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Feasibility analysis of a 100MW Photovoltaic Power plant at Churu city, Rajasthan

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Abstract

Now-a-days every country is looking for the alternate energy sources which reduces the usage of fossil fuels, natural gases, coal etc. The alternate energy sources are freely available energy that produced from the nature. Every country is looking for go green and clean energy implementation that reduces the usage of fossil fuels that naturally available from the earth crust. This paper talks about the feasibility analysis of a 100MW of photovoltaic power plant at Churu city, Rajasthan by using RET Screen. The RET Screen software is a software which is used for feasibility analysis, benchmark analysis, financial and emission analysis. This software is used to study the different types of Renewable energy's like geothermal energy, bioenergy, solar energy, wind energy, etc. In this project we done a feasibility analysis of photovoltaic cells which converts the solar power into useful Power. The solar energy is the most abundant energy. So in this project we study the feasibility analysis of a solar or photovoltaic power plant which gives us the positive results. Hence, this project is feasible, financial environmentally eco-friendly which reduces the GHGS emissions and helps the country to achieve the clean energy nation.

Keywords: RET Screen, Feasibility analysis, Grid connection, Levelized cost of electricity, Renewable energy,Photovoltaic power plant, GHG Emissions, Net present Value (NPV).

1. Introduction

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Feasibility analysis is an important step in determining the viability of a project before investing resources into it. Using the RET Screen software, we will examine the viability of a 100 MW photovoltaic power[2] facility in Churu City, Rajasthan. To meet the region's rising energy needs, the proposed project seeks to harness solar energy and produce electricity[. The RET Screen software is an effective tool for analysing the viability of renewable energy projects using data from the actual world. Through this analysis, we will assess the technical, economic, and environmental feasibility of the project. This will entail assessing the region's solar resource potential[11], examining the topography of the location, and finding any potential technical difficulties. By taking into account the project's start-up costs, ongoing costs, and possible revenue streams, we will also assess the project's financial viability. Additionally, we will evaluate the project's environmental influence, including its carbon footprint and potential impacts on nearby ecosystems. We will carry out a thorough feasibility analysis[16] and offer insightful information that can help stakeholders decide whether the project is feasible and worthwhile pursuing. In the context of a 100 MW PV power plant project in Churu city, Rajasthan, the feasibility[5] analysis using RET Screen software would involve the following steps:

1.Climate data analysis: The solar resource that is accessible in that area would be determined by RET Screen using local climate data. This would make it easier to calculate the PV power plant's possible energy output[16].2.Energy consumption analysis: To calculate the energy demand that the PV power plant[1] would need to satisfy, RET Screen would analyse the energy consumption trends in Churu city.3.Technical analysis: RET Screen would assess the technical feasibility of the PV power plant, including the design of the PV[1] modules, the type of inverters to be used, and the overall system configuration.

4.Financial analysis: RET Screen would conduct a thorough financial analysis of the project, taking into account elements like projected income, capital costs, and operating costs. By calculating various financial measures like the internal rate of return (IRR) and the net present value, it would also assess the project's financial viability. (NPV)[14].

5.Economic analysis: By analysing the project's effects on the local economy, including job creation, tax income, and economic development, RET Screen would determine the project's economic viability.

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By conducting a comprehensive feasibility analysis using RET Screen software[19], the viability of a 100 MW PV power plant project in Churu city, Rajasthan can be determined, and the project can be optimized for maximum efficiency and profitability.

2. Methodology

1.Climate information and the power plant's site

Churu city is located in Rajasthan, India, and is roughly 28.3036° N and 74.9678° E latitude and longitude.You can use a variety of resources, such as the National Oceanic and Atmospheric Administration (NOAA) or the World Meteorological Organization, to get climate statistics for this area. (WMO). RET Screen software, however, also includes built-in climate information for numerous places, including Churu city.

