, engineering costs, as well as interest incurred during construction, the initial funding of all required reserve accounts, financing closing costs, and lender fees (if applicable)*

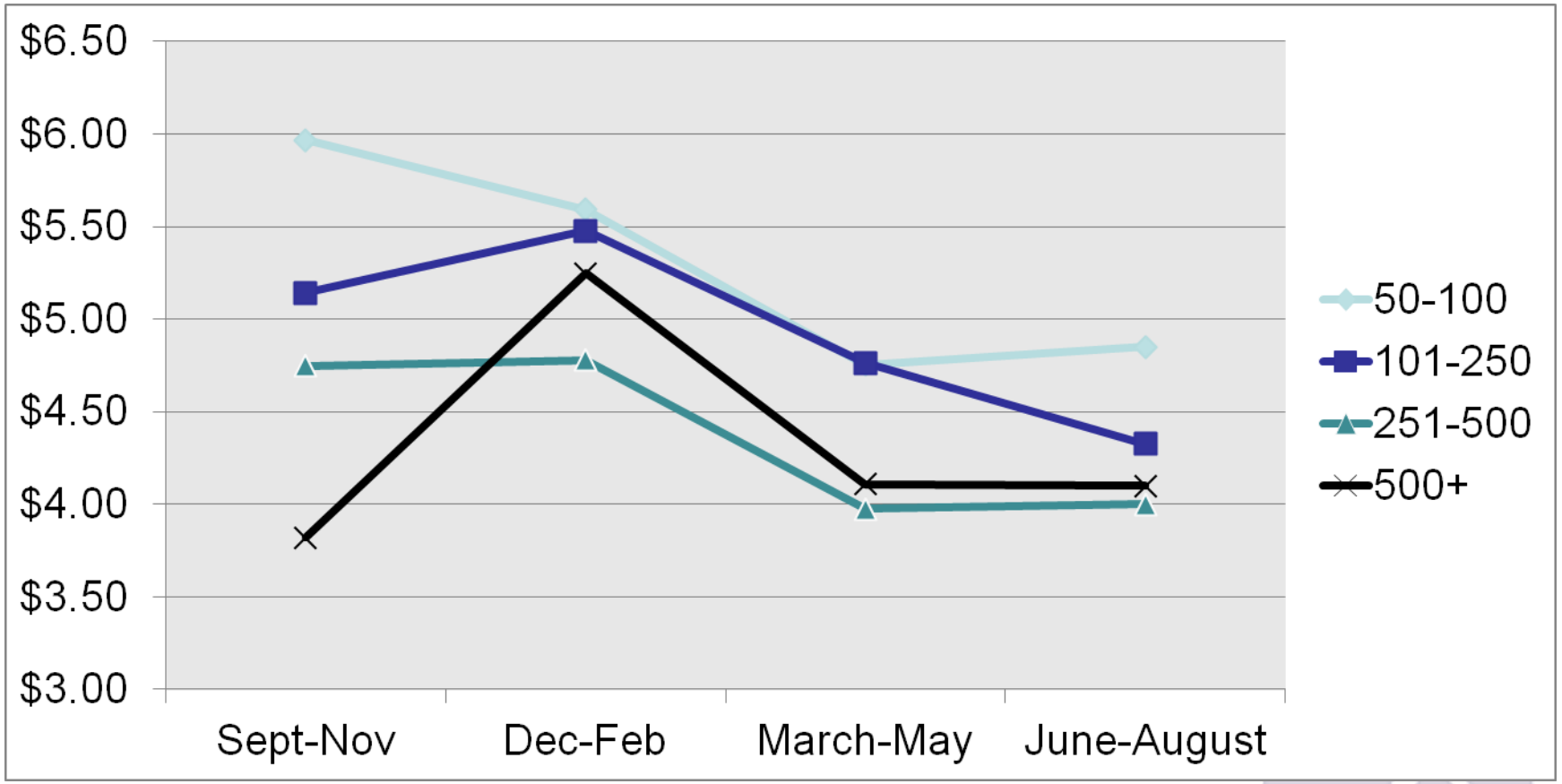
Inverter warranty: *The solar CREST model has the ability to incorporate two capital expenditures during operations, which could be used to model inverter replacements. In response to recent data and stakeholder feedback, however, this analysis assumes that a 20-year inverter warranty is included in the total installed cost estimate. No additional inverter replacement costs are modeled.*

Mass SREC Database
(Sept 2011-August 2012)

Mass SREC Database - Average Installed Cost by Bin Quarter				
Size Bin (kW)	Sept-Nov 2011	Dec-Feb	March-May 2012	June-August
50-100	$5.97	$5.59	$4.75	$4.85
101-250	$5.14	$5.48	$4.76	$4.33
251-500	$4.75	$4.78	$3.98	$4.00
500+	$3.82	$5.25	$4.11	$4.10

Mass SREC Database - Average Installed Cost for Target Sizes by Quarter				
Size Bin (kW)	Sept-Nov 2011	Dec-Feb	March-May 2012	June-August
350-650	$5.05	$4.88	$4.35	$3.84
1000-2500		$5.75	$4.33	$3.98

Mass SREC Database Trend: Average Cost
(Sept 2011-August 2012)



