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Audit Report - Solar Farm #470

Overview

GCA: Fatima Khaziyeva

Location: 346 Baker St, Longmont, CO 80501, USA

Coordinates: 40.165429548066456, -105.09434493287257

Solar Panels:

Quantity: 18

Brand and Model: CS6R-395MS by Canadian Solar

Warranty: 25 years

System Wattage Output: 7.11 kWDC, 5.22 kWAC

Installation and Operations:

Installation Date: After June 12, 2024

PTO Date: October 4, 2024

Short ID: 470

Carbon Footprint & Production:

Average Sunlight per day: 4.6830 hours

Adjusted Weekly Carbon Credits = 0.1414

Weekly Total Carbon Debt = 0.0432

Net Carbon Credit Earnings Weekly = 0.0982

Protocol Fees: \$8,107.61

Final Cost of Power: \$0.1041 per kWh

Solar Farm Site Profile

Tests performed by GCA	Results	Reference
Inspected the Residential Solar Energy System Purchase Agreement to verify the legal name of the entity owning the solar farm.	Owner: Solar Farm #470	Residential Solar Energy System Purchase Agreement
Inspected the Residential Solar Energy System Purchase Agreement, and conducted on-site verification to ensure the geographic coordinates of the solar farm are accurate.	40.165429548066456, -105.09434493287257	Residential Solar Energy System Purchase Agreement & Screenshot of GCA phone location
Inspected the Plan sets, and conducted an on-site physical verification to corroborate the size of the solar farm as stated in the documents.	7.11 kWDC, 5.22 kWAC	Planset p.1 & Audit Pictures
Inspected the Property Ownership Document, and conducted on-site verification to confirm the address and the zip code of the property.	346 Baker St, Longmont, CO 80501, USA	Mortgage Statement & Residential Solar Energy System Purchase Agreement
Conducted on-site verification to visually confirm the installation of solar panels on the property	There are 3 rows of panels. Each row with 6 panels. For a total of 18 panels.	Audit Pictures
Conducted on-site verification to visually assess the general condition and features of the property.	The solar panels are new and in good condition. They are ground-mounted and located next to the house.	Audit Pictures

Solar Panel details

Tests performed by GCA	Results	Reference
Inspected the document and conducted on-site verification to confirm the brand and model of the solar panels installed	CS6R-395MS by Canadian Solar	Planset [p.10] Audit pictures
Inspected the Manufacturer Warranty Document to verify the warranties provided for the solar panels	25-year warranty by Canadian Solar	Planset [p.10]
Inspected the Installation Approval by Longmont County Building Department and conducted on-site verification to confirm the installation method of the solar panels	Installed professionally, adhering to industry norms.	Inspection and Permit document

Calculation of the Expected Carbon Credit Production

Conducted calculations based on the specifications of the solar panels, historic data from WattTime and NASA, and any expected degradation to determine the expected carbon credit production per megawatt hour of electricity produced. For an in-depth understanding of these calculations, reference is made to the 'Assumption Documentation'.

Coordinates: 40.165429548066456, -105.09434493287257

Average Sunlight per day: 4.6830 hours

Carbon Credit Production per MWh: 0.9334

Calculations:

<http://95.217.194.59:35015/api/v1/geo-stats?latitude=40.165429548066456&longitude=-105.09434493287257>

Legal Documents

Tests performed by GCA	Results	Reference
Inspected the document to verify the ownership of the electricity generated by the solar panels	Ownership of the electricity generated by the solar panels has been confirmed.	Residential Solar Energy System Purchase Agreement
Inspected the document to verify the authorization for certifying carbon credit	The document has been inspected and verified for proper authorization to certify carbon credits.	Residential Solar Energy System Purchase Agreement