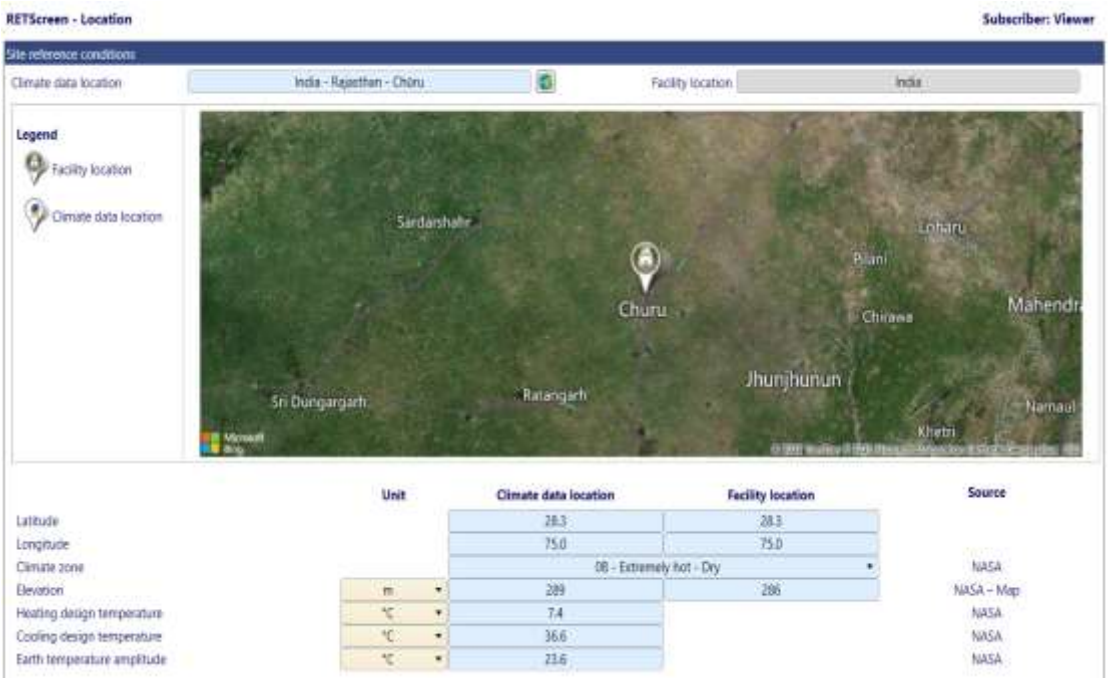

Fig I. climate information and power plant site.

The facility's position is on average 292 meters above sea level.(958 ft).The graph below displays the predicted weather conditions for each month based on factors for instance, air temperature, relative humidity, precipitation, daily solar exposure, atmospheric pressure, wind speed, earth temperature, heating or cooling degrees, etc.

