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für Internationale  
Zusammenarbeit (GIZ) GmbH

# CAPEX REPORT



**Published by**

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH  
Indo German Solar Energy Partnership

**Registered offices**

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Germany

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**As at:**

New Delhi, 2024

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# ABBREVIATIONS

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<b>BMZ</b>	<b>German Federal Ministry for Economic Cooperation and Development</b>
<b>CAPEX</b>	<b>Capital Expenditure</b>
<b>EPC</b>	<b>Engineering, Procurement, and Construction</b>
<b>GDP</b>	<b>Gross Domestic Product</b>
<b>GIZ</b>	<b>Duetsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH</b>
<b>GST</b>	<b>Goods and Services Tax</b>
<b>GW</b>	<b>Gigawatt</b>
<b>IGSP</b>	<b>Indo-German Solar Energy Partnership</b>
<b>I-RISE</b>	<b>Indian Rooftop PV Installers Skilling and Employment</b>
<b>IRR</b>	<b>Internal Rate of Return</b>
<b>I-SMART</b>	<b>Indian Solar Market Aggregation for Rooftops</b>
<b>ISTS</b>	<b>Waiver of Inter State Transmission System</b>
<b>MNRE</b>	<b>Ministry of New and Renewable Energy, Government of India</b>
<b>NDC</b>	<b>Nationally Determined Contribution</b>
<b>OPEX</b>	<b>Open Expenditure</b>
<b>PPA</b>	<b>Power Purchase Agreement</b>
<b>PV</b>	<b>Photovoltaic</b>
<b>RE</b>	<b>Renewable Energy</b>
<b>RESCO</b>	<b>Renewable Energy Service Companies</b>
<b>RPO</b>	<b>Renewable Purchase Obligation</b>
<b>RTPV</b>	<b>Rooftop Photovoltaic</b>
<b>TOT</b>	<b>Training Of Trainers</b>
<b>TP</b>	<b>Training Partner</b>
<b>SCGJ</b>	<b>Skill Council for Green Jobs</b>
<b>UT</b>	<b>Union Territories</b>
<b>EPC</b>	<b>Engineering Procurement and Construction</b>
<b>MSME</b>	<b>Micro, Small and Medium Enterprises</b>

# BACKGROUND

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## Solar Growth in India

India's CO<sub>2</sub> emissions increased by 80 Megatons (Mt) in 2021 compared to 2019, reflecting the rapid urbanisation and changing lifestyles in India.<sup>1</sup> In view of this continuing megatrend, India is facing an increased energy demand in cities. Therefore, a steady and increased energy supply is needed that also urgently improves India's climate balance. Renewable Energy (RE), including Photovoltaic (PV) solar, is one of the most important ways to curb the climate imbalances in India and provide a climate-neutral source of energy, which can be integrated into the urban space.

Recognising this RE potential, India defined its goal to achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources in its Nationally Determined Contributions (NDCs) in August 2022. Furthermore, India's Prime Minister Narendra Modi announced to reduce the emissions intensity of India's Gross Domestic Product GDP by 33 to 35 percent by 2030 compared to 2005. Furthermore, this reflects the country's long-term goal of reaching net-zero by 2070 as well as reducing the total projected carbon emission by one billion tonnes between now and 2030.<sup>2</sup> These high ambitions call for extensive actions.

Presently, the major contributors of solar PV installations across India are ground-mounted or rooftop installations. These conventional methods of solar adoption rely heavily on land utilisation and can only address the target in part.