<p>Inspected the document and verified the solar farm owner's signature authorizing the list of information permitted for online publication</p>	<p>The solar farm owner's signature authorizing the list of information for online publication has been inspected and confirmed.</p>	<p>Residential Solar Energy System Purchase Agreement</p>
<p>Inspected the document to verify the details concerning the long-term operation of the solar panels</p>	<p>The document detailing the long-term operation plans and specifications of the solar panels has been inspected and verified.</p>	<p>Residential Solar Energy System Purchase Agreement</p>
<p>Inspected the document and verified the solar farm owner's signature authorizing the installation and utilization of monitoring equipment</p>	<p>The solar farm owner's authorization for the installation and utilization of monitoring equipment has been inspected and validated.</p>	<p>Residential Solar Energy System Purchase Agreement</p>
<p>Inspected the document and verified the solar farm owner's signature authorizing additional auditor visits.</p>	<p>Confirmation was obtained on the solar farm owner's signature authorizing additional auditor visits as per the inspected document.</p>	<p>Residential Solar Energy System Purchase Agreement</p>

Carbon Footprint Assessment & Calculations

In the assessment of the carbon footprint of the solar farm using monocrystalline technology, the harmonized emission result of 40g CO₂-eq/kWh was applied. This figure is anchored in assumptions such as ground-mount application, solar irradiation of 2,400 kWh/m²/yr, a performance ratio of 0.8, and a panel lifetime of 30 years. For an in-depth understanding of these assumptions, reference is made to the '[Assumption Documentation](#)'.

Tests performed by GCA	Results	Reference
Conducted independent calculations to assess the weekly minimum carbon payment required	<p>The carbon payment plan is an automated process, subtracted directly from the farm's weekly carbon credit production. This system does not involve any actual monetary transfers. Additionally, a crucial safeguard is in place whereby an owner cannot default on these carbon payments, as auditors will not certify any farm whose debt payments exceed its capacity to offset.</p> <p>Adjusted Weekly Carbon Credits = 0.1414 Weekly Total Carbon Debt = 0.0432 Net Carbon Credit Earnings Weekly = 0.0982</p>	Detailed calculations [p1]

Disaster Risk Assessment

In the disaster risk assessment of the solar farm, a conservative failure rate of 1% within the first 10 years of operation in the United States was adopted. This rate is derived from extensive research on historical failure rates and professional surveys, coupled with a conservative approach to accommodate unforeseen circumstances. Consequently, the per-year failure rate is calculated to be 0.17%. For a comprehensive explanation of the underlying assumptions and methodology, refer to the detailed information provided in the '[Assumption Documentation](#)'.

Technical Innovations

Upon physical inspection, it was observed that the solar farm employs standard commercial solar panels and does not feature any distinct technological innovations.

Communication Channels

The owner has acknowledged receipt and understanding of the established protocols for post-audit communication. This includes a comprehensive system for reporting any incidents, abnormalities, or significant changes that may occur following audit activities. Additionally, the owner confirms having received an updated list of contacts designated for post-audit communication purposes. A commitment has been made to adhere strictly to these protocols

and to promptly report any valuable changes or findings in accordance with the outlined procedures. The full details of these declarations and compliance are documented in the referenced 'Residential Solar Energy System Purchase Agreement'.

GCA information

This audit report has been prepared and finalized by an auditor who has fully complied with and signed the required clauses as outlined in the 'Auditor Disclosure and Declaration Document'. These clauses include the auditor's non-ownership of solar farms, non-possession of Glow tokens unless staked, non-ownership of unretired carbon credits, restriction on owning stocks or tokens outside of broad market exposure index funds, absence of business conflicts of interest, and adherence to the Glow International Code of Conduct. Additionally, the auditor has agreed to maintain a low community profile, with an undertaking to retire if they exceed a threshold of 5,000 social media followers/friends, ensuring unbiased and impartial auditing. The full details of these declarations and compliance are documented in the referenced 'Auditor Disclosure and Declaration Document'.

Conclusion

The audit confirms that the solar farm's location and specifications match the owner's reported information. The audit confirms that the solar farm meets these specifications, qualifying it for Glow Labs' incentive protocol.

