Renewable Energy System Project Report
Sylhet Engineering College

School of Applied Science and Technology
Shahjalal University of Science and Technology

Course code: EEE-723

Project: Feasibility Study for a small-scale PV project in North Baghbari,Sylhet

Project Submitted By

Rashedul Albab (2019338548)
Syed Nadim Mehdi (2019338563)

BSc in Electrical and Electronic Engineering
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Sylhet Engineering College

Project Submitted To

Md. Faiyaj Ahmed limon
Adjunct Lecturer,
Dept. of Electrical & Electronic Engineering
Sylhet Engineering College
Sylhet,Bangladesh

Exploring Solar Potential: Feasibility Study for a Small-Scale PV Project in North Baghbari, Sylhet

Towards a Greener Future

1. **Introduction:**

This report aims to evaluate the feasibility of a solar photovoltaic (PV) energy project in Bagbari, located in Sylhet, Bangladesh. The study employs the System Advisor Model (SAM) to estimate energy yield, assess financial viability, and analyze environmental impacts. Bagbari, characterized by its open landscape and absence of high-rise buildings, presents an ideal setting for a small-scale solar PV system. The project seeks to address the local energy demand sustainably while leveraging the area's abundant solar resources.

Project Overview:

- Location: Baghbari, Sylhet, Bangladesh.
- Latitude, Longitude: 24.90°N, 91.85°E
- System Type: Solar PV
- Inverter: Sungrow Power Supply Co-Ltd : SC1000KU [540V]
- Module: JA Solar JAM60S10-345/MR

2. Energy Yield Analysis:

The energy yield of the solar PV project was estimated using SAM,

considering the solar irradiance for North Baghbari and the system specifications.

I. Solar Irradiance:

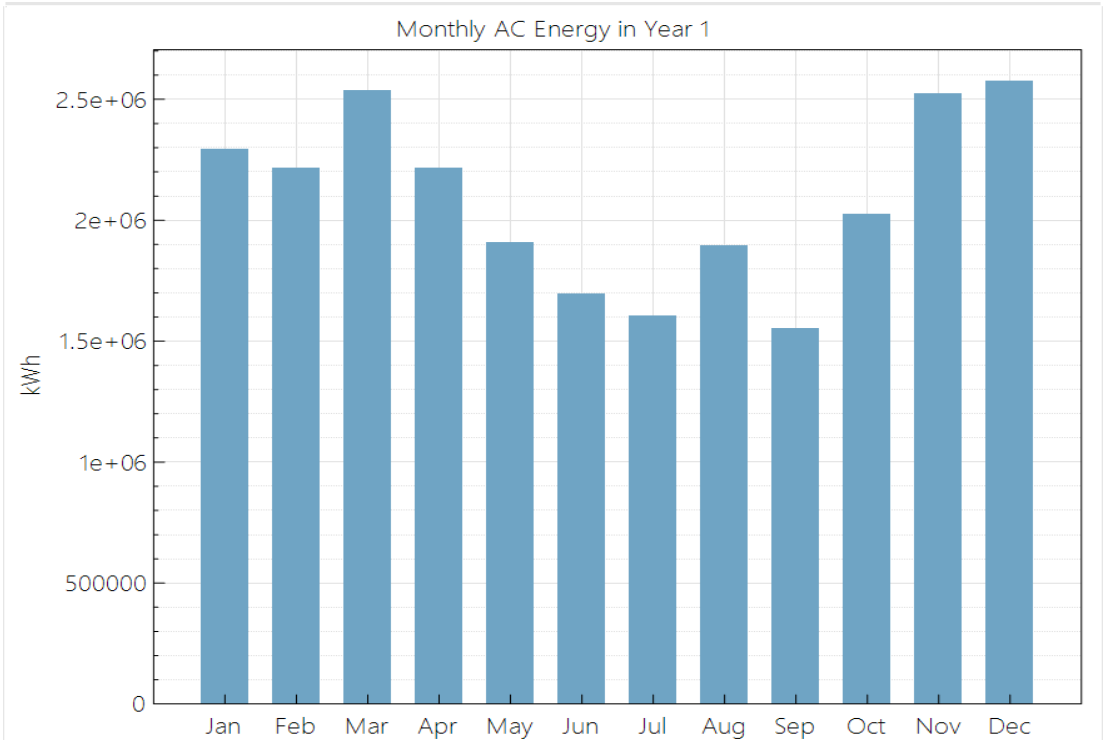
The selected location experiences an average solar irradiance of 4.52 kWh/m²/day annually, with high irradiation during the dry season (October to April) and lower levels during the monsoon season (May to September).

