CURRENT NEWS

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CHOOSING ROOFTOP SOLAR PV SYSTEM WISELY- PART 1 : TYPES OF SOLAR CELLS

B.KIRUBAKARAN

With rising electricity costs driven by factors such as increasing energy demand, and increasing fossil fuel cost, many consumers are seeking more affordable and sustainable energy solutions. One such option rapidly gaining popularity is the rooftop solar photovoltaic (PV) system. Thanks to various government incentives, subsidies, and awareness campaigns, more people demonstrate interest in installing solar systems at home. Solar power not only helps reduce electricity bills but also contributes to a greener environment with zero emissions.

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This article is the first in a series aimed at helping consumers understand the basics of solar energy. In this part, we will focus on the types of solar cells used in solar panels.

At the heart of every solar PV system are the solar panels, and within each panel lie multiple solar cells—the core component responsible for converting sunlight into electricity.

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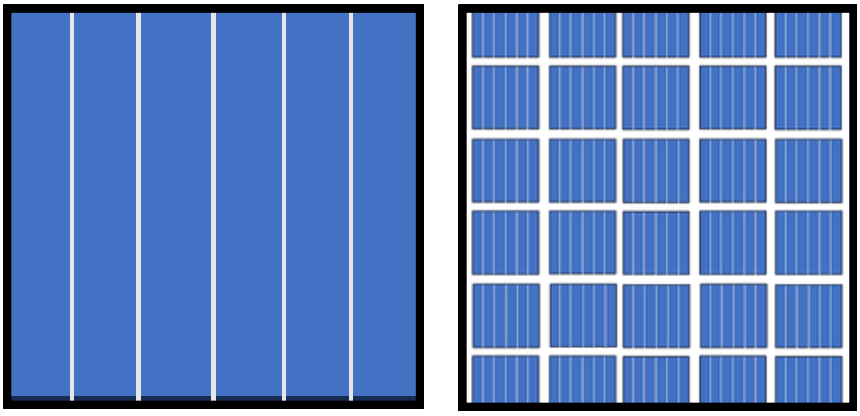


Solar Cell **Solar panel**

Figure : Solar cell and Solar Panel | CAG

A solar cell works on the principle of the photovoltaic effect. When sunlight, composed of photons, strikes the cell, it dislodges electrons from atoms, creating an electric current. These cells function silently with no moving parts, require no fuel, and produce no emissions.

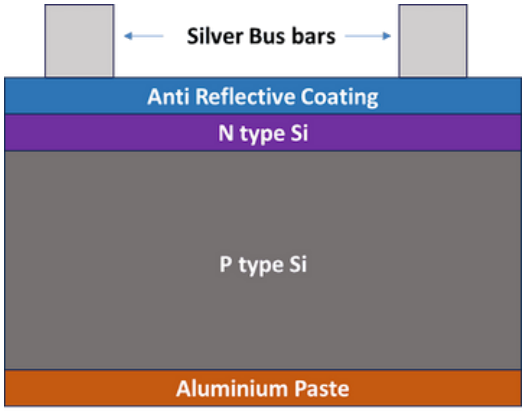
Types of Solar Cells Based on Material

1. Crystalline Silicon Solar Cells (Most Common)

Among the different types of solar cells, crystalline silicon solar cells are the most common and reliable. Silicon, being the second most abundant element on Earth, is relatively inexpensive. However, it must be purified to an extremely high degree — 99.9999% for solar applications, making the process energy-intensive.

1.1. Structure of a Standard Silicon Solar Cell:

A typical silicon solar cell is structured like a PN junction diode, with a p-type silicon wafer at the base and an n-type layer formed through gas diffusion at the top. An anti-reflective coating enhances light capture, while metal contacts—bus bars on the top surface and an aluminum layer at the back—help in collecting electricity.