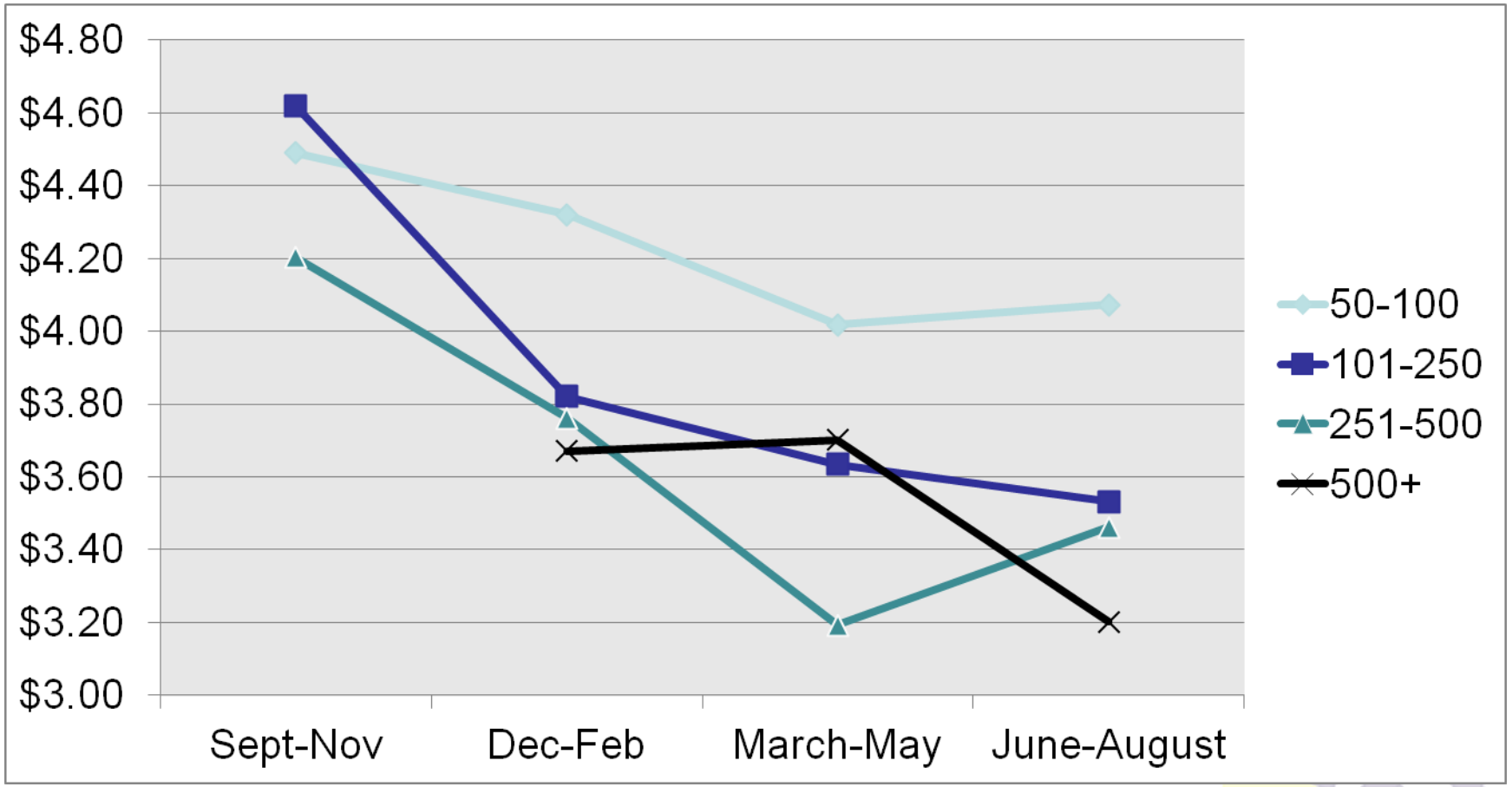
Mass SREC Database: Avg. - 1 Std. Deviation
(Sept 2011 – August 2012)

Mass SREC Database – Avg. Installed Cost minus 1 Std Dev by Qtr.				
Size Bin (kw)	Sept-Nov 2011	Dec-Feb	March-May 2012	June-August
50-100	$4.49	$4.32	$4.02	$4.07
101-250	$4.62	$3.82	$3.64	$3.53
251-500	$4.20	$3.76	$3.19	$3.46
500+		$3.67	$3.70	$3.20

Mass SREC Database – Avg. Inst. Cost minus 1 Std Dev for Target Sizes by Qtr.				
Size Bin (kw)	Sept-Nov 2011	Dec-Feb	March-May 2012	June-August
350-650	$4.06	$3.99	$3.79	$2.88*
1000-2500		$4.08	$4.07	$3.13

* StdDev not meaningful due to small sample size.

Mass SREC Database Minus 1 Standard Deviation
(Sept 2011-August 2012)

