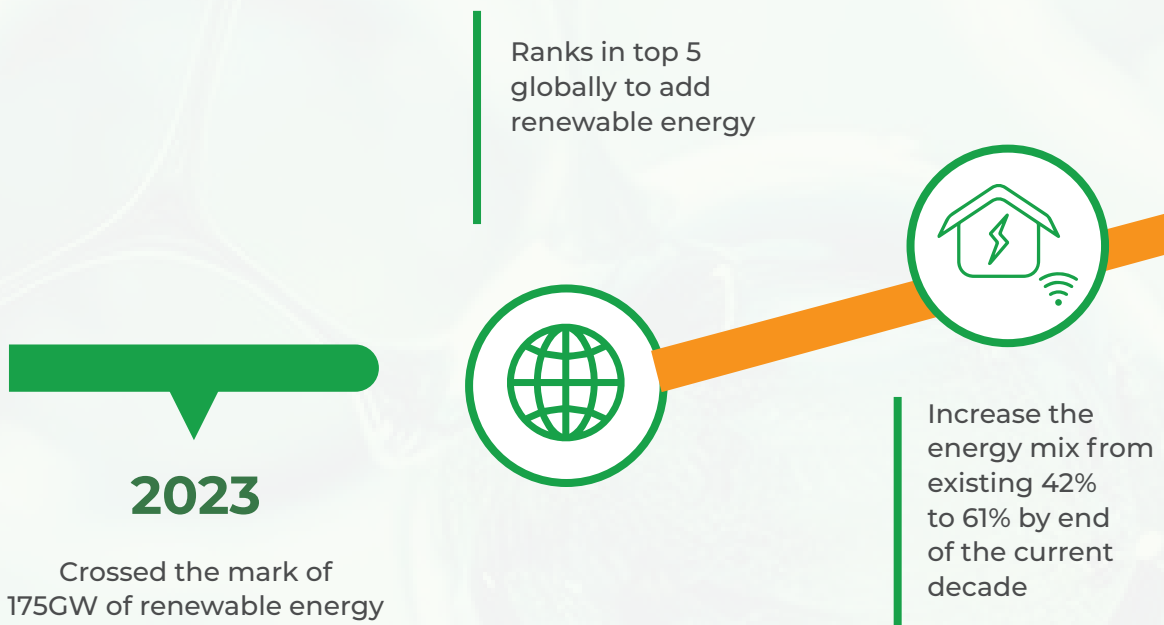
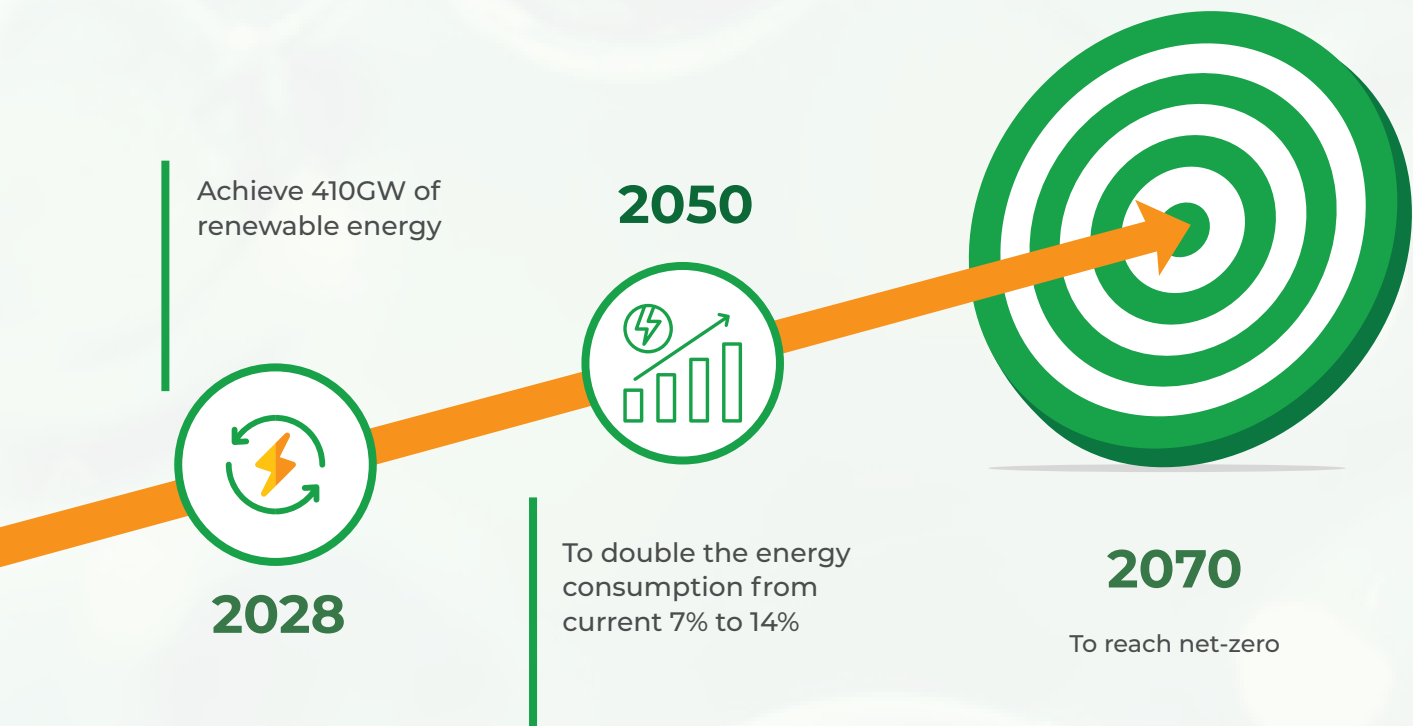


