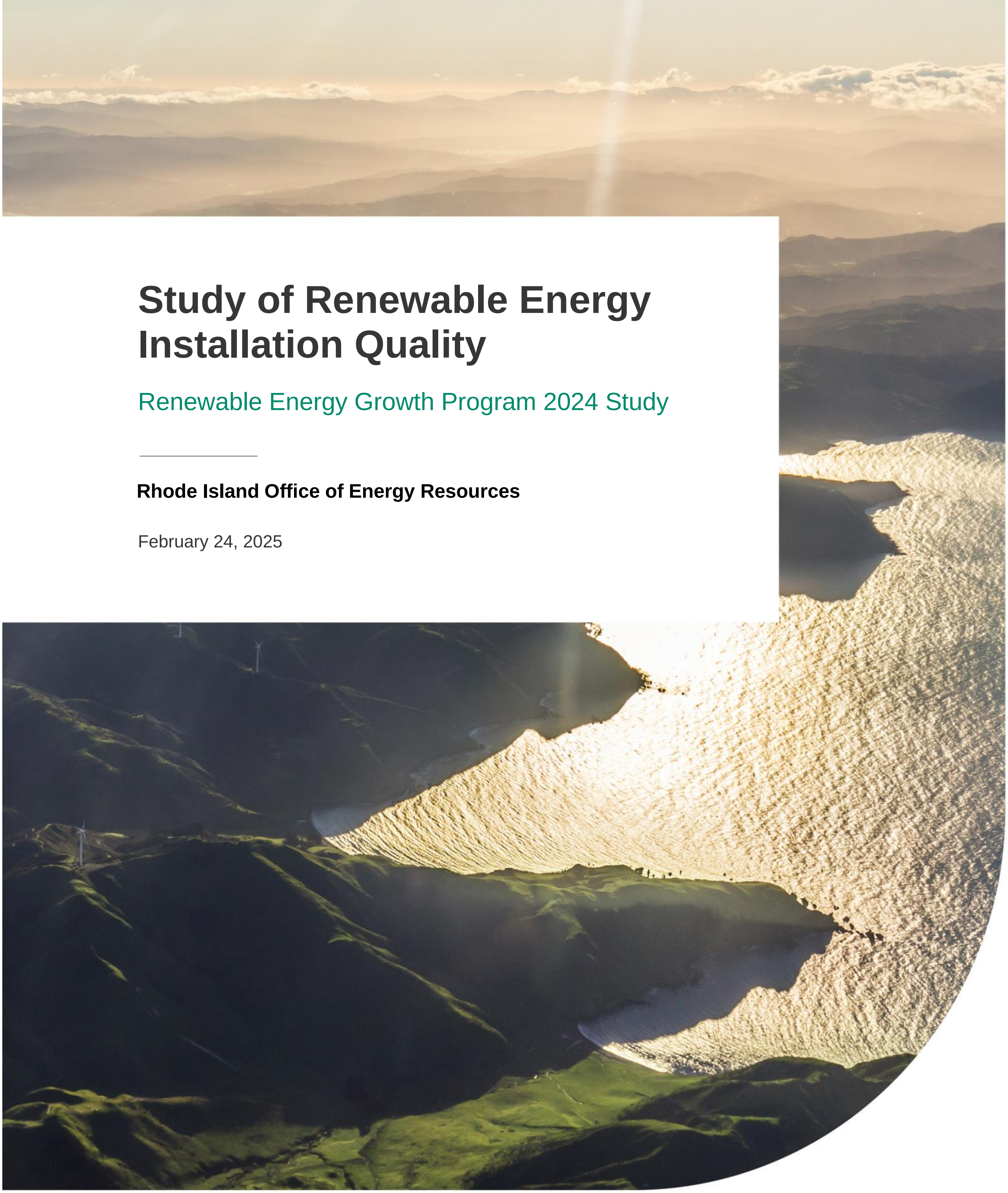

Study of Renewable Energy Installation Quality

Renewable Energy Growth Program 2024 Study

Rhode Island Office of Energy Resources

February 24, 2025

OUR VISION

Working to create a world powered by renewable energy

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Document history

Author	Matthew Piantedosi, Ashley Lambert, Alexandria Dionigi
Checked	Reece Enderson, Head of Technical Advisory
Approved	Jackie Hanberg, Head of Commercial Services

Client Details	
Contact	Shauna Beland
Client Name	Rhode Island Office of Energy Resources
Address	1 Capitol Hill Providence, RI 02908

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Local Office:

60 Railroad Place, Suite 205
Saratoga Springs, NY 12866
USA
Tel: +1 (518) 308 0200

Registered Office:

Natural Power Consultants LLC
60 Railroad Place, Suite 205
Saratoga Springs, NY 12866
USA

Taxpayer Identification Number: 27-0935846

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1. Executive Summary

Natural Power, working under contract with the Rhode Island Office of Energy Resources (“OER”), has completed the process of inspecting and evaluating the installation quality of projects installed through the Renewable Energy Growth (“REG”) program. The REG program, a tariff-based program, supports renewable energy system development across Rhode Island.

Natural Power has completed inspections for 77 small scale solar, 10 medium scale solar, and 8 small scale plus storage systems. Due to low participant volume, a 2023 quality assurance study was not conducted. To ensure continuity between the 2022 quality assurance study and the 2024 study, the most recent operational small-scale solar installations from the 2022 through 2024 tariff years from Rhode Island Energy provided data were sampled. The medium solar projects represent most recent operational installations from Rhode Island Energy provided data for the 2022 and 2023 REG tariff years. The small-scale plus storage projects included storage projects from the 2022 through 2023 tariff years. This report summarizes the results from these efforts. Inspections were performed according to a standardized inspection process and the use of Natural Power’s PV quality evaluation and scoring tool developed specifically for the REG quality assurance program. The inspection tool focused heavily on the 2020 edition of the National Electrical Code (“NEC”) requirements.

Key findings outlined in this report:

- Major overhead service interconnection termination issues were identified in almost half of small-scale installations;
- Many small-scale inspections identified labeling issues related to rapid shutdown and disconnect directory requirements;
- Many small-scale inspections identified a missing lock or seal on a hinged disconnect switch enclosure, a new requirement in the 2020 NEC;
- Energy storage system connection in the REG program requires additional equipment and consideration beyond a typical non-REG connection. Systems were generally code-compliant, however field-labeling and identification were the most common findings; and
- The customer survey results showed the REG program participant knowledge is limited, and many survey respondents would like to have more information available.

Natural Power summarized recommendations based on the findings in the quality assurance program.

- Offer targeted training for small-scale installers based on findings from the study;
- Enhance technical guidance resources. Natural Power is updating the new installer training program to include comprehensive details on unique interconnection requirements and technical guidance. This update aims to improve installers' awareness and understanding of the technical requirements within the REG program;
- Continue quality assurance inspections and increase the sample size of small-scale plus storage projects; and
- Create an information center on the OER website for REG participants to find contact information, frequently asked questions, and additional resources.

2. Introduction

This report outlines the results from Natural Power's quality assurance study reviewing the quality of renewable energy installations funded by the REG program in Rhode Island through the 2024 tariff year. The Rhode Island OER commissioned this study on behalf of the Rhode Island Distributed Generation Board ("DG Board"). These results are based upon completed inspections which include inspections of 77 small scale solar, 10 medium scale solar, and 8 small-scale plus storage systems.

