

MEASURES UNDERWAY FOR TRANSITION IN THE ENERGY SECTOR (A PRELIMINARY REPORT)

**MINISTRY OF POWER,
MINISTRY OF NEW AND RENEWABLE ENERGY, MINISTRY
OF PETROLEUM & NATURAL GAS, MINISTRY OF COAL**

**PUBLIC ACCOUNTS COMMITTEE
(2023-24)**

ONE HUNDRED AND FORTY FIFTH REPORT

SEVENTEENTH LOK SABHA



**LOK SABHA SECRETARIAT
NEW DELHI**

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OF PETROLEUM & NATURAL GAS, MINISTRY OF COAL**



Presented to Hon'ble Speaker on: 29.04.2024

Presented to Lok Sabha on:

Laid in Rajya Sabha on:

**LOK SABHA SECRETARIAT
NEW DELHI**

April, 2024 /Vaishakh, 1946 (Saka)

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COMPOSITION OF THE PUBLIC ACCOUNTS COMMITTEE
(2023-24)

Shri Adhir Ranjan Chowdhury - Chairperson

MEMBERS

LOK SABHA

2. Shri Subhash Chandra Baheria
3. Shri ThalikkottaiRajuthevar Baalu
4. Shri Bhartruhari Mahtab
5. Shri Jagdambika Pal
6. Shri Pratap Chandra Sarangi
7. Shri Vishnu Dayal Ram
8. Shri Rahul Ramesh Shewale
9. Shri GowdarMallikarjunappaSiddeshwara
10. Dr. Satya Pal Singh
11. Shri Rajiv Ranjan Singh alias Lalan Singh
12. Shri Jayant Sinha
13. Shri Balashowry Vallabhaneni
14. Shri Ram Kripal Yadav
15. Vacant¹

RAJYA SABHA

16. Shri Shaktisinh Gohil
17. Dr. K Laxman
18. Shri Derek O'Brien
19. Shri Tiruchi Siva
20. Dr. M. Thambidurai
21. Shri Ghanshyam Tiwari
22. Vacant²

SECRETARIAT

1. Dr. Sanjeev Sharma - Joint Secretary
2. Shri Partha Goswami - Director
3. Ms. Malvika Mehta - Under Secretary
4. Ms. Khyati - Assistant Committee Officer

¹ Shri Brijendra Singh resigned w.e.f 12 March 2024

² Dr. Sudhanshu Trivedi retired from Rajya Sabha w.e.f. 2 April 2024

INTRODUCTION

I, the Chairperson, Public Accounts Committee (2023-24), having been authorised by the Committee, do present this One Hundred and Forty-fifth Report (Seventeenth Lok Sabha) on the subject “**Measures underway for Transition in the Energy Sector**” (A Preliminary Report).

2. The Public Accounts Committee (2023-24) selected the subject *suo-moto* for detailed examination and report. This Preliminary Report is based on the evidence of the representatives of the Ministries of Power, Coal, Petroleum & Natural Gas and New & Renewable Energy along with representatives of 26 Public Sector Undertakings taken by the Committee on 21 February 2024.

3. Pending examination of other witnesses and receipt of written replies from certain Ministries/Departments, the Committee authorised the Chairperson to finalise a draft preliminary report on the subject and present the same to the Hon'ble Speaker. The Committee, accordingly, considered and adopted the draft preliminary report on the subject *vide* digital circulation on 20 April 2024. The Minutes of the sittings of the Committee are appended to the Report.

4. The Committee would like to express their thanks to the representatives of the Ministries of Power, Coal, Petroleum & Natural Gas and New & Renewable Energy along with representatives of 26 Public Sector Undertakings for tendering evidence before them and furnishing the requisite information to the Committee in connection with the examination of the subject.

5. For facility of reference, the observations/recommendations of the Committee have been printed in **bold** in the body of the Report.

6. The Committee also place on record their appreciation of the assistance rendered to them in the matter by the Committee Secretariat and the office of the Comptroller and Auditor General of India.

