

Overview

On behalf of the Rhode Island Office of Energy Resources (OER) and Distributed Generation Board (DG Board), Sustainable Energy Advantage, LLC (SEA) is looking to better understand the cost differences between different types of Solar projects in Rhode Island.

In order to quantify the in practice cost differences between different categories of solar projects and use those cost differences to inform data-driven policy making, we are asking solar developers to answer some questions for us based on their recent and current project development.

Throughout this survey, please use the following definitions:

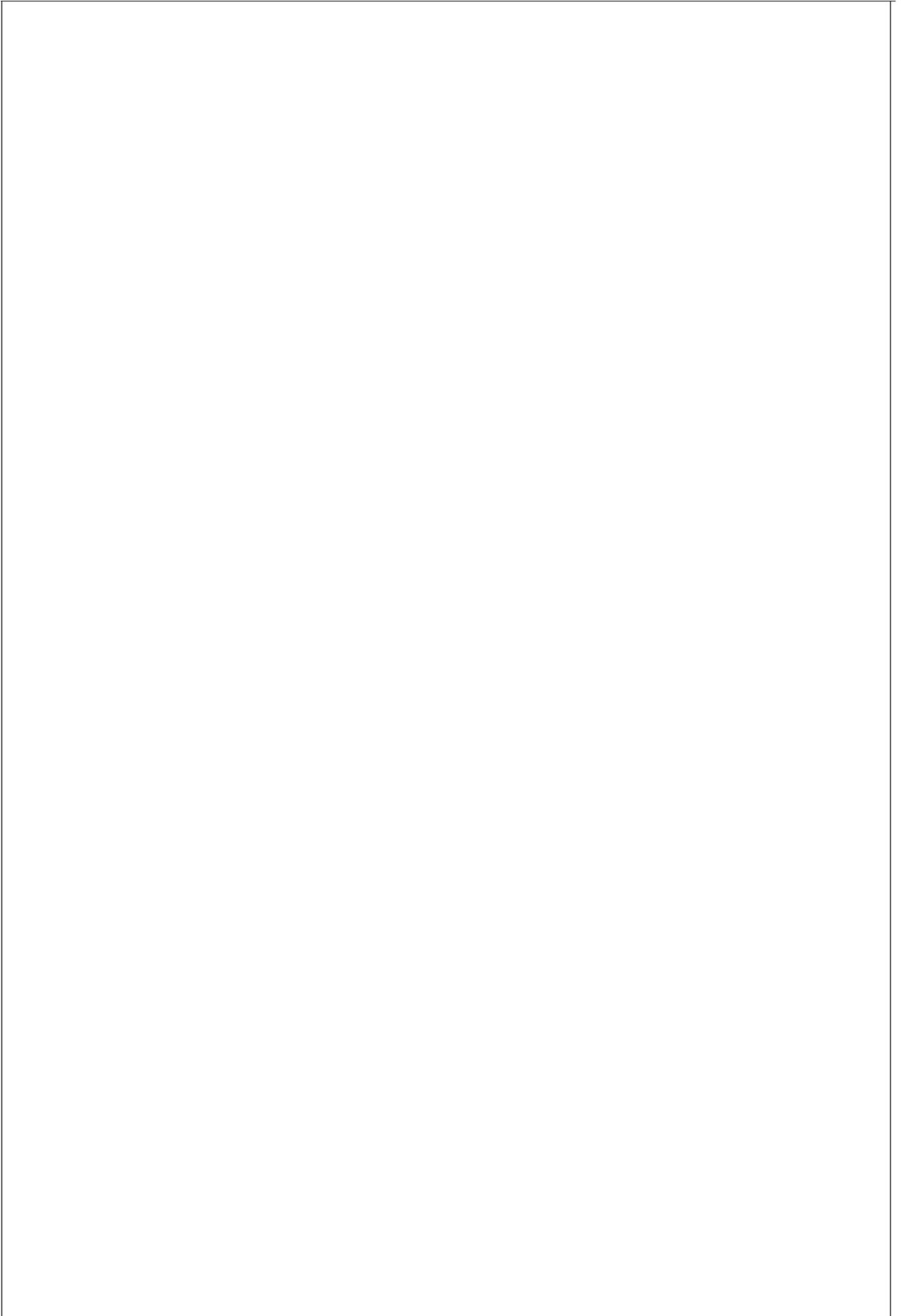
- **Greenfield:** Ground mount projects sited on undisturbed land (including agricultural land)
- **Low- and Moderate-Income (LMI):** Ground- or roof-mounted projects that serve low- and moderate-income offtakers that are customers of the Narragansett Electric Company (d/b/a National Grid Rhode Island).
- **Rooftop:** Projects mounted to a roof or overhang of a permanent building
- **Solar Canopy:** Projects installed on top of a parking surface, pedestrian walkway, or canal in a manner that maintains the function of the area beneath the canopy
- **Brownfield:** Projects sited on a disposal site containing oil or hazardous materials as defined by the relevant state agency
- **Landfill:** Projects sited on a capped landfill.
- **Incremental Costs:** The amount of cost (either capital or operating) of a particular type of renewable energy project in excess of a referenced type of renewable energy project.
- **Total Installed Costs/Total Project Costs:** This represents the total expected all-in project capital cost, which should include all hardware, balance of plant, design, construction, permitting, development (including developer fee), interest during construction, financing costs and reserves. This figure should not account for any tax incentives, grants, or other cash incentives, which will be accounted for separately. It should also exclude the assumed interconnection cost, which is specified separately. This category only excludes interconnection from upfront costs, and does not include O&M expenses or replacement costs. ALL other upfront capital costs must be included.