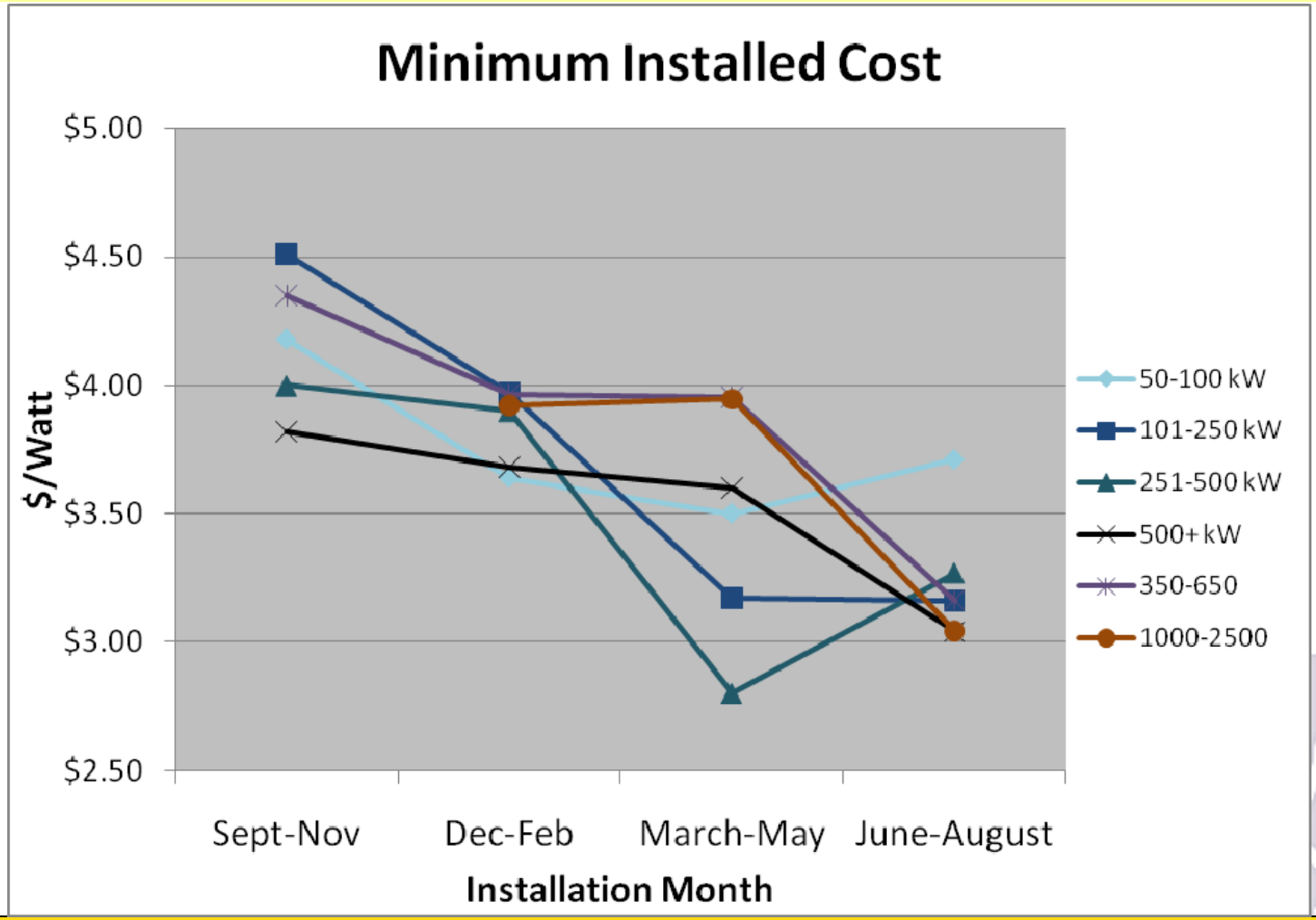


Mass SREC Database: Minimum Installed Cost in Each Bin

Bin	Installation Month (Range)	Min Installed Cost ($/Watt)
50-100	Sept-Nov	$4.18
	Dec-Feb	$3.64
	March-May	$3.50
	June-August	$3.71
101-250	Sept-Nov	$4.51
	Dec-Feb	$3.97
	March-May	$3.17
	June-August	$3.16
251-500	Sept-Nov	$4.00
	Dec-Feb	$3.90
	March-May	$2.80
	June-August	$3.27
500+	Sept-Nov	$3.82
	Dec-Feb	$3.68
	March-May	$3.60
	June-August	$3.04

Target Size	Installation Month (Range)	Min Installed Cost ($/Watt)
350-650	Sept-Nov	$4.35
	Dec-Feb	$3.96
	March-May	$3.95
	June-August	$3.16
1000-2500	Sept-Nov	
	Dec-Feb	$3.92
	March-May	$3.95
	June-August	$3.04

Mass SREC Database: Minimum Installed Cost in Each Bin



NREL National PV Cost Estimates

	Mean Costs	St Dev	Mean – 1 St Dev
<10 kW	$4.78	$0.82	$3.96
10-100	$4.43	$0.54	$3.89
100-1000	$3.67	$0.67	$3.00
1-10MW	$3.38	$0.61	$2.77

Data from: *Distributed Generation Renewable Energy Estimate of Costs*
National Renewable Energy Laboratory, July 2012
http://www.nrel.gov/analysis/pdfs/2012_dg_icoe_data.pdf

Operation & Maintenance (O&M) Cost

Sources

- NREL National PV Cost Estimates

Project Size	Fixed O&M ($/kW-year)	O&M Std Dev
<10 kW	$29	$20
10-100 kW	$26	$19
100-1000 kW	$24	$13
1-10 MW	$22	$10

- MCG experience
- SEA experience
- Stakeholder DR

Researched cost, O&M & financing inputs: Solar ≈ 100 kW dc (1)

Input category*
Expected Annual Average Net capacity factor, (%) DC **Proposed Input = 14.39%** **2011 Input = 14.39%**
Annual Production Degradation (%) **Proposed Input = 0.5%** **2011 Input = 0.5%**
Total installed cost ($/kW$_{DC}$), excluding Interconnection Cost **Proposed Input = $3,100/kW** **2011 Input = $3,900** **+ $70/kW 20-yr inverter warranty**
Interconnection cost ($) **Proposed Input = $50/kW** **2011 Input = $210/kW**
O&M expenses (in $/kW$_{DC}$-year) in Year 1 of operations **Proposed Input = $20/kW-yr** **2011 Input = $22/kW-yr**

*There was no 100kW CP in 2011. The 2011 150 kW inputs are shown here for comparison.