Cross section view of solar cells | CAG

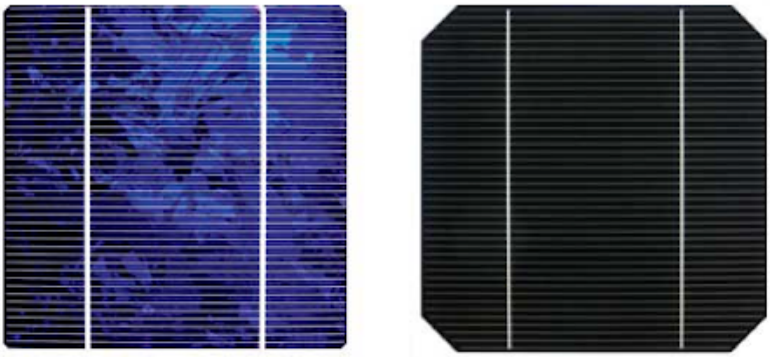


Figure 2 : Polycrystalline vs Monocrystalline solar cells | Solar quotes

Crystalline silicon solar cells are mainly divided into two types: monocrystalline and polycrystalline cells. Monocrystalline cells are made from a single crystal structure, offering higher efficiency, typically between 15% to 20%, and are identified by their uniform black appearance. On the other hand, polycrystalline cells are composed of multiple silicon crystals arranged randomly, which lowers their efficiency to around 13% to 16%. These cells often appear blue with a grainy texture.

2. Advanced Silicon Cell Technologies

To enhance the performance and efficiency of solar cells, several advanced technologies have recently emerged. PERC (Passivated Emitter and Rear Contact) cells include an additional layer at the back to capture more light. HIT (Heterojunction with Intrinsic Thin layer) technology combines crystalline and amorphous silicon layers, which performs well even in high-temperature regions. IBC (Interdigitated Back Contact) cells move all the electrical contacts to the back, maximizing sunlight absorption on the front surface. Another promising technology is TOPCON (Tunnel Oxide Passivated Contact), which merges the advantages of both PERC and HIT, offering excellent efficiency and thermal stability.

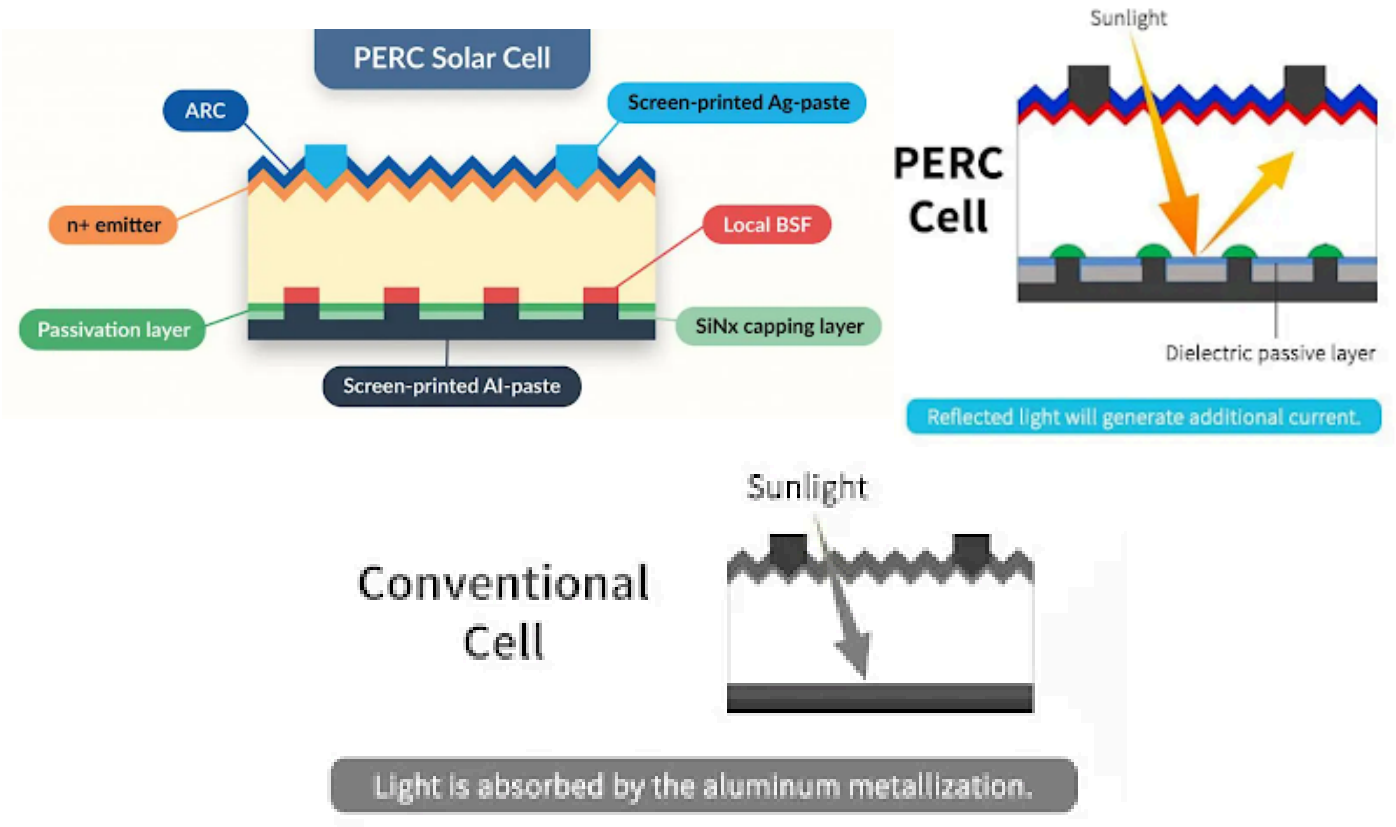
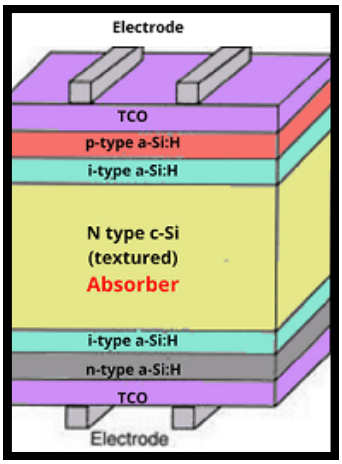
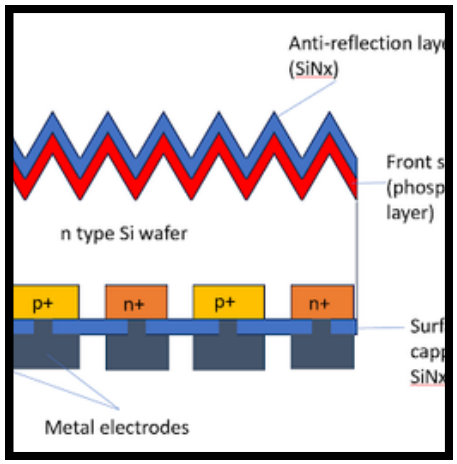