The installed solar energy capacity in India has already one of the highest rates of growth for renewable energy in the world with an achieved cumulative installed renewable energy capacity (excluding large hydro) of 125.69 GW. Solar power capacity has increased by more than 25 times in the last nine years from 2.6 GW in March 2014 to 67 GW in April 2023. Presently, solar tariff in India is very competitive and has achieved grid parity. This is making India to hold the fourth position globally in solar power deployment.<sup>3</sup>

In order to further encourage the use of PV solar and to achieve its ambitious targets, the Government of India has launched various schemes to encourage the generation of solar power in the country like Solar Park Scheme, Defence Scheme, Canal bank & Canal top Scheme, Grid Connected Solar Rooftop Scheme and many more.<sup>4</sup>

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<sup>1</sup> IEA 2022: <https://iea.blob.core.windows.net/assets/c3086240-732b-4f6a-89d7db01be018f5e/GlobalEnergyReviewCO2Emissionsin2021.pdf>

<sup>2</sup> India NDC Update UNFCCC, 2022: <https://unfccc.int/sites/default/files/NDC/2022-08/India%20Updated%20First%20Nationally%20Determined%20Contrib.pdf>

<sup>3</sup> MNRE, 2022: <https://unfccc.int/sites/default/files/NDC/2022-08/India%20Updated%20First%20Nationally%20Determined%20Contrib.pdf>

<sup>4</sup> MNRE, 2022: <https://unfccc.int/sites/default/files/NDC/2022-08/India%20Updated%20First%20Nationally%20Determined%20Contrib.pdf>

Various policy measures undertaken include a declaration of trajectory for Renewable Purchase Obligation (RPO) including solar, a Waiver of Inter State Transmission System

(ISTS) charges and losses for inter-state sale of solar and wind power for projects to be commissioned up to March 2022; guidelines for procurement of solar power through a tariff based competitive bidding process and standards for deployment of solar photovoltaic systems and devices. Additionally, there are also policies regarding provision of roof top solar and guidelines for development of smart cities, amendments in building byelaws for mandatory provision of roof top solar for new construction or higher Floor Area Ratio, as well as infrastructure status for solar projects, raising tax free solar bonds, and providing long tenor loans from multi-lateral agencies.<sup>5</sup>

India has a functional solar module manufacturing capacity of around nine to ten GW and around 30GW annual demand for the next ten years. Hence, the Government of India seeks to enhance the domestic manufacturing capacity, consistently bringing out policies to support domestic PV manufacturing.



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<sup>5</sup> MNRE, 2022: <https://unfccc.int/sites/default/files/NDC/2022-08/India%20Updated%20First%20Nationally%20Determined%20Contrib.pdf>

## CAPEX Business Model

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In India, there are different ways to invest in rooftop solar and the most common one includes a Capital Expenditure (CAPEX) or Open Expenditure/Renewable Energy Service Company (OPEX/RESCO) business model. CAPEX is a self-funding model that relies on the consumers to cover all expenditures associated with the rooftop solar system upfront. This may include not only the setting up, maintenance and operation of the solar, but also the costs for the equipment, labour and upgrades. All future costs for the rooftop system will therefore also be covered by the consumer. Hence, by covering all the costs for the rooftop system, the costumer has full ownership of the rooftop system and its profits.

The CAPEX model is used by those organisations and individuals, who are able to pay for the product upfront and are interested in availing Goods and Service Tax (GST) and depreciation benefits. Hereby, businesses and consumers with significant financial reserves should choose CAPEX, as they can claim depreciation and GST benefits totalling for roughly 40 percent. For individuals in residential areas, the CAPEX model is attractive if it can be combined with government subsidy (40% up to 3kWp and 20% for next 7kWp). Consumers can expect to see returns on their capital investments in approximately three to five years. The owner must, however, take full responsibility for the rooftop system and its risks including under performance due to dust, shadowing due to future construction, module damage due to hailstorms, etc. This is considered to be a disadvantage of the CAPEX business model.<sup>6</sup>

Opposed to CAPEX, the OPEX model, meaning Open Expenditure, is a model in which the developer is the owner of the solar project. Therefore, the consumer must pay for the energy produced by the solar module, but not for the module itself. Thereby, all associated performance risks are the responsibility of the company and not the costumer.<sup>7</sup> This model, however, requires the costumer to not only commit to a long-term agreement that ensures the legal usage of the roof on which the solar system is installed, but also to sign a long-term Power Purchase Agreement (PPA) for the power supply. PPAs can extend to a period of 25 years in which the customer pays a pre-determined rate. In this model, the Engineering, Procurement, and Construction (EPC) is carried out by the developer.<sup>8</sup> On the one hand, it allows the customer to use solar energy without having to invest into an own solar system with great upfront expenditures, minimising monetary risks and enjoying low electricity fares. This is appropriate for customers who are not looking to invest into technology capital, do not have the technical expertise or do not want to maintain the solar systems.<sup>9</sup>

