Rhode Island Renewable Energy Growth Program:

Research, Analysis, & Discussion in Support of First Draft 2020 Ceiling Price Recommendations

July 19, 2019

Sustainable Energy Advantage, LLC
Mondre Energy, Inc.

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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 2020 Renewable Energy Growth (REG) Program.

- To develop Ceiling Price recommendations through an iterative, public process.

Draft 2020 Ceiling Prices, Categories and Modeling Parameters

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Proposed Ceiling Price Categories

2020 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	**Modeled Size for CP Development**	**Eligible System Size Range**	**Tariff Length**
Small Solar I[1]	5 kW	≤ 10 kW	15 Years
Small Solar II	25 kW	11 to 25 kW	20 Years
Medium Solar	250 kW	26 to 250 kW	20 Years
Small Commercial Solar (NEW)	500 kW	251 to 500 kW	20 Years
Large Commercial Solar (NEW)	999 kW	501 to 999 kW	20 Years
Large Commercial Solar – Community Remote DG (CRDG)[2]	999 kW	501 to 999 kW	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
Wind[3]	3,000 kW	0 to 5 MW	20 Years
Anaerobic Digestion	750 kW	≤ 5 MW	20 Years
Hydropower	500 kW	≤ 5 MW	20 Years

1. The Ceiling Price for Small Solar I is a hybrid set of average and quartile measures for all projects 1-10 kW, and thus the specific modeled size is not relevant to the analysis.
2. The 2019 Program Year includes the Commercial Solar - CRDG category with an eligible system size range of 251-000 kW and a modeled system size of 500 kW. As proposed, the 2020 Commercial CRDG category will be the same eligible and modeled system sizes as the 2020 Large Commercial Solar Category.
3. The Large and Small Wind categories have been consolidated into a single Wind category with an eligibility range from 0-5 MW.

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

Technology	Size Range kW (Modeled Size kW)	2019 Approved CP	2020 *Proposed* CP
Small Solar I	1-10 (5)	28.45	**29.25 / (3%)[1]**
Small Solar II	11-25 (25)	27.65	**27.35 / (-1%)**
Medium Solar	26-250 (250)	23.55	**21.35 / (-14%)**
Small Commercial Solar	251-500 (500)	17.85[2]	**17.85 / (0%)**
Large Commercial Solar	501-999 (999)	17.85[2]	**16.65 / (-7%)**
Large Comm. Solar-CRDG	501-999 (999)	20.53	**19.152 / (-7%)[3]**
Large Solar	1,000-5,000 (2,000)	15.15	**13.75 / (-9%)**
Large Solar-CRDG	1,000-5,000 (2,000)	17.42	**15.81** / (-9%)[3]**

1. Proposed 2020 CP increased for Small Solar I driven by higher installed cost data as available for 2020 first draft. Proposed CPs for all other solar categories decreased despite the reduction of the ITC, driven by lower installed cost data and other inputs (see Appendix).
2. Represents 2019 Ceiling Price for Commercial Solar (a category proposed to be subdivided into Small Commercial and Large Commercial as shown above)
3. This is the maximum CRDG Ceiling Price allowed by law. The calculated 2020 values are 20.85 for Commercial CRDG and 17.05 for Large CRDG. 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 (cents/kWh)

Technology	Size Range kW (Modeled Size kW)	2019 Approved CP 20 year Tariff Duration	2020 Proposed CP 20 year Tariff Duration
Wind	0-5,000 (3,000)	19.35	**20.65[1] / (7%)**
Large Wind - CRDG	0-5,000 (3,000)	21.65	**23.05 / (6%)**
Hydroelectric	1-5,000 (500)	27.15	**27.55[2] / (1%)**
Anaerobic Digestion	1-5,000 (750)	20.55	**21.35[3] / (4%)**

1. The increase in 2019-2020 ceiling price for Large Wind is a factor of the expiration of the Production Tax Credit in 2020 and resulting changes to depreciation schedules and financing assumptions.
2. The small change represents a mixture of updated (and higher) post-contract revenue estimates for the final 10 operating years of a hydro project, which reduce the needed tariff revenue, and increases in assumed interest on term debt.
3. The small change is a result of increases in assumed interest on term debt.

Modeling Inputs for Initial Proposed Prices

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Summary: Cost & Production Assumptions (Solar)

	Small I	Small II	Medium	Small Comm'l	Large Comm'l	Lg. Comm'l CRDG	Large	Large CRDG
Nameplate Capacity (kW)	5	25	250	500	999	500	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)	$3,336 [$3,185]	$2,962 [$3,027]	$2,333 [$2,678]	$1,944 [$2,087]	$1,930 [$2,087]	$1,899* [$2,237*]	$1,571 [$1,876]	$1,721* [$2,026*]
Fixed O&M ($/kW-yr)	$35	$35	$14 [$35]	$14 [$15]	$12	$37 [$40]	$12	$37 [$40]
O&M Inflation	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Insurance (% of Cost)	0.0%	0.0%	0.27%	0.27%	0.45%	0.45%	0.45%	0.45%
Project Management ($/yr)	$0	$0	$750	$750	$3,000	$3,000	$12,000	$12,000
Site Lease ($/yr)	$0	$0	$10,000 [$6,250]	$20,000 [$12,500]	$20,000 [$12,500]	$20,000 [$12,500]	$50,000	$50,000

Values in [Brackets] represent 2019 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).

Summary: Financing Assumptions (Solar)

	Small I	Small II	Medium	Small Comm'l	Large Comm'l	Lg. Comm'l CRDG	Large	Large CRDG
Federal Investment Tax Credit (%)	26% [30%]	26% [30%]	26% [30%]	26% [30%]	26% [30%]	26% [30%]	26% [30%]	26% [30%]
% Debt	0%	0%	55% [50%]	60% [55%]	60% [55%]	60% [55%]	60% [55%]	65% [55%]
Debt Term (years)	N/A	N/A	15	15	15	15	15	15
Interest Rate on Term Debt	N/A	N/A	7.50% [7.00%]	7.00% [6.50%]	7.00% [6.50%]	7.00% [6.50%]	7.00% [6.50%]	7.00% [6.50%]
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	5.3% [5.0%]	9.7% [5.0%]	9.5% [9.4%]	9.5% [9.4%]	9.5% [9.4%]	9.5% [9.4%]	9.5% [9.4%]	9.5% [9.4%]

Values in [Brackets] represent 2019 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	$10,431 [$8,750]	$10,502
Fixed O&M ($/kW-yr)	$30.00	$26.50	$51.50	$2.00	$600
O&M Inflation	2.0%	2.0%	2.0%	2.0%	2.0%
Insurance (% of Cost)	0.25%	0.20%	0.20%	2.0%	1.0%
Project Management ($/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. *Note: Includes $150 per kW for interconnection costs*

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

	Small Wind	Large Wind	Large Wind - CRDG	Hydroelectric	Anaerobic Digestion
% Debt	50% [45%]	70% [65%]	70% [65%]	70%	60%
Debt Term (years)	15	15	15	20	15
Interest Rate on Term Debt	7.0% [6.0%]	7.0% [6.0%]	7.0% [6.0%]	7.5% [6.5%]	7.5% [6.5%]
Lender's Fee (% of total borrowing)	2.0%	1.0%	1.0%	1.88%	1.5%
Target After-Tax Equity IRR	10% [9.4%]	10% [9.4%]	10% [9.4%]	10% [9.4%]	10% [9.4%]

Overview of Key Stakeholder Feedback and Modeling Implications

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Summary of Data/Survey Response

Ceiling Price Category	# of Data Points Received (Data Request or Survey)
Solar	28
Non-Solar	3
TOTAL	**31**

Installed & Interconnection Cost Assumptions & Methodology

- Changes In Data Availability
  - NJ solar costs associated with SREC Registration Program (open mainly to distributed-scale projects) made public for the first time (but may not be generally available in the future)
  - EnergySage able to provide average pricing data from quotes accepted from (not just quotes provided to) MA, CT, NY and RI customers
  - However…
    - MA DOER has not yet been able to provide cost data associated with SMART-qualified projects from 2018 or 2019
    - CT Residential Solar Investment (RSIP) dataset for <=25 kW projects has not been updated in 2019
  - **Modeling Implication (M.I.): No MA (or CT RSIP systems from 2019) are accounted for in current prices, but goal is to incorporate whatever data we may receive from both states in later rounds. NJ costs included as shown/described in Appendix**

