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The economic and technical feasibility analysis for solar power plant

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Abstract : *Solar power plants connected to the grid have emerged as reliable sources of renewable energy to supplement conventional fossil fuel power plants connected to the grid. The capital investment for solar power projects has become economical in the present time due to the advancement in photovoltaic module technology. The investment in a solar power project is non-recourse in financial structure. The case study for project finance in the renewable energy domain is narrated with the help of the operation research methodology of mathematical models for financial statements. The economic viability of a project is analysed by financial metrics, i.e., internal rate of return (IRR), net present value (NPV), and debt service coverage ratio (DSCR). The mathematical model for financial statements provides forecasts of revenue and cash flow. The mathematical model provides a risk assessment for credit. The identification of technical requirements for a greenfield project is described for the assessment of the technical feasibility of the project. The decrease in capital and operating costs associated with the increase in efficiency of solar power plants, accompanied by the financial incentive scheme introduced by the government, provides attractive business opportunities for the renewable energy value chain.*

Keywords: *Economic indicator for the infrastructure project, Mathematical model for financial statements, Project risk assessment by financial metrics*

1. INTRODUCTION :

India has the potential to generate renewable energy through solar power plants connected to the grid. Investment in solar power projects is typically non-recourse in financial structure. The equity firm and venture capital firm invest in solar power projects. The efforts of Indian government agencies and private business entities to achieve a greater share in the renewable energy market segment have led to a substantial increase in the installation of solar power projects in India. The generation of power from conventional fossil fuel power plants is a source of greenhouse gas emissions, which contribute to global warming. The geographical location of India provides solar radiation to almost all parts of the country, which accounts for 4–7 kW h of solar radiation per square meter. Photovoltaic modules, or PV panels, are made of semiconductors, which convert solar energy into direct current with the help of solar cells. The economies of scale associated with an increase in production lower the cost of photovoltaic (PV) modules. The power generated from a solar power plant has efficient utilization of energy due to nil energy storage losses. The solar power plant connected to the grid supplies the excess power after auxiliary consumption to the grid. Power generation by a solar power plant is expensive due to its high initial capital cost and low operational cost.

A typical infrastructure project for a solar power plant with a capacity of 10 MW requires approximately 50 acres of land. The solar power plant connected to the grid should have a minimum distance from the grid to minimize losses due to transmission. The geographical location and availability of unfertile land near canal sides and airport sides should be considered for the installation of a solar power project. The individual solar panel block has a generation capacity of approximately 625 kW. The total of sixteen blocks is combined to generate power of 10 MW. The land allocation is done for the solar block and its ancillary equipment. During the absence of solar radiation, power is imported from the grid for solar power plant auxiliary power requirements. The typical solar power plant connected to the grid consists of thin-film PV modules or crystalline silicon panels combined into arrays, inverters, power conditioning units, and grid connection equipment. The crystalline silicon panels are constructed by placing a single slice of silicon through a series of processing steps to create one solar cell. These solar cells are then assembled in multiples to produce a solar panel. The thin-film PV modules consist of CIGS, amorphous silicon, and CIS. Thin-film PV panels are made by applying thin layers of semiconductor material to various surfaces, generally glass. The optimal tilt angle of the PV module is kept near the latitude angle of the location for maximum solar radiation reception. The optimal tilt angle is varied in the range of 2 degrees to 3 degrees, depending on the latitude angle of the location. The PV panel mounting structure is designed to withstand rain, wind, and adverse weather conditions. The clamps, bolts, nuts, and fasteners for PV module mounting are made of stainless steel. The optimum distance between the lower level of the PV module and the ground is provided for maintenance work.