NEW DELHI:
20 April, 2024
18 Chaitra, 1946 (Saka)

ADHIR RANJAN CHOWDHURY
Chairperson,
Public Accounts Committee

REPORT

Part-I

INTRODUCTORY

India, at the 26th session of the United Nations Framework Convention on Climate Change (COP 26) in November, 2021, announced its target to achieve net zero carbon emissions by 2070. In the view of India's ambitious energy transition journey, it becomes imperative for the Public Accounts Committee to comprehensively assess the progress and challenges associated with this pivotal shift. Keeping this in view, the Public Accounts Committee (2023-24) decided to take up suo-moto for detailed examination and report, the subject, **"Measures underway for Transition in the Energy Sector"**.

2. As India starts a new decade of energy transition, it is an opportune time to assess where India stands in achieving its targets as well as the key challenges being faced during this transition. The Committee find it important in view of rising concern of climate change and sustainable development goals to evaluate the allocation and utilization of resources, ensuring transparency, and holding authorities accountable for achieving the set targets. Moreover, as the transition impacts diverse stakeholders, including consumers, workers, and communities, the Committee desired to look into potential trade-offs between affordability, security, and sustainability for detailed examination.

3. The Country's sheer size and its huge scope for growth means that its energy demand is set to grow by more than that of any other country in the coming decades. It is imperative that India's energy transition needs to benefit its citizens. The transition away from fossil fuels usage can have both positive and negative impact on consumers, workers, communities and regions. On the one hand, this transition can support new livelihoods, expand job opportunities, distribute economic activity away from fossil fuel production centers, and decentralize and "democratize" energy production by allowing consumers to also produce energy through, for example, solar rooftop projects, On the other hand, energy transition can exacerbate the economic vulnerabilities of communities reliant on fossil fuel supply chains or increase the financial insecurity of those involved in extracting crucial minerals. The Committee obtained information in this connection from the concerned Ministries particularly, related with the energy sector, i.e. Ministry of Power, Ministry of Petroleum & Natural Gas, Ministry of Coal and Ministry of New & Renewable Energy. To further obtain varied perspectives towards this transition in the energy sector, the Committee took up informal discussions with the Ministries of Power, Petroleum & Natural Gas, Coal and New & Renewable Energy and related PSUs involved in the Energy Sector. The Committee took oral evidence of the representatives of the Ministries of Power, Petroleum & Natural Gas, Coal and New & Renewable Energy on the subject "Measures underway for Transition in the Energy Sector" along with various concerned PSUs at their sitting held on 21.02.2024. The Committee's in depth examination of the subject is detailed in the succeeding paragraphs:

A. Role of Ministry of Power in Energy Transition:

4. Background:

4.1. Energy transition is happening across the world and India is also committed to energy transition from fossil fuels to non-fossil fuels. India is currently one of the fastest growing economies in the world, home to almost one-sixth of humanity. Its growth momentum is an integral part of global development and is essential to meet the world's sustainable development goals. A number of challenges confront India's development agenda including that of climate change. Nevertheless, India is committed to combating climate change, by keeping in view, energy security, affordability and accessibility as critical inalienable priorities to ensure growth and development alongside Energy transition of the economy towards net-zero by 2070.

4.2. Paris Agreement and COP 26 commitments made by India:

During the Conference of Parties (COP -26) held in Glasgow, UK, in November 2021, the enhanced ambitions announced by India are as given below:

- a) India will meet 50 per cent of its cumulative electric power installed capacity from non-fossil fuel sources by 2030.
- b) By 2030, India will reduce the carbon intensity of its economy by 45 per cent from 2005 level.
- c) By 2070, India will achieve the target of net zero emissions.

4.3. Indian Power Sector:

a) India has over-achieved its commitment made at COP 21- Paris Summit by achieving 40% of its installed power capacity from non-fossil fuels in 2021 - almost nine years ahead of its commitment and the share of solar and wind in India's energy mix have grown phenomenally and the non-fossil fuel installed capacity as on 31.01.2024 is about 44.00%.

b) Due to increasing share of RE in the Grid and improvement in efficiency of TPS, the carbon intensity of grid is reducing. It can be seen from the illustration as given below that there is significant decrease in average carbon emission of grid electricity in India in the previous years.