In addition, please report all system sizes and costs in DC terms. All system sizes and costs referenced in the survey text are in DC terms.

Please complete all questions to the best of your ability and as applicable (we are not asking you to provide information on sectors in which you are not active). Required questions are noted with an asterisk.

All Survey responses are voluntary and will be kept confidential in accordance with the State's Access to Public Record Act. Any information provided in response to this Survey will not be identified in relation to, or attributed to, an individual respondent in any public presentation or public document.

We thank you for your participation in this survey. If you have any questions about the survey or this research effort, please do not hesitate to contact Jim Kennerly (jkennerly@seadvantage.com) from SEA.



Respondent Background

* 1. Please provide your name, organization, and contact information.

Name

Company

Email Address

Phone Number

Greenfield Projects

Based upon analysis of regional data sources and market intelligence, we have estimated the median installed cost of recently developed greenfield projects to be:

- o 25-250 kW: \$2.40/W
- o 251-999 kW: \$1.99/W
- o 1 – 5 MW: \$1.45/W

In addition, our initial research and analysis suggests that greenfield solar projects in Rhode Island have a Year 1 Direct Current (DC) capacity factor of between 14.7% and 15.2%.

Please respond regarding how representative those costs are in the questions below.

2. Is your firm currently involved in developing greenfield projects in the Northeastern United States?

- Yes
- No

*** 3. In a couple of sentences, please characterize your firm's experience with developing, financing, constructing, interconnecting, selling, and/or acquiring greenfield solar projects in the Northeastern United States.**

4. Does \$2.40/W represent an accurate typical installed cost of a greenfield project sized between 25 - 250 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

5. Provide a more reasonable estimate of the total installed costs, in \$/W, for a greenfield project sized between 25-250 kW.

6. Does \$1.99/W represent an accurate typical installed cost of a greenfield project sized between 251 - 999 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

7. Provide a more reasonable estimate of the total installed costs, in \$/W, for a greenfield project sized between 251-999 kW.

8. Does \$1.45/W represent an accurate typical installed cost of a greenfield project sized between 1 - 5 MW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

9. Provide a more reasonable estimate of the total installed costs, in \$/W, for a greenfield project sized between 1-5 MW.

10. Does the range of Year 1 DC capacity factors indicated above - 14.7% to 15.2% - represent a reasonable range for greenfield solar projects in Rhode Island?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

11. (As applicable) What is the typical Year 1 DC capacity factor (in %) for a greenfield solar project at the following system sizes?

