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नवीन एवं
नवीकरणीय ऊर्जा मंत्रालय
MINISTRY OF
NEW AND
RENEWABLE ENERGY

सत्यमेव जयते

Renewable Energy Akshay Urja

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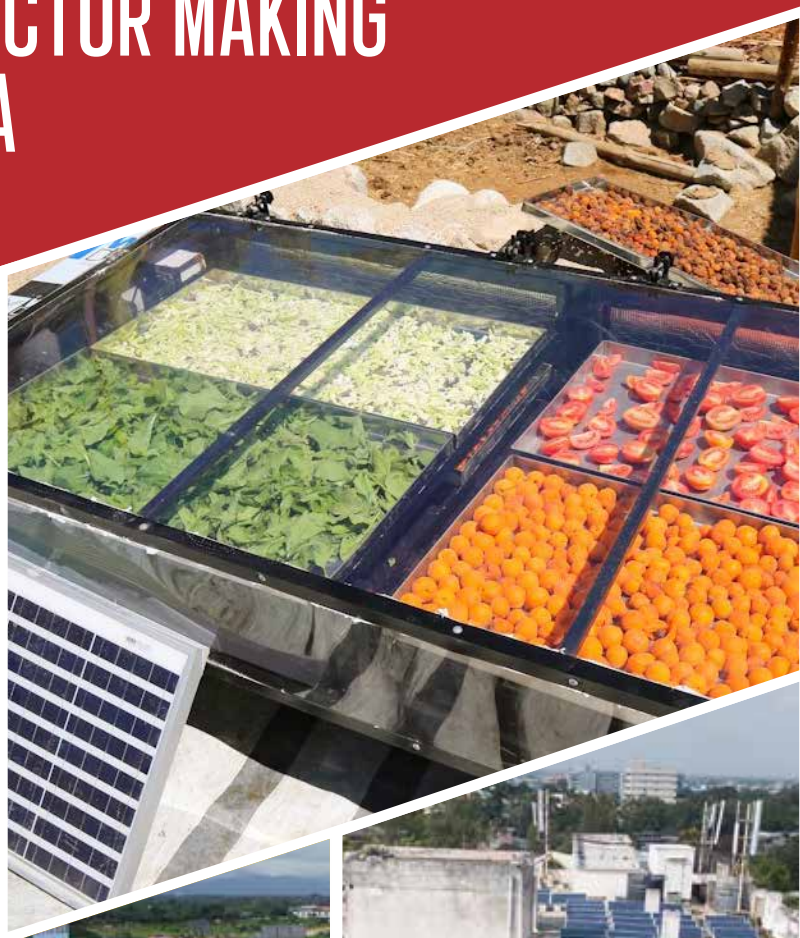
RENEWABLE ENERGY SECTOR MAKING GIANT STRIDES IN INDIA



MINISTRY OF
NEW AND
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PM Surya Ghar Muft Bijli Yojana

"The scheme will lead to more income, lesser power bills and employment generation for people."
- Narendra Modi, Prime Minister

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Secretary
Government of India
Ministry of New and Renewable Energy

Message

India has made remarkable progress in the past decade, setting new benchmarks in the global renewable energy landscape. Despite many challenges, the country has installed 198.96 GW of RE capacity as of 31 August 2024. This includes 89.43 GW of solar power, 46.92 GW of large hydro, 47.19 GW of wind power, 10.35 GW of bio-power, and 5.07 GW of small hydro power.

In the financial year 2023/24, a record RE capacity of 18.56 GW was added, including 15.03 GW from solar power, 3.25 GW from wind power, 0.137 GW from hydro power, and 0.14 GW from bio-power.

The impressive growth in the overall RE capacity has been made possible through the supportive policies and incentives. In the case of solar energy through the National Solar Mission, we have seen establishment of ultra-mega solar parks with the Bhadla Solar Park in Rajasthan being the largest in the world at 2.25 GW. Additionally, rooftop solar installations have reached approximately 7 GW, significantly contributing to decentralized power generation.

Our wind energy sector has also seen substantial growth, with installed capacity rising from 21 GW in 2014 to over 42 GW by 2023. The government's strategic initiatives, such as competitive bidding and streamlined regulatory processes, have attracted significant private sector investment. States like Tamil Nadu, Gujarat, and Karnataka have been at the forefront, leveraging their high wind energy potential to boost capacity.

In addition to solar and wind, India has effectively harnessed biomass and small hydro power resources. Biomass power capacity has increased to about 11 GW, supported by the National Biomass Power Program, which promotes the use of agricultural residues and industrial waste for energy generation. Small hydro power capacity has reached close to 5.00 GW, providing clean energy in remote and hilly areas, thereby enhancing energy access and local employment.

We have made the integration of renewable energy into the national grid a priority. The Green Energy Corridor project, aimed at strengthening transmission infrastructure, has enabled the efficient flow of renewable energy across states. Moreover, investments in energy storage technologies have grown, with several large-scale projects being rolled out in the country to enhance grid stability and ensure the continuous supply of renewable energy.

All our efforts go on to show our commitment to achieving 500 GW of non-fossil fuel capacity by 2030. Moreover, India aims to reach net-zero carbon emissions by 2070, reflecting our long-term commitment to combating climate change and promoting sustainable development.

MNRE has unwavering commitment to a sustainable future as evidenced by the various policy initiatives and national schemes to promote renewable energy development. As we strive towards our ambitious targets for 2030 and beyond, I am confident that India will continue to lead the global renewable energy revolution.

With best wishes

Bhupinder Singh Bhalla

Renewable Energy
Akshay Urja

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EDITORIAL OFFICE
Ministry of New and Renewable Energy
Atal Akshya Urja Bhawan
Pragati Vihar, New Delhi 110 003
Tel. 011-20849145

PRODUCED BY
TERI, Darbari Seth Block
India Habitat Centre
Lodhi Road, New Delhi – 110 003
Email: tpsankar@teri.res.in

PUBLISHER AND PRINTER
Ministry of New and Renewable Energy
Atal Akshya Urja Bhawan
Pragati Vihar, New Delhi 110 003
Tel. 011-20849145 | Email: akshayurja@nic.in

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From the **Editor's Desk...**

Dear readers,

Akshay Urja is now in the 15th year of its publication. Ever since it began in 2005, our readers have expressed immense interest and faith in Akshay Urja as the most authentic source of information on the renewable energy (RE) sector. We are extremely thankful to each one of you for your continued patronage and support. The Akshay Urja after a gap of 5 years is again before you, now in digital form.

Continuing with its track record, this issue also carries stories that will update you about the latest developments in the RE scenario of the country. Message from Secretary of MNRE does instil a lot of confidence among stakeholders with regard to fulfilling India's commitment to the world of achieving 500 GW from non-fossil energy sources by 2030.

The Cover Story with loads of data points captures the main achievements of the solar energy and wind energy sectors during the financial year 2023/24. You will see in the cover story as to how the numbers and policy initiatives are favourably stacked up against the 2030 target of 500 GW.

The various initiatives undertaken by Cochin International Airport Ltd to deploy green energy within the airport premises, potential of nanotechnology and plasmonic materials that can redifine the landscape of RE technologies have been presented. Besides, adoption of DRE-powered appliances to enhance post-harvest value of agriculture products. Yateendra Joshi's 'energy-smart' story may help you reduce your residential electricity bills and shrink your carbon footprints on the environment.

Hope you find this issue of immense value. As always, I look forward to your suggestions to make Akshay Urja more valuable to its readers.

Arun K Tripathi

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NATIONAL

India's Solar Power Growth: 89,431.98 MW Installed And 58.58% Renewable Contribution As Of August 2024

India has experienced a remarkable surge in solar energy adoption in recent years, driven by falling costs and advancements in photovoltaic (PV) technology. As of August 2024, the nation's installed solar PV capacity has reached 89,431.98 MW, accounting for over 58.58% of its renewable energy capacity, excluding large hydro. In August alone, India added more than 2.224 GW of solar PV capacity (93.5%), demonstrating its commitment to expanding its renewable energy base.

Source: Ministry of New and Renewable Energy, Government of India

NHPC invites bids for 1,200 mw solar projects with energy storage to boost renewable power in India

The NHPC Limited issued a tender for the selection of Solar Power Generators (SPGs) to set up 1,200 MW of grid-connected Solar PV Power Projects with an Energy Storage System (ESS) of 600 MW/1,200 MWh. This is being done through a competitive bidding process, with the possibility of an additional capacity of up to 1,200 MW with ESS under a "Greenshoe Option." This initiative is aimed at increasing renewable energy production in India by encouraging investment and providing state utilities with stable, dispatchable power sources.

Source: https://solarquarter.com/2024/09/24/nhpc-invites-bids-for-1200-mw-solar-projects-with-energy-storage-to-boost-renewable-power-in-india/

Zetwerk to supply made-in-India solar modules for NTPC's 1200 MW project in Gujarat

This new contract is notably four times the size of the previous order from NTPC Renewables secured in 2023. The company has established itself as a reliable partner in the renewable energy sector by consistently delivering high-quality, Made-in-India solar PV modules. Scheduled to be serviced within just 210 days, this order highlights Zetwerk's agility and capability to handle large-scale projects efficiently. The company has previously partnered with notable firms such as JSW Energy, Teesta Solar Limited, and Continuum Energy in the solar and renewable energy domain.

Source: https://energy.economictimes.indiatimes.com/news/renewable/zetwerk-to-supply-made-in-india-solar-modules-for-ntpcs-1200-mw-project-in-gujarat/113694056

PM Modi inaugurates 4th Global Renewable Energy Investor's Meet and Expo (RE-INVEST) in Gandhinagar

Prime Minister Narendra Modi inaugurated the 4th Global Renewable Energy Investor's Meet and Expo in Gandhinagar. He highlighted the government's achievements in renewable energy and infrastructure development, emphasizing India's commitment to becoming a developed nation by 2047. He also discussed initiatives like the PM Surya Ghar Free Electricity Scheme and offshore wind energy projects.

Source: https://economictimes.indiatimes.com/industry/renewables/pm-modi-inaugurates-4th-global-renewable-energy-investors-meet-and-expo-re-invest-in-gandhinagar/articleshow/113391407.cms?from=mdr

Banks, FIs to invest Rs 32.5 trillion in renewable energy by 2030: Centre

Leading renewable energy (RE) project developers, manufacturing companies, banks, and financial institutions committed close to $386 billion or around Rs 32.45 trillion to the development of RE projects by 2030. This commitment was made at the inaugural ceremony of the 4th RE-Invest Summit hosted by the Ministry of New and Renewable Energy (MNRE) and Confederation of Indian Industry (CII). Public sector and private project developers have committed to building close to 570 GW of RE capacity. Union minister of MNRE Mr Pralhad Joshi said while India aims to build 500 GW of renewable energy by 2030, the ministry has received commitments worth 570 GW from the solar power industry.

Source: https://www.business-standard.com/industry/banking/banks-fis-commit-rs-32-5-trillion-for-investment-in-renewable-energy-124091600389_1.html

Gujarat leads way as India sets ambitious renewable energy targets

Gujarat has emerged as a trailblazer in the field of renewable energy with an overall installed capacity of 28 plus GW. Out of that, roughly 14.5 GW is solar. It is number one in solar rooftop in the country, where more than 50 percent contribution of residential solar rooftop. Gujarat has a very supportive regime from the DISCOMs to promote residential solar rooftop. Under the RE policy 2023, Gujarat aims to install 100GW RE by 2030 and contribute in a big way to the PM's vision of 500GW RE by 2030.

Source: https://www.business-standard.com/india-news/gujarat-leads-way-as-india-sets-ambitious-renewable-energy-targets-124092100287_1.html

Solar, wind energy generation rises as discoms cut payment delays in FY24: Fitch

Wind and solar power generation in India rose as payment delays narrowed in FY24, according to Fitch Rating, bringing the nation closer to its renewable energy target. Producers of clean power received payments from distribution companies or discoms closer to the schedule in FY24 than the year before, boosting cash collections. The ratings agency said in a report on 30 August 2024 receivable days at Fitch's rated portfolio for revenue from the sale of power improved to around 100 days in FY24, from about 140 days in FY23. Receivable days for solar energy improved to 88 in FY24 from 117 in the previous fiscal, while the metric narrowed to 112 days from 165 for wind power, it said.

Source: https://www.livemint.com/industry/energy/wind-solar-power-generation-renewable-energy-fitch-rating-discoms-ntpc-11725025148193.html

India powers up green hydrogen: 15,000 MW electrolysers with ₹45,000 crore boost by 2026

The SIGHT (Strategic Interventions for Green Hydrogen Transition) programme, which the backbone of India's Green Hydrogen efforts, is already making significant progress Through a fair and transparent tendering process, around 15 companies have been sel to develop this 15,000 MW capacity. India's ambitious plans to establish a massive 15,000 MW electrolyser manufacturing capacity for Green Hydrogen production will require an estimated investment of ₹30,000- 45,000 crore, according to senior officials spearheading the initiative. This substantial financial commitment underscores the scale of India's vision under the National Green Hydrogen Mission, where the government has also set aside ₹12,500 crore in incentives to support this capacity expansion over the next five years.