2. Objectives :

The economic and technical assessment of solar power projects connected to the grid provides guidance to entrepreneurs for the development of upcoming grid-connected solar power projects in the future. The infrastructure project development for a solar power plant has one of the highest initial capital investments in the domain of renewable energy. The infrastructure project development cost is approximately ₹ 10 crore per MW of solar power generation. The project development cost includes the cost of PV panels and the balance of plants, the cost of land acquisition for the power plant, and the project support manpower cost. The mathematical models for financial statements provide detailed financial figures for all expected developments in the infrastructure project. The mathematical model for financial statements allows project stakeholders to interpret project financial figures and hypothesize different development stages of the project. A mathematical model for financial statements is a tool that facilitates the decision-making power of equity investors, commercial banks, project developers, and entrepreneurs.

3. Literature Review :

Solar power projects are built up through government entities, private enterprises, and public-private partnerships (PPP) enterprises. The project financing model used by the PPP project with separate incorporation, i.e., the special purpose vehicle (SPV), raises non-recourse debt financing (Esty, 2004; Srivastava and Kumar, 2010). These SPVs, deemed bankruptcy-remote, have high leverage due to the use of non-recourse debt and contractual arrangements, often up to 90%-95% (Srivastava and Kumar, 2010). The provision of tie-ups with local business enterprises as joint ventures or special purpose vehicles (SPV) for capital investment provides a boost for solar power projects in India. Solar power projects are completed for commercial operations in a much shorter timeframe in comparison to conventional fossil fuel power projects. The turmoil, irrational panic, and breakdowns of financial markets impact public confidence and the stability of the financial systems as a whole and necessitate governmental interventions (Beltratti & Stulz, 2019; McKibbin & Fernando, 2020). In infrastructure projects, due to the defined location and non-movability, private investment through PPP is found to be more susceptible to hold-up pressures by local bodies post-investment, with a higher possibility of such obsolescing bargaining in developing economies (Jenkins, 1986; Wells and Gleason, 1995). The equity firms provide large-capital and medium-capital investments. The venture capital firm provides a smaller amount of investment. The equity and debt used to finance the solar power project are paid back from the positive cash flow generated after the commercial operation of the solar power project.

Anticipating the progress of financial instruments and attempting to pinpoint the next financial crises are actively pursued aspirations of many practitioners and academics (Lo Duca & Peltonen, 2013; Poon & Granger, 2003). The commercial bank and equity sponsor are interested in cash flow generation from the commercial operation of the solar power project and the debt service coverage ratio. Most of these capital-intensive projects have a high degree of technical, managerial, and political risk, due to which innovative approaches are required for effective financing and management, which are provided by PF structures (Beidleman et al., 1990). The mathematical model for financial statements provides a tool for an entrepreneur to make confident decisions after a potential risk assessment. The availability of big financial data on a tick-by-tick basis reveals potential for a deeper understanding of stated properties, trading processes, or the management and assimilation of financial asset risks (Cordis & Kirby, 2014; Bodnar & Hautsch, 2016). The best way to assess the profitability of the project is by examining the financials it is expected to produce in the future.

4. Methodology :

The mathematical model for financial statements provides the economic indicators for project feasibility through the computation of equity IRR, project IRR, DSCR, NPV of equity, and NPV of the project. The mathematical model serves as a virtual representation of economic activities. The main purpose is to build a reasonable proxy of the foreseen economic period in the future and to validate project decisions based on facts and figures. The calculations performed in the mathematical model for financial statements are logically related, and the result of the calculation shows clear relationships between expenditure, revenue, cash flow, and debt repayment. The mathematical model for financial statements provides a credit analysis of the borrower’s ability to repay debt in the future on the basis of cash flow generation from projects and the debt service coverage ratio (DSCR).

5. Analysis & Discussion :

The financial analysis of the solar power project is narrated with the help of a case study of a solar power project developer in India. The mathematical model for financial statements is applied to provide an assessment of the economic feasibility of the project. The output of the mathematical model allows an entrepreneur to make confident decisions.