On the other hand, OPEX installers are often looking for large installations of 100KW and above and may not offer solar systems to smaller rooftops that may be in the five to fifty kW range. Hence, the CAPEX model is favourable for small and medium size installations for residential, educational institutes, commercial complexes, Micro, Small and Medium Enterprises (MSMEs) etc. To support the target of 40 GW rooftop installations by 2022, the benefits of the CAPEX model must be communicated to the stakeholders/owners. To better understand the suitability of the CAPEX model for different customers

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<sup>6</sup> India Solar Rooftop, 2022: <https://indiasolarrooftop.com/capex-vs-opex-solar-models-whats-the-difference/>

<sup>7</sup> Energyhive, 2020: <http://www.energyhive.in/blog/solar-capex-vs-opex/>

<sup>8</sup> India Solar Rooftop, 2022: <https://indiasolarrooftop.com/capex-vs-opex-solar-models-whats-the-difference/>

<sup>9</sup> India Solar Rooftop, 2022: <https://indiasolarrooftop.com/capex-vs-opex-solar-models-whats-the-difference/>

sub-categories, the “Identification of Rooftop Solar PV Business Models with High Replication Potential in India” study was conducted by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the Federal Ministry for Economic Cooperation and Development. The study investigates twelve case studies across the six Indian states of Gujarat, Maharashtra, Delhi, Odisha, Tamil Nadu and Jammu and Kashmir for eight sub sectors namely residential, large commercial retail, warehousing, religious, educational, manufacturing-textiles, healthcare and government on five parameters (tariffs, support and facilitation, roof availability, visibility and ease of adoption).<sup>10</sup>

Today, a total of 10,221 MW of solar rooftop capacity has been installed in India. Hereby, 7,628 MW was installed through CAPEX and 2,593 MW through OPEX, making CAPEX a model that is used almost three times as much as the OPEX business models.<sup>11</sup> Yet, the growth of installation is slow according to a report of the Ministry of New and Renewable Energy (MNRE), Government of India, as many challenges await the consumers of CAPEX and OPEX business models.

## Challenges

Aside from a limited access to financial support by financial institutions, there is an inadequacy of standardised procedure in procurement, making the access to CAPEX or OPEX business model more difficult, as there is only a limited awareness among the consumers. Furthermore, developers face a high degree of individualisation, when they install rooftop systems on small size rooftops, as each one requires individual system design and customisation. Hereby, larger projects and consumers aid the developers in scaling up the installation of rooftop PV systems.

The effects of the pandemic are however yet to be determined. As a period defined by instability, economic decline and insecurities, the investments into solar did not go untouched. Lockdowns and other restrictions prevented the physical installation of solar PV on rooftops, as government restrictions encouraged physical distancing. Small Engineering, Procurement and Construction (EPC) contractors who do not have the financial capacity have to face financial losses.

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<sup>10</sup> Identification of Rooftop Solar PV Business Models with High Replication Potential in India study by GIZ

<sup>11</sup> Bridge to India: “India Solar Rooftop Map – June 2022” <https://bridgetoindia.com/report/india-solarrooftop-map-june-2022/>



## Analysing different sub-sectors

The evaluation result of the study for different sub-sectors on basis of five parameters i.e., tariffs, support and facilitation, roof availability, visibility and ease of adoption depicts the following matrix with a total score on a scale of 1- 5 (5 being the highest and 1 being the lowest) for each consumer category.