Source: https://energy.economictimes.indiatimes.com/news/renewable/india-powers-up-green-hydrogen-15000-mw-electrolysers-with-45000-crore-boost-by-2026/112978779

INTERNATIONAL

African Development Bank Group's Sustainable Energy Fund for Africa approves €6 Million for Desert to Power - Burkina Faso Solar Project

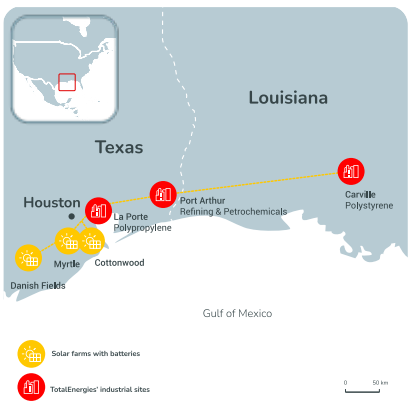
The African Development Bank Group has approved a €6 million concessional financing package from the Sustainable Energy Fund for Africa (SEFA), a special multi-donor fund managed by the Bank, to accelerate the completion of Burkina Faso's Dédougou photovoltaic solar project in support of the Bank's Desert-to-Power initiative. The project involves designing, constructing and operating an 18-megawatt solar power plant in Dédougou, located 250 kilometres west of the capital, Ouagadougou. Burkina Faso is one of five priority countries under the Desert-to-Power initiative, which aims to generate 10 gigawatts of solar power across 11 Sahelian countries by 2030, promoting socio-economic development.

Source: https://www.afdb.org/en/news-and-events/press-releases/african-development-bank-groups-sustainable-energy-fund-africa-approves-eu6-million-desert-power-burkina-faso-solar-project-74432

Tunisia seeks to be at the forefront of the global green hydrogen scene

Tunisia has unveiled an ambitious national strategy aimed at transforming the country into a world leader in the production of green hydrogen. The strategy lays out a comprehensive roadmap that includes a massive expansion of renewable energy, with significant increases coming mainly from solar and wind power. This expansion is essential to fuel the production of green hydrogen. One aspect of the plan is to reallocate existing gas pipelines to transport green hydrogen, which will facilitate direct connections with European markets. Combining local needs with global ambitions, Tunisia's strategy will initially focus on the production of green ammonia for fertilisers. The aim is first to meet local demand before diversifying into exports. International collaboration is also emphasised, with Tunisia actively seeking partnerships to attract foreign investment.

Source: https://www.tunisianmonitoronline.com/index.php/2024/09/28/tunisia-seeks-to-be-at-the-forefront-of-the-global-green-hydrogen-scene/



TotalEnergies Starts Up its Largest Utility-Scale Solar Farms with Batteries in the United States

TotalEnergies has started commercial operations of Danish Fields and Cottonwood, two utility-scale solar farms with integrated battery storage located in southeast Texas. These new projects, with a combined capacity of 1.2 GW, are part of a portfolio of renewable assets totaling 4 GW in operation or under construction in Texas. Danish Fields is TotalEnergies' largest solar farm in the United States, with a capacity of 720 MWp and 1.4 million ground-mounted photovoltaic panels. Danish Fields also features a 225 MWh battery storage system supplied by Saft, the battery subsidiary of TotalEnergies. 70% of Danish's solar capacity has been contracted through long-term Corporate Power Purchase Agreements (CPPAs) signed with industry players like Saint-Gobain, featuring an upside sharing mechanism indexed on merchant price.

Source: https://totalenergies.com/news/press-releases/renewables-totalenergies-starts-its-largest-utility-scale-solar-farms-batteries

Saudi Arabia launches sixth round of solar and wind projects under NREP

The Saudi Power Procurement Company (SPPC) has officially announced the release of a request for qualification (RFQ) for the sixth round of solar and wind energy projects under the National Renewable Energy Program (NREP). This initiative, which is overseen by the Ministry of Energy, aims to bolster the Kingdom's renewable energy capacity significantly. The total capacity for the Round 6 projects is set at an impressive 4,500 megawatts (MW).

Source: https://solarquarter.com/2024/09/26/saudi-arabia-launches-sixth-round-of-solar-and-wind-projects-under-nrep/

Australia Boosts Domestic Solar Manufacturing with $1 Billion Solar Sunshot Program

Australia is making significant strides toward boosting its renewable energy manufacturing sector with the launch of the Albanese Government's $1 billion Solar Sunshot program. This new initiative aims to strengthen Australia's solar capabilities, support local jobs, and enhance the resilience of its supply chains. The Solar Sunshot program, managed by the Australian Renewable Energy Agency (ARENA), is set to kick off with an initial $550 million investment. This funding will focus on the commercialization and expansion of Australian solar photovoltaic (PV) innovations. Specifically, $500 million will be dedicated to advancing solar panel manufacturing within Australia, targeting modules, module components, and deployment systems, while $50 million will be allocated to feasibility and engineering studies for solar PV manufacturing.

Source: https://www.gleaf.in/news/australia-boosts-domestic-solar-manufacturing-with-1-billion-solar-sunshot-program

Albanese and Miles Governments Invest $116M in Energy Upgrades for Queensland Social Housing

The Albanese and Miles Labor Governments are taking action in Queensland, rolling out energy performance upgrades for thousands of social housing tenants to reduce energy bills and ease the cost of living. A $116 million joint investment will provide upgrades such as thermal shell improvements, air cooling solutions, ceiling fans, solar PV systems, energy-efficient hot water systems, and fixed appliance upgrades. The Albanese Government continues to deliver on its Social Housing Energy Performance Initiative, while the Miles Government progresses its Homes for Queenslanders plan to build one million homes, including 53,500 social homes.

Source: https://solarquarter.com/2024/09/11/albanese-and-miles-governments-invest-116m-in-energy-upgrades-for-queensland-social-housing/

Europe's biggest floating solar farm could power a large town

Berlin-based renewable energy firm Q Energy has secured €50mn in debt finance to complete work on Europe's largest floating solar farm, set to power up in 2025. The plant is already under construction at the site of a former quarry in the Haute-Marne region of France. Once finished, the farm will comprise 134,649 floating solar panels covering an area equivalent to 180 football pitches. The huge 73MW array will cater to the electricity needs of around 37,000 people, Q Energy estimates. Floating solar farms or "floatovoltaics" work much like their land-based cousins, but on water. Each one comprises an island of panels, mounted atop a buoyant platform, and anchored to the bottom of the water body by cables.

Source: https://thenextweb.com/news/europes-biggest-floating-solar-farm-could-power-a-large-town

These Record-Breaking New Solar Panels Produce 60 Percent More Electricity

Experimental cells that combine silicon with a material called perovskite have broken the efficiency record for converting solar energy and could eventually supercharge how we get electricity. The research demonstrates a record power-conversion efficiency for tandem solar cells. In the new Nature paper, a team of researchers at the energy giant LONGi has reported a new tandem solar cell that combines silicon and perovskite materials. Thanks to their improved sunlight harvesting, the new perovskite-silicon tandem has achieved a world record 33.89 percent efficiency.

Source: https://www.wired.com/story/tandem-solar-panel-cells-efficiency-energy/

Renewable Energy Sector Making Giant Strides in India

Solar energy leads from the front

Here is a look back at the major achievements in the renewable energy sector for 2023/24. The article reviews the sector's performance so far in light of India's commitment to achieving 500 GW from renewable energy sources by 2030. In this article, the developments in the solar energy sector and wind energy sector have been covered. The next issue will touch upon the developments in the other sources of RE.

India's renewable energy (RE) sector has come a long way since 2014. The Ministry of New and Renewable Energy (MNRE), which is driving the RE sector, is leaving no stone unturned to ensure that the sector makes a substantial contribution to the energy security of the country. In the wake of the Hon'ble Prime Minister's announcement at COP26, the Ministry has shifted gears to gather further momentum to achieve the target of 500 GW of installed electricity capacity from non-fossil sources by 2030.

In that journey riddled with innumerable challenges, the country has put up a creditable show by installing 199.58 GW of RE capacity as of August 31, 2024. This includes 89.43 GW of solar power, 52 GW of hydro (including 5.07 GW small hydro), 47.19 GW of wind power, and 10.96 GW of bio-power. Table 1 gives a picture of sector-wise achievements till 31.08.2024. The numbers do indicate that the country is truly on the path of achieving the target of 500 GW from non-fossil fuel sources by 2030.

In this context, it is also worthwhile to look at some of the RE-related facts that are playing as great enablers for the sector to grow further in the coming days. For instance, the share of thermal sources in the total installed capacity has come down from 68.47% in 2014/15 to 55.03% in 2023/24 (up to March 2024). The share of non-fossil fuel in the total installed capacity has increased from 31.53% to 44.97%.

Another fact is that RE now enjoys a share of 43.12% of the total installed generation capacity of the country. In the case of non-fossil fuel-based sources (RE and nuclear), it is 44.97% of the total installed generation capacity of the country. When it comes to the RE share in the total electricity generation, it has seen an increase of 3.70%; that is from about 17% in 2014/15 to about 20.70% in 2023/24.

As per the IRENA Statistics 2023, India stands 4th globally in RE installed capacity, 4th in wind power capacity, and 5th in solar power capacity. While the international standing holds good for the country, it also poses challenges for the country to move up the order. Such climate-friendly competition among nations augurs well for the good of the Mother Earth.

A rather pleasing development during 2023/24 is increase of about 29.6 GW of solar manufacturing capacity in the country, i.e., from about

Table 1: Sector-wise Installed Capacity (Including Nuclear Power) as on 31-8-2024

Sector	Installed capacity (GW)
Solar power	89.43
Wind power	47.19
Bio-energy	10.96
Small hydro	5.07
Hybrid/Round-the-clock (RTC)/Peaking power/Thermal + RE bundling	---
Sub-total	**152.65**
Large hydro	46.93
Total	**199.58**
Nuclear power	8.18
Total non-fossil fuel	**207.76**

22.4 GW on March 31, 2023 to about 52 GW on March 31, 2024.

Among RE sources, as Table 1 reveals, the progress of the solar energy sector has been remarkable to say the least. Solar energy may be the low-hanging fruit among RE sources, but that alone could not be the reason for its upswing in the recent past. Both the 'push' and 'pull' factors must have been at play here. The roll-out of innovative schemes by the MNRE has indeed pulled more serious stakeholders (big and small) into the solar energy sector. That surely has made a big, positive difference in the prospects of solar energy sector.

This article briefly looks at those 'superhit' MNRE schemes that energized the solar sector and also at the developments in the wind energy sector.

Powering the Solar Energy Sector to First Among Equals

The innovative schemes rolled by the MNRE in the past few years have really caught the imagination of RE stakeholders in the country. From households to both big and small entrepreneurs, the schemes were able to pull many new stakeholders into the solar energy sector. The 'more, the merrier' seemed the mantra as their entry has galvanized the solar sector in several unchartered geographical territories too, including rural households. In other words, democratization of the benefits of solar energy accruing to every section of our society has truly kicked off in the country. With the huge solar energy potential that exists in India and the MNRE guiding the sector in the right direction, the growth of the solar sector can only gain further momentum in the days and months to come.

Apart from unstinting support from the Hon'ble Prime Minister to the RE sector as a whole, MNRE—with its nose, eyes, and ears on the ground—has played a vital role in creating an enabling environment for the solar sector to thrive. Schemes such as (a) Solar Park, (b) PM KUSUM, (c) PM Surya Ghar, (d) Production-linked Incentive (PLI) for the manufacturing sector, (e) Central Public Sector Undertaking initiatives, and (f) PM JANMAN have penetrated into newer areas while synergizing the solar sector. Given below is a run-down in brief on the salient features of the above schemes.

Solar Park Scheme

The Scheme for 'Development of Solar Parks and Ultra Mega Solar Power Projects' was rolled out in December 2014, with an aggregate capacity of 20,000 MW. Further, the capacity of the Solar Park Scheme was enhanced from 20,000 MW to 40,000 MW in March 2017 to set up at least 50 solar parks by 2025/26. All the States and Union Territories are eligible for getting benefits under the Scheme.

So far, the Ministry has sanctioned 55 solar parks with an aggregate capacity 40 GW to various solar power park developers under the Solar Park Scheme. Similarly, solar projects to the tune of 11,591 MW of solar projects have been commissioned in various solar parks, so far.

In the fiscal year 2023/24 alone, it is remarkable to note that nine new solar parks of aggregate capacity 3010 MW have been approved and solar projects of aggregate capacity 1304 MW have been commissioned in various solar parks in the country.

PM KUSUM Scheme

The PM-KUSUM Scheme was launched by the Government of India in March 2019 to provide financial support to the farmers for installation of standalone solar pumps and solarization of existing grid-connected agriculture pumps, and to provide the farmers an opportunity to become solar entrepreneurs by installing solar power plants on their barren/fallow/agriculture land. The Scheme consists of three components:

- Component A: 10,000 MW of decentralized ground-mounted grid-connected solar power plants
- Component B: Installation of 14 lakh standalone solar-powered agriculture pumps
- Component C: Solarization of 35 lakh grid-connected agriculture pumps

All three components put together, the scheme aims to add a solar capacity of 34.8 GW with a total central financial assistance of INR 34,422 crore including service charges on eligible CFA (Central Financial Assistance) to implementing agencies. The timeline for implementation of the Scheme has been extended till March 31, 2026.

Under Component C, apart from solarizing individual agriculture pumps, solarization of complete agriculture feeders is also allowed for which there is no mandatory requirement of state/farmer's share. This will help the DISCOMs to reduce losses on account of agriculture subsidies and provide farmers a reliable daytime power to irrigate their fields at very low tariff prices or even free. To ease the implementation, the Ministry amended the scheme guidelines and issued the Comprehensive guidelines in January 2024. Component B and Component C (IPS: Individual Pump Solarisation) have also been amended and can be implemented without the state share of 30% where the CFA will continue to remain at 30% and the rest 70% will be borne by the farmer.