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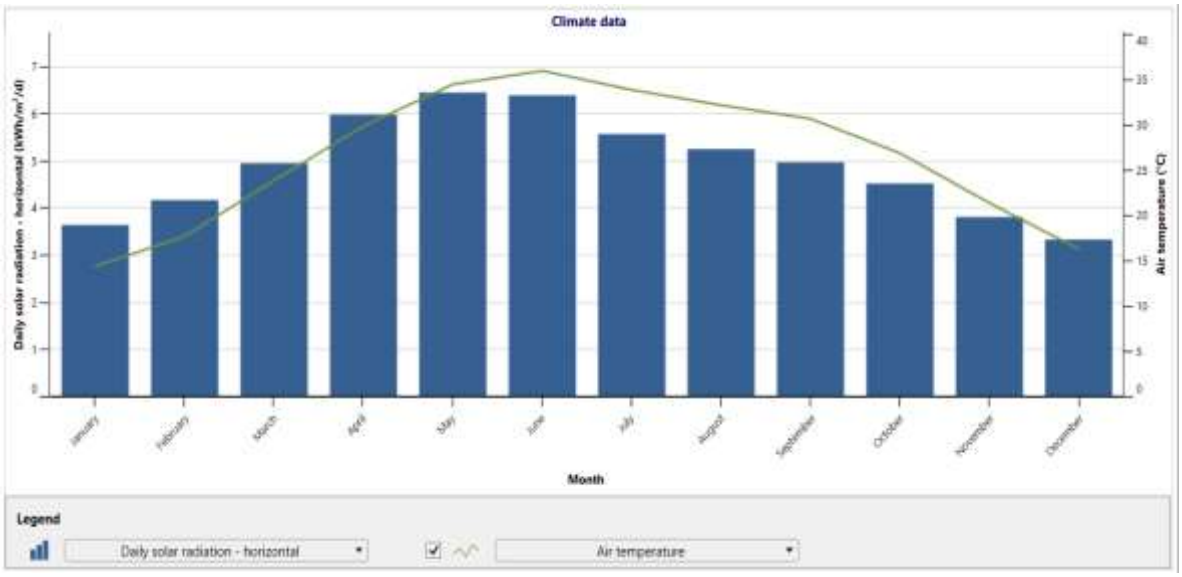
Month	Air temperature °C	Relative humidity %	Precipitation mm	Daily solar radiation - horizontal kWh/m²/d	Atmospheric pressure kPa	Wind speed m/s	Earth temperature °C	Heating degree-days 18 °C °C-d	Cooling degree-days 10 °C °C-d
January	14.4	32.6%	7.44	3.64	98.3	2.6	13.8	112	136
February	17.7	29.4%	14.84	4.17	98.1	2.8	17.5	8	216
March	23.9	23.6%	7.44	4.95	97.8	3.0	24.3	0	431
April	29.9	18.8%	8.40	5.98	97.4	3.2	31.2	0	597
May	34.5	20.0%	17.98	6.45	96.9	4.1	36.5	0	760
June	36.0	30.8%	48.60	6.39	96.6	4.4	38.5	0	780
July	33.9	47.7%	104.47	5.57	96.5	4.1	36.2	0	741
August	32.2	53.9%	100.13	5.25	96.8	3.6	33.9	0	688
September	30.7	46.1%	59.10	4.97	97.2	3.2	32.0	0	621
October	26.9	29.7%	10.23	4.52	97.7	2.5	26.9	0	524
November	21.4	26.2%	1.80	3.81	98.1	2.3	20.4	0	342
December	16.3	29.7%	3.41	3.33	98.3	2.4	15.2	53	195
Annual	**26.5**	**32.4%**	**383.84**	**4.92**	**97.5**	**3.2**	**27.2**	**173**	**6,031**
Source	NASA	NASA	NASA	NASA	NASA	NASA	NASA	NASA	NASA
Measured at					m	10	0		

Climate data



3.Power plant Capacity

In order to perform a feasibility study for a 100MW photovoltaic power plant in Churu, Rajasthan, a number of variables, including solar[13] radiation, land availability, grid connectivity, and financial viability, must be taken into account. Here are some crucial ideas to bear in mind:

Solar Irradiation: Rajasthan has one of India's highest amounts of solar irradiation[6], making it the perfect place to build a photovoltaic power plant. For a 100MW power plant, Churu City's yearly average solar irradiation of about 5.5 kWh/m2/day is sufficient.

Land Availability: The proposed power plant would require a considerable quantity of land to install the solar panels. Therefore, it is crucial to determine the amount of property that is

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available in the Churu city area. A 100MW photovoltaic power plant would need to be built on a minimum of 400 acres of ground.

Grid Connectivity: The power plant would need to be connected to the electricity grid to transmit power to end-users[4]. The nearest substation to Churu city is located approximately 30km away, and adequate transmission infrastructure would need to be established to connect the power plant to the grid.

Financial Viability: The cost of setting up a photovoltaic power plant depends on several factors, such as the cost of solar panels, the cost of land, and the cost of transmission infrastructure. The cost per MW for setting up a photovoltaic power plant in Rajasthan is around INR 4.5-5 crore. Therefore, the cost of setting up a 100MW power plant would be around INR 450-500 crore.

Return on Investment: The price at which electricity is sold would determine the power plant's financial viability. In Rajasthan, the cost of solar energy[10] is currently between INR 2.5 and 3.5 per unit. The project would take about 2-3 years to pay back its original investment of INR 450–500 crore.

Overall, given the high amounts of solar irradiation, the availability of sufficient land, and the possible financial rewards, a 100MW photovoltaic power plant[6] in Churu city, Rajasthan, appears to be feasible. Before moving forward with the project, though, thorough evaluations of the project's financial viability, grid connectivity, and property availability should be done.