Researched cost, O&M & financing inputs: Solar ≈ 100 kW dc (2)

Input category*
Insurance, Yr 1, (% of total project costs or $/yr) **Proposed Input = 0.3% of total project costs** **2011 Input = 0.3%**
Project Management, Yr 1 ($/yr) **Proposed Input = $1,400/yr** **2011 Input= included in overall O&M**
Land Lease, Yr 1 ($/yr) **Proposed Input = $2,500/yr** **2011 Input = $1,500 for 150 kW project**
Annual average escalation rate for O&M expenses (%) **Proposed Input = 3%** **2011 Input = 3%**
Royalties (% of Revenue, or $/yr) **Proposed Input = 0.0% (covered in lease)** **2011 Input = 0.0%**
Property Taxes ($ in Yr 1 and annual adjustment factor) **Proposed Input = yr 1 = *$4,185 (using 90% of $15/1000), basis declines by 10%/yr thereafter to floor of 20% of installed cost*** **2011 Input = $5,250 for 150 kW project, annual adjustment factor = -10.0%**

*There was no 100kW CP in 2011. The 2011 150 kW inputs are shown here for comparison.

Researched cost, O&M & financing inputs: Solar ≈ 100 kW dc (3)

Input category*
Length of construction period (months) **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Source (D/E) and Cost (e.g. interest rate) of construction financing **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Debt-to-equity ratio **Proposed Input = same** **2011 Input = debt optimized to cash flow**
Debt tenor (years) **Proposed Input = 14 yrs; 2011 Input = 12 years**
Interest rate on debt (%) **Proposed Input = 6.5%; 2011 Input = 6.5%**
Lender's Fee (% of loan amt) **Proposed Input = same; 2011 Input = included in cap. cost**
Avg. Debt Service Coverage Ratio **Proposed Input = 1.40; 2011 Input = 1.45**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input = 12%; 2011 Input =13%**
Decommissioning Reserve? **Proposed Input = same; 2011 Input = $0 (= salvage value)**

*There was no 100kW CP in 2011. The 2011 150 kW inputs are shown here for comparison.

Researched cost, O&M & financing inputs: Solar ≈ 250 kW dc (1)

Input category*
Expected Annual Average Net capacity factor, (%) DC **Proposed Input = 14.39%** **(rationale: 7 of 8 respondents had no comments on what was in 2011)** **2011 Input = 14.39%**
Annual Production Degradation (%) **Proposed Input = 0.5%** **2011 Input = 0.5%**
Total installed cost ($/kW$_{DC}$), excluding Interconnection Cost **Proposed Input = $2,750/kW** **2011 Input = $3,900 (excl. Interconnection costs) + $70/kW 20-yr inverter warranty**
Interconnection cost ($) **Proposed Input = $40/*kW*** **2011 Input = $210/kW**

*There was no 250kW CP in 2011. The 2011 150 kW inputs are shown here for comparison.

Researched cost, O&M & financing inputs: Solar ≈ 250 kW dc (2)

Input category*
O&M expenses (in $/kW$_{DC}$-year) in Year 1 of operations **Proposed Input** = $**20/kW-yr** **2011 Input** = $**22.00/kW**
Insurance, Yr 1, (% of total project costs or $/yr) **Proposed Input = 0.3% of total proj. costs** **2011 Input = 0.3%**
Project Management, Yr 1 ($/yr) **Proposed Input = $3,500/yr** **2011 Input= included in overall O&M**
Land Lease, Yr 1 ($/yr) **Proposed Input = $10,000/yr** **2011 Input = $1,500/yr for 150 kW project**
Annual average escalation rate for O&M expenses (%) **Proposed Input = 3%** **2011 Input = 3%**
Royalties (% of Revenue, or $/yr) **Proposed Input = 0.0% (covered in lease)** **2011 Input = 0.0%**
Property Taxes ($ in Yr 1 and annual adjustment factor) **Proposed Input = yr 1 = *$9,281 (using 90% of $15/1000), basis declines by 10%/yr thereafter to floor of 20% of installed cost*** **2011 Input = $5,250 for 150 kW project, annual adjustment factor = -10.0%**

*There was no 250kW CP in 2011. The 2011 150 kW inputs are shown here for comparison.

Researched cost, O&M & financing inputs: Solar ≈ 250 kW dc (3)

Input category*
Length of construction period (months) **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Source (D/E) and Cost (e.g. interest rate) of construc. financing **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Debt-to-equity ratio **Proposed Input = same** **2011 Input = debt optimized to cash flow**
Debt tenor (years) **Proposed Input = 14 yrs; 2011 Input = 12 years**
Interest rate on debt (%) **Proposed Input = 6.5%; 2011 Input = 6.5%**
Lender's Fee (% of loan amt) **Proposed Input = same; 2011 Input = included in cap. cost**
Avg. Debt Service Coverage Ratio **Proposed Input = 1.35; 2011 Input = 1.45**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input = 11.5%; 2011 Input =13%**
Decommissioning Reserve? **Proposed Input = same; 2011 Input = $0 (= salvage value)**

*There was no 250kW CP in 2011. The 2011 150 kW inputs are shown here for comparison.

Researched cost, O&M and financing inputs: Solar ≈ 450 kW dc (1)

Input category
Expected Annual Avg. Net c.f. (%) **Proposed Input = 14.56%** **(rationale: 7 of 8 respondents had no comments)** **2011 Input = 14.56%**
Annual Production Degradation (%) **Proposed Input = .5%** **2011 Input = 0.5%**
Total installed cost ($/kW$_{DC}$), excluding Interconnection Cost **Proposed Input = $2,500/kW** **2011 Input = $3,700 (excl. Interconnection costs) +$60/kW 20-yr inverter warranty**
Interconnection cost ($) **Proposed Input = $300/kW** **2011 Input = $185/kW**

Researched cost, O&M and financing inputs: Solar ≈ 450 kW dc (2)

Input category
O&M expenses (in $/kW$_{DC}$-year) in Year 1 of operations **Proposed Input = $20/kW-yr** **2011 Input = $22/kW**
Insurance, Yr 1, (% of total project costs or $/yr) **Proposed Input = 0.3% of total proj. costs** **2011 Input = 0.3%**
Project Management, Yr 1 ($/yr) **Proposed Input = $6,500/yr** **2011 Input= included in overall O&M**
Land Lease, Yr 1 ($/yr) **Proposed Input = $15,000** **2011 Input = $7,500**
Annual avg. escalation rate for O&M expenses (%) **Proposed Input = 3%** **2011 Input = 3%**