Till August 31, 2024, about 292.33 MW capacity has been installed under Component A; over 4.65 lakh agriculture pumps have been installed under Component B; and 18,546 pumps have been solarized under Component C.

PM Surya Ghar: Muft Bijli Yojana

The Government of India approved the PM Surya Ghar Muft Bijli Yojana on February 15, 2024 with a total outlay of INR 75,021 crore for installing rooftop solar and providing free electricity up to 300 units every month for 1 crore households. Going further, the households can even sell the surplus electricity generated by them and earn some revenue for themselves. The scheme provides subsidies to the tune of INR 78,000 to those interested in installing solar power generating units. The subsidy structure designed for residential households and group housing societies/resident welfare associations (GHSs/RWAs) is quite attractive too.

Subsidy for residential households

- INR 30,000/- per kW up to 2 kW
- INR 18,000/- per kW for additional capacity up to 3 kW
- Total subsidy for systems larger than 3 kW is capped at INR 78,000

Table 2 indicates the ideal rooftop solar plant capacity for a typical household based on the monthly electricity consumption.

Table 2: Suitable rooftop solar plant capacity for households

Average monthly electricity consumption	Suitable rooftop solar capacity
0–150 units	1–2 kW
150–300 units	2–3 kW
>300 units	Above 3 kW

Subsidy for GHS/RWA

For common facilities, the subsidy amount is INR 18,000 per kW, which is inclusive of EV charging. The subsidy is available for up to 500 kW capacity (@3 kW per house) with the upper limit being inclusive of individual rooftop plants installed by individual residents in the GHS/RWA.

This scheme will result in the addition of about 30 GW of solar capacity through rooftop solar in the residential sector, generating 1000 BUs (billion units) of electricity and resulting in a reduction of 720 million tonnes of CO_2 equivalent emissions over the 25-year lifetime of rooftop systems. It is estimated that the scheme will create about 17 lakh direct jobs in manufacturing, logistics, supply chain, sales, installation, O&M, and other services.

As of May 31, 2024, a cumulative capacity of 12.12 GW solar rooftop projects have been set up in the country. In the FY 2023/24, the overall capacity addition in the country was 2866 MW.

PLI Scheme for High Efficiency Solar PV Modules

The Production Linked Incentive (PLI) Scheme under the National Programme on High Efficiency Solar PV

Modules has started gaining traction. In 2021, 8737 MW of fully/partially integrated solar module manufacturing blossomed under Tranche-I of the scheme. Under Tranche-II, Letters of Award have been issued to 11 successful bidders in April 2023 for setting up fully/partially integrated solar PV module manufacturing capacity of 39,600 MW a year. Four manufacturers have already started module manufacturing.

CPSU Scheme Phase II (Government Producer Scheme)

The MNRE is implementing a scheme for setting up grid-connected solar PV power projects by Central Public Sector Undertakings (CPSUs) with domestic cells and modules. Viability Gap Funding (VGF) support is provided under this scheme. Apart from adding solar capacity, the scheme creates demand for domestically manufactured solar cells/modules, and thus helps domestic manufacturing. Under this scheme, the Government of India has sanctioned around 8.2 GW of projects as on March 31, 2024. About 1.65 GW of solar PV power projects has been commissioned till March 2024. About 0.13 GW of solar PV power projects have been commissioned during FY 2023/24.

New Solar Power Scheme under PM JANMAN

Under PM JANMAN (Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan), a new solar power scheme was introduced on January 4, 2024. This new scheme is exclusively meant for 'Particularly Vulnerable Tribal Groups' (PVTG) Habitations/Villages with duration of two years (2023/24 to 2025/26).

The Scheme will cover electrification of 1 lakh un-electrified households (HHs) in PVTG areas by provision of off-grid solar systems where electricity supply through grid is not techno-economically feasible. PVTG areas are identified by the Ministry of Tribal Affairs (MoTA) and are located in 18 States, namely Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Rajasthan, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, Uttarakhand and West Bengal, and UT of Andaman and Nicobar Islands.

In addition, the scheme includes a provision for providing solar lighting in 1500 Multi-Purpose Centres (MPCs) in PVTG areas where electricity through the grid is not available. The total approved financial outlay of the Scheme is INR 515 crore. Based on the demand received from states, off-grid solar systems for 5067 PVTG households have been sanctioned in six states.

Wind Energy

The wind energy sector has also been

making steady progress. As Table 1 reveals, the total installed capacity of wind energy is 46.42 GW and 21.24 GW of projects are under implementation. The year 2023/24 saw wind power registering its highest annual capacity addition since 2017/18 with projects worth 3.25 GW getting off the ground. The unit size of wind turbine generator has also gone up from 3.6 MW to 5.2 MW. It is also heartening to note that the annual wind turbine manufacturing capacity has increased from 15 GW to 18 GW in the Country.

Efforts are also underway to ensure optimum utilization of wind energy resource by maximizing energy (kWh) yield per sq. km. This would entail using the latest state-of-the-art onshore wind turbine technologies. However, with the National Institute of Wind Energy pegging the wind energy potential at 1164 GW at 150 metres above ground level in the country, it has opened up lots of possibilities, opportunities, and challenges for the wind sector in terms of scaling up.

Offshore Wind Energy

Tapping offshore wind energy has been on the radar of the Ministry in the recent past. Preliminary assessment from satellite data and data available from other sources, the National Institute of Wind Energy has identified the offshore wind energy potential at about 70 GW. This mainly comes from 16 zones, 8 each in Gujarat and Tamil Nadu, with almost equal share of the potential.

Considerable efforts have been made by the Ministry to up the ante on tapping offshore wind energy. With a target of tapping 37 GW by 2030, the Ministry in September 2023 came up with revised strategy too wherein various business models for project development were suggested.

The ball was set rolling with the issuance of a call for propos als and work on tapping 10 GW (5 GW each of Gujarat and Tamil Nadu coast) has already been initiated. Another initiative is the Solar Energy Corporation of India (SECI) issuing the first tender for 'Leasing out Seabed for development of 4 GW of Offshore Wind Power Projects. It is to be noted that adequate facilitative action has also been taken to fast-track action as per the revised strategy. Mooting the idea of a viability gap funding (VGF) scheme with a total outlay of INR 7453 crore for the period 2025/26 to 2031/32 must be seen in this regard. The approval of the Union Cabinet is awaited in this case.

The take-away from all the actions in the offshore wind energy area is that by 2030, the country is expected to see some substantial contribution to the RE kitty from this sector too.

Conclusion

The RE sector in the country is testimony to the saying, 'Actions

speak louder than words'. Under the leadership of the MNRE, the RE sector has been progressing fast and has covered a lot of ground in the past 10 years. The numbers coming out from the sector have been encouraging enough to take further efforts going forward. As per the current trend of RE installation, the country, in all likelihood, will reach the target of achieving 500 GW by 2030, which is a commitment by India to the world.

Eashwar K P with inputs from MNRE

Pioneering Sustainable Aviation

The CIAL green saga

In this engaging article, **S Suhas** discusses the various initiatives undertaken by the Cochin International Airport Ltd (CIAL), the world's first airport fully powered by solar energy, to deploy green energy within the airport premises.

We all can be change agents in considering and designing sustainable outcomes in the world around us that affect systemic well-being. The Cochin International Airport Ltd (CIAL), being the world's first airport fully powered by solar energy, frames sustainability as a practice. This practice of sustainability helps us create a future that we are excited about living in while generating optimism towards solving complex problems. Pair that with creative thinking, and we will have tangible outcomes that are positively disrupting the status quo. The key is for more people to adopt the tools of change—not just follow the trends, but be willing to do the work to understand what needs to change. CIAL's vision is to focus on the opportunities that can make a real difference and facilitate further action that helps our planet.

A huge establishment like an airport requires a high volume of energy to operate. And by using green energy, CIAL hopes to contribute in its way to a healthier and greener planet. One of our innovations, which proved that relying on green energy is possible even for high-energy consumers like an airport, won us the 'Champions of the Earth' award instituted by the UN. It is a rarity for airport operators to tread into the business of green energy

production. Aviation is one of the fields, which is being reprimanded for the production of greenhouse gases. At this juncture, CIAL believes that it is our responsibility to venture into projects producing green energy and thereby reducing our carbon footprints.

CIAL and Deployment of Green Energy

A huge establishment like an airport requires a high volume of energy to operate upon. According to reports, the aviation industry accounts for 11% of all transportation-related emissions in the United States. In India, the percentage may be much lower, yet it is quite significant. Our objective was not to offset airplane-related emissions at the airport but to take a small step towards powering the entire airport and allied facilities through solar energy and to send out a message to the world that a medium-sized airport can become self-sufficient on solar power.

Solar Plant on Premises of Airport

CIAL has been trying to enhance green energy production since the inception of its first-ever solar project in 2013. In 2015, CIAL became the first airport in the world that completely operates on solar power comprising 46,150 solar panels laid across 45 acres near the cargo complex. Significantly, CIAL has 2.25 lakh sq. ft solar carport with an installed capacity of 5 MWp power from around 8500 solar panels. It can accommodate 2500 cars at a time. We have seven plants near the premises of the airport having a cumulative capacity of 40 MWp and we are adding to it.

Agri-Voltaic Practices in the Airport

In July 2021, CIAL scaled up the farming practice by incorporating the modern method of agri-voltaic procedure. We have seven solar plants on the premises of the airport. The biggest one, near the cargo terminal, has an area of 45 acres and has an installed capacity of 14.5 MWp; of which 20 acres has been used for agri-voltaic practice. We have cultivated vegetables such as yam, long yard bean, drumstick, mountain ginger, turmeric, cabbage, cauliflower, and green chilli. Water used for cleaning solar photovoltaic panels is being used for irrigating the cultivation. These crops are expected to modify the micro-climates below PV modules in reducing the temperature which results in increasing their efficiency in power generation. Moreover, the crop coverage in between PV arrays will also check the erosion of soil and thus will reduce the dust load on the PV module. Another advantage is that the cultivation dampens the weed growth underneath the PV panel mounts.

CIAL's Floating Solar Power Plants

CIAL's trysts with the experiments in producing green energy achieved another milestone with the installation of cost-effective high-density polyethene floats using French technology, upon which 1300 photovoltaic panels were mounted and laid over two artificial lakes located in the 130-acre CIAL golf course. The plants covering a total area of one acre are connected to the Kerala State Electricity Board Limited (KSEBL) power grid, which is to be banked on when needed. CIAL successfully executed the idea of Total Sustainability Management (TSM) in its golf course where treated water from the sewage treatment plant of the airport is used for water harvesting with the help of 12 artificial lakes. The water from these lakes is used for irrigating the lawns of the golf course and now these are one of the biggest floating solar panels in the state.

Hydro-electric Project at Arippara, Kozhikode

After the successful implementation of solar projects, we have ventured into the production of hydro energy as CIAL has commissioned a hydroelectric project at Arippara, Kozhikode. The 4.5-MW run-of-the-river small hydro project (SHP) was awarded to CIAL by the Power Department, Government of Kerala, as per the Kerala Small Hydropower Policy under Built-Own-Operate-Transfer (BOOT) for a lease period of 30 years. Being a run-of-the-river project, CIAL SHP at Arippara works on limited storage of water causing no adverse effect on the environment.

12 MWp Terrain-based Solar Power Plant at Payyannur, Kannur

In terrain-based installation, the orientation and tilt of solar modules will depend on the orientation

and slope of the land area. Terrain-based installation increases the land utilization compared to a flat land by decreasing the space between the solar module arrays, which is not possible in a flat land. The land area required for solar PV installation is reduced to approximately 2.75 acres/MW as compared to 3.75 acres/MW in a flat land. Therefore, we were able to install 35% additional capacity from the land area as compared to a typical flat ground south-oriented installation.

The cumulative capacity of CIAL's power plant is now 50 MWp, producing 2 lakh units of electricity per day and 7.3 crore units of power (green energy) yearly. This would mean that we are reducing the carbon footprint by 28,000 metric tonnes per year. This is equivalent to the amount of fresh air that we get by planting 46 lakh trees for 10 years or saving 1.19 crore litres of fossil fuel every year.

CIAL generates 200,000 units of power daily, while its daily power consumption stands at 160,000 units. The excess energy is supplied to the KSEBL, resulting in some earning for CIAL.

Hydrogen, the Fuel of the Future

In a strategic move to bolster its pathbreaking green energy initiatives, CIAL has entered into a Memorandum of Understanding (MoU) with Bharat Petroleum Corporation Limited (BPCL) for setting up a Green Hydrogen plant in the premises of Cochin Airport. This collaborative effort, combining technological prowess and infrastructure, will result in the world's first 'Green Hydrogen Plant' and fuelling station located within an airport setting.

Green hydrogen, produced from water using renewable energy sources, is recognized as a future fuel and aligns with zero-carbon energy strategies. CIAL augments its capabilities through a strategic collaboration with BPCL for setting up a 1000 kW pilot project at the airport premises. Under the agreement, BPCL will oversee the establishment of the integrated Green Hydrogen Plant and fuelling station at Cochin airport, providing technology and managing the operations. CIAL will contribute suitable land, water, and green energy resources. The initial output of the plant will be utilized for powering vehicles within the airport.

S Suhas IAS, Managing Director, Cochin International Airport Ltd.

