RI RENEWABLE ENERGY GROWTH PROGRAM 2020 CARPORT ADDER PILOT EVALUATION

Prepared for:
The RI Office of Energy Resources and the RI Distributed Generation Board

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Executive Summary

This report provides an evaluation of the Rhode Island Renewable Energy Growth Program 2020 Carport Adder Pilot, including a quantitative analysis of the Carport Adder's costs and benefits. Four projects eligible for the Carport Adder have been submitted in the in the 2020 program year thus far. National Grid selected two Commercial Solar Carport projects and one Large Solar Carport project.

Siting, Location, and Development Timelines of Carport Projects

Interviews with developers indicated that carport projects are most likely to be proposed in commercial or industrial zones in suburban areas. Carport activity thus far has been concentrated in Providence County. Municipal planning staff indicated that the public perception of carport projects is more favorable than ground-mount projects due to environmental and aesthetic concerns. None of the four municipalities interviewed that have received permit applications for carport solar projects reported any difficulties. Developers noted that the permitting process for carport projects can be 6 to 12 months faster than for ground-mounted projects.

Carport Adder Costs and Benefits

We estimate total costs of the Carport Adder Pilot as estimated production from the Carport project multiplied by the value of the 2020 Carport Adder (6 ₵/kWh). The benefits of the Carport Adder Pilot are measured as the difference in interconnection costs between carport projects and non-carport projects, and land use benefits that occur if a carport project displaces the development of a greenfield project, weighted by REG class to reflect the proportion of ground-mounted and rooftop projects in past awards.

Table ES 1: Summary of NPV of Benefits

	Commercial ($/kW)		Large ($/kW)	
	Low	High	Low	High
Interconnection Cost Savings	$149.49	$151.68	$149.49	$151.68
Carbon Sequestration	$10.41	$148.68	$29.19	$66.08
Ecosystem Services	$18.93	$37.85	$18.93	$37.85
Avoided Property Value Loss	$823.67	$3,294.67	$183.04	$366.07
Total (Avoided Greenfield)	$1,002.49	$3,632.88	$380.64	$621.69
Total (Weighted by Avoided Project Type)	**$635.70**	**$2,135.96**	**$380.64**	**$621.69**

Table ES 2: Summary Results of Benefit-Cost Analysis

Case	Project Category	NPV Total Benefits ($/kW)	NPV Total Costs ($/kW)	Benefit-Cost Ratio
Low Benefits, Low Costs	Commercial	$635.70	$703.44	0.90
	Large	$380.64	$703.44	0.54
High Benefits, Low Costs	Commercial	$2,135.96	$703.44	3.04
	Large	$621.69	$703.44	0.88
Low Benefits, High Costs	Commercial	$635.70	$783.98	0.81
	Large	$380.64	$783.98	0.49
High Benefits, High Costs	Commercial	$2,135.96	$783.98	2.72
	Large	$621.69	$783.98	0.79

Overall Findings and Recommendations for 2021 Program Year

Given the small number of projects and limited data, we recommend an extension of the Carport Adder Pilot in 2021 in order to collect more data on carport costs, benefits, and REG bidding behavior with the presence of a Carport Adder.

The Consulting Team's levelized cost of energy analysis using the CREST model results in adder levels ranging from 4.9 ₵/kWh under a low cost, high production scenario and 7.7 ₵/kWh under a mean cost, low production scenario. If the policy makers' objective is to encourage the highest performing, least cost projects, it would be appropriate to set the carport adder at a level of at least 4.9 ₵/kWh. National Grid has proposed a continuation of the Carport Pilot Adder at a 5.0 cent level, within the range of adder outcomes under the cost and production scenarios modeled. With a 5.0 cent adder, the resulting benefit-cost ratios would range from 0.97 to 3.64 for Commercial Solar Carports and from 0.58 to 1.06 for Large Solar Carports.

Introduction

The Rhode Island Renewable Energy Growth (REG) Program is designed to facilitate the development of grid-connected distributed renewable energy in the state through the offer of a long-term tariff at a fixed price. Ceiling prices are set at a price designed to cover a project's costs and earn the project's investors a reasonable rate of return; projects (other than solar sized 25 kW or under) bid competitively at prices up to the ceiling price. The REG Program encourages a diversity of renewable energy project types and sizes through the definitions of project classes and megawatt (MW) allocations available to each class.

On February 18, 2020, the Rhode Island Public Utilities Commission (PUC) approved a Ceiling Price Adder of $0.06/kWh for carport installations, on a pilot basis for the 2020 Program Year only. The PUC noted that the purpose of the Pilot is to gather additional information to identify public policy benefits, and directed the Office of Energy Resources (OER) and the Distributed Generation (DG) Board to report on lessons learned from the Carport Adder Pilot.[1] OER engaged the consulting team, Sustainable Energy Advantage, LLC (SEA) and its subcontractor Mondre Energy, Inc., to conduct the evaluation of the 2020 Carport Pilot. This report summarizes the consulting team's findings.

This report aims to address the learning objectives identified by OER and the DG Board in response to PUC Data Requests in Docket 4983. These learning objectives are presented in the Technical Appendix and addressed throughout the report. They relate to the results of the open enrollments, observed costs of carport projects, the geographic distribution of carport applications, and the approach to permitting and local approvals of carport projects.

The PUC also noted that the 2020 Carport Pilot would be an opportunity to conduct a more in-depth benefit cost analysis (BCA) using the Docket 4600 guidelines. This report therefore outlines costs and benefits, quantifies those that are possible to quantify, and assesses the outcome of the resulting BCA.

Methodology

To address OER's and the DG Board's learning objective and to conduct a quantitative BCA, the Consulting Team gathered data and information from multiple sources:

- **Analysis of data provided by National Grid:** The Company provided data on REG Open Enrollment applications and selections, and interconnection costs of projects selected through REG Open Enrollments and carport projects.
- **Survey to solar developers:** To inform the cost-based analysis of appropriate adder levels, the consulting team conducted a survey to gather input on the incremental costs of carport projects and other categories of projects under consideration for a public policy adder.
- **Interviews with solar carport developers:** The consulting team conducted interviews with a total of nine solar developers active in New England that have developed carports or expressed interest in the carport sector.
- **Interviews with municipal planning staff:** The consulting team conducted interviews with a total of eighteen municipalities to understand the local approvals process for carport projects.

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[1] Rhode Island Public Utilities Commission. Docket No. 4983. February 18, 2020 Open Meeting Decision as reflected in Report and Order issued June 23, 2020.

- **Coordination with National Grid and desktop research on quantifiable benefits:** The consulting team coordinated with the Company as it developed its BCA Framework to support the Company's proposal related to carport and other public policy adders. Where appropriate, the consulting team adopted the Company's inputs in the analysis. The consulting team conducted additional desktop research to identify quantifiable benefits of carport projects and appropriate metrics and methods for their valuation.

Discussion of Lessons Learned

Results of 2020 Renewable Energy Growth Open Enrollments

Bidding activity in the 2020 REG Program Year provides a critical perspective on the impact of the Carport Adder. As of this writing, National Grid has published the results of the First and Second Open Enrollments of the 2020 Program year, while the Third Open Enrollment is not yet complete. Therefore, while the results are informative, the data are limited.

Four projects eligible for the Carport Adder have been submitted in the in the 2020 Program Year thus far[2]. Three applications were under the Commercial Solar class and one was in the Large Solar class. Of these, National Grid selected two Commercial Solar Carport projects and one Large Solar Carport project. All four projects applied as standalone carport projects (rather than including any portion of the project that was installed on a rooftop). Table 1 shows the 2020 REG Program Year open enrollment activity for carport projects, across the First and Second Open Enrollments.

Table 1: 2020 REG Open Enrollment Carport Activity

REG Class	Total Number of Applications*	Number of Carport Applications	Total Number of Awards	Total Number of Carport Awards
Commercial Solar (251-999 kW DC)	11	3	7	2
Large Solar (1,000 – 5,000 kW DC)	9	1	5	1
*Includes carports but does not include CRDG				

In addition to projects participating in the REG open enrollments, National Grid interconnection data as of August 2020 includes eight additional carport projects sized above 25 kW in the interconnection process. Of those projects, four would fall under Large Solar REG class, one would fall under the Commercial Solar class, and three would fall under the Medium Solar REG class if they were to submit applications into the REG Program (rather than enrolling in net metering, which one project has done). In total as measured by the number of projects, there is carport activity in almost equal levels between

[2] The fourth project was submitted by Hexagon Energy in the 2nd Open Enrollment but was rejected due to uncertainties regarding the project's compliance with National Grid's anti-segmentation rules. The question of the project's eligibility is being discussed in RIPUC Docket 5060.

the Commercial Solar and Large Solar classes, and slightly lower in the Medium Solar class, as shown in Table 2.

Table 2: Carport Activity by Project Class

Proxy REG Project Class	Number of Projects in IC Queue (Eligible for either NEM or REG)
Medium Solar	3*
Commercial Solar	4
Large Solar	5
*Includes one project that has been withdrawn from the interconnection process.	

Given the small number of submitted and/or selected projects, it is difficult to assess whether the Carport Adder influenced bidding behavior (in particular, there being only one Large Solar project submitted with a Carport Adder). We can observe the competitive bid prices of Carport projects compared to non-Carport projects, as shown in Table 3.

Table 3: REG Average Solar Bid Prices (Carport and Non-Carport Projects)

	2020 Average Bid Price	2020 Base CP	Delta from CP
All Commercial	17.67	18.55	-4.73%
Commercial - Carport	17.61		-5.07%
Commercial - Non-carport	17.69		-4.64%
All Large	12.96	13.65	-5.02%
Large - Carport	13.64		-0.07%
Large - Non-carport	12.88		-5.64%

In the Commercial Solar class, the average competitive bid price of eligible Carport projects is 0.08 cents lower than the average bid price for non-Carports. The Carport project in the Large Solar class' bid price is 0.76 cents higher than the average bid price of all non-carport projects in the Large Solar segment. However, it is not possible to attribute the difference in bid prices to the Carport Adder given the small number of projects, as many additional factors influence a project's economics and its resulting bid.

Siting and Location

Public Perception of Carport vs. Ground-Mounted Solar

The consulting team's interviews with both carport solar developers and municipal planning staff provide insight into the barriers and opportunities for siting carport solar projects. We review several such insights below.

- The public perception of carport projects may (depending on the community in which it is sited) be influenced significantly by an individual community's experience with siting ground-mounted solar projects on parcels under their jurisdiction. For example, in Rhode Island, many communities have strongly opposed clearing trees to construct solar projects (including many distributed- and utility-scale solar projects alike). In some instances, stormwater runoff from large, ground-mounted solar sites has not been properly managed, which has been a concern in the project host communities.