25-250 kW

251-999 kW

1-5 MW

Low- and Moderate-Income Projects

Based upon analysis of regional data sources and market intelligence, we estimate the median installed cost of recently developed projects serving low- and moderate-income (LMI) customers to be:

- o 25-250 kW: \$3.00/W (for roof-mounted projects) and \$2.80/W (for ground-mounted projects)
- o 251–999 kW: \$2.61/W (for roof-mounted projects) and \$2.39/W (for ground-mounted projects)
- o 1–5 MW: \$2.07/W (for roof-mounted projects) and \$1.85/W (for ground-mounted projects)

Our initial research and analysis also indicates that

1. LMI projects typically have capital costs between \$0.30/W and \$0.50/W higher than greenfield and rooftop projects that do not serve LMI customers. It is our understanding that this premium represents incremental upfront cost associated with customer acquisition during the development and/or construction process.

2. LMI projects typically have customer retention and acquisition-related O&M expenses of a minimum of \$25/kW-yr greater than a greenfield or rooftop project.

Please respond regarding how representative those costs are in the questions below.

* 12. Is your firm currently involved in developing projects that specifically serve LMI customers in the Northeastern United States?

Yes

No

13. In a couple of sentences, please characterize your firm's experience with developing, financing, constructing, interconnecting, selling, and/or acquiring solar projects that serve low- and moderate-income (LMI) customers in the Northeastern United States.

14. Does \$2.80/W represent an accurate typical installed cost of a ground-mounted LMI project sized between 25-250 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with ground-mounted LMI projects of this size)

15. Provide a more reasonable estimate of the total installed costs, in \$/W, for a ground-mounted LMI project sized between 25-250 kW.

16. Does \$3.00/W represent an accurate typical installed cost of a roof-mounted LMI project sized between 25-250 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with roof-mounted LMI projects this size)

17. Provide a more reasonable estimate of the total installed costs, in \$/W, for a roof-mounted LMI project sized between 25-250 kW.

18. Does \$2.39/W represent an accurate typical installed cost of a ground-mounted LMI project sized between 251-999 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with ground-mounted LMI projects this size)

19. Provide a more reasonable estimate of the total installed costs, in \$/W, for a ground-mounted LMI project sized between 251-999 kW.

20. Does \$2.61/W represent an accurate typical installed cost of a roof-mounted LMI project sized between 251-999 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with roof-mounted LMI projects this size)

21. Provide a more reasonable estimate of the total installed costs, in \$/W, for a roof-mounted LMI project sized between 251-999 kW.

22. Does \$1.85/W represent an accurate typical installed cost of a ground-mounted LMI project sized between 1-5 MW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with ground-mounted LMI projects this size)

23. Provide a more reasonable estimate of the total installed costs, in \$/W, for a ground-mounted LMI project sized between 1-5 MW.

24. Does \$2.07/W represent an accurate typical installed cost of a roof-mounted LMI project sized between 1-5 MW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with roof-mounted LMI projects this size)

25. Provide a more reasonable estimate of the total installed costs, in \$/W, for a roof-mounted LMI project sized between 1-5 MW.

26. Does the incremental upfront cost estimate indicated above - \$0.30/W to \$0.50/W more than the same size greenfield and/or rooftop project - represent an accurate typical premium for LMI projects?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

27. (As applicable) What is the typical incremental cost of completing an LMI project as compared to a greenfield or a rooftop project of the same size, based on **\$/W** over the the total installed cost of a greenfield or rooftop-only project? Provide incremental costs **in \$/W** based on the following project sizes:

25-250 kW

251-999 kW

1-5 MW

28. Please characterize the difference in the following categories of operating expense for LMI on either a greenfield or rooftop on a \$/kW annual basis **in percentage (%) terms**, relative to either a greenfield or rooftop project:

Operations and Maintenance (O&M, defined as all fixed and variable expenses associated with project operations, except annual expenses for insurance, property taxes, land leases, royalties, and project management)

Insurance

Land/Site Lease

Project Management (defined as all time and activities devoted to managing the installation incurred by the development company and/or owner following the commercial operation date)

29. What factors (other than the ones named in previous questions) cause the capital cost difference to be higher or lower?

30. What factors (other than the ones named in previous questions) cause the differences in operating costs to be higher or lower?

