



**Rhode Island
Renewable Energy Growth Program:
*Research & Discussion in Support of
2017 Ceiling Price Recommendations***

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Purpose

- To present stakeholder data responses, survey results, and supplemental research,
- To *begin* the discussion that supports the development of Ceiling Price inputs and recommendations for the 2017 Renewable Energy Growth (REG) Program.
- To develop Ceiling Price recommendations through an iterative, public process.



Overview: Ceiling Price Categories

2017 REG Program: Proposed Technology, Size & Tariff Length Parameters

For the 2017 REG Program, the DG Board and OER seek comment on the following Ceiling Price technology, system size and tariff length parameters.

Eligible Technology	System Size for CP Development	Eligible System Size Range	Tariff Length
Small Solar I	5 kW	1 to 10 kW	15 and 20 Years Options
Small Solar II	25 kW	11 to 25 kW	20 Years
Medium Solar	140 kW	26 to 250 kW	20 Years
Commercial Solar	500 kW	251 to 999 kW	20 Years
Large Solar	1.5 MW	1 to 5 MW	20 Years
Wind I	1.65 MW	1 to 2.99 MW	20 Years
Wind II	3.3 MW	3 to 5 MW	20 Years
Wind III	4.95 MW	3 to 5 MW	20 Years
Anaerobic Digestion I	325 kW	150 to 500 kW	20 Years
Anaerobic Digestion II	750 kW	501 kW to 5 MW ★	20 Years
Small Scale Hydropower I	150 kW	10 to 250 kW	20 Years
Small Scale Hydropower II	500 kW	251 to 5 MW ★	20 Years

★ Eligible up to 5 MW. Expected to be 1 MW or less.






New Categories

- Shared Solar Facilities
 - Small or medium scale
 - Shared solar facilities will receive the same ceiling price and enroll from the same classes of other projects of the same size and ownership as established by the board for a given program year.
 - Allocates bill credits to between 2 and 50 accounts in the same customer class and on the same or adjacent parcels of land (public entities may allocate bill credits without regard to physical location within the municipality)
 - Allocated credits must not exceed the prior 3 years' average annual usage
- Community Remote Distributed Generation Systems, “shall not”:
 - Comprise more than thirty percent (30%) of the annual total of capacity available under the renewable energy growth program in each year;
 - Be subject to a ceiling price that is more than fifteen percent (15%) higher than the then in effect ceiling price for the same technology of the same size as recommended by the 5 board and approved by the commission; or
 - Transfer credits to any account in an amount that in kWh exceeds the prior three (3) year annual average usage.



Overview of Research to Inform CP Inputs

- Direct stakeholder input
 - Through *Data Request and Survey*
- Supplemental research
 - Primary research:
 - Interviews
 - Program data (bids, executed contracts)
 - Additional data from National Grid (Actual interconnection costs)
 - Secondary research:
 - Northeast regional cost databases
 - Northeast data from national reports
 - Technology-specific, competitively bid long-term contract pricing data (VT)
- DG Standard Contracts bid data (2011 – 2014)
- REG bid data (2015 & early 2016)

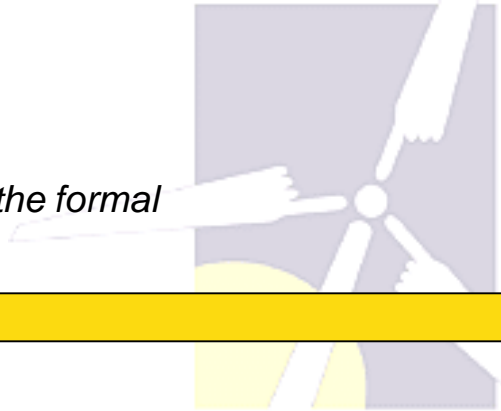


Summary of Data/Survey Response

Ceiling Price Category	# of Data Points Received (Data Request / Survey)
Small Solar	5 / 3
Medium Solar	2 / 1
Commercial Solar	5 / 3
Large Solar	5 / 2
Wind	5 / 0
Anaerobic Digestion	2 / 1
Hydro	6* / 1

Detailed data provided in Appendix.

** Through supplemental research and data provided through other than the formal data request template.*





Small Solar I, Installed Costs, Res.

Requires further review for presence of FMV-reported data.