- None of the municipal officials interviewed believed that there was widespread opposition to carport solar projects, but only if they are constructed in commercial or industrial zones and meet zoning requirements such as setback and height limits.
- Municipal planning staff stated that carport solar projects should not interfere with commercial and emergency vehicle access and snow removal.
- In some communities, opposition to ground-mounted solar has led to skepticism about carport project development. However, most municipal officials the consulting team interviewed believed that carports would likely be more favorably perceived by the public given that they would be constructed in parking lots that have already been cleared of trees. In addition, the municipal officials interviewed also perceived carport projects as having limited adverse impacts on stormwater flows relative to ground-mounted projects, since rain would flow over the solar panels and onto the paved parking lot surface and into existing drainage systems, the same impact as it would have prior to installation of the solar carport.
- Communities also often object to ground-mounted solar panels being visible from abutting properties or from public thoroughfares. Planting trees and installing fences are commonly used to mitigate concerns about visual impact. The municipal officials interviewed believed that solar carports constructed in parking lots would not materially detract from the appearance of the parking lots and, as a result, would not draw community opposition.

Solar Carport Locations

The solar developers interviewed by the consulting team also provided several additional valuable observations regarding the siting of Carport projects. We summarize these below:

- Carport projects bidding in the REG program are more likely to be proposed for construction in parking lots located in commercial or industrial zones, where space that would be sufficient to construct a carport project of at least 250 kW is more likely to be available.
- Siting a carport project in retail center parking lots depends on whether the property owner choses to collect site lease payments from a solar developer rather than to preserve the option to construct and operate a building where a solar carport would be located.
- Other considerations for siting carports in a retail setting include ensuring the project would: 1) not block retail signage; 2) allow for emergency vehicle and truck clearance; and 3) not have competing uses. Developers referenced examples of successful carport projects at industrial sites (e.g. an automobile recycling facility) in remote locations (e.g. near an airport).
- Suburban areas offer more potential sites for carport development than rural or urban areas, given that:
    - Commercial or industrial zones with parking lots are more prevalent in suburban areas than in rural areas;
    - Urban areas are usually more congested than suburban areas, which limits ability to construct carports large enough to capture economies of scale, unless added to existing large parking structures;
    - In comparison, rural areas do not have high enough parking demand to support carports;
    - Parking lots in suburban areas are likely to be larger and have less shading than in urban areas, resulting in larger projects with lower $/kW upfront costs and higher output than could be constructed in urban areas; and

- Depending upon the community, suburban land values could be lower than urban areas.

Locations of Carport projects in REG program or interconnection queue

The four projects that applied in the First or Second 2020 REG Open Enrollments are proposed in Warwick, East Providence, Burrillville, and Cumberland – three in Providence County and one in Kent County; two urban and two suburban locations. Based on the facility addresses provided, the project sites are either commercial or industrial uses. None of the four projects are located on retail sites or in residential areas.

The eight additional >25 kW Carport projects in National Grid's interconnection queue that did not apply in either 2020 REG Open Enrollments are predominantly located in Providence County (two in Providence, and one each in Cranston, Smithfield, and Cumberland), with additional projects in Kent County (one each in Warwick and Coventry) and Bristol County (Barrington). Table 1Table 4 summarizes the county distribution of carport projects proposed to date in Rhode Island.

Table 4: County Distribution of Proposed RI Carport Projects >25 kW

County	Number of Proposed Projects
Providence	8*
Kent	3
Bristol	1

* Includes one project that has been withdrawn from the interconnection process.

Development Timelines and Non-Cost Barriers of Carport Projects

Developers noted several ways in which carports create value for the host and community, as well as several ways in which they are more difficult and costly to develop. In addition, several developers noted that some of the barriers to developing carport projects under the REG program relate to the program structure itself. Specifically, several developers find that the upfront time and resources required to submit an application to the REG program (i.e., filing an interconnection application) is a deterrent given that an award is not guaranteed. Some developers active in carport development in other areas of New England have not participated in the REG program because they find the size of the program creates too much risk of lost time and investment if the project is not selected.

Site Leases and Offtake Agreements

The solar developers interviewed stated that site lease discussions with a parking lot owner for a carport solar project may be protracted if the owner believes that the site could potentially be used for other commercial purposes that could generate more income that a site lease with a solar developer. It can take three to four months to negotiate a site lease for a carport solar project. Negotiating a site lease for a ground-mounted solar project in rural areas can sometimes be completed in only a few weeks if landowners are motivated to monetize otherwise non-productive land.

Further, many potential carport projects would require separate offtake agreements and site leases. Many commercial and retail properties suitable for a carport have master leases that complicate site lease and offtake agreement negotiation. Developers noted that involving more than one counter party in an agreement requires more development time and could be an impediment to finalizing a project deal.

Permits

The solar developers also stated that it can take six to twelve months longer to secure permits for ground-mounted solar projects than carport projects. This is because the time required to resolve community objections to tree removal, landscaping, and stormwater runoff issues that are commonly associated with ground-mounted solar projects are not relevant to carport solar projects.

Overall Development Time

Solar carport supports are typically classified as a structure and must meet building code design requirements, which call for a more robust design than support structures for ground-mounted solar panels. Carport solar design and construction can take four to six months longer than ground-mounted solar because of time needed to assess geological conditions beneath the parking lot and to drive pilings ten to sixteen feet to support the carport canopy structure as building codes require. Support structures for ground-mounted solar panels use earth screws driven to only about eight feet and, reportedly, can readily go through rock. This results in less subsurface design and construction time than for carport solar support structures.

Local Approvals

Interviews with municipal staff revealed several findings related to local approvals of carports:

- Nine of the 18 municipalities interviewed have solar ordinances in place or that are being developed or revised. Solar ordinances typically address ground-mounted and rooftop solar that have been most prominent in recent years. Solar carports have been proposed less often, with the result that they are often not expressly addressed in solar ordinances.
- If solar ordinances categorize carport solar as an accessory use, the permitting process would be shorter than if a development plan review or special use permit were required.
- Of the 18 municipalities interviewed, six require special use permits for carports, three require master plan review, eight require development plan review, and one issues carport permits by right. These permitting requirements are summarized in Table 5.
- Based on interviews with representatives of the 18 municipalities, there are no permitting issues that represent insurmountable barriers to carport solar development. The most rigorous approval processes for carport solar projects would require a zoning variance and would be subject to the same public scrutiny as ground-mounted solar projects.
- Four of the municipalities interviewed have received permit applications for carport solar projects. None reported any difficulties with carport permit applications:
    1. **Burrillville:** Permit review in progress. Setback, buffering and visibility issues remain to be addressed.
    2. **Cumberland:** Height variance granted by zoning board
    3. **Lincoln:** Permit review in progress. Setback and visibility issues remain to be addressed.
    4. **Smithfield:** Carport permits are issued by right.

Table 5: Summary of Permitting Requirements for Carports in RI Municipalities

Permitting Process	Number of Muni's	Process description and requirements	Typical timelines
Special Use Permits	6	**Lincoln - One Carport Solar Application:** (1) Apply for special use permit, (2) Permit request review by zoning board (3) apply for building permit	2 Months
Master Plan Review	3	**Burrillville - One Carport Solar Application:** (1) pre-application, (2) master plan review, (3) special use permit from Zoning Board, (4) Planning Board approval, (5) apply for building permit. **Cumberland - One Carport Solar Application:** (1) Combined master plan, preliminary plan review, (2) final plan review.	**Burrillville:** Less than 6 months **Cumberland:** 16 Months
Development Plan Review	8	None of the municipalities interviewed that plan to use the development plan review process have received applications for carport solar.	**Ground-Mounted Solar Review Times:** **Middletown:** 3-5 Months **Richmond:** 6-8 Weeks **Tiverton:** 6 Months Min.
By Right	1	**Smithfield - One Carport Solar Application:** (1) Technical review by engineer and Public Works, (2) apply for building permit	10 days to 1 Month

Quantitative Costs and Benefits

Carport Costs

In addition to collecting information from solar developers and municipal staff, the consulting team collected data from various sources on the costs of carport projects, on an absolute and relative (to ground-mount solar projects) basis. The three sources of cost data utilized in this evaluation are:

1) A survey designed by SEA and distributed to Rhode Island solar stakeholders;
2) Interviews with carport solar developers conducted by MEI; and
3) Cost data provided by projects participating in REG Open Enrollments.

These three sources of data provided slightly different results related to the costs of carport solar in Rhode Island.

Survey Results

The consulting team's survey asked respondents to identify the total upfront capital costs of carport projects as well as the typical incremental costs of a carport project, relative to a ground-mounted project of the same size. The survey was designed to ask respondents to react to a benchmark cost, a successful strategy SEA has used in the past to increase the willingness of the respondent to provide a precise answer. Given the nature of the survey design, the benchmark is frequently the mode of responses, and therefore often the median as well. However, the results also reveal that developers respond with different values when they do not find the benchmark to be accurate. In addition to the costs of carports, the survey sought cost information for all categories of projects under consideration for a public policy adder in the 2021 REG Program Year – rooftop projects, projects serving low-moderate income (LMI) customers, projects constructed on landfills, and projects constructed on brownfields.

In total, 27 Rhode Island renewable energy stakeholders responded to the survey, and 15 of those stakeholders provided information regarding carport costs. **Error! Reference source not found.** Table 6 provides a summary of the survey results related to the total installed costs of carport projects. These costs are higher than equivalently sized ground-mounted projects, as shown in the table. The resulting incremental costs of carport projects over ground-mounted ranges from $0.70/W to $1.48/W.

Table 6: Survey Results of Total Installed Costs, Carports vs Greenfield ($/W)

		N	SEA Benchmark	1st Quartile	Median	3rd Quartile	Mean
25-250 kW	Carport	9	$2.85	$3.15	$3.50	$3.50	$3.33
	Greenfield	12	$2.40	$2.40	$2.40	$2.80	$2.58
	Difference	--	**$0.45**	**$0.75**	**$1.10**	**$0.70**	**$0.75**
251-999 kW	Carport	15	$3.36	$3.20	$3.36	$3.38	$3.21
	Greenfield	15	$1.99	$1.99	$1.99	$2.20	$2.03
	Difference	--	**$1.37**	**$1.21**	**$1.37**	**$1.18**	**$1.18**
1-5 MW	Carport	12	$2.99	$2.93	$2.99	$3.03	$2.88
	Greenfield	18	$1.45	$1.45	$1.60	$1.84	$1.64
	Difference	--	**$1.54**	**$1.48**	**$1.39**	**$1.19**	**$1.24**

In Table 6, the incremental costs are represented as the difference between the values provided for total costs of carport projects and the values provided for total costs of greenfield projects. The survey also asked respondents to provide a direct estimate of the incremental costs of a carport project relative to a greenfield project. Those results are shown in Table 7.

Table 7: Survey Results of Incremental Costs of Carport Projects

	N	1st Quartile	Median	3rd Quartile	Mean
250 kW	4	1.00	1.15	1.28	1.13
500 kW	4	1.08	1.20	1.32	1.19
4.5 MW	4	0.84	1.08	1.33	1.09

The directly stated incremental costs range from $0.84/W to $1.20/W, representing a more narrow range than the revealed differences between the stated total cost values of greenfield and carport projects.

Interviews with Carport Developers

In the interviews with solar carport developers, the consulting team asked several questions related to the costs of developing carport projects, including the incremental costs for developing carports over greenfield projects. Developers provided the following insights:

- The "soft costs" (i.e., the non-capital development costs) are not significantly different for carport projects than for ground-mounted solar.
- Costs may vary significantly among carport projects, depending on factors such as:
  - Geotechnical engineering and drilling costs to construct steel supports;
  - Decommissioning costs and whether the carport structure will remain in place after the solar component's useful life;
  - Whether the carport includes snow guards and shelters from the elements; and
  - If clearance for emergency vehicles or large trucks is required;
- The costs of developing a carport project (or any solar project) are higher in Rhode Island than in neighboring states due to labor rules regarding licensed electricians.