Installed & Interconnection Cost Assumptions & Methodology

- Stakeholder Feedback
  - Many indicated state cost databases and EnergySage were accurate
  - However, others suggested data from public sources can sometimes represent construction-only costs (and may not include developer fees, interconnection or other upcharges borne by developers or their customers)
    - **M.I.: All REG bids or qualification requests in Program Year 2019 and thereafter now explicitly required to include interconnection and all appropriate development costs. We (the consulting team) acknowledge that the difficulty in determining what data (e.g. construction-only or all-in costs) are being reported by industry in other states, but we intend to continue to rely on state cost datasets**

Installed Cost Assumptions & Methodology (Cont'd)

- Assumption of Year-on-Year Cost Declines
  - **Stakeholder feedback:** Assuming added cost declines (as requested by consultants to the Division of Public Utilities and Carriers, to account for year-ahead nature of Ceiling Price analysis) is inappropriate, given impacts of Trump administration tariffs and associated uncertainty
  - **Consulting Team Response:** In general, estimated total development cost values (inclusive of interconnection & development fees) from 1st Open Enrollment bids and state databases align with installed cost inputs from 2019 CP process, suggesting cost decline factors are warranted to capture appropriate cost reduction
  - **M.I.: No current change in approach, but consulting team is utilizing an across-the-board 4% reduction factor from 2019 to 2020 based on SEA custom forecast until NREL ATB 2019 (or similar) issued (expected in July 2019)**

Installed Cost Assumptions & Methodology (Cont'd)

- Treatment of Large Solar
  - **Stakeholder feedback:** Given significant solar siting challenges emerging statewide, going-forward expectation is most Large Solar projects functionally will need to be sited on landfills, brownfields, or other disturbed areas (which have higher upfront permitting and other soft costs)
  - **M.I.: No current change in Large Solar cost estimation, but consulting team plans to solicit additional data regarding added costs of siting ground mounted projects on disturbed parcels**

Increases in Interconnection (IC) Cost

- Changes from CY 2018-2019 YTD
  - Large increases in average IC costs for Commercial and Large Solar
  - Total IC costs for Medium and Small fall slightly, staying mostly stable
- Treatment of Interconnection Costs
  - Federal Investment Tax Credit (ITC) for solar excludes interconnection equipment & upgrades from ITC eligibility
  - However, state cost databases and 1st Open Enrollment data assumed to include IC costs
  - **M.I.: No change to assumed installed costs (since IC is either explicitly or assumed included), but higher 2019 RI Median interconnection costs assumed deducted from basis for 26% ITC**

RI Median IC Cost per kW_{DC}	2018	2019 YTD
Large Solar (1-5 MW)	$3.11	**$155.13**
Large Commercial Solar (500 kW - 1 MW)	$129.90	**$202.84**
Small Commercial Solar (251-500 kW)	$ -	**$22.10[1]**
Medium Solar (25-250 kW)	$8.10	**$22.10**

[1]Assumed same as Medium Solar as proxy

New (and Revised) Categories

- Elimination of 20-year option for Small Solar I
  - **Previous approach:** offer 15- and 20-year terms for Small Solar I and II
  - **Stakeholder Feedback:** few customers select 20-year option
  - **M.I.: 15-year option maintained, but 20-year option eliminated**
- Splitting Small and Large Commercial Solar
  - OER/DG Board proposing to split the Commercial (251-999 kW) category into individual Small Commercial (251-500 kW) and Large Commercial (501-999 kW) categories
  - **Stakeholder Feedback on Pricing:** Significant differences in the economics and scale characteristics of each category, for both capital (CAPEX) and operating (OPEX) expenses; recommend setting OPEX at prices for 26-250 kW (arguing scale gains do not manifest for OPEX until >500 kW)
  - **M.I.: OPEX for Small Commercial (and Interconnection CAPEX for adjustment to ITC basis) set at 26-250 kW values, except for Site/Land Lease; CAPEX calculated separately from one another**

New (and Revised) Categories

- Consolidation of Wind categories
  - No bids for Small Wind received in past two years of bidding
  - **M.I.: No proposed Small Wind Ceiling price, but capacity can bid into consolidated Wind category up to Ceiling Price (with eligibility limit up to 5 MW)**
- Solar Carports
  - OER/DG Board Goals for Carport adder:
    - Facilitate project development on sites (in this case, parking lots) that avoid disturbance/disruption of natural resources and ecosystems
    - Mitigate costs of REG-enabled Solar projects to National Grid ratepayers
  - **M.I.: None (no current proposal, but OER/DG Board will roll out a proposed definition of a Carport Solar project in the coming days, and SEA will propose a Carport "adder“ as part of 2nd Draft of Ceiling Prices) for Medium and Commercial Solar categories/subcategories**

Changes to OPEX Assumptions

- **Fixed O&M:** Wood Mackenzie analysis in kWh Analytics' 2019 Solar Risk Assessment report suggested O&M contract costs are falling rapidly
  - **M.I.: Values revised slightly downward for all non-Small I & II solar projects**
- **Project Management:** Some stakeholders suggested PM costs too low – however, no documentary evidence was supplied to this effect
  - **M.I.: No change until documentary evidence supplied (given esoteric nature of data)**
- **Land/Site Lease:** Stakeholders suggested (both in 2019 CP process and initial 2020 Data Request and Survey) that Land/Site Lease costs are too low
  - 2019 CP land/site lease costs were left unchanged due to lack of documented higher costs than assumed.
  - However, RI-based stakeholder furnished four confidential lease documents to the consulting team
  - **M.I.: Increases implemented for Medium and Small/Large Commercial Solar based on feedback (shown in table below), while other Solar categories left unchanged**

Project Type	Medium Solar (26-250 kW_{DC}) [1]	Small Commercial Solar (251-500 kW_{DC})	Large Commercial Solar (501-999 kW_{DC}) [1]
Proposed Lease Cost $/kW	$40	$40[2]	$20
Modeled Size (kW_{DC})	250	500	999
Assumed New Lease Payment ($/yr)	$10,000	$20,000	$19,980
Rounded Assumed 2020 CP Assumed Lease Payment Input ($/yr)	**$10,000**	**$20,000**	**$20,000**
2019 CP Analysis Assumed Lease Payment Input ($/yr)	*$6,250*	*$12,500*	*$12,500*

[1]Based on confidential RI leases shared by stakeholder[1]

[2]Assumed same as Medium per OPEX decision to unify assumptions for Medium and Small Commercial

Federal Tax Incentives

- 2020 Investment Tax Credit (ITC) Phase-Down for Solar Projects
  - On 1/1/2020, first ITC phase-down from 30% to 26% slated to take place under current law
  - All projects “beginning construction” (spending 5% of project cost or engaging in on-site physical work, both as defined by the IRS) can “safe harbor” tax credit at given year’s value
  - **M.I.: No safe harbor at 2019 ITC value of 30% baked into CPs, in part given not all market participants possess scale, competitive advantage or resources to do so**

Federal Tax Incentives (Cont'd)

- 2020 Expiration of ITC in Lieu of PTC (and Opening for 100% Bonus Depreciation)
  - Federal Production Tax Credit expires 1/1/2020
  - As a result, the ability to take the ITC in lieu of the PTC (ILoPTC) also expires that day (goes from 12% in 2019 to 0% in 2020)
  - **Consulting Team Assumption #1 (in lieu of Wind stakeholder feedback):** Wind developers likely to attempt to entice sponsor equity to take 100% bonus depreciation allowed under Tax Cuts and Jobs Act of 2017, since expiration of ILoPTC takes tax equity - which (solar developers suggest) lack the capacity to take 100% bonus in most cases – out of the picture
  - **Consulting Team Assumption #2 (in lieu of Wind stakeholder feedback):** Construction/pre-operational periods remain too long for Hydro or AD to take any bonus depreciation
  - **M.I.: Small and Large Wind Assumed to take 100% bonus to offset loss of ILoPTC**