KTPA	Kilo Tonnes per Annum
LiFE	Lifestyle for Environment
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MoEFCC	Ministry of Environment, Forest and Climate Change
MMTPA	Million Metric Tonnes Per Annum
MTCO_{2e}	Million Tonnes of Carbon Dioxide equivalent
MW	Mega Watt
NDCs	Nationally Determined Contributions
NGHM	National Green Hydrogen Mission
NISE	National Institute of Solar Energy
PEM	Proton Exchange Membrane
PLI	Production linked Incentive
PHS	Pumped Hydro Storage Plant
PV	Photovoltaics
RE	Renewable Energy
REC	Renewable Energy Certificates
RPO	Renewable Purchase Obligation
RCS	Regulations, Codes and Standards
RfS	Request for Selection
RTC	Round The Clock
SECI	Solar Energy Corporation of India
SEZs	Special Economic Zones
SHP	Small Hydro Power
SHIP	Strategic Hydrogen Innovation Partnership
SIGHT	Strategic Intervention for Green Hydrogen Transition
SPV	Special Purpose Vehicles
UAE	United Arab Emirates
UNFCC	United Nations Framework for Climate Change
WB	World Bank
WRI	World Resources Institute

INDIA'S "PANCHAMRIT" TO ACHIEVE NET-ZERO



1. Raising the non-fossil fuel-based energy capacity of the country to 500 GW by 2030.
2. Half of the energy requirements of the country would be met using renewable energy sources by 2030.



Source: MNRE

3. Reduce one billion tons of carbon emission by 2030.
4. The carbon intensity would be reduced to less than 45% by 2030.
5. By 2070, India would become carbon neutral and achieve net zero emissions.

PRIME MINISTER'S SPEECH AT COP-26

'India has delivered Paris commitments in letter and spirit', said Mr. Narendra Modi

Friends, Today I am representing amid you, the land which gave this mantra thousands of years ago-

सम्-गच्छ-ध्वम्, (Let's move together)

सम्-व-दद्वम्, (Let's all interact together)

सम् वो मानसि जानताम्! (Everyone's minds should also be one)

Friends,

When I first came to Paris for the Climate Summit, it was not my intention to add one promise to the many promises already being made in the world. I came with a concern for the humanity. I came as a representative of a culture that gave the message of '**Sarve Bhavantu Sukhinah**', which means "Happiness for All" and so, for me the event in Paris was not a summit, it was a sentiment and a commitment. And India was not making those promises to the world, but 125 crore Indians were making those promises to themselves.