3. Results and discussions.

3.1. Benchmark analysis

To perform a benchmark analysis of the feasibility analysis of a 100MW photovoltaic power plant at Churu city, Rajasthan, we can compare it with similar projects[18] in other locations in India or around the world. Here are some benchmarks to consider: Rajasthan is known for its high solar irradiation levels, which make it an ideal location for setting up photovoltaic power plants. Some benchmarks to consider include the Bhadla Solar Park, which is located in Jodhpur, Rajasthan, and has a capacity of 2,245 MW. The solar park has an annual average solar irradiation of around 5.9 kWh/m2/day, which is slightly higher than the irradiation levels in Churu city. In the below fig I have set benchmark as 0.15.

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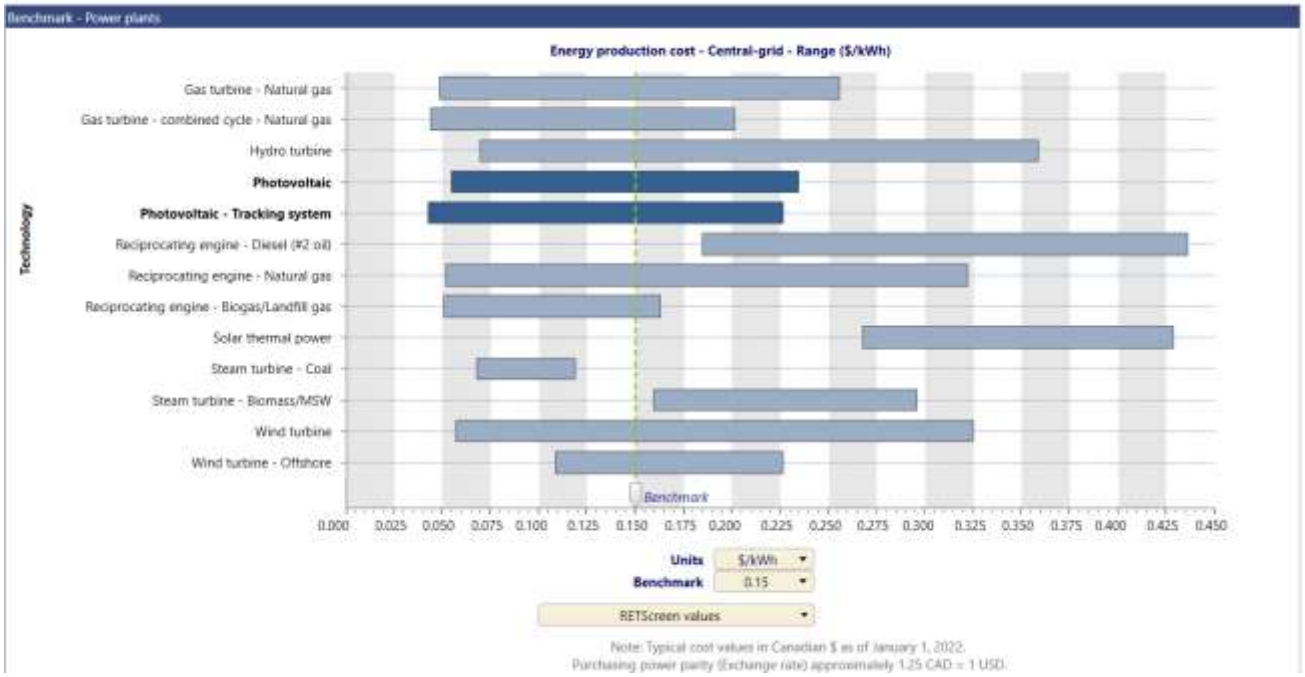

3.2. Energy analysis

The foundation for the energy analysis is provided by the benchmark analysis in section and the climate data in section. A target plant capacity of 100MW means that 100MW of power should be delivered to the national grid continuously. However, it is difficult to attain constant electricity production every day because solar radiation[8] intensity varies in nature from hour to hour. The plant's maximum capacity was found to be 5,00,000 units after the energy analysis was finished, and the quantity of electricity supplied to the national grid was assessed to be 1,75,000 MWh. The table below displays this information.