2.1. About the Renewable Energy Growth Program

REG, a program administered by Rhode Island Energy, supports the development of distributed generation projects in Rhode Island. Several technologies are eligible for the program, including solar, wind, hydropower, and anerobic digestion. Participants in the program are enabled to sell their generation output using the long-term tariffs at fixed price. The program updates the ceiling prices, megawatt allocation plan, and recommendations from the quality assurance program on an annual basis. A ten-member board, the DG Board, oversees the development and recommendations for the annual program plan.

A consultant is hired for the quality assurance program annually to ensure the safety, quality, performance, and conformance of the distributed generation projects to the stated specifications. Licensed electrician-conducted inspections of the installed systems are used to determine code compliance and verification of system components installed as compared to what was filed for the project interconnection application to Rhode Island Energy. Final inspection reports are submitted to OER detailing findings from all inspections. Inspections are conducted for small scale projects (<25kW), medium scale projects (25kW-250kW), and large-scale projects (250kW+). To further enhance the quality assurance study, a customer feedback survey is conducted to understand perception of the program, satisfaction, and feedback. A final report and presentation are completed to convey results and recommendations to the DG Board.

3. Study Goals

The goal of this study is to determine the quality of renewable energy installations funded through the 2024 REG tariff year. Natural Power was commissioned to study the safety, quality, performance, and conformance of the installations. The study analyzed the quality of renewable energy installations for small, medium, large-scale PV installations, and small-scale plus storage installations across different installers, basing inspection results on a one to five quality scale. Common and serious installation issues were identified and summarized by elements and severity ranging from incidental to critical. In addition to analyzing the installation issues, the responsiveness of installers to reconciling issues was reviewed. Finally, a small-scale customer survey was conducted to further understand participant's satisfaction and perceptions of the program. From these results, recommendations were made to improve the program in subsequent years.

4. Study Methodology

4.1. Sampling Process

Natural Power prepared a sample of inspections across technologies and installers. Inspections were recommended for all installers, with an average sample of one to five inspections per installer. Table 4.1 outlines the summary of inspections and installers by technology. The sample was adjusted from the original sampling memo to properly distinguish small-scale PV installations from small-scale plus storage. This adjustment was necessary due to a data integrity issue in the provided data, identified after the initial sampling process.

Table 4.1: REG quality study sample selection

Inspections	Projected Number of Inspections	Projected Number of Installers	Actual Number of Inspections	Actual Number of Installers
Small Solar Inspections	77	20	77	20
Medium Solar Inspections	13	11	10[1]	8
Small-Scale Plus Storage Inspections	8	5	8	4

For the small-scale solar installations, Natural Power selected sites randomly, in proportion to the number of operational sites per installer. The sample targeted inspecting all installers with operational sites enrolled in the REG program for the most recent REG tariff years. Natural Power selected small scale solar projects based on the strategy outlined in Table 4.2. Alternate sites were included for instances where participants were unable to be contacted.

Table 4.2: Small scale sampling summary for 2022-2024 tariff years

Small Scale Solar Installer Category	Total Operational Installations	Target Sample Size
Large Installer	Greater than 29	5 - 10
Medium Installer	29 or less	3 - 5
Small Installer	5 or less	1 - 3

4.2. Inspection Process

All on-site inspections of the renewable energy systems were completed by Natural Power subcontractors, Ridgeline Energy Analytics and Neo Virtus Engineering. During on-site inspections, licensed electricians collected all relevant data using a mobile device application developed by Natural Power specifically for the REG quality assurance program. Subcontractors scheduled and conducted all inspections with system owners. A standard operating procedure was followed with all communications throughout the inspection process to be cognizant of customers' perception of the program.

[1] Natural Power was unable to schedule three medium scale projects due to non-responsiveness from installers, or inability to reach the appropriate owner of the system. OER was notified of the non-responsiveness from the installers.

4.2.1. On Site Data Collection

To provide timely reporting and tracking of inspections, Natural Power developed a mobile application form specific for the REG quality assurance program, hereinafter called the "Inspection Tool". The Inspection Tool was developed to collect, analyze, and report inspections for the program. The specific inspection fields, based heavily on the 2020 edition of the National Electrical Code, ensured consistency of inspections and reporting. The Inspection Tool allowed the inspection team to import system data, complete inspections on a mobile phone or tablet, and produce inspection reports. All inspection reports were reviewed by an engineering manager, and additionally by a Rhode Island licensed electrician and NABCEP Certified PV System Inspector. Additionally, a corrective action report was produced to reconcile issues noted during the inspection process. A summary of the Inspection Tool can be seen in Figure 4.1.

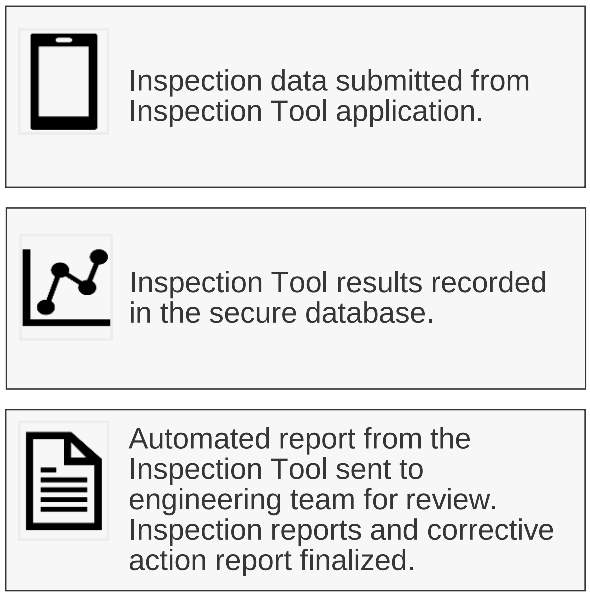


Figure 4.1: Summary of Inspection Tool

Based on identified violations during site inspections, the Inspection Tool generated a quality score. This was based on a one to five score that Natural Power used to quantify the quality of the systems. Table 4.3 summarizes the scoring system categorization, descriptions of the categorizations, and examples of violations seen based on the categorization.

Table 4.3: Inspection tool scoring system

Defect Category	Summary	Examples	Typical Score
No Issues	No identified issues.	No issues.	5
Incidental	Minimal issues not expected to impact safety or system operations.	Poor wire management, missing or incomplete labels.	4
Minor	Mid to long term risk of safety or system failure.	Bonding issues, insufficient clearance, undersized circuit protection, improperly supported conductors.	3
Major	Short term risk likely to affect system performance	Missing grounding equipment, module damage, missing or undersized grounding	2

Defect Category	Summary	Examples	Typical Score
	or safety, though not posing immediate hazard.	electrode conductors, improperly secured modules, cross-mated DC connectors, improper service conductor connectors.	
Critical	Immediate risk of system failure and/or safety hazards.	Exceedance of current limits on busbars or conductors, exceeding inverter voltage limits, and use of non-rated equipment in DC circuits.	1

Source: <Insert Source text here>

A scoring algorithm was developed that calculates the score based on the issues observed. A PV system with incidental issues would generally score a four out of five using the Inspection Tool scoring scale. However, if there were many incidental issues the score may become three out of five, instead of four out of five.

