CADMUS

Memorandum

To: New Jersey Board of Public Utilities

From: Chad Laurent, Edward Galvin, and Jeremy Eckstein; Cadmus

Subject: Results of Performance-Based Incentive Models

Date: February 17, 2023

In November 2022, the New Jersey Board of Public Utilities (BPU) engaged Cadmus to update specific inputs to its 2021 incentive modeling for the New Jersey Solar Transition Final Capstone Report.[1] The updated inputs reflect recent changes to the New Jersey solar photovoltaics (PV) market, including federal investment tax credits (ITC), solar PV capital costs, operation and maintenance costs, and interest rates.

On December 2, 2022, Cadmus presented its draft approach to adjusting economic inputs and modeling incentives in a stakeholder engagement session hosted by the BPU. The BPU and Cadmus reviewed comments submitted orally during the session and via written response in the weeks following.

Using these updated inputs and the National Renewable Energy Laboratory's System Advisor Model (SAM), Cadmus estimated incentive levels for 9 representative project variants with the same method that Cadmus applied for estimating incentives for the Capstone Report.

Table 1 shows the representative project variants and corresponding Administratively Determined Incentive (ADI) Program market segments, for which Cadmus updated economic inputs and modeled incentives.

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[1] Cadmus. January 7, 2021. *New Jersey Solar Transition Final Capstone Report.* Prepared for New Jersey Board of Public Utilities. https://www.nj.gov/bpu/pdf/boardorders/2021/20210107/8B%20-%20Capstone%20Report.pdf

Table 1. Project Variants by System Size

Project Variant	System Size MW (dc)	Modeled System Size (kW-DC)	Administratively Determined Incentive (ADI) Program Market Segment
Residential Roof – Direct-Owned	All Sizes	8	Net-metered residential
Residential Roof – Third-Party–Owned		8	
Commercial Roof – Direct-Owned - Medium	< 1 MW	350	Small net-metered nonresidential located on rooftop, carport, canopy and floating solar
Commercial Roof – Third-Party–Owned – Medium		250	
Commercial Ground – Direct-Owned – Medium		500	Small net-metered nonresidential ground mount
Commercial Roof – Direct-Owned - Large	1 MW – 5 MW	2,000	Large net-metered nonresidential located on rooftop, carport, canopy and floating solar
Commercial Roof – Third-Party–Owned - Large		2,000	
Commercial Ground – Direct-Owned - Large		3,500	Large net-metered nonresidential ground mount
Commercial Ground – Third-Party–Owned - Large		3,500	