Datasets: MA SREC, NY , CT RSIP

State	Bin	Sector	Year	Avg Cost Per kW	25th percentile	75th percentile
MA	1_10	Res	2015	4,397	3,621	4,972
MA	1_10	Res	2016	4,100	3,430	4,547
NY	1_10	Res	2015	4,675	3,920	5,600
NY	1_10	Res	2016	4,388	3,447	5,600
CT	1_10	Res	2015	4,423	3,730	5,250
CT	1_10	Res	2016	4,401	3,463	5,250

Dataset: NREL, Tracking The Sun, 2015

State	Bin	Sector	Year	Avg. Cost Per kW	20th percentile	80th percentile
CT	1_10	Res	2015	\$3,818	\$3,366	\$4,186
DE	1_10	Res	2015	\$4,266	\$3,495	\$4,991
MA	1_10	Res	2015	\$4,430	\$3,472	\$5,230
MD	1_10	Res	2015	\$4,485	\$3,326	\$5,336
NH	1_10	Res	2015	\$3,964	\$3,365	\$4,463
NJ	1_10	Res	2015	\$3,660	\$3,173	\$3,977
NY	1_10	Res	2015	\$4,386	\$3,582	\$5,270
RI	1_10	Res	2015	\$4,019	\$3,643	\$4,406
VT	1_10	Res	2015	\$4,343	\$3,696	\$4,861



Small Solar I, Installed Costs, non-Res.

Requires further review for presence of FMV-reported data.

Datasets: MA SREC, NY

State	Bin	Sector	Year	Avg Cost Per kW	25th percentile	75th percentile
MA	1_10	Non Res	2015	4,380	3,500	5,137
MA	1_10	Non Res	2016	4,460	3,511	4,832
NY	1_10	Non Res	2015	4,828	3,727	5,423
NY	1_10	Non Res	2016	4,027	2,744	4,631

Dataset: NREL, Tracking The Sun, 2015

State	Bin	Sector	Year	Avg. Cost Per kW	20th percentile	80th percentile
CT	1_10	Non Res	2015			
DE	1_10	Non Res	2015	\$3,652	\$3,652	\$3,652
MA	1_10	Non Res	2015	\$4,204	\$3,947	\$4,476
MD	1_10	Non Res	2015			
NH	1_10	Non Res	2015	\$3,967	\$3,446	\$4,022
NJ	1_10	Non Res	2015	\$3,706	\$3,512	\$3,805
NY	1_10	Non Res	2015	\$4,678	\$3,405	\$5,578
RI	1_10	Non Res	2015			
VT	1_10	Non Res	2015	\$3,748	\$3,672	\$3,824