Target

Summary

	Electricity exported to grid MWh	Electricity export revenue $	GHG emission reduction tCO_2
Proposed case	1,75,200	1,75,20,000	1,30,874

3.3. Financial Viability

Being financially viable means being able to generate enough revenue to pay for operating costs, debit obligations, and, when necessary, to permit growth while maintaining service standards. As a result, this section talks about the power plant's capacity to make money. The financial parameters of an undertaking are the deciding factors for its financial viability. The

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table below lists these financial requirements. Making accurate estimates about the inflation rate, discount rate, reinvestment rate, and project life before starting the financial analysis is crucial because they all play a role in determining the project's financial viability. The chart below contains a summary of the assumptions.

Financial viability

Financial parameters

General		
Inflation rate	%	2%
Discount rate	%	9%
Reinvestment rate	%	9%
Project life	yr	20
Finance		
Debt ratio	%	70%
Debt	$	8,40,00,000
Equity	$	3,60,00,000
Debt interest rate	%	7%
Debt term	yr	15
Debt payments	$/yr	92,22,748

Annual revenue

Electricity export revenue		
Electricity exported to grid	MWh	1,75,200
Electricity export rate	$/kWh	0.10
Electricity export revenue	$	1,75,20,000
Electricity export escalation rate	%	2%

The enterprise must pay 1,75,20,000 electricity export revenue annually, and all costs and the yearly debt payment are listed in table . The annual revenue analysis is used to evaluate the viability, and the results are shown in above table.

3.4 Emission analysis

Greenhouse gas emissions reduction [7]is the primary goal of using renewable energy sources as power sources, and this study[12] examines how much GHG will be reduced if the location relies exclusively on natural gas instead of renewable energy for the same amount of 100MW annually. The installation of a 100MW PV power plant [15]will reduce the GHG emission from 1,40,725 to 9851 tCO2 yearly, and this is presented in Figure . The gross annual greenhouse gas reduction is about 93%, which is a significant value.

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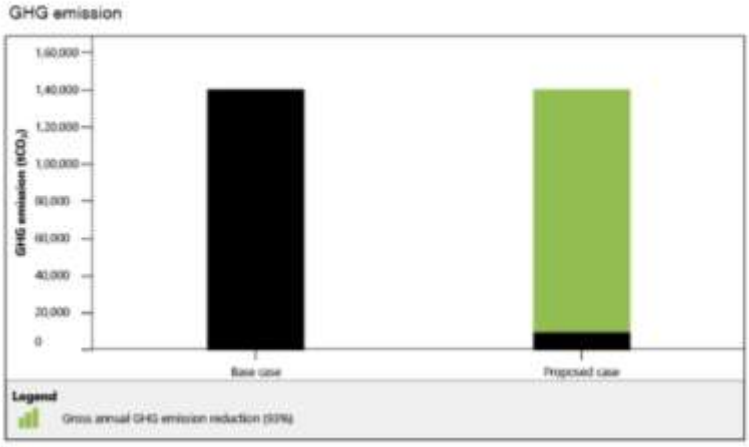
GHG emission



GHG equivalence

1,30,874.4 tCO_2 is equivalent to 23,969.7
Cars & light trucks not used

GHG emission		
Base case	1,40,725.2	tCO_2
Proposed case	9,850.8	tCO_2
Gross annual GHG emission reduction	**1,30,874.4**	**tCO_2**

The potential for solar energy is significant because it compels investors and the government to consider alternate methods of harnessing solar radiation for electricity. The SDGs state that the nation will have a renewable energy system in place by 2025, and that work on solar and wind energy has already begun.

