

Rhode Island Renewable Energy Growth Program:

Research, Analysis, & Discussion in Support of First Draft 2019 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 2019 Renewable Energy Growth (REG) Program.
- To develop Ceiling Price recommendations through an iterative, public process.

Draft 2019 Ceiling Prices, Categories and Modeling Parameters



Proposed Ceiling Price Categories

2019 REG Program: Proposed Technology, Size & Tariff Length Parameters

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	≤ 10 kW	15 and 20 Year Options
Small Solar II	25 kW	11 to 25 kW	20 Years
Medium Solar	250 kW	26 to 250 kW	20 Years
Commercial Solar	500 kW	251 to 999 kW	20 Years
Commercial Solar – Community Remote DG (CRDG)	500 kW	251 to 999 kW	20 Years
Carport	1,000 kW	500 kW to 5 MW	20 Years
Large Solar	2,000 kW	1 to 5 MW	20 Years
Large Solar - CRDG	2,000 kW	1 to 5 MW	20 Years
Small Wind	100 kW	≤ 999 kW	20 Years
Large Wind	3,000 kW	1.0 to 5.0 MW	20 Years
Anaerobic Digestion	750 kW	≤ 5 MW	20 Years
Hydropower	500 kW	≤ 5 MW	20 Years



Summary Results (1): Solar, (cents/kWh)

Technology	Size Range kW (Modeled Size kW)	2018 Approved CP	2019 Proposed CP
Small Solar I – 15 year Tariff Duration	1-10 (5)	32.25	26.45 / (-18%)
Small Solar I – 20 year Tariff Duration	1-10 (5)	28.55	23.25 (-19%)
Small Solar II	11-25 (25)	29.45	26.15 / (-11%)
Medium Solar	26-250 (250)	24.95	22.75 / (-9%)
Commercial Solar	251-999 (500)	19.65	17.05 / (-13%)
Comm. Solar-CRDG	251-999 (500)	22.45	19.61* / (-13%)
Carport	500-5,000 (1,000)	N/A	26.35
Large Solar	1,000-5,000 (2,000)	16.45	14.45 / (-12%)
Large Solar-CRDG	1,000-5,000 (2,000)	18.92*	16.62* / (-13%)

*This is the maximum CRDG Ceiling Price allowed by law. The calculated 2019 values are 20.55 for Commercial and 17.65 for Large. Note, however, that this CP would allow cost-competitive projects (bidding below the CP) access to > a 15% premium compared to actual project costs.



Summary Results (2): Wind, Hydro & AD

Technology	Size Range kW (Modeled Size kW)	2018 Approved CP 20 year Tariff Duration	2019 Proposed CP 20 year Tariff Duration
Small Wind	1-999 (100)	22.25	22.25 / (0%)
Large Wind	1,000-5,000 (3,000)	17.55	17.55 / (0%)
Large Wind - CRDG	1,000-5,000 (3,000)	19.35	19.75* / (2%)
Hydroelectric	1-5,000 (500)	24.55	25.05** / (2%)
Anaerobic Digestion	1-5,000 (750)	20.55	20.55 / (0%)

*Large Wind – CRDG ceiling price change driven by stakeholder feedback on customer acquisition and customer care and replacement costs.

**Hydroelectric – Ceiling price change driven by changes in post-tariff market value of production, which impacts hydro projects more than solar, wind, and AD because of its longer assumed useful life.



Summary: Cost & Production Assumptions (Solar)

	Small I	Small II	Medium	Commercial	Commercial CRDG	Carport	Large	Large CRDG
Nameplate Capacity (kW)	5	25	250	500	500	1,000	2,000	2,000
Capacity Factor	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%	15.30%	15.30%
Annual Degradation	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Total Cost^ (\$/kW)	\$3,185 [\$3,834]	\$3,027 [\$3,584]	\$2,678 [\$2,981]	\$2,087 [\$2,326]	\$2,237* [\$2,526*]	\$3,828	\$1,876 [\$2,139]	\$2,026* [\$2,339*]
Fixed O&M (\$/kW-yr)	\$35 [\$50]	\$35	\$35	\$15 [\$21]	\$40 [\$36**]	\$15	\$15	\$40 [\$30**]
O&M Inflation	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Insurance (% of Cost)	0.0%	0.0%	0.27%	0.45%	0.45%	0.45%	0.45%	0.45%
Project Management (\$/yr)	\$0	\$0	\$750	\$3,000	\$3,000	\$12,000	\$12,000	\$12,000
Site Lease (\$/yr)	\$0	\$0	\$6,250	\$12,500	\$12,500	\$12,500	\$50,000	\$50,000

Values in [Brackets] represent 2018 ceiling price inputs

^ Impacts due to solar module trade tariffs are assumed to be incorporated in installed cost data.

* Reflects installed cost of non-CRDG project from same category, plus estimated cost of customer acquisition (\$150/kW [\$200/kW in 2018]).

** Reflects O&M cost of non-CRDG project from same category, plus estimated cost of customer care and replacement (\$25/kW [\$15/kW in 2018]).



Summary: Financing Assumptions (Solar)

	Small I	Small II	Medium	Commercial	Commercial CRDG	Carport	Large	Large CRDG
% Debt	0%	0%	50%	55% [50%]	55% [50%]	55% [50%]	55%	55%
Debt Term (years)	N/A	N/A	15 [12]	15 [12]	15 [12]	15 [12]	15 [10]	15 [10]
Interest Rate on Term Debt	N/A	N/A	6.50%	6.00%	6.00%	6.00%	6.00%	6.00%
Lender's Fee (% of total borrowing)	N/A	N/A	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Target After-Tax Equity IRR	5.0%	5.0%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%

Values in [Brackets] represent 2018 ceiling price inputs.

Summary: Cost & Production Assumptions

Wind, Hydro, and AD

	Small Wind	Large Wind	Large Wind - CRDG	Hydroelectric	Anaerobic Digestion
Nameplate Capacity (kW)	100	3,000	3,000	500	725
Capacity Factor	21.00%	21.00%	21.00%	55.00%	92% ¹
Annual Degradation	0.5%	0.5%	0.5%	0.0%	0.0%
Total Cost (\$/kW)	\$3,500	\$2,820	\$2,970 [\$3,020] ²	\$8,750	\$10,150 ³
Fixed O&M (\$/kW-yr)	\$30.00	\$26.50	\$51.50 [\$41.50] ⁴	\$2.00	\$600
O&M Inflation	2.0%	2.0%	2.0%	2.0%, 1.0%	2.0%
Insurance (% of Cost)	0.25%	0.20%	0.20%	2.0%	1.0%
Project Management (\$/yr)	\$750	\$18,000	\$18,000	\$3,000	\$75,000
Site Lease (\$/yr)	\$5,000	\$162,000	\$162,000	\$8,750	\$35,000

Values in [\[Brackets\]](#) represent 2018 ceiling price inputs

1. Note: For Anaerobic Digestion we use an Availability Factor
2. Reflects installed cost of non-CRDG project from same category, plus estimated cost of customer acquisition (\$150/kW [\$200/kW in 2018])
3. Note: Includes \$150 per kW for interconnection costs
4. Reflects O&M cost of non-CRDG project from same category, plus estimated cost of customer care and replacement (\$25/kW [\$15/kW in 2018]).

Summary: Financing Assumptions (Wind, Hydro, and AD)

	Small Wind	Large Wind	Large Wind - CRDG	Hydroelectric	Anaerobic Digestion
% Debt	45%	65%	65%	70%	60%
Debt Term (years)	15	15	15	20	15
Interest Rate on Term Debt	6.0%	6.0%	6.0%	6.5%	6.5%
Lender's Fee (% of total borrowing)	2.0%	1.0%	1.0%	1.88%	1.5%
Target After-Tax Equity IRR	9.4%	9.4%	9.4%	9.4%	9.4%

Overview of Stakeholder Feedback (and Modeling Implications)



Summary of Data/Survey Response

Ceiling Price Category	# of Data Points Received (Data Request or Survey)
Small Solar I/II	7
Medium Solar	2
Commercial Solar	8
Commercial Solar - CRDG	3
Large Solar	10
Large Solar - CRDG	3
Carport	8
Small Wind	1
Large Wind	4
Large Wind - CRDG	0
Anaerobic Digestion	1
Hydro	3
TOTAL	29*

**Rows do not sum to total as sum respondents provided input in multiple categories.*

Small Solar I & II Incentive Approach

- OER/DG Board sought feedback on two main options:
 - A two-tranche approach in which the initial 6.55 MW tranche would receive a cost-based incentive rate, and the second tranche (of capacity exceeding 6.55 MW) would receive a lower rate
 - A single-tranche approach that would represent the midpoint between a cost-based and lower rate for all of the 2019 capacity
- Majority of respondents preferred a single-tranche approach, arguing that it would be easier to administer and create enhanced business certainty
- Other suggestions included:
 - Setting a single cost-based value for the entire tranche; and
 - Developing a pricing option that would be based on the midpoint of the 15- and 20-year Small Solar pricing options that would apply to the single tranche
- ***M.I. for Initial Draft Prices: Single-tranche approach for all capacity***