And I am happy that a developing country like India, which is working to lift crores of people out of poverty, and which is working day and night on the Ease of Living for crores of people, today, despite being 17 % of the world's population, whose responsibility has been only 5 percent in emissions, it has left no stone unturned to show that it has fulfilled its obligation.

Today the whole world believes that India is the only big economy which has delivered in letter and spirit on the Paris Commitment. We are making every effort with determination; and we are working hard and showing results.

Friends,

Today, as I come among you, I have brought India's track record. My words are not just words; they are announcements of a bright future for our future generations. Today, India ranks 4th in the world in installed renewable energy capacity. India's non-fossil fuel energy has increased by more than 25% in the last 7 years and now it has reached 40% of our energy mix.

Friends,

Every year more passengers travel by Indian Railways than the population of the world. This huge railway system has set a target of making itself 'Net Zero' by 2030. This initiative alone will lead to a reduction of emissions by 60 million tonnes annually. Similarly, our massive LED bulb campaign is reducing emissions by 40 million tonnes annually. Today, India is working at a faster pace on many such initiatives with a strong will.

Along with this, India has also given institutional solutions to cooperate with the world at the international level. As a revolutionary step in solar power, we initiated the initiative of International Solar Alliance. We have created a coalition for disaster resilient infrastructure for climate adaptation. This is a sensitive and vital initiative to save millions of lives.

Friends,

I would like to draw your attention to one more important topic. Today, the world admits that lifestyle has a big role in climate change. So, I propose before you a One-Word Movement.

This One-Word, in the context of climate, can become the basic foundation of One World. This word is LiFE - Lifestyle For Environment. Today, there is a need for all of us to come together and take LiFE forward as a campaign.

This can become a mass movement of environmental conscious lifestyle. What is needed today is mindful and deliberate utilization, instead of mindless and destructive consumption. These movements together can set goals that can revolutionise many sectors in diverse areas such as Fishing, Agriculture, Wellness, Dietary Choices, Packaging, Housing, Hospitality, Tourism, Clothing, Fashion, Water Management and Energy.

These are subjects where each of us should make conscious choice every day. These choices exercised by billions of people daily around the world, will take the fight against climate change, billions of steps forward every day. And I consider it as a movement on all grounds like on economic grounds, on scientific grounds, on the basis of the experiences of the past century, it meets every criterion. This is the path of self-realization. This is the only way to benefit.

Friends,

In the midst of this global brainstorming on climate change, on behalf of India, I would like to present five nectar elements, 'Panchamrit', to deal with this challenge.

- **First:** India will take its non-fossil energy capacity to 500 GW by 2030.
- **Second:** India will meet 50 percent of its energy requirements from renewable energy by 2030.
- **Third:** India will reduce the total projected carbon emissions by one billion tonnes from now till 2030.
- **Fourth:** By 2030, India will reduce the carbon intensity of its economy by more than 45 percent.
- **Fifth:** by the year 2070, India will achieve the target of Net Zero.

These '**Panchamrits**' will be an unprecedented contribution of India to climate action.

CHAPTER

1

EXECUTIVE SUMMARY



COP 26 has given the birth to “Green Hydrogen” for enabling India’s journey towards net zero by 2070.

Only a targeted approach towards **Green Hydrogen eco system** can enable India’s energy transition, while supporting its growing energy needs. India has set a target to achieve net zero by 2070 at the United Nations Climate Change Conference in Glasgow (COP26), held in 2021.

Green Hydrogen is the key to help meet India’s energy security needs while reducing emissions in hard-to-abate sectors such as Steel, fertilizers, Refinery, Cement & Mobility, on the path to Net-Zero. Indian government launched the ‘National Green Hydrogen Mission’ in early 2023.

Today, most of the country’s hydrogen supply is grey hydrogen, which is produced using fossil fuels in a process that creates CO₂ gas emissions. The **National Green Hydrogen Mission** has set a target to produce 5 MTPA of Green Hydrogen by 2030.