Five respondents provided additional estimates of incremental costs relative to greenfield solar development. The average incremental cost estimate from interviews was $1.08/W while the median was $0.90/W. These costs are within the range of the survey responses (greater than the minimum response, less than the maximum response), but are lower than the survey median and mean.

REG Open Enrollment Cost Data

REG open enrollment bid applications require information on the project's total development cost, and the specific carport structure costs included in the total project costs. From this data, we can assess the incremental average cost of carport structures, as shown in Table 8.

Table 8: Incremental Costs of Projects Submitting REG Applications

Renewable Energy Class	***N***	***Average ($/kW)***	***Weighted Average ($/kW)***
Commercial Solar (251-999 kW DC)	3	$950	$723
Large Solar (1,000-5,000 kW DC)	1	[redacted]	[redacted]

The results on a weighted average basis are notably lower than the incremental costs revealed through the survey and interview results and represent actual projects in Rhode Island. We use the cost data to model cost-based adder levels given the direct applicability of these projects to the REG Carport Adder Pilot. However, we acknowledge that the open enrollments data include only four projects, a very small data set from which to draw meaningful conclusions.

Benefits of Carports

The benefits of carport projects relate to reduced system costs of projects sited closer to load, as reflected in interconnection costs, and the policy objective of improved siting on disturbed lands rather than undeveloped greenfields. As the costs of the pilot program are measured in comparison to a non-carport project, we present benefits derived from building a carport project rather than a non-carport solar project. We specifically compare a carport project against a ground-mounted greenfield project in order to address the policy objective of improved siting. Most projects awarded in the Large Solar class are greenfield projects, and therefore the total benefits for carports in the Large Solar class are assumed to include the full value of avoiding greenfield development. REG awards in the Commercial Solar class have gone to a mix of rooftop and ground-mounted projects, and therefore the total benefits estimated for Carports in the Commercial Solar category are weighted to reflect the historic composition of Commercial Solar projects. In other words, the benefits derived from avoiding greenfield development are discounted for Commercial Solar Carports in proportion to the amount of Commercial Solar greenfield projects awarded in past open enrollments.

Interconnection costs of carport and non-carport projects

Carport projects provide benefits at the power system level, as carport projects tend to have lower interconnection costs and are sited closer to load than greenfield projects. Such benefits are demonstrated through the costs of interconnection. To assess the level of benefits, the direct upfront interconnection costs (in $/kW DC) for carport projects can be compared against the direct upfront interconnection costs (in $/kW DC) for all other Solar projects.

To compare actual power system cost savings realized to date, we compare the interconnection costs of the Carport projects that have been selected through the REG open enrollments to date with all other non-Carport solar projects selected in the same open enrollments. The result is a savings of $151.68 per kW on a weighted average basis. We use this estimate to evaluate the power system level benefits of the Carport Pilot because it reflects the differential in costs of actual projects participating in the 2020 Program Year, though we again acknowledge the low number of selected carports.

Table 9: Interconnection Costs of Recent REG Selected Projects: Carports and Non-Carports, $/kW

Project Class (Type)	N	Median	Average	Wtd. Avg.
All Carports	3	$58.82	$69.25	$60.74
All Non-Carport Solar Projects	25	$58.82	$207.66	$212.41
Difference (Carport v. Non-Carport Solar)	--	***$0.00***	***$138.41***	***$151.68***

There are several other comparisons one could make to compare typical interconnection costs of Carport and non-Carport projects, though all are limited by the small number of Carport projects compared against a larger set of non-Carport projects. For example, the project that bid into the Second Open Enrollment but that was not selected has significantly higher interconnection costs on a per-kW basis than the other selected carport projects, and its inclusion in the analysis changes the results in a significant way. However, if we use all carport projects in National Grid's interconnection queue (including net metered and non-selected carport projects) as a proxy for a larger set of carport projects that could be potential REG program participants, and compare those costs against all REG selected projects from the past four open enrollments, we still see significant costs savings as presented in Table 10.

Table 10: Interconnection Costs of All Carports and Recent REG Selected Projects, $/kW

Project Class (Type)	N	Median	Average	Wtd. Avg.
All Carport Projects	13	$6.96	$55.46	$35.43
All Solar Projects	35	$60.38	$183.36	$184.91
Difference (Carport v. All Solar)		***$53.42***	***$127.91***	***$149.49***

Therefore, while it is difficult to draw meaningful conclusions from only four bid and three selected carport projects in the REG program, there is compelling evidence to believe that there is a quantifiable and verifiable system cost savings related to carport projects.

Quantifiable Land Use Benefits

The primary perceived benefit of carport projects is that they encourage solar development without impacting greenfield space. Carport projects avoid clearing forests or disturbing wetlands and other habitat. Typically located in commercial or industrial areas, carport projects can avoid some of the community conflicts over land preservation and aesthetics.

It is possible to quantify some of these benefits, though not all aspects of land preservation are easily converted to dollar values. Further, the quantified benefits are based on actions *avoided*, and defining the "but-for" alternative is difficult and imprecise by nature. The following is a description of the land use benefits of carports that can be quantified using well-defined parameters where possible and reasonable proxies otherwise.

Carbon Sequestration

Carports avoid the release of carbon emissions that occurs when forest land and trees are cleared for greenfield solar development. Forest clearing releases carbon that is already sequestered in trees, soil, and plant matter, and eliminates the ability for that forest to continue to sequester carbon over time. Thus, the carbon benefits of carports can be calculated based on:

1) The acreage of forest clearing avoided
2) The amount of carbon sequestered in an acre of forest land
3) The annual uptake of carbon by forests
4) The dollar value of carbon emissions avoided (the social cost of carbon)

These values have been quantified by National Grid using The Value of RI Forests study developed for the Rhode Island Department of Environmental Management Division of Forest Environment, as follows:

Table 11: Quantified Carbon Benefits of Forests

Input	Source	Value
Forest cleared in recent REG projects (acres)	NG questionnaire to recent large and commercial project developers	Large: Mean = 5.3 acres (0,12) N=5 Commercial: Mean = 0.21 acres (0,3) N=14 All: Mean = 1.55 acres (0,12) N=19
Currently stored carbon (metric tons/acre)	The Value of RI Forests (2019)[3]	76.2 (95% CI = 73.0, 79.4)
Annual carbon uptake (metric tons/acre/year)	The Value of RI Forests (2019)	1.31 (95% CI = 1.22, 1.40)
Impact per ton of CO2 ($ per short ton)	AESC 2018[4]	$68

The total quantified value of carbon benefits attributable to the Carport Adder Pilot relates to the assumed acreage of forests cleared to construct a greenfield solar project. To address the variability in how much tree clearing occurs at different greenfield project sites, we estimate a range of benefits related to the avoidance of clearing forest land. To estimate the low end of the range, we use the mean response for number of acres cleared provided to National Grid in a recent survey to project developers, and we use the maximum response of acres cleared in the high benefits case. Though the range in acres cleared for a project sized within the Commercial Solar category is smaller in absolute quantity, the maximum is a much higher percentage of the mean than the corresponding range for projects sized in the Large Solar category. As a result, the benefits increase by a greater proportion for Commercial Solar between the low and high benefits case than they do for Large Solar.

Ecosystem Services

Forest land and other natural landscapes also provide several additional environmental and health benefits beyond carbon sequestration. Such benefits include water supply and improved water quality from the avoidance of run-off, reduced damage from disturbance events such as storms, and reduced air pollution. These “ecosystem services” have tangible impacts on human health, property, and quality of life; however, they are especially difficult to quantify, and vary significantly depending on the type of open space and location of land. There are few estimates of the quantified value of such services specific to open space in Rhode Island. In order to approximate the potential value of the ecosystem services maintained by avoiding solar development on greenfields, we utilize a 2010 report, “The Economic

[3] Rhode Island Tree Council. “The Value of Rhode Island Forests.” Prepared for RI Department of Environmental Management Division of Forest Environment. August 2019. Available at: http://www.dem.ri.gov/programs/bnatres/forest/pdf/forest-value.pdf

[4] Synapse Energy Economics. Avoided Energy Supply Components in New England: 2018 Report. March 30, 2018. Available at: https://www.synapse-energy.com/sites/default/files/AESC-2018-17-080.pdf

Value of Protected Open Spaces in Southeastern Pennsylvania." The report quantifies the following values attributable to conserved open land:[5]

Table 12: Quantified Ecosystem Services

Service	Implied dollar value per acre
Water supply	$251.00
Water quality	$54.50
Flood mitigation	$187.50
Wildlife habitat	$84.50
Air pollution removal	$75.50
Total Non-Carbon Benefits	**$653.00**

While the study focused on land in southeastern Pennsylvania, it is reasonable to apply the values to land in Rhode Island given that the two states share relatively similar landscapes. In fact, the underlying values used in the Pennsylvania report were derived from a meta-analysis of valuation studies pertaining to ecosystems in New Jersey. Variation in the dollar value estimates is driven mostly by the type of land (e.g., forest, riparian buffer, pasture) than the land's geographic location,[6] which intrinsically makes capturing truly accurate ecosystem services values for an unspecified, hypothetical tract of land impossible. Instead, we use these proxy values that reflect central tendencies across a wide range of ecosystem types and valuation methods. To test the sensitivity of the quantified ecosystem services benefits and model a range of possible outcomes, we conservatively assume that the Pennsylvania study values are the high end of the possible ecosystem benefits, and model a low benefits scenario using a proxy value of $326.5/acre, half of the quantified value from the Pennsylvania study.

Avoided Property Value Loss

Research conducted in 2020 by Vasundhara Gaur and Corey Lang of the University of Rhode Island (URI) found a quantifiable negative impact on property values of homes in Massachusetts and Rhode Island located near ground-mount solar arrays. Specifically, the URI researchers found that houses located in urban or suburban areas and within one mile of a ground-mount solar array of 1 MW or larger experienced a one-time reduction in value by 1.7%. The drop in property value was larger for homes located within 0.1 miles of the solar project (a decline of 7%) or where the solar was installed on previous farm or forest land in suburban areas (a decline of 5%).[7] However, the research found no statistically significant difference in property values in rural areas as a result of the installation of ground-mounted solar arrays of 1 MW or larger.

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[5] The Economy League of Greater Philadelphia, Econsult Corporation, and Keystone Conservation Trust. "The Economic Value of Protected Open Space in Southeastern Pennsylvania." Prepared for GreenSpace Alliance and the Delaware Valley Regional Planning Commission. January 2011. Available at: https://www.dvrpc.org/Products/11033A/

[6] Ibid, Technical Appendix B

[7] Vasundhara Gaur and Corey Lang. "Property Value Impacts of Commercial-Scale Solar Energy in Massachusetts and Rhode Island" University of Rhode Island Cooperative Extension (2020). Available at: http://works.bepress.com/corey_lang/33/

In directly comparing the costs and benefits of a carport project to a greenfield ground mount project, we presume that a carport project would avoid the property value impact observed with greenfield projects, as carports are constructed in locations where buildings, parking lots, or other built infrastructure already exist. To apply the research findings in our analysis, we must estimate the number of homes that would be impacted by the hypothetical avoided greenfield solar development. In the study data set, the median number of properties located within one mile of a greenfield solar site is 317.[8] The average assessed value of properties within one mile of a greenfield solar site is $305,684.40. Applying the average property value reduction of 1.7% to this averaged assessed value, a hypothetical greenfield development reduces area property values by $5,196 per home and a total of $1,647,333 per project.