Researched cost, O&M and financing inputs: Solar ≈ 450 kW dc (3)

Input category
Royalties (% of Revenue, or $/yr) **Proposed Input = 0.0% (covered in lease)** **2011 Input = 0%**
Property Taxes ($ in Yr 1 and annual adjustment factor) **Proposed Input = yr 1 = *$15,188 (using 90% of $15/1000), basis declines by 10%/yr thereafter to floor of 20% of installed cost*** **2011 Input = $17,500 annual adjustment factor = -10.0%**
Length of construction period (months) **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Source (D/E) and Cost (e.g. int. rate) of constr. financing **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Debt-to-equity ratio **Proposed Input = same** **2011 Input = debt optimized to cash flow**

Researched cost, O&M and financing inputs: Solar ≈ 450 kW dc (4)

Input category
Debt tenor (years) **Proposed Input = 14 yrs;** **2011 Input = 12 years**
Interest rate on debt (%) **Proposed Input = 6.0%** **2011 Input = 6.5%**
Lender's Fee (% of loan amt) **Proposed Input = same;** **2011 Input = included in cap. cost**
Avg. Debt Service Coverage Ratio **Proposed Input = 1.35** **2011 Input = 1.45**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input = 11%** **2011 Input = 13%**
Decommissioning Reserve? **Proposed Input = $0 (= salvage value)** **2011 Input = $0 (= salvage value)**

Researched cost, O&M and financing inputs: Solar ≈ 1,500 kW dc (1)

Input category
Expected Annual Avg. Net capacity factor, (%) **Proposed Input = 14.56%** **2011 Input = 14.65%**
Annual Production Degradation (%) **Proposed Input = .5%** **2011 Input = 0.5%**
Total installed cost ($/kW$_{DC}$), excluding Interconnection Cost **Proposed Input =$2,400** **2011 Input = $3,400 (excl. Interconnection costs) + $50/kW 20-yr inverter warranty**
Interconnection cost ($) **Proposed Input = $150/kW** **2011 Input = $132/kW**

Researched cost, O&M and financing inputs: Solar ≈ 1,500 kW dc (2)

Input category
O&M expenses (in $/kW$_{DC}$-year) in Year 1 of operations **Proposed Input = $15/kW-yr** **2011 Input = $24/kW**
Insurance, Yr 1, (% of total project costs or $/yr) **Proposed Input = 0.25%** **2011 Input = 0.2%**
Project Management, Yr 1 ($/yr) **Proposed Input = $10,000** **2011 Input= included in overall O&M**
Land Lease, Yr 1 ($/yr) **Proposed Input = $30,000** **2011 Input = $33,000**

Researched cost, O&M and financing inputs: Solar ≈ 1,500 kW dc (3)

Input category
Annual average escalation rate for O&M expenses (%) **Proposed Input = 3%** **2011 Input = 2.5%**
Royalties (% of Revenue, or $/yr) **Proposed Input = 0.0% (covered in lease)** **2011 Input = 0.0%**
Property Taxes ($ in Yr 1 and annual adjustment factor) **Proposed Input = yr 1 = *$48,600 (using 90% of $15/1000), basis declines by 10%/yr thereafter to floor of 20% of installed cost*** **2011 Input = $52,500, annual adjustment: -10%**

Researched cost, O&M and financing inputs: Solar ≈ 1,500 kW dc (4)

Input category
Length of construction period (months) **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Source (D/E) and Cost (e.g. interest rate) of construction financing **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Debt tenor (years) **Proposed Input = 14 yrs;** **2011 Input = 12 yrs**
Interest rate on debt (%) **Proposed Input = 5.5%** **2011 Input = 6%**

Researched cost, O&M and financing inputs: Solar ≈ 1,500 kW dc (5)

Input category
Lender's Fee (% of loan amt) **Proposed Input = same;** **2011 Input = included in cap. cost**
Avg. Debt Service Coverage Ratio **Proposed Input = 1.35** **2011 Input = 1.45**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input = 12%** **2011 Input =13%**
Decommissioning Reserve? **Proposed Input = $200,000** **2011 Input = $0 (= salvage value)**

Interconnection

Details, Sources

- National Grid:
  - data from Standard Offer bids, plus
  - random sample of 21 MA & RI projects
- Stakeholder DR

Finance Structure & Costs of Debt and Equity

Details, Sources

- Stakeholder Data Request
- SEA Experience
- Model optimized based on avail cash flows

Incentives

- Federal Investment Tax Credit (ITC) assumed available at time of initial operation (2013/2014)
- Assume Bonus Depreciation no longer available
- Assume full monetization of available tax benefits

- No federal, state, local or other grants assumed

Performance

Details, Sources

- PV Watts assumes no tracking, idealized orientation & tilt
- Stakeholder Data Request
- Inverter conversion factor based on data request and manufacturer input
- MA CEC PTS: actual historic production
- Same adjustments as made in 2011.