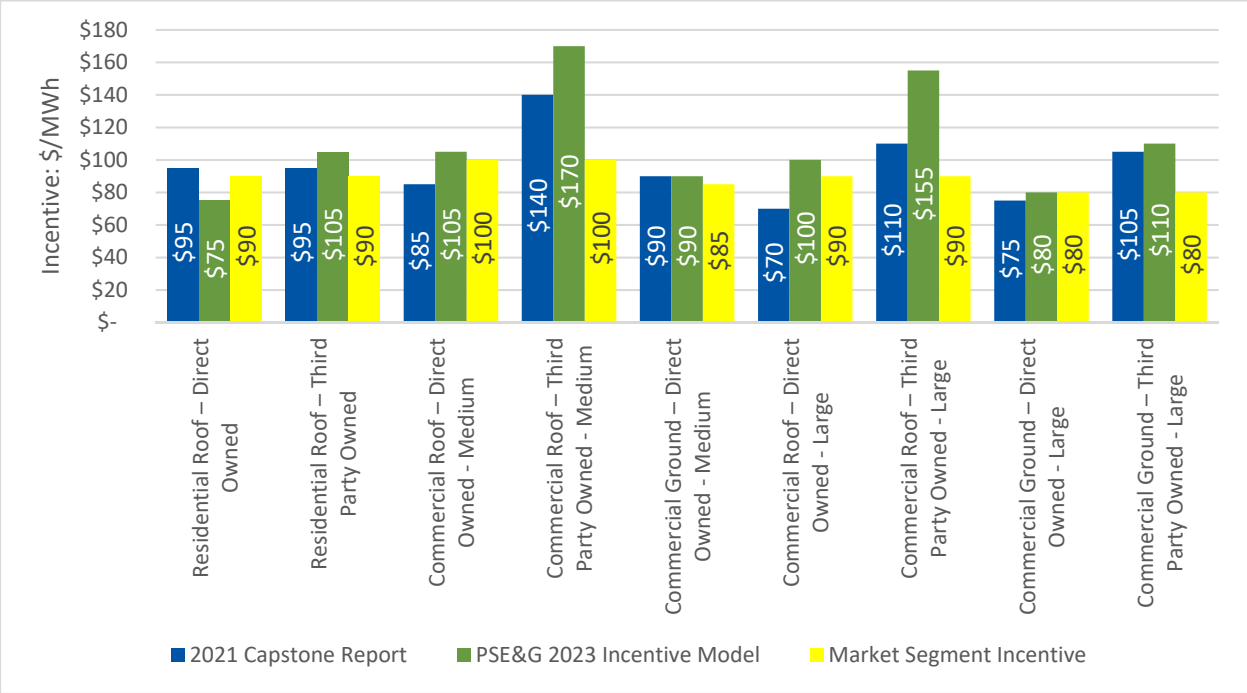
Results

Cadmus estimated the performance-based incentive needed for each representative project variant to reach an internal rate of return (IRR) target of 12.5% for commercial direct-owned projects and 9.7% for commercial third-party–owned projects. Using SAM, Cadmus modeled these incentives on a dollar per megawatt-hour ($/MWh) of electricity produced by PV systems. The incentive terms for all project variants were assumed to be 15 years in line with the current ADI program.

Cadmus modeled incentives consistent with the 2021 Capstone Report for the Public Service Electric and Gas (PSE&G) utility territory so that results are comparable to the 2021 Capstone Report.

Figure 1. Comparison of Incentives ($/MWh) provides a comparison of the resulting incentives modeled by project variant in the 2021 Capstone Report and this 2023 update along with the corresponding incentive levels currently available in the ADI Program for each market segment. The market segments are matched to project variants in Table 1.

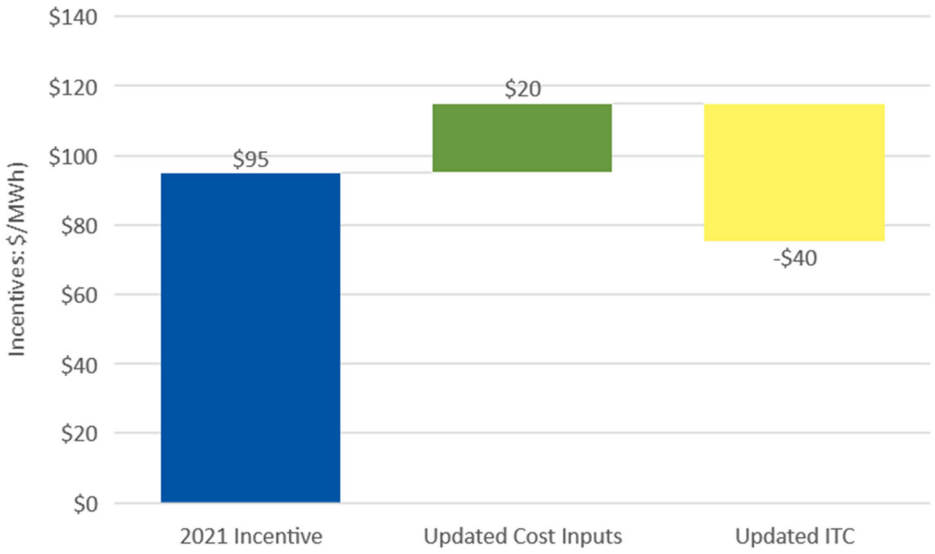
Figure 1. Comparison of Incentives ($/MWh)



As shown in the figure, Market Segment Incentive is the ADI Program incentive applicable to that project variant. The modeled incentives pictured were based on PSE&G electric rate values for 2020, which were not updated to expedite the modeling results. Given the updated economic inputs, these modeled 2023 incentives represent increases of varying levels for all variants except Residential Roof – Direct-Owned and are equal to or greater than the matched market segment incentive.