Gaur and Lang included solar projects sized 1 MW and above in their data set and did not examine impacts on property values for projects under 1 MW. However, the study did test the sensitivity with project size for projects over 1 MW, and did not find statistically significant differences in the property value impact between the smallest projects in the data set and the largest projects in the dataset. We therefore assume that projects in the REG Commercial Solar category would also have a discernable impact on property value, and that it would be similar to the findings for larger projects. We therefore estimate the same property value loss for a greenfield Commercial Solar project as for a greenfield Large Solar project under the high benefits scenario. In the low benefits scenario for Commercial Solar Carports, we estimate the impacts of both a smaller impact to the property value of each home affected and a smaller number of homes impacted, in the case that a smaller footprint of a project results in a shorter distance from the project required to notice a property value impact.

We caveat that the application of Gaur and Lang's findings require a few simplifying assumptions regarding the location of the avoided greenfield solar project and the number of homes impacted. Specifically, the study did not find statistically significant property value losses when the solar projects were located in rural areas, which includes towns such as Hopkinton, Coventry and Burrillville that have hosted significant greenfield solar development in recent years. Gaur and Lang hypothesize that no property value impact was observed in rural areas because land is relatively abundant there, and/or the visual impacts of projects in rural areas are dampened by distance and vegetative buffers. We therefore assume that, given the increasing acreage of land in these towns that has been dedicated to solar development and large degree of community resistance to additional greenfield solar projects there, that these communities may not be representative of other rural communities in the data set, and instead realize the same property value impact as suburban communities.

Given the uncertainty in applying Gaur and Lang's property value impacts in this context, we define the estimates derived from their research as the high end of a range of possible impacts. We demonstrate the sensitivity of the overall analysis to the property value impacts by presenting a case in which the realized property value impacts are equal to 50% of the mean value cited in Gaur and Lang.

Other identified non-quantified or quantifiable benefits of carports

- **Reduced utility operational expenses related to less complex and costly interconnections:** The interconnection cost savings presented above represent the capital costs of the interconnection,

[8] Email communication with Corey Lang, October 12, 2020.

study costs, and operations and maintenance costs related to the interconnection upgrade that are the responsibility of the interconnection customer. In addition, National Grid has operational and maintenance expenses related to the system upgrades required for project interconnections, including property taxes, operation and maintenance over the asset life, and general and administrative expenses. More extensive system upgrades will be associated with higher operation and maintenance costs. These internal operational expenses to the Company have not been estimated on a per-project basis to incorporate into the analysis.

- **Community Acceptance:** The community is likely to favor carport projects over greenfield solar development for multiple reasons. This preference of the community overall would not be captured in the measure of property value discussed above, as there are likely members of the community whose individual homes would not be affected by solar development, but who still hold a preference for carports. The preference for carports is driven by:
    - **No Adverse Visual Impacts:** Objections are often raised about the visibility of ground-mounted solar panels from abutting properties or from public thoroughfares. Solar carports that are constructed in parking lots would not materially detract from the appearance of the parking lots and, as a result, would not likely draw community opposition. In addition, carports would not be constructed in historic or rural areas where they could be perceived as undermining community aesthetic standards or local character.
    - **No clearing of trees:** Many communities have strongly opposed clearing trees to construct solar projects. Solar carports would be constructed in parking lots that have already been cleared of trees. While some of this value is captured in the value of ecosystem services measurement, there are also aesthetic and moral sentiments to preserving trees or other habitat that are not captured in quantified ecosystem services.
- **Willingness to pay to preserve open space:** In addition to the benefits the community accrues from a more favorably sited project, individuals in and outside of the community may have a willingness to pay to protect open land and the services it provides. The ecosystem services values that are quantified represent cost savings from avoided damages such as those related to air pollution, water contamination, and storm surges, but do not capture the preferences of individuals, which may be rooted in moral values, aesthetics, recreation, or other perspectives.
- **Snow clearing and shelter from elements:** Many businesses and residents in New England build shelter for parking without solar production available, because the shelter from snow, rain, and sun is valuable on its own. Parking in shade keeps cars cooler in the summer and decreases the air conditioning and engine cooling needs of the vehicle, thereby reducing fuel needed and producing an additional comfort benefit as well as greenhouse gas emission reduction. This impact is difficult to measure and in a temperate climate like Rhode Island, likely small compared to other quantified benefits. Shelter from snow is likely a perceived value for those parking under the solar carport, but the costs of snow clearing may either increase or decrease depending on the design of the carport and parking lot.
- **Branding and publicity value for commercial carport hosts:** Many large consumer brands recognize that customers value actions the company takes to reduce its environmental and climate footprint. Carports are a highly visible form of solar and allow a company to demonstrate its environmental commitments to employees or customers. Large U.S. retailers including Whole Foods and Walmart have built carports and sought press attention for doing

so.[9] Some of this benefit may be internalized through the structure of a site lease, but some may remain uncaptured or unquantified.

The number of unquantified benefits, and the potential magnitude of items like community acceptance and willingness to pay to protect open space, suggest that the quantitative benefit-cost analysis underestimates total benefits of carport projects.

Benefit-Cost Analysis Results and Assessment

Evaluating the 2020 REG Carport Adder Pilot through the lens of a Docket-4600 style Benefit-Cost Analysis (BCA) presents several difficulties:

- First and foremost, the data from less than one full year of the Pilot are few – only four carport projects have bid into the 2020 open enrollments held to date, and only three were selected. The small data set of carport projects requires one to assume that these projects are representative of future potential carports that would participate in the program, an assumption that is more reliable when examining a large set of projects where outliers may be muted by a larger set of more standard projects.
- The analysis requires us to make assumptions regarding the appropriate baseline in order to measure incremental benefits and incremental costs. The analysis we present measures the costs and benefits of a carport project compared to a non-carport project, assuming that in a program with limited MW capacity allocations available, that carports would compete against the least cost projects in the bid category (which for Large Solar has historically been greenfields, and for Commercial Solar, a mix of rooftop and ground-mount projects). While that premise represents a plausible scenario, in actuality, a carport project may not always displace a non-carport project on a one-to-one basis, as some project categories may be undersubscribed in the program.
- Many benefits of carports are non-market benefits that are difficult to measure and quantify. We use reasonable proxy values where possible but leave out and potentially underestimate many benefits related to environmental attributes, community preference, and ancillary benefits of the carport structure (i.e., shade and shelter).
- Many benefits of carports are at the societal level rather than at the power system level. We include these in our analysis in line with Docket 4600 guidelines and recognize that some benefits included in this analysis accrue to a broader population than ratepayers who directly bear the costs. As the ratepayers would benefit from the non-system level benefits included in this analysis, we find it appropriate to include them in the evaluation.

The BCA is conducted using the assumptions outlined above and includes both upper and lower bounds of estimated benefits. For benefits that continue over time, such as the annual uptake of carbon in forests or ecosystem services, we quantify the benefits over the 20-year tariff term. While solar assets, including carport projects, typically have a 25 year useful life, the post-tariff revenue of the project is uncertain, and therefore the project's continued operation beyond the tariff is also uncertain.

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[9] https://ir.tesla.com/press-release/solarcity-announces-new-solar-power-and-energy-storage-projects, https://media.wholefoodsmarket.com/nyserda-announces-whole-foods-market-flagship-store-in-brooklyn-uses-energy

Measuring annual benefits for 20 years instead of extending them through a 25 year period useful life results in a conservative estimate of total benefits.

The BCA results indicate that the quantifiable benefits of carports range from 0.49 to 3.04 of the costs of the carport adder depending on the project class and case assumptions. These results occur under the assumptions outlined in Table 13.

Table 13: Summary of BCA Inputs and Assumptions

Cost or Benefit Category	Lower Benefit Case	Higher Benefit Case	Explanation and Source
Solar Production - Capacity Factor	14.6%	13.1%	SEA Survey
System Sizes	Commercial – 500 kW_{DC} Large – 4500 kW_{DC}		Modeled system sizes for ceiling price
Carport Adder Value	$0.06/kWh		Approved 2020 REG value
Avoided Interconnection Costs	$149.49/kW	$151.68/kW	National Grid provided interconnection data. Low: difference of weighted average IC costs between all carports in queue and all non-carport projects selected in past 4 open enrollments. High: difference of weighted average IC costs between selected carports and non-carports in 2020 Open Enrollments
Forest Acres Cleared	Commercial – 0.21 Large - 5.3	Commercial – 3 Large – 12	Developer data reported to National Grid. Low: Mean value. High: Max Value
Carbon Stored	76.2 metric tons per acre		Mean value, RI Value of Forest Study
Carbon Uptake	1.31 metric tons/acres/year		Mean value, RI Value of Forest Study
Cost of Carbon	$68/short ton CO_2		AESC 2018
Ecosystem Services	$326.5/acre	$653/acre	The Economic Value of Protected Open Space in Southeastern Pennsylvania. Low: 50% of the total values reported. High: Total values reported.
Acres of open land preserved	Commercial – 2.5 Large – 22.5	N/A	SEIA
Avoided property value loss	0.85% of assessed value	1.7% of assessed value	Gaur and Lang 2020. Base: Mean estimate. Low Benefits: 50% of mean estimate.
Number of homes avoiding reduced value	Commercial – 159 Large – 317	Both - 317	Average number of homes within 1 mile of a greenfield solar project, from Gaur and Lang 2020, provided by email
Discount rate	7%		National Grid consolidated cost of capital

Based on these assumptions as described in the preceding text, the total benefits by category on a net present value basis are as presented in Table 14. The table presents the benefits across all categories, assuming an avoided greenfield project. The total benefits included in the comparison to project costs for the Commercial category assume only a portion of these greenfield-related benefits.

Table 14: Summary of NPV of Benefits by Category

	Commercial ($/kW)		Large ($/kW)	
	Lower Benefit Case	Higher Benefit Case	Lower Benefit Case	Higher Benefit Case
Interconnection Cost Savings	$149.49	$151.68	$149.49	$151.68
Carbon Sequestration	$10.41	$148.68	$29.19	$66.08
Ecosystem Services	$18.93	$37.85	$18.93	$37.85
Avoided Property Value Loss	$823.67	$3,294.67	$183.04	$366.07
Total (Avoided Greenfield)	$1,002.49	$3,632.88	$380.64	$621.69
Total (Weighted by Avoided Project Type)	**$635.70**	**$2,135.96**	**$380.64**	**$621.69**

We estimate total costs to be the estimated production from the Carport project (less degradation), multiplied by the value of the 2020 Carport adder of 6 ¢/kWh. Our estimate of total cost depends on production. The consulting team's case-specific estimates of total quantifiable costs, benefits, and benefit-cost ratio for Carport projects in the Commercial and Large Solar REG classes is presented in Table 15.