The Inspection Tool is heavily weighted on the 2020 edition of the National Electrical Code compliance and product installation instructions. The highly specific tool allows for consistency across inspections, and straightforward comparison and analysis of results.

4.3. Report Delivery and Installer Follow-Up

4.3.1. Installer Inspection Reports

The Inspection Tool automatically stores and collects inspection data. Additionally, the application automatically sends a draft report to the engineering team after the inspection is submitted through the Inspection Tool. This automation allows for review and approval of inspections in a timely manner. After processing, the reports are delivered to installers if any violations were found. In addition, a corrective action response ("CAR") template is created to aid installers in reporting reconciliation of issues.

4.3.2. Homeowner Inspection Reports

As part of the 2024 quality assurance study, Natural Power developed a homeowner-focused inspection report. This report translated the findings of the highly technical installer inspection report, discussed above, into a more accessible format for non-technical audiences. To ensure clear and consistent communication, Natural Power used a dedicated REG quality assurance email for all follow-up correspondence, ensuring homeowners received information from a single, trusted sender regarding inspection details. Each report highlighted any issues, provided relevant details, and included contact information for homeowners to reach out directly to their installer. Natural Power actively monitored this email and responded to any homeowner inquiries to ensure clarity and support throughout the process.

4.3.3. Procedures for Follow-Up with Installers

Natural Power used a REG quality assurance specific email for all follow-ups to ensure installers received information from a specific sender for all inspection details. Template emails were used for initial contact and for follow up emails with installers. After initial contact with the installer was made, Natural Power followed up on a weekly basis if corrective action was not taken. Natural Power tracked the installer response rate between the initial delivery of the inspection reports and CAR's and the date of response with suitable corrective action made, or response noting corrective action will be made.

4.4. Data Aggregation and Analysis

Natural Power reviewed the aggregate data for frequency of installation issues and deficiencies. Natural Power used the Inspection Tool quality score as a metric for determining the quality of installations. In addition, Natural Power observed the frequency of component issues by PV component. A summary of statistics Natural Power analyzed is shown in Table 4.4.

Table 4.4: Summary of metrics analyzed

Metric	Unit
Average Inspection Tool score	1-5
Weighted average Inspection Tool score	1-5
Average Inspection Tool score per installer	1-5
Frequency of system deficiencies	Total occurrences
Average time from initial outreach to completed corrective action times	Days

5. Study Findings

Natural Power has completed 95 inspections including 77 inspections of small-scale PV installations, 10 inspections of medium-scale installations, and 8 inspections of small-scale solar plus storage systems.

5.1. Small Solar PV System Findings

Natural Power completed inspections of 77 small-scale solar PV installations falling in the 2022 through 2024 tariff years.

5.1.1. Overall Small-Scale Solar Installation Quality Scores

Table 5.1 summarizes the small-scale inspection count per quality score. Natural Power calculated the average quality score for the small-scale PV installations. The average unweighted score across inspections was 2.66.

Table 5.1: Small-scale quality score summary

Score	Category Description	Installations with Quality Score
1	Critical and/or major deficiencies	10
2	Major deficiencies	31
3	Multiple minor deficiencies	15
4	Incidental/minor issues	17
5	No deficiencies or incidental deficiencies	4

Source: Natural Power Inspection Data

Figure 5.1 shows the proportion of quality scores for the small-scale installations inspected. 27.3% of installations have a quality score of four and five with no issues to minor issues, 19.5% of installations have a quality score of three with several minor deficiencies, and 53.2% of installations have a quality score of one and two with major to critical deficiencies.

Source: Natural Power Inspection Data

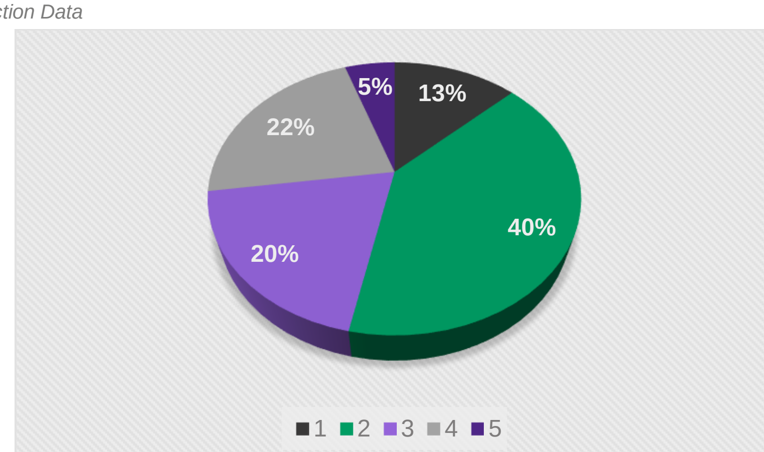


Figure 5.1: Proportion of small-scale quality scores

Natural Power also calculated the weighted quality score for the small-scale installations, as the unweighted average does not account for the proportion of installations per installer. This approach creates a larger emphasis on high volume installers. The weighted average quality score of 2.68 is 0.7% higher than the unweighted average, suggesting higher volume installers may have slightly fewer deficiencies in installations. The use of a weighted average presents a more representative analysis of the program, as the sample is disproportionate to the overall program installations.

5.1.2. Quality Score for Low Volume Installers

Natural Power further studied the installation quality by installer, specifically by low volume installers with 5 or fewer installations in the 2022 through 2024 REG tariff years. Overall, 22% of low-volume installers had a quality score of 4 and above with incidental issues observed, 67% had a score of 2 to 3 presenting major deficiencies, and 11% of low-volume installers had a score of 1 presenting critical issues. Table 5.2 outlines the average scores for low-volume installers.

Table 5.2: Low-volume installer average quality scores

Installer	Average Score
101	1.0
102	2.0
103	2.0
104	2.0
105	2.0
106	2.3
107	2.3
108	4.0
109	4.0

Source: Natural Power Inspection Data

5.1.3. Most Common Installation Issues

Natural Power tracked the occurrences of issues by major component in the PV installation. Table 5.3 shows the major components of PV installations and the occurrences of issues observed based on the components. Issues were often noted on the supply-side connection to the grid.