Small Solar II, Installed Costs

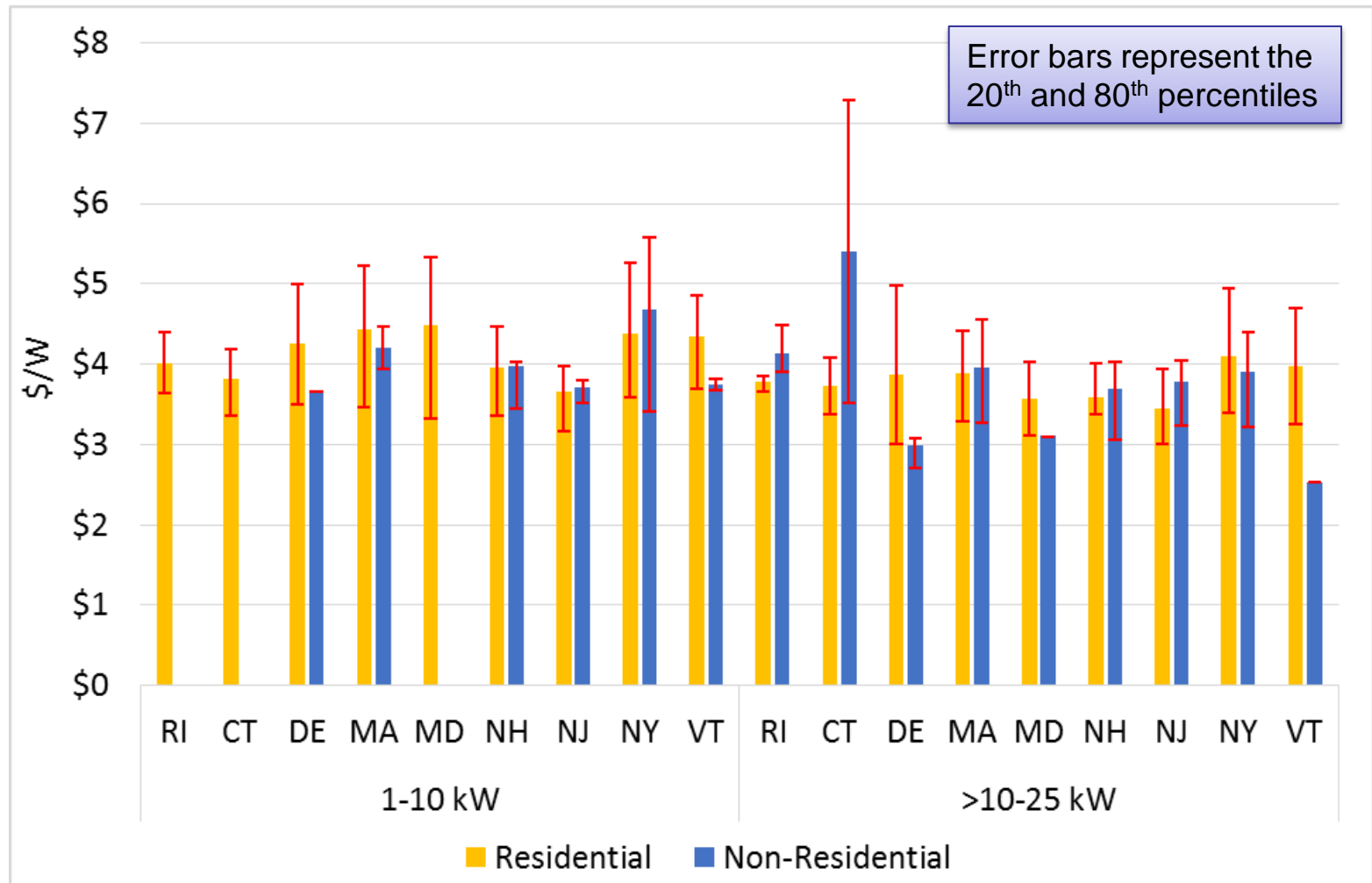
Datasets: MA SREC, NY

State	Bin	Sector	Year	Avg Cost Per kW	25th percentile	75th percentile
MA	10_25	Non Res	2015	3,929	3,327	4,241
MA	10_25	Non Res	2016	3,992	3,547	4,463
NY	10_25	Non Res	2015	3,895	3,285	4,161
NY	10_25	Non Res	2016	3,581	2,805	3,945

Dataset: NREL, Tracking The Sun, 2015

State	Bin	Sector	Year	Avg. Cost Per kW	20th percentile	80th percentile
CT	11_25	Non Res	2015	\$5,402	\$3,517	\$7,288
DE	11_25	Non Res	2015	\$2,993	\$2,706	\$3,073
MA	11_25	Non Res	2015	\$3,963	\$3,272	\$4,559
MD	11_25	Non Res	2015	\$3,110	\$3,097	\$3,101
NH	11_25	Non Res	2015	\$3,695	\$3,060	\$4,030
NJ	11_25	Non Res	2015	\$3,774	\$3,236	\$4,045
NY	11_25	Non Res	2015	\$3,904	\$3,226	\$4,391
RI	11_25	Non Res	2015	\$4,139	\$3,903	\$4,486
VT	11_25	Non Res	2015	\$2,537	\$2,537	\$2,537

Small Solar I+II Cost Comparison



* Figures drawn from LBNL's 2015 Tracking the Sun Data, disaggregated into residential and non-residential. States 9 with no data in a particular size category had no installations in the size class in 2015.



Medium Solar Installed Costs

Datasets: MA SREC, NY

State	Bin	Sector	Year	Avg Cost Per kW	25th percentile	75th percentile
MA	25_250	Non Res	2015	3,170	2,734	3,489
MA	25_250	Non Res	2016	3,069	2,568	3,685
NY	25_250	Non Res	2015	3,624	3,020	3,950
NY	25_250	Non Res	2016	3,460	2,903	4,001

Dataset: NREL, Tracking The Sun, 2015

State	Bin	Sector	Year	Avg. Cost Per kW	20th percentile	80th percentile
CT	26_250	Non Res	2015	\$3,518	\$2,884	\$4,203
DE	26_250	Non Res	2015	\$2,983	\$2,769	\$3,088
MA	26_250	Non Res	2015	\$3,190	\$2,643	\$3,543
MD	26_250	Non Res	2015	\$2,822	\$2,337	\$3,504
NH	26_250	Non Res	2015	\$3,214	\$2,888	\$3,455
NJ	26_250	Non Res	2015	\$3,089	\$2,560	\$3,593
NY	26_250	Non Res	2015	\$3,632	\$2,957	\$4,025
RI	26_250	Non Res	2015	\$3,669	\$3,140	\$4,009
VT	26_250	Non Res	2015	\$2,529	\$2,529	\$2,529



Commercial Solar Installed Costs

Datasets: MA SREC, NY

State	Bin	Sector	Year	Avg Cost Per kW	25th percentile	75th percentile
MA	250_1000	Non Res	2015	2,725	2,276	3,020
MA	250_1000	Non Res	2016	2,683	2,397	2,938
NY	250_1000	Non Res	2015	2,464	2,346	2,585
NY	250_1000	Non Res	2016	3,100	3,100	3,100