Sub-sector	Tariff		Support and Facilitation		Roof Availability	Visibility	Ease of adoption		Total Score
	Tariff Category	Consumption	DISCOM Facilitation	Government Support			Affordability	Awareness	
Large Commercial Retail	5	5	1	1	2	5	5	5	3.6
Education	5	3	3	5	3	4	3	5	3.8
Manufacturing Textiles	3	5	3	3	4	3	4	4	3.6
Residential	1	1	5	5	1	4	1	2	2.5
Cold Storage	5	5	3	3	5	2	4	3	3.7
Religious	5	1	3	5	1	5	5	1	3.2
Healthcare	5	5	3	1	3	2	4	2	3.0
Government Offices	5	3	5	5	2	1	1	1	2.6

*Table 1: Overall rating matrix for selected sub sectors*

The results show that the education sector has the highest replicability potential in the selected six states. The educational sector also pays among the highest tariffs in the country since educational institutes fall under the commercial tariff category. Tariffs for the commercial category in all states studied are higher than the levelised cost of electricity from the Rooftop Photovoltaic (RTPV) systems. Hence, educational institutes would form prime targets for a targeted deployment of rooftop solar PV. Government buildings and offices in addition have operation and maintenance challenges and usually the OPEX model is suggested for them.

Result Summary	Potential (MW)
Potential for all Universities and Colleges	2,932
Potential for all Private Schools	4,739
Potential for all Government Schools	4,759

*Table 2: Estimated cumulative RTPV potential of Education sub sector across the six selected states.*

The analysis shows that the educational sector has a significant potential that far outstrips the potential for the other three recommended segments: Cold Storages, Large Commercial Retail and Manufacturing – Textiles.

# GIZ Intervention

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1. Under the Indo-German development cooperation project, Indian Solar Market Aggregation for Rooftops (I-SMART)<sup>12</sup>, GIZ enrolled volunteers from educational institutions and trained them in solar rooftop technology and its schemes in respective states. These Solar Ambassadors outreached various consumer segments including educational institutions and created solar rooftop awareness amongst them.
2. Under the Indo-German development cooperation project, the Indian Rooftop PV Installers Skilling and Employment (I-RISE)<sup>13</sup>, GIZ onboarded 45 Training Partners (TPs) institutions of Skill Council for Green Jobs (SCGJ) and TOTs were conducted for 100+ trainers on Solar PV Installers, also referred to as *Suryamitra*. In total 1,742 *Suryamitra* were upskilled on quality installation and marketing techniques. These upskilled *Suryamitra* enhanced the Indian solar market development by catering to almost all of the sub-sectors.

## Evaluation

The CAPEX model has various advantages like low payback period and high Internal Rate of Return (IRR), clean and free electricity, policy support, no Power Purchase Agreement (PPA) foundations, incentive for maximised generation, safeguard from increase in electricity prices and tax benefits. It is suited for all the customer categories when they have capital available. As per the study<sup>14</sup>, it is best suited and recommended for educational institutions to get rooftop solar PV installed through the CAPEX model. The study results show an IRR of above 30% and payback period between three to five years for majority of the educational institutions.

The Indo-German Solar Energy Partnership (IGSP)<sup>15</sup> team through various projects, is creating awareness about RTPV benefits and the CAPEX model to various consumer categories. Under I-SMART project, 300+ awareness events have been organised in eleven states and UTs in India by Solar Ambassadors<sup>16</sup>. Under the I-RISE project, more than 50% of the surveyed participants confirmed that they have started their own enterprise doing quality installations including on educational institutions. In doing so, GIZ's support has been catalytic in creating awareness and demand in the Indian solar industry. Despite this, the availability of capital remains one of the biggest factors holding back the solarisation of many smaller educational institutions.

The availability of capital for rooftop solar PV installation is still one of the demerits of the CAPEX business model. This is one of the main reasons behind the rise of more and more OPEX installations, even though the OPEX

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<sup>12</sup> Bridge to India: "India Solar Rooftop Map – June 2022" <https://bridgetoindia.com/report/india-solarrooftop-map-june-2022/>

<sup>13</sup> Indian Rooftop PV Installers Skilling and Employment (I-RISE), <https://www.renac.de/projects/current-projects/irise>

<sup>14</sup> Identification of Rooftop Solar PV Business Models with High Replication Potential in India study by GIZ