Table 5.3: Summary of issues observed by major PV components

PV Component	Incidental	Minor	Major	Critical	Total Occurrences
Array	3	10	1	0	14
Inverter	3	7	1	0	11
AC Combiner	1	6	3	1	11
AC Disconnect	0	2	0	0	2
Supply-Side Connection	150	101	46	1	298

Source: Natural Power Inspection Data

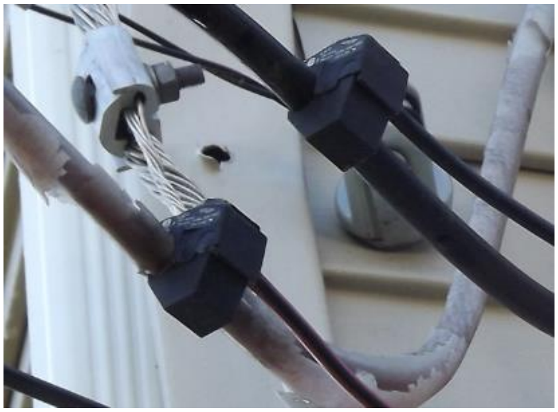
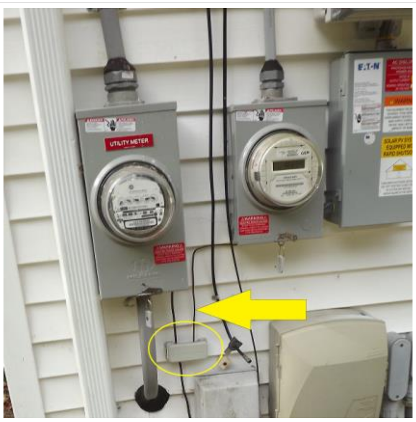
Table 5.4 outlines several deficiencies commonly observed during inspections. There were a very large number of deficiencies identified at the supply-side connection. This is likely because the method required by the program is unique and unconventional with a supply-side connection anywhere outside of this program. The supply-side connection is the point of interconnection and refers to the utility side of the main breaker or disconnect switch. The three most common supply-side connection findings are:

1. **Labeling/Identification:** In 90% of the systems inspected, the PV system disconnect did not have the proper directory labeling. Because this connection is on the utility side of the existing main breaker, a directory is required to indicate the additional disconnect that needs to be turned off in the event of an emergency. In addition, 65% of the PV disconnects were missing the reflective rapid shutdown label required by the NEC. This label informs firefighters that the system is equipped with rapid shutdown and identifies the rapid shutdown switch.
2. **Connection to Service Conductors:** 44% of the connectors used to tap into the existing outdoor electrical service conductors were not listed for outdoor use. The two most common types observed were insulation-piercing connectors and insulated mechanical lugs, both intended for use inside an enclosure. This issue is limited to an overhead electrical service where parallel services are provided from the weatherhead to individual meter sockets.
3. **Grounding:** 36% of the new PV service connections were not grounded in accordance with NEC requirements. This includes wiring the PV system disconnect like a second “tenant” on the house, connecting the PV grounding system to the main house grounding electrode system, and bringing the house grounding electrode system up to the current code requirements. 17% of inspections contained either a missing or undersized grounding electrode conductor, and 9% contained an improper connection to the intersystem bonding termination, which is intended for communication systems.

In addition, 80% of disconnect switches inspected were missing a lock or seal on its hinged door. This is a new requirement for the 2020 NEC and is intended to prevent unauthorized access to energized conductors. Without a lock, seal, or other component “requiring a tool” to open, energized conductors may be easily accessible to unqualified people, creating a potential shock hazard. Although the quantity of findings is lower than the last study, it is evident installers are still becoming familiar with this new requirement.

Table 5.4: Summary of small-scale common inspection issues

Pictures of Issues	Description of Issues
	The PV system disconnect is missing the following labeling/directories: • Directory of power sources at the house (NEC 705.10). – Showing how to safely de-energize all power to house. • PV system disconnect identification label (NEC 690.13(B)). • Rapid shutdown switch label (NEC 690.56(C)(2)). – Notifying firefighters this switch will initiate rapid shutdown. • Rapid shutdown directory (NEC 690.56(C)). – Identifying the type of rapid shutdown this array is equipped with.

Pictures of Issues	Description of Issues
	Indoor-rated insulation-piercing connectors used on outdoor service connection. (NEC 110.3(B))
	Indoor-rated insulated mechanical lugs used on outdoor service connection. (NEC 110.3(B))
	Improper PV system grounding connection to intersystem bonding termination (intended for communication system grounding). (NEC 250.64(C) and 250.94)

Source: Natural Power Site Inspections

5.2. Medium Solar PV System Findings

Natural Power completed 10 inspections of medium-scale solar PV installations that fell in the 2022 through the 2023 tariff years.

5.2.1. Overall Medium-Scale Solar Installation Quality Scores

Natural Power calculated the average quality score for the medium-scale PV installations. Table 5.5 outlines the results, summarizing the inspection count per quality score for medium-scale installations. The average score across inspections is 3.10.

Table 5.5: Medium-scale quality score summary

Score	Category Description	Installations with Quality Score
1	Critical and/or major deficiencies	2
2	Major deficiencies	1
3	Multiple minor deficiencies	3
4	Incidental/minor issues	2
5	No deficiencies or incidental deficiencies	2

Source: Natural Power Inspection Data

Source: Natural Power Inspection Data

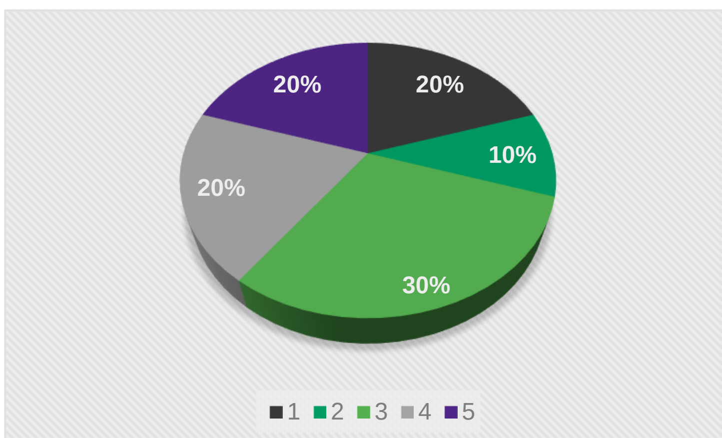


Figure 5.2: Proportion of medium-scale quality scores

5.2.2. Quality Score by Installer

Natural Power further studied the installation quality by installer. Overall, 63% of installers had a quality score of 3 and above with no issues to minor issues observed, and 37% had major to critical installation issues noted. Table 5.6 summarizes the average quality score by installer.

Table 5.6: Installer average quality scores

Installer	Average Score
201	1.0
202	1.0
203	2.0
204	3.0
205	3.0
206	4.0
207	4.5
208	5.0

Source: Natural Power Inspection Data

5.2.3. Most Common Installation Issues

Natural Power tracked the occurrences of issues by major component in the PV installation. Table 5.7 shows the major components of PV installations and the occurrences of issues observed based on the components. Major issues identified on the medium scale systems included cross-mated DC connectors, array grounding, and grid connection methods. The most common non-labeling issues observed were array conductors exposed to physical damage (40%), and array grounding (40%). Other issues observed in 20-30% of inspections included electrical conduit/raceway/cable support, DC connector mating/compatibility, and accessible disconnect switches missing a lock or seal on their hinged door.

Table 5.7: Summary of issues observed by major PV components

PV Component	Incidental	Minor	Major	Critical	Total Occurrences
Array	2	11	3	0	16
Inverter	0	0	1	0	1
AC Combiner	1	1	0	0	2
AC Disconnect	0	2	0	0	2
Supply-Side Connection	9	6	1	0	16

Source: Natural Power Inspection Data

Table 5.8 summarizes common deficiencies found in the medium-scale projects inspected.

Table 5.8: Summary of medium-scale common inspection issues

Pictures of Issues	Description of Issues
	Array conductors are not protected from physical damage. (NEC 300.4)
	Grounding hardware is not listed for outdoor use. (NEC 110.3(B) and 690.43)
	PV cables are not properly supported. (NEC 330.30)
	Cross-mated DC connectors: NEC 690.33(C) and UL standard QIJQ require mating of identical brands or product family unless evaluated for cross-mating. No such test exists between different brands.