Fortunately, India has a high potential in terms of renewable energy, which can support its goals for Green Hydrogen growth but needs rapid capacity addition. Government has released multiple of PLI schemes to encourage capacity addition of Renewable Energy in every sectors such as Solar, On Shore Wind, Offshore wind, Biomass, Hydro, & Pumped Storage, along with BESS for storage to provide RTC (Round the Clock) renewable energy requirement for Green Hydrogen sector. Pilot projects schemes have already been launched for use of hydrogen in Steel, Shipping and Mobility sector and several other are in pipeline.

Chapter 2: The Foundation - Renewable Energy

This chapter lays the groundwork by examining the crucial role of Renewable Energy sources in powering the production of Green Hydrogen. It explores the current state of renewable energy deployment, analyses ongoing technological advancements, and discusses the challenges associated with large-scale integration.

Chapter 3: Green Hydrogen - The Clean Energy Carrier

The chapter dives deep into Green Hydrogen, explaining the Green Hydrogen value chain. It covers Green Hydrogen standard, National Green Hydrogen Mission , other initiatives by Ministry of New and Renewable Energy towards achieving the goals of NGHM.

Chapter 4: Enabling Policies and Regulations

Recognizing the importance of supportive policies, this chapter explores the role of government initiatives in fostering the development and adoption of Green Hydrogen. It analyses various policy instruments, including feed-in tariffs, carbon pricing mechanisms, and regulatory frameworks aimed at creating a conducive environment for Green Hydrogen production and utilization.

Chapter 5: Financing Green Hydrogen - Bridging the Gap

Financing Green Hydrogen projects often requires innovative approaches due to their initial capital-intensive nature. This chapter examines various financing options, including public-private partnerships, green bonds, and innovative financial instruments designed to bridge the investment gap and accelerate the growth of the Green Hydrogen sector.

Chapter 6: Pilot Projects - Leading the Way

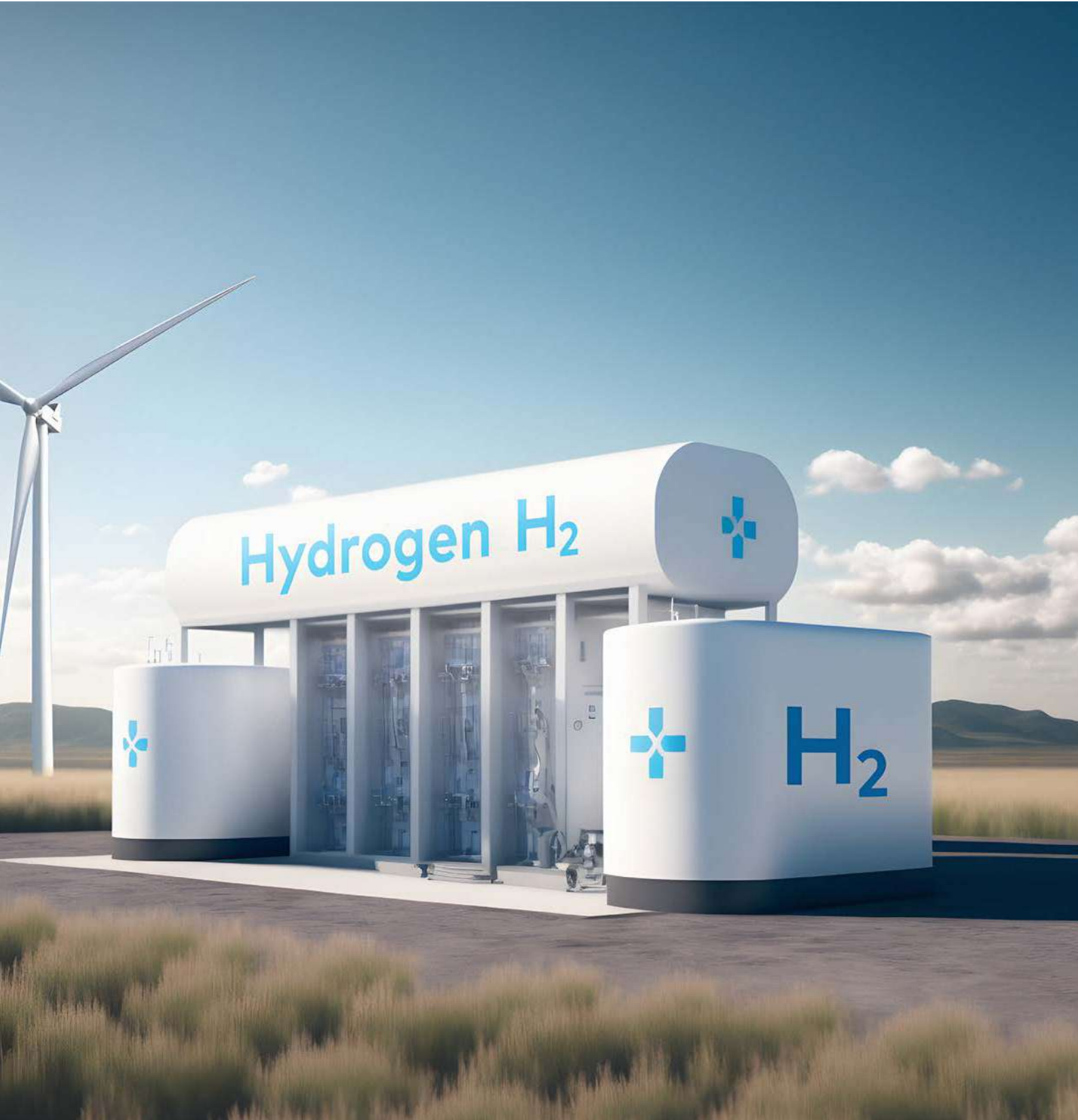
Showcasing the real-world implementation of Green Hydrogen, this chapter explores ongoing pilot projects across different sectors and geographies, thereby providing valuable insights for future large-scale deployment.