The on-site inspection and monitor box installation was fully completed by Jared Morgan on October 15th, 2024.

Appendix - Calculations

carbon debt per KWh	value	details				
carbon footprint (CO2 g/KWh)	40	<i>see assumption document</i>				
convert grams to metric tons	0.00004	<i>conversion</i>				
solar irradiation (total h/y)	2400	<i>see assumption document</i>				
performance ratio	0.8	<i>see assumption document</i>				
panel lifetime (y)	30	<i>see assumption document</i>				
total carbon debt per KWh	2.304					
adjustment due to uncertainty	35%	<i>see assumption document</i>				
total carbon debt adjusted per KWh	3.1104					
Adjusted carbon debt	value	details				
annual interest rate	0.17%	<i>see assumption document</i>				
Commitment (y)	10	<i>see assumption document</i>				
total adjusted carbon debt per KWh	2.343					
weekly production	value	details	weekly Carbon debt	value	details	
Power Output (MWh)	0.0071	<i>based on solar production (see planset doc)</i>	total carbon debt adjusted (KWh)	3.1104	<i>calculated above</i>	
Hours of Sunlight Per Day	4.6830	<i>based on NASA data API</i>	Power Output (MWh)	0.0071	<i>based on solar production (see planset doc)</i>	
Weekly Power Production (MWh)	0.2331		convert to KW	7.1100	<i>conversion</i>	
Carbon Offsets per MWh	0.9334	<i>based on WattTime data API</i>	Total Carbon Debt produced	22.1149		
Weekly Carbon Credits	0.2176		disaster risk assesement per year	0.0017	<i>see assumption document</i>	
adjustment due to uncertainty	0.3500	<i>see assumption document</i>	Commitment (y)	10.0000	<i>see assumption document</i>	
Adjusted Weekly Carbon Credits	0.1414		Adjusted Total Carbon Debt	22.4871		
			Weekly Total Carbon Debt	0.0432		
NET Carbon Credit Earnings weekly	0.0982					

Protocol fees calculations

First Year Electricity Old Price	value	details
Electricity Price (paid by user) (in kW)	\$0.1041	see electrical usage bill (September 2024)
convert kW to mW	1000	conversion
Hours of Sunlight Per Day	4.6830	based on NASA data API
Power Output (MWh)	0.00711	based on solar production (see planset doc)
number of days	365.25	

First Year Electricity Old Price	\$1,265.44	
Lifetime Old Electricity Value		
First Year Electricity Old Price	\$1,265.44	calculated above
Escalator Rate	2.65%	see escalator reference for CO: https://www.solarreviews.com/blog/average-electricity-cost-increase-per-year
Cashflow Discount	11.00%	see assumption document
Continuous Growth Rate LN(escalator * discount)	9.04%	
Commitment (years)	10	
Present Value	\$8,107.61	

Protocol fees \$8,107.61

Detailed Energy Cost Calculation - September 2024

Total kWh usage	613
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Charges and Fees

	Fee amount
Energy Cost	61.61
City Sales tax 3.53%	2.17
Total Fees	63.78
Total Price per kWh (total cost / Total kWh use)	0.1041

Address:	346 Baker St, Longmont, CO 80501, USA
Coordinates:	40.165429548066456, -105.09434493287257
API Link:	http://95.217.194.59:35015/api/v1/geo-stats?latitude=40.165429548066456&longitude=-105.09434493287257
input average_sunlight	4.6829909041096
input average_carbon_certificates	0.9334135466633
system size from planset:	7.11 kWDC, 5.22 KWAC
# of panels:	18

CITY OF LONGMONT
 Customer: [REDACTED]
 Account No: [REDACTED]
 Service Address: 346 BAKER ST
 Bill date: 09/13/24
 Last account balance: \$239.36
 Thank you for paying: \$239.36
 Balance DUE NOW: \$0.00