Federal Tax Incentive Ramifications for Financing Assumptions

- **Debt/Equity Shares in Capital Stack:**
  - Given long-term nature of REG tariff compensation, projects assumed to (and stakeholders largely confirmed that they would) take on more project debt in capital stack to mitigate cost increase due to less available tax benefits for tax equity.
  - **M.I.: Assumed debt shares for all solar projects increased 5%, and will increase additional 5% when ITC fully phases down to 10% for business taxpayers**
- **Impact on Sponsor & Tax Equity Markets:**
  - In general, project financiers and developers nationally have recently indicated that tax equity has been competing for more deals ahead of phase-down to 10% in 2022, offering more favorable terms.
  - **M.I.: Assumed tax equity after-tax IRR assumed to decline 25 basis points to reflect high supply of tax equity capital ahead of phase-downs**

Federal Tax Incentive Ramifications for Financing Assumptions (Cont'd)

- **100% Bonus Depreciation for Solar:**
  - **Solar stakeholder feedback:** More customers (particularly host customers) can take advantage of 100% bonus depreciation in Tax Cuts and Jobs Act of 2017
  - However, most indicate it is still generally less attractive for most sources of sponsor and tax equity capital to utilize.
  - **M.I: No change for Solar/Hydro/AD, but (as described previously) adopted for Large and Small Wind given ITC in Lieu of PTC phase-out**
- **ITC "Safe Harbor" & Impact on 3rd Open Enrollment:**
  - OER/DG Board proposes to recommend selection of all Solar projects in the earlier Open Enrollments (avoiding, if possible, the 3rd Open Enrollment).
  - **M.I.: No change from 2019 approach**

Changes to Financing Assumptions for >25 kW Projects

- Interest on Term Debt (%)
  - **Stakeholder Feedback:** 6.5% (assumed for projects over 250 kW) too low, use 8% instead
  - **Consulting Team Response:** Federal Funds Rate and WSJ Prime Rate rose 49 and 50 basis points in past 12 months
  - **M.I.: Increase interest assumption 50 basis points for all >25 kW projects (Solar and Non-solar alike)**
- After-Tax Sponsor Equity Returns (IRRs)
  - **Stakeholder Feedback:** Overall equity returns for distributed solar projects closer to 12%-13%; several suggested assuming 10% sponsor AT IRR on a levered basis is unrealistic
  - **Consulting Team Response:** Market participants queried by Norton Rose Fulbright suggest range of 6%-10% weighted average cost of capital (WACC) is broadly typical for distributed solar projects.
  - **M.I.: Increase assumed after-tax sponsor equity IRRs from 10% to 11% for solar.**
    - **Given this change (plus the increase in debt and 25 basis point drop in after-tax tax equity IRRs) target WACCs for >25 kW Solar range from 6.85%-7.27% - within the range laid out by market participants discussed above, and consistent with a lower revenue risk tariff program like REG (relative to an SREC or other program offering less "hedged" compensation)**

Small Solar I and II Financing Assumptions

- **Consulting Team Historical Approach:** Assumed a very broad diversity in financial and/or environmental goals underlying host-owned solar purchases (a condition no longer driving a more mature market)
  - **Historical M.I.: Discount rate of 5% for Small Solar I (which was adjusted upward to account for increases in the cost of debt), and assumption of fully "project financed" Small Solar II for small commercial**
- **Stakeholder Feedback:**
  - Several sources made clear that current "typical" host-owned customer not only is looking strictly at financial return, but is financing every system with some form of debt (either a home equity or specialty "solar" loan), and is paying a substantial dealer fee (ranging from 5%-20% of the loan volume, baked into the debt repayment terms)
- **Consulting Team Response:** We concur that historical 5% discount rate approach (along with fully "project financed" Small Solar II) is unrealistic given current (and more mature) market conditions, and plan to survey the Small Solar I and II market to determine a more appropriate set of financing assumptions regarding 1) loan term, 2) type of loan, 3) typical interest at varying terms, and 4) other information as applicable
- **M.I.: No change for current pricing round, but issue of Small Solar I and II financing terms (and a shift to debt/and loans as default assumption) will be revisited during current Ceiling Price development process.**

Non-Solar Stakeholder Feedback

- Hydro
  - “Fixed O&M…running closer to $25 per kW per year (and this just provides for mechanical maintenance. Manpower for trash clearing, oil changes, site maintenance for a typical site is around $32,000 per year”
  - “Cost of revenue…all in in around 20%”
  - “Insurance (r)ates have been going up and we use $1.75 per $100 of project cost per year.”
  - “(With project management at $3000) we lose three times that. A reasonable PM rate would be $12,000 per year
  - “Lease rates...are coming in around $30,000 per acre per year...influenced by what owners have been getting for cell towers."
- Wind & Anaerobic Digestion
  - N/A (No response received)

Further Stakeholder Input Sought

- Large Solar – assume disturbed sites as default assumption?
- Small Solar I
  - What is the market share of customers financing a purchase with 1) home equity loans/lines of credit, 2) specially-designed solar loans, and 3) cash?
  - What are the typical tenors for home equity loans? Solar loans?
  - What are the typical interest rates for home equity loans? Solar loans?
  - What are typical dealer fees for home equity loans? Solar loans?
- Small Solar II
  - Additional questions regarding financing likely
- More (of any) Non-Solar feedback – particularly Wind and AD
- Provide documentary evidence on project management costs

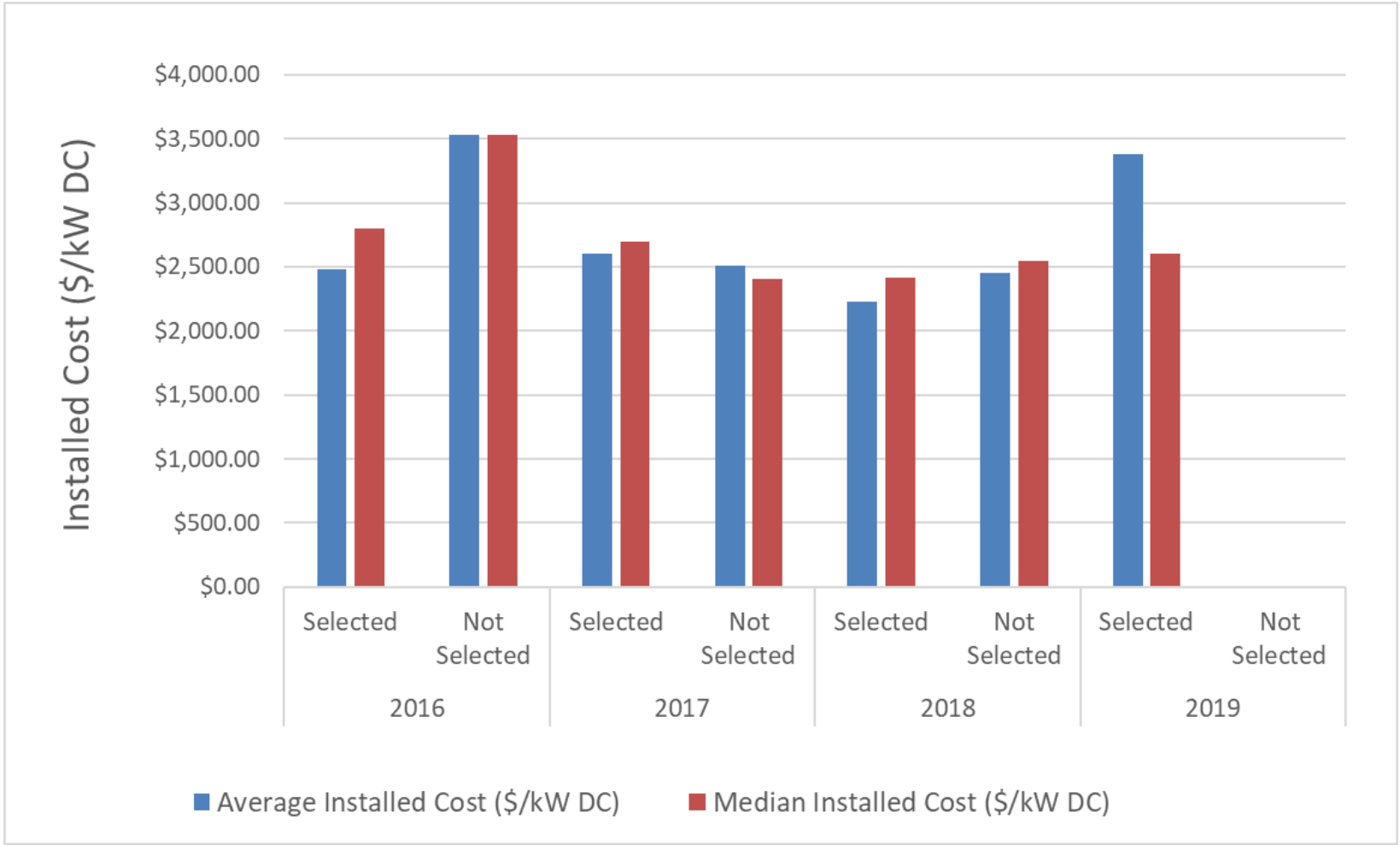
Appendix: Bid Data, Regional Benchmarking, and Additional Assumptions