4th Global Renewable Energy Investors Meet and Expo (RE-INVEST 2024): Catalysing India's Renewable Energy Future

Hon'ble Prime Minister of India, Shri Narendra Modi, inaugurates RE-INVEST 2024

The 4th Global Renewable Energy Investors Meet and Expo (RE-INVEST 2024) was held from 16–18 September 2024, at the Mahatma Mandir in Gandhinagar, Gujarat. The event, organized by the Ministry of New and Renewable Energy (MNRE), Government of India, marked another significant milestone in the country's journey towards clean energy transition. It provided a global platform for policymakers, investors, business leaders, and technology innovators to converge and discuss strategies to accelerate the adoption of renewable energy.

India has already positioned itself as one of the leading nations in renewable energy deployment, with ambitious targets to meet 50% of its energy requirements through non-fossil sources by 2030. The 4th RE-INVEST came at a critical time, as India continues to expand its renewable energy capacity, focusing not only on solar and wind but also on emerging technologies such as Green Hydrogen and energy storage.

The event brought together a footfall of over 25,000+ delegates, 250 speakers, 363 companies, and hosted 816 B2B and 110 B2G meetings, driving the energy transition forward.

With 4 partner countries, 8 partner states, and 22 State/UT delegations on board, the event underscored the power of collaboration and innovation for a sustainable future.

Overview of RE-INVEST 2024

The theme of the 4th RE-INVEST was 'Catalysing Investment in India's Clean Energy Transition.' The event served as a critical forum for discussions on investment opportunities, technology partnerships, and policy reforms necessary to meet India's renewable energy goals. More than 25,000 participants from over 50 countries (including 4 partner countries) and 6 partner states and 22 states/UTs attended, including heads of state, ministers, industry leaders, investors, and representatives from international organizations such as the International Renewable Energy Agency (IRENA) and the International Solar Alliance (ISA).

Inauguration and Keynote Addresses

The event was inaugurated by the Honorable Prime Minister of India, Shri Narendra Modi, who has been a strong advocate for renewable energy. In his inaugural speech, the Prime Minister reiterated India's commitment to reducing its carbon footprint and becoming a global leader in clean energy. He highlighted the country's achievements, noting that India had already surpassed 200 GW of installed non-fossil power capacity and was well on its way to achieving 500 GW by 2030.

He also emphasized the critical role of the private sector in driving the renewable energy revolution. India is not just a market for renewable energy, but a driver of innovation, policy leadership, and investment opportunities in this sector, said the Prime Minister.

Addressing the gathering, Hon'ble Union Minister for New and Renewable Energy, Shri Pralhad Joshi, emphasised how under Shri Narendra Modi's leadership India is claiming a leading position in the global renewable energy sector. He also made an appeal to all stakeholders to invest in India's vibrant and rapidly growing RE sector.

Germany, Australia, Denmark, and Norway took part in the event as partner countries. Gujarat is the host state and Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Telangana and Uttar Pradesh participated as Partner States. Key dignitaries from partner countries and global organizations such as ISA and IRENA delivered addresses, showcasing their support for India's renewable energy initiatives and expressing interest in collaborating on future projects.

Key Highlights of the 4th RE-INVEST

The three-dmay event featured numerous discussions, exhibitions, and networking opportunities aimed at driving forward India's clean energy agenda. Some of the key highlights of the 4th RE-INVEST include:

1. **Investment Commitments and Partnerships**

   One of the major outcomes of RE-INVEST 2024 was the announcement of new investment commitments. Various Indian and international companies committed to investing in large-scale renewable energy projects across India.

   Several Memorandums of Understanding (MoUs) were signed between Indian companies and international organizations to collaborate on technology transfer, joint ventures, and research in areas such as solar energy, wind power, and Green Hydrogen.

2. **Focus on Green Hydrogen**

   Green hydrogen emerged as a key focus area at RE-INVEST 2024. India's National Hydrogen Mission has already set ambitious targets for producing Green Hydrogen to decarbonise sectors like industry, transportation, and shipping. During the event, several discussions were held on the potential of Green Hydrogen, with experts exploring how India could become a global hub for Green Hydrogen production.

   The Government of Gujarat announced plans to develop a Green Hydrogen Corridor in the state, with large-scale investments from both domestic and foreign investors. Additionally, partnerships were signed with international companies for the development of hydrogen electrolysis technology and the establishment of Green Hydrogen production facilities.

3. **Advances in Solar and Wind Energy**

   RE-INVEST 2024 showcased India's leadership in solar and wind energy. Exhibitions featured cutting-edge solar photovoltaic (PV) technologies, wind turbine innovations, and hybrid renewable energy systems combining both solar and wind power.

   The event also emphasized offshore wind energy, which has gained traction in India, especially along the coasts of Gujarat and Tamil Nadu. Offshore wind farms are poised to play a crucial role in India's energy future, with significant potential for large-scale deployment.

4. **Energy Storage Solutions**

   As India continues to increase its renewable energy capacity, energy storage has become a critical issue for ensuring grid stability and addressing the intermittent nature of solar and wind power. Several companies showcased the latest in battery storage technologies, including lithium–ion and advanced flow batteries.

   Participants discussed the need for large-scale storage solutions to enable round-the-clock renewable energy supply and mitigate grid challenges. The Government of India announced new policy initiatives to incentivize investments in energy storage, including support for domestic manufacturing of batteries.

5. **Financing the Clean Energy Transition**

   The event brought together key financial stakeholders, including global banks, venture capitalists, and multilateral institutions, to explore innovative financing mechanisms for renewable energy projects. The event highlighted the importance of de-risking investments in clean energy to attract more private capital.

   The World Bank and the Asian Development Bank (ADB) reaffirmed their commitment to supporting India's energy transition, announcing new lines of credit for renewable energy projects. Discussions centred around green

bonds, blended finance models, and carbon markets as tools to mobilise funding for large-scale renewable energy deployment.

Policy Announcements and Regulatory Reforms

Several important policy announcements were made during the event. The Government of India revealed its plans to update the Renewable Purchase Obligation (RPO) framework, ensuring that utilities procure a certain percentage of their energy from renewable sources. The RPO targets for solar, wind, and Green Hydrogen were increased, signalling the government's commitment to pushing renewable energy further into the mainstream.

Additionally, MNRE announced new incentives for domestic manufacturing of renewable energy components, including solar modules, wind turbines, and energy storage systems, as part of the 'Atmanirbhar Bharat' (Self-Reliant India) initiative. These incentives are aimed at reducing dependence on imports and creating a robust domestic renewable energy manufacturing ecosystem.

International Collaboration

The deliberations and discussions during the event strengthened international cooperation in the renewable energy space. The event saw participation from countries including the United States, Germany, France, Japan, and Australia, all of which expressed interest in collaborating with India on renewable energy projects.

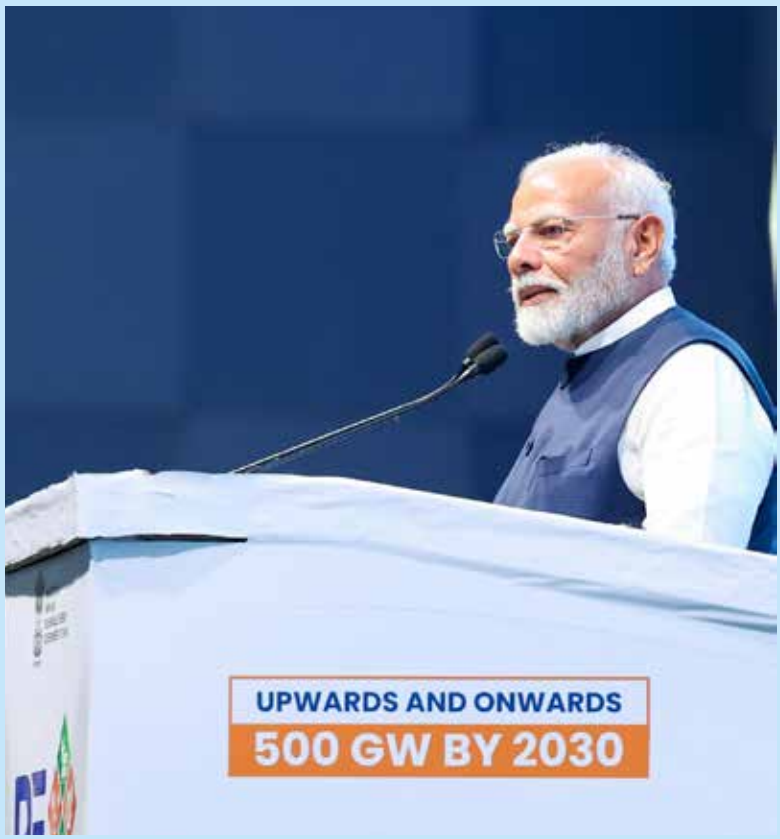
The International Solar Alliance (ISA), an India-led initiative, played a prominent role in discussions, focusing on facilitating international solar projects, particularly in Africa and Asia. ISA members highlighted the need for knowledge sharing, technology transfer, and capacity building to accelerate solar energy deployment in developing countries.

Conclusion: Paving the Way for a Greener Future

The 4th RE-INVEST successfully reinforced India's leadership in renewable energy. With significant investment commitments, technological innovations, and international partnerships, the event underscored India's determination to become a global clean energy hub.

The event at Gandhinagar was not just a conference but a testament to India's commitment to a greener, more sustainable future. It stands as a reminder that the path to a renewable energy-powered world requires collective action, innovation, and investment on a global scale.

Thus Spake the Dignitaries…



Shri Narendra Modi, Prime Minister of India

- *India is not just a market for renewable energy; we are leading by example. Our commitment to achieving 500 GW of renewable energy by 2030 is not just a goal, but a pledge to future generations to build a cleaner and greener India.*
- *India's leadership in solar energy and the International Solar Alliance is a testament to our vision for a sustainable world. We invite global investors to partner with us as we embark on this mission of clean energy transition.*

Shri Pralhad Joshi, Union Minister for New and Renewable Energy, Government of India

- *The government has received record investment commitments worth Rs 32.45 lakh crore up to 2030 through 'Shapath Patras'. State governments have given commitments for setting up 520 GW RE capacity and manufacturers have committed additional manufacturing capacity of 340 GW for solar modules, 240 GW for solar cells, 22 GW for wind turbines, and 10 GW for electrolysers.*
- *This speaks of the trust of the investors. Beyond this, banks and financial institutions have also come forward for supporting a greener and sustainable India. I am thankful to the developers, manufacturers, and banks and financial institutions as they have voluntarily pledged the commitments.*

Dr. Ajay Mathur, Director General, International Solar Alliance (ISA)

- *The ISA is committed to driving solar energy deployment across the world. Through India's leadership and platforms like RE-INVEST, we are building the foundations for a solar-powered future that leaves no country behind.*
- *Solar energy is the key to achieving global energy security and sustainability. The 4th RE-INVEST has reaffirmed our belief that the world is ready for large-scale solar investments, and India is leading the charge.*

Shri Bhupendra Patel, Chief Minister of Gujarat

- *Gujarat is a leader in India's renewable energy story, and hosting RE-INVEST 2024 in Gandhinagar is a proud moment for us. Our state is committed to building a sustainable energy future with investments in solar, wind, and Green Hydrogen.*

Mr. Francesco La Camera, Director-General, International Renewable Energy Agency (IRENA)

- *India has shown remarkable leadership in scaling up renewable energy. The 4th RE-INVEST is an important platform for mobilizing investments, and IRENA is proud to support India's efforts to drive the global clean energy transition.*
- *The global energy transition is accelerating, and India is at the forefront of this movement. By sharing knowledge and building partnerships, we can together create a future that is both sustainable and inclusive.*

RE-INVEST 2024 – AT A GLANCE

1. Total Number of Sessions: 43

2. Delegates and Speakers: The event brought together a footfall of over 25000+ delegates every day registered from across the country and more than 20,000 students and members of academia, with 250 international delegates in attendance. Additionally, there were 250 speakers.

3. Country Participation: Denmark, Germany, Norway, and Australia were country partners. There were delegates from countries like UAE, Singapore, Bhutan.

4. Participation of States: There were eight partner states: Gujarat, Andhra Pradesh, Rajasthan, Karnataka, Maharashtra, Telangana, Uttar Pradesh, and Madhya Pradesh and six state sessions (Gujarat, Andhra Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, and Madhya Pradesh).

   There were delegations from 22 states / UT (other than partner states) like Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Haryana, Himachal Pradesh, Kerala, Meghalaya, Nagaland, Odisha, Punjab, Tamil Nadu, Tripura, Uttarakhand, West Bengal, Chandigarh (UT), Dadra & Nagar Haveli and Daman & Diu (UT), Delhi [National Capital Territory (NCT)], Jammu & Kashmir (UT), Ladakh (UT), Puducherry (UT).

5. State CMs: Six Chief Ministers from Gujarat, Andhra Pradesh, Rajasthan, Madhya Pradesh, Chhattisgarh, and Goa, and one deputy CM from Telangana.

6. Number of MoUs Signed - India–Germany Platform for Investments in Renewable Energies Worldwide: The aim is to develop concrete and sustainable solutions for the accelerated expansion of renewable energy. The platform will bring together international stakeholders from across the globe, including the private sector (both financial sector and industry), international organizations, development banks and bilateral partners, to create business opportunities, for meeting the increasing demand for capital, technology transfer and innovative technical solutions.