Source: Natural Power Site Inspections

5.3. Small-Scale Plus Storage Findings

Natural Power completed eight small-scale plus storage inspections falling in the 2022 through 2023 tariff years.

5.3.1. Overall Small-Scale Plus Storage Quality Scores

Table 5.9 outlines the results, summarizing the inspection count per quality score for the small-scale plus storage installations. Natural Power calculated the average quality score for the small-scale plus storage installations. The average score across inspections is 3.63.

Table 5.9: Small-scale storage quality score summary

Score	Category Description	Installations with Quality Score
1	Critical and/or major deficiencies	1
2	Major deficiencies	1
3	Multiple minor deficiencies	2
4	Incidental/minor issues	0
5	No deficiencies or incidental deficiencies	4

Source: Natural Power Inspection Data

Source: Natural Power Inspection Data

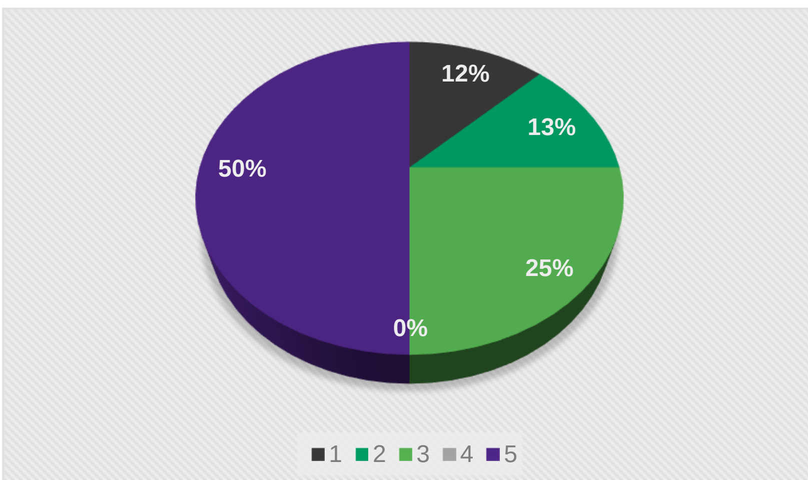


Figure 5.3: Proportion of small-scale plus storage quality scores

5.3.2. Quality Score by Installer

Natural Power further studied the installation quality by installer for the small scale plus storage projects. A summary of inspection scores by installer is found in Table 5.10.

Table 5.10: Installer average quality scores

Installer	Average Score
401	1.0
402	3.5
403	4.0
404	5.0

Source: Natural Power inspection data

5.3.3. Most Common Installation Issues

Natural Power tracked the occurrences of issues by major component in the energy storage system ("ESS") installation. All storage systems inspected were installed on homes with solar systems. Inspections were limited to the ESS component and grid connection and did not include review of the solar PV component. Table 5.11 shows the major components of small-scale plus storage installations and the occurrences of issues observed based on the components. Issues were often noted in the ESS labeling and supply side connection. Major issues were observed at a single inspection (24AD056) and were related to the service conductors and connection, like those on small-scale systems.

Energy storage system connection and configuration is far more complex than a PV system connection. Unlike a typical utility-interactive PV system where the inverter will shut down upon loss of primary utility power, an ESS requires external components such as a microgrid interconnect device ("MID") for grid isolation. For a configuration on an REG system, the PV output travels through the REG meter under normal operation, like a non-storage configuration. However, the addition of an automatic transfer switch is required to switch the PV output to a backup loads panel (normally connected to the existing meter) along with the ESS during a grid outage. This unconventional configuration, paired with the unique aspect of the REG service connection, creates additional complexity and increases the criticality of accurate labeling and identification.

Table 5.11: Summary of issues observed by major components

Component	Incidental	Minor	Major	Critical	Total Occurrences
ESS Labeling	7	4	0	0	11
ESS Configuration	0	5	0	0	5
ESS Structural	0	0	0	0	0
Supply Side Connection	2	1	2	0	5

Source: Natural Power Inspection Data

Table 5.12 provides examples of the configuration and labeling required for small-scale storage projects.

Table 5.12: Examples of small-scale plus storage configuration and labeling requirements

<table>
<tr><th>Pictures of Examples</th><th>Description of Examples</th></tr>
<tr><td>
</td><td>Example of the many components of a solar plus storage system for the REG program.
1. Main electrical panel
2. Backup loads panel
3. Utility breaker for PV system
4. PV inverter
5. Automatic transfer switch
6. Microgrid interconnect device
7. Energy storage system batteries</td></tr>
<tr><td>
</td><td>Standard configuration with all components properly identified for their purpose and noting the multiple sources of power.</td></tr>
<tr><td>
</td><td>Examples of the system characteristics (690.54) and configuration (706.21) labels required by the NEC.</td></tr>
</table>

Pictures of Examples	Description of Examples
	ESS disconnect identification required by NEC 706.15(C).

Source: Natural Power Site Inspections

5.4. Installer Responsiveness to Quality Installation Issues

Natural Power tracked installer responsiveness from initial outreach to receipt of response from the installer. There were 23 installer responses that provided corrective action. 6 responses were received notifying Natural Power that corrective action would be made, but there were delays in the installers' availability to conduct corrective action. On average it took 26 days from the initial outreach for receipt of installer response. Figure 5.4 outlines installer response by email reminder. 4% of responses were accounted for after initial contact, 42% were accounted for after the 1st follow up email, 21% account for response after the 2nd follow up email and 33% account for response after the 3rd follow up email.

Source: Natural Power installer responsiveness data

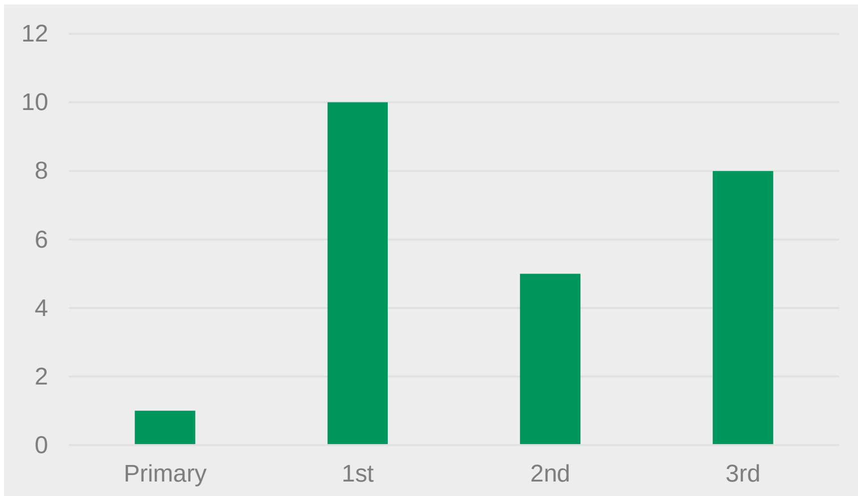


Figure 5.4: Installer response by email

Figure 5.5 summarizes the installer response by the initial score received from the inspections. Of installers that responded, 63% received a score of 4, 4% received a score of 3, 21% received a score of 2, and 8% received a score of 1. Overall, the average inspection score with installer response was 3.34.