Table 15: BCA summary Results

Case	Project Category	NPV Total Benefits ($/kW)	NPV Total Costs ($/kW)	Benefit-Cost Ratio
Low Benefits, Low Costs	Commercial	$635.70	$703.44	0.90
	Large	$380.64	$703.44	0.54
High Benefits, Low Costs	Commercial	$2,135.96	$703.44	3.04
	Large	$621.69	$703.44	0.88
Low Benefits, High Costs	Commercial	$635.70	$783.98	0.81
	Large	$380.64	$783.98	0.49
High Benefits, High Costs	Commercial	$2,135.96	$783.98	2.72
	Large	$621.69	$783.98	0.79

The resulting BCA ratios range from 0.49 to 0.88 for Large Solar and 0.81 to 3.04 for Commercial Solar. As demonstrated in Table 14, total benefits are driven largely by interconnection cost savings and the estimated avoided loss in property value that results from greenfield solar development near homes. The total property value loss is dependent upon assumptions related to the location of the avoided project and the number of properties in proximity to that project, as well as assumptions related to how property value loss scales for projects under 1 MW.[10]

[10] The substantially higher benefits associated with Commercial projects in the High Benefits cases are associated with the assumption of a similar number of homes within one mile of a Commercial project (relative to a Large project) from the URI analysis described on page 14.

If the analysis were restricted to quantified power-system level benefits, i.e., interconnection cost savings, the resulting BCA ratios would range from 0.19 to 0.22 for both Commercial and Large REG program categories.

Finally, we model one additional sensitivity related to the discount rate. The 7% discount rate used above reflects National Grid's consolidated cost of capital, in line with other benefit-cost analyses the company has performed and reflective of the costs of the Carport Adder. As many of the benefits analyzed reflect societal level benefits, we assess the costs and benefits utilizing a lower discount rate of 2.5%, in line with discount rates used for National Grid's energy efficiency planning[11] and more broadly for climate change mitigation benefits.[12] Under a low discount rate sensitivity, the net benefits of the Carport Adder are lower and range from 0.34 to 0.63 for Large Solar and 0.56 to 2.09 for Commercial Solar, as shown in Table 16.

Table 16: BCA Summary Results under 2.5% Discount Rate

Case	Project Category	NPV Total Benefits ($/kW)	NPV Total Costs ($/kW)	Benefit-Cost Ratio
Low Benefits, Low Costs	Commercial	$640.78	$1,028.08	0.62
	Large	$390.91	$1,028.08	0.38
High Benefits, Low Costs	Commercial	$2,151.42	$1,028.08	2.09
	Large	$642.80	$1,028.08	0.63
Low Benefits, High Costs	Commercial	$640.78	$1,145.80	0.56
	Large	$390.91	$1,145.80	0.34
High Benefits, High Costs	Commercial	$2,151.42	$1,145.80	1.88
	Large	$642.80	$1,145.80	0.56

Overall Findings and Recommendations for 2021 Program Year

Two of the key learning objectives for the 2020 Carport Adder Pilot are:

1. Can a carport adder help alleviate some of the concerns of solar siting?
2. Does the adder overcome financial barriers to developing carports?

The consulting team's interviews with carport developers and municipal permitting staff indicate that the answer to Question 1 is yes. Municipal planning staff noted either expected or revealed community acceptance of solar carport projects, and developers noted many of the community acceptance benefits to siting over existing parking infrastructure rather than on greenfields. Our research into the benefits of carports also shows that there are measurable and quantifiable benefits to siting solar on carports rather than ground-mounted greenfield projects. However, there is insufficient data in one year of program results to understand if the carport adder results in an actual shift from ground-mounted to carport applications within the REG program. Developers active in the region also noted numerous

[11] See http://www.ripuc.ri.gov/eventsactions/docket/5076-NGrid-2021EEPlan(10-15-2020).pdf, Attachment 4.

[12] Qingran Li and William A. Pizer. "Discounting for Public Cost-Benefit Analysis." Resources for the Future (February 2019). Available at: https://media.rff.org/documents/WP-19-02-Li-Pizer-f.pdf

obstacles to developing carports, including added costs and limited site availability, as a reason that some of them were not currently seeking to develop carport projects in Rhode Island.

Regarding Question 2, the consulting team conducted levelized cost of energy (LCOE) analysis using the CREST model, using the same approach as taken for setting REG program Ceiling Prices. Using the capital cost differentials as reported by the REG open enrollment data, and capacity factors and incremental operational expenses from the consulting team's survey, the consulting team found that the following adder values would be necessary to meet project costs and recover investors' expected rate of return:

Table 17: Cost-based Adder Levels

Cost and Production Case	(₵/kWh)
Low OpEx Costs, High Production (14.6% CF)	4.9
Low OpEx Costs, Low Production (13.1% CF)	7.0
Mean OpEx Costs, High Production (14.6% CF)	5.6
Mean OpEx Costs, Low Production (13.1% CF)	7.7

Table 17 indicates that if the carport project is designed to meet a capacity factor of 14.6% as modeled, the 6 ₵/kWh adder level from the 2020 Program Year is sufficient to overcome the additional costs of developing a carport project. If the project has lower production, the 2020 adder level would not be sufficient to overcome the incremental costs.

The incremental capital cost of carport projects utilized in the LCOE modeling is based on the small number of Carport projects that participated in the REG pilot. Notably, the revealed incremental costs from REG open enrollment data varied materially from the incremental cost results from the survey and interviews the Consulting Team conducted, which provides the consulting team with reason to believe that additional project data would change the outcome of the cost-based modeling. In interviews, two developers expressed that the adder was reasonable and sufficient, while seven indicated it would need to be higher to be an incentive to develop carport projects under the REG program. It is important to note, however, that it is in the developers' interest in such conversations to advocate for a higher incentive level, and that the true adequacy of an incentive can only be measured by the number of successful projects that are selected in an Open Enrollment under the provided incentive and subsequently reach commercial operation.

Therefore, given the small number of projects and limited data, the consulting team recommends an extension of the Carport Adder Pilot in 2021 in order to collect more data on carport costs, benefits, and REG bidding behavior with the presence of a Carport Adder.

Pipeline of carport projects to inform MW Allocation

According to National Grid-provided interconnection data, there are another seven carport projects in the interconnection queue that are (as of this writing) not aiming to receive service under the net metering tariff, and have not submitted an application to an REG Open Enrollment. One project (which we estimate would have a DC capacity of 0.3 MW, would submit a bid as a Commercial Solar project, while three other projects totaling 7.2 MW_{DC} would be in the Large Solar project class. Interviews with developers did not reveal any planned projects that have not already been identified through REG program data. However, we note that it is common for projects to not enter the interconnection queue until shortly before submitting an REG open enrollment application, which suggests our estimate of this project pipeline is likely on the lower end relative to what is possible.

Incentive Level

REG Ceiling Prices are required by statute to be set to a price that would allow a project owner to recover its costs and earn a reasonable rate of return. The objective of setting a Ceiling Price for a competitive procurement in this manner is to simultaneously encourage continued development in the project sector, while maximizing price competition. Therefore, if the policy makers' objective is to ensure the healthy growth of a solar carport sector in Rhode Island with an adder sufficient to support a typical carport project, it would be appropriate to set the carport adder at a level of at least 5.5 ₵/kWh, the level that recovers costs under a mean operational expenses and high production scenario. If the policy makers' objective is to encourage the highest performing, least cost projects, it would be appropriate to set the carport adder at a level of at least 4.9 ₵/kWh, the level that recovers costs under a low operational expenses and high production scenario.

National Grid has proposed a continuation of the Carport Adder Pilot at a level of 5.0 ₵/kWh, which falls within the range of adder outcomes under the cost and production scenarios modeled. With a 5.0 cent adder, the resulting benefit-cost ratios (assuming a 7% discount rate) would be:

Table 18: Benefit-Cost Ratios Resulting from 5.0 Cent Carport Adder

Case	Commercial	Large
Low Benefits, Low Costs	1.08	0.65
High Benefits, Low Costs	3.64	1.06
Low Benefits, High Costs	0.97	0.58
High Benefits, High Costs	3.27	0.95

Under a high benefit/low cost scenario, the benefits of a Carport Adder in the Commercial Solar class would outweigh the costs by over three to one, and the benefits of a Large Solar class Carport Adder would be slightly higher than the costs. Under the opposite extreme, a low benefit/high cost scenario, the benefits of a Commercial Solar class Carport Adder would almost equal costs, and the benefits of a Large class Carport Adder would be just over half of its costs.

For the benefits of both Large and Commercial Solar Carports to at least equal the costs of the Carport Adder under the low benefits and high costs scenario and assuming a 7% discount rate, the Carport Adder would need to be set at a level of 2.9 cents. Given our estimates of incremental costs, as well as survey and interview feedback, that level is not likely to be sufficient to support a material number of carport projects.

Technical Appendix

- Learning Objectives identified by OER and the DG Board in response to PUC Data Requests
- Consulting team survey questions sent to solar developers
- Preliminary results of carport evaluation presented at an August 13, 2020 Technical Meeting
- Anonymized Interview Summaries

Learning Objectives identified by OER and the DG Board in response to PUC Data Requests

Learning objectives as identified in the Distributed Generation Board's Responses to the Commission's First Set of Data Requests:

- How many commercial solar class applications submit project proposals with the carport adder for a portion or all the project system size in the application;
- How many large solar class applications submit project proposals with the carport adder for a portion or all the project size in the application;
- How many commercial solar class applications are awarded with the carport adder;
- How many large solar class applications are awarded with the carport adder;
- How many carport adder projects include a portion of a project being installed on a roof top to as part of an application;
- How many commercial and large solar class applications were just standalone carport projects;
- The results of the initial competitive bidding change with the commercial and large solar classes with some projects trying to obtain a tariff with the carport adder, if it's located in a parking lot;
- Collect project cost data from carport projects to reevaluate the carport adder incentive with the development of the recommendations for the RE Growth 2021 PY;
- Collect and compare interconnection costs associated with carport applications to standalone ground mounted commercial and large class solar applications.
- Monitor where the commercial and large solar class carport adder projects are being proposed. Examples: existing grocery stores, business shopping centers, affordable housing complexes;
- What is the timeline or difference with solar developers executing agreements with parking lot owners compared with traditional land owners;
- Will the execution of agreements with parking lot owners result in applications not being ready to apply until the 3rd enrollment period in the fall;
- Which of the two solar classes eligible for the carport adder is having more activity relating to interconnection studies and submitted applications;
- Will there be a geographic and county (Kent, Washington, Providence, Bristol, Newport) distribution of carport related applications submitted;
- Will the carport related project proposals be in the urban, suburban or rural areas of the State;
- Will municipalities permit and review these projects through a special use permit, development plan review or master plan review;
- Evaluate if there are any permitting barriers to developing carport projects within municipalities;
- How many carport related applications remain in National Grid interconnection queue, that weren't awarded tariffs during the commercial enrollment periods in 2020 to help inform possible megawatt allocation plans for the development of the 2021 RE Growth Program; and
- Observe how municipalities (through communications with the RI Chapter of the American Planning Association and the RI League of Cities and Towns) handle carport applications.