Dataset: NREL, Tracking The Sun, 2015

State	Bin	Sector	Year	Avg. Cost Per kW	20th percentile	80th percentile
CT	251_999	Non Res	2015	\$2,714	\$2,645	\$2,789
DE	251_999	Non Res	2015			
MA	251_999	Non Res	2015	\$2,707	\$2,151	\$3,274
MD	251_999	Non Res	2015			
NH	251_999	Non Res	2015	\$2,444	\$2,644	\$2,644
NJ	251_999	Non Res	2015	\$2,898	\$2,216	\$3,151
NY	251_999	Non Res	2015	\$2,472	\$2,339	\$2,584
RI	251_999	Non Res	2015			
VT	251_999	Non Res	2015			



Large Solar Installed Costs

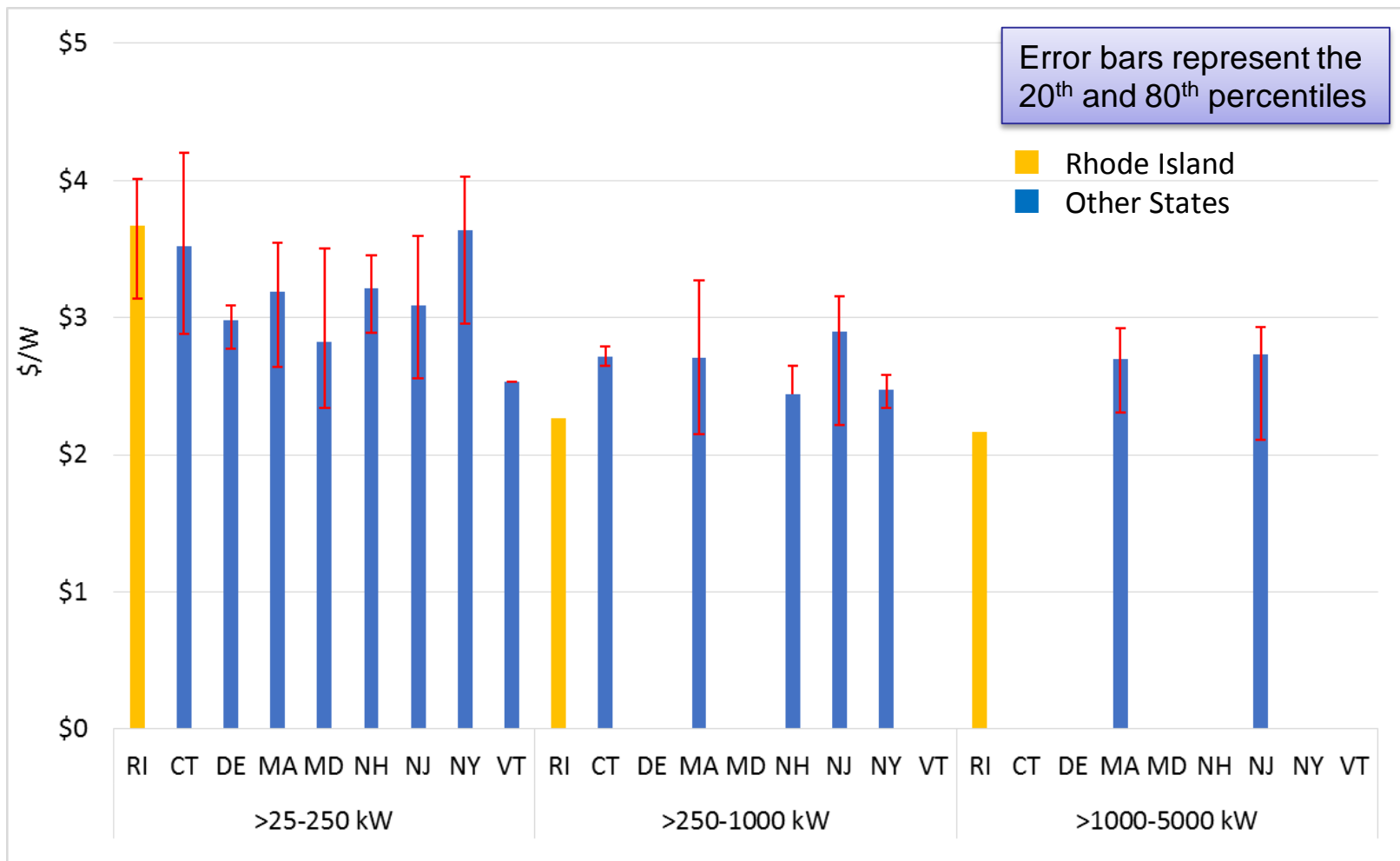
Datasets: MA SREC

State	Bin	Sector	Year	Avg Cost Per kW	25th percentile	75th percentile
MA	1000_6000	Non Res	2015	2,691	2,430	2,891
MA	1000_6000	Non Res	2016	2,277	1,800	2,554