Source: Natural Power installer responsiveness data

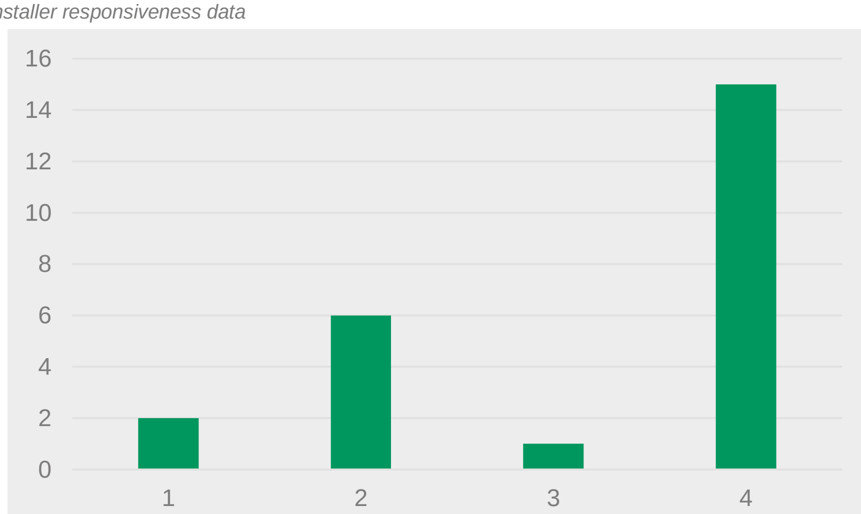


Figure 5.5: Installer response by score

5.5. Homeowner Inspection Report Findings

Natural Power provided homeowner inspection reports to all small-scale PV and small-scale plus storage participants following the inspection. Of the emails sent to homeowners, only two responses were received. The low volume of queries from homeowners suggested that most participants either reached out to their installer directly, did not review the email, had no concerns, or were satisfied with the inspection results. In comparison to the 2022 quality assurance survey, where responses were received from 36% of the small-scale PV and small-scale plus storage installers who underwent inspections, the 2024 survey saw a higher response rate of 62%. This increase may indicate that homeowners were more proactively directing their installers to address any identified nonconformities.

5.6. Customer Survey

In parallel with the inspection process, Natural Power surveyed small scale REG program participants with operational sites from the 2022 through 2024 REG tariff years on September 5, 2024. A reminder email was sent on September 19, 2024, to those who had not completed the survey. Of the REG program participants, 74% were from the 2022 REG tariff year, 23% were from the 2023 REG tariff year, and 3% were from the 2024 REG tariff year. The survey included 260 participants, with 46.9% of participants opening the invitation, 46.2% invitations unopened, 5.0% bounced invitations, and 1.9% opted out of the survey. Of the opened invitations, 18% completed the survey.

The survey asked questions related to program prior knowledge, perception of system quality, satisfaction with installers and Rhode Island Energy, feedback on the quality assurance inspection process, cost, and customer support.

5.6.1. Customer Feedback on Installer

Several questions surveyed the respondents' satisfaction with their system installer. Questions targeted installer performance of installations and customer service. The survey participants were asked to rate the performance from "very satisfied" to "not satisfied at all" for the following questions:

- How would you rate your satisfaction with your installer's performance when installing your system?
- How would you rate your satisfaction with your installer's customer service (e.g., responsiveness to questions and concerns, clarity, and timeliness of communication)?

Figure 5.6 outlines participant satisfaction with the installer's installation performance. The responses show general satisfaction for installation performance from installers.

Source: Rhode Island OER REG Quality Survey 2024 SurveryMonkey Results

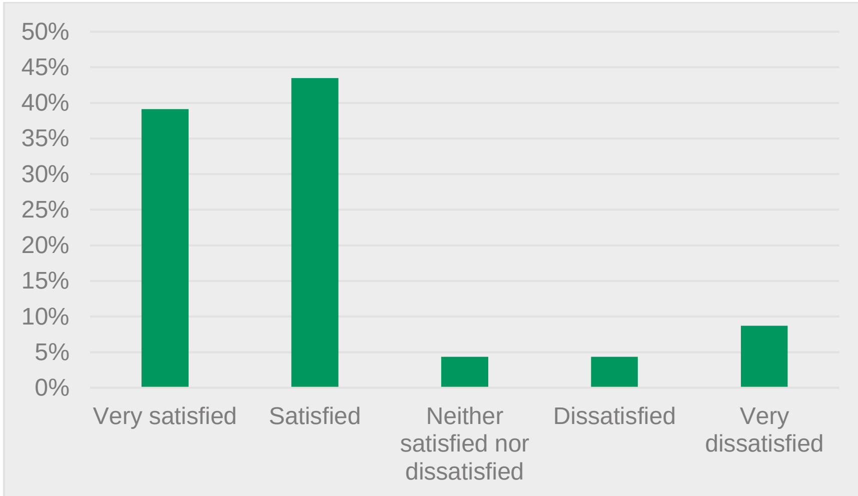


Figure 5.6: Satisfaction with installer's installation performance

Figure 5.7 outlines satisfaction with installer customer service. 69.6% of participants were satisfied, 13.0% were indifferent, and 17.4% were dissatisfied with their installer's installation performance and customer service. Overall, the results show participants had favorable satisfaction with their installers.

Source: Rhode Island OER REG Quality Survey 2024 SurveyMonkey Results

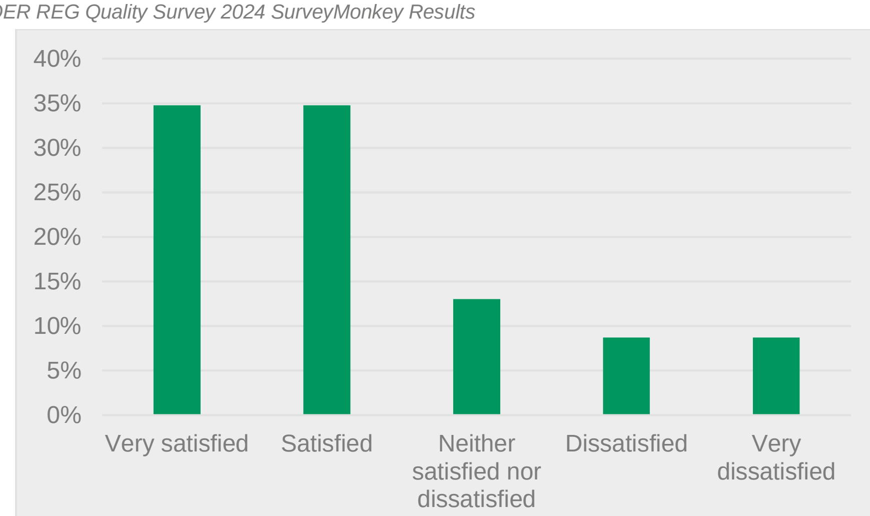


Figure 5.7: Satisfaction with installer's customer service

5.6.2. Performance and Benefit Expectations

Survey participants were asked questions related to the performance and payment expectations. The respondents were asked to rate their system's production and REG payments from "much lower" to "much higher" than their expectations for the following questions:

- How does the system's production/energy output compare with what you expected?

- How different is the Renewable Energy Growth compensation compared to what you anticipated?