This booklet aims to equip readers with a comprehensive understanding of Green Hydrogen, its potential, and the key factors governing its successful adoption in India. By analysing the various facets of this clean energy carrier, the booklet contributes to the ongoing dialogue on achieving a sustainable and carbon-neutral future.

CHAPTER

2

RENEWABLE ENERGY IN INDIA



2.1 Role

Renewable Energy is the key ingredient that makes hydrogen production truly green, without which hydrogen would still rely on fossil fuels, defeating the purpose of this clean energy alternative.

The standard issued by the Ministry of New and Renewable Energy (MNRE), Government of India outlines the emission thresholds that must be met for hydrogen produced to be classified as 'Green', i.e., from Renewable Sources.

"Green Hydrogen" shall mean hydrogen produced using renewable energy, including, but not limited to, production through electrolysis or conversion of biomass. Renewable energy also includes such electricity generated from renewable sources which is stored in an energy storage system or banked with the grid in accordance with applicable regulations.

Renewable Energy Sources

- Solar
- Wind
- Hydro
- Pumped Storage
- Tidal
- Biomass

2.2 Requirement

To achieve its target of 5 MMT of Green Hydrogen production, India will need 125 GW of Renewable Energy, by 2030. This requirement can be mainly fulfilled through Solar, Wind, and Pumped Storage. India is on spree to enhance the installation of Renewable Energy to 500 GW by 2030, to achieve its goal. Several tenders have been floated for offshore wind and Pumped Storage projects. Solar plants have gained a huge momentum from last 10 years and is on the rising trend, thanks to the initiatives by SECI in accelerating the growth of Solar in India. Even Concentrated Solar Power (CSP) is being thought of to add to the capacity at minimum possible operating cost of generation. Several Pumped Storage projects have been announced by companies like Tata, JSW, Torrent & others in last few months.

