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Techno-Commercial Analysis of Subsidized Domestic 3kW Solar Generation Plant

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Abstract: *This study analyses the techno-commercial feasibility of installing a 3-kilowatt-peak (kWp) photovoltaic (PV) system in two different places in Indore. In this paper we have calculated Generation, Payback time, Savings, effect of degradation in efficiency of Solar Panels. Our results show that the 3-kWp PV system can generate 100% of electricity consumed by a typical residential household in Indore with average of 300 sunny days. The payback period of this system would be approximately 3-4 years. The PV systems with 3 kWp capacity is the most feasible solution to generate enough amount of electricity for most households in Indore city.*

Keywords: Techno-Commercial, Domestic, Solar Generation, Payback Period.

I. INTRODUCTION

Solar PV systems are most feasible electrical energy generation systems [1] and they have great potential to meet the day to day increasing energy demand [2]. So, it is need to widespread solar installations. Several case studies have been done in this context [3-6].

1.1 Current Solar Energy Status in Madhya Pradesh (MP)

The renewable energy department of MP drafted a policy under "Madhya Pradesh policy for Net-metered Renewable Energy Applications,2016". In the policy the department had set a target for solar power generation as shown in Table 1. The policy intends to promote consumption of energy generated from renewable energy resources by individual users at decentralized locations. This would decrease the burden on conventional sources of energy.

According to the article published on Nov 26, 2021 in Times of India the energy produce by solar power is 5300 MW, which is more than 10 times the target set in the above mention policy.

Table 1: Target for Rooftop Solar Power Generation In Madhya Pradesh By 2022 [7]

Year	Targets (in MW)
2015-16	10
2016-17	265
2017-18	275
2018-19	330
2019-20	385
2020-21	440
2021-22	495

1.2 Average Energy Consumption of Household

Indore, in central India, is considered a Tier 2 city, located in Madhya Pradesh (MP). It's often referred to as "Mini Mumbai" because of their similarities both being the commercial and financial capitals of their respective states.

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The change in the life style in the city has increase the use of household electronics appliances like refrigerator, microwave, induction, and air conditioner has drastically increased the power consumption of a house hold. The average power consumption of a middle-class families nearly 250-300 kWh with approximate DISCOM charges amounting to 2000-2500. With the rising energy charges and subsidy provided on domestic solar plant, PV solar power generation has become a household name.

1.3 Techno-Commercial Analysis

Analysis of technologies, product or research ideas considering both technical and economic factor is techno-commercial analysis [8].

One of the most important activities during the development phase of new products or services is the evaluation of their economic feasibility/viability - a process known as "techno-economic analysis" (TEA).

TEA also provides insight into areas where further R&D should be focussed to achieve the most significant improvement in the economics - e.g. through the replacement of an expensive raw material, or improvement of the yield in a particular process step.

The analysis looks at the market that the service or product is entering, anticipated selling price and cost of production (input costs). This information is used to predict future cash flows and the likely return on investment.

1.4 Net Metering

A Renewable Energy based power plant is installed on the roof, open space, walls, agriculture farm, etc., i.e., within the legal premises, of the customer to generate electricity. Fig 1 illustrates basic work process of a Net Metering system. The power thus generated is first used in the building for captive requirement and the surplus power is fed to the grid of DISCOM. In case power requirement of the building is more than the power being generated, the extra power requirement is drawn from the grid. The complete process is also explained in Fig 2.

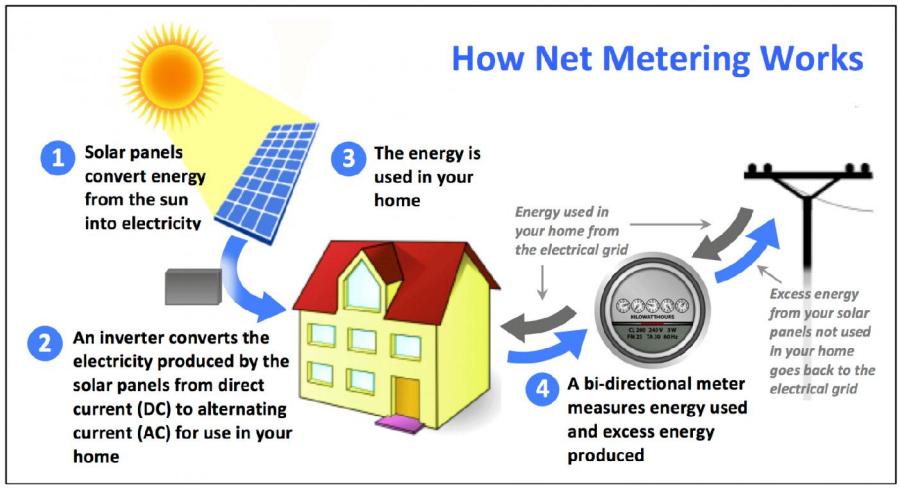

Figure 1: Basic work process of a Net Metering system.