Rooftop Projects

Based upon analysis of regional data sources and market intelligence, we estimate the median installed cost of recently developed rooftop projects to be:

- o 25-250 kW: \$2.40/W
- o 251-999 kW: \$2.21/W
- o 1-5 MW: \$1.67/W

Our initial research and analysis also indicates that:

1. Rooftop project typically cost between \$0.00/W and \$0.22/W more than greenfield projects; and
2. The typical Year 1 Direct Current (DC) capacity factor for a rooftop project in Rhode Island is between 13.3%-13.4%.

Please respond regarding how representative those costs are in the questions below.

* 31. Is your firm currently involved in developing rooftop solar projects in the Northeastern United States?

- Yes
- No

32. In a couple of sentences, please characterize your firm's experience with developing, financing, constructing, interconnecting, selling, and/or acquiring rooftop solar projects in the Northeastern United States.

33. Does \$2.40/W represent an accurate typical installed cost of a rooftop project sized between 25-250 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

34. Provide a more reasonable estimate of the total installed costs, in \$/W, for a rooftop project sized between 25-250 kW.

35. Does \$2.21/W represent an accurate typical installed cost of a rooftop project sized between 251-999 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

36. Provide a more reasonable estimate of the total installed costs, in \$/W, for a rooftop project sized between 251-999 kW.

37. Does \$1.67/W represent an accurate typical installed cost of a rooftop project sized between 1-5 MW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

38. Provide a more reasonable estimate of the total installed costs, in \$/W, for a rooftop project sized between 1-5 MW.

39. Does the incremental cost estimate indicated above - \$0.00/W to \$0.22/W more than the same size greenfield project - represent an accurate typical premium for rooftop projects?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

40. (As applicable) What is the typical incremental cost of completing a rooftop project as compared to a greenfield project of the same size, based on **\$/W** over the the total installed cost of a greenfield project? Provide incremental costs **in \$/W** based on the following project sizes:

25-250 kW

251-999 kW

1-5 MW

41. Does the range of Year 1 DC capacity factors indicated above - 13.3% to 13.4% - represent a reasonable range for rooftop solar projects in Rhode Island?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

42. (As applicable) What is the typical Year 1 DC capacity factor (**in percentage (%) terms**) for a rooftop solar project at the following system sizes?

25-250 kW

251-999 kW

1-5 MW

Other (specify project size)

43. Please characterize the difference in the following categories of operating expense for rooftop projects on a \$/kW annual basis **in percentage (%) terms**, relative to a greenfield project:

Operations and Maintenance (O&M, defined as all fixed and variable expenses associated with project operations, except annual expenses for insurance, property taxes, land leases, royalties, and project management)

Insurance

Land/Site Lease

Project Management (defined as all time and activities devoted to managing the installation incurred by the development company and/or owner following the commercial operation date)

44. What, in your experience, drives the incremental capital costs between greenfield and rooftop projects? What factors cause the cost difference to be higher or lower?

45. What, in your experience, drives the incremental operating expenses between greenfield and rooftop projects? What factors (other than the ones named in previous questions) cause the cost difference to be higher or lower?

Solar Canopy Projects

Based upon analysis of regional data sources and market intelligence, we estimate the median installed cost of recently developed solar canopy projects to be:

- o 25-250 kW: \$2.85/W
- o 251-999 kW: \$3.36/W
- o 1-5 MW: \$2.99/W

Our initial research and analysis also indicates that:

1. Solar canopy projects typically cost between \$0.45/W and \$1.54/W more than greenfield projects on a \$/W basis; and
2. The typical Year 1 Direct Current (DC) capacity factor for Solar Canopy projects in Rhode Island is between 13.1% and 13.5%.

Please respond regarding how representative those costs are in the questions below.

* 46. Is your firm currently involved in developing solar canopy projects in the Northeastern United States?

Yes

No

47. In a couple of sentences, please characterize your firm's experience with developing, financing, constructing, interconnecting, selling, and/or acquiring solar canopy projects in the Northeastern United States.

48. Does \$2.85/W represent an accurate typical installed cost of a solar canopy project sized between 25-250 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

49. Provide a more reasonable estimate of the total installed costs, in \$/W, for a solar canopy project sized between 25-250 kW.

50. Does \$3.36/W represent an accurate typical installed cost of a solar canopy project sized between 251-999 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

51. Provide a more reasonable estimate of the total installed costs, in \$/W, for a solar canopy project sized between 251-999 kW.