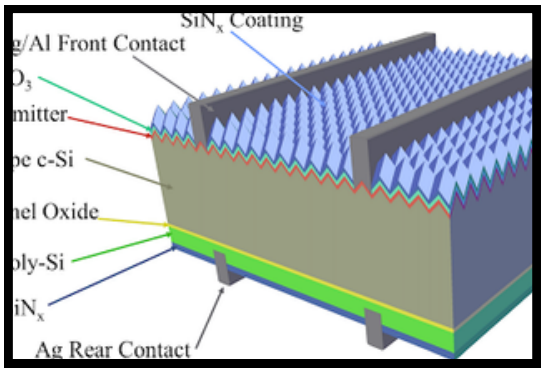
Figure : PERC solar cell cross section and comparison with conventional solar cell | Just Solar



HIT solar cell



IBC solar cell



TOPCON solar cell

Figure : Advanced crystalline Silicon solar cells | KSCHAN, Scholarly community Encyclopedia

3. Thin-Film Solar Cells

These are created by depositing thin layers of photovoltaic materials onto substrates like glass or metal. Based on the material used, thin-film cells can be of types such as Amorphous Silicon (a-Si), Cadmium Telluride (CdTe), and Copper Indium Gallium Selenide (CIGS). These cells are lighter and less costly to manufacture but have lower efficiency and shorter operational life. Commercially available thin film solar cells generally have lower efficiencies (7% to 18%) and shorter lifespan compared to traditional crystalline silicon solar cells.They are mainly used where flexibility and lightweight modules are essential, such as in portable or curved applications.