Additional Assumptions

- COD achieved in 2013
- Project Useful Life: 25 years
- 0.5%/yr production degradation
- Debt Service Coverage Ratio:
  - Min = 1.20X
  - Avg. varies by case
- Interconn. Costs depreciated on 15-year MACRS schedule
- All other project costs:
  - 96% depreciated on 5-year MACRS
  - 2% depreciated on 15-year MACRS
  - 2% not depreciable
- Fed. Income Tax rate 35%; State rate 9%
- All tax benefit utilized in period generated, unless otherwise noted
- *Assumed NEPOOL Membership costs either covered by NGRID as lead participant, or spread over many installations and therefore negligible*
- Market value of production (assumed revenue) post-contract = 90% of sum of ***solar-weighted*** energy and capacity price forecasts from 2011 Avoided Energy Supply Cost Study and $5/REC (next slide)

Additional Assumptions:
Forecast of Market Value of Production

Project Year	Calendar Year	Time-of-Production Weighted Market Value of Production (incl. energy, capacity & RECs) (cents/kWh)
16	2029	11.95
17	2030	12.18
18	2031	12.42
19	2032	12.66
20	2033	12.91
21	2034	13.16
22	2035	13.41
23	2036	13.67
24	2037	13.94
25	2038	14.21

Benchmarking to CT ZREC Program

October 2012 Results

Large ZREC: 250kW – 1 MW **Medium ZREC**: >100 kW <250 kW **Small ZREC**: ≤ 100 kW ***(All Behind the Meter)***	UI Large ZREC ($/REC)	CL&P Large ZREC ($/REC)	UI Medium ZREC ($/REC)	CL&P Medium ZREC ($/REC)
Weighted Average **Bid Price of Accepted Bids**	$117.27	$101.36	$135.36	$149.29
	6 accepted bids: All but 1 winner <500 kW	Winners span whole size range.	Winners range from 132 – 250 kW	Winners range from 101 – 250 kW
Approx. Value of Retail Electricity Purchases Avoided	$133-153		$133-153	
Est. Value Under 3rd-Party Net Metering (Assumed 10-15% discount, common in MA)	$113-138		$113-138	
Est. Equivalent to Calculated LCOE	$230-255		$248-273	

Est. of 15-year levelized contract: Solar

In 2011, LCOE modeling was performed under two scenarios, and the ceiling price was established as the arithmetic average of the 2 cases. For 2013, we propose to use the same approach.

Scenario (Modeling Assumptions)	**Estimated Contract Price (¢/kWh)**			
	50-100 kW	101-250 kW	251-499 kW	500 kW and above
Debt optimized to meet both min + average DSCR; Tax Benefits utilized as generated	27.55	26.35	25.65	21.35
Debt optimized to meet both min + average DSCR; NOL carried forward and used only by project	28.25	26.85	26.15	21.75
Average = Proposed Ceiling Price	**27.90**	**26.60**	**25.90**	**21.55**
2011 Ceiling Prices	***33.35 (150 kW)***	***33.35 (150 kW)***	***31.60***	***28.95***

WIND

Researched cost, O&M and financing inputs: Wind 1,500 kW (1)

Input category
Expected Annual Average Net capacity factor, (%) **Proposed Input = 27.5% *(to account for new turbine optimization to low wind regimes)*** **2011 Input = 25%**
Annual Production Degradation **Proposed Input = 0.5%** **2011 Input = 0.5%**
Total installed cost ($/kW), **excluding** Interconnection Cost **Proposed Input = $3,200/kW** **2011 Input = $2,750/kW** **(excl. interconnection costs)**
Typical Interconnection cost ($/kW) **Proposed Input = $100/kW** **2011 Input = $117/kW**
O&M expenses in Year 1 of operations **Proposed Input = $30/kW-yr** **2011 Input = $55/kW-year**
Insurance Expense (as % of total proj. cost, or in $/yr) **Proposed Input = 0.3% of total project cost** **2011 Input = included in O&M**

Researched cost, O&M and financing inputs: Wind 1,500 kW (2)

Input category
Project Management **Proposed Input = $15,000/yr** **2011 Input = included in O&M**
Land Lease, Year 1 ($/year) **Proposed Input = $20,000/yr** **2011 Input = included in O&M**
Annual avg. escalation rate for O&M expenses (%) **Proposed Input = 2.5%** **2011 Input = 2%**
Royalties **Proposed Input = included in lease exp.** **2011 Input = included in O&M**
Property Taxes **Proposed Input, yr 1 = *$64,800 (using 90% of $15/$1000), basis declines 10%/yr thereafter to floor of 20% of inst. cost*** **2011 Input = included in O&M**
Length of construction period (months) **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**

Researched cost, O&M and financing inputs: Wind 1,500 kW (3)

Input category
Source and Cost of Construction Financing **Proposed Input = included in installed costs;** **2011 Input = included in installed costs**
Debt-to-equity ratio **Proposed Input = same** **2011 Input = debt optimized to cash flow**
Debt tenor (years) **Proposed Input = 15 yrs** **2011 Input = 12 Yrs.**
Interest rate on debt (%) **Proposed Input = 5.5%** **2011 Input = 6.5%**
Lender's Fee **Proposed Input = same;** **2011 Input = included in cap. cost**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input = 11% with PTC; 10% w/o PTC** **2011 Input = 13%**
Decommissioning Reserve **Proposed Input = $0 (= salvage value)** **2011 Input = $0 (= salvage value)**

Researched cost, O&M and financing inputs: Wind 750 kW (1)

Input category
Expected Annual Average Net capacity factor, (%) **Proposed Input = 24%**
Annual Production Degradation **Proposed Input = 0.5%**
Total installed cost ($/kW), **excluding** Interconnection Cost **Proposed Input = $2,800**
Typical Interconnection cost ($/kW) **Proposed Input = $137/kW**
O&M expenses (in ¢/kWh) in Year 1 of operations **Proposed Input = $30/kW-yr**
Insurance Expense (as % of total project cost, or in $/yr) **Proposed Input = 0.3% of total proj. costs**
Project Management **Proposed Input = $15,000**
Land Lease, Year 1 ($/year) **Proposed Input = $10,000**
Annual avg. escalation rate for O&M expenses (%) **Proposed Input = 2.5%**

Researched cost, O&M and financing inputs: Wind 750 kW (2)