2.3 India's Progress in RE

2.3.1 Current Status

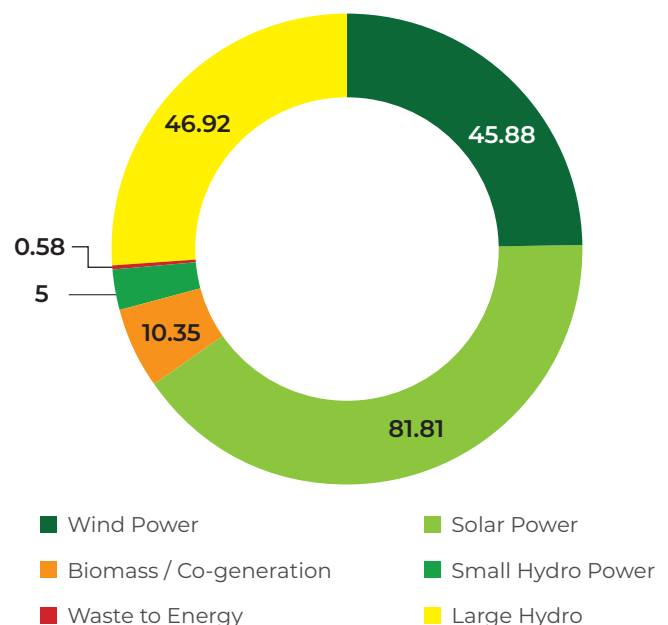
Globally, India stands 4th in Renewable Energy Installed capacity (including Large Hydro), 4th in Wind Power capacity & 5th in Solar Power capacity (as per REN21 Renewables 2022 Global Status Report). The country has set an enhanced target of 500 GW of non-fossil fuel-based energy by 2030, at the COP26. This has been a key pledge under the Panchamrit and is the world's largest expansion plan in Renewable Energy. India's installed non-fossil fuel capacity has increased to 396% in the last 9 years.

INDIA ON THE TOP

- 4th globally for total Renewable Power capacity additions.
- 4th in Wind Power Capacity and
- 5th in Solar Power Capacity globally.
- India assumed the presidency of the 13th Assembly of the International Renewable Energy Agency (IRENA)

As of Mar 2024, Renewable Energy sources, including large hydropower, have a combined installed capacity of 190.57 GW. The following is the installed capacity for Renewables:

RE Capacity installed as of March 2024 (GW)



2.3.2 Progress

India saw the highest year-on-year growth in Renewable Energy additions of 9.83% in 2022. The installed Renewable Energy capacity (including large hydro) has increased by around 128% since 2014.

- **Solar**

The installed solar energy capacity has increased by more than 30 times in the last 9 years and stands at 88 GW as of 31 March 2024. India's solar energy potential is estimated to be 748 GWp as estimated by National Institute of Solar Energy (NISE).

- **Wind**

A study was conducted by the National Institute of Wind Energy to assess the wind power potential of the country at a height of 150 Meters. The potential now assessed for onshore projects is 1,163 GW. However, the potential sites having high Capacity Utilization Factor (CUF) of 36% and above (which is necessary for financial viability of the project) is 163 GW. India has already utilized sites of total capacity of 42 GW and now a balance 120 GW would be available for new development.

- **Offshore Wind Energy**

India is blessed with a coastline of about 7600 km (Mainland) surrounded by water on three sides and has good potential for offshore wind energy generation. Initial assessment of offshore wind energy potential within the identified zones has

been estimated to be about 70 GW off the coast of Gujarat and Tamil Nadu.

A revised strategy for development of offshore wind energy projects has been issued in September 2023, indicating a bidding trajectory for installation of 37 GW capacity of Off-shore Wind Energy. Further, Central Transmission Utility has completed the planning of required transmission infrastructure for offshore wind projects for initial 10 GW offshore capacity (5 GW each off Gujarat and Tamil Nadu coasts).



- **National Green Hydrogen Mission**

The Union Cabinet approved the National Green Hydrogen Mission with a total initial outlay of INR 19,744 Cr, including an outlay of INR 17,490 Cr for the SIGHT programme, INR 1,466 Cr for pilot projects, INR 400 Cr for R&D, and INR 388 Cr towards other Mission components.

Target - 2030

- Reduction of the carbon intensity of the economy by 45% by 2030, over 2005 levels.
- 50% of its energy requirements from renewable energy by 2030.
- 500GW Non-fossil energy capacity by 2030.
- Reduction of total projected carbon emissions by one (01) billion tonnes from 2023 to 2030.
- Five (05) million tonnes of annual production capacity of Green Hydrogen by 2030, supported by 125 GW of renewable energy.
- 50 Solar Parks with an aggregate capacity of 37.49 GW.
- Wind Energy has an offshore target of 30 GW by 2030
- 26.7 GW of Pumped Storage requirement by 2032
- 47.2 GW of BESS requirement by 2032