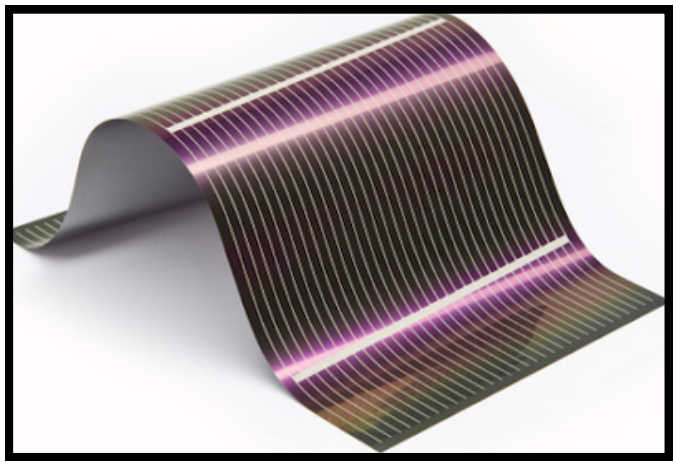
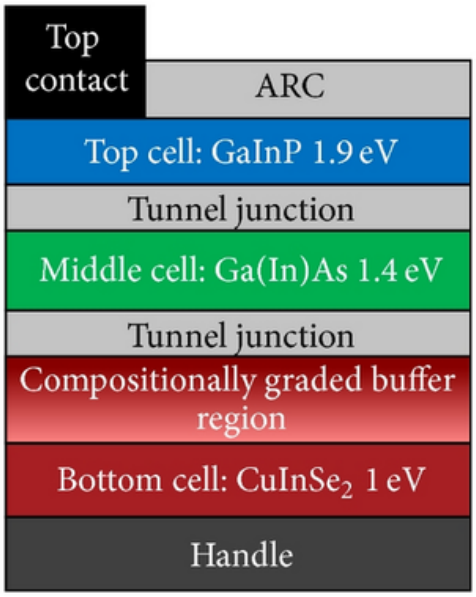


Figure : Thin Film Flexible Solar Cells | Material District



4. Tandem or Multi-Junction Solar Cells :

Another cutting-edge category is tandem or multi-junction solar cells, which stack multiple layers of PN junctions to absorb various wavelengths of sunlight. These cells have demonstrated extremely high efficiencies—up to 45% in laboratory settings—but are currently limited to niche applications like satellites, space probes, concentrated solar PV systems, due to their high cost and complexity

Figure : Tandem or Multi-junction solar cells | Willey

5. Emerging Solar Cell Technologies

There is also research on emerging solar technologies, which include perovskite solar cells, dye-sensitized cells, organic solar cells, and quantum dot-based solar cells. Although these technologies are still in experimental or early commercial stages, they hold promise for the future due to their potential for low-cost, high-efficiency, and flexible applications.

Solar cell having highest efficiency :

The National Renewable Energy Laboratory (NREL), a pioneer in solar research, maintains a chart that tracks the highest solar cell efficiencies achieved in laboratory settings across various technologies. According to their latest data, the highest efficiency recorded to date is 47.6%, achieved by multi-junction solar cells.

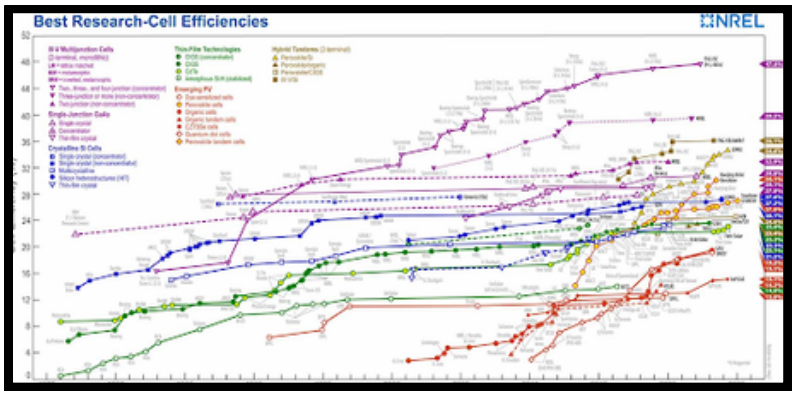


Figure : NREL Best research cell efficiencies of various solar cell technologies | NREL

Market share of different solar cell technologies :

Looking at current and projected market trends, the global solar industry is undergoing a significant transition from traditional technologies to high-efficiency solar cells. According to the 2024 edition of the International Technology Roadmap for Photovoltaics (ITRPV), PERC technology currently dominates the market due to its balance of cost and performance. However, its market share is expected to decline after 2025.