52. Does \$2.99/W represent an accurate typical installed cost of a solar canopy project sized between 1-5 MW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

53. Provide a more reasonable estimate of the total installed costs, in \$/W, for a solar canopy project sized between 1-5 MW.

54. Does the incremental cost estimate indicated above - \$0.45/W-\$1.54/W more than the same size greenfield project - represent an accurate typical premium for solar canopy projects?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I don't work with projects this size)

55. (As applicable) What is the typical incremental cost of completing a solar canopy project as compared to a greenfield project of the same size, based on **\$/W** over the the total installed cost of a greenfield project? Provide incremental costs **in \$/W** based on the following project sizes:

250 kW

500 kW

2 MW

Other (specify project size)

56. Does the range of Year 1 DC capacity factors indicated above - 13.1% to 13.5% - represent a reasonable range for solar canopy projects in Rhode Island?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

57. (As applicable) What is the typical Year 1 DC capacity factor (**in percentage (%) terms**) for a solar canopy project at the following system sizes?

25-250 kW

251-999 kW

1-5 MW

58. Please characterize the difference in the following categories of operating expense for solar canopy projects on a \$/kW annual basis **in percentage (%) terms**, relative to a greenfield project:

Operations and Maintenance (O&M, defined as all fixed and variable expenses associated with project operations, except annual expenses for insurance, property taxes, land leases, royalties, and project management)

Insurance

Land/Site Lease

Project Management (defined as all time and activities devoted to managing the installation incurred by the development company and/or owner following the commercial operation date)

59. What factors (other than the ones listed in previous questions) cause the upfront capital costs for solar canopy projects to be higher or lower than for similarly-sized greenfield projects?

60. What factors (other than the ones listed in previous questions) cause the operational expenses for solar canopy projects to be higher or lower than for similarly-sized greenfield projects?

Landfill Projects

Based upon analysis of regional data sources and market intelligence, we estimate the median installed cost of landfill projects to be:

- o 25-250 kW: \$2.56/W
- o 251-999 kW: \$2.15/W
- o 1-5 MW: \$1.83/W

Our initial research and analysis also indicates that:

1. Landfill solar projects typically cost between \$0.16/W and \$0.38/W more than greenfield projects; and
2. The typical Year 1 Direct Current (DC) capacity factor for landfill solar projects is between 14.5% and 15.2%.

Please respond regarding how representative those costs are in the questions below.

* 61. Is your firm currently involved in developing landfill solar projects in the Northeastern United States?

Yes

No

62. In a couple of sentences, please characterize your firm's experience with developing, financing, constructing, interconnecting, selling, and/or acquiring landfill solar projects in the Northeastern United States.

63. Does \$2.56/W represent an accurate typical installed cost of a landfill solar project sized between 25-250 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I do not work with projects of this size)

64. Provide a more reasonable estimate of the total installed costs, in \$/W, for a landfill solar project sized between 25-250 kW.

65. Does \$2.15/W represent an accurate typical installed cost of a landfill solar project sized between 251-999 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I do not work with projects of this size)

66. Provide a more reasonable estimate of the total installed costs, in \$/W, for a landfill solar project sized between 251-999 kW.

67. Does \$1.83/W represent an accurate typical installed cost of a landfill solar project sized between 1-5 MW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I do not work with projects of this size)

68. Provide a more reasonable estimate of the total installed costs, in \$/W, for a landfill solar project sized between 1-5 MW.

69. Does the incremental cost estimate indicated above - \$0.16/W-\$0.38/W more than the same size greenfield project - represent an accurate typical premium for landfill solar projects?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

70. (As applicable) What is the typical incremental cost of completing a landfill solar project as compared to a greenfield project of the same size, based on **\$/W** over the the total installed cost of a greenfield project? Provide incremental costs **in \$/W** based on the following project sizes:

25-250 kW

251-999 kW

1-5 MW

* 71. Does the range of Year 1 DC capacity factors indicated above - 14.5% to 15.2% - represent a reasonable range for landfill projects in Rhode Island?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

72. (As applicable) What is the typical Year 1 DC capacity factor (**in percentage (%) terms**) for a landfill project at the following system sizes?