6. Salient Features of Exhibition: Cutting-edge sustainable engineering design, technology, and innovation showcased at the event.
   - Renewable Power Production
   - Green Fuels and Energy Storage
   - GHG Emissions Reduction and Net Zero Consulting
   - Cost-Effective Operational Strategies
   - Solar Generation Enhancement & Asset Optimization
   - Energy-from-Waste Technologies
   - Rooftop Solar and Autonomous Robotic Systems
   - Solar IPP/EPC Services
   - FLEXI BIOGAS to BIO-CNG Plants
   - EPC Solutions for Energy Efficiency
   - Green Building Certification

   Leading RE developers, manufacturers, and suppliers displayed innovative products and technology.
   - Eco-efficient PV Modules, Solar Modules, and Solar Photovoltaic Modules
   - Made-in-India Wind Turbines (Small and Large WTG)
   - Advanced Electrolysers and Battery Energy Storage Systems
   - EV Scooters and Smart Solar Huts
   - Membrane-less Electrolysers and Heavy Engineering Products
   - Biomass and MSW-based Gasifiers, Rotary Kilns, Classifiers, and More
   - Solar-powered Innovations: Food Trucks, Modular Kiosks, Battery Operated Cooking Plates
   - DC Air Heaters, Refrigeration Systems, Compressors, and Freezers
   - Green Energy Products: Solar Pumps, Solar Trees, Solar Tiles, and Solar Facades
   - Solar Rooftop, Ground Mounted, and Street Lighting Solutions
   - Solar EV Charging, Hybrid Collectors, Trackers, and Material Handling Equipment

7. Total Number of B2B, B2G, G2G Meetings: Around 363 companies participated, representing both Indian and global businesses. 816 B2B (Business to Business) meetings and 110 B2G (Business to Government) meetings held

8. Social Media Activities:
   - Estimated reach – 377.5 million
   - 8+ million reach
   - 67.4k engagement
   - 500+ posts
   - #Reinvest2024 and related hashtags trended in 4th position for all 3 days on X platform

9. Major Takeaways
   - States made pledges for working toward renewable energy with Gujarat leading with a commitment to add 128.60 GW by 2030. Andhra Pradesh and Maharashtra followed with pledges of 72.60 GW and 62.73 GW, respectively.
   - Renewable energy developers, both solar and wind, committed to adding 570 GW of installed capacity, and manufactures and suppliers have also made substantial pledges to enhance production.
   - Commitment of Rs 32.45 lakh crore worth of investment that is expected to generate an employment for 82 lakh persons.
   - Financial institutions demonstrated strong support by committing Rs 25 lakh crore. Major banks and financial institutions such as REC, IREDA Limited, and the State Bank of India are leading this effort.

Readers of Akshay Urja are encouraged to contribute your stories about technology, and innovations, along with your views on future developments in the renewable energy sector. Contributions can be 400, 800, or 1600 words long, accompanied by high-resolution photographs that complement your story. Please write to:

Editor
Akshay Urja
Ministry of New and Renewable Energy
Atal Akshay Urja Bhawan, Lodhi Road
New Delhi – 110003
Email: akshayurja@nic.in

Nanotechnology Gives Hope for a Sustainable Energy Future

In this article, **Tiju Thomas** eloquently sheds light on the potential of harnessing the power of infinitesimally small particles through nanotechnology to reshape the landscape of renewable energy technologies. Among nanomaterials, he draws attention to a class of objects called plasmonic materials. These materials are often meticulously engineered metal nanoparticles at the nanometre scale. These tiny structures, if duly engineered, possess extraordinary properties that could aid their utilization in solar energy technologies.

Ever since the world's scientific discourse veered towards the threats posed by climate change and global warming, the talk of alternative or renewable energy with lesser or no carbon footprint also gained momentum. Solar, wind, biomass, hydro, tidal, and even nuclear energy have been termed as good sources of alternative or renewable energy. Among these, solar energy stands out due to its abundance, inexhaustibility, etc. It also qualifies as a low-hanging fruit among the RE sources, which, perhaps, ignited the hope of a sustainable future.

Having said this, it has not been an easy task to harness the potential of solar energy thus far. To talk of only India, the National Institute of Solar Energy (NISE) estimates India's solar energy potential to be at 748 GW if 3% of India's waste land area is covered by solar photovoltaics (PV) modules. You can do the math yourself to arrive at the land area in terms of square kilometres. As of May 2024, we have been able to tap only 85 GW, which is just over 10% of the identified potential!

Although substantial progress has been made in the past decade, a lot of distance is yet to be covered in this regard. The challenges are primarily on two counts, among others: first, of course, is about increasing the coverage in physical terms, and the second is about increasing the efficiency of solar technologies.

While the first relates to scaling up, the second is about focused R&D in material sciences. It is in the latter that nanotechnology comes in and provides a glimmer of hope for both efficiency increase and sustainability.

'Sustainability' is a much harder challenge as it entails a whole host of requirements, including the decision-making paradigms and data on emerging materials design and selection paradigms. The incremental or the leapfrogging approach to innovation and research makes scientists the world over go hard at it in order to get 'more bang from the buck' from these technologies. Needless to say, such scientific rigour is always driven by a vast vision and solid commitment to the process of science.

Now nanotechnology is a special area in the broader landscape of energy materials. Nanotechnology entails the use of rather small materials, typically 100 nanometers (nm) or less in one of the dimensions. To put things in perspective, your hair is about 100 microns in thickness. If you split your hair into 1000 parts, reducing the thickness, you would be in the nm range! Now that is pretty small, isn't it? These small materials are special because many functions can be elicited from them. And that makes them potentially useful for emerging solar energy technologies and also for energy storage (e.g., batteries and related devices).

Among nanomaterials, I would like to draw your attention to a class of objects called plasmonic materials. These materials are often meticulously engineered metal nanoparticles at the nm-scale. These tiny structures, if duly engineered, possess extraordinary properties that could aid their utilization in solar energy technologies. Let me try and give you some insights regarding this.

The metal objects (most of which are big, and hence 'bulk') you see around are usually very good conductors. These objects contain many electrons that are free to move. If you make these metal objects tiny, and bring it down to the nm range, they start showing size-dependent optical phenomena. For instance, gold could be made to look pink if you can shape it into a sphere of 90 nm diameter! Specifically, such a size-dependent phenomenon is explained based on something called localized surface plasmon resonance (LSPR). Briefly, size determines the wavelength that is reflected, and hence determines the colour of the particles. Of course, this phenomenon can kick in even when particles are stimulated by sunlight. This opens up fresh possibilities, especially in harnessing a wider range of solar spectrum than we do today!

Recently in my research group, we have been using plasmonic materials to develop some plausibly game-changing opportunities. We have been using plasmonic materials to harvest solar energy for improving water distillation and solar water heating.

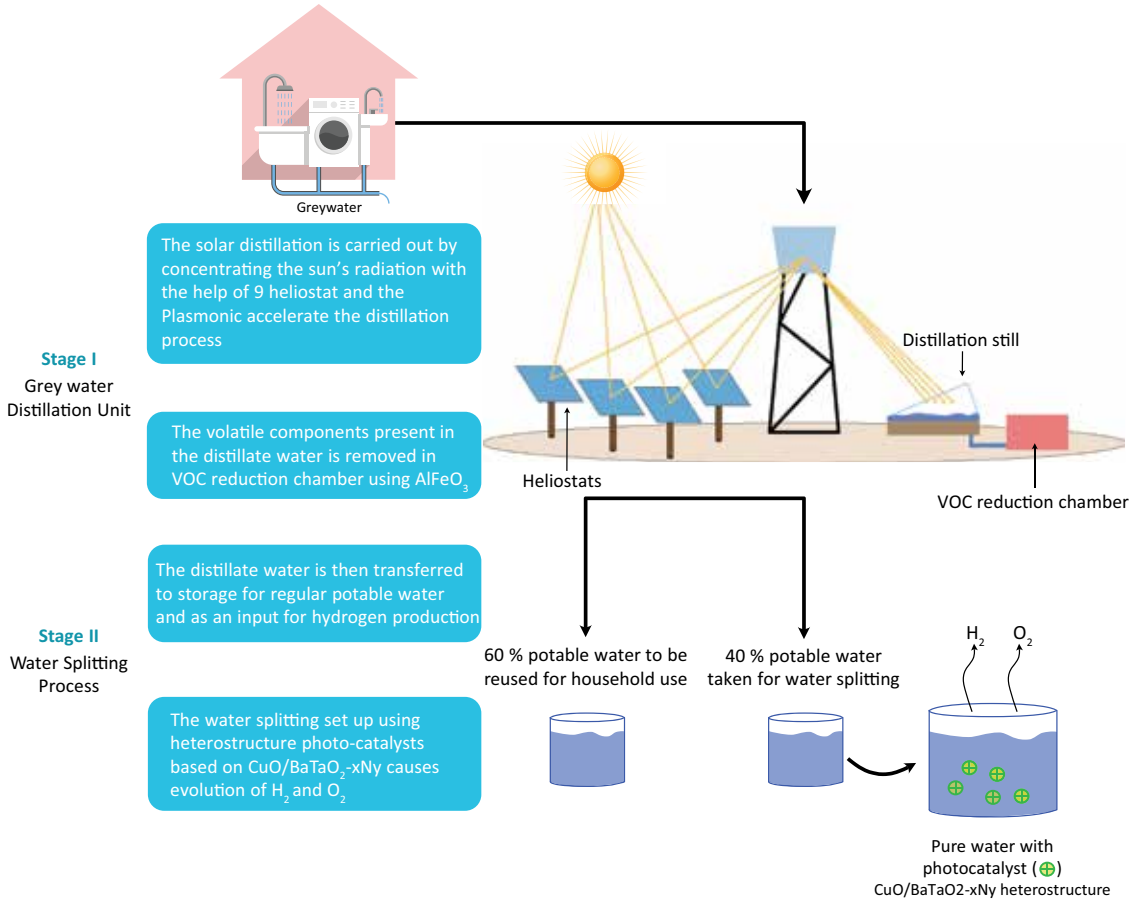


Figure showing an ongoing project in IIT Madras. Grey water such as that from bathrooms and kitchens is used to make pure water. A fraction of this pure water could be put to good use for hydrogen production, once again through solar-driven approaches. The solar concentrators and materials are all 'home-made' (built in our lab). *Figure Courtesy: Mr T R Adithyan, Research Scholar, Applied Nanostructure Engineering and Nanochemistry Lab, IIT Madras.*

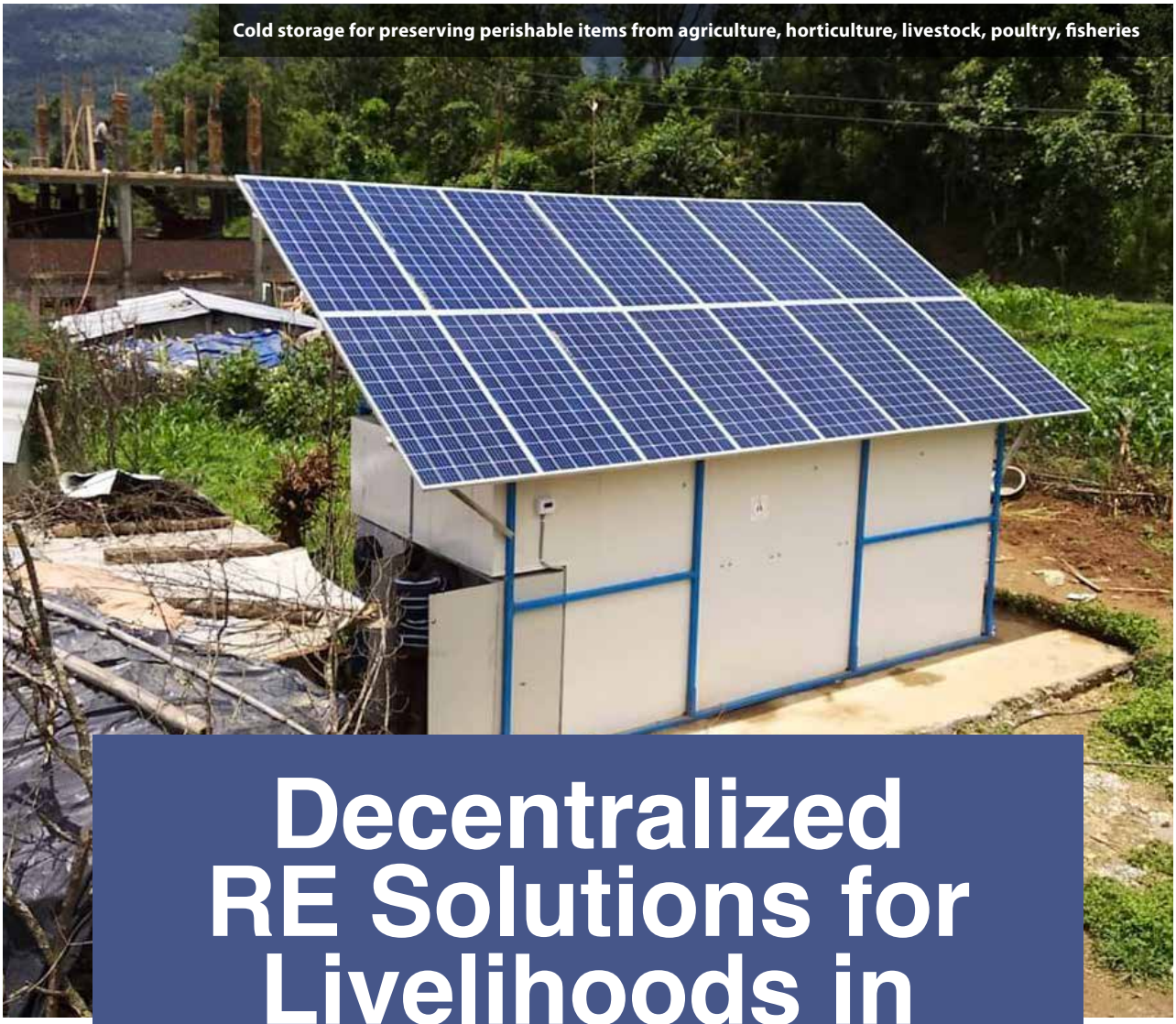
Conventional solar thermal systems often grapple with issues of bulkiness and inefficiency. However, integrating metal nanoparticles into the design can potentially open up possibilities of reducing the real-estate footprint associated with solar water heating technologies.