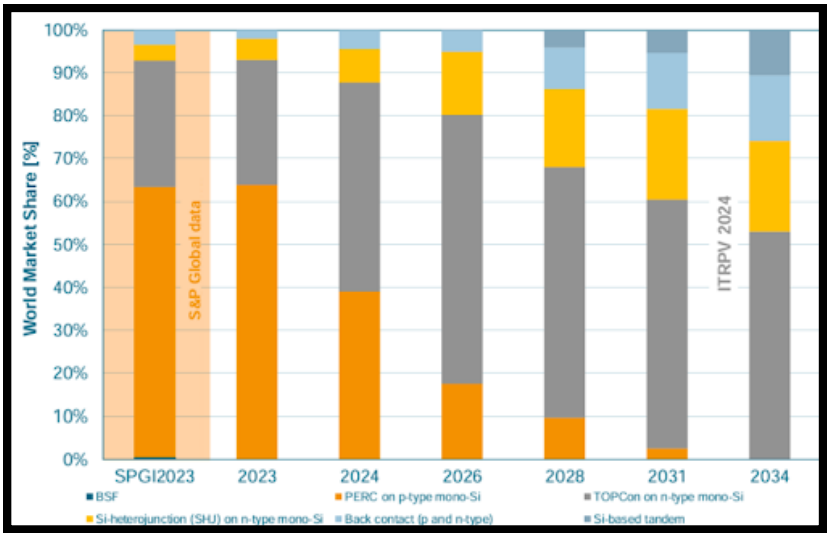


Figure : Market share of different solar cell technologies | ITRPV 2024

In contrast, advanced technologies such as TOPCON and Heterojunction are projected to gain significant traction owing to their superior performance, especially in warmer climates. By 2031, TOPCON is forecasted to lead the market, followed closely by Heterojunction and back-contact technologies like IBC. Furthermore, tandem solar cells are expected to enter the commercial market post-2030, highlighting the industry's continuous push toward ultra-high efficiency and next-generation innovations.

This concludes the first part of our series. We've explored the various types of solar cells, their construction, performance, and market trends. In the upcoming parts, we will delve deeper into solar panels—how solar cells are assembled, what technical specifications consumers should check before buying, and how to choose the right panel for your rooftop.

(To be continued)

CONSUMER FOCUS

The petitioner is an agricultural consumer who submitted an agriculture application under the special category on 21.08.2017. The petitioner opted for the RSFS (Revised Self-Financing Scheme) scheme by paying Rs. 50,000/- to avail of the agricultural service connection. The petitioner was out of the country from March 2024 to August 2024. During that time, the respondent (TNPDCL) had sent a notice to effect the service connection. When the petitioner later enquired about the status of the application, she was informed that the period to pay had lapsed.

Therefore the petitioner submitted a complaint to the Consumer Grievance Redressal Forum (CGRF) contending that an application cannot be declined under these circumstances, where she had not received the notice on time.

During the CGRF hearing, the respondent stated that the petitioner's application was selected under the RFPS category. These are special priority schemes introduced by the Government of Tamil Nadu to facilitate agricultural service connections. During the 2021-2022 financial year, the Government of Tamil Nadu issued an instruction to proceed with the applications filed between 01.04.2013 and 31.03.2018.

Based on this, the respondent issued a notice on 24.12.2021 to submit the latest revenue documents before 31.01.2022. (The latest revenue documents are key documents, whether the petitioner's agricultural connection is ready to effect the service connection.) Based on the notice, the petitioner submitted the required revenue documents on 06.01.2022.

On 17.02.2024, the Executive Engineer prepared an estimate of Rs.80,130/-, which was sent to the petitioner on 17.05.2024 via India Post with a 30-day payment period. The respondent also submitted a copy of the acknowledgement of receipt of the letter, which was received by the petitioner's neighbour Mr.Y, dated 25.05.2024. They therefore claimed that the notice was received by the petitioner on 25.05.2024, and she was therefore expected to pay the estimated amount within the stipulated period.