The Fig 2 shows how the electric bill is generated after the 'Net Metering', as explained below:

- **Case-I:** In case generation of power from Renewable Energy based Power Project equals the power requirement of the Net metering consumer, there is no export or import of power from the grid. Hence, net billing units for this type of consumers will be zero.
- **Case-II:** In case generation of power from Renewable Energy based Power Project is greater than the power requirement of the Net metering consumer, additional power generated can be supplied to the grid and settled against future surplus within the settlement period, as per the Regulations.
- **Case-III:** In case generation of power from Renewable Energy based Power Project is less than the power requirement of the Net metering consumer, additional power required can be imported from the grid and settled at the prevailing DISCOM rate.

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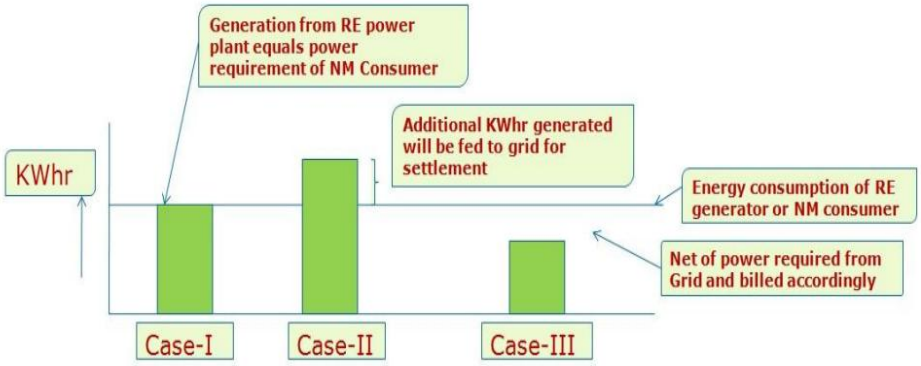

Figure 2: Three different cases in the process of Net metering.

II. DATA ANALYSIS

2.1 Technical Analysis

In this section, the comparison of the solar power generated at the two different places in Indore for the month Feb-2022 is given. The latitude and longitude of the places are as follows: Place 1= (22.648010, 75.831210) and Place 2= (22.795330, 75.914300).[data source: https://www.latlong.net/]

From the Fig. 3, it is observed that power generation at the two places is approximately same. There is a dip in graph (point A) for place 2, which is due to the power failure at that place on the day. In case of power failure from DISCOM, the Net Metering of the Solar Power Generation also stops as a safety measure because of bidirectional use of meter.

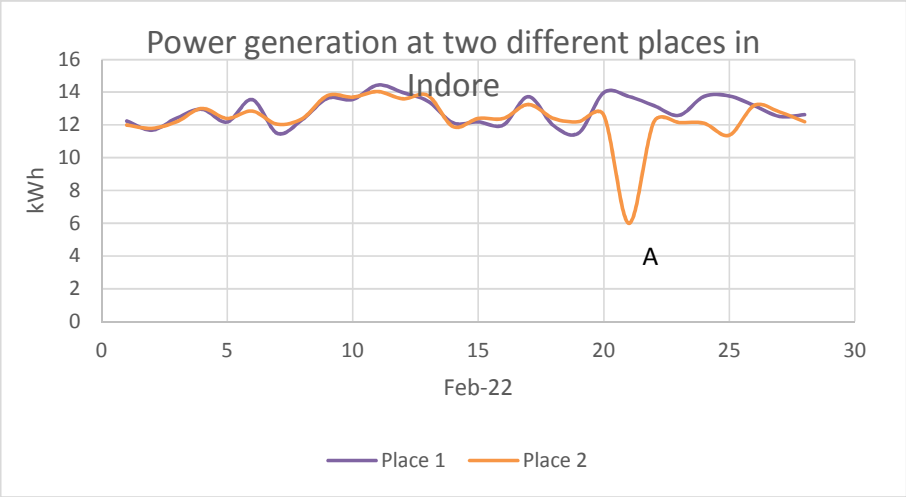

Figure 3: Power generation at two different places in Indore

2.2 Commercial Analysis

MP power management company limited has taken initiative toward the awareness of solar rooftop energy generation at every household by providing subsidy upto 10kW domestic consumption. For 3kW domestic consumption the subsidy provided is approximately 40% of total costing 1.11 lac. The subsidized amount has made possible common household to use the roof for solar power generation.

Table 2: Conversion of the Generated Power of Feb-22 Into INR

Total Generation (kWh)	Rate/ Unit	Amount Saved (Rs)
360.8	7.3	2633.84

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The table 2 depicted the commercial aspect for the rooftop solar plant. Conversion of the generated power into money is done. According to this calculation the payback period can be found.

It is shown shows the savings of Feb-22, thus with an average 300 sunny days in Indore which sums up to approx. savings of 26000□. The Subsidised Rooftop Solar Power Project of 3 kW has a Payback within 3 years from the date of commissioning. The warranty of a Solar PV panel supplied by the manufacturer has 80 % of the total output at the end of 25 years, thus after 3 years from the date of commissioning the solar PV it's a profit-making investment.

III. CONCLUSION

This study supports the adaptability of a 3kWh PV system to fulfil successfully the domestic household electricity demand at Indore (M.P.), India. The installation of a domestic PV system not only justifies the techno commercial feasibility but also it reduces the carbon footprint of a household. The places where study was done has reduced the CO_2 emission by 364 kg. which is equivalent 2.6 trees seedling for 10 years. Neil Armstrong's famous quote,' "That's one small step for man, one giant leap for mankind."

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