The project developer has signed a PPA (power purchase agreement) for 25 years with a utility electricity distribution company for a 10 MW solar power plant at a fixed tariff of ₹ 3.50 per kWh. They are expecting a net annual energy production of 18 million kWh per year, with a degradation rate of 1% per year. The expected capital expenditures are ₹ 3 crore per MW, and operational expenditures are ₹ 30 crore per annum for the whole plant. They are seeking a non-recourse debt with a debt-to-equity ratio of 70:30 from leading commercial banks in India as a 12-year (maximum) term loan. The calculations in the mathematical model for financial statements are done in Indian rupees.

Table 1 provides data for capital expenditures. The capital cost for the project consists of land acquisition, erection, and commissioning activities for a solar power plant connected to the grid.

Table 1. Data for capital expenditures

Project Cost (Cap Ex)			
Installation cost (MW / INR lakhs)	MW	**300**	**% of Project Cost**
Solar project capacity installed (MW)	10	3,000	100.0%
Total solar project cost (INR lakhs)		**3,000**	

Table 2 provides data for operational expenditures. Operation and maintenance costs consist of the maintenance costs of solar equipment and operational expenses.

Table 2. Data for operational expenditures

O & M Cost (yearly Breakdown) (OpEx)		
Solar plant cost (Operation & Maintenance)	30	30
Total O&M Cost (In INR lakhs)		**30**

Table 3 provides financial projection data for project finance through the debt and loan repayment schedule. The total cost of the project is ₹ 3000 crore. The funds raised 70% by debt through commercial banks provide a total debt amount of ₹ 2100 lakh. The term loan is for 12 years. The total payment given to the commercial bank, including an interest rate of 10% on the principal amount, is ₹ 3629.40 lakh.

Table 3. Debt and loan repayment financial projection data

Debt /Loan Repayment Schedule

Debt Amount	2100.00
Debt rate	10.00%
Moratorium	0.25 yrs
Term	12.0 yrs
Payment Periods	48
One period is one quarter	
COD	19-Oct-2023
First Quarter End	17-Jan-2024

Period No.	Date (EoQ)	Int. Pmt.	Prin. Pmt.	Total Pmt.	Prin. Balance
0	19-Oct-2023	52.50	0	52.50	2100.00
1	17-Jan-2024	52.50	23.11	75.61	2076.89
2	16-Apr-2024	51.92	23.69	75.61	2053.20
3	15-Jul-2024	51.33	24.28	75.61	2028.91
4	13-Oct-2024	50.72	24.89	75.61	2004.02
5	11-Jan-2025	50.10	25.51	75.61	1978.51
6	11-Apr-2025	49.46	26.15	75.61	1952.36
7	10-Jul-2025	48.81	26.80	75.61	1925.56
8	8-Oct-2025	48.14	27.47	75.61	1898.09
9	6-Jan-2026	47.45	28.16	75.61	1869.93
10	6-Apr-2026	46.75	28.86	75.61	1841.06
11	5-Jul-2026	46.03	29.59	75.61	1811.47
12	3-Oct-2026	45.29	30.33	75.61	1781.15
13	1-Jan-2027	44.53	31.08	75.61	1750.07
14	1-Apr-2027	43.75	31.86	75.61	1718.20
15	30-Jun-2027	42.96	32.66	75.61	1685.55
16	28-Sep-2027	42.14	33.47	75.61	1652.07
17	27-Dec-2027	41.30	34.31	75.61	1617.76
18	26-Mar-2028	40.44	35.17	75.61	1582.59
19	24-Jun-2028	39.56	36.05	75.61	1546.55
20	22-Sep-2028	38.66	36.95	75.61	1509.60
21	21-Dec-2028	37.74	37.87	75.61	1471.72
22	21-Mar-2029	36.79	38.82	75.61	1432.90
23	19-Jun-2029	35.82	39.79	75.61	1393.11
24	17-Sep-2029	34.83	40.78	75.61	1352.33
25	16-Dec-2029	33.81	41.80	75.61	1310.53
26	16-Mar-2030	32.76	42.85	75.61	1267.68
27	14-Jun-2030	31.69	43.92	75.61	1223.76
28	12-Sep-2030	30.59	45.02	75.61	1178.74
29	11-Dec-2030	29.47	46.14	75.61	1132.59
30	11-Mar-2031	28.31	47.30	75.61	1085.29
31	9-Jun-2031	27.13	48.48	75.61	1036.81
32	7-Sep-2031	25.92	49.69	75.61	987.12
33	6-Dec-2031	24.68	50.93	75.61	936.19
34	5-Mar-2032	23.40	52.21	75.61	883.98
35	3-Jun-2032	22.10	53.51	75.61	830.47
36	1-Sep-2032	20.76	54.85	75.61	775.62
37	30-Nov-2032	19.39	56.22	75.61	719.39
38	28-Feb-2033	17.98	57.63	75.61	661.77
39	29-May-2033	16.54	59.07	75.61	602.70
40	27-Aug-2033	15.07	60.55	75.61	542.15
41	25-Nov-2033	13.55	62.06	75.61	480.09
42	23-Feb-2034	12.00	63.61	75.61	416.48
43	24-May-2034	10.41	65.20	75.61	351.28
44	22-Aug-2034	8.78	66.83	75.61	284.45
45	20-Nov-2034	7.11	68.50	75.61	215.95
46	18-Feb-2035	5.40	70.21	75.61	145.74
47	19-May-2035	3.64	71.97	75.61	73.77
48	17-Aug-2035	1.84	73.77	75.61	0.00