Solar Carport Costs & Incentives

- Typical Carport Sizing
 - Stakeholders provided a range of responses between 250 kW-1.5 MW, with most respondents suggesting systems greater than 500-700 kW would be preferable (matching with the 500 kW-5 MW initial size category)
- Differences in Carport Costs
 - Balance of system costs were found to be around \$0.50-\$1.25/W higher than for a ground-mounted system of the same size
 - At least five stakeholders raised permitting costs as significantly higher for Carport systems, suggesting that municipal height restrictions for new structures could require costly applications for a variance
 - Structural engineering cost differences were found to be at least 2-3 additional cents per Watt
- Slight lean in preference towards an adder, rather than a separate Ceiling Price category, for Carports
- ***M.I. for Initial Draft Prices: Carports assumed to have their own Ceiling Price category***

Solar Permitting

- Stakeholders mostly suggested that assuming permitting cost reductions across the board at 10% of total permitting cost may not be reasonable (thus arguing larger reductions may not be justifiable at this time)
- Several Large Solar developers suggest that the 2017 state permitting law did not substantially reduce their cost
 - One stakeholder pointed out that the applicability of the initial law extended only to ministerial permits (such as building and electrical), but not non-ministerial permits that larger Solar projects need
- Other installers/developers in other Solar segments suggest that the gains associated with permitting cost reduction have been uneven, as not all municipalities have embraced the state's e-permitting system
- ***M.I. for Initial Draft Prices: 10% permitting reduction retained across-the-board, but consideration to be given during 2019 process to reassessing cost reductions for projects requiring non-ministerial permits***

New (or Different) Ceiling Price Categories

- Subdividing Commercial Solar into 250-500 kW and 501-999 kW segments
 - One stakeholder argued that splitting Commercial Solar would allow for more diversity of large C&I rooftop applications, since current cutoffs incentivize projects to size to 249 kW (within Medium Solar) and 999 kW (within Commercial Solar)
- Consolidation of CRDG categories into one (rather than for Commercial and Large Solar)
- Several stakeholders suggested incentives for non-greenfield projects (including for closed landfills, brownfields, quarries and other areas with disturbed land)
- Several stakeholders have signaled interest in incentivizing systems with paired energy storage
- One stakeholder suggested splitting hydro into small scale <500 kW and large <1MW
- ***M.I. for Initial Draft Prices: Carports to be added as a separate Ceiling Price category, but no additional incentive or “adder” categories have been developed at this time***

Financing and Federal Tax Assumptions

- During PY 2019, the federal Investment Tax Credit applicable to solar and Small Wind will step down from 30% to 26% of total system cost
- Extension of federal Investment Tax Credit (ITC) in late 2015's Consolidated Omnibus Appropriations Act allows systems to “commence construction” during a given tax year (rather than become operational)
- However, several stakeholders have suggested that while projects selected in either the First or Second Open Enrollments can expect to “commence construction” during 2019, projects selected in the Third Open Enrollment would be unlikely to reach commercial operation in a timely-enough manner to receive the 2019 ITC value of 30%
- Federal tax credits for hydro and AD have expired.
- ***M.I. for Initial Draft Prices: SEA is assuming all projects will “commence construction” during 2019***

Additional solar stakeholder feedback

- Labor costs are higher in RI, driven by cost of electricians and labor ratio of electricians vs. other laborers/helpers. Large union presence relative to neighbor states. Rhode Island specific license is required.
- Non-profit and municipal customers do not receive tax credits
- Bonus depreciation – mixed feedback, but most not taking it:
 - Assume a typical 5-year MACRS.
 - Bonus depreciation has been very helpful and has served to offset module tariffs. Its more vital to large projects where 1 cent/watt makes a big difference and contracts are negotiated more closely
 - Immediate bonus depreciation hasn't been a major game changer.
 - ***M.I. for Initial Draft Prices: SEA assumes investors elect 5-year MACRS rather than bonus depreciation.***
- Tax equity availability and rates:
 - “Equity markets have been liquid enough, but equity returns have fallen. Assume that in a steady interest rate world, IRRs would be down.”
- Loan terms:
 - “Still not seeing [commercial] lenders step into long term loans – maybe for huge PPAs. Your term assumptions are over generous. Terms more typical for 7 or 10 years.”
 - ***M.I. for Initial Draft Prices: SEA initially proposed to model a loan term input of 18 years for 2019, adjusted to 15 years as a result of this feedback.***
- Interconnection cost assumptions:
 - “Limited to project specific upgrades, but not accounting for high costs associated with substation upgrades” (e.g. 3Vo)
- Siting Issues:
 - “Clarity of the path forward takes out uncertainty from a development perspective. No specific cost impacts at this point.”



Additional non-solar stakeholder feedback

- Wind

- “With small projects, returns are never as you model them.”
- “Costs are not necessarily going up. Cost of new turbines is dropping. So, total cost should be less if you are able to site it.”
- “Interconnection costs are higher than estimated. For new projects, even higher.”
- “Add a modeling category for 1.5MW and a category for 3.0MW. There are significant economies of scale for installing more capacity, particularly on interconnection.”

- Hydro

- “Total FERC license prep is about 10% of total cost. Need to invest \$500K to \$750K before FERC licensing complete.”
- “Approvals from FERC costing several thousand in additional studies. If fish ladder is required, then it will stop the project on cost (prohibitive).”
- Impending steel tariffs from Canada may be a major issue – could “sink projects.”
- “Interconnection cost estimates are wildly off. Use of variable speed drive is causing confusion.”

Further Stakeholder Input Sought

- The IRS recently issued guidance regarding commenced construction requirements to qualify for ITC levels in a given year. As with qualification for the PTC, projects may qualify by starting significant physical work or incurring 5% or more of the total costs. Given these allowances, please explain and justify whether the assumption that projects participating in the 2019 program year will commence construction by 2019 is reasonable.
- We have limited data points for installed costs of carports. Please provide input on typical project costs for a ~1 MW carport system.
- Carport capacity factor: Some data received indicated a lower CF than comparable ground-mount or rooftop systems. Please explain and provide documentation for why a carport would have a lower CF.
- Steel tariffs: what are the implications for project costs, particularly for solar carports and hydro?
- FERC licensing requirements for hydro: please comment on potential costs, given uncertainties in the context of project development timelines.

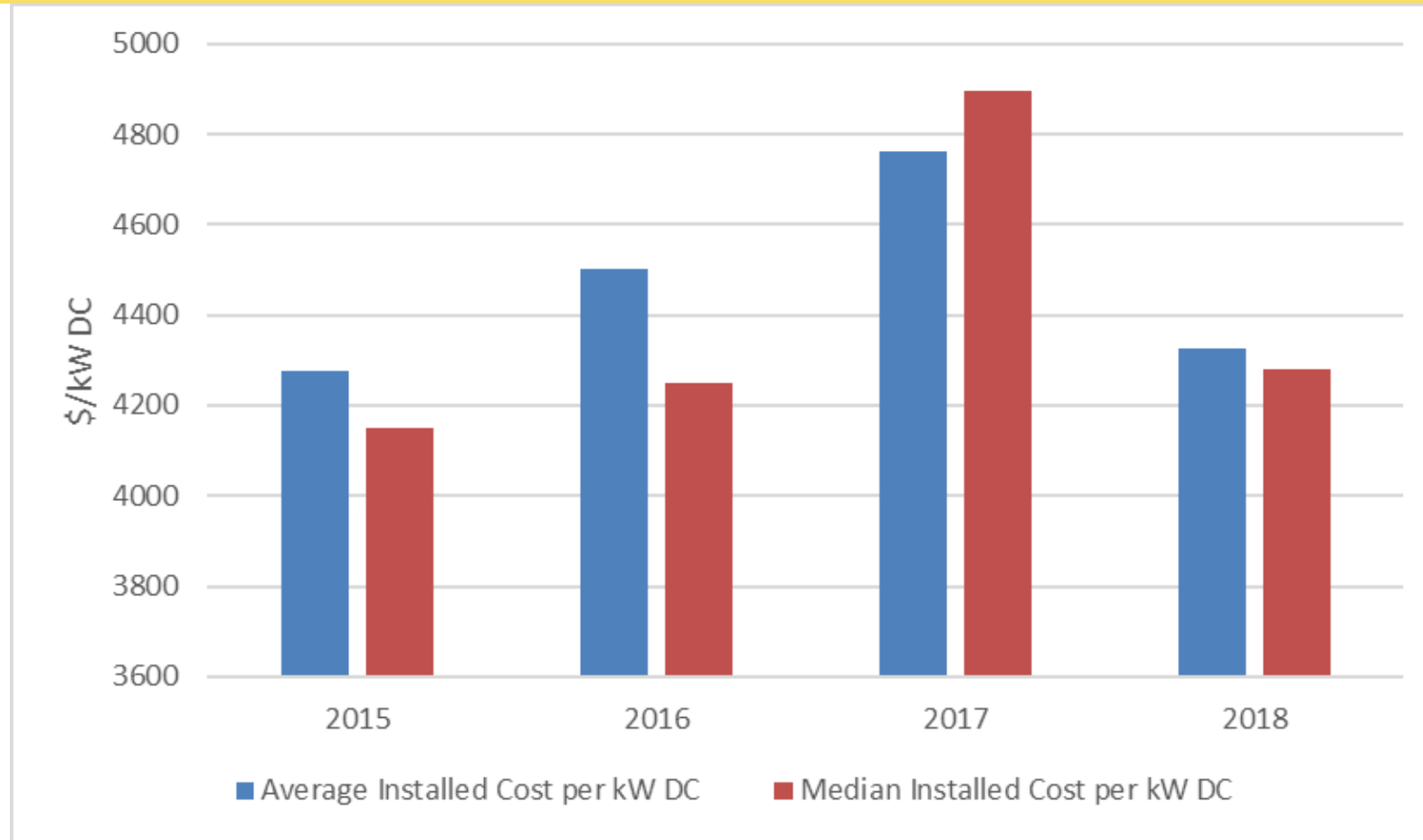
Appendix: Bid Data, Regional Benchmarking, and Additional Assumptions