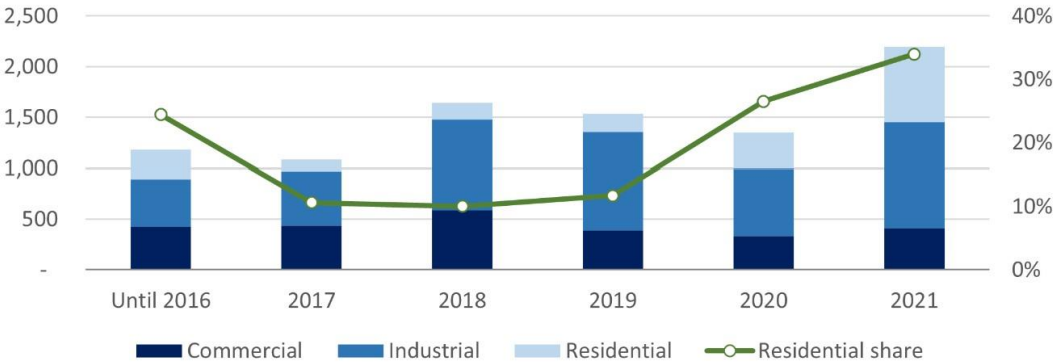
<sup>15</sup> GIZ India Indo-German Solar Energy Partnership (IGSP), <https://www.giz.de/en/worldwide/76413.html>

<sup>16</sup> Indian Solar Market Aggregation For Rooftops (I-SMART), <https://www.ismartsolar.in/>

model is generally not offered to smaller size installations. As per the feedback of the study, consumers are happy with their CAPEX installations and in general CAPEX presents good capital deployment opportunity.

In a recent report, *Bridge to India* estimated that new rooftop installations in 2021 touched a record high of 2,196 MW, up 62 percent over the previous year. These numbers are highly encouraging, coming after two years of market decline, and in face of several acute challenges including 7 percent annual CAPEX increase, module shortage and net metering policy uncertainty in many states.

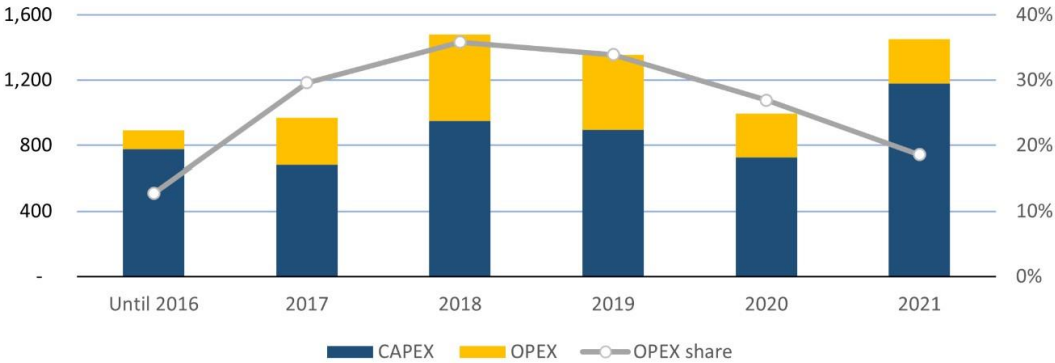
**Figure 1: New installations by consumer segment, MW**



Source: BRIDGE TO INDIA research

Even though high capex cost is a deterrent for many consumers, the self-financed market is growing robustly. Share of the OPEX model has now been falling for three straight years.

**Figure 2: C&I installations by business model, MW**



Source: BRIDGE TO INDIA research

Even though the Indian solar market is keenly fragmented across regions, consumer segments and business models, there is no sign of consolidation in the market. Leading industry players are making impressive gains in both CAPEX and OPEX business models. Analysts estimate that the market would grow by about 10-15% over the last year, led again by the residential segment. With the growing industry the share of capex installations would grow led by small and medium scale entrepreneurs catering to different sub-sectors.

January 2024

Published by  
Deutsche Gesellschaft für  
Internationale Zusammenarbeit (GIZ) GmbH  
Indo – German Energy Programme – Energy Transition with DISCOMs

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