Objectives as identified by OER's response to the Commission's Second Set of Data Requests:

With regard to how OER will measure whether the Carport Incentive was able to address the problems [of local siting concerns for Commercial and Large Solar development]:

- The geographic and county (Kent, Washington, Providence, Bristol, Newport) distribution of carport related applications submitted and observing the reaction to such applications by local Planning and Zoning Boards;
- If carport applications will advance through local Planning and Zoning Boards at a greater pace than compared to traditional commercial and large solar applications that may be proposed in developed or undeveloped commercial, industrial and residential lots;
- The number of carport related applications that receive local permit approvals by the end of 2020 and the number of potential projects that remain in National Grid's interconnection queue that would be looking to submit an application with the 2021 REG program.

Consulting team survey questions sent to solar developers

Preliminary results of carport evaluation presented at an August 13, 2020 Technical Meeting

Anonymized Interview Summaries

Interviews with Municipal Planning Staff

A. LOCAL APPROVALS: (1) How do you plan for securing local approvals for carport solar projects? (2) Compare the process, timing, and cost of securing local approvals for carport solar projects to ground-mounted solar projects

Medium and C&I Developer 9/11	The cost of securing local permits for carport and ground-mounted solar projects are similar.
DG Developer 9/11	The cost of securing local permits for carport and ground-mounted solar projects are similar. It may be possible to bypass speed permitting by getting permit for a carport structure as an accessory use, then adding solar panels afterward.
C&I and Large Developer 9/15	Ground mount: 12 months to permit. Carport 6 months to permit. The cost of securing local permits for carport and ground-mounted solar projects are similar. Additional permitting costs may be incurred for "low level environmental checklist" for carport solar. Incentive award should be better synchronized with permitting, "don't let one get ahead of the other." Cranston is good example of fast track solar permitting.
Medium Scale Developer 9/15	The cost of securing local permits for carport and ground-mounted solar projects are similar.
Residential & Commercial Developer 9/22	Permitting for ground-mounted solar takes 6 months to 1 year longer than carport solar. The cost of securing local permits for carport and ground-mounted solar projects are similar. Permits for ground-mounted solar take longer because tree removal and landscaping issues can slow down the approval process.
ESCO/Commercial Solar Provider 9/22	Company has no carport experience in R.I. but would expect permitting to be easier than for ground-mount. Community resistance to carport solar should be less because construction is on properties that have already been developed. In most instances, carport solar projects require planning review and only need comply with existing zoning. Ground-mounted solar requires environmental approval. Utility interconnection may take up to a year in ISO New England. Interconnection cost would be approximately $60,000 but could cost much more if system upgrades are needed. "Time kills all deals."
DG Developer 9/23	Not active in R.I. Too difficult to find land. Company focus is on larger markets. Company currently operates 16 ground-mounted and 4 rooftop solar projects nation-wide. One carport and 4 ground-mounted solar projects under construction.
Community Solar & Early Stage Developer 9/23	Permitting process is quicker for carports than for ground-mounted solar. Company expects that ground-mounted projects in R.I. would be more difficult to permit than carport projects.
Medium-Large Scale Developer 9/24	The cost of securing local permits for carport and ground-mounted solar projects are similar.

B. DEVELOPMENT TIMELINES: (1) Compare development steps and timelines of carport solar to traditional commercial or large-scale solar. (2) Compare the steps that must be taken to secure a site access agreement with a parking lot owner for a solar carport vs. a landowner for a ground-mounted system.

Medium and C&I Developer 9/11	Time to resolve carport structure geotechnical issues may extend development time.
DG Developer 9/11	90% of development time is for securing site lease. Discussions with landowner may take a long time if site could potentially be used for other commercial purposes that could generate more income that the solar site lease.
C&I and Large Developer 9/15	Site lease discussions for carport solar are more protracted because opportunities for commercial property can be more valuable than the lease payments from carport solar. "Securing a ground-mounted solar site lease has a 50% success rate versus 20% for carport solar." Relationships with real estate community important for site access for development of carport solar projects. Carport development steps/issues include: (1) Conduct GIS analysis, (2) soils analysis, (3) rough site plan, (4) estimate lease payment, (5) arrange site visit, (6) possibly discuss tax equity split with property owner.
Medium Scale Developer 9/15	Carport solar projects can be viewed as favorable vs. ground-mounted but may not result in faster permitting. Ground-mounted and carport solar projects are sometimes treated similarly for permitting purposes. Carport projects can take longer to develop than ground-mount. 90% of carport development time is for negotiating a site access agreement. A site access agreement for ground-mounted solar can take 2 to 3 months. Carport site access agreements can take 4 to 6 months because of geotechnical work and architectural reviews that are not needed for ground-mounted solar. It can take 3.5 months to negotiate site lease payment for a carport project. Ground-mount takes less time because landowners may be anxious to monetize non-productive land. Sometimes it can take only a week to negotiate a land lease for ground-mounted solar.
Residential & Commercial Developer 9/22	No comments offered on differences between carport and ground-mounted solar projects.
ESCO/Commercial Solar Provider 9/22	We have carport projects in other states but none in R.I. Site access can be more challenging for carport solar because landowner may have other options for the site.
DG Developer 9/23	The permitting process is longer for carport versus ground-mounted solar if zoning approval is needed. If the carport solar project meets zoning requirements, only a building permit would be needed. Investment threshold is "not there" for carport solar which makes it difficult to justify the development effort needed for carport solar projects.
Community Solar & Early Stage Developer 9/23	Landowner must be amenable to having on the property for 25+ years. Siting carport solar can be very difficult because the steel structure may prevent future development or complicate sale of the property.
Medium-Large Scale Developer	Site lease negotiations can be as issue if site has alternative uses.

9/24	

B. DEVELOPMENT TIMELINES (CONTINUED): (3) What specific plans must be provided for local approval of solar carport and ground-mounted systems? (4) Other than zoning, what other local approvals are needed for solar carport projects and ground-mounted systems? (5) What other stakeholders' input is required for local approval of solar carport vs. ground-mounted systems?

Medium and C&I Developer 9/11	Without a solar ordinance, carport solar projects must go through a public permitting process which adds to development time. Height restrictions and visual impact of carport solar can impact approval of carport solar projects.
DG Developer 9/11	Solar permitting paths: • By Right - No review • Site Plan Review - takes time but permit cannot be denied. • Special Permit /Variance, takes time and permit can be denied.
C&I and Large Developer 9/15	Solar permitting steps: (1) Pre-Application, (3) Master Plan, (3) Preliminary Plan, (4) Final Plan. If carport solar does not meet zoning requirements, then permitting process is the same as for ground-mounted solar.
Medium Scale Developer 9/15	Unlike ground-mounted solar racking, building codes are applicable to carport solar support structures. If carport solar does not meet zoning requirements, then permitting process is the same as for ground-mounted solar.
Residential & Commercial Developer 9/22	If carport project does not meet zoning requirements, a variance would be needed which adds to permitting timeline. Greenfield and landfill ground-mount solar permitting can go through a public permitting process which can be challenging if trees must be removed.
ESCO/Commercial Solar Provider 9/22	Sometimes former farmland still zoned residential so variance would be required to install ground-mount on these sites.
DG Developer 9/23	Typically, if a project complies with zoning, no approvals, other than a building permit would be required.
Community Solar & Early Stage Developer 9/23	Zoning or planning approval is needed if carport project does not meet zoning requirements. If no zoning variance is needed only a building permit would be required.
Medium-Large Scale Developer 9/24	Zoning or planning approval is needed if carport project does not meet zoning requirements. If there is no zoning variance, only a building permit would be needed.

B. DEVELOPMENT TIMELINES (CONTINUED): (6) What types of sites do you target for carport solar development? (7) What are the most challenging or risky aspects of developing a carport solar project?

Medium and C&I Developer 9/11	The Company believes there would be fewer opportunities for financially viable carport solar projects because of higher EPC costs versus ground-mounted solar. Consequently, the Company does not focus on carport solar development.
DG Developer 9/11	Lead times for custom steel fabrication is a big issue with carport solar. Soft costs not significantly different than ground-mounted solar. Carport solar structural design must allow access underneath for snow removal. Costs for water management and snow management also add to carport solar costs. Ground-mount carport solar soft costs are similar.
C&I and Large Developer 9/15	Site lease discussions may be protracted if landowner believes site could potentially be used for other commercial purposes that would yield more revenue than the site lease payment for carport solar.
Medium Scale Developer 9/15	Panel tilt in carport solar is not optimal. Carport solar power generation is less than a ground-mounted solar project with optimally oriented panels. For example, yield for a carport project would be 1,188 kWh/kW vs. 1,332 kWh/kW for ground-mounted solar. If fire access under canopy is required, then 14 ft clearance would be needed (vs. 9 ft otherwise) resulting in higher steel costs. Carport structure may limit visibility of store signs which can be an issue in retail center parking lots. Carports are of interest in other states but the Company is "not actively pursuing" carport solar projects in R.I.
Residential & Commercial Developer 9/22	Panel orientation on carports results in lower power yield than ground-mounted solar.
ESCO/Commercial Solar Provider 9/22	In southern R.I., solar projects under 1 MW must be reviewed by ISO New England which adds to the development timeline. If a variance is required, permit goes through town council , planning and zoning which could take 2 to 6 months.
DG Developer 9/23	The company focuses on carport projects with minimum 3 MW capacity. One 6 MW carport solar project is currently under construction at an automobile recycling facility.
Community Solar & Early Stage Developer Energy 9/23	The Company does not develop carport solar projects.
Medium-Large Scale Developer 9/24	The Company prefers working in towns with a solar ordinance in place that treats carport solar structures as an accessory use structure. Solar ordinances accelerate the permitting process. Many solar ordinances do not contemplate carport solar projects.

C. DEVELOPMENT COSTS: (1) Compare the cost of securing a site access agreement with a parking lot owner for a solar carport vs. a landowner for a ground-mounted system. (2) Compare the cost of securing local permits for a solar carport vs. a ground-mounted system. (3) Compare hard costs, soft costs, and decommissioning costs for a solar carport vs. a ground-mounted system.