Overview of Research to Inform CP Inputs

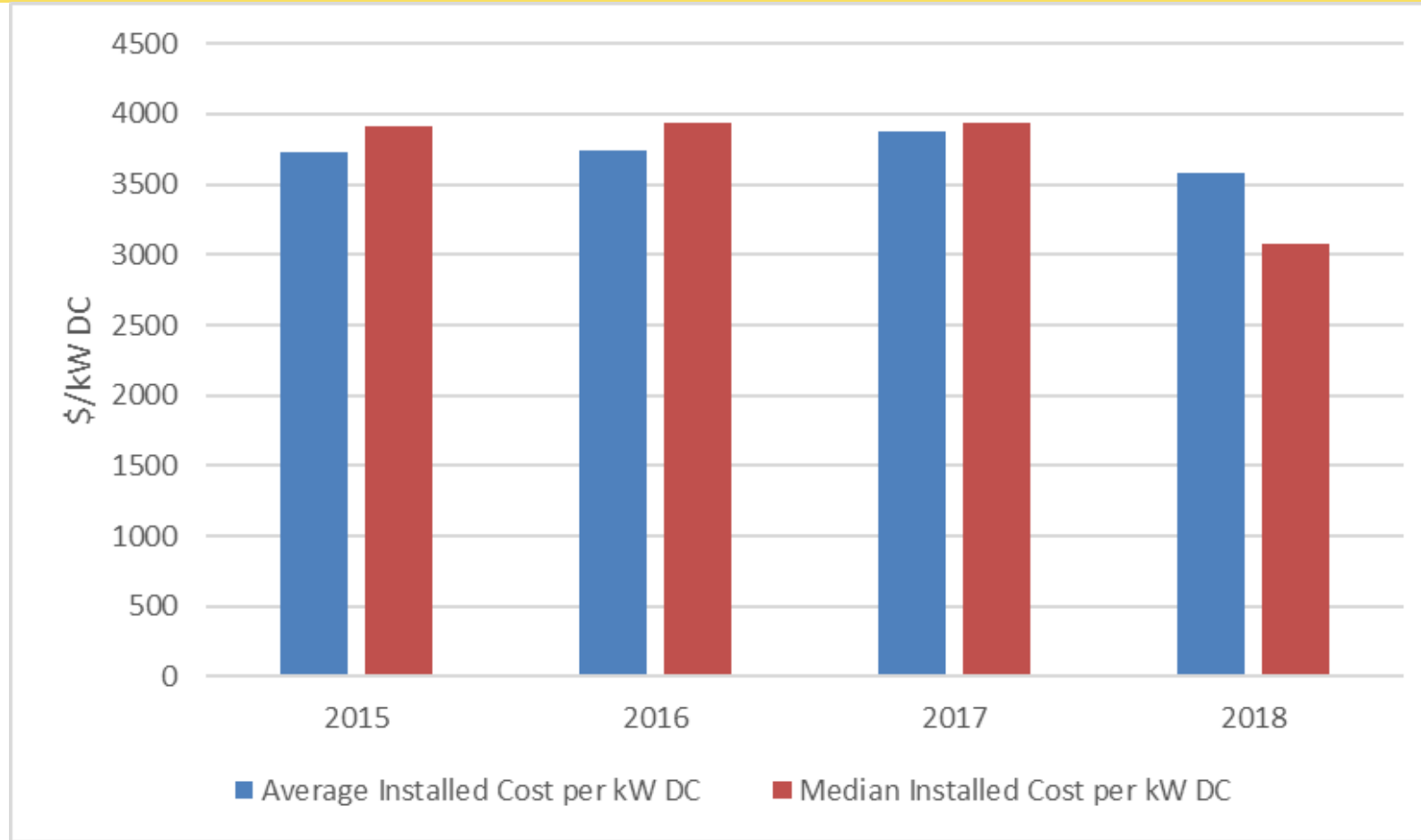
- Direct stakeholder input
 - Through *Data Request and Survey*
- Supplemental research
 - Interviews
 - Program data (bids, executed contracts)
 - Additional data from National Grid (Actual interconnection costs)
 - Northeast regional cost databases
 - Revealed pricing data for ≤ 25 kW system from EnergySage
 - Northeast data from national reports (LBNL *Tracking the Sun*, which will be analyzed for the 2nd round of prices)
 - Technology-specific, competitively bid long-term contract pricing data (VT)
- DG Standard Contracts bid data (2011 – 2014)
- REG bid data (2015, 2016, 2017 & 2018 1st Open Enrollment)

REG Bid Data – Average & Median Installed Cost for Small Solar I Under Different Tariff Years



Note: Data includes 375 projects with contracts under the 2015 tariff, 920 under the 2016 tariff, 1062 under the 2017 tariff, and 645 thus far under the 2018 tariff. 229 projects (9% of the total) lacking cost data are omitted from analysis.

REG Bid Data – Average & Median Installed Cost for Small Solar II Under Different Tariff Years



Note: Data includes 10 projects with contracts under the 2015 tariff, 20 under the 2016 tariff, 10 under the 2017 tariff, and 25 thus far under the 2018 tariff. 6 projects (9% of the total) lacking cost data are omitted from analysis.

REG Bid Data – Small Solar Installed Costs (2015-18)

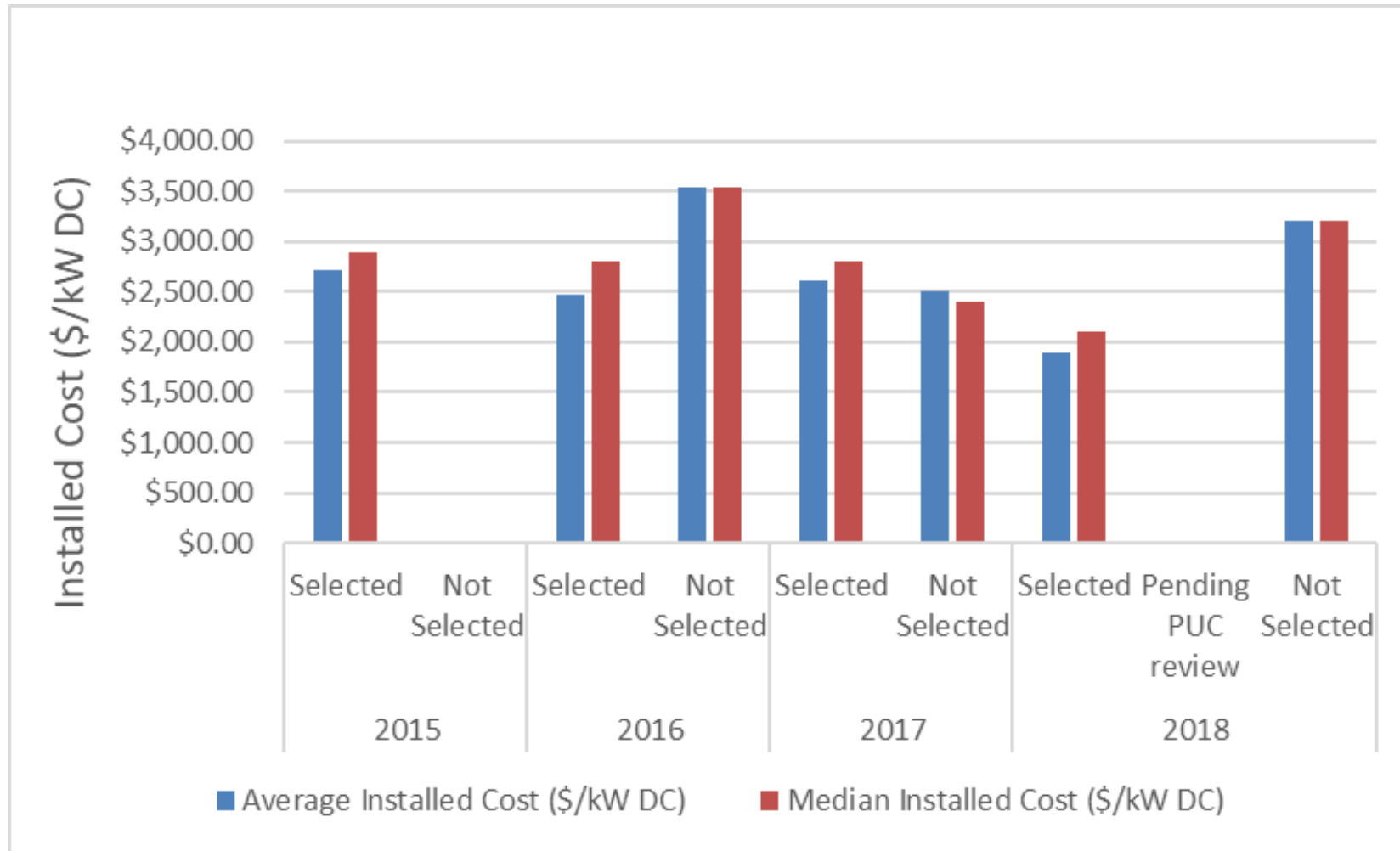
Installed Cost Analysis of REGrowth Systems 1-25 kW, 2015-2018