Input category
Royalties **Proposed Input = included in lease exp.**
Property Taxes **Proposed Input, yr 1 = *$28,350 (using 90% of $15/$1000), basis declines 10%/yr thereafter to floor of 20% of inst. cost***
Length of construction period (months) **Proposed Input = included in installed costs;**
Source and Cost of Construction Financing **Proposed Input = included in installed costs;**
Debt-to-equity ratio **Proposed Input = debt optimized to cash flow**
Debt tenor (years) **Proposed Input = 15 yrs**
Interest rate on debt (%) **Proposed Input = 6%**
Lender's Fee **Proposed Input = included in cap. cost**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input = 12%**
Decommissioning Reserve **Proposed Input = $0 (salvage value)**

Researched cost, O&M and financing inputs: Wind 100kW (1)

Input category
Expected Annual Average Net capacity factor, (%) **Proposed Input = 23%**
Annual Production Degradation **Proposed Input = 0.5%**
Total installed cost ($/kW), **excluding** Interconnection Cost ***Proposed Input = $5,600/kW***
Typical Interconnection cost ($/kW) **Proposed Input = $200/kW**
O&M expenses (in $/kW-year) in Year 1 of operations **Proposed Input = $20/kW-yr**
Insurance Expense (as % of total project cost, or in $/yr) **Proposed Input = 0.3% of total proj. costs**

Researched cost, O&M and financing inputs: Wind 100kW (2)

Input category
Project Management **Proposed Input = $2,000**
Land Lease, Year 1 ($/year) **Proposed Input = $2000/year**
Annual avg. escalation rate for O&M expenses (%) **Proposed Input = 2.5%**
Royalties **Proposed Input = included in lease exp.**
Property Taxes **Proposed Input = assumed exempt**
Length of construction period (months) **Proposed Input = included in installed costs;**

Researched cost, O&M and financing inputs: Wind 100kW (3)

Input category
Source and Cost of Construction Financing **Proposed Input = included in installed costs;**
Debt-to-equity ratio **Proposed Input = debt optimized to cash flow**
Debt tenor (years) **Proposed Input = 15 yrs**
Interest rate on debt (%) **Proposed Input = 6%**
Lender's Fee **Proposed Input = included in cap. cost**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input = 12%**
Decommissioning Reserve **Proposed Input = $0 (salvage value)**

Capital Cost, Installed

(Includes soft costs & construction financing; excludes Interconnection)

Details, Sources

- Stakeholder DR
- SEA Experience
- Interviews

Costs embedded in total installed cost estimates include:

***Soft Costs**: development, permitting, engineering costs, as well as interest incurred during construction, the initial funding of all required reserve accounts, financing closing costs, and lender fees (if applicable)*

O&M Cost

Details, Sources

- Stakeholder DR
- Interviews
- SEA Experience

Interconnection

Details, Sources

- Stakeholder DR
- National Grid: random sample of projects in RI & MA

Finance Structure & Costs of Debt and Equity

Details, Sources

- Stakeholder DR
- Interviews
- SEA Experience
- Model optimized based on available cash flows

Incentives

- Current Production Tax Credit (PTC) expires as of 12/31/2012.
  - For 750 kW and 1500 kW wind, ceiling prices calculated both with and without PTC extension.
  - For 100 kW wind, assume ITC available through 2016.
- Assume Bonus Depreciation no longer available
- Assume full monetization of available tax benefits
- No federal, state, local or other grants assumed

Performance

Details, Sources

- Stakeholder DR
- SEA Experience
- MA CEC PTS
- Adjustment made for recent improvements in low wind-speed turbine performance, per SEA analysis.

Additional Assumptions

- Commercial operation achieved in 2013
- Project Useful Life: 20 years
- Minimum Debt Service Coverage Ratio: 1.20X
- Average Debt Service Coverage Ratio: 1.35X
- Interconnection Costs depreciated on 15-year MACRS schedule
- All other project costs:
  - 96% depreciated on 5-year MACRS
  - 2% depreciated on 15-year MACRS
  - 2% not depreciable
- Federal Income Tax rate 35%; State rate 9%
- All tax benefit utilized in period generated, unless otherwise noted
- Market value of production (assumed revenue) post-contract = 90% of sum of ***wind-weighted*** energy and capacity price forecasts from 2011 Avoided Energy Supply Cost Study and $5/REC (see next slide)

Additional Assumptions:
Forecast of Market Value of Production

Project Year	Calendar Year	Time-of-Production Weighted Market Value of Production (incl. energy, capacity & RECs) (cents/kWh)
16	2029	11.46
17	2030	11.68
18	2031	11.91
19	2032	12.13
20	2033	12.37

Est. of 15-year levelized contract: Wind

In 2011, LCOE modeling was performed under two scenarios, and the ceiling price was established as the arithmetic average of the 2 cases. For 2013, we propose to use the same approach.

Scenario (Modeling Assumptions)	**Estimated Contract Price (cents/kWh)**				
	1.5 MW		750 kW		100 kW
	w/PTC	w/o PTC	w/PTC	w/o PTC	
Debt optimized to meet both min + average DSCR; Tax Benefits utilized as generated	15.55	17.65	17.45	19.25	24.25
Debt optimized to meet both min + average DSCR; NOL carried forward and used only by project	15.95	17.95	17.75	19.55	24.85
Average = Proposed Ceiling Price	**15.75**	17.80	**17.60**	**19.40**	**24.55**
2011 Ceiling Price	***13.35***	***N/A***	***N/A***	***N/A***	***N/A***

ANAEROBIC DIGESTION

Anaerobic Digestion - Overview

- The most common opportunity for AD in RI is *assumed* to be for food waste digesters. Sludge or manure-based applications are also possible.