Sustainable Energy Advantage, LLC

Overview of Research to Inform CP Inputs

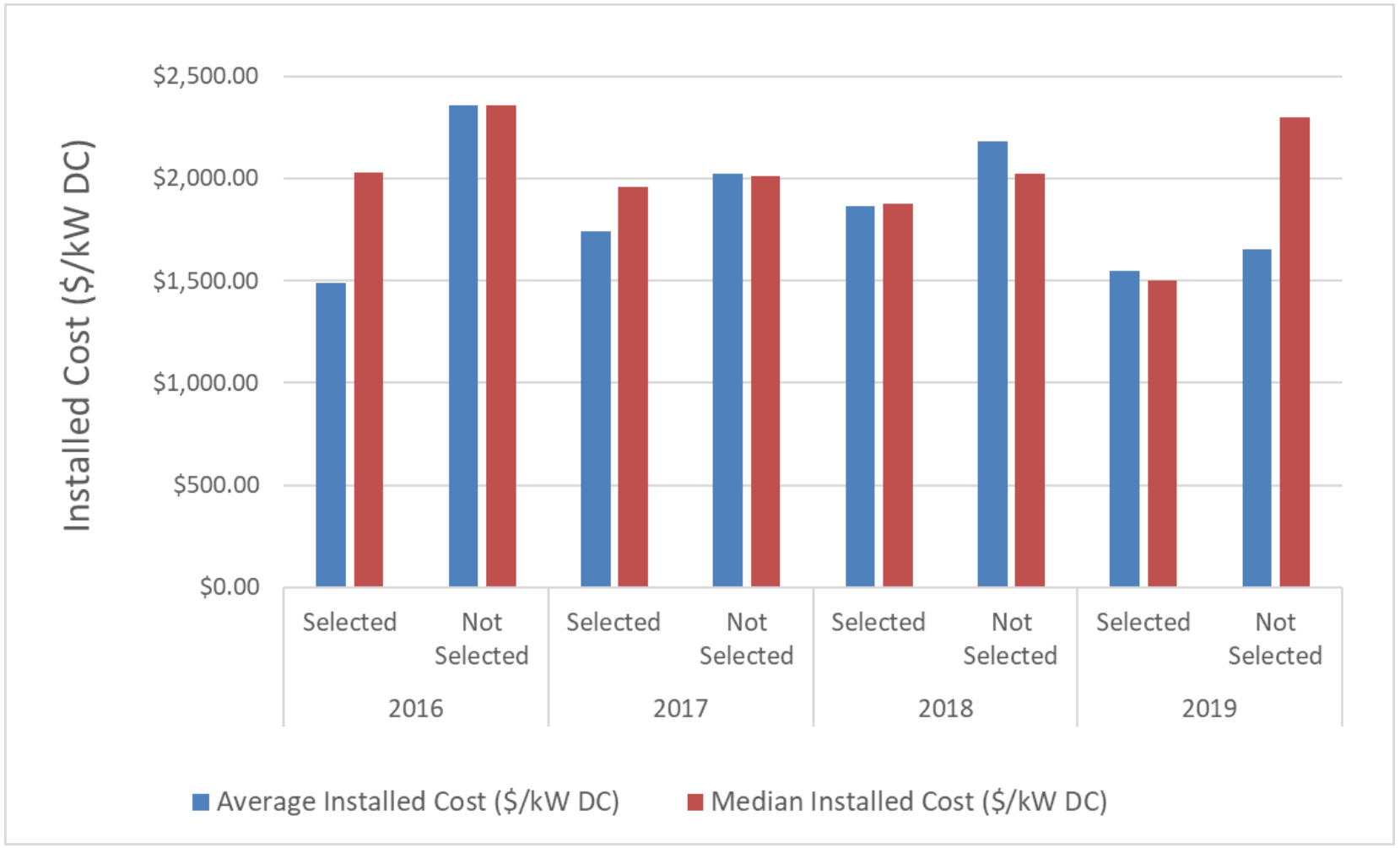
- Direct stakeholder input
  - Through *Data Request and Survey*
- Supplemental research
  - Interviews
  - Program data (bids, executed contracts)
  - Additional data from National Grid (Actual interconnection costs)
  - Northeast regional cost databases
  - Revealed pricing data for <=25 kW system 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 (2015-2018 Open Enrollments and 1st Open Enrollment of 2019)