	Tariff Year	Average cost (\$/kW)	Median cost (\$/kW)	1 st Quartile	3 rd Quartile	N*
Small Solar I (1-10 kW)	2015	\$4276.71	\$4150	\$3798.57	\$4636.52	375
	2016	\$4502.14	\$4250	\$3850.04	\$5021.69	920
	2017	\$4761.23	\$4894.12	\$4100	\$5499.38	1062
	2018	\$4324.89	\$4279.96	\$3451.37	\$5000	561
Small Solar 2 (10-25 kW)	2015	\$3733.70	\$3911.72	\$3694.25	\$4121.90	10
	2016	\$3740.98	\$3931.08	\$3548.69	\$4103.92	20
	2017	\$3875.31	\$3942.33	\$3170.41	\$4240.63	10
	2018	\$3584.64	\$3076.89	\$2998.76	\$4011.50	21

Note: Data from National Grid REGrowth Report

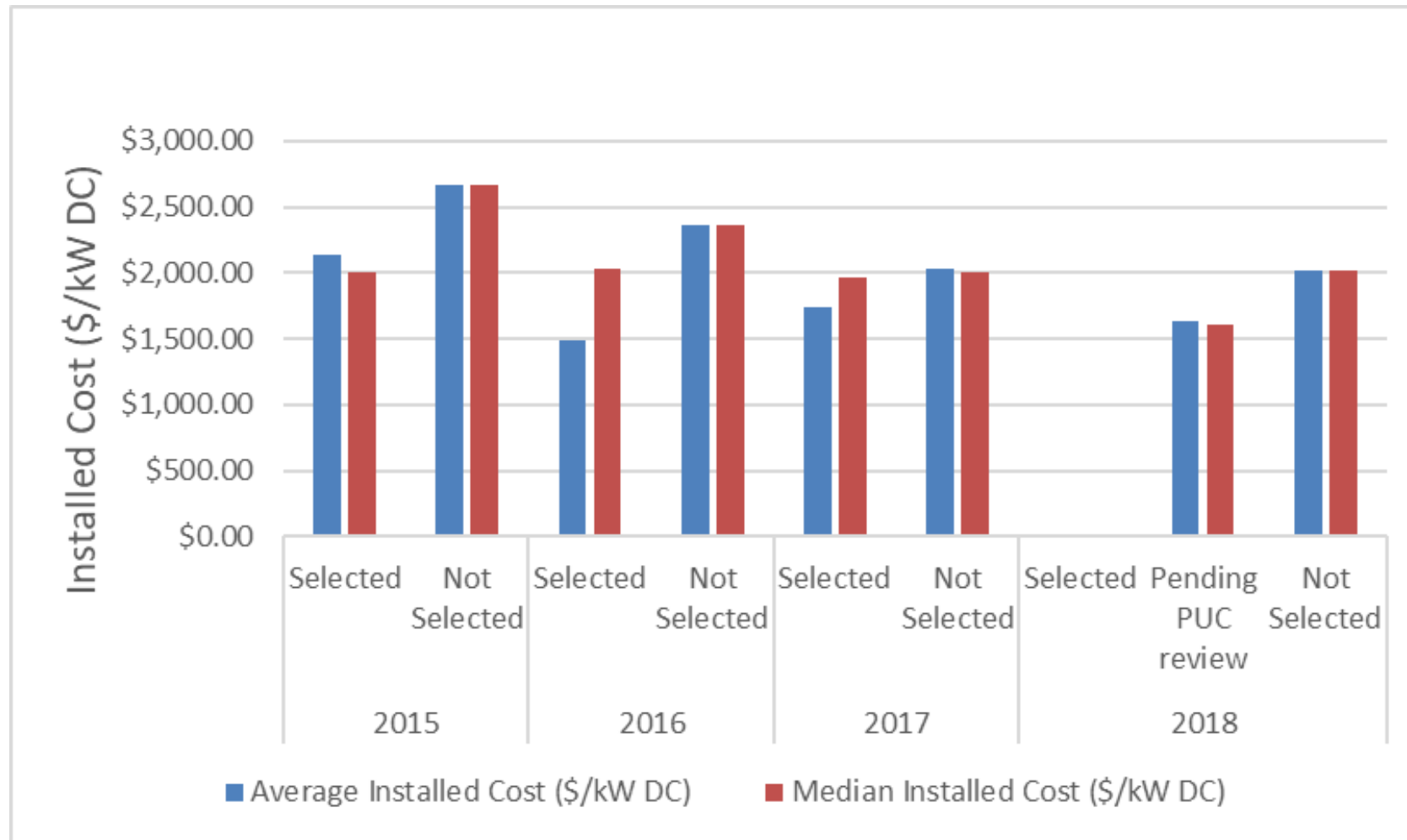
**Counts represent projects with cost data available. 299 Small Solar I projects and 6 Small Solar II projects are missing data.*

REG Bid Data – Average & Median Installed Cost for Medium Solar Under Different Tariff Years



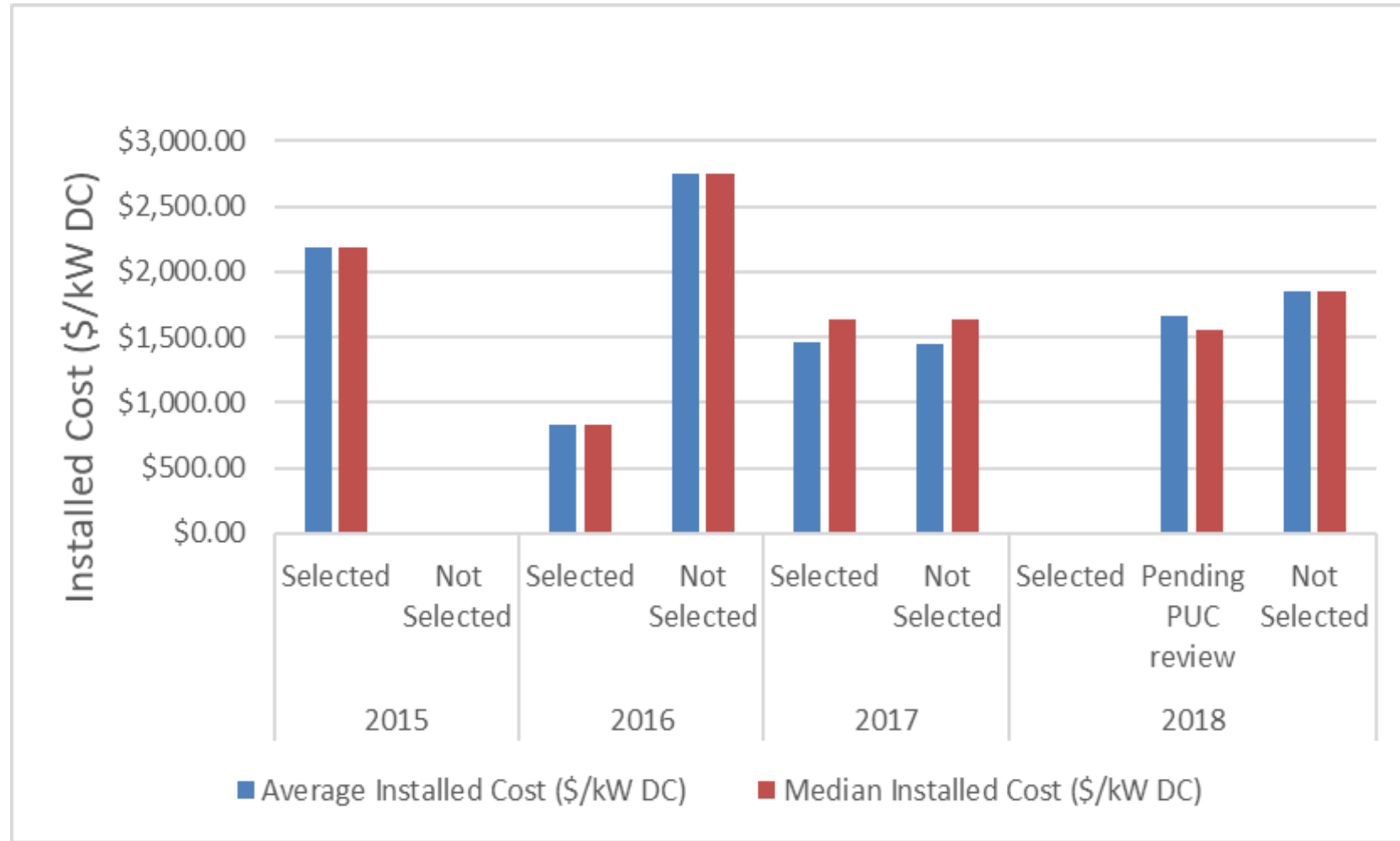
Note: Only 1 project was not selected under the 2016 tariff and thus far under the 2018 tariff.