Medium and C&I Developer 9/11	Cost of steel supports makes carport solar more expensive. Geotechnical costs can be unpredictable. Piles may be driven 10 to 12 feet which results in "lots of unknowns". "Drilling costs can be high."
DG Developer 9/11	Carport solar has 40c/W higher steel costs and 18c/W higher costs for water management. The Company assumes $4/kW-year for decommissioning costs. If seen as a benefit, carport structure can remain in place after end of solar operating life.
C&I and Large Developer 9/15	There is a 50c/W total EPC cost premium for carport vs. ground-mount solar. Site clearing costs are lower for carport solar. Decommissioning for ground-mount and carport solar are similar (i.e. restore to original condition).
Medium Scale Developer 9/15	Insurance costs are higher for carports because activity continues underneath them vs. ground-mounted solar which is fenced off from the public. $0.65/W EPC cost in Massachusetts vs. $1.30/W in R.I. because the number of master electricians required is based on the number of laborers on site per R.I. Department of Labor rules. Foundation costs in R.I. are higher because of sandy soil.
Residential & Commercial Developer 9/22	Carport solar canopy costs are high. Soil conditions, water and snow management add to costs for carport solar. Ground-mounted solar requires tree clearing and landscaping whereas carport solar would not, however, larger ground-mount generating capacity makes these costs a smaller percentage of total project cost. Solar modules are recycled after decommissioning.
ESCO/Commercial Solar Provider 9/22	Additional cost of carport vs. ground mounted solar due to carport structural steel costs. Carport structure that is designed for shelter from the elements will cost more than a shade structure design. Ground-mounted EPC cost: $1 to $1.85/W. Carport EPC cost: $2.80 to $2.85/W which increases to $3.30 to $3.50/W with decking and snow guards. Carport piles go 12 ft. below grade vs, 6 ft. for ground-mounted solar which adds to carport EPC cost. Lighting may also be needed under carport structure but would only add 2 to 3 c/W to EPC cost. No decking on solar on garage roof because doing so would classify the solar structure as a roof and change permitting category of the garage. In R.I, a solar canopy is considered a structure and must be built to support Code snow load. Massachusetts requires truss canopy supports and Y-shaped configuration that avoids cost of snow guards. Roof-mounted solar has lowest EPC cost. REG adder should equalize ROI for carport solar and roof-mounted solar. The Company's investors seek 6% to 7% unlevered returns on solar projects.
DG Developer 9/23	No cost information offered.
Community Solar & Early Stage Developer 9/23	1 to 5 MW ground mount solar: $1.20 -$1.50/W EPC. Carport solar: $2 to $2.50/W EPC. Racking costs for ground-mount less than for carport solar. If clearance for trucks is needed, the additional cost of structural steel will "upend" carport solar economics.
Medium-Large Scale Developer 9/24	Carport solar rack cost: $0.80 to $1/W. Ground-mount rack cost: $0.09 to $0.14/W. Carport drainage costs could add 20 to 25 c/W. LED lighting under carport could add 5 to 10 c/W. Geotechnical costs for carports are higher because piles must be driven 12 to 16 feet to support racking. Earth screws are used for ground-mounted solar that are driven about 8 feet and can go through rock. Carport structure will

	outlast the solar panels and electrical systems. The Company budgets $25,000/MW for decommissioning bond. End of lease purchase option (by landowner) can avoid decommissioning cost.

C. DEVELOPMENT COSTS (CONTINUED): (4) Was the REG 6 cent adder necessary for development of the carport solar projects that you have completed? (5) Would you have pursued these opportunities if the adder had been smaller or if there were no adder? (6) Did you complete the recent survey on solar incremental costs? If so, any additional input would be helpful.

Medium and C&I Developer 9/11	Massachusetts has a larger adder for carports than R.I. **(Consulting Team Note: The 6 cent value for the Carport adder was chosen to be equivalent in value to what is offered under the SMART program in MA.)** The Company's carport projects in RI used grant proceeds to reduce EPC cost. REG Medium-Scale solar adder is too low.
DG Developer 9/11	6 c/kWh makes solar carports breakeven with ground-mounted and is not an incentive.
C&I and Large Developer 9/15	Carport adder should be increased to account for declining ITC and the 40% EPC cost premium for carport versus ground-mounted solar. The Company would not pursue carport projects in R.I. if there were no adder.
Medium Scale Developer 9/15	Adder was critical for the Company's project in R.I. Construction costs in R.I. are higher than in Massachusetts. REG 6 c/kWh adder is not enough. The tariff in Massachusetts is 32 c/kWh for a 240 kW solar project.
Residential & Commercial Developer 9/22	The Company has no carport projects in R.I. The REG adder is not sufficient. High front-end costs would be incurred by the Company without certainty of obtaining an award. Carport adder needs to be 10 c/kWh. The Company prefers to pursue carport solar projects over 500 kW capacity because of scale economies. Interviewee suggested using a declining block structure like Massachusetts with higher incentive for early blocks. The Company sent incremental cost survey to SEA about two months ago.
ESCO/Commercial Solar Provider 9/22	Many carport adders are being pursued in other states. The Company would pursue carport solar in R.I. if the adder were higher. 6c/kWh adder in R.I. is consistent with Smart Program in Massachusetts. REG is a small program with 3 enrollments. Not uncommon to be fully subscribed in first enrollment and have to wait a year. "REG program is smaller than the demand for solar." Carport adder should assume use of decking and water management.
DG Developer 9/23	6 c/kWh adder is appropriate. Need at least 1 MW capacity for carport solar financial viability.
Community Solar & Early Stage Developer 9/23	Carport solar development costs are lower than for ground-mounted solar. Higher incentive price needed for smaller carport projects to pencil out. Need at least 20 c/kWh (tariff) price for carport solar to be financially viable. Westchester County NY offers 30 c/kWh. The Company seeks to balance "volume" (i.e. the number of projects constructed) and "value" (i.e. a high feed-in tariff price). "R.I. offers low value and low volume". In addition, greenfield permitting is difficult in R.I., consequently, the Company's solar development focus "goes elsewhere". Decommissioning requires that land be returned to

	its original condition. Decommissioning bond should exclude salvage value. Solar panel recycling has not been required.
Medium-Large Scale Developer 9/24	The REG 6 c/kWh carport adder is reasonable.

D. APPLICATION EVALUATION AND SELECTION PROCESS: (1) Will you have carport projects ready to submit in the third open enrollment in October? If not, did you plan to submit? (2) Do you have plans to submit a carport project in 2021? (3) If the PUC did not approve a carport adder for the 2021 year, would you still enter projects in the REG open enrollment? Would you pursue the project under a different program or offtake?

Medium and C&I Developer 9/11	"Carports don't pencil out unless they are large." Large carports sites are hard to find. REG carport adder should be applicable to the Medium Scale Solar category. Open Small Scale enrollment target and expand the Medium Scale enrollment target.
DG Developer 9/11	In Massachusetts, solar cannot be denied a permit. **(Consulting Team Note: State law in Massachusetts does bar towns from utilizing ordinances to prohibit certain solar uses outright, but there is no specific prohibition in state law that would bar a town from denying a permit for a solar use on a given parcel if it does not pass "special permit" scrutiny.[13])** The Company's appetite for projects in R.I. is limited because of the small enrollment target and the risk that award may be denied after development time and money has been spent. A larger enrollment target would mean less risk of being denied a tariff. Big deposits needed for steel fabrication adds to the financial risk of solar carport projects.
C&I and Large Developer 9/15	One REG carport application has been submitted. A commercial scale project may be submitted in the third round.
Medium Scale Developer 9/15	Carport solar needs its own category that does not compete with ground-mount. Carport adder should better reflect the additional EPC cost as well as yield penalty resulting from less than optimal panel tilt and orientation versus ground-mounted solar. Faster approval for adder would reduce financial risk. Tariff approval upon receipt of interconnection agreement would be better. It could take 5 months between payment of deposit and notice of award eligibility. The Company is not developing carport solar projects in R.I. and would not pursue carport projects in R.I. without a larger adder.
Residential & Commercial Developer 9/22	"Milestone risk" in R.I.: The developer may incur costs but may not get the adder. REG is a small and relatively complicated program. The Company has no solar projects in R.I.

[13] Many towns in Massachusetts require special permit/variance to site ground-mounted solar projects. For a list of decisions on town ordinances regarding solar siting by the Attorney General's Municipal Law Unit (which include a description of the level of scrutiny the towns apply in the ordinances), please visit https://massago.onbaseonline.com/MASSAGO/1801PublicAccess/mlu.htm, and select "SOLAR" under search topics.

ESCO/Commercial Solar Provider 9/22	The Company has no carport solar in R.I. because incentive is too low.
DG Developer 9/23	The Company has not looked in R.I. because it is too difficult to find land for solar development (versus in other states). The Company's focus is on solar projects larger than carport scale. REG program capacity (enrollment target) is limited.
Community Solar & Early Stage Developer Energy 9/23	In R.I., the developer "willing to make the least money" wins. R.I. has a "reputation for permit denials". The Company has no plans for solar projects in R.I. The Company is focused on rooftop solar for large warehouses in central Massachusetts and in New Jersey.
Medium-Large Scale Developer 9/24	The REG program is "so small". "No way" for small carport solar to compete (financially) with larger ground-mounted solar projects.

Interviews with Municipal Planning Staff

QUESTION 1: How are carport solar projects perceived by the public?

The public perception of carport solar projects would likely be favorable. No carport solar projects have been constructed or proposed to date. One ground-mounted and three rooftop solar projects have been constructed under OER Solarize program. High land values are an obstacle to the financial viability of carport and ground-mounted solar.
The public perception of carport solar projects would likely be favorable. One carport application has been received to date. Large solar can be installed in industrial areas, not residential or farming districts. Deemed accessory use if net metered self-supply. Nine ground-mounted solar projects installed, a dozen applications on hold.
The public perception of carport solar projects would likely be favorable. No carport solar projects have been constructed or proposed to date in central Falls or Johnston.
The community generally accepts solar. No carport solar projects have been constructed or proposed to date
Unsure of public perception of carport solar. No public outreach on this subject has been conducted. Public comments for carport included potential visual impact on nearby residences.
No carport solar projects have been constructed or proposed to date. The public perception of ground-mounted solar turned decisively negative after several large ground-mounted solar projects were viewed as ruining the Town's rural character. Town council values revenue from large solar projects. "Hopkinton is the epicenter" of solar development because of its abundance of suitable land area 24 solar projects are in operation. Another dozen waiting for zoning changes. The Town's solar ordinance addresses ground-mount and rooftop solar but not carport solar.
The public perception of carport solar projects would likely be favorable. No carport or ground-mounted solar projects have been constructed or proposed to date. A solar ordinance has been proposed but not yet approved.
Carport solar projects would be perceived well by the public as long as they are not visible.
Solar has the attention of the public. No carport solar projects have been constructed or proposed to date A zoning amendment has been proposed to facilitate carport solar permitting. Two

ground-mounted solar projects are in operation; one on commercially zoned farmland and another at an office park that is zoned industrial. High land values are an obstacle to financial viability of carport and ground-mounted solar.
The public is highly sensitive to stormwater runoff issues. XX believes that carport solar in currently asphalted areas that does not impact runoff would probably be perceived well by the public. The only commercial rooftop solar that has been installed to date is not visible from the street. No carport solar projects have been constructed or proposed to date
The public would likely support small-scale solar projects. There are no large parking lots on Block Island and no carport solar projects have been constructed or proposed to date. The solar ordinance allows commercial solar only as an accessory use.
People are “aware” of solar generally. Public “stress” over approval of special use permit for ground-mounted solar on 200 acres may affect perception of carport solar. No carport solar projects have been constructed or proposed to date
Large scale solar not accepted near residences without proper buffering . Tree clearing for installation of solar is not accepted. Stormwater runoff is also a public concern. No experience with carport solar to date.
The public perception of carport solar projects would likely be favorable.
“Not many” objections to carport solar are expected. No carport solar projects have been constructed or proposed to date.
Negative public reaction to two large ground-mounted solar projects resulted in revocation a 2018 solar ordinance. A revised ordinance is under development. The community does not want solar panels to be visible and does not support cutting down trees for installation of solar projects. No carport solar projects have been constructed or proposed to date.
Carport solar would be received “fairly well” by the public. Solar projects proposed for installation on wood lots would be contentious. A solar ordinance is under development. No carport solar projects have been constructed or proposed to date
No anticipated public objections to carport solar. No carport solar projects have been constructed or proposed to date.