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

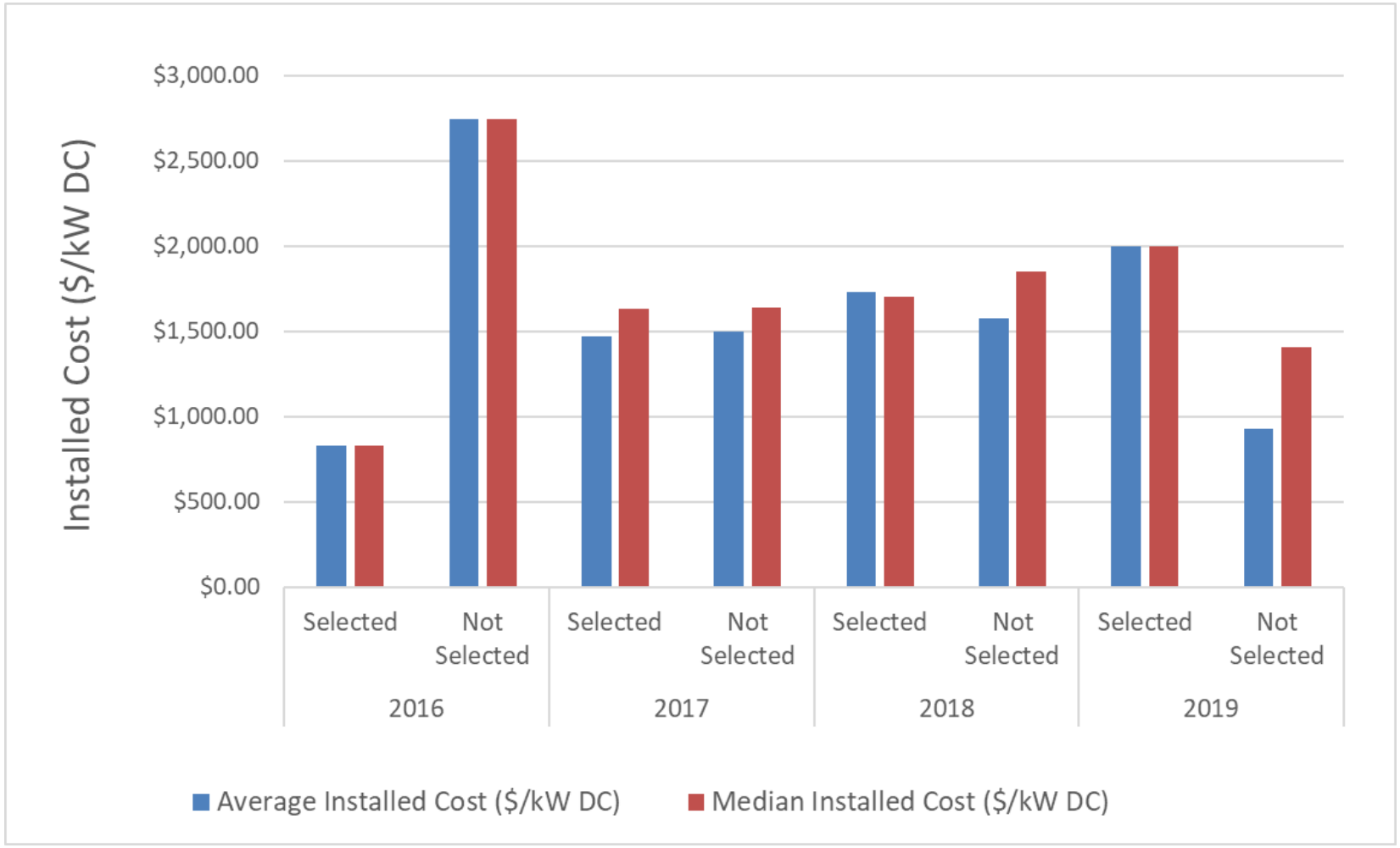


Note: Only 1 project was not selected under the 2016 tariff

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

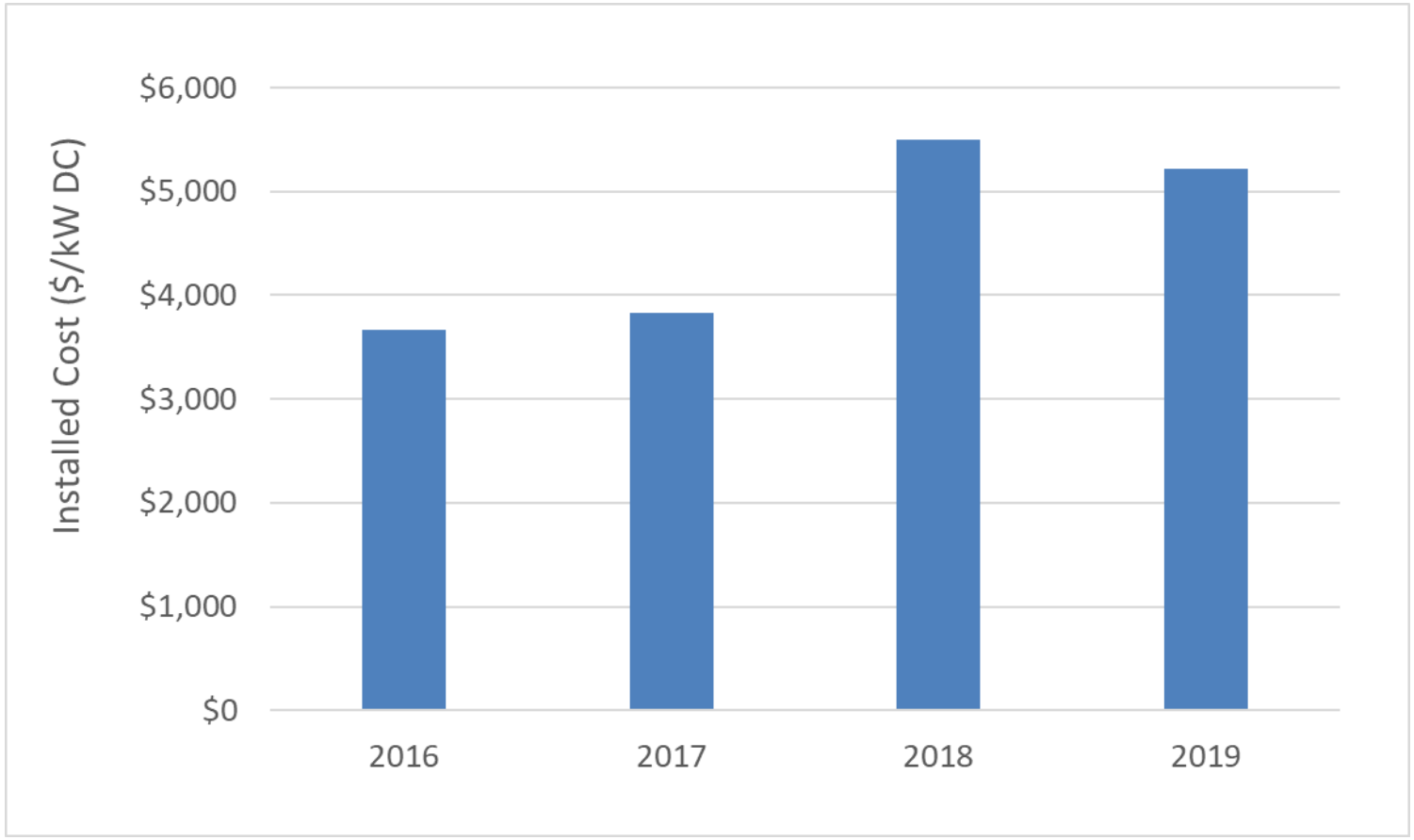


REG Bid Data – Average & Median Installed Cost for Large Solar Bids Under Different Tariff Years



Note: Only one cost data point was available for projects selected under the 2016 tariff. Two projects under the 2019 tariff are excluded from analysis due to implausibly high costs ($66 million +), which suggest data entry errors.

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



Note: Only 2 projects were bid in years 2016-2018 (all were accepted).
Only one project bid in 2019.

Small Solar I, Installed Costs

Small Solar I (1-10 kW) Installed Costs				
	2018-2019			
Dataset	Average ($/kW)	Median	25th Percentile ($/kW)	75th Percentile ($/kW)
NY - NYSERDA Solar Electric Programs	$4,131	$4,000	$3,421	$4,569
CT - via LBNL TTS, 2018 only	$3,632	$3,627	$3,264	$4,110
Energy Sage				
NY - Accepted quotes	$3,139	Unavailable	Unavailable	Unavailable
MA - Accepted quotes	$3,217	Unavailable	Unavailable	Unavailable
CT - Accepted quotes	$3,194	Unavailable	Unavailable	Unavailable
RI - Accepted quotes	$3,381	Unavailable	Unavailable	Unavailable
RI - All data	$3,447	$3,388	$3,260	$3,592

Datasets: NY (NYSERDA Solar Programs 2018-2019 data), CT (Residential Solar Investment Program via LBNL's Tracking the Sun 2018 data – direct RSIP data unavailable for 2019), Energy Sage revealed pricing data for past four quarters (Q2 2018-Q1 2019). MA SMART data will be incorporated for 2nd round.

Small Solar II, Installed Costs

Small Solar II (11-25 kW) Installed Costs				
	2018-2019			
Dataset	Average ($/kW)	Median	25th Percentile ($/kW)	75th Percentile ($/kW)
NY - NYSERDA Solar Electric Programs	$3,321	$3,250	$2,738	$3,854
CT - via LBNL TTS, 2018 only	$3,268	$3,314	$3,050	$3,600
Energy Sage				
NY - Accepted quotes	$2,966	Unavailable	Unavailable	Unavailable
MA - Accepted quotes	$3,099	Unavailable	Unavailable	Unavailable
CT - Accepted quotes	$3,176	Unavailable	Unavailable	Unavailable
RI - Accepted quotes	$3,149	Unavailable	Unavailable	Unavailable
RI - All data	$3,312	$3,308	$3,154	$3,474

Datasets: NY (NYSERDA Solar Programs 2018-2019 data), CT (Residential Solar Investment Program via LBNL's Tracking the Sun 2018 data – direct RSIP data unavailable for 2019), Energy Sage revealed pricing data for past four quarters (Q2 2018-Q1 2019). MA SMART data will be incorporated for 2nd round.

Medium, Commercial, and Large Solar Installed Costs

	2018-2019			
Dataset	Average ($/kW)	Median	25th Percentile ($/kW)	75th Percentile ($/kW)
Medium Solar (26-250 kW)				
NY - NYSERDA Solar Electric Programs	$2,937	$2,623	$2,334	$3,250
NJ Summary Data		$2,377	$2,100	$3,155
RI REG Bids	$2,595	$2,363	$2,209	$4,463
Small Commercial Solar (251-500 kW)				
NY - NYSERDA Solar Electric Programs	$2,222	$2,480	$1,677	$2,480
NJ Summary Data		$2,010	$1,725	$2,613
RI REG Bids	$2,128	$2,095	$2,017	$2,323
Large Commercial Solar (501-999 kW)				
NY - NYSERDA Solar Electric Programs	$2,230	$2,204	$1,739	$2,480
NJ Summary Data*		$2,300	$1,950	$3,000
RI REG Bids	$1,933	$1,877	$1,182	$3,800
Large Solar (1000-5000 kW)				
NY - NYSERDA Solar Electric Programs	$1,614	$1,532	$1,421	$1,700
NJ Summary Data*		$1,700	$1,656	$2,040
RI REG Bids	$1,755	$1,662	$352	$1,850

*NJ Summary Data size bins used are 500-2,000 kW and 2000-5.000 kW.