Figure 2 visualizes the changes between 2021 and 2023 incentive levels for the Residential Roof – Direct-Owned variant. Updated inputs of increased costs and an increase in the federal investment tax credit had counteracting impacts on the resulting incentive level for PSE&G.

Figure 2. Impacts of Updated Inputs on Incentive for Residential Roof Direct-Owned ($/MWh)



As shown in Figure 2, the increase in cost assumptions raised the resulting incentive by $20/MWh to $115/MWh, but this was more than offset by the increase in the federal investment tax credit, which decreased the required incentive by $40/MWh, resulting in a net decrease of $20/MWh, to a total incentive of $75/MWh.

Updated Economic Inputs

Cadmus updated four high-impact and recently changing economic input variables from the inputs used for the incentive models in the 2021 Capstone Report:

- Investment tax credits
- Project capital expenditures
- Project operating expenses
- Interest rates

Investment Tax Credits

In the 2023 incentive model, Cadmus adjusted the variable for the federal investment tax credit to 30% for all variants, in line with the federal 2022 Inflation Reduction Act, as shown in Table 2. This variable was 22% in the Capstone Report.

Table 2. Investment Tax Credit Input Adjustment

	2021 Capstone Report	2023 Incentive Model
ITC Level	22%	30%

Project Capital Expenditures

To determine project capital expenditures, Cadmus reviewed costs for solar PV projects installed during 2020 through 2022 as well as pipeline all-in costs. Cadmus assessed cost data by size tier and mounting type. Cadmus determined a single cost across ownership types (for example, $2.37 was assumed for both Commercial Roof – Direct-Owned - Medium and Commercial Roof – Third-Party–Owned) due to an unexplained divergence in costs for Residential Roof – Direct-Owned and Residential Roof – Third-Party–Owned.

Cadmus applied an inflation adjustment to commercial 2022 project costs, which were trending up, but not to residential projects because residential costs were trending in opposite directions, depending on the ownership type. This means that the costs for the commercial 2023 incentive models were based on 2020 through 2022 project costs in addition to an inflation adjustment. The costs for the residential 2023 incentive models were based on 2020 through 2022 costs without an inflation adjustment.

Cadmus also reviewed market standard reports and resources as benchmarks to its findings for capital expenditures by segment.[2,3] Cadmus' findings and modeled costs by project variant are detailed below in Table 3. Costs are in dollars per Watt-DC.

Table 3. Capital Expenditures Input by Project Variant

Project Variant	2021 Capstone Cost ($/W-DC)	2023 Incentive Model ($/W-DC)	Change ($/W-DC)	Percentage Change
Residential Roof – Direct-Owned	$3.45	$3.51	$0.06	2%
Residential Roof – Third-Party–Owned	$3.45	$3.51	$0.06	2%
Commercial Roof – Direct-Owned - Medium	$2.10	$2.37	$0.27	14%
Commercial Roof – Third-Party–Owned - Medium	$2.05	$2.37	$0.32	16%
Commercial Ground – Direct-Owned - Medium	$2.40	$2.56	$0.16	7%
Commercial Roof – Direct-Owned - Large	$1.70	$2.20	$0.50	30%
Commercial Roof – Third-Party–Owned - Large	$1.65	$2.20	$0.55	35%
Commercial Ground – Direct-Owned - Large	$1.90	$2.20	$0.30	16%
Commercial Ground – Third-Party–Owned - Large	$1.85	$2.20	$0.35	20%

Costs in the commercial rooftop segment did not vary as much by size class as did costs in the commercial ground-mounted segment. Cadmus reviewed the data for medium and large roof-mounted commercial systems (100 kw to 5,000 kw) installed 2020 through 2022 and found no evident trend to demonstrate that larger roof-mounted systems correlate with lower

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[2] Lawrence Berkeley National Laboratory. September 2022. *Tracking the Sun - 2022 Edition*. https://emp.lbl.gov/tracking-the-sun

[3] Wood Mackenzie, Solar Energy Industries Association. December 13, 2022. *U.S. Solar Market Insight – Q4 2022*.

development costs. However, Cadmus assumed that larger projects have lower costs per watt for two reasons. The first reason was to align with the theory that economies of scale will benefit large projects. The second was because the sample size for large projects (above 1 MW) was low (from 2020 through 2022, BPU cost data had 50 large projects compared to 579 medium projects).