Dataset: NREL, Tracking The Sun, 2015

State	Bin	Sector	Year	Avg. Cost Per kW	20th percentile	80th percentile
CT	1000_5000	Non Res	2015			
DE	1000_5000	Non Res	2015			
MA	1000_5000	Non Res	2015	\$2,694	\$2,308	\$2,923
MD	1000_5000	Non Res	2015			
NH	1000_5000	Non Res	2015			
NJ	1000_5000	Non Res	2015	\$2,728	\$2,107	\$2,931
NY	1000_5000	Non Res	2015			
RI	1000_5000	Non Res	2015			
VT	1000_5000	Non Res	2015			

Installed Cost Trends – Larger Size Categories*



*Including Interconnection Costs

*Draws from 2015 RI REG Program Data and LBNL's Tracking the Sun Data



REG Bid Data

- Medium Solar
 - 2015: \$2,900 - \$3,200
 - 2016: \$2,500 - \$3,500
- Commercial Solar
 - 2016: \$2,000 – \$2,200
 - 2015: \$2,000 – \$2,700
- Large Solar
 - 2016: ~\$2,100
 - 2015: ~\$2,100



Interconnection Cost Analysis (1)

Massachusetts and Rhode Island Solar Interconnection Costs

	Number of Projects	Wtd. Average Cost (\$/kW DC)
Small Solar I <=10	0	N/A
Small Solar II <=25	0	N/A
Medium Solar	200	\$11
Commercial Solar	149	\$84
Large Solar	48	\$105
Wind I	5	\$76
Wind II/III	2	\$77
Anaerobic Digestion I	0	N/A
Anaerobic Digestion II	0	N/A



**Based on National Grid Data, excludes projects assumed to require safety equipment related to islanding (i.e. DTT, 3Vo, etc.)*



Interconnection Cost Analysis (2)

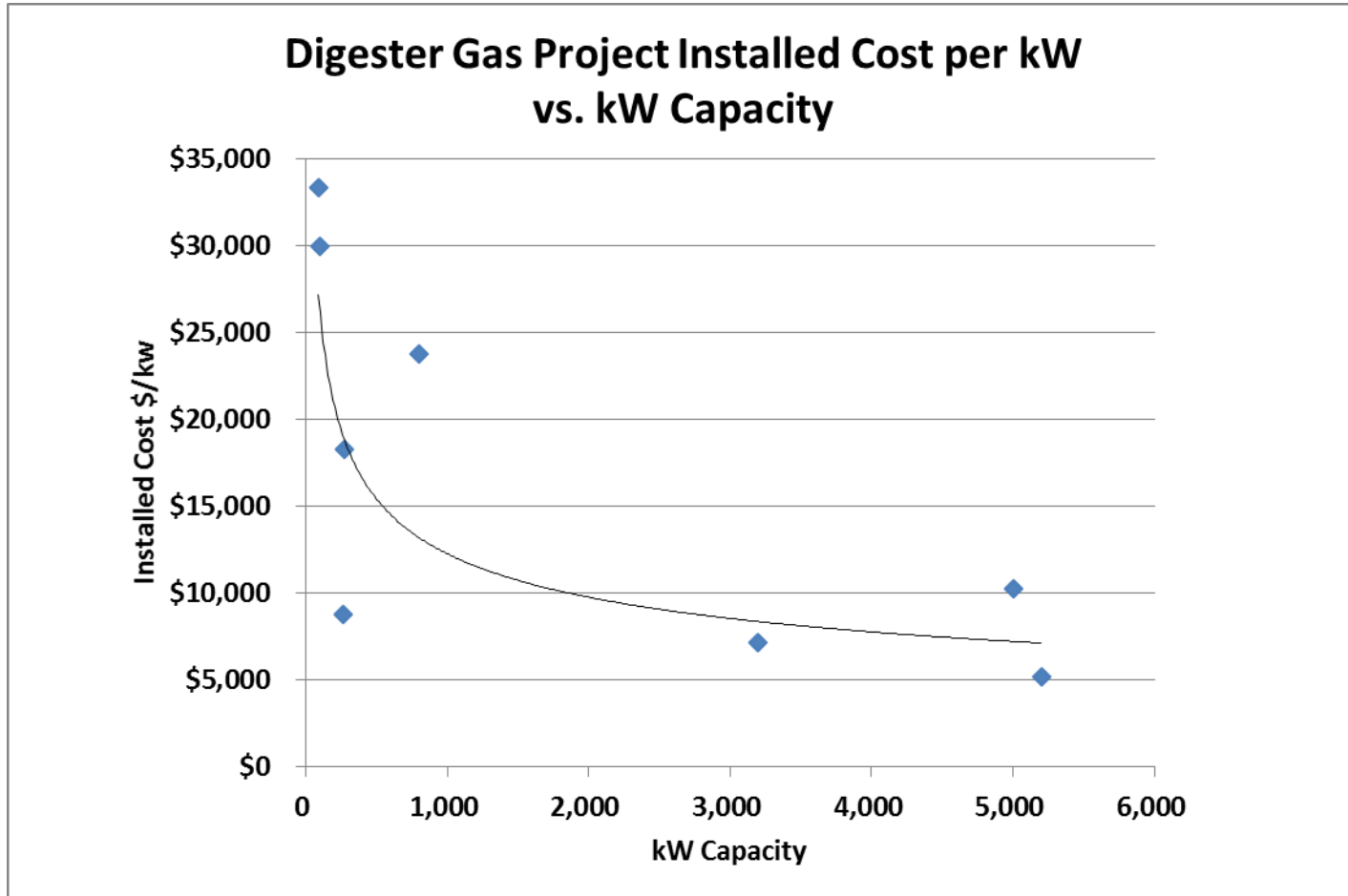
Rhode Island Solar Interconnection Costs