Datasets: NY (NYSERDA Solar Programs), Summary statistics of installed costs from recent NJ pipeline projects; RI Renewable Energy Growth bids for 2018-2019 enrollments

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

Installed Cost Analysis of Renewable Energy Fund (REF) Systems 1-25 kW, 2019					
	Average cost ($/kW)	Median cost ($/kW)	1st Quartile	3rd Quartile	N
1-10 kW	$ 3,638.36	$ 3,700.85	$ 3,240.96	$ 4,250.00	120
10-25 kW	$ 3,390.04	$ 3,330.00	$ 2,990.00	$ 3,871.43	23

Note: Data from RI Renewable Energy Fund (CommerceRI).

Interconnection Cost Analysis

	Rhode Island 2019 Projects		
	Number of Projects with Cost Data	Median Cost ($/kW DC)	Average Cost ($/kW DC)
Solar (<25 kW)	15	$0.00	$59.53
Solar (25-250 kW)	13	$22.10	$49.37
Solar (250-500 kW)	1	$1.89	$1.89
Solar (500-1000 kW)	4	$202.84	$188.49
Solar (1000-5000 kW)	5	$155.13	$134.18
Small Wind (<=999 kW)	0	N/A	N/A
Large Wind (1000-5000 kW)	6	$291.95	$301.06

Note: Based on National Grid Data. Dataset includes additional projects that do not have cost data available.

VT Standard Offer 2019 Bid Prices: SOLAR

	Project Size (kW)	Bid Price* ($/kWh)
Salvage Yard Solar	2,100	0.1200
Center Road Solar	2,100	0.1240
Vermont Solar DG	2,200	0.0838
St. Albans Solar DG	2,200	0.0849
Post Road Solar 1	2,200	0.0861
Post Road Solar 2	2,200	0.0861
Sand Hill Solar	2,200	0.0910
Vergennes Solar DG	2,200	0.0919
ER The Narrows Solar	2,200	0.0930
Silk Road Solar	2,200	0.0939
Lemay Solar Park	2,200	0.0998

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.

VT Standard Offer 2019 Bid Prices: SOLAR (Cont.)

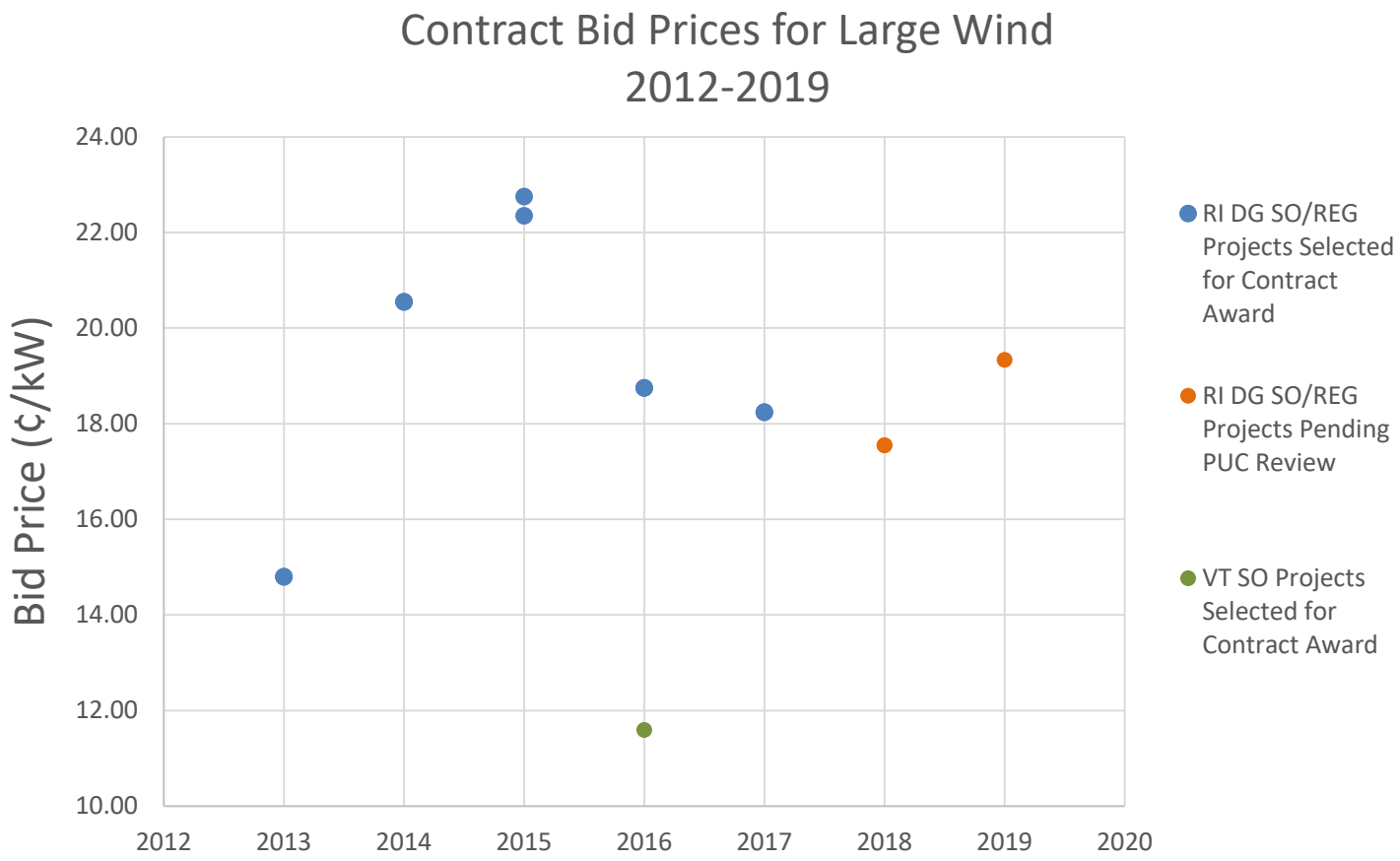
Project Name	Project Size (kW)	Bid Price* ($/kWh)
Windsor Solar	2,200	0.1079
Safford Solar	2,200	0.1182
Galusha Solar	2,200	0.1184
Cannon Green Solar	2,200	0.1186
Willard Solar	2,200	0.1187
Rose Solar	2,200	0.1188
Brown Bridge Solar	2,200	0.1191
Lemuel Solar	2,200	0.1196
St. Andrews Solar	2,200	0.1199
Sawyer Road Solar	2,200	0.9981**

Highlighted Blue= Projects awarded a contract (recommended)