F.Y.	Total Emissions (Million Tonnes)	Co2 (Million)	Total Electricity Generation (BU) including RE	Carbon Emission factor of Grid Electricity (including RE) (tCo2/MWh)
2013-14	727.4		939.83	0.77

2014-15	805.4	1033.76	0.78
2015-16	846.3	1092.81	0.77
2016-17	888.34	1154.39	0.77
2017-18	922.18	1223.41	0.75
2018-19	960.9	1291.92	0.74
2019-20	928.14	1301.31	0.71
2020-21	910.02	1294.77	0.70
2021-22	1002.01	1401.01	0.71
2022-23	1091.96	1523.72	0.72

c) India's Projected Peak Demand & Energy (Electricity) requirement as per 20th

Electric Power Survey (EPS) is as under:-

Year	Peak Demand in GW	Energy Requirement in BU
2026-27	277.2	1907.8
2029-30	334.8	2279.6
2031-32	366.3	2473.8

d) To meet its growing demand of Electricity, India has adopted the Energy transition pathway with focus on non-fossil fuel based power generation capacity in its future Electricity planning. Based on National Electricity Plan (NEP), the likely installed capacity(IC) at the end of year 2026-27, 2029-30 and 2031-32 along-with current installed capacity as on 31.03.2023 is given as below:

Table : Installed Capacity

Resource	#Installed Capacity (IC) as on 31.03.2023 (MW)	% Share	Installed Capacity 2026- 27 (MW)	% Share	Installed Capacity 2029-30 (MW)	% Share	Installed Capacity 2031-32 (MW)	% Share
Hydro	42104.65	10.13	52,446	8.6	53,860	6.93	62,178	6.91
PSP	4745.60	1.14	7,446	1.22	18,986	2.44	26,686	2.96
Small Hydro	4,944.30	1.19	5,200	0.85	5,350	0.69	5450	0.61
Solar PV	66780.34	16.07	185566	30.44	2,92,566	37.65	364566	40.49
Wind	42633.13	10.26	72896	11.96	99,895	12.85	121895	13.54
Bio-Mass	10802.4	2.60	13000	2.13	14,500	1.87	15,500	1.72
Nuclear	6,780.00	1.63	13,080	2.15	15,480	1.99	19,680	2.19
Coal + Lignite	211855	50.99	235133	38.57	2,51,683	32.39	259643	28.84
Gas	24824	5.97	24824	4.07	24,825	3.19	248424	2.76
Total	415469.19	100	6,09,591	100	7,77,145	100	9,00,422	100

#excluding Diesel IC 509.71 MW

e) It may be seen from above table that, the non-fossil fuel (Hydro, Nuclear, Solar, Wind, Biomass, Small Hydro, PSP) based capacity which is 178 GW (42.97%) out of 416 GW of total installed capacity in 2022-23 is likely to increase to 349 (57.35%) in 2026-27, 500 GW (64.42%) in 2029-30 and further to 615 OW (68.40%) out of 900 GW installed capacity in 2031-32. This represent an increase of 3.57 times of non-fossil fuel installed capacity from 2022-23 to 2031-32.

f) As per Central Electricity Authority (CEA), MoP "Report on Optimal Generation Capacity Mix for the year 2029-30 (Version 2.0)", the likely generation capacity mix based on the long-term generation planning studies for the study period (2022-30) are given below:-

Resource	Installed Capacity 2029-30(MW)	% Share
Hydro	53860	6.93
PSP	18986	2.44
Small Hydro	5350	0.69
Solar PV	292566	37.65
Wind	99895	12.85
Bio-Mass	14500	1.87
Nuclear	15480	1.99
Coal + Lignite	251683	32.38
Gas	24824	3.19
Total	777144	100
BESS (5- Hr) MW/MWh	41650/ 208250	

4.4. Domain of Energy Efficiency

a) The National Mission for Enhanced Energy Efficiency (NMEEE) primarily aimed to strengthen the market for energy efficiency by creating conducive policy regime and by leveraging innovative and sustainable business models for improving the energy efficiency.

b) Ministry of Power (MoP) through Bureau of Energy Efficiency (BEE) was entrusted with the task of implementing NMEEE. By the end of 2022, implementation of initiatives under NMEEE has resulted in energy savings of about 25.77 MTOE translating into avoiding of about 110.64 million tonne of CO₂ emissions and investment (reported by Industries) of about Rs. 75, 400 Crores.