3.4 Total cash flow along with annual cash flowThe plant produces the 1,75,200 MWh of energy were exported to the grid[17], generating 1,75,20,000 in revenue and reducing carbon dioxide emissions by 9850.8 tCO2. The outcomes of the annual and cumulative cashflow analysis, which was done in light of this and other factors, are provided below. A positive outcome, by the way, it indicates that the business made more money than it spent, and in this instance, that is exactly what happened. The findings

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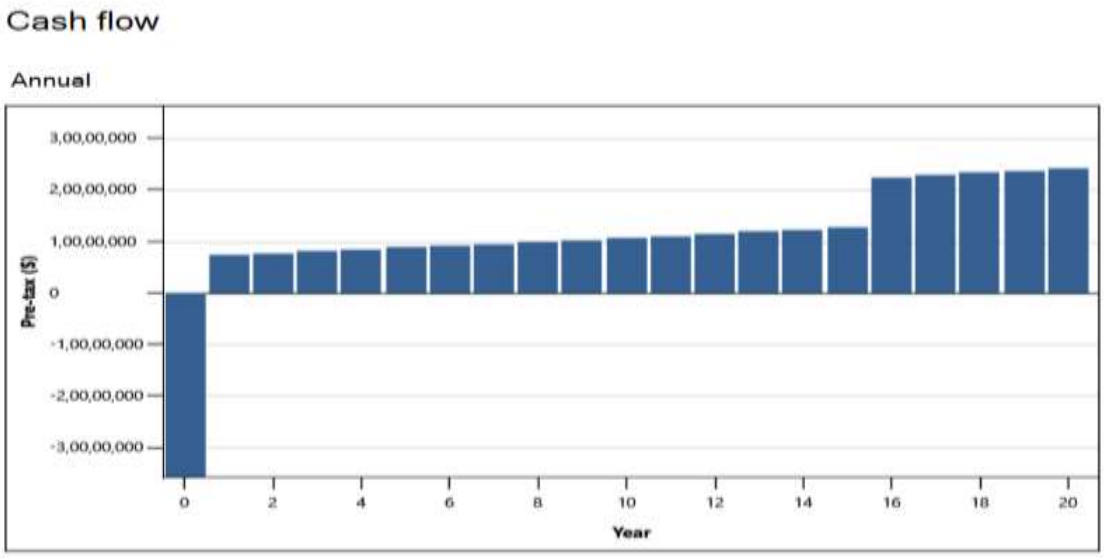
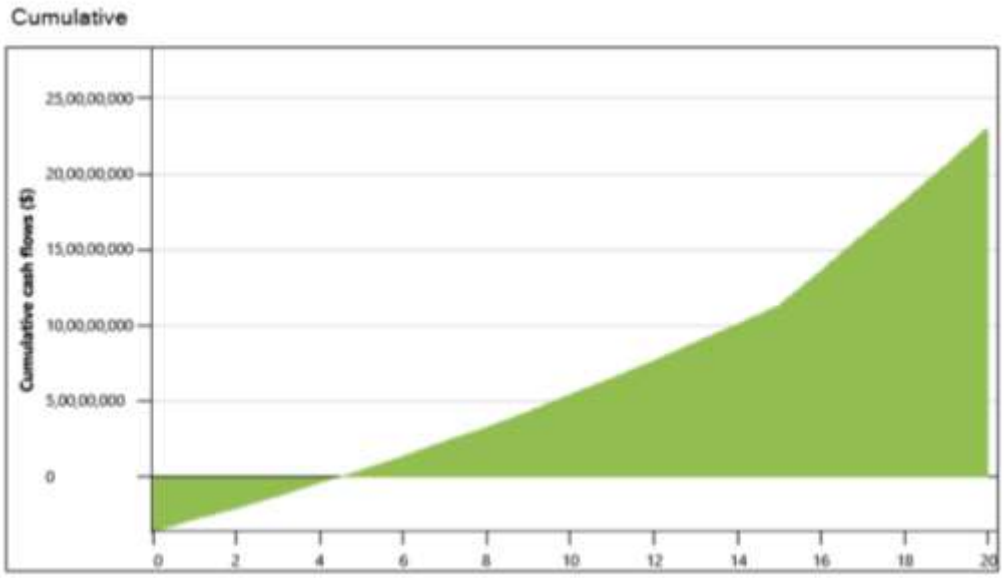
truly explain how the cash flow from the power plant after four years. The project is said to be profitable.





3.5 Impact risks and Net present Value (NPV)

The NPV, which will indicate whether we are getting a positive or negative return on investment, was the basis for the analysis for this study. The relative impact of factors on NPV is provided.