> *As per TNPDCL's instruction, only 120 days are permitted to make payment of the estimated cost under the RSFS scheme from the date of receipt of the demand notice. {TNPDCL's instruction - Reference Memo No: SE/IEMC/EE8/AEE2 /V.40/D.20 2/98 (Technical branch) dt.27.03.98)}*

The respondent stated that it was for this reason that traditional field assessments were replaced with a remote assessment system. The respondent claimed that the petitioner was receiving notifications regarding their electricity bills and any relevant notices via their registered mobile number.

The relevant TNPDCL instructions allow a maximum of 120 days, as follows:

1. The instructions permit a 30-days initial period, from the date of the first notice to complete the payment process.
2. It allows a 30-day extension to be approved by the Executive Engineer, if the applicant did not pay in the initial period,
3. This is followed by an additional 60 day extension on approval by the Superintending Engineer

The respondent also submitted that the petitioner neither came forward to pay the estimated charges within 30 days from the date of receipt of notice nor to seek further time extension as stipulated in the notice. If the petitioner had approached the respondent within the period of 120 days i.e on or before 21.09.2024, the application would have been processed. But since the petitioner approached the respondent beyond the 120 day period, the application was moved to the normal category from the special category (RSFS scheme).

The petitioner contended that the notice received by Mr.Y had not been communicated to her.

Based on hearing both sides, the CGRF ordered that issuing a new notice to extend the payment modalities for the RSFS category was not feasible because there are no such provisions in the TNPDCL instructions. Hence, the petitioner's complaint was closed.

Dissatisfied with the CGRF's order, the petitioner filed an appeal with the Electricity Ombudsman.

During the hearing, the Electricity Ombudsman observed the following:
The petitioner argued that the notice was handed over to Mr.Y, who is not an applicant, which marked the start of the 120-day period. The petitioner stated that this is unfair as they were not in the country nor informed of the notice received. Further, the petitioner referred to the TNPDCL instruction, which specifies that the 120-day payment period starts when the "applicant" receives the approval letter (notice). Therefore, the petitioner argued that the stipulated period should not have commenced until she actually received it, rendering the denial of service unjust.

The following are the Ombudsman's findings:
The Ombudsman highlighted "Regulation 5 of the TNE Distribution Standard of Performance regulations" which states that

> "*5. Exceptions on Duty to Supply for Agricultural and Hut Services: The provision under Section 43 of the Act is, however, not applicable in the case of agricultural and hut services, which shall be governed by the directives issued by the Commission from time to time, based on the guidance provided by the National Electricity Policy (as stipulated in Section 86(4) of the Act) and the policy directions issued in the public interest by the State Government (as stipulated in Section 108 of the Act).*"

For any agricultural services other than the normal category, the rules to be followed will be based on the instructions issued by the licensee from time to time. The said rules/guidelines issued by the licensee -
{Memo. No. SE/IEMS/EE8/AEE2/V.40/D.202/98. (Tech. Branch) Dated: 27.03.1998}, which states that "a period of 120 days is permitted to make payment of the estimated cost under the RSFS scheme from the date of receipt of the demand notice"

The Ombudsman pointed out that the petitioner accepted that Mr.Y,her neighbour, had received the notice, while also claiming that it was not communicated to her. The petitioner therefore lacks merit, as it does not credibly establish that she failed to receive the Respondent's communication on time. Furthermore, despite having sufficient time between her return from her international trip on August 2024 and the expiry of the notice period (21.09.2024), the petitioner neither contacted the Respondent to inquire about the status of the application nor made any effort to pay the required estimated charges within the stipulated 120-days period.

After hearing both parties, the Electricity Ombudsman ordered that the respondent adhere to the rules without any procedural lapse. Therefore, the petitioner's request for exceptional consideration is rejected.