c) In addition to the NMEEE, several other energy efficiency activities are undertaken at Ministry of Power and most of these activities have now been included as part of India's NDCs.

d) Ministry of Environment, Forests and Climate Change (MoEFCC) had requested that all the Climate Change Missions be revised to ensure fulfilment of the enhanced commitments made by India under the NDCs. Accordingly, Bureau of Energy Efficiency (BEE) under the guidance of Ministry of Power, developed a strategic plan to contribute towards India's NDCs by 2030 through a systemic Energy Transition programme for GHG reduction in key sectors.

4.5. Key initiatives on Energy Transition taken by Ministry of Power through various agencies/ divisions:-

(A). Key initiatives on Energy Transition taken by Ministry of Power, Govt. of India:-

The Government of India is implementing reforms towards a secure, affordable and sustainable energy system to power a robust economic growth and have taken several measures to decarbonize the energy sector like increasing the share of installed RE capacity & its uptake and promoting energy efficiency in all sphere of life and to make energy transition from Fossil Fuel to

Non-Fossil Fuel. In order to push the share of Renewable Power in the energy mix of the country, Government has taken various steps as below:-

a) Ambitious RE targets: As per revised Nationally Determined Contribution (NDCs) submitted to UNFCCC in August, 2022, India target is to achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 .

b) Green energy corridors to strengthen transmission networks in eight RE rich states by laying of new transmission lines and creating new sub-station capacity for evacuation of renewable power. Transmission System for Integration of over 500 GW RE Capacity by 2030 has been prepared

c) Green Open Access Rules, 2022:-For unshackling the RE Sector, i.e. to remove barriers in availability and utilization of RE and to address the issues that have hindered the growth of open access for a long time, Green Open Access Rules, 2022 have been issued. The Rules reduces the Open Access limit from 1 MW to 100 kW, which pave the way for small consumers also to purchase RE and there is no limit for Captive Consumers.

d) Waiver of ISTS charges for RE sources:- To promote RE generation addition, the waiver of ISIS charges on electricity generated from solar and wind sources, has been extended for projects to be commissioned up to 30th June 2025. With a view to encourage the capacity addition in battery storage and pumped storage projects, waiver of ISTS charges has also been allowed for Hydro PSP and BESS projects with certain conditions.

e) Introduction of Green Term Market(GTAM) & Green Day Ahead Market (GDAM):- To make clean environment and to facilitate achieving green energy targets in a most efficient and cost optimized manner, different market products exclusively for RE have been introduced i.e Green Term Market (GTAM) in Aug, 2020 and Green Day Ahead Market (G-DAM) in Oct, 2021. These products will deepen the green market and will provide competitive price signals, besides offering an opportunity to the market participants to trade in green energy, in the most transparent, flexible, competitive, and efficient manner.

f) Introduction of Real Time Market:- In a move towards competitive markets, for the first time in India, a platform for trading in electricity closer to delivery / supply called Real Time Market (RTM) was introduced in June, 2020, which allows the DISCOMs to meet the challenge in grid management due to intermittent and variable nature of RE generation.

g) Energy Storage Systems:- India has recognized the key role of Energy Storage Systems in meeting our energy transition goals and becoming a net zero carbon emitter by 2070. Energy Storage System (ESS) has been included in the Harmonized Master List of Infrastructure to unlock capital and tax concessions.

To address the challenges posed by intermittency and variability of renewable energy, a pilot project is currently being implemented for a 1000 MWh Battery Energy Storage System (BESS), which provide grid support and act as a peaking product on a commercial basis.

h) Competitive Bidding Guidelines:-Transparent bidding guidelines for procurement and utilization of renewable energy such as Solar, wind, hybrid technologies etc. and BESS have been formulated to promote development of green and clean energy in the country.

i) Policy Support and Financial Assistance to RE Projects:-Central Government has extended various policy support and financial assistance(Capital Subsidy, viability Gap Funding - VGF) through various schemes for the development of RE. Scheme for Viability Gap Funding (VGF) for development of Battery Energy Storage Systems (BESS) has been approved for development of 4,000 MWh of BESS projects in next few years, with a financial support of up to 40% of the capital cost as budgetary support. The total outlay of the Scheme is Rs.9,400crore, including a budgetary support of Rs.3,760 crore.