ELECTRIC SERVICES
 Electric subtotal: \$61.61
 Monthly service fee: \$16.40
 3.53% city sales tax: \$2.75
TOTAL ELECTRIC SERVICE: \$80.76

WATER SERVICES
 Water subtotal: \$126.74
 Monthly service fee: \$9.13
TOTAL WATER SERVICE: \$135.87

WASTEWATER SERVICES

Electric usage (kWh)
 SEE BACK FOR USAGE DETAILS
 Water usage (gallons)
 SEE BACK FOR USAGE DETAILS

Appendix - Protocol fees - Proof of payment

Transaction hash:


0xd49778d38b11fc2849f1dd0af5ccea22dcdbfbe56848199925e27ef0c835960

Etherscan link:

<https://etherscan.io/tx/0xd49778d38b11fc2849f1dd0af5ccea22dcdbfbe56848199925e27ef0c835960>

Amount paid: 8,107.61 USDG

Date of payment: Oct-16-2024 09:28:23 PM UTC

Transaction Hash: 0xd49778d38b11fc2849f1dd0af5ccea22dcdbfbe56848199925e27ef0c835960 

Status: Success

Block: 20980810 26 Block Confirmations

Timestamp: 5 mins ago (Oct-16-2024 09:28:23 PM UTC)

Transaction Action: Transfer 8,107.61 ERC20 *** To 0xd5970622b740a2eA5A5574616c193968b10e1297



From: 0x2e2771032d119fe590FD65061Ad3B366C8e9B7b9 

Interacted With (To): 0x6Fa8C7a89b22bf3212392b778905B12f3dBAF5C4  

ERC-20 Tokens Transferred: All Transfers Net Transfers

From 0x2e277103...6C8e9B7b9 To 0xd5970622...8b10e1297 For 8,107.61 ERC20 ***

Appendix - Evidences Obtained From Solar Farm Owner

The GCA has successfully completed a thorough review and verification process for the following critical documents:

1. Residential Solar Energy System Purchase Agreement
2. Planset
3. Mortgage Statement
4. Two recent Utility Bills
5. City Permit
6. Inspection Document
7. Permission To Operate (PTO document)

Appendix - Drone Footage

To ascertain the additionality of the solar farm, the GCA procured drone footage BEFORE the solar panels were installed. This step was vital to confirm that the farm had not previously produced power, aligning with Glow's strict requirement that only new solar farms are eligible for incentives.

Scott-Front Range Drone Operations, a local company, was contracted by the GCA to capture pre-installation photos. The drone footage before installation was obtained on June 12th, 2024.

After the solar panels were installed and the farm secured its Permission To Operate (PTO), the GCA acquired new drone footage. This subsequent step ensured that the panels were correctly installed and that their quantity matched the specifications outlined in the plansets.

The drone footage after installation was obtained by Jared Morgan on October 15th, 2024.

Appendix - Cost of Power Verification

The determination of the protocol fee involves the homeowner submitting a utility bill, which outlines their power expenses. To ensure the integrity of this fee calculation, the GCA cross-reference the utility bill with publicly available data from the utility provider regarding local power rates.

The GCA accessed the Standard Residential Rates from City of Longmont Utilities, applicable in Colorado. For the protocol fee calculation, the rate of \$0.1041 per kWh, was applied.

Link:

<https://longmontcolorado.gov/longmont-power-communications/rates-and-fees/residential-rates/>

Appendix - Assumptions document

Assumptions Documentation

This document outlines the assumptions and methodologies employed in the audit of solar farms. It is intended to provide a clear basis for the procedures and findings reported in the audit report. This document should be referred to for a deeper understanding of the audit findings and the underpinning rationale for the audit procedures.