QUESTION 2: What zoning/planning issues impact approval of carport solar projects?

Solar ordinance has been drafted but is does not specifically address carport solar. Carport solar would require Building Permit and review of carport structure by an engineer. Aesthetics are an issue in the historic district. Planning Board approval required for ground-mounted solar in commercial and industrial zones if not part of expansion of existing buildings. Solar not allowed as principal use in order to preserve industrial sites for economic growth opportunities.
Issues include visibility of solar panels and structures, buffering and setback.
Town A: No zoning ordinance for carports at Central Falls, therefore zoning variance would be required. Garages are the only recognized accessory use. **Town B:** Carport solar is allowed by rights. Simple site plan review. Provision in zoning code for energy production irrespective of how energy is produced. `
Carport solar is considered a minor accessory and is acceptable in any zoning district but must not alter streetscape. Plan review required. Plan is revised until zoning code requirements are met.
Carport required height variance, which was granted by Zoning Board

Carport solar likely to be classified as accessory use. Changes to comprehensive plan; Needs to demonstrate impact on flood plain, glare, visibility from road and neighbors; noise; setbacks; principal use vs accessory use; self-use of generating output vs. sale back to grid;
Rooftop solar only needs a building permit. Ground-mounted solar viewed as accessory use and needs to meet setback criteria for approval. Carport solar likely to be considered as an accessory use as well.
Setbacks and visibility are the primary issues that would impact approval of carport solar projects.
The proposed zoning amendment that includes carport solar as a category and provides height limits and coverage limits that facilitate carport solar permitting.
The public is highly sensitive to environmental impacts such as to stormwater runoff. Dimensions of carport structures would also impact approval.
Setbacks, aesthetics, native vegetation impacts, environmental impacts would impact approval. Project must not interference with beauty of the island. Solar ordinance limits carport structure height to 12 ft.
Zoning and planning issues include setbacks, lot coverage area, solar reflection, and aesthetics of the support structure.
Carport solar issues are aesthetics, canopy height, and impact on stormwater runoff.
New solar ordinance whereby carport solar treated the same as roof -mounted solar come under zoning for roof mounted systems as long as the solar array does not extend beyond the edge of the support structure. Previously, carports required a special use permits.
Solar projects must comply with zoning, have appropriate aesthetics, and minimal glare impacts. Accessory solar systems require building permit application.
Solar panels should not be visible from the road or on the property. Trees or wooded areas should not be cleared for solar project installation. Buffer should be used apply to subdivision of a property.
Carport solar projects would be highly visible, may look industrial and may be located near residences. Zoning ordinance is under development. Accessory use designation for carport solar being considered. Trying to incorporate overlay in zoning plan for the flexibility it would provide when reviewing solar permit applications.
Stormwater runoff and aesthetics

QUESTION 3: What permitting and review process is used for solar carport projects? Special use permit? Development plan review? Master plan review?

All solar projects currently require development plan review and Planning Board approval.
Carport solar review process: (1) pre-application, (2) master plan review, (3) special use permit from Zoning Board, (4) Planning Board approval.
Town A: Variance will require Zoning Board review. Special use permit requires (1) Master Plan review, (2) Special use permit from Zoning Board, (3) Full engineering plan for final review. **Town B:** Site plan review and building permit.
Rooftop solar by right up to 200 kW. Over 200 kW requires Development Plan review. All carport solar projects require Development Plan Review.
All solar projects are classified as either Major Land Development or Development Plan Review (which follows Major Land Development procedures).
If carport project requires zoning change, a Master Plan Review process is used. If no zoning change is needed, then Development Plan Process is used.

No permitting or review process is required for solar projects. Carport solar must meet setback and other zoning requirements to obtain a building permit. Solar in new construction would be reviewed as part of development plan. Farms protected by easements which prevents ground-mounted and carport solar on these properties.
Carport solar is considered a structure and would use special use permit review process. Review process: (1) advertising, (2) plan review, (3) zoning application, (4) technical review committee, (5) planning board, (6) zoning board, (7) final design.
Carport solar projects use the development plan review process. Utility interconnection approval required with application.
The Town has no solar ordinance in place. If power generation is principal use, carport solar would currently require a zoning variance. If accessory use, it must meet height, dimensional requirements.
Carport solar must comply with zoning code accessory use definition for approval. Ground-mounted solar over 750 sq. feet requires special use permit and development plan review.
Solar carport projects on less than 2 acres would require a special use permit.
Carport solar projects are subject to development plan review per solar ordinance: (1) pre-application, (2) development plan review, (3) building permit. Interconnection service agreement and decommissioning plan required.
Carport solar projects are subject to master plan review.
New Principal solar systems are subject to development plan review. Major changes to existing systems are subject to development plan review. Carport solar likely an accessory use and subject to development plan review.
Rooftop solar only requires a building permit for rooftop solar. Carport and ground-mounted solar projects under 1 acre are subject master plan review and require a special use permit. Ground-mounted solar projects over 1 acre in size are subject to land development review.
Considering administrative review for carport solar to avoid Planning Board review. Also considering Planning Board review for carport solar projects over 40,000 SF.
Carport solar requires special use permit and is subject to design review by the Planning Board.

QUESTION 4: Compare the process of securing local approvals for carport solar projects to ground-mounted solar projects.

Ground-mounted and carport solar must meet setback requirements, height restrictions, buffering requirements for Planning Board approval.
Each stage has different requirements for detail. Understanding the requirements and how to address can help expedite the process.
Town A: Ground-mounted permitting process is the same as carport solar as described in Question 3. Town B: Ground-mounted permitting process is the same as carport solar as described in Question 3.
Approval steps for carport and ground-mounted solar: (1) submit pre-application, (2) submit preliminary plan, (3) Planning Board meeting and vote. (4) submit final plan and fee, (5) building permits. No ground-mounted solar allowed anywhere except sites that are zoned industrial. Primary use solar acceptable on sites that are zoned industrial.

Ground-mounted solar: (1) Master Plan,(2) Preliminary Plan,(3) Final Carport solar: Combined Master/Preliminary Plan
Review process for carport solar is the same as for same for ground-mounted solar.
No carport or ground-mounted solar projects have been constructed or proposed to date. Carport and ground-mounted solar must meet setback and other zoning requirements to obtain a building permit.
Carport and ground-mounted solar projects are both subject to special use permit review process.
The special use permit process is used for carport and ground-mounted solar projects in all zoning districts.
Carport solar permit requires approvals from building, fire marshal, environmental departments. If denied, application must go through zoning approval.
No response
Ground-mounted and carport solar both require special use permits.
Ground-mounted and carport solar both require development plan review. Rooftop solar requires only a building permit and no development plan review.
Carport solar and small ground-mounted solar are allowed by right in commercial and industrial zones. Medium size ground-mounted solar requires special use permit in all zones except industrial. Large scale ground-mounted solar requires special use permit in all zones.
Carport solar projects must meet zoning requirement to obtain a building permit. Variance would result in development plan review. Ground-mounted solar requires development plan and major land development review. Carport and ground-mounted solar projects both require appropriate departmental approvals (e.g. Fire and Police Departments)
Carport and ground-mounted solar projects are subject to master plan review and require a special use permit: (1) pre-application, (2) master plan, (3) preliminary plan, (4) final plan.
Large or ground-mounted solar projects require development plan, and master plan review. Principal use solar requires Planning Board Review consistent with Comprehensive Plan. The Approval process for carport solar is unclear because no applications have been received.
Carport solar requires special use permit and is subject to design review by the Planning Board. Ground-mounted solar requires special permit and is subject to design review by the Planning Board and Zoning Board review.

QUESTION 5: Is the time required to approve carport solar projects longer than for ground-mounted solar?

Shorter approval time for ground-mounted solar because the panel supports are not classified as a structure and do not have to meet building code requirements. Carport solar structures must be reviewed to ensure that fire truck movements, traffic circulation and snow removal are not impeded.
Differentiated by size. Viewed as a land use issue. Ground-mounted systems: 6 months or longer.
Town A: Carport or ground-mounted solar permitting would take 3 to 5 months. Average is 2.5 months. **Town B:** Carport or ground-mounted solar permitting would take 1 to 5 days.
One to two months for carport and ground-mounted solar approval. Ground- mounted solar as principal use by right in industrial zones.
Both the carport project and ground-mounted solar took about 16 months from initial application to final plan recording. There were pauses along the way by the applicant for both projects
Approval of any solar project that requires zoning revision and master plan review would take approximately 18 to 24 months. If zoning change is not required, development plan review would take approximately 7 months.

Permitting times would likely be similar, however, no carport or ground-mounted solar projects have been constructed or proposed to date.
Approval times are roughly equivalent (approximately 2 months) for carport and ground-mounted solar projects.
Carport and ground-mounted solar project require 3 to 5 months for approval.
If carport solar project is classified as an accessory use, approval could take two weeks. If a zoning variance is required, approval could take 3 months
No response
Two to six months for carports. Six months to twelve months for ground-mounted systems.
Both carport and ground-mounted solar projects 6 to 8 weeks for approval.
Carport approval takes 10 days up to one month for technical review with engineer and Department of Public Works. Ground-mounted solar approval can take from 6 months to 24 months.
Approval time depends on the complexity of the project.
6 months minimum.
Carports 2-3 month process; Ground-mounted, 12 to 18 months
Carport solar projects can be approved in 30 to 60 days. Ground-mounted solar approvals would be due to Zoning and Planning Board reviews and monthly meeting schedules.

QUESTION 6: Are permitting costs higher for carport solar projects than for ground-mounted solar?

Carport solar permit cost would be higher because the applicant must reimburse the Town for engineering review of structural design. The panel supports for ground-mounted solar are not classified as a structure and does require engineering review.
Roughly equivalent
Permit costs are based upon project cost of construction.
Permitting costs are the same for carport and ground-mounted solar projects.
Permitting costs are the same for carport and ground-mounted solar projects.
Permitting costs would be essentially the same.
Permitting costs would likely be similar, however, no carport or ground-mounted solar projects have been constructed or proposed to date.
Permitting costs would be essentially the same.
Permitting costs would be roughly the same.
No response
No response
No substantive difference in permit fees.
No substantive difference in permit fees.
A separate State solar application fee for large, ground-mounted solar projects would not apply to carport solar projects.
An accessory use installation requires only a building permit. Projects that require development plan review will incur higher fees.
No response
Due to the number of steps involved in ground-mounted process, fees could be 4 to 5 times higher for ground-mounted v. carport projects
No response

QUESTION 7: Have there been any applications for carport solar?

None
One carport solar application is in the approval process. Issues to be resolved are buffering and height.
No applications for carport solar have been received to date at either Central Falls or Johnston .
None
One application for a 254 kW carport solar project with a 13,000 SF canopy has been received.
None
None
One application for carport solar has been received to date.
None
None
None
None
None
One. Reviewed other opportunity near schools but was too expensive.
None
None
None. Only inquiries. One is under review at the PUC.
None