Date (EoQ)	Int. Pmt.	Prin. Pmt.	Total Pmt.	Year
31-Oct-2024	206.47	95.98	302.45	1
31-Oct-2025	196.51	105.94	302.45	2
31-Oct-2026	185.51	116.94	302.45	3
31-Oct-2027	173.37	129.08	302.45	4
30-Oct-2028	159.97	142.48	302.45	5
30-Oct-2029	145.18	157.27	302.45	6
30-Oct-2030	128.86	173.59	302.45	7
30-Oct-2031	110.84	191.61	302.45	8
29-Oct-2032	90.94	211.51	302.45	9
29-Oct-2033	68.99	233.46	302.45	10
29-Oct-2034	63.15	239.30	302.45	11
29-Oct-2035	57.17	245.28	302.45	12
Total	**1586.97**	**2042.43**	**3629.40**	

Table 4 provides financial projection data for revenue. The revenue for solar power plants comes from the power purchase agreement (PPA) with the utility electricity distribution company for a period of 25 years. The utility electricity distribution company purchases renewable energy from solar power plants at a rate of ₹ 3.50 per kWh. The revenue from the sale of 18 million kWh per year to the utility electricity distribution company is ₹ 630 lakh per year. The solar power plant's efficiency reduces by 1% per year, resulting in a degradation of revenue of 1% per year. The net revenue after 25 years is ₹ 490.03 lakh.

Table 4. Revenue financial projection data

Revenue Parameters	
Project Location	India
Tariff rate (INR/Kwh)	3.50
Production (Kwh/annum)	1.80E+07
Degradation/annum	1.00%

Year--->	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Revenue (in INR lakhs)	630.00	623.70	617.46	611.29	605.18	599.12	593.13	587.20	581.33	575.52
Degradation(INR Lakhs)	6.30	6.24	6.17	6.11	6.05	5.99	5.93	5.87	5.81	5.76
Net Revenue (INR lakhs)	623.70	617.46	611.29	605.18	599.12	593.13	587.20	581.33	575.52	569.76

11	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*
569.76	564.06	558.42	552.84	547.31	541.84	536.42	531.05	525.74	520.49	515.28	510.13	505.03	499.98	494.98
5.70	5.64	5.58	5.53	5.47	5.42	5.36	5.31	5.26	5.20	5.15	5.10	5.05	5.00	4.95
564.06	558.42	552.84	547.31	541.84	536.42	531.05	525.74	520.49	515.28	510.13	505.03	499.98	494.98	490.03