SOURCE: OMBUDSMAN CASE

NEWS FROM TAMIL NADU

Over 10K service connections merged by Tangedco in last 9 months in Madurai city

As many as 4,490 commercial connections and 5,900 domestic connections were merged by the Tangedco officials in Madurai city within the last nine months, and a total of Rs 55 lakh was collected as charge by the officials. It may be noted that the merger is carried out for those availing multiple connections within the same family or single business in one building complex in Madurai. According to Tangedco records, a total of 50,600 service connections under the domestic category were inspected and 5,900 service connections were merged. Local officials inspected over 27,000 service connections in commercial establishments, and 4,490 service connections were merged. The field inspections were carried out from May 27, 2024 till January 2025. According to an office bearer from TNEB Retired Employees Union, these inspections are carried out by the Tangedco, as the institution has been facing a huge financial burden. "It is likely that few domestic consumers could get upset over the merger. For instance, two small families with individual power consumption of over 150-200 units could suffer, as they would lose the 100-unit free electricity for two families. However, commercial shops also indulge in similar practices," he said. Speaking to TNIE, an official from Tangedco (Madurai) said, "During the domestic category inspection in Madurai city, most of the mergers were in Madurai south zone. Around 500 mergers were carried out in areas such as KK Nagar, Koil, Keelavasal and Tamil Sangam. Besides, Jhansi and Town hall areas saw 300 mergers each, and these were houses belonging to the same family. During the inspections for 27,000 service connections under commercial categories, around 4,000 consumers objected to our merger. However, we rejected their objections. Around Rs 55 lakh has been generated through the mergers.

SOURCE: THENEWINDIANEXPRESS, FEBRUARY 25,2025

NEWS FROM ACROSS THE COUNTRY

India may miss key climate goal of 500-GW RE capacity by 2030 due to high capital cost

India may fail to achieve its target of deploying 500 gigawatts (GW) of renewable energy capacity by 2030 if the annual funding does not increase by 20 per cent from the current levels, a new report warns. The report prepared by global energy think tank Ember said project-commissioning delays and uncertainties related to new age "Firm and Dispatchable Renewable Energy" (FDRE) projects could raise the cost of capital by up to 400 basis points. Delays in project commissioning have been caused by land-acquisition issues, grid connectivity delays and delays in signing power purchase agreements (PPAs), it said. According to the report, a 400 basis points increase in financing costs could result in India falling short of its 500-GW renewable energy target by up to 100 GW. A higher cost of capital would also increase electricity costs for consumers, it said. Investments in renewable power generation and transmission in the financial year 2024 were estimated at USD 13.3 billion, a 40-per cent increase from the previous year. However, to meet the targets outlined in the NEP-14, annual financing must grow at a consistent rate of 20 per cent each year, reaching USD 68 billion by 2032," the report said. The NEP-14 incorporates this goal, targeting 596 GW of renewable energy capacity by 2032. This would account for 68.4 per cent of the country's total installed capacity and meet 44 per cent of its electricity demand. The plan sets specific targets of 365 GW of solar, 122 GW of wind, 47 GW/236 GWh of battery energy storage systems and 26.7 GW of pumped storage plants.

SOURCE: THEWEEK, FEBRUARY 25, 2025

WORLD NEWS

Solar-Powered Reactor Turns Carbon into Renewable Energy

Researchers are working on a reactor that absorbs CO2 and creates renewable energy while a source of renewable energy powers it. That's right—it's a full circle of green energy. The reactor pulls carbon from the air and converts it into a sustainable fuel. The team of University of Cambridge researchers says the solar-powered reactor could one day generate fuel for cars and planes. The reactor could also produce the many chemicals and pharmaceuticals we rely on and generate fuel in remote locations or off-grid areas. Unlike most carbon capture technologies, the reactor opts for solar power rather than fossil fuels. Carbon Capture and Storage (CCS) is regarded as a promising solution to the climate crisis. However, it's energy-intensive and there are concerns over the long-term safety of pressurized CO2 storage deep underground. There are ongoing safety studies regarding CCS. "Aside from the expense and the energy intensity, CCS provides an excuse to carry on burning fossil fuels, which is what caused the climate crisis in the first place," said Professor Erwin Reisner, who led the research. "CCS is also a non-circular process, since the pressurized CO_2 is, at best, stored underground indefinitely, where it's of no use to anyone."