Figure 5.8 summarizes the participant's satisfaction with the production of their system. 56.5% of participants found their production to be as expected or higher, and 39.1% found production to be lower than expected.

Source: Rhode Island OER REG Quality Survey 2024 SurveyMonkey Results

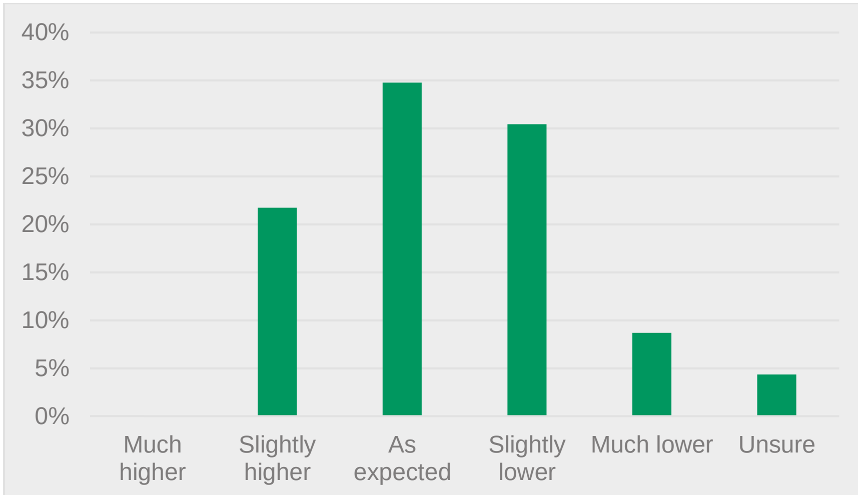


Figure 5.8: System production satisfaction

Figure 5.9 summarizes the participants' perception of the REG payments. 56.5% of participants found the payments to be as expected or higher than expected, and 43.5% of participants found the payments lower than their expectations. Production was slightly higher than the expectations of the participants, and the payments were correlated as being expected or slightly higher than expected.

Source: Rhode Island OER REG Quality Survey 2024 SurveyMonkey Results

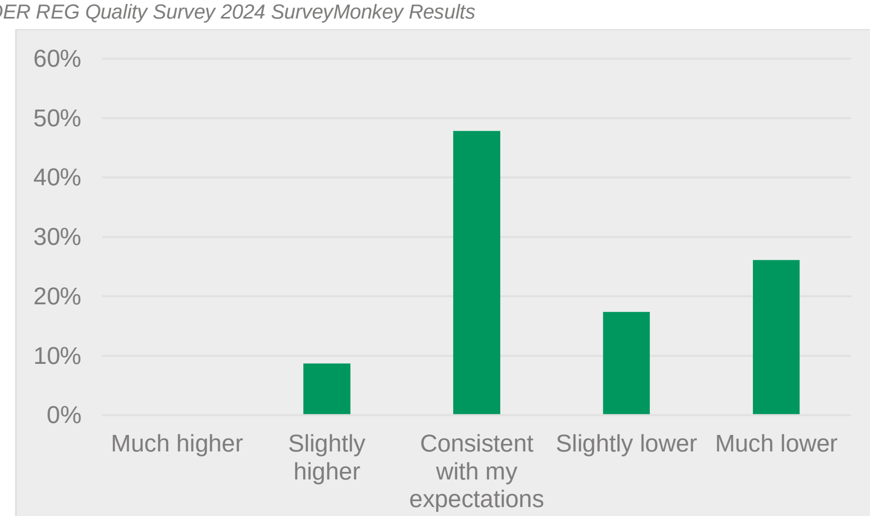


Figure 5.9: REG payment perception

Survey respondents were asked the following question related to the percentage of their monthly bill that is covered by payments:

- Approximately what percentage of your electric bill over the course of an entire year is covered by your Renewable Energy Growth bill credits and payments?

Figure 5.10 shows the results from survey respondents on the percentage of the REG bill credits and payments cover the electricity bill. Overall, 52.2% of respondents found credits cover 51% and above their electricity bill and 47.8% of respondents cover 50% or less of their electricity bill.

Source: Rhode Island OER REG Quality Survey 2024 SurveyMonkey Results

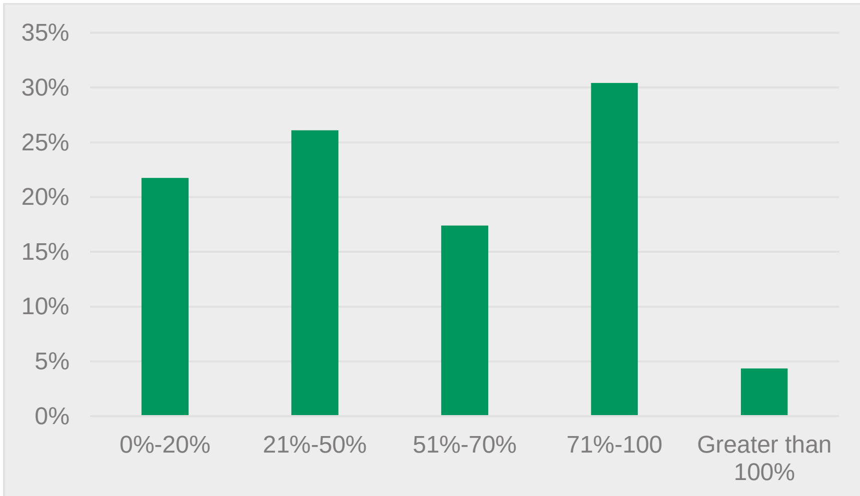


Figure 5.10: Electricity bill coverage over the course of a year

5.6.3. Quality Concerns

Respondents were asked if their system was operating as expected, of the respondents 13% answered no. Natural Power subsequently asked the following question:

- What part(s) of your system is not operating as expected? (Select all that apply)

Figure 5.11 outlines the survey respondents quality concerns by PV system component. Several free response answers were given noting issues with billing.