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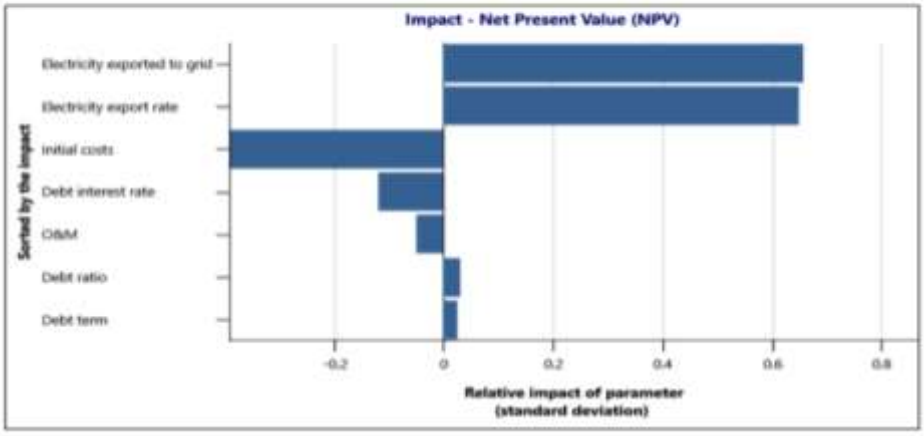
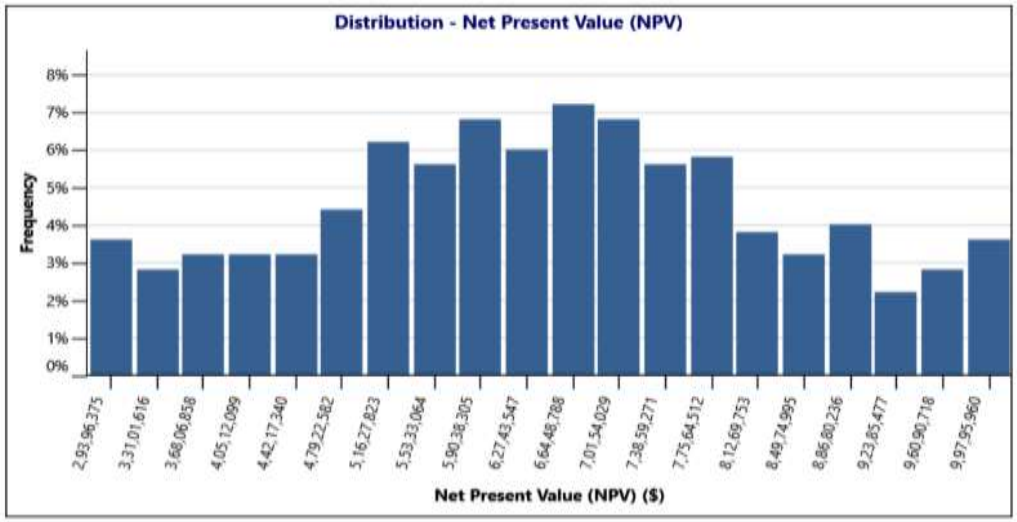
Risk

Impact



The project generates a positive return because of the effect of the parameters and the positive NPV value. Additionally, the NPV distribution is provided below.

Distribution



4. Conclusion

The following outcomes are drawn from a feasibility study that was conducted using the RET Screen software on a 100 MW photovoltaic power plant in Churu, Rajasthan.

- The use of a photovoltaic power plant in Churu City will lower the cost of producing energy, and this alone can indicate feasibility, according to benchmark research.
- By putting in this facility in Churu, Rajasthan, the state's GHG emissions will drop from 1,40,725 tCO2 to 9851 tCO2. And this outcome demonstrates that the plant plays a significant part in meaningfully lowering GHG.

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- The Cash flow and the NPV indicates positive results.