Testing Methodologies

Nature of tests performed

Type	Description
Inquiry	Engaged with relevant personnel to gather information and corroborated the details
On-site verification (Observation)	Conducted a thorough observation to verify the application and performance, as well as the physical existence of the solar farm's components
Inspection	Performed a detailed examination of documents, records, or tangible assets to validate their authenticity and relevance to the audit
Calculation	Performed calculations to ascertain various metrics pertinent to the audit scope

Assumptions

Protocol fees

Introduction: When a solar farm joins the Glow network, a protocol fee in USDC is required. This fee is distributed as rewards to carbon credit producers over four years.

Assumption: It's necessary to compute the cost of the protocol fee over a 10-year span. This calculation must encompass potential variations in electricity pricing and consider the long-term financial implications for the solar farm.

Methodology:

First Year Electricity Price Calculation: Begin by calculating the first year of electricity price using the following formula: Previous Electricity Price in kW × Hours of Sunlight Per Day × Power Output (MW) Per Hour × number of days.

Present Value Calculation: Next, extrapolate this first-year electricity price over a 10-year period, accounting for potential escalations in electricity prices. The escalation rate is dependent on the state in which the farm is located, with data sourced from reliable industry insights. This approach assumes that electricity prices will increase over time, which is a significant factor in the economics of solar energy.

Cash Discount Application: Apply a cash discount of 11% to the present value calculation. This rate is derived from doubling the current federal rate (estimated at 5.5%), with the rationale being the relative ease of surpassing this federal rate under current economic conditions. This 11% rate is specifically for the beta period of Glow, incentivizing early solar farm onboarding. After the beta phase, the standard federal rate will be used for discount calculations.

References

- <https://www.solarreviews.com/blog/average-electricity-cost-increase-per-year>

Disaster Risk Assessment

Assumption: A conservative failure rate of 1% is assumed for solar farms within the first 10 years of operation in the United States.

Methodology: Extensive research on historical failure rates of solar farms in the United States within the first 10 years has been conducted, with a conservative multiplier applied. Furthermore, professional surveys have been conducted. Despite discussions with solar professionals indicating a failure rate far below 1% over the lifetime of the solar farm, a conservative estimate of 1% was chosen to account for unforeseen circumstances. The per-year rate is 0.17%.

Carbon Credit Estimation Calculation

Assumption: WattTime's historical data is reliable and accurate for conducting calculations related to carbon credit production.

Methodology: Calculations were conducted based on the specifications of the solar panels and using historical data from WattTime. WattTime, a reputable non-profit organization in the emissions reduction domain, provides robust technology solutions for such assessments. Additionally, the methodology incorporates data from NASA's API to determine the expected number of sunlight hours for a solar panel in a specific location. This data is crucial for accurately estimating the average hours of sunlight per day and the average carbon offset per MWh.

To calculate the expected lifetime carbon credit production, the power capacity of the solar panels is multiplied by the sunlight hours, integrating both WattTime's and NASA's data. The script iterates over historical data from the WattTime API, combined with NASA's sunlight data, to estimate the number of credits a panel would have produced annually.

A 35% discount is then applied to the final carbon production value. This conservative approach is designed to account for any uncertainties in the calculations, ensuring that the results are within safety margins. This not only enhances the credibility of the protocol and methodology but also positions the analysis positively, especially when subjected to detailed reviews.

Real-Time Monitoring: It should be noted that for real-time monitoring of power output, NASA data is not utilized; instead, this monitoring relies on the installed equipment at the solar farm. This data can be cross-referenced with NASA's data if any discrepancies or suspicions arise, providing an additional layer of verification and accuracy.

Reference:

- https://github.com/glowlabs-org/gca-backend/blob/main/watttime-scripts/carbon_credits_per_kw.py

Carbon Footprint Assessment

Assumption: Considering the inherent variability in life cycle assessment (LCA) results for solar technologies as per ISO 14040 and 14044 standards, we have selected the highest value from NREL's harmonized data set for our conservative approach. This decision acknowledges the ISO standards' provision of a flexible framework for LCA, which can lead to a broad range of outcomes depending on the practitioner's choices. By adopting the highest value, we aim to account for the upper bound of potential environmental impacts, thereby ensuring that our audit conclusions are robust against the variability in LCA practices.