REG Bid Data – Average & Median Installed Cost for Commercial Solar Under Different Tariff Years



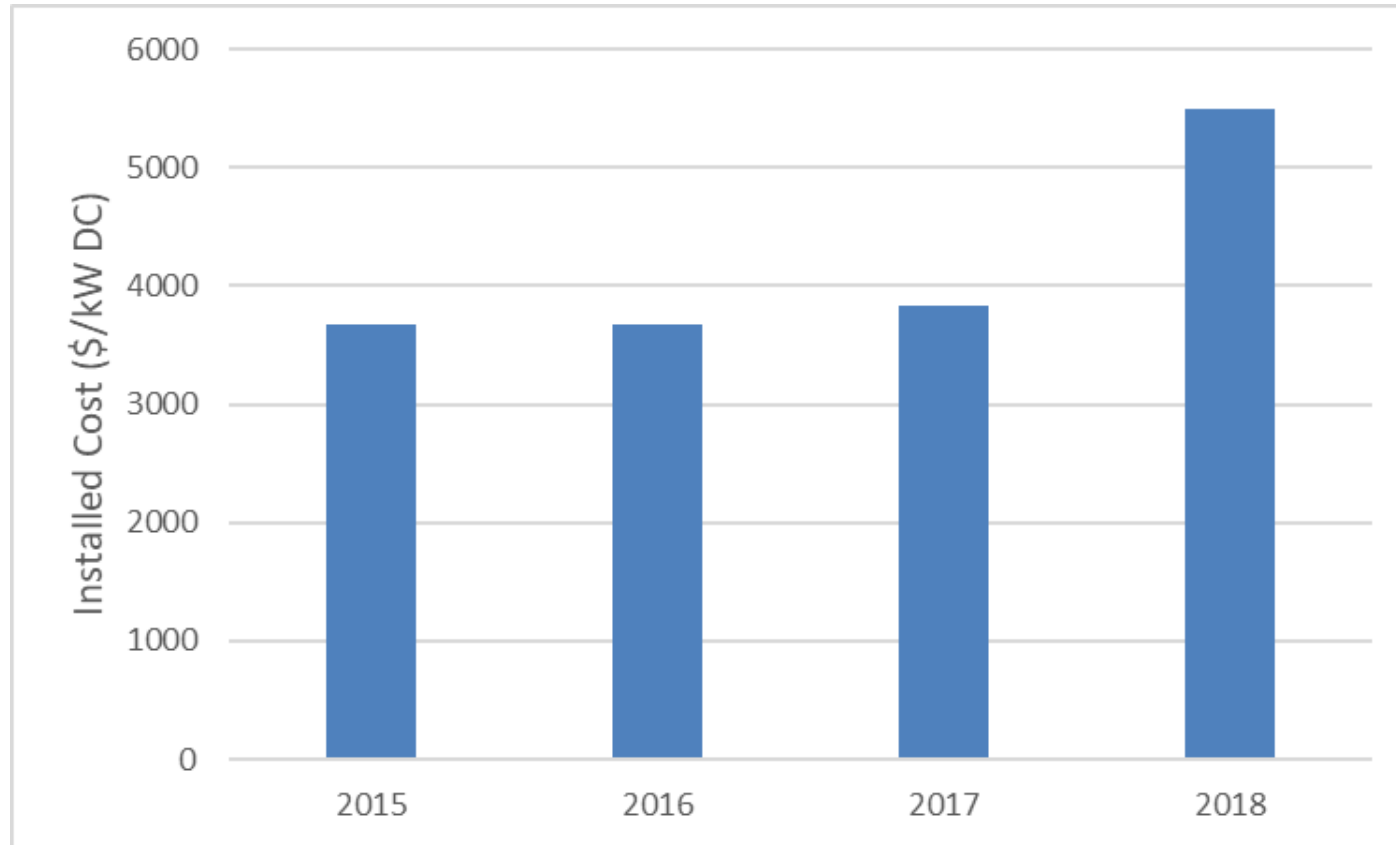
Note: Only 1 project was not selected under the 2018 tariff.

REG Bid Data – Average & Median Installed Cost for Large Solar Under Different Tariff Years



Note: Only one cost one data point was available for projects selected under the 2016 tariff.

REG Bid Data – Average Installed Costs for Large Wind Under Different Tariff Years



Note: Only 2 projects were bid in each year's tariff (all were accepted).

Small Solar I, Installed Costs

Small Solar I (1-10 kW) Installed Costs						
Dataset	2017			2018		
	Average* (\$/kW)	25th Percentile (\$/kW)	75th Percentile (\$/kW)	Average (\$/kW)	25th Percentile (\$/kW)	75th Percentile (\$/kW)
NY - NYSERDA Solar Electric Programs	\$4,064	\$3,390	\$4,605	\$4,085	\$3,410	\$4,480
MA RPS Solar Carve Out II (Qualified & Operational)	\$3,871	\$3,350	\$4,353	\$3,751	\$3,341	\$4,190
MA RPS Solar Carve Out II (Under Review)	\$4,080	\$3,381	\$4,584	\$3,801	\$3,272	\$4,227
MA Performance Tracking System	\$3,874	\$3,350	\$4,369	\$3,684	\$3,249	\$4,083
CT Residential Solar Investment Program	\$3,355	\$2,920	\$3,690	\$3,429	\$3,121	\$3,811
NY - Energy Sage	\$3,400	\$3,217	\$3,510	\$3,400	\$3,200	\$3,650
MA - Energy Sage	\$3,263	\$3,120	\$3,430	\$3,220	\$3,090	\$3,440
RI - Energy Sage	\$3,420	\$3,307	\$3,643	\$3,430	\$3,280	\$3,700

*Median pricing used for Energy Sage data given apparent outliers in dataset.

Datasets: MA SREC, MA PTS, NY (NYSERDA Solar Programs), CT (Residential Solar Investment Program), Energy Sage revealed pricing data. LBNL Tracking the Sun data to be incorporated when available.

Small Solar II, Installed Costs

Small Solar II (11-25 kW) Installed Costs						
Dataset	2017			2018		
	Average* (\$/kW)	25th Percentile (\$/kW)	75th Percentile (\$/kW)	Average (\$/kW)	25th Percentile (\$/kW)	75th Percentile (\$/kW)
NY - NYSERDA Solar Electric Programs	\$3,527	\$2,987	\$3,999	\$3,433	\$2,910	\$3,896
MA RPS Solar Carve Out II (Qualified & Operational)	\$3,666	\$3,221	\$4,028	\$3,539	\$3,185	\$3,900
MA RPS Solar Carve Out II (Under Review)	\$2,948	\$2,365	\$3,765	\$3,412	\$3,006	\$3,935
MA Performance Tracking System	\$3,666	\$3,214	\$4,010	\$3,484	\$3,144	\$3,815
CT Residential Solar Investment Program	\$3,191	\$2,828	\$3,533	\$3,278	\$3,067	\$3,464
NY - Energy Sage	\$3,267	\$2,960	\$3,400	\$3,200	\$2,950	\$3,400
MA - Energy Sage	\$3,140	\$2,973	\$3,317	\$3,150	\$3,000	\$3,350
RI - Energy Sage	\$3,343	\$3,230	\$3,433	\$3,300	\$3,170	\$3,490

*Median pricing used for Energy Sage data given apparent outliers in dataset.

Datasets: MA SREC, MA PTS, NY (NYSERDA Solar Programs), CT (Residential Solar Investment Program), Energy Sage revealed pricing data. LBNL Tracking the Sun data to be incorporated when available.



Medium, Commercial, and Large Solar Installed Costs

Dataset	2017			2018		
	Average (\$/kW)	25th Percentile (\$/kW)	75th Percentile (\$/kW)	Average (\$/kW)	25th Percentile (\$/kW)	75th Percentile (\$/kW)
Medium Solar (26-250 kW)						
NY - NYSERDA Solar Electric Programs	\$3,307	\$2,673	\$3,738	\$3,088	\$2,300	\$3,519
MA RPS Solar Carve Out II (Qualified & Operational)	\$3,064	\$2,592	\$3,376	\$3,166	\$2,624	\$3,738
MA RPS Solar Carve Out II (Under Review)	\$2,452	\$2,145	\$2,628	\$3,104	\$2,329	\$4,151
MA Performance Tracking System	\$3,138	\$2,605	\$3,419	\$3,231	\$2,767	\$3,515
CT Residential Solar Investment Program	\$3,004	No Data	No Data	No Data	No Data	No Data
MA RPS Solar Carve Out II (Qualified & Not Operational)*				\$3,129	\$2,610	\$3,469
Commercial Solar (251-999 kW)						
NY - NYSERDA Solar Electric Programs	\$2,283	\$2,134	\$2,589	\$2,534	\$2,259	\$2,983
MA RPS Solar Carve Out II (Qualified & Operational)	\$2,541	\$2,133	\$2,788	\$2,916	\$2,330	\$3,205
MA RPS Solar Carve Out II (Under Review)	\$1,835	No Data	No Data	\$1,858	\$1,650	\$2,064
MA Performance Tracking System	\$2,732	\$2,297	\$2,874	\$3,047	\$2,603	\$3,353
CT Residential Solar Investment Program	No Data	No Data	No Data	No Data	No Data	No Data
MA RPS Solar Carve Out II (Qualified & Not Operational)*				\$2,430	\$2,089	\$2,803
Large Solar (1000-5000+ kW)						
NY - NYSERDA Solar Electric Programs	\$2,485	\$1,736	\$3,250	\$1,780	No Data	No Data
MA RPS Solar Carve Out II (Qualified & Operational)	\$2,411	\$2,008	\$2,669	\$2,524	\$2,086	\$3,056
MA RPS Solar Carve Out II (Under Review)	\$2,701	\$2,381	\$3,020	\$1,261	\$31	\$2,040
MA Performance Tracking System	\$2,605	\$2,194	\$2,885	\$2,664	\$2,195	\$3,162
CT Residential Solar Investment Program	No Data	No Data	No Data	No Data	No Data	No Data
MA RPS Solar Carve Out II (Qualified & Not Operational)*				\$2,332	\$1,774	\$2,765

*Not Operational projects have no completion date. Datasets: MA SREC, MA PTS, NY (NYSERDA Solar Programs).