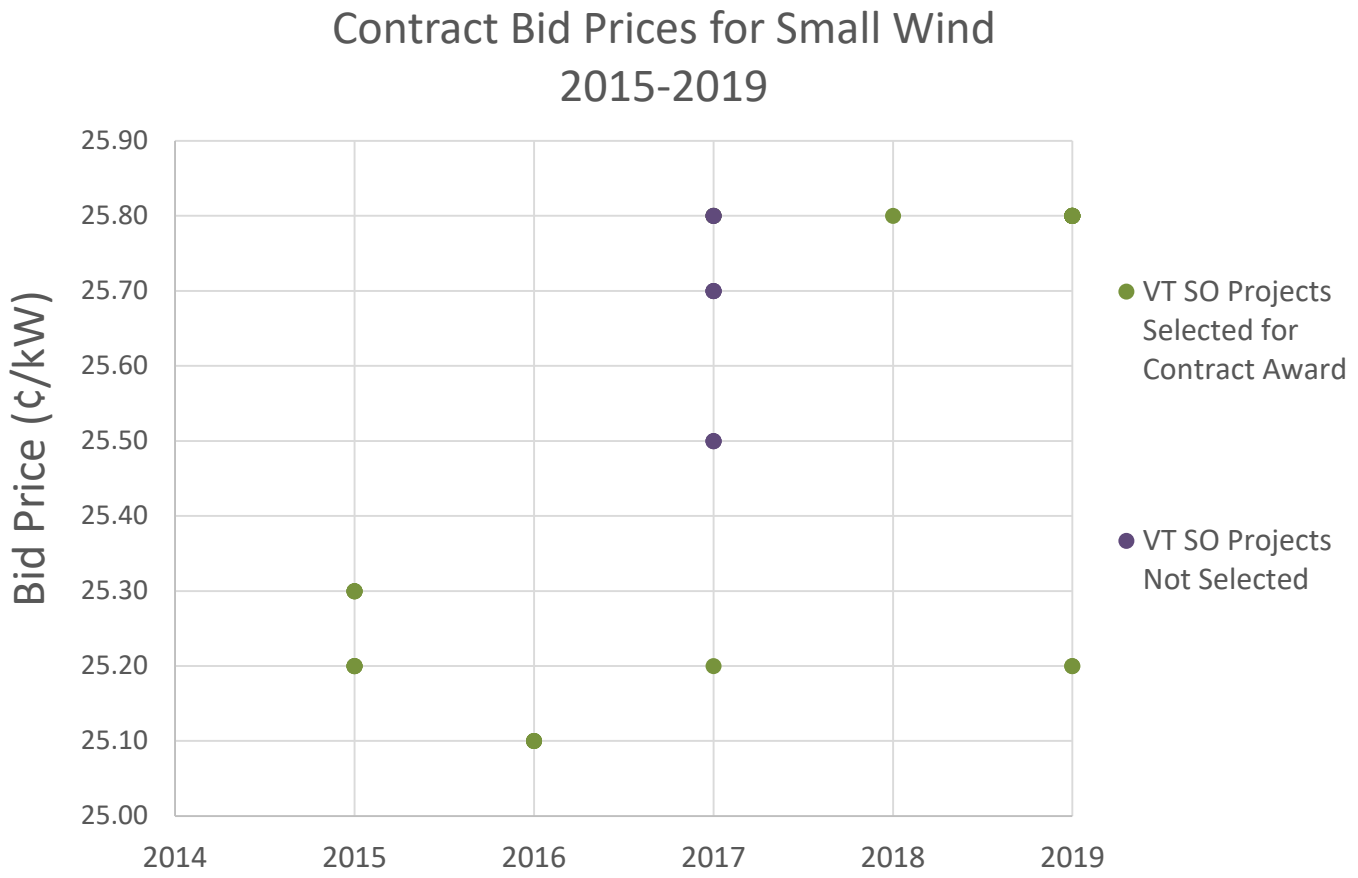
Highlighted Green = Projects selected for "Reserve Group" – these projects will be contracted if a project in the "Award Group" is withdrawn following selection (recommended)

**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

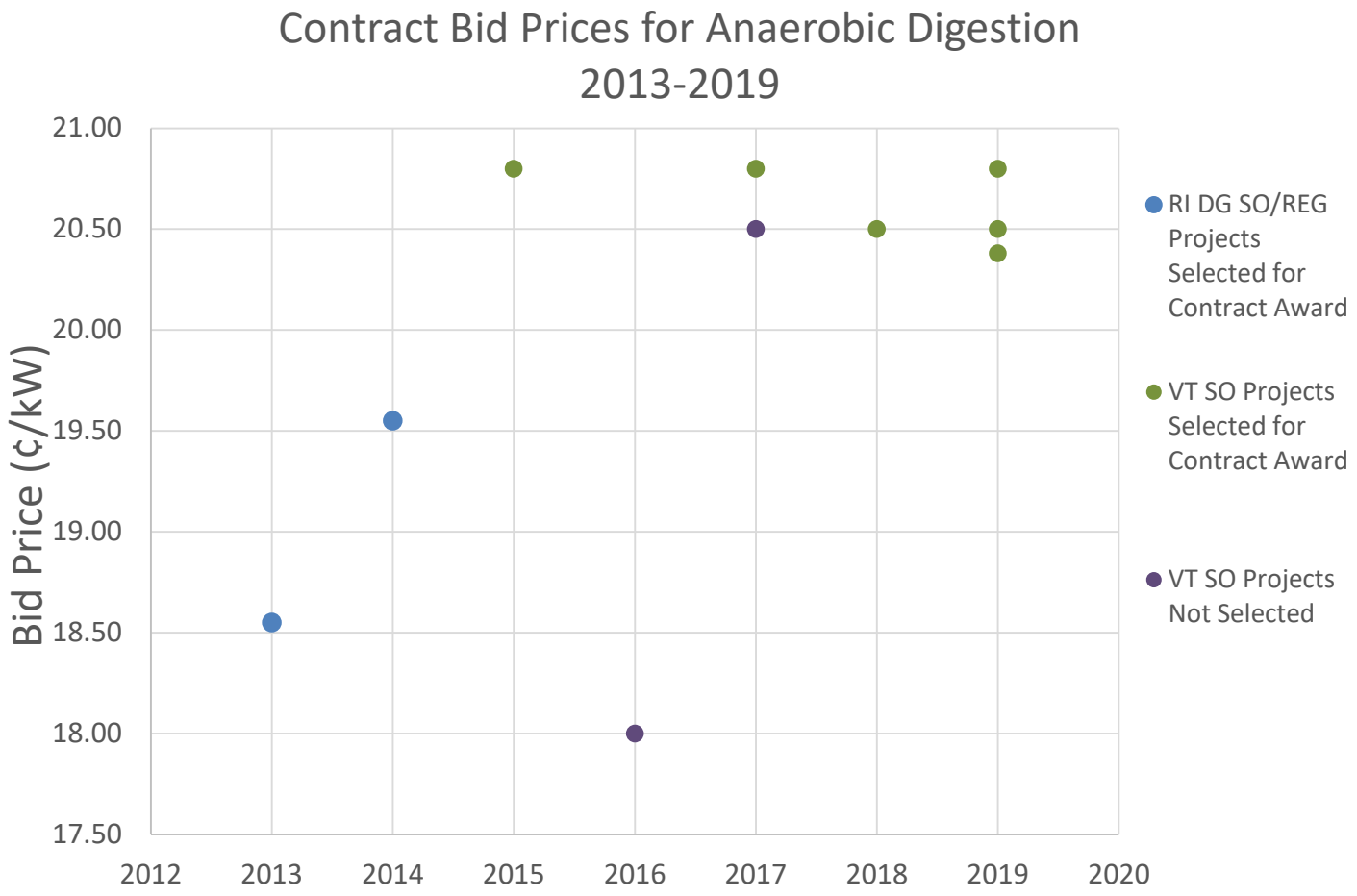


Comparison of RI DG Standard Contract/REG & VT Standard Offer Bid Price History: Small Wind