Table 5 provides financial projection data for project cash flow. In the mathematical model for the projection of cash flow to compute the financial return from the project, a few assumptions have been made. The assumptions help in the mathematical model for the projection of cash flows, the internal rate of return (IRR), the net present value (NPV), and the debt service coverage ratio (DSCR).
The inflation rate is taken to be 4% by observing the economic conditions. The tax rate is taken to be 25%.
The debt rate is taken to be 10%.
The discount rate for the investment is 10%.

The estimation of cash flow is done after considering all the assumptions. The steps involved were the following:

The revenue was calculated as per the available financial data set. The project developer did not mention additional revenue sources, so other sources of income were not added for the computation of the financial figure.

The operating expenses were subtracted from the revenue, and EBITDA was calculated. After this, non-operating expenses were deducted from EBITDA.

Income before tax was generated

Then tax was deducted, and finally income after tax was calculated. The depreciation was added back to get the final cash flow.

Table 5. Project cash flow financial projection data

PROJECT DETAILS			ASSUMPTIONS					
Installation cost / MW	10	3000.00	Inflation	4.00%	Debt rate	10.0%	USD/INR	70.00
Equity	30%	900.00	DDT	0.00%	Moratorium	0.25 yrs	Discount	10%
Debt	70%	2100.00	Tax Holiday	0 yrs	Debt tenure	12.0 yrs	Construction Time	0.25 yrs
Debt Service Resv (DSR)	0.25 yrs		Tax rate	25.00%	Depreciation	7.00%	MAT	18.5%

Year ------>	Today	COD	1	2	3	4	5	6	7	8	9
Date --->	20-Jul-2023	19-Oct-2023	31-Oct-2024	31-Oct-2025	31-Oct-2026	31-Oct-2027	31-Oct-2028	31-Oct-2029	31-Oct-2030	31-Oct-2031	31-Oct-2032
Revenue Collection											
Revenue (in INR lakhs)			630.00	623.70	617.46	611.29	605.18	599.12	593.13	587.20	581.33
Degradation (INR Lakhs)			6.30	6.24	6.17	6.11	6.05	5.99	5.93	5.87	5.81
Net Revenue (INR lakhs)			623.70	617.46	611.29	605.18	599.12	593.13	587.20	581.33	575.52
Operating expenses											
Whole plant O & M (INR lakhs)			30.00	31.20	32.45	33.75	35.10	36.50	37.96	39.48	41.06
Total Operating Expenses (INR lakhs)			30.00	31.20	32.45	33.75	35.10	36.50	37.96	39.48	41.06
EBITDA			593.70	586.26	578.84	571.43	564.03	556.63	549.24	541.85	534.46
Non Operating Expenses											
Interest payment			-206.47	-196.51	-185.51	-173.37	-159.97	-145.18	-128.86	-110.84	-90.94
Depreciation			-210.00	-195.30	-181.63	-168.91	-157.09	-146.09	-135.87	-126.36	-117.51
Total Non-Operating Expenses			-416.47	-391.81	-367.14	-342.29	-317.07	-291.28	-264.73	-237.19	-208.46
Income before taxes			177.23	194.45	211.70	229.14	246.96	265.35	284.52	304.66	326.00
Tax			-44.31	-48.61	-52.92	-57.29	-61.74	-66.34	-71.13	-76.16	-81.50
Net Income			132.92	145.84	158.77	171.86	185.22	199.02	213.39	228.49	244.50
Cash Flow											
Equity	-900.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Income			132.92	145.84	158.77	171.86	185.22	199.02	213.39	228.49	244.50
Add back depreciation			210.00	195.30	181.63	168.91	157.09	146.09	135.87	126.36	117.51
Principal Payment (-)			-95.98	-105.94	-116.94	-129.08	-142.48	-157.27	-173.59	-191.61	-211.51
CSR (0.50 % of Net Income) (-)			-1.71	-1.71	-1.70	-1.70	-1.71	-1.73	-1.75	-1.77	-1.81
Final Project Cashflow (Equity)	-900.00	0.00	245.23	233.49	221.76	209.99	198.13	186.12	173.92	161.46	148.70
DSCR			1.82	1.78	1.74	1.70	1.66	1.62	1.58	1.54	1.50
Final Project Cashflow	-3000.00	0.00	547.68	535.94	524.21	512.44	500.58	488.57	476.37	463.91	451.15