Average & Median Installed Cost/kW for RI REF Data (2017-18)

Installed Cost Analysis of Renewable Energy Fund (REF) Systems 1-25 kW, 2017-2018

	Average cost (\$/kW)	Median cost (\$/kW)	1 st Quartile	3 rd Quartile	N
1-10 kW	\$3,821.44	\$3,796.39	\$3,506.25	\$4,128.26	148
10-25 kW	\$4,048.94	\$3,999.67	\$3,622.33	\$4,470.62	15

Note: Data from RI Renewable Energy Fund (CommerceRI). Two outliers above \$10,000/kW and below \$2,000/kW were removed.



Interconnection Cost Analysis: MA & RI (2017-18)

	Massachusetts & Rhode Island		Rhode Island only	
	Number of Projects with Cost Data	Wtd. Average Cost (\$/kW DC)	Number of Projects with Cost Data	Wtd. Average Cost (\$/kW DC)
Small Solar I (<=10 kW)	0	NA	0	NA
Small Solar II (11-25 kW)	0	NA	0	NA
Medium Solar (26-250 kW)	11	\$158.07	4	\$306.85
Commercial Solar (251-999 kW)	55	\$281.15	10	\$108.85
Large Solar (1000-5000 kW)	96	\$189.39	6	\$120.53
Small Wind (<=999 kW)	0	NA	0	NA
Large Wind (1000-5000 kW)	1	\$239.80	1	\$239.80
Anaerobic Digestion (<=5000 kW)	0	NA	0	NA
Hydro	0	NA	0	NA

Note: Based on National Grid Data. Few projects in 2017-2018 indicate whether or not safety equipment related to islanding (i.e. DTT, 3Vo, etc.) is required; unknown whether reported project costs include safety equipment costs. Dataset includes additional projects that do not have cost data available.

MA SMART Procurement Results

Procurement Summary	NGrid	Nantucket	NSTAR	WMECo	Unitil
MW Solicited (MW-AC)	45.00	2.00	46.00	8.00	4.00
MW Received (MW-AC)	53.30	0.00	2.00	13.00	0.00
MW Selected (MW-AC)	43.57	0.00	2.00	7.70	0.00
Clearing Price (\$/kWh)	\$ 0.16933	N/A	\$ 0.17000	\$ 0.14890	N/A
Weighted Average Clearing Price (\$/kWh)	\$ 0.15563	N/A	\$ 0.17000	\$ 0.14288	N/A
Block 1 Base Compensation Rate (\$/kWh)	\$ 0.15563	\$ 0.17000	\$ 0.17000	\$ 0.14288	\$ 0.15563

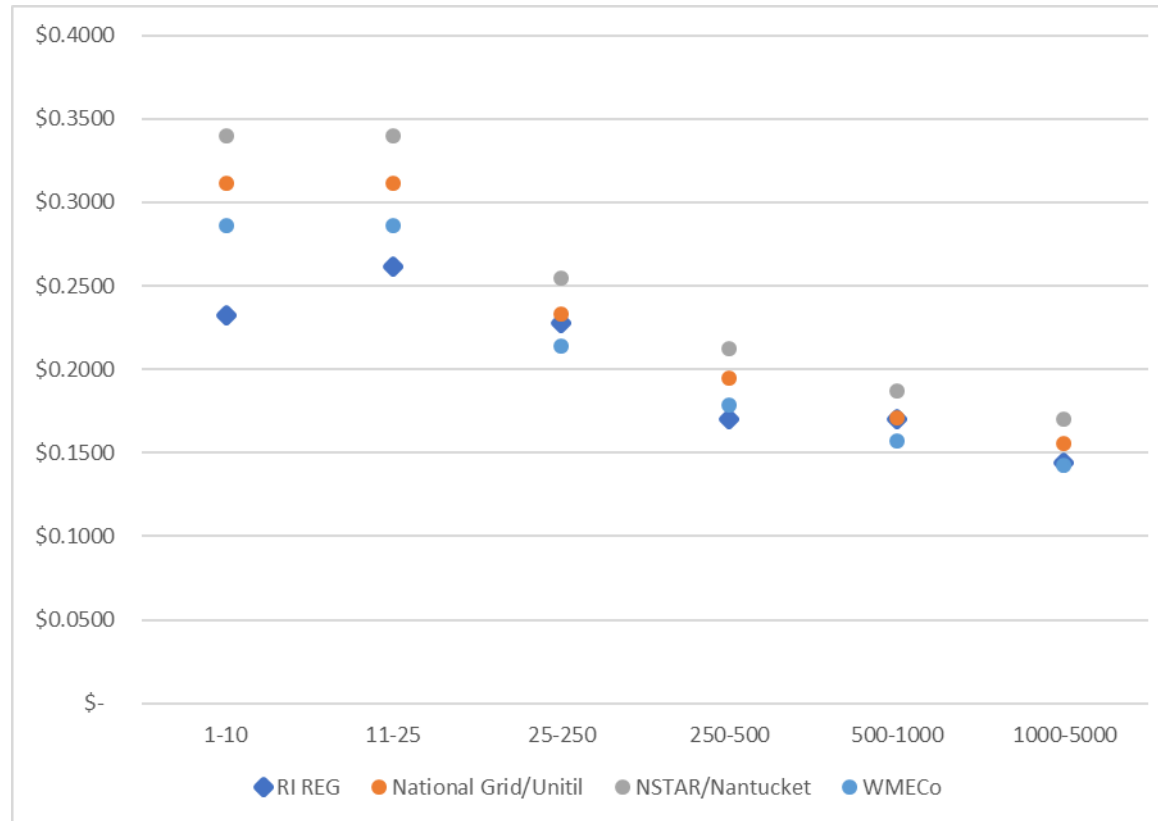
Block 1 Base Compensation Rates

Size Bucket	Capacity Based Rate Factor	NGrid	Nantucket	NSTAR	WMECo	Unitil
Low Income <=25 kW	230%	\$ 0.3579	\$ 0.3910	\$ 0.3910	\$ 0.3286	\$ 0.3579
<=25 kW	200%	\$ 0.3113	\$ 0.3400	\$ 0.3400	\$ 0.2858	\$ 0.3113
25-250 kW	150%	\$ 0.2334	\$ 0.2550	\$ 0.2550	\$ 0.2143	\$ 0.2334
250-500 kW	125%	\$ 0.1945	\$ 0.2125	\$ 0.2125	\$ 0.1786	\$ 0.1945
500-1000 kW	110%	\$ 0.1712	\$ 0.1870	\$ 0.1870	\$ 0.1572	\$ 0.1712
1-5 MW	100%	\$ 0.1556	\$ 0.1700	\$ 0.1700	\$ 0.1429	\$ 0.1556

Procurement projects receive the clearing price (highest bid value) as their base compensation rate, while the rest of the compensation in the program is based on the weighted average clearing price.

RI REG Ceiling Prices and SMART Base Compensation Rates

First Draft Proposed 2019 Ceiling Prices and SMART Block 1 Base Compensation Rates (\$/kWh)



Note: SMART Base Compensation Rates are set as a percentage-based factor from the weighted average clearing price of the opening competitive procurement for projects sized 1-5 MW. Projects bidding into the procurement receive the clearing price.

VT Standard Offer 2018 Bid Prices: SOLAR

Project Name	Project Size (kW)	Bid Price* (\$/kWh)
1861 Solar	1,000	0.1250
Bennington East Solar	1,700	0.0874
Furnace Brook Solar	1,700	0.0884
Power Factor Solar	2,200	0.0899
Warner Solar	2,200	0.1087
Stark Solar	2,200	0.1106
Otter Creek 1 Solar	2,200	0.1112
Otter Creek 3 Solar	2,200	0.1126
Vergennes Solar	2,200	83.9800**
Charlotte Solar – Lake Road	2,200	86.5000**
St. Albans Solar	2,200	-

Highlighted Blue= Projects awarded a contract (recommended)