- Feed stocks are expected to be derived from food manufacturing, restaurant and grocery waste. *No manure or WWTP sludge are assumed – although such projects may be possible in RI. Economics will vary; VT Standard Offer established farm digester price esc. from 13.6 to 15.0 cents/kWh over 20 years.*

- This approach means that there are *no fuel costs*. Fuel deliveries will generate a *tipping fee*, and are assumed to arrive clean, with no cost to dispose of packaging.

- Further, it is assumed that digestate will be sold, generating additional revenue for the facility.

Researched cost, O&M and financing inputs: Anaerobic Digestion, ~500 kW (1)

Input category
Biogas consumption/day (ft^3/day) **Proposed Input** = **175,000**
Energy content/cubic foot (BTU/cubic ft) **Proposed Input** = **650** BTU/cubic ft
Heat Rate (BTU/kWh) **Proposed Input** = **9,000** BTU/kWh
Availability Factor **Proposed Input** = **92**%
Station Service/Parasitic Load **Proposed Input** = **10**%
Annual Production Degradation (%) **Proposed Input** = **0**%
Total installed cost ($/kW), excl. Interconnection Cost **Proposed Input** = $**9,500**/kW

Researched cost, O&M and financing inputs: Anaerobic Digestion, ~500 kW (2)

Input category
Typical Interconnection cost ($) **Proposed Input** = $**150,000**
O&M expenses ($/kW-yr), Yr 1 (excluding those listed below) **Proposed Input** = $**300**/kW-yr
Variable O&M (¢/kWh), Yr 1 (excluding those listed below) **Proposed Input** = **2**¢/kWh
Insurance, Yr 1, (provide as % of total project cost, or in $/yr) **Proposed Input** = **0.4%**
Project Management, Yr 1 ($/yr) **Proposed Input** = $**30,000**/yr

Researched cost, O&M and financing inputs: Anaerobic Digestion, ~500 kW (3)

Input category
Land Lease, Yr 1 ($/yr) **Proposed Input** = $**5,000**/yr
Annual average escalation rate for O&M expenses (%) **Proposed Input** = **2** %
Royalties (% of revenue, or $/yr) **Proposed Input** = **0%**
Property Taxes ($ in Yr 1 and annual adjustment factor, or as annual estimates with methodology clearly described) **Proposed Input, yr 1 = $64,125** ***(using 90% of $15/$1000), basis declines 10%/yr thereafter to floor of 20% of inst. cost***
Length of construction period (months) **Proposed Input** = **included in installed costs;**
Source and Cost of Construction Financing **Proposed Input** = **included in installed costs;**
Debt-to-equity ratio **Proposed Input** = **debt optimized to cash flow**

Researched cost, O&M and financing inputs: Anaerobic Digestion, ~500 kW (4)

Input category
Debt tenor (years) **Proposed Input** = **13** years
Interest rate on debt (%) **Proposed Input** = **7** %
Lender's Fee **Proposed Input** = **included in cap. cost**
Avg. Debt Service Coverage Ratio **Proposed Input** = **1.5**
After Tax Return on Equity (e.g. IRR) (%) **Proposed Input** = **12** %
Decommissioning Reserve **Proposed Input** = **$0**
Tipping Fees/Digestate Revenue, If Applicable: $/ton, and tons per year **Proposed Input** = **Tipping Fee: $10/ton; 10,000 tons per year** **Digestate: 7 cents/gal.; 4M gal/yr**

Details, Sources

Capital Cost, Installed (Includes soft costs & construction financing; excludes Interconnection)

- Stakeholder DR
- Interviews

Costs embedded in total installed cost estimates include:

***Soft Costs**: development, permitting, engineering costs, as well as interest incurred during construction, the initial funding of all required reserve accounts, financing closing costs, and lender fees (if applicable)*

O&M

- Stakeholder DR

Interconnection

- Stakeholder DR

Finance Structure and Cost of Debt & Equity

- Stakeholder DR
- Model optimized based on available cash flows

Performance

- Stakeholder DR

Incentives

- Current Production Tax Credit (PTC) expires as of 12/31/2012.
  - Anaerobic digesters eligible for 50% of face value
  - Ceiling prices calculated both with and without PTC extension.
- Assume Bonus Depreciation no longer available
- Assume full monetization of available tax benefits

- No federal, state, local or other grants assumed

Additional Assumptions

- Commercial operation achieved in 2013
- Project Useful Life: 20 years
- Minimum Debt Service Coverage Ratio: 1.20X
- Average Debt Service Coverage Ratio: 1.50X
- Interconnection Costs depreciated on 15-year MACRS schedule
- All other project costs:
  - 96% depreciated on 5-year MACRS
  - 2% depreciated on 15-year MACRS
  - 2% not depreciable
- Federal Income Tax rate 35%; State rate 9%
- All tax benefit utilized in period generated, unless otherwise noted
- Market value of production (assumed revenue) post-contract = 90% of sum of energy and capacity price forecasts from 2011 Avoided Energy Supply Cost Study and $5/REC (see next slide)

Additional Assumptions:
Forecast of Market Value of Production

Project Year	Calendar Year	Market Value of Production (incl. energy, capacity & RECs) (cents/kWh)
16	2029	11.54
17	2030	11.76
18	2031	11.99
19	2032	12.22
20	2033	12.46

Est. of 15-year levelized contract: Anaerobic Digestion

Scenario (Modeling Assumptions)	Estimated Contract Price (cents/kWh)	
	500 kW	
	w/PTC	w/o PTC
Debt optimized to meet both min + average DSCR; Tax Benefits utilized as generated	13.65	14.75
Debt optimized to meet both min + average DSCR; NOL carried forward and used only by project	13.95	15.15
Average = Proposed Ceiling Price	**13.80**	**14.95**

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