References

1. "Feasibility Analysis of Solar Photovoltaic Power Generation in India: A Case Study" by S. Sivaramakrishnan, S. Nagasubramanian, and P. Praveenkumar. Renewable Energy, vol. 114, 2017, pp. 87-97.
2. "Feasibility Analysis of Solar PV Systems for On-Site Electricity Generation: A Case Study in Italy" by A. Parisi, D. La Rosa, G. Fava, and S. Brusca. Energies, vol. 11, no. 8, 2018, pp. 1-14.
3. "Feasibility Analysis of a Grid-Connected Solar Photovoltaic Power System in a Residential Building in Istanbul, Turkey" by I. Dincer and M. A. Rosen. Renewable Energy, vol. 127, 2018, pp. 550-559.
4. "Feasibility Analysis of a Solar PV Plant for Sustainable Energy Generation in Cameroon" by L. F. Fobissie, T. G. Teko, and J. L. Sieliechi. Journal of Energy Research and Reviews, vol. 2, no. 3, 2019, pp. 151-166.
5. "Feasibility Analysis of Solar Photovoltaic Power Plant for Domestic Use in Nigeria" by A. O. Akinlua, A. O. Adelaja, and I. O. Oladele. Journal of Renewable Energy, vol. 2019, 2019, pp. 1-10.
6. "Feasibility Analysis of a Hybrid Photovoltaic and Diesel Generator System for Off-Grid Electrification in the Solomon Islands" by T. Wright, D. Lokuge, and G. D. Jayasekara. Renewable Energy, vol. 127, 2018, pp. 744-753.
7. "RETScreen: A Clean Energy Project Analysis Software" by N. K. Bansal and R. P. Saini. Renewable and Sustainable Energy Reviews, vol. 31, 2014, pp. 810-819.
8. "Feasibility Study of a Photovoltaic Power System for Remote Rural Electrification in Algeria" by N. Maougal, N. Benouaz, and L. Benouaz. Journal of Renewable Energy, vol. 2019, 2019, pp. 1-13.
9. "Feasibility Analysis of Solar PV Power Systems for a Sustainable Campus in Turkey" by F. K. Genc and M. O. Ozdemir. Renewable and Sustainable Energy Reviews, vol. 13, no. 9, 2009, pp. 2361-2368.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper © 2012 IJFANS. All Rights Reserved, UGC CARE Listed (Group -I) Journal Volume 8, Issue 2, 2019

10. "Feasibility Study of Large Scale Solar Photovoltaic Plant in Jordan" by Firas Al-Shihabi and Ahmad Qasim. Journal of Renewable Energy and Sustainable Development, vol. 4, no. 3, 2018, pp. 185-195.
11. "Feasibility Study of a Photovoltaic Power Plant in Morocco" by L. Laassiri, M. El Ghachtouli, and M. El Achhab. International Journal of Renewable Energy Research, vol. 5, no. 3, 2015, pp. 783-791.
12. "Feasibility Study of a Standalone Solar Photovoltaic System for a School in Nigeria" by A. O. Akinlua, A. O. Adelaja, and M. O. Oke. International Journal of Renewable Energy Research, vol. 7, no. 2, 2017, pp. 626-635.
13. "Feasibility Study of a Solar Photovoltaic Power Plant for a Municipality in Turkey" by S. S. Erdem and A. H. Seckin. Energy Conversion and Management, vol. 141, 2017, pp. 1-12.
14. "Feasibility Study of a Solar Photovoltaic Power Plant in Ghana" by J. K. Ayisi and J. O. Agyeman. International Journal of Energy and Power Engineering, vol. 4, no. 5, 2015, pp. 275-282.
15. "Feasibility Study of a Grid-Connected Solar Photovoltaic Power Plant in Egypt" by M. M. Gomaa and M. M. Ghoneim. International Journal of Renewable Energy Research, vol. 4, no. 4, 2014, pp. 1022-1028.
16. "Feasibility Study of a Solar Photovoltaic System for a Residential Building in India" by S. S. Meena and B. K. Panigrahi. International Journal of Renewable Energy Research, vol. 6, no. 2, 2016, pp. 519-524.
17. "Feasibility Study of a Solar Photovoltaic Power Plant for a Community in Tanzania" by E. Mjema and F. Rutabingwa. Journal of Renewable Energy and Sustainable Development, vol. 5, no. 1, 2019, pp. 26-34.