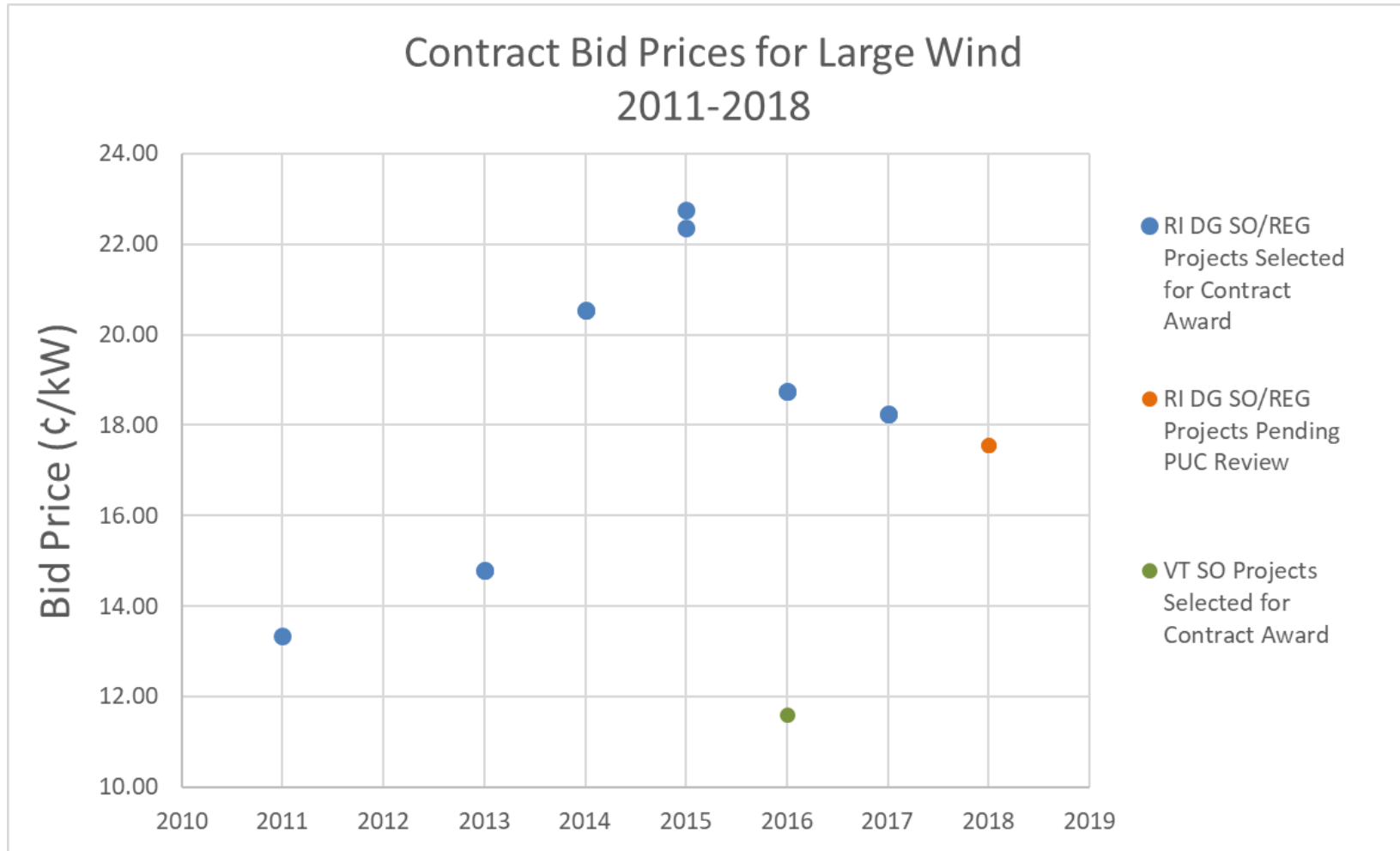
Highlighted Green = Projects selected for “Reserve Group” – these projects will be contracted if a project in the “Award Group” is withdrawn following selection (recommended)

**Note that the VT SO Program offers 25-year fixed price contracts, compared to 20 years in RI. In 2018, the program changed incentive allocations to a competitive block and a technology diversity block, but did not change overall eligibility.*

***Bid Price is shown as reported. Projects were not selected due in part to bid price being greater than allowable under program rules.*



Comparison of RI DG Standard Contract/REG & VT Standard Offer Bid Price History: Large Wind

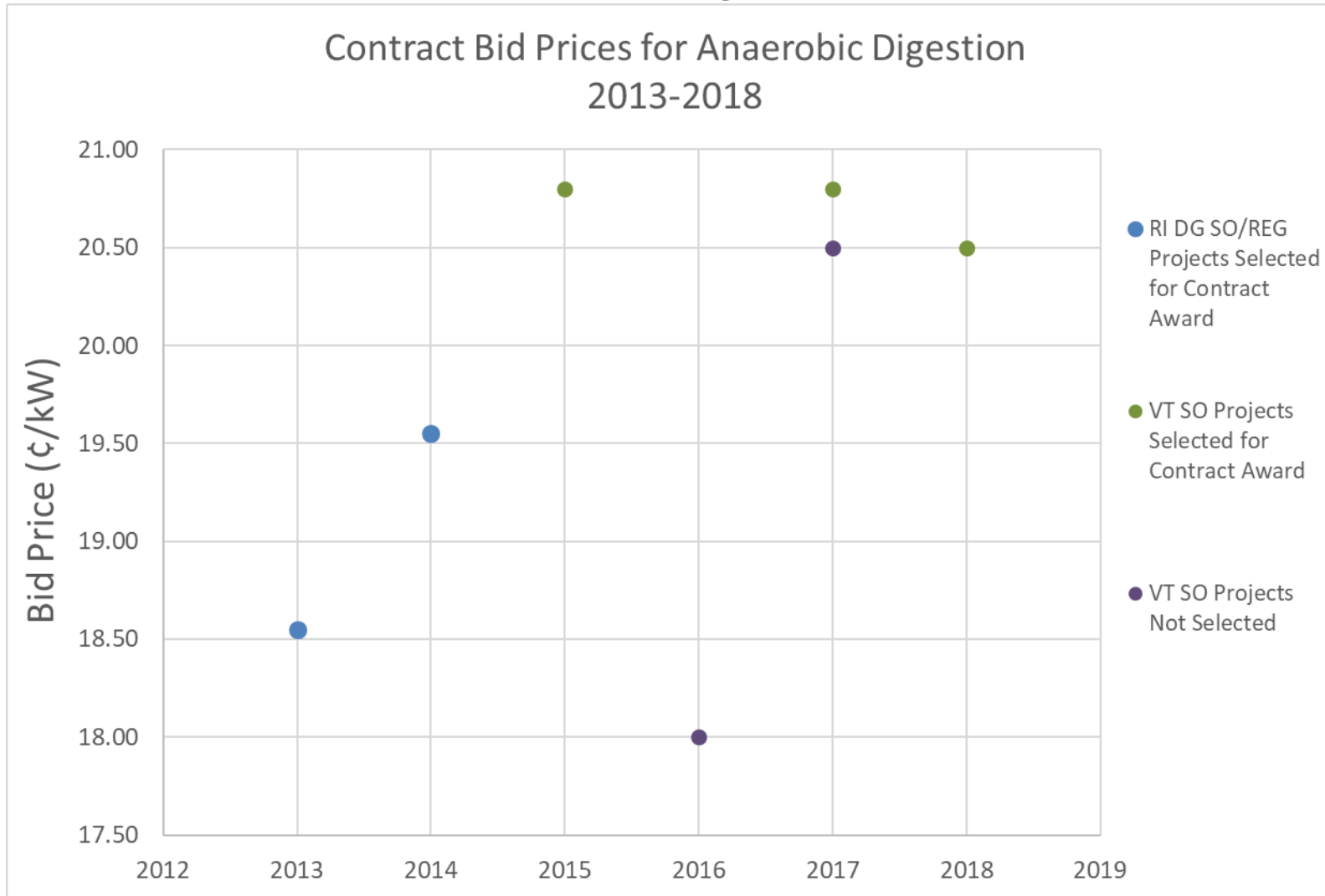


Comparison of RI DG Standard Contract/REG & VT Standard Offer Bid Price History: Small Wind



** Note that there were multiple projects bid in at each price point in the graph above.*

Comparison of RI DG Standard Contract/REG & VT Standard Offer Bid Price History: AD



* Note that no AD Bids were made prior to 2013.

VT Standard Offer 2018 Bid Prices: NON-SOLAR

Small Wind

Project Name	Project Size (kW)	Bid Price (/kWh)
Tomlinson Wind	90	\$0.258

Highlighted Blue=
Projects awarded a
contract
(recommended)