10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
31-Oct-2033	31-Oct-2034	31-Oct-2035	31-Oct-2036	31-Oct-2037	31-Oct-2038	31-Oct-2039	31-Oct-2040	31-Oct-2041	31-Oct-2042	31-Oct-2043	31-Oct-2044	31-Oct-2045	31-Oct-2046	31-Oct-2047	31-Oct-2048
575.52	569.76	564.06	558.42	552.84	547.31	541.84	536.42	531.05	525.74	520.49	515.28	510.13	505.03	499.98	494.98
5.76	5.70	5.64	5.58	5.53	5.47	5.42	5.36	5.31	5.26	5.20	5.15	5.10	5.05	5.00	4.95
569.76	564.06	558.42	552.84	547.31	541.84	536.42	531.05	525.74	520.49	515.28	510.13	505.03	499.98	494.98	490.03
42.70	44.41	46.18	48.03	49.95	51.95	54.03	56.19	58.44	60.77	63.21	65.73	68.36	71.10	73.94	76.90
42.70	44.41	46.18	48.03	49.95	51.95	54.03	56.19	58.44	60.77	63.21	65.73	68.36	71.10	73.94	76.90
527.06	519.66	512.24	504.81	497.36	489.89	482.39	474.86	467.31	459.71	452.08	444.39	436.66	428.88	421.04	413.13
-68.99	-63.15	-57.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-109.29	-101.64	-94.52	-87.91	-81.75	-76.03	-70.71	-65.76	-61.15	-56.87	-52.89	-49.19	-45.75	-42.54	-39.57	-36.80
-178.27	-164.79	-151.69	-87.91	-81.75	-76.03	-70.71	-65.76	-61.15	-56.87	-52.89	-49.19	-45.75	-42.54	-39.57	-36.80
348.79	354.87	360.55	416.90	415.61	413.86	411.68	409.11	406.15	402.84	399.18	395.20	390.92	386.33	381.47	376.33
-87.20	-88.72	-90.14	-104.23	-103.90	-103.46	-102.92	-102.28	-101.54	-100.71	-99.80	-98.80	-97.73	-96.58	-95.37	-94.08
261.59	266.15	270.41	312.68	311.70	310.39	308.76	306.83	304.61	302.13	299.39	296.40	293.19	289.75	286.10	282.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
261.59	266.15	270.41	312.68	311.70	310.39	308.76	306.83	304.61	302.13	299.39	296.40	293.19	289.75	286.10	282.25
109.29	101.64	94.52	87.91	81.75	76.03	70.71	65.76	61.15	56.87	52.89	49.19	45.75	42.54	39.57	36.80
-233.46	-239.30	-245.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-1.85	-1.84	-1.82	-2.00	-1.97	-1.93	-1.90	-1.86	-1.83	-1.80	-1.76	-1.73	-1.69	-1.66	-1.63	-1.60
135.56	126.65	117.83	398.58	391.49	384.49	377.57	370.73	363.94	357.21	350.52	343.87	337.24	330.63	324.04	317.45
1.45	1.42	1.40													
438.01	429.10	420.28	398.58	391.49	384.49	377.57	370.73	363.94	357.21	350.52	343.87	337.24	330.63	324.04	317.45

6. Results

Table 6 provides financial figures from the final calculations performed on the spreadsheet-based mathematical model for financial statements, generally known as the financial modelling technique.