	Number of Projects	Wtd. Average Cost (\$/kW DC)
Small Solar I <=10	0	N/A
Small Solar II <=25	0	N/A
Medium Solar	10	\$54
Commercial Solar	15	\$97
Large Solar	4	\$91
Wind I	1	\$102
Wind II/III	1	\$100
Anaerobic Digestion I	0	N/A
Anaerobic Digestion II	0	N/A

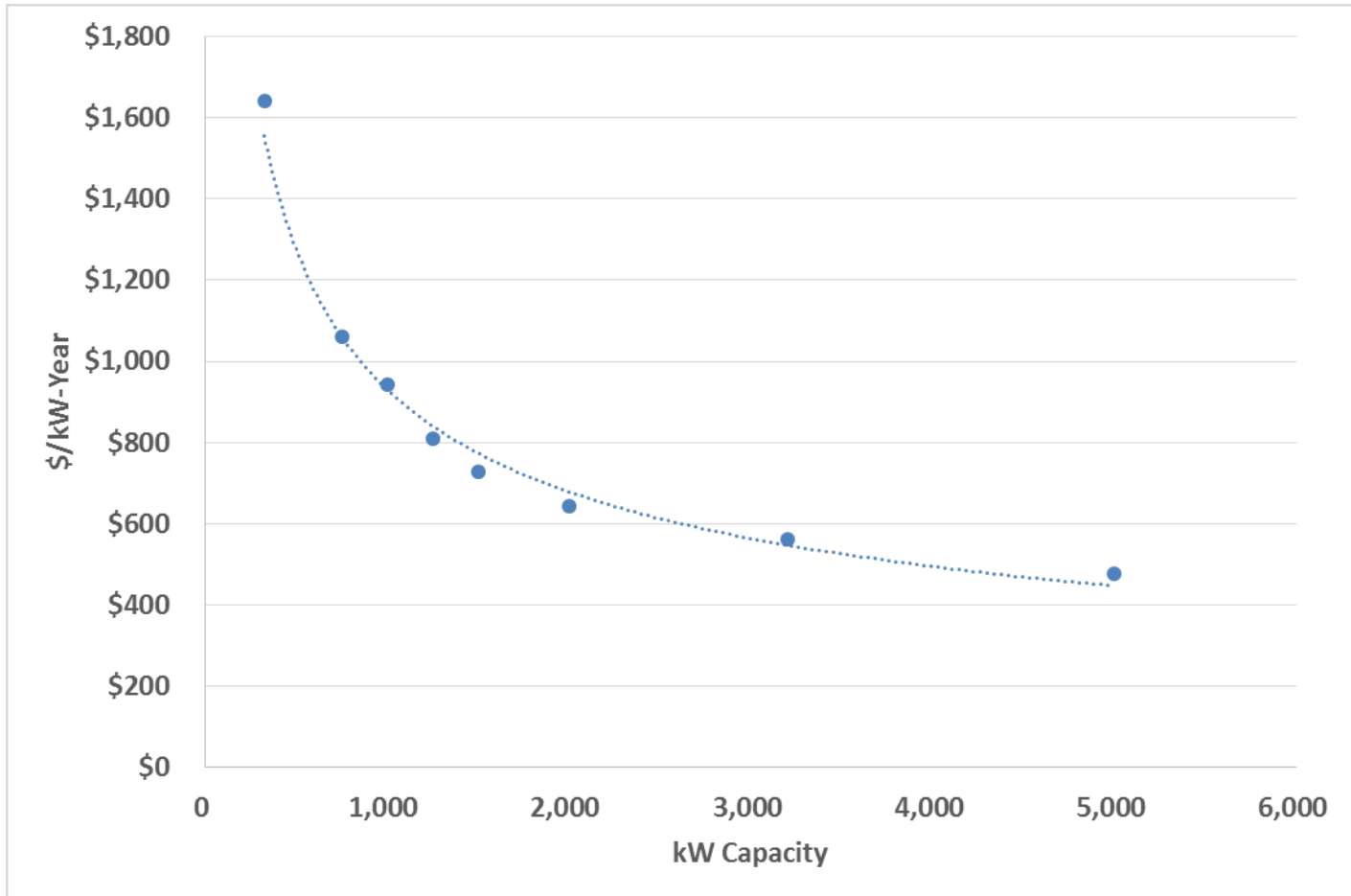


**Based on National Grid Data, excludes projects assumed to require safety equipment related to islanding (i.e. DTT, 3Vo, etc.)*