The transformative potential of plasmonic materials extends far beyond solar thermal applications. In the domain of photovoltaics, these nanoparticles are rewriting the rulebook for solar cell efficiency and performance. By embedding metal nanoparticles within the active layers of solar panels, researchers have been able to enhance light absorption, amplify charge carrier generation, and elevate overall device efficiency. However, this is also a can of worms, and we shall unravel more, perhaps someday in person, or via this article series! For now, it would suffice to say that the crux of this advancement lies in the symbiotic interplay between plasmonic nanoparticles and incident sunlight, with an extremely careful selection of materials and their structures.

I would like to leave you with this thought. A significant number of researchers are currently pursuing technologies guided by the United Nation's Sustainable Development Goals (UN SDGs). A good question to ask is, what is the know-how we have, and what is it that we are missing to reduce our ecological, carbon, and water footprints, while also ensuring energy security to one and all? There is plenty of work to be done, and I would welcome each one of you reading this to think of your part in this grand tapestry we will need to weave as a collective, as one humanity!

You are welcome to visit my website: ***https://sites.google.com/view/tiju-thomas***

Tiju Thomas, *Professor, IIT Madras. His research areas comprise nanomaterials for solar energy harvesting, clean hydrogen technologies, computational materials design, automation in energy device production, reliability in energy devices, etc.*



Cold storage for preserving perishable items from agriculture, horticulture, livestock, poultry, fisheries

Decentralized RE Solutions for Livelihoods in Meghalaya

Various factors constrain horticulture processing in Meghalaya, including limited access to modern post-harvest technologies and poor grid supply in rural areas. Despite over 90% grid electricity connections, outages are frequent and prolonged. **Akanksha Chaurey**, **Rekha Krishnan**, **Svati Bhogle**, and **Tauseef Ahmad** suggest that adopting decentralized renewable energy (DRE) technologies can drive mechanization and reduce diesel generator use. Use cases for DRE integration in Meghalaya's pineapple, banana, and turmeric value chains show that DRE-powered post-harvest appliances like dryers, boilers, processors, and cold storage can significantly enhance post-harvest value.

Portable solar pump used for irrigation in Meghalaya

Meghalaya, with Gross State Domestic Product of over INR 46,600 crore, has agriculture and allied sectors as its single largest contributor at 17%, as per a study by CLEAN (Clean Energy Network). Eighty per cent of the state's population is engaged in agriculture/ horticulture. Other major livelihoods sectors include tourism, handicrafts, and sericulture, apart from mining.

Owing to its terrain and climatic conditions, the state is ideally suited for various types of horticulture crops such as fruits, vegetables, spices, etc. The state is particularly well-known for pineapple and turmeric. Fruits and vegetables comprise 89% of the horticulture in the state. Most of the fruit production is consumed within the state in fresh form. Only 10% or less of the fruits are processed. It is estimated that 30% of fruits and vegetables are lost due to limited infrastructure for storage, processing, and access to markets.

There are various factors that constrain and inhibit horticulture processing in the state including limited access to and awareness about modern post-harvest technologies. Further, poor grid supply in rural areas hinders the operation of electric machines; although grid electricity connection is over 90%, outages are frequent and long. Adoption of decentralized renewable energy (DRE) technologies can catalyse mechanization while also replacing/ avoiding diesel generators in use in many areas.

Based on use cases developed for DRE integration in three value chains in Meghalaya—pineapple, banana, turmeric—it is evident that market-ready DRE-powered post-harvest appliances such as dryers, boilers, horticulture processors, and cold storage can significantly enhance post-harvest value. For instance, another study by CLEAN indicated that the payback period for spicy dried pineapple, where an attractive market is envisaged, can be as short as one or two harvesting seasons.

Integrating DRE in Livelihoods Sector: need for a pro-DRE ecosystem

Being a nascent sector, DRE has multi-dimensional challenges associated with technology customization, financing, market design, acceptability, after-sales service, etc. Several DRE technologies need customization to make them suitable for specific end-use applications. Further, quality, safety, reliability, durability, and performance guarantee are some other issues that need to be addressed adequately to increase the confidence level of users and investors. There are case examples and good practices that have showcased the way to address some of the above challenges, albeit at pilot scale. Yet, specific awareness and understanding of what, why, how, and where about DRE technologies are lacking among decision makers of end-use (i.e., livelihoods) sectors.

To bring DRE at the centre stage of state-level planning and

implementation of livelihoods programmes, an enabling ecosystem is needed at the state/regional level. Pro-DRE ecosystem involves elements across technology innovations, financing solutions, upstream and downstream linkages (supply chain, markets), skills/capacity enhancement support, and conducive policies and regulatory landscape. These enablers must be embedded within various departments in the state including those dealing with power, renewable energy, rural development, horticulture, fisheries, sericulture, ecotourism, etc. Unless the end-use departments champion the use of DRE, its potential to create an impact on rural economy in Meghalaya and in the North-Eastern Region (NER) would remain undermined.

At the very beginning, policy commitments to DRE must be visible in the schemes of the user-departments as part of their endeavours to energize mechanization, productivity improvement, etc. The objective would be to include as many mature DRE technologies into the existing schemes as possible. Table 1 gives a few examples of electric and thermal DRE applications identified as relevant for NER. In line with the RE potential in the NER, electric applications can be powered by solar, biomass, small hydro and/or small wind.

Further, some specific policy steps to catalyse DRE integration into livelihoods schemes should be undertaken. For example, the existing incentives in these schemes offered for mechanization or energization or electrification can be modified to include DRE integration in the form of DRE-powered appliances/equipment and/or powering a unit/centre with DRE. Similarly, policies that provide subsidy on grid electricity connections or grid electricity usage may be modified to include electricity from DRE. In fact, a higher subsidy may be extended to such clean and decentralized electricity for captive generation and use.

Finally, inter-departmental coordination must be streamlined to ensure synergies and avoid overlaps. Among the ways to scale up DRE for livelihoods, the involvement of state nodal agencies for renewable energy, state rural livelihoods missions, state infrastructure development agencies, state-level bankers' committees, district administrations, NGOs, civil society organizations, consumer groups, etc., is important. Considering the vast and diverse spread of the livelihoods sector and sub-sectors, DRE integration in them needs to be facilitated in a coordinated, coherent, and competent manner. An integrated and inclusive approach and inter-departmental coordination should be of prime importance for maximizing socio-economic impact while keeping carbon emissions low through DRE-energized livelihoods in NER.

Solar powered dryer for drying various vegetables and fruits

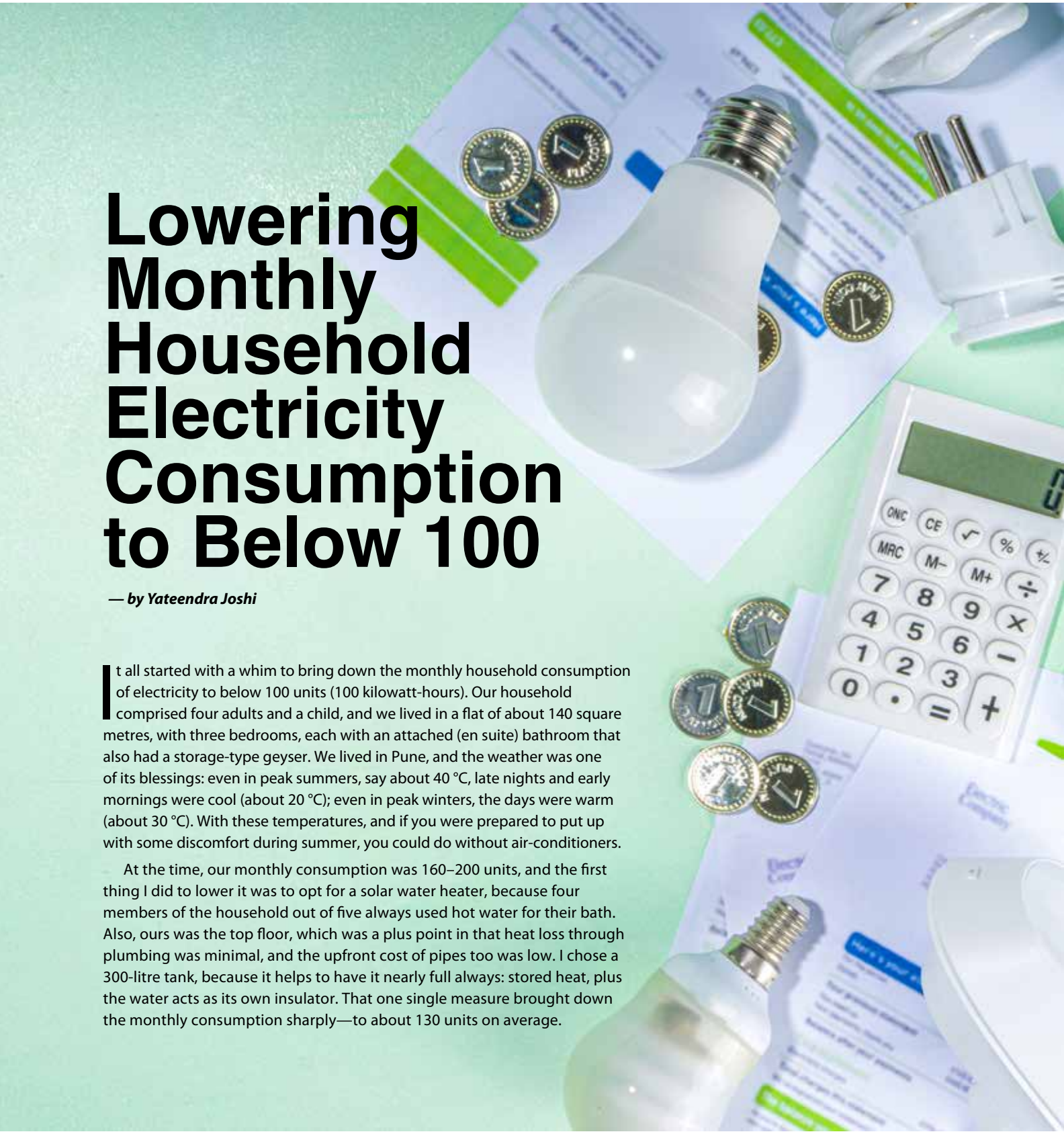
Biomass powered dryer for drying various vegetables and fruits

Table 1: DRE integration possibilities across major livelihoods sectors in Meghalaya and across NER

Sector	DRE integration possibilities
Agriculture including horticulture	▪ Irrigation – solar water pump On-farm applications – e.g., solar sprayer, solar chaff cutter, battery-operated tea leaves plucker, solar fencing ▪ Post-harvest management – solar-powered milling, hulling, rolling, powdering, juice and pulp-making; cold storage and dryers powered by RE (solar, biomass, etc), improved biomass stoves/boilers (e.g., for rice par-boiling)
Livestock, poultry, animal husbandry	▪ Solar-powered cold storage portable and large – for semen, vaccines, milk, meat ▪ Improved biomass stoves for boiling animal feed, milk-boiling ▪ Solar-powered fodder cutters ▪ Sheds with lighting and ventilation powered by solar ▪ Solar water heaters ▪ Energy generation (e.g., biogas from cow dung, electricity from poultry litter)
Fishery	▪ Solar-powered fishing boats ▪ Solar pond aerators ▪ Solar or biomass-based dryers ▪ RE-powered cold storage and ice boxes
Tourism	▪ Solar lights and lantern ▪ Solar charging stations for battery-operated buggies and solar boats ▪ Solar fencing ▪ Solar water heaters ▪ Improved biomass and biogas stoves
Handicrafts	▪ Improved biomass kilns for metal smelting and casting processes, brick, or clay-based furnace (bhatti) and sand or clay-based casting ▪ Solar-powered cutting, buffing, powdering ▪ Solar sewing machines, polishers, etc.
Handloom and sericulture	▪ Solar lighting for individual weavers and community work sheds ▪ Solar-powered silk reeling and twisting, winding, jacquard lifting, warping machine ▪ Improved biomass boilers for water heating for dyeing, cocoon boiling

Akanksha Chaurey, Director, IT Power Pvt. Ltd. and Advisor, WEFT Research LLP; Rekha Krishnan, Managing Partner, WEFT Research LLP; Svati Bhogle, Former Chairperson and mentor TIDE; and Tauseef Ahmad, Consulting Associate, WEFT Research LLP and Consultant, ITPEnergised.

The authors acknowledge their partnership with CLEAN (Clean Energy Access Network) in this project. Photographs in this article are of DRE systems of CLEAN members - portable pump (Envo Renewable Energy Services); solar dryer (Rudra Solar), cold storage (Inficold), biomass dryer (Purna Enterprises / TIDE).