Source: Rhode Island OER REG Quality Survey 2024 SurveyMonkey Results

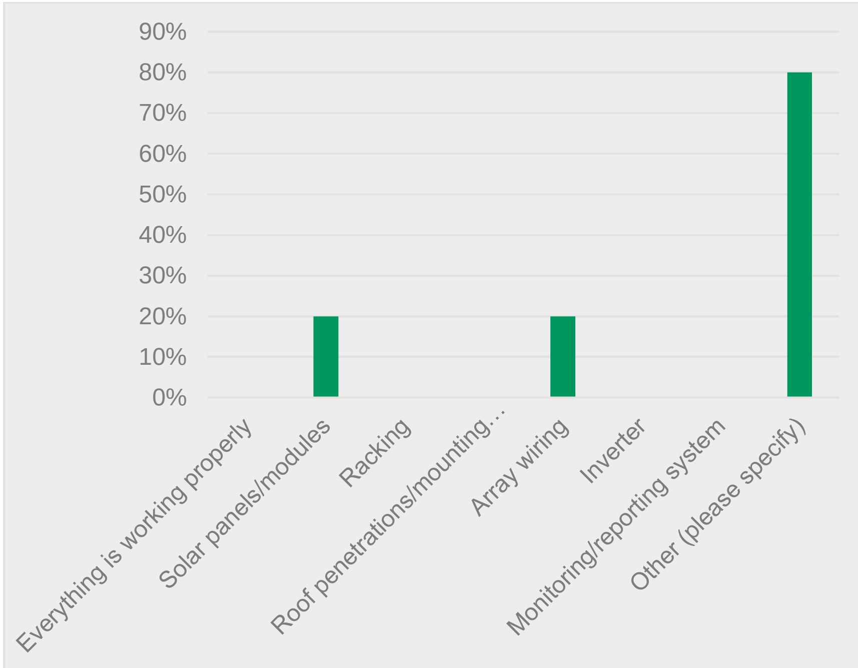


Figure 5.11: Quality concerns from survey respondents

5.6.4. Roof Age

Natural Power found that 60.8% of survey respondents were not made aware of the possibility of moving the system to facilitate roof replacement at some point in the next 20 years, and 34.8% were made aware of roof replacement over the lifetime of the system. Solar PV systems have a lifetime of 20 to 25 years. The lifespan of asphalt shingles is 15 to 20 years, the lifespan of architectural shingles is 20-30 years, and the lifespan of premium shingles is between 25 to 40 years. The installation of a PV system on a roof in the middle or end of its lifespan poses warranty and safety concerns of roof leakage, collapse, or costly removal of the system and reinstallation for roof replacement.

Survey respondents were asked the following question about the age of their roof system:

- If your renewable energy installation is installed on your roof, what was the age of your roof at the time of installation?

Figure 5.12 shows a summary of the roof age of the survey respondents. 34.8% of installations were installed on roofs that are 8 years or older. As the average expectancy of asphalt shingles is 20 years, PV systems are recommended to be installed on roofs no older than approximately 5-8 years old. PV system costs often do not include the removal and reinstallation for roof replacement.

Source: Rhode Island OER REG Quality Survey 2024 SurveyMonkey Results

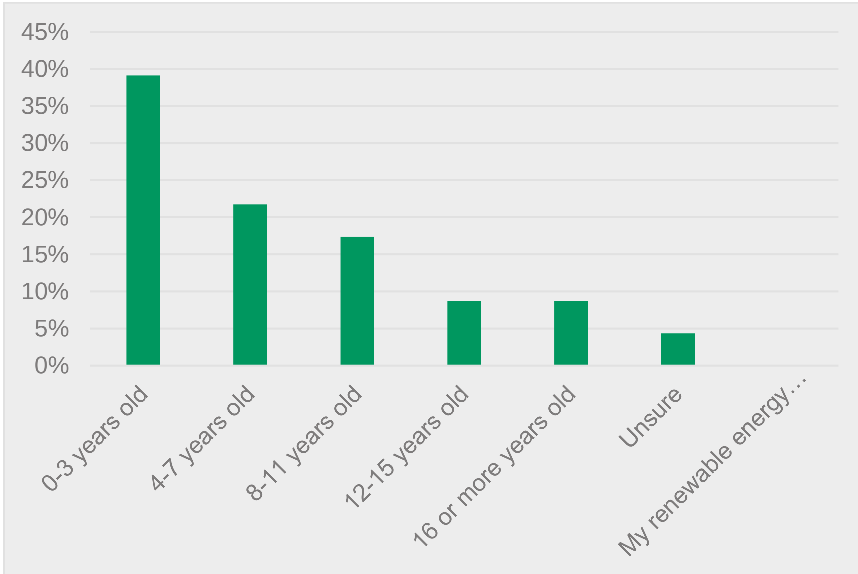


Figure 5.12: Survey respondents roof age

5.6.5. Consumer Disclosure Form

Natural Power surveyed respondents' knowledge of the consumer disclosure form and found that 8.7% signed the form, and 86.7% were unsure if they had signed the form. Overall, a large portion of the survey respondents were unsure of if they signed this form, suggesting there is not enough knowledge related to this form.

6. Conclusions and Recommendations

Natural Power noted trends in the results of the survey and from inspections. Several recommendations have been noted in the following sections from high priority to low priority based on the timeline these recommendations should be completed. High priority recommendations should be completed as soon as possible, and medium priority recommendations should be completed within six-months to a year. Figure 6.1 outlines the priorities and the timeline the recommendations should take place.

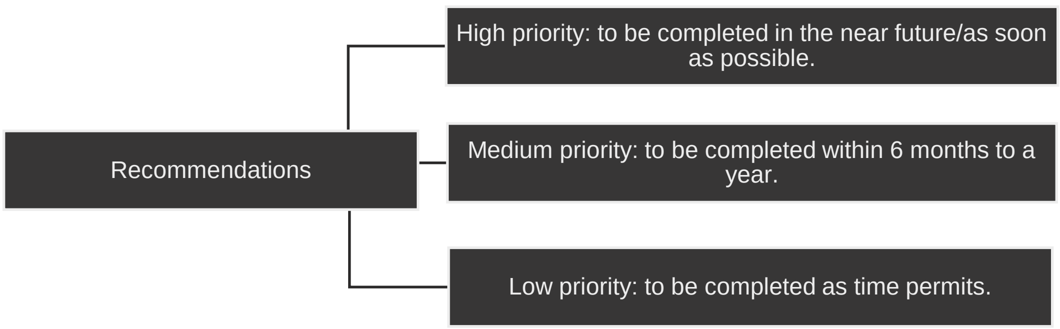


Figure 6.1: Recommendation priorities and timeline

6.1. High-Priority Recommendations

6.1.1. Installer Training

From the results of the inspections, Natural Power has noted several low-volume installers in the small-scale sample have lower quality scores as compared to the large volume installers. Natural Power recommends providing additional technical guidance and/or training sessions for these installers to raise awareness of the unique type of interconnection required for these systems. As noted in prior studies, the grid connection for this program is very unconventional for a residential application and installers have minimal guidance with the unique program and electrical code requirements. Natural Power is updating the new installer training program to include comprehensive details on unique interconnection requirements and technical guidance. This update aims to improve installers' awareness and understanding of the technical requirements within the REG program.

6.1.2. Inspections/Guidance During Construction

Natural Power recommends conducting 15-30 inspection-type site visits during the construction phase to offer installers on-the-job training. These site visits can count towards one of the required program inspections for each installer.

6.2. Medium-Priority Recommendations

6.2.1. Continued Quality Assurance Studies

Based on study findings, Natural Power recommends the continuation of quality assurance studies for REG funded renewable energy installations to further improve quality.

6.2.2. Continued Small-Scale and Storage Inspections

Natural Power recommends inspecting small-scale solar and storage installations to ensure the safety, quality, and conformance of installations. Natural Power recommends increasing the number of inspections of storage from 8-10 to 10-12 installations across different installers to collect enough data to understand typical deficiencies, trends, and areas in need of improvement.

6.2.3. Enhance Program Knowledge

The Quality Assurance Survey found 87% of participants that completed the survey would like to be provided a contact list of who to contact when issues occur, 35% of participants would like to have a frequently asked questions forum or report to help solve common issues, 26% of respondents would like to have an online community to talk to other REG participants, 8.7% are content with the status of the REG program, and 4.3% provided additional responses requesting more timely responses on questions and information requests. Based on these responses, Natural Power recommends creating an information center for REG participants to find contact information, frequently asked questions, and additional resources on the OER website.

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naturalpower.com
sayhello@naturalpower.com

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