Food Waste

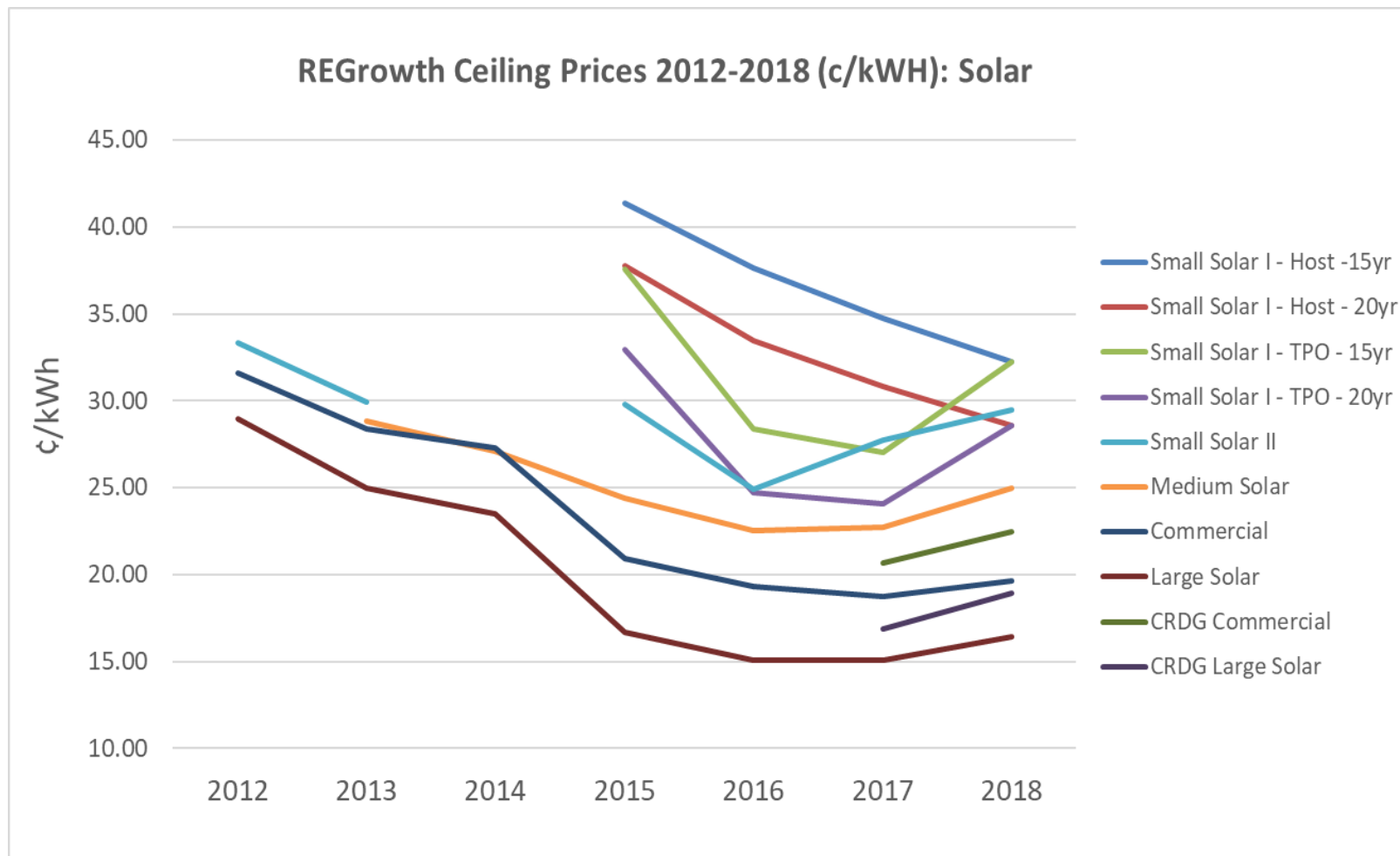
Project Name	Project Size (kW)	Bid Price (/kWh)
Middlebury Resource Recovery	1,014	\$0.205

Hydro

Project Name	Project Size (kW)	Bid Price (/kWh)
North Hartland Unit 3	500	\$0.13



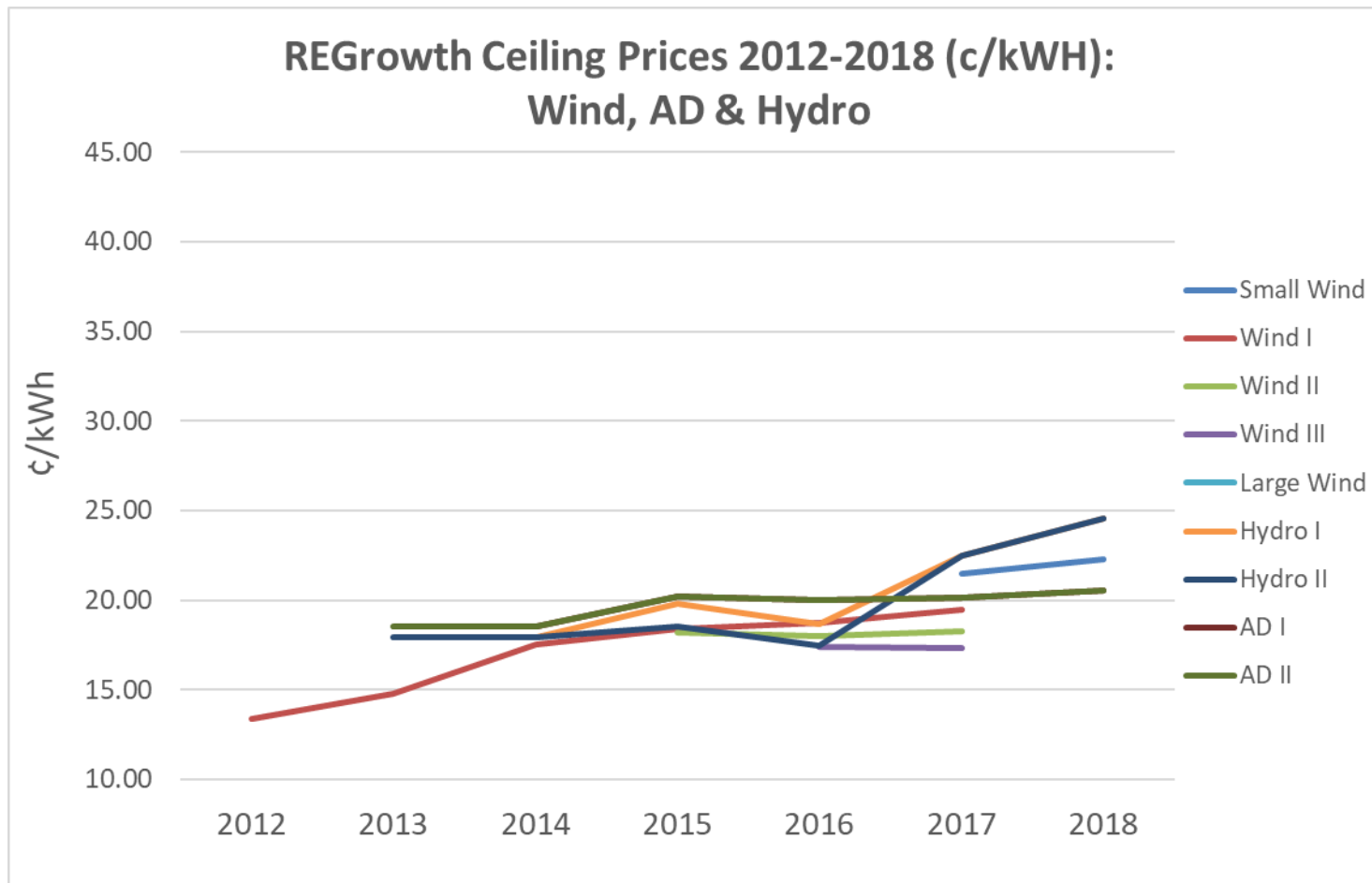
Summary of Ceiling Prices: 2012 – 2018 (Solar)



Percent Change in Ceiling Prices				
Technology Class	2015-2016	2016-2017	2017-2018	2015-2018
Small Solar I - Host - 15yr	-9%	-8%	-7%	-22%
Small Solar I - Host - 20yr	-11%	-8%	-7%	-24%
Small Solar I - TPO - 15yr	-25%	-5%	NA	NA
Small Solar I - TPO - 20yr	-25%	-3%	NA	NA
Small Solar II	-16%	11%	6%	-1%
Medium Solar	-8%	1%	10%	2%
Commercial	-8%	-3%	5%	-6%
Large Solar	-10%	0%	9%	-1%
CRDG Commercial	NA	NA	9%	9%
CRDG Large Solar	NA	NA	12%	12%

Note: Graph for Demonstration Purposes only. Ceiling Price Classes have changed over time, making cross-comparison across enrollments tenuous.

Summary of Ceiling Prices: 2012 – 2018 (Non-Solar)



Percent Change in Ceiling Prices				
Technology Class	2015-2016	2016-2017	2017-2018	2015-2018
Small Wind	NA	NA	4%	4%
Wind I	2%	4%	NA	NA
Wind II	-1%	1%	NA	NA
Wind III	NA	0%	NA	NA
Large Wind	NA	NA	NA	NA
Hydro I	-6%	20%	9%	24%
Hydro II	-6%	29%	9%	32%
AD I	-1%	1%	2%	2%
AD II	-1%	1%	2%	2%

Note: Graph for Demonstration Purposes only. Ceiling Price Classes have changed over time, making cross-comparison across enrollments tenuous.

Tax Credits

- Solar:
 - All projects selected in 2019 solicitations are assumed able to qualify for a 30% ITC by commencing construction by 12/31/2019.
 - No monetization “haircut” assumed.
- Wind
 - All projects selected in 2019 solicitations are assumed to qualify for ITC in lieu of PTC
 - ITC value modeled reflects a reduction of 40% to face value.
 - No monetization “haircut” assumed.
- AD & Hydro
 - No PTC (or ITC in lieu thereof) for facilities commencing construction after 12/31/2016.

Depreciation Benefits

- MACRS depreciation creates deduction benefit by reducing taxable income.
- Where depreciation expense is $>$ operating income, the project will 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
- Bonus Depreciation:
 - Based on year of commercial operation
 - Majority of projects selected under 2019 enrollments assumed to come on-line in 2019
 - However, given stakeholder feedback, most projects are opting not to take bonus depreciation. Therefore, 5 year MACRS assumed.
 - Hydro assumed to come on-line in 2020 or later. Therefore, no bonus depreciation is applied.

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
 - (Nominal) REC revenue (\$5)

Post-Tariff Market Value of Production

Project Year	Calendar Year	Market Value of Production (incl. energy & RECs) (cents/kWh)	
		Solar	Hydroelectric
16	2034	5.87	
17	2035	6.03	
18	2036	6.33	
19	2037	6.52	
20	2038	6.78	
21	2039	7.02	6.75
22	2040	7.25	6.97
23	2041	7.47	7.18
24	2042	7.62	7.33
25	2043	7.78	7.48
26	2044	7.95	7.64
27	2045	8.12	7.80
28	2046	8.29	7.97
29	2047	8.46	8.14
30	2048	8.64	8.31





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