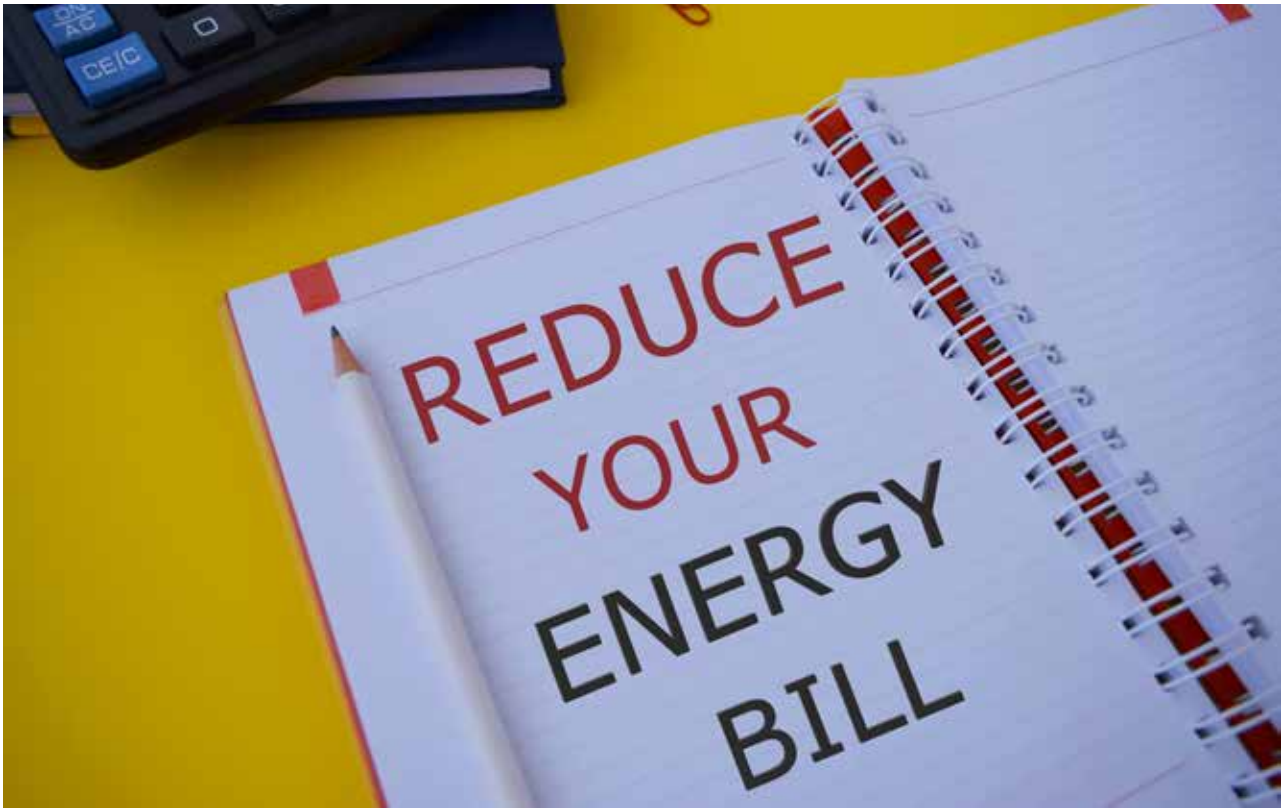


Lowering Monthly Household Electricity Consumption to Below 100

— by Yateendra Joshi

It all started with a whim to bring down the monthly household consumption of electricity to below 100 units (100 kilowatt-hours). Our household comprised four adults and a child, and we lived in a flat of about 140 square metres, with three bedrooms, each with an attached (en suite) bathroom that also had a storage-type geyser. We lived in Pune, and the weather was one of its blessings: even in peak summers, say about 40 °C, late nights and early mornings were cool (about 20 °C); even in peak winters, the days were warm (about 30 °C). With these temperatures, and if you were prepared to put up with some discomfort during summer, you could do without air-conditioners.

At the time, our monthly consumption was 160–200 units, and the first thing I did to lower it was to opt for a solar water heater, because four members of the household out of five always used hot water for their bath. Also, ours was the top floor, which was a plus point in that heat loss through plumbing was minimal, and the upfront cost of pipes too was low. I chose a 300-litre tank, because it helps to have it nearly full always: stored heat, plus the water acts as its own insulator. That one single measure brought down the monthly consumption sharply—to about 130 units on average.



Next, I replaced three of the ordinary ceiling fans that would be on for the longest hours—one in each bedroom—with energy-efficient fans (35 watts instead of 70 watts) and replaced all the bulbs, including a few CFLs (compact fluorescent lamps) with LED bulbs, their power rating running from as low as 3 watts to as high as 12 watts. With these devices, the monthly consumption was down to about 110 units. And there it remained, refusing to budge.

Luckily, two experts, independently, pointed to the same culprit: they asked me whether by any chance I was using an induction-type stove. "Yes, we make our morning tea on a hot plate," I said. Right away, we switched to cooking gas even for the morning tea—and the first electricity bill to arrive after the switch showed that the consumption was down to 98 units!

However, all this meant that we were a borderline case, whereas I was looking for ways to always remain in the no-more-than-100-units a month bracket. By that time, net metering was becoming more common, and I applied for permission to put up a solar rooftop system on the terrace. The housing society dithered for a while, but showing the society's secretary a copy of the order by the state government that such permission should be granted straightaway clinched the matter in my favour. Because Maharashtra does not pay the consumer for unconsumed units but merely carries the balance forward, I was advised to opt for a small, 1-kilowatt system, and that is what we did. The system included four polycrystalline panels, each of 250 watts, costing INR 8250/-. The total cost, in mid-2017, including installation and commissioning and payment to the discom, namely Maharashtra State Electricity Distribution Co. Ltd, was INR 1,06,500/-, to which the Ministry of New and Renewable Energy (MNRE) contributed INR 18,300/- as subsidy. Currently (mid-2024), financial assistance from the Ministry of New and Renewable Energy is fixed at INR 30,000 each for the first two kilowatt of the project with a capping of INR 78,000 for projects with 3 kWh and above.

In the meanwhile, I also replaced the old refrigerator with an energy-efficient one, with a 5-star rating awarded by the Bureau of Energy Efficiency.

The net result of all this—and especially of the grid-tied rooftop PV system—has been that ever since, our household electricity consumption has been lower than what the system generates, and we have been paying only the fixed costs of a connection, about INR 400/- a month and thus are thus practically immune to the rising power tariffs—because less than 100 units a month is a slab that is usually protected from steep increases in electricity tariffs.

Yateendra Joshi works as a freelance copy editor of technical manuscripts

International Conference on Green Hydrogen 2024

The International Conference on Green Hydrogen (ICGH) 2024, hosted by the Ministry of New and Renewable Energy (MNRE), Government of India, in New Delhi from September 11–13, marked a defining moment in the global pursuit of a sustainable energy future. The event's rich agenda and the diverse mix of speakers and attendees established a new standard for dialogue on Green Hydrogen and its integral role in the energy transition.

The conference was inaugurated with a session that set a high bar for the discussions to follow. Mr Bhupinder S Bhalla, Secretary-MNRE, extended a warm welcome to the delegates, and Prof. Ajay K Sood, Principal Scientific Adviser to the Government of India, chaired the session. A video showcasing India's strides towards a Green Hydrogen economy was displayed, followed by addresses from Mr Hardeep S Puri, the Hon'ble Minister for Petroleum and Natural Gas, and Mr Pralhad Venkatesh Joshi, the Hon'ble Minister for New and Renewable Energy. A special video address by the Honourable Prime Minister of India underscored the nation's commitment to a greener planet and the pivotal role of Green Hydrogen in India's energy strategy.

The conference featured a series of plenary sessions that offered international perspectives on Green Hydrogen. Dr Sunita Satyapal from the US Department of Energy and Reta Jo Lewis from the Export-Import Bank of the United States provided insights from the USA. Mr Jorgo Chatzimarkakis of Hydrogen Europe shared the EU's viewpoint, and Dr Patrick Hartley from CSIRO's Hydrogen Industry Mission contributed the Australian perspective.

Breakout sessions delved into the various facets of the Green Hydrogen value chain, covering topics such as the optimization of electrolysis processes, storage and transportation solutions, and the potential of Green Hydrogen in the defence sector and biomass pathways. A CEO Roundtable brought together industry leaders to envision the future of Green Hydrogen, while country-specific sessions like the European Union and Member States Roundtable fostered discussions on collaborative efforts and shared objectives. Interactive sessions, including a poster presentation, GH2 Thron, and a quiz competition, engaged participants in diverse formats, sparking lively discussions, particularly among the youth, who are crucial to the sector's future growth.

The conference consistently highlighted the need for a skilled workforce, with dedicated sessions focusing on building a Green Hydrogen workforce and addressing educational and training requirements. Public sector undertakings and their initiatives in the Green Hydrogen sector were also a point of discussion, emphasizing the government's role in fostering innovation. The exhibition hall buzzed with activity, showcasing over 23 exhibitors and the latest hydrogen-powered vehicles and technologies, reflecting the significant interest in Green Hydrogen.

The event concluded with a valedictory session featuring key government officials, including Shripad Yesso Naik, Hon'ble Minister of State for MNRE. The Secretary of MNRE and other dignitaries encouraged attendees to sustain the momentum from the conference and to continue driving innovation, collaboration, and change towards a sustainable energy future.

ICGH 2024 was more than just a conference; it was a confluence of ideas, a showcase of innovation, and a clarion call to action. It provided a unique platform for stakeholders from around the world to unite, share knowledge, and commit to a collective vision for a sustainable and green future powered by hydrogen. The insights gained, relationships built, and commitments made during the conference are expected to have a lasting impact, propelling the Green Hydrogen movement forward and contributing to a cleaner, more sustainable planet for future generations.

In the context of India's quest for energy independence, the

conference resonated with the words of the late Hermann Scheer: "Our dependence on fossil fuels amounts to global pyromania, and the only fire extinguisher we have at our disposal is renewable energy." India's pledge to achieve 50% of its energy mix from non-fossil sources by 2030 and to reach 500 GW of renewable capacity by then was a central theme of the discussions. The National Green Hydrogen Mission (NGHM), launched in 2023, aims to produce 5 million metric tonnes of Green Hydrogen by 2030, signifying a major step towards energy independence and the decarbonization of industries that are difficult to electrify directly.

The SIGHT scheme, a component of the NGHM, has played a pivotal role in promoting domestic manufacturing of electrolyzers and Green Hydrogen production. With financial incentives based on production levels, the initiative seeks to reduce import reliance and enhance local manufacturing capabilities. The enthusiastic response to these initiatives, with industry bids nearly doubling the offered capacity for electrolyzer manufacturing, reflects strong industry interest.

State-level policies, such as land allocation for Green Hydrogen production sites in Uttar Pradesh and Gujarat, have been implemented to further support the development of the Green Hydrogen ecosystem. These policies, along with waivers of interstate transmission charges and facilitation of renewable energy banking, aim to attract industry investment.

Pilot projects in shipping, steel, and transport, backed by significant funding, are scaling Green Hydrogen technologies, with initiatives like vessel retrofitting at Tuticorin port and the deployment of hydrogen-powered vehicles. Comprehensive R&D programmes are underway to enhance electrolyzer technology, develop advanced hydrogen storage and transportation solutions, and improve fuel cell technology.

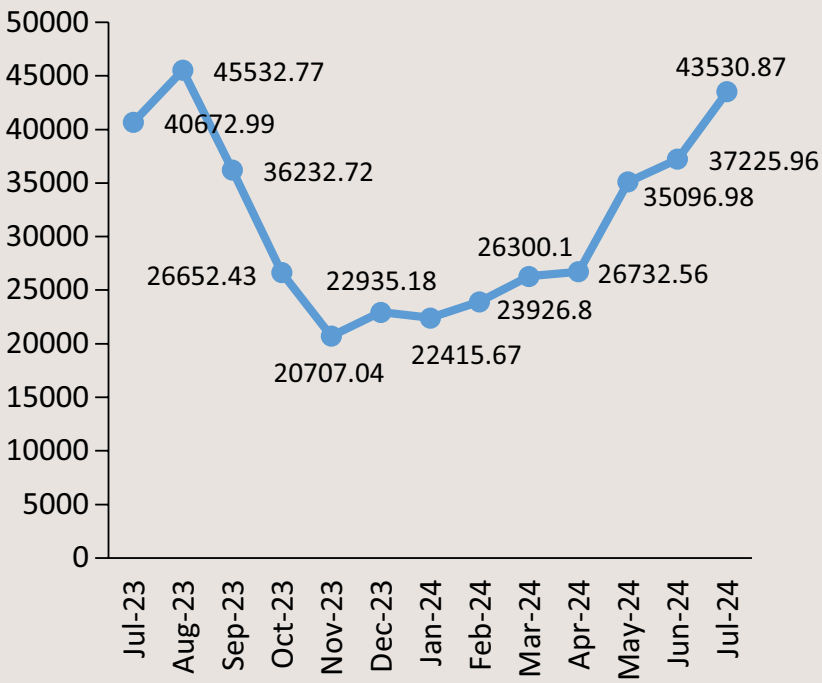
The NGHM is expected to create approximately 600,000 jobs over the next six years, spanning skilled, semi-skilled, and unskilled roles within the Green Hydrogen value chain. The Ministry of Skill Development and Entrepreneurship is actively working to bridge the skill gap in this emerging sector. To ensure that Indian-produced Green Hydrogen meets international sustainability standards, the MNRE is developing a certification system. This will enhance the global marketability of Indian Green Hydrogen, particularly in regions like Europe, Japan, Korea, and Singapore. Indian companies are already securing agreements to supply green ammonia internationally, reinforcing India's role in the global Green Hydrogen market.