** 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 2019 Bid Prices: NON-SOLAR

Small Wind

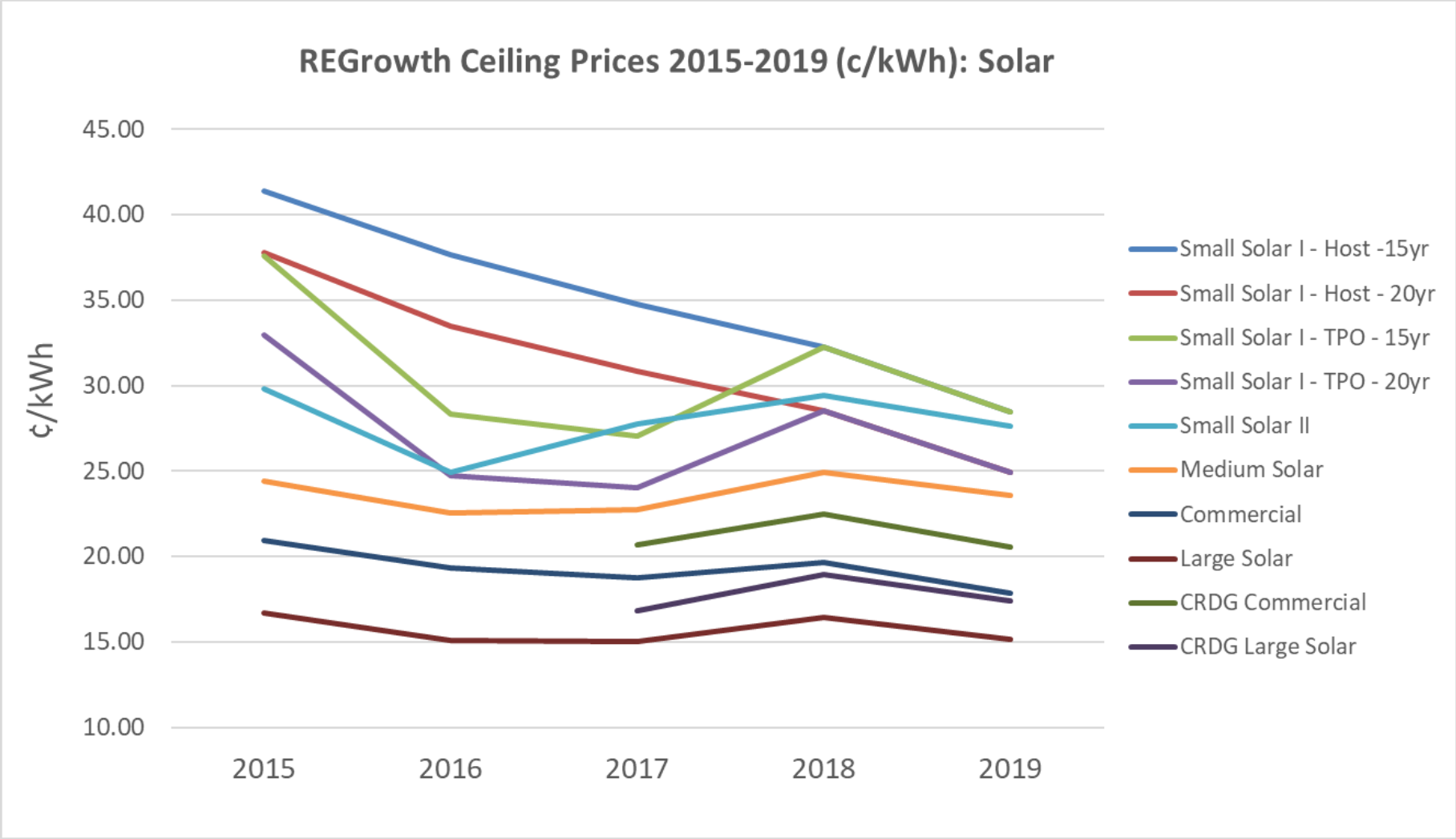
Project Name	Project Size (kW)	Bid Price ($/kWh)
Rothblatt Wind	25	0.2520
Shepard Wind	25	0.2520
Cross Wind Project A	50	0.2580
Cross Wind Project B	50	0.2580
Cross Wind Project C	50	0.2580
Cross Wind Project D	50	0.2580
Tomlinson Wind 2	50	0.2580
Howrigan Wind Farm	100	0.2580
Way Out Wind Farm	100	0.2580
Merck Forest Wind Farm	100	0.2580
Hespos Wind Farm	100	0.2580
Auger Heights Wind A	100	0.2580
Auger Heights Wind B	100	0.2580
Pennock Hill Wind	100	0.2580

Food Waste

Project Name	Project Size (kW)	Bid Price ($/kWh)
Purpose Energy-St. Albans	1,014	0.2038
Franklin Foods VT Recovery Ctr.	710	0.2050
Cabot Creamery	250	0.2080

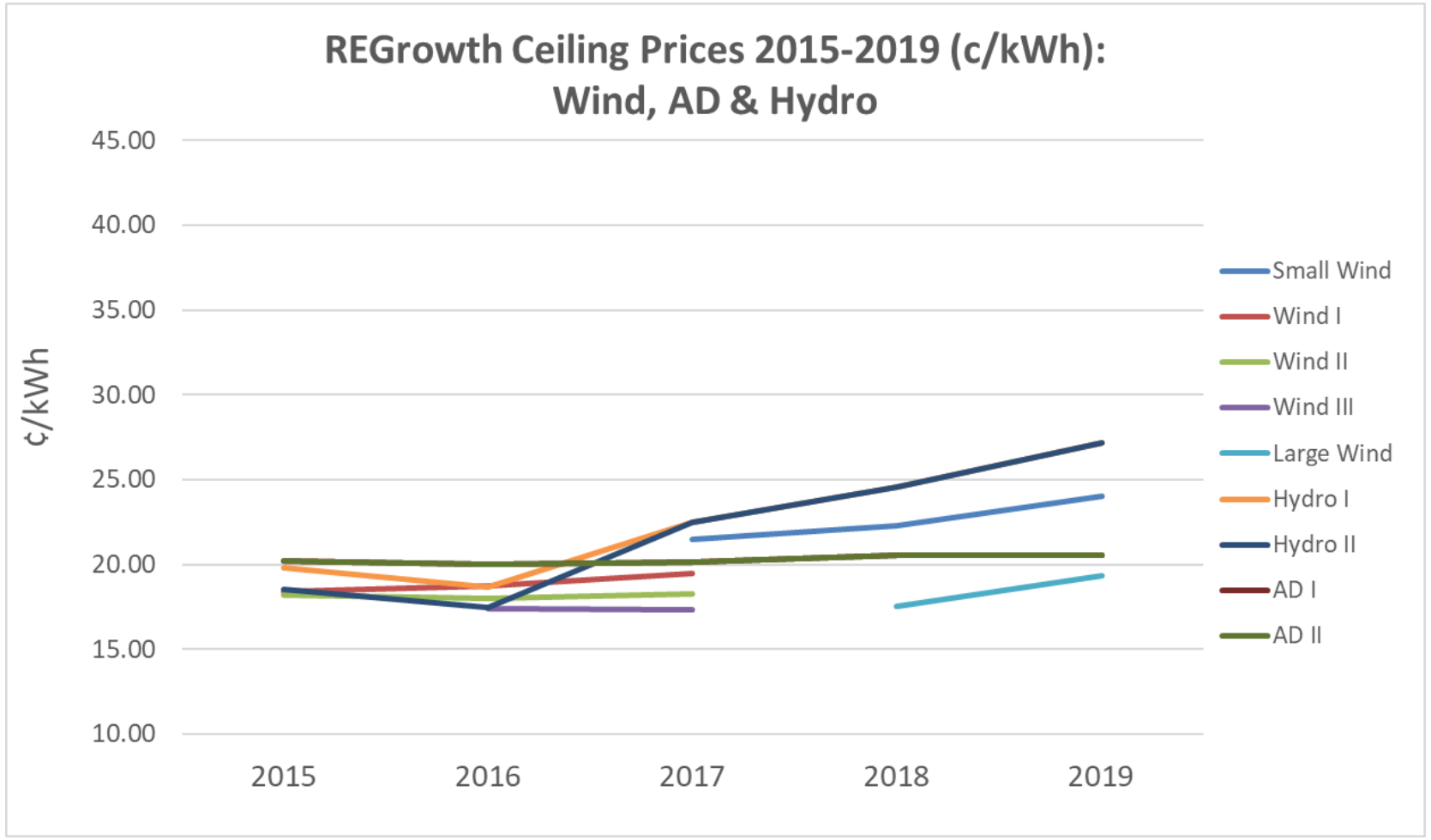
Highlighted Blue= Projects awarded a contract (recommended)

Summary of Ceiling Prices: 2015 – 2019 (Solar)



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

Summary of Ceiling Prices: 2015 – 2019 (Non-Solar)



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 2020 solicitations are assumed able to qualify for a 26% ITC by commencing construction by 12/31/2019.
  - No monetization “haircut” assumed.
- Wind
  - All projects selected in 2020 solicitations are assumed to have an ITC in lieu of PTC value of 0% (given assumed expiration of the Wind PTC)
- 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 and capacity revenue +
    - Production-weighted for solar
    - All-hours for hydro
  - (Nominal) REC revenue (assumed to be $5/MWh)

Post-Tariff Market Value of Production (2020 CPs)

Project Year	Calendar Year	Market Value of Production (incl. energy, capacity & RECs) (cents/kWh)	
		Solar	Hydroelectric
16	2035	5.46	7.36
17	2036	5.65	7.61
18	2037	5.84	7.87
19	2038	5.98	8.15
20	2039	6.16	8.44
21	2040	6.38	8.75
22	2041	6.61	9.07
23	2042	6.86	9.41
24	2043	7.11	9.76
25	2044	7.37	10.12
26	2045	7.65	10.49
27	2046	7.93	10.88
28	2047	8.22	11.28
29	2048	8.53	11.70
30	2049	8.84	12.13

Post-Tariff Market Value of Production (2019 CPs)

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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