25-250 kW

251-999 kW

1-5 MW

73. Please characterize the difference in the following categories of operating expense for landfill solar projects on a \$/kW annual basis **in percentage (%) terms**, relative to a greenfield project:

Operations and Maintenance (O&M, defined as all fixed and variable expenses associated with project operations, except annual expenses for insurance, property taxes, land leases, royalties, and project management)

Insurance

Land/Site Lease

Project Management (defined as all time and activities devoted to managing the installation incurred by the development company and/or owner following the commercial operation date)

74. What factors (other than the ones listed in previous questions) cause the upfront capital costs for landfill projects to be higher or lower than for similarly-sized greenfield projects?

75. What factors (other than the ones listed in previous questions) cause the operational expenses for landfill projects to be higher or lower than for similarly-sized greenfield projects?

Brownfield Projects

Based upon analysis of regional data sources and market intelligence, we estimate the median installed cost of brownfield solar projects to be:

- o 25-250 kW: \$2.53/W
- o 251-999 kW: \$2.12/W
- o 1-5 MW: \$1.72/W

Our initial research and analysis also indicates that:

1. Brownfield solar projects typically cost between \$0.13/W and \$0.27/W more than greenfield projects; and
2. The typical Year 1 Direct Current (DC) capacity factor for brownfield solar projects is between 14.5% and 15.2%.

Please respond regarding how representative those costs are in the questions below.

* 76. Is your firm currently involved in developing brownfield solar projects in the Northeastern United States?

Yes

No

77. In a couple of sentences, please characterize your firm's experience with developing, financing, constructing, interconnecting, selling, and/or acquiring brownfield solar projects in the Northeastern United States.

78. Does \$2.53/W represent an accurate typical installed cost of a brownfield solar project sized between 25-250 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I do not work with projects of this size)

79. Provide a more reasonable estimate of the total installed costs, in \$/W, for a brownfield solar project sized between 25-250 kW.

80. Does \$2.12/W represent an accurate typical installed cost of a brownfield solar project sized between 251-999 kW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I do not work with projects of this size)

81. Provide a more reasonable estimate of the total installed costs, in \$/W, for a brownfield solar project sized between 251-999 kW.

82. Does \$1.72/W represent an accurate typical installed cost of a brownfield solar project sized between 1-5 MW?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high
- N/A (I do not work with projects of this size)

83. Provide a more reasonable estimate of the total installed costs, in \$/W, for a brownfield solar project sized between 1-5 MW.

84. Does the incremental cost estimate indicated above - \$0.13/W-\$0.27/W more than the same size greenfield project - represent an accurate typical premium for brownfield solar projects?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

85. (As applicable) What is the typical incremental cost of completing a brownfield solar project as compared to a greenfield project of the same size, based on **\$/W** over the the total installed cost of a greenfield project?

Provide incremental costs in **\$/W** based on the following project sizes:

25-250 kW

251-999 kW

1-5 MW

86. Does the range of Year 1 DC capacity factors indicated above - 14.5% to 15.2% - represent a reasonable range for brownfield projects in Rhode Island?

- No, it is far too low
- No, it is moderately too low
- Yes, it is about right
- No, it is moderately too high
- No, it is far too high

87. (As applicable) What is the typical Year 1 DC capacity factor (**in percentage (%) terms**) for a brownfield project at the following system sizes?

25-250 kW

251-999 kW

1-5 MW

88. Please characterize the difference in the following categories of operating expense for brownfield solar projects on a \$/kW annual basis **in percentage (%) terms**, relative to a greenfield project:

Operations and Maintenance (O&M, defined as all fixed and variable expenses associated with project operations, except annual expenses for insurance, property taxes, land leases, royalties, and project management)

Insurance

Land/Site Lease

Project Management (defined as all time and activities devoted to managing the installation incurred by the development company and/or owner following the commercial operation date)

89. What, in your experience, drives the incremental capital costs between greenfield and brownfield solar projects? What factors cause the cost difference to be higher or lower?

90. What, in your experience, drives the incremental operating expenses between greenfield and brownfield solar projects? What factors (other than the ones named in previous questions) cause the cost difference to be higher or lower?