The government's role in creating conducive policies and incentives is crucial, but the realization of a Green Hydrogen-powered economy in India will require continued collaboration between the government, industry, and academia. Together, these stakeholders can drive India's transition to a hydrogen economy and position the country as a global leader in clean energy. Join us for the next edition of the International Conference on Green Hydrogen (ICGH) in 2025, where we will continue to forge the path towards a sustainable energy future. Building on the success of ICGH 2024, which saw the USA as our partner country and Gujarat as our partner state, we invite you to be part of a global gathering that is shaping the future of green energy. This year, we welcomed 8,585 participants, including 240 esteemed speakers and over 3,000 delegates, who came together to share insights, innovations, and strategies in the rapidly evolving Green Hydrogen sector. Your presence will contribute to the vibrant exchange of ideas and the collaborative spirit that defines ICGH. Don't miss the opportunity to connect with industry leaders, policymakers, and the youth who are driving the Green Hydrogen revolution, follow MNRE website for updates and be physically present for an event that promises to inspire, educate, and empower.

As we look forward to ICGH 2025, we extend a warm invitation to energy enthusiasts, industry professionals, and innovators from around the world to join us in-person for an event that promises to be even more impactful than this year. ICGH-2024 drew an impressive crowd, with thousands of individuals from diverse backgrounds, including a significant number of young participants, all united by their interest in Green Hydrogen. This may be your chance to be part of a pivotal moment in the energy transition, to network with experts, and to witness firsthand the advancements and opportunities that Green Hydrogen presents.

Sujit Pillai and Arpo Mukherjee

All India Total Renewable Energy Generation in July 2024

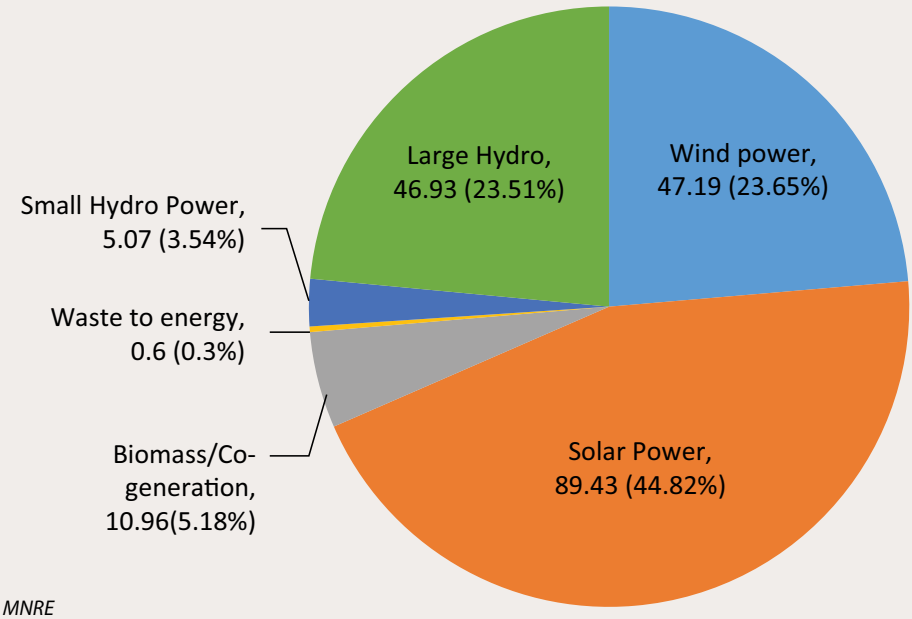


Month	Wind	Solar	Biomass	Bagasse	Small Hydro	Large Hydro	Others	Total (MU)
Jul-23	12449.42	8435.4	261.65	120.72	1249.04	17924.48	232.27	40672.99
Aug-23	12394.14	9325.8	257.34	142.35	1238.78	21959.8	214.57	45532.77
Sep-23	8850.82	9220.78	263.13	138.56	1222.11	16322.75	214.56	36232.72
Oct-23	3548.34	10219.75	266.66	183.16	965.61	11240.45	228.46	26652.43
Nov-23	3544.27	7820.94	278.62	1439.55	774.58	6621.29	227.79	20707.04
Dec-23	5113	8594.51	306.46	1932.57	592.32	6167.11	229.22	22935.18
Jan-24	4075.12	9008.47	306.36	1967.43	482.88	6352.28	223.14	22415.67
Feb-24	4907.58	10421.22	271.07	1725.32	442.67	5928.16	230.77	23926.8
Mar-24	4578.06	12225.83	305.15	1455.71	468.22	7015.7	251.42	26300.1
Apr-24	4729.26	12021.05	278.73	781.11	581.9	8109.14	231.36	26732.56
May-24	8257.63	12645.99	295.16	317.07	734.16	12595.42	251.56	35096.98
24-Jun	10134.92	11445.66	273.43	188.61	776.37	14173.69	233.29	37225.96
24-Jul	13627.00	10356.35	284.12	132.36	1323.02	17562.91	245.11	43530.87

Source: CEA

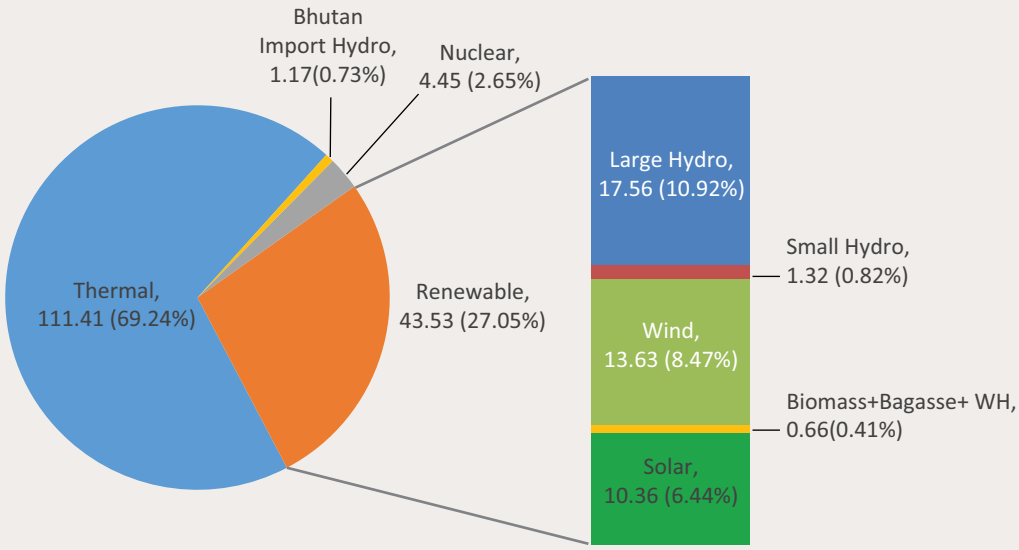
State wise RE Generation (MU)		
Name of State/UT	**Jul-24**	**Jul-23**
NORTHERN REGION		
Chandigarh	0.68	0.59
Delhi #	60.15	59.75
Haryana*	175.86	116.34
Himachal Pradesh	6703.35	6101.99
Jammu & Kashmir	2265.35	2279.93
Ladakh*	64.75	65.71
Punjab	836.79	1085.80
Rajasthan	4974.71	3984.57
Uttar Pradesh	463.29	478.60
Uttarakhand *	2183.80	1979.32
SUB TOTAL (NR)	**17728.73**	**16152.6**
WESTERN REGION		
Chhattisgarh	256.23	211.35
Gujarat	4386.18	3347.43
Madhya Pradesh	1364.73	1502.77
Maharashtra	2476.35	2456.8
Dadra and Nagar Haveli and Daman and Diu	1.35	1.81
Goa	5.44	6.99
Sub Total (WR)	**8490.29**	**7527.15**
SOUTHERN REGION		
Andhra Pradesh	1910.01	2550.43
Telangana	739.04	616.81
Karnataka	5356.68	4013.69
Kerala	1040.33	639.44
Tamil Nadu	5633.07	5061.72
Lakshadweep *	0.01	0.01
Puducherry*	1.02	1.02
SUB TOTAL (SR)	**14680.16**	**12883.12**
EASTERN REGION		
Andaman Nicobar	3.60	2.85
Bihar*	32.14	18.96
Jharkhand*	11.73	7.23
Odisha	608.04	805.07
Sikkim	350.62	1784
West Bengal	451.22	523.65
SUB TOTAL (ER)	**1457.36**	**3141.76**
NORTH-EASTERN REGION		
Arunachal Pradesh	603.55	696.96
Assam	188.15	67.46
Manipur*	78.87	13.78
Meghalaya	190.48	133.42
Mizoram *	48.85	14.85
Nagaland	63.94	41.40
Tripura	0.50	0.49
SUB TOTAL (NER)	**1174.34**	**968.36**
ALL INDIA TOTAL	**43530.87**	**40672.99**

INSTALLED RE CAPACITY (200.18 GW) AS ON 31-08-2024

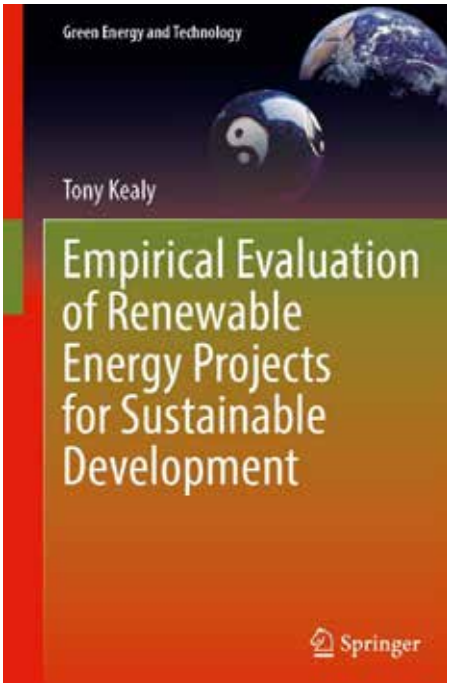


Source: MNRE

ALL INDIA MONTHLY ENERGY GENERATION IN INDIA (160.56 BU) AND SHARE OF RE: JULY 2024

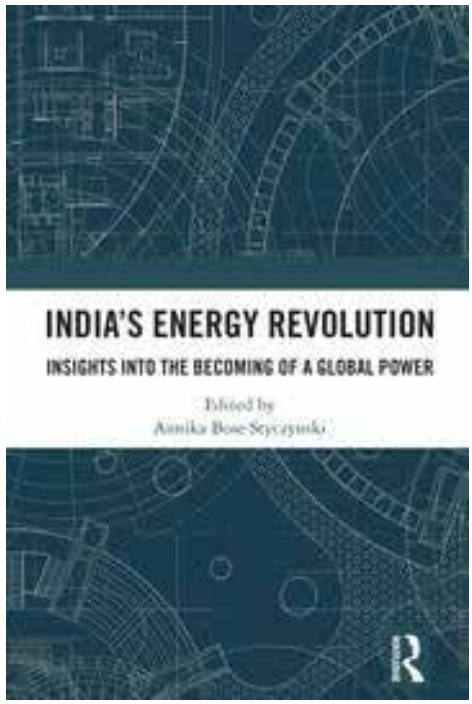


Source: CEA



Empirical Evaluation of Renewable Energy Projects for Sustainable Development (Green Energy and Technology)
by Tony Kealy
Year: 2025
Publisher: Springer International Publishing AG
490 pages
ISBN: 978-3031651908

This book critically analyses renewable energy sources of electrical power/energy utilized to save money on the amount of electrical energy imported from the national electricity grid and help nations meet binding environmental goals. The main renewable energy sources analysed are wind turbine generators, hydroelectric plant, and solar PV systems. The book presents a robust evaluation framework that can be used in the renewable energy analysis process. One of the main findings is the identification of short-term variations associated mainly with wind turbine electrical generator power output signals. These short-term variations are negating the potential advantages of installing wind turbine electrical generators. One of the suggested methods to counteract the short-term variations is the use of energy storage. Without utility-sized energy storage, binding energy targets will be very difficult to achieve. The three main realms of sustainable development, namely environmental, economic, and human realms, are discussed throughout the book. The three realms are closely interlinked so a weakness identified in any one realm affects the overall sustainability of the (business, country, any organization) development process.



India's Energy Revolution: Insights into the Becoming of a Global Power
Edited By Annika Bose Styczynski
Year: 2024
Publisher: Routledge India
252 pages
ISBN: 9781032251523

India is the third-largest emitter of greenhouse gases, which makes it an important player whose climate mitigation actions and inactions are closely scrutinized. This book studies developments in India's energy system from a governance perspective. It presents a unique compilation and synthesis of research findings that capture achievements, shortcomings, and persistent and transient challenges of India's transition towards a net-zero economy by 2070.

The book grounds its analysis in domestically formulated goals and reflects on dynamics at the structural level of India's multi-scalar innovation system, by highlighting the influencing factors of energy system status and change. It presents the perspectives and positions of different actor groups, studies the market and business, and discusses cases influenced by existing or changing institutions across the whole spectrum of energy resources from fossil to non-fossil fuels and respective technologies.

RNI No DELENG/2007/22701