Project Operating Expenses

Cadmus applied a one-time inflation adjustment to the operating expenses assumptions used in the 2021 Capstone Report. The inflation adjustment was derived from the Gross Domestic Product Price Index (GDP-PI), which measures inflation impacts similar to the Consumer Price Index – Urban (CPI-U), but also measures price changes for goods and services purchased by businesses, governments, and foreigners but not importers.[4] The assumptions for operating expenses include project management costs, property tax and payment in lieu of property taxes (PILOTs), site leases for third-party–owned systems, as well as a capacity-based operations and maintenance fees, and insurance costs. Cadmus assumed that inverters would be replaced in year 13, with costs varying by size tier, and decommissioning are expected to occur in year 25.

Table 4. Operating Expense Input by Project Variant

Project Variant	2021 Capstone Report	2023 Incentive Model			
	Total Operating Expense	Project Management Costs	Property Tax/PILOT	Site Lease	Total Operating Expense
Residential Roof – Direct-Owned	$17	$18	Exempt	N/A	$18
Residential Roof – Third-Party–Owned	$17	$18	Exempt	N/A	$18
Commercial Roof – Direct-Owned - Medium	$3,000	$3,311	Exempt	N/A	$3,311
Commercial Roof – Third-Party–Owned - Medium	$11,625	$1,794	Exempt	$11,037	$12,831
Commercial Ground – Direct-Owned - Medium	$3,000	$3,311	Exempt	N/A	$3,311
Commercial Roof – Direct-Owned - Large	$5,000	$5,519	Exempt	$5,519	$5,519
Commercial Roof – Third-Party–Owned - Large	$60,000	$5,519	Exempt	$60,705	$66,224
Commercial Ground – Direct-Owned - Large	$5,000	$5,519	Exempt	N/A	$5,519
Commercial Ground – Third-Party–Owned - Large	$60,000	$5,519	Exempt	$60,705	$66,224

[4] Bureau of Labor and Statistics. March 2016. *Comparing the Consumer Price Index with the gross domestic product price index and gross domestic product implicit price deflator.* https://www.bls.gov/opub/mlr/2016/article/comparing-the-cpi-with-the-gdp-price-index-and-gdp-implicit-price-de flator.htm

Interest Rates

As interest rates have increased since the 2021 Capstone Report, Cadmus has adjusted this input. In developing the 2021 Capstone Report modeling inputs, Cadmus used a stakeholder survey to obtain estimates of market interest rates used to finance solar PV projects. Various respondents said that market interest rates were based on a referenced market index with an adjustment. Cadmus revisited the current levels of the referenced indices to revise its interest rate assumption. Figure 1. Comparison of Incentives ($/MWh)Table 5 shows the interest rate adjustment for the 2021 Capstone Report and the 2023 incentive models. Two respondents referenced the Prime Rate, but with separate adjustments.

Table 5. Interest Rate Base Assumption Build-Up by Index

Index Name	2021 Capstone Report Rate	Updated Rate	Adjustment per Stakeholder Survey	Estimated Market Interest Rate
10-Year U.S. Treasury Bond	1.1%	3.7%	+6%	9.7%
Prime	4.3%	7.0%	+1%	8.0%
Prime	4.3%	7.0%	+2%	9.0%
Average				**9.0%**

Updated Rate used for 2023 Incentive Model was from November 29, 2022. Rates for the 2021 Capstone were updated on March 13, 2020, coinciding with the date of the stakeholder survey.

For the 2023 incentive models, Cadmus used the 9.0% interest rate as the base rate and, consistent with the 2021 Capstone Report, made adjustments for the residential project variants. Cadmus assumed that Residential Roof – Direct-Owned solar PV projects have an interest rate 0.5 % lower than the base assumption, and Residential Roof – Third-Party–Owned projects have an interest rate 0.5% higher than the base assumption. Cadmus assumed that all commercial projects, both third-party–owned and direct-owned, had the base interest rate.