The equity IRR turned out to be 22.89%, which is more than the discount rate of 10%, with a net present value (NPV) of ₹ 1186.48 lakh. The value of this investment is worth ₹ 1186.48 lakh today.
The project IRR turns out to be 14.89%, which is more than the discount rate of 10%, with a net present value (NPV) of ₹ 1091.68 lakh. The value of this investment is worth ₹ 1091.68 lakh today.
The minimum debt service coverage ratio is 1.40, and the average debt service coverage ratio is 1.60.

Table 6. The mathematical model computed the economic indices NPV, IRR, and DSCR.

RESULTS			
Equity IRR	22.89%	1186.48	NPV Equity
Min DSCR	1.40		
Avg DSCR	1.60		
Project IRR	14.89%	1091.68	NPV Project

7. Recommendations

NPV positive values are an indication of a feasible project, and NPV negative values are indications of a non-feasible project. A debt service coverage ratio of 1 or above indicates that the solar power plant is generating sufficient operating income to cover its annual debt and interest payments. The mathematical model generates positive NPV and DSCR values greater than 1. The output of the mathematical model for the financial statement should encourage entrepreneurs to pursue business opportunities in the renewable energy solar power plant segment.

The SWOT analysis for a solar power plant is as follows:

Strengths:
A high-growth industry with significant potential. The sun is available in sufficient quantities in many regions. The technology is proven to have low operation and maintenance costs. The debt facility is available through a government incentive scheme for the growth and expansion of solar power projects.

Weakness:
The solar power project has a high capital cost, and as a result, the project promoter needs external incentives to be economically feasible, thus increasing dependence on governmental policies. The capital-intensive nature of the project might favour larger business entities over smaller business entities. The distributed and intermittent nature of solar energy makes it difficult for utilities connected to the grid to rely on solar power for base load and peak load demand.

Opportunities:
The government's promotion and financially attractive policies in the solar power segment open up many avenues for investment. Opportunities exist all along the solar power business value chain. The innovative technology causes a reduction in operating costs and provides better efficiency.

Threats:
High-innovation technology creates the risk of obsolescence. The off-peak seasons reduce cash flow. The solar power plant is a relatively new business segment, so the availability of skilled manpower is relatively low.

8. Conclusion

The Indian government has undertaken a national solar mission to provide significant incentives to solar power project developers. The return on investment (ROI) depends on different parameters like cash flow, internal rate of return (IRR), and payback period. The return on investment (ROI) is calculated based on inputs like installed plant capacity, bank rate, debt, equity, loan term, and moratorium. The cost components involved in a solar power project are equipment costs, manpower costs, infrastructure development costs, and bank processing fees. The positive cash flow generated from the commercial operation of the project is first utilized to repay the debt from the commercial bank and provide working capital for power plant operation and maintenance. The residual fund is used to pay dividends to sponsors of the project.

List of abbreviation

NPV: Net Present Value; IRR: Internal Rate of Return; DSCR: Debt Service Coverage Ratio; EBITDA: Earnings Before Interest, Taxes, Depreciation, and Amortization; MAT: Minimum Alternate Tax; DDT: Dividend Distribution Tax

REFERENCES:

1. Shailendra Singh, Majed Alharthi, Abhishek Anand, Amritanshu Shukla, Atul Sharma, & Hitesh Panchal. (2022). Performance evaluation and financial viability analysis of grid associated 10 MWp solar photovoltaic power plant at UP India. Scientific Reports 12, Article number: 22380.
https://doi.org/10.1038/s41598-022-26817-4

2. Ashish Kumar, Vikas Srivastava, & Mosab I. Tabash (2021). Infrastructure project Finance: a systematic literature review and directions for future research. Qualitative Research in Financial Markets, Vol. 13 No. 3, pp. 295-327.
https://doi.org/10.1108/QRFM-07-2020-0130.