AD (Food Waste) Installed Cost Curve



AD (Food Waste) O&M Expense Curve



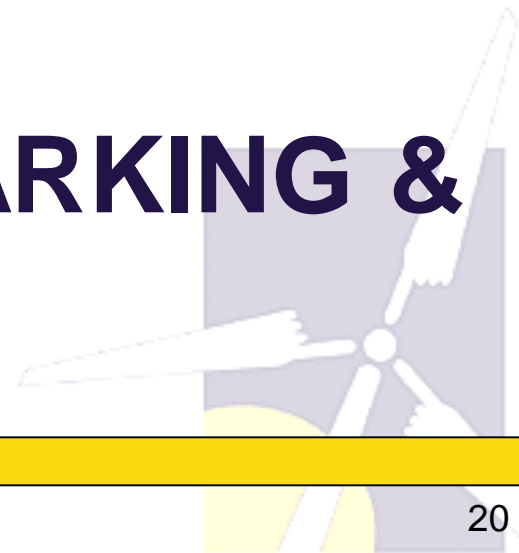


AD: Additional Data

- Tipping Fees
 - 2016 CP: \$22.50
 - Supplemental Research data Points
 - \$35/ton
 - \$10-\$40/ton
 - \$60/ton
- Parasitic Load (Station Service)
 - 12.5%
 - 13.8%
- Capacity Factor
 - 95%



REGIONAL BENCHMARKING & DG SC BID DATA



VT Standard Offer 2016 Bid Prices: SOLAR

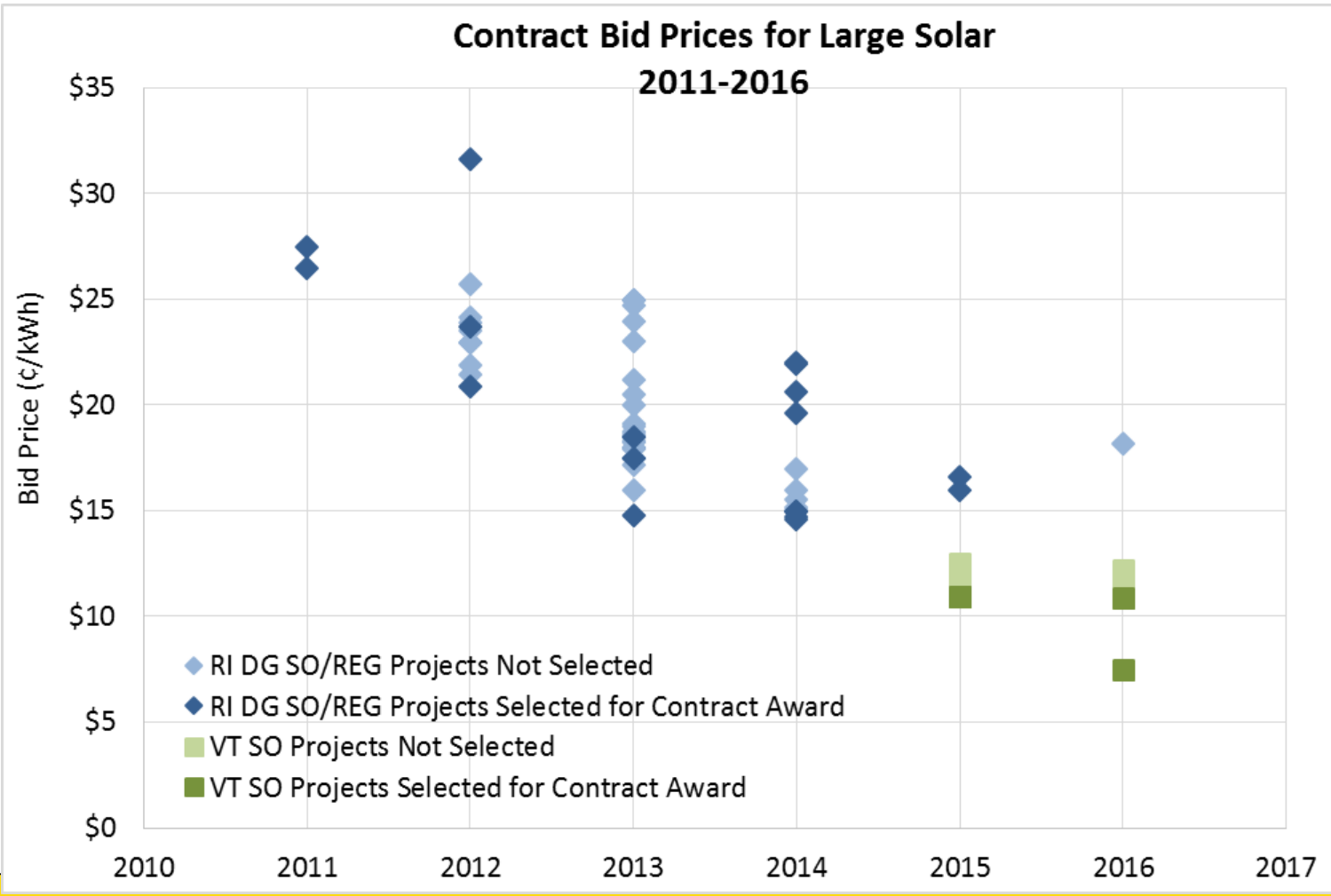
Project Name	Project Size (kW)	Bid Price* (\$/kWh)
Checkerberry Solar Park	2,160	\$0.075
Pit Site	2,050	\$0.1087
Cornfield Site	2,200	\$0.1088
Missisquoi Valley Solar	2,200	\$0.1108
Time L Tell Solar	2,200	\$0.1168
Gilman Landfill Solar	2,100	\$0.1094
Otter Creek 1 Solar	2,200	\$0.1089
Otter Creek 2 Solar	2,200	\$0.1137
Otter Creek 3 Solar	2,200	\$0.1176
Weybridge 1 Solar	2,200	\$0.1210
Weybridge 2 Solar	2,200	\$0.1220
Sunderland 1 Solar	2,200	\$0.1181
Sunderland 2 Solar	2,200	\$0.1184
Sunderland 3 Solar	2,200	\$0.1190
Battle Creek 1 Solar	2,200	\$0.1087
Battle Creek 2 Solar	2,200	\$0.1129
Battle Creek 3 Solar	2,200	\$0.1171