Methodology: The methodology involves utilizing the harmonized LCA results, which are refined by NREL to enhance precision and reduce variability. By adhering to a consistent set of methods and assumptions, harmonization narrows the range of greenhouse gas (GHG) emissions estimates, allowing us to base our audit on a more reliable and standardized benchmark.

It is important to note the specific harmonized greenhouse gas (GHG) emissions medians identified in our assessment. For monocrystalline Silicon (mono-Si), the harmonized GHG median is 40 g CO₂-eq/kWh, and for multi-crystalline Silicon (multi-Si), it is 47 g CO₂-eq/kWh. These values are calculated based on assumptions of ground-mount application, solar irradiation of 2,400 kWh/m²/yr, a performance ratio of 0.8, and a panel lifetime of 30 years. By integrating these specific medians into our assessment, we ensure a comprehensive and precise understanding of the potential environmental impacts of these solar technologies.

A 35% adjustment is then applied to the total carbon debt. This conservative approach is designed to account for any uncertainties in the calculations, ensuring that the results are within safety margins. This not only enhances the credibility of the protocol and methodology but also positions the analysis positively, especially when subjected to detailed reviews.

Detailed calculations:

Initial Calculation:

- 40 grams CO₂ per kWh (emissions rate).
- Multiplied by 2400 hours per year (operational hours).
- Multiplied by 0.8 (performance ratio).
- Multiplied by 30 years (lifespan of the panels).

Adjusted Carbon Debt:

- Calculated by adding a 0.17% annual interest rate.
- The total carbon debt is multiplied by 1.0017¹⁰ to account for 10 years.

Weekly Debt Payment:

- Determined by dividing the final carbon debt by 520 weeks (which accounts for 10 years, considering 52 weeks per year).

Reference:

- [NREL harmonized life cycle assessments \(LCAs\)](#)
- [Methodology Guidelines on Life Cycle Assessment of Photovoltaic Electricity](#)
- https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf p.7
- <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1530-9290.2011.00423.x> p.9
 - Research base on solar irradiation of 2,400 kilowatt-hours per square meter per year (kWh/m²/yr) and lifetime = 30 years
- <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1530-9290.2011.00439.x>

- The harmonized GHG medians decline to 40 g CO₂-eq/kWh for mono-Si and 47 g CO₂-eq/kWh for multi-Si.

CGA Disclosure and Declaration Document

CGA Personal and Professional Information

Name: Fatima Khaziyeva

Nationality: Canada

Declarations

1. No Ownership of Solar Farms:

I hereby declare that I do not own or operate more than one solar farm.

2. Glow Tokens Holding:

I declare that I do not own any Glow tokens, unless staked in accordance with company policies.

3. Carbon Credits:

I confirm that I do not own any unretired carbon credits.

4. Stocks and Tokens Ownership:

I declare that I do not own stocks or tokens, except for those within broad market exposure index funds.

5. Conflict of Interest:

I confirm the absence of any business conflicts of interest that could affect my impartiality as an auditor.

6. Code of Conduct Compliance:

I acknowledge having read, understood, and agreed to adhere to the Glow International Code of Conduct.

7. Community Presence and Popularity Clause:

I acknowledge that as a Glow Certified Auditor (GCA), it is imperative to maintain a low profile within the community to ensure unbiased and fair auditing processes. I agree that:

- If I previously expressed thoughts or opinions publicly, I understand these should not influence my role as a GCA.
- I will not leverage my position or knowledge gained as a GCA to become a known figure within the Glow ecosystem, recognizing the importance of an unbiased and impartial audit process.

Signature

The undersigned hereby agrees to the above terms and confirms that all statements made are true and accurate to the best of my knowledge.

Name: Fatima Khaziyeva

Signature: *Fatima Khaziyeva*

Date: October 16th, 2024