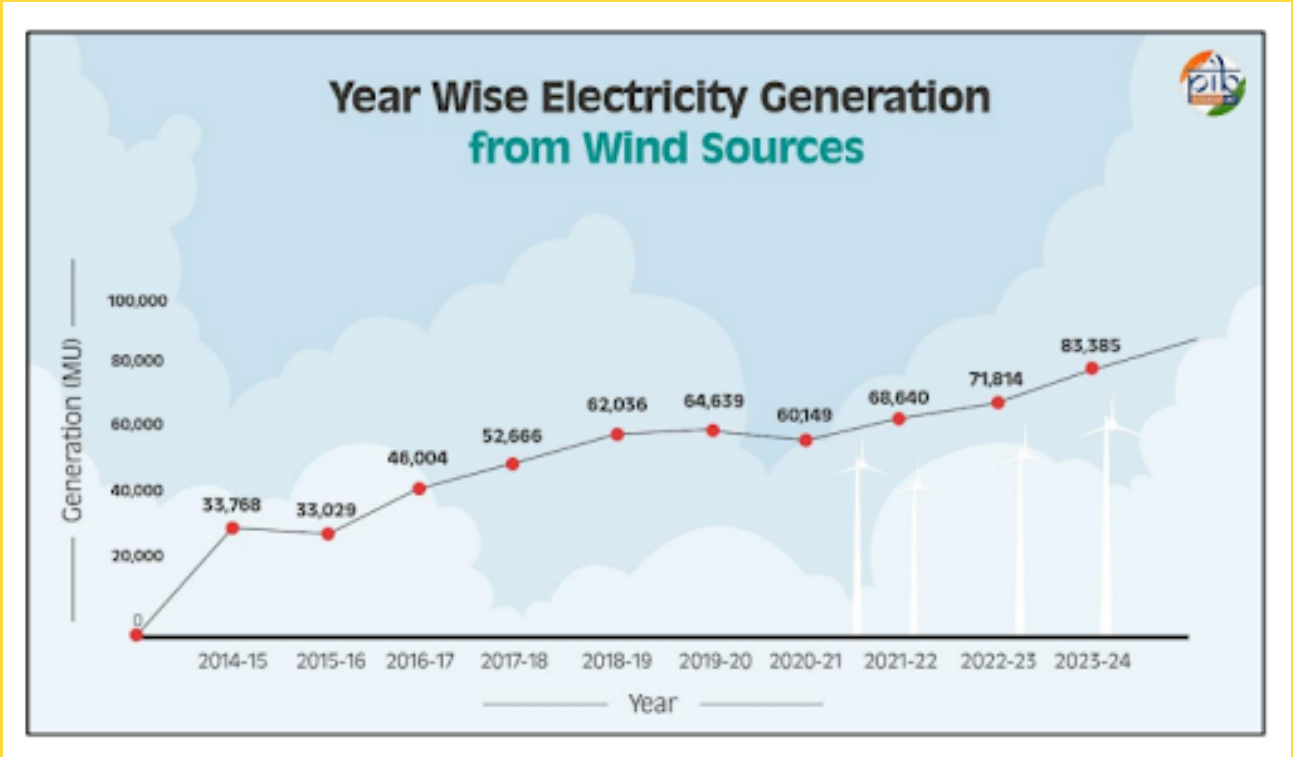
The team's mission was to find an alternative approach to generate renewable energy. "What if instead of pumping the carbon dioxide underground, we made something useful from it?" said first author Dr. Sayan Kar from Cambridge's Yusuf Hamied Department of Chemistry. "CO2 is a harmful greenhouse gas, but it can also be turned into useful chemicals without contributing to global warming. "Instead of continuing to dig up and burn fossil fuels to produce the products we have come to rely on, we can get all the CO2 we need directly from the air and reuse it," said Reisner. "We can build a circular, sustainable economy - if we have the political will to do it."

SOURCE: TOMORROWSWORLDTODAY, FEBRUARY 23, 2025

PUBLICATIONS

- **Energy Security in India, MNRE, February 2025**
- **Guidelines for Installation and Operation of Battery Swapping and Charging Stations, Ministry of Power, February 2025**
- **Clarification in the Operational Guidelines for Implementation of PM Surya Ghar Muft Bijli Yojana for the component "CFA to residential consumers", MNRE**
- **Electricity 2025, An Analysis and forecast to 2027, IEA**

YEAR-WISE ELECTRICITY GENERATION FROM WIND SOURCES IN INDIA



SOURCE: PIB

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+91(44) 2435 4458 | 2435 0387

helpdesk@cag.org.on

No.103 (First Floor), Eldams Road, Teynampet, Chennai-18