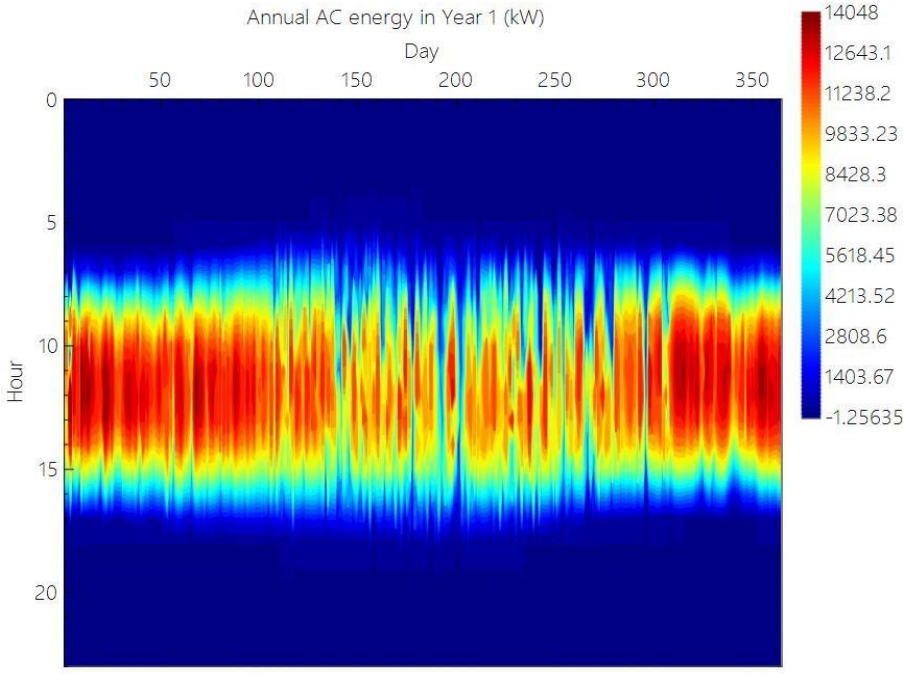
II. System Specifications:

- Module: JA Solar JAM60S10-345/MR
- Number of Modules: 50,400
- Inverter: Sungrow Power Supply Co-Ltd : SC1000KU [540V]
- Number of Inverter: 15
- Total Capacity: 15MW (based on 1.16 DC to AC ratio)

III. Monthly and Annual Energy Production:

Using SAM, the monthly and annual energy output was estimated. The system shows peak energy production during the dry season(October to April), with production ranging from 202,494 kWh/month to 221,631 kWh/month, maximum production is in the month of December with 257,663KWh\month with annual output expected around 250,353,56 kWh/y


Monthly AC Energy in Year 1
kWh
2.5e+06
2e+06
1.5e+06
1e+06
500000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Annual AC energy in Year 1 (kW)
Day
50
100
150
200
250
300
350
Hour
0
5
10
15
20
14048
12643.1
11238.2
9833.23
8428.3
7023.38
5618.45
4213.52
2808.6
1403.67
-1.25635

3. Financial Feasibility:

A detailed financial analysis was conducted using SAM's financial tools, taking into account initial investment, operating costs, and local energy prices.

Key Financial Metrics:

- Initial Investment: Estimated at $ 16,482,427.39 (per capacity =
- $ 0.95/Wdc)
- Operating & Maintenance Costs: $14/kW-year(fixed cost by
- capacity).
- Energy Revenue: Based on local electricity rates of
- $0.06/kWh.
- Payback Period: 15 years
- DC capacity factor in year 1: 16.4%(Reasonable for a solar project, demonstrating good energy generation efficiency relative to capacity.)
- Internal Rate of Return(IRR): 15.95%(Efficient and attractive, a good indicator of financial viability and profitability.)
- Net Present Value (NPV): $ 2,527,412 (positive NPV indicating financial viability) The payback period of 15 years is acceptable for small-scale projects, given the long operational life of solar PV systems (typically 25-30 years). The project is economically feasible based on its estimated energy production, positive NPV, solid IRR, reasonable assumptions and local electricity rates.

4. Environmental Impact:

The solar PV project in North Baghbari offers significant environmental benefits due to its reliance on renewable energy instead of conventional fossil fuels. Here's a brief analysis of its impact:

I. CO_2 Emissions Avoided:

- Annual energy production of 2,147,929 kWh avoids
- ~1,975.1tons of CO_2/year (based on 0.92 kg CO_2/kWh for
- grid electricity).
- Over 25 years, the system will prevent 49,377.5 tons of CO_2
- emissions.

II. Reduced Fossil Fuel Dependence: Replaces fossil fuel-based electricity, cutting harmful emissions like SO_2 and NO_x, improving air quality.

III. Promotes Renewable Energy: Demonstrates the potential of small-scale solar projects for sustainable energy solutions in rural areas.

IV. Minimal Environmental Footprint: Requires minimal land use, ensuring efficient resource use without disrupting the local environment.

5. Conclusion:

The feasibility assessment of the proposed solar PV project in North Baghbari highlights its potential as a sustainable and practical energy solution. Predominantly a residential area with two private hospitals, the project promises to meet local energy demands effectively. The financial analysis indicates economic viability, featuring a reasonable payback period and attractive financial returns. Additionally, the project offers significant environmental benefits, including a notable reduction in CO_2 emissions, making it an excellent choice for clean energy adoption in the community.