Highlighted Orange= Projects awarded a contract

Highlighted Green = Projects selected for "Reserve Group" – these projects will be contracted if a project in the "Award Group" is withdrawn following selection

* Note that the VT SO Program offers 25-year fixed price contracts, compared to 20 years in RI.

RI DG Standard Contract/REG Bid Price History & Comparison to VT Standard Offer Bid Prices



* Note that the VT SO Program offers 25-year fixed price contracts, compared to 20 years in RI.



VT Standard Offer 2016 Bid Prices: NON-SOLAR

Food Waste

Project Name	Project Size (kW)	Bid Price (/kWh)
Blue Sphere AD Project	2,200	\$0.180

Wind

Project Name	Project Size (kW)	Bid Price (/kWh)
Dairy Air Wind	2,200	\$0.1160
Tomlinson Wind A	100	\$0.251
Tomlinson Wind B	50	\$0.251
FELLCO 78A	100	\$0.251
FELLCO 78A	50	\$0.251



VT Standard Offer 2015 Bid Prices (NON-SOLAR)

Food Waste

Project Name	Project Size (kW)	Bid Price (/kWh)
Brattleboro Organic Energy	300	\$0.2080

Wind

Project Name	Project Size (kW)	Bid Price (/kWh)
Highgate Wind 1 Project	100	\$0.2520
Highgate Wind 2 Project	100	\$0.2520
Highgate Wind 3 Project	100	\$0.2520
Highgate Wind 4 Project	100	\$0.2520
Tesla Wind	36	\$0.2530
Baily Hill Wind	24	\$0.2530
Danby Wind Farm	96	\$0.2530
Hedgehog Hill Wind B	96	\$0.2530

Hydro

Project Name	Project Size (kW)	Bid Price (/kWh)
Pownal Tannery	1,100	\$0.1226



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
 - Starting point = \$5.00 per kWac installed
 - Effect: Tax expense is fixed and flat



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.
 - No monetization “haircut” assumed.
- Wind
 - For facilities commencing construction in 2017, PTC/ITC value is reduced by 20%
 - For facilities commencing construction in 2018, PTC/ITC value is reduced by 40%
 - No monetization “haircut” assumed.
- 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.
- RI State Investment Tax Credit
 - Modeled as a one-time, year-one benefit of \$3,750 for small, third-party owned solar



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



Post-Tariff Market Value of Production

- Applied after tariff expires, for remainder of modeled useful life, if applicable.
 - Solar (years 21 through 25)
 - Hydro (years 21 through 30)
 - Does not apply to wind and AD, modeled as 20-year useful life
- Purpose = to take full useful life and market revenues into account when recommending ceiling price
- Methodology
 - Wholesale energy revenue +
 - Production-weighted for solar
 - All-hours for hydro
 - Capacity revenue +
 - (Nominal) REC revenue (\$5)
- Values will be provided with draft Ceiling Prices





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