1) Scheme for Flexibility in Generation and scheduling of Thermal/Hydro Power Stations through bundling with RE and Storage Power:- Innovative solutions as replacement of thermal energy with renewable energy have been introduced to reduce carbon footprint. Scheme for Flexibility in Generation and scheduling of Thermal/Hydro Power Stations through bundling with Renewable Energy and Storage Power issued on 12th April 2022. Trajectory for replacement of Thermal Energy with Renewable Energy by 2025-26 issued on 26th May 2022.

k) Renewable Purchase Obligation (RPO) and Energy Storage Obligation (ESO) :-Ministry of Power vide order dated 22nd July 2022 notified the Renewable Purchase Obligation (RPO) and Energy Storage Obligation (ESO) Trajectory till 2029-30 in an effort to enable demand creation for greater off-take of renewables and Energy Storage Systems.

l) Renewable Generation Obligation:- Ministry has notified Renewable Generation Obligation on 27th February 2023 for coal based projects being established after 31st March 2023. All such plants will be required to procure/establish equivalent RE of capacity of 40% of thermal capacity. Deadline for compliance has been set as early as 1st April, 2025

m) Electricity (Promotion of Generation of Electricity from Must-Run Power Plant) Rules, 2021:- RE projects are given a must run status in the country which means their dispatch is prioritized over other sources and only in case of grid related technical constraints, the RE generation dispatch can be reduced.

n) Rules for introduction of Time of Day Tariff:Ministry of Power vide notification dated 14.06.2023 has introduced Time of Day Tariff through the Electricity

B. Role of Ministry Of New And Renewable Energy in Energy Transition

5. Background:

Since 2014, India has witnessed the fastest rate of growth in the renewable energy sector among all large economies. The installed Renewable energy capacity has increased from 76.37 GW in March 2014 to 182.04 GW in Jan 2024, i.e. an increase of around 2.38

times. During this period, the share of non-fossil based installed electricity capacity has increased from 32.54% as on 31.03.2014 to 44.08% as on 31.01.2024 and RE generation share has increased from 5.56% in the FY 2014-15 to 12.53% in the FY 2022-23 (upto March, 2023).

A decade back, RE was considered to supplement conventional sources, however, now it forms an important part of the energy mix. India achieved its commitment made at COP 21- Paris Summit by meeting 40% of its power capacity from non-fossil fuels nine years ahead of schedule in 2021. The share of solar and wind in India's energy mix has grown phenomenally. Owing to technological developments, steady policy support and a vibrant private sector, India has become a leading investment destination for global clean energy investors. India now stands 4th globally in Renewable Energy Installed Capacity, 4th in Wind Power capacity & 5th in Solar Power capacity.

The steps taken by India towards clean energy transition offer great opportunities for innovation, growth and sustainable jobs. There is focus on creating an enabling ecosystem for ensuring widespread adoption of distributed renewables, including for sustainable livelihood creation in the country. Steps have been initiated to facilitate purchase of RE by Commercial & Industrial consumers through Green Open Access, trade of RE in exchanges and the use of Green Hydrogen for industry and mobility in industrial applications.

5.1. Present Power Scenario :

The Installed Capacity of the country as on 31.01.2024 was 429.96 GW comprising of 240.44 GW thermal, 7.48 GW Nuclear and 182.04 GW Renewables. The total renewable installed capacity comprised of 44.97 GW of wind, 74.31 GW of solar, 10.85 GW of bio-Power & waste power and 4.99 GW of small hydro plants and 46.92 GW large hydro.

5.2. Present RE Status :

The Status of projects as on 31st Jan, 2024 is given below:

Sector-wise Achievement as on 31/01/2024				
Sector	Installed capacity (GW)	Under Implementation (GW)	Tendered (GW)	Total Installed/ Pipeline (GW)
Solar Power	74.31	68.24	37.67	180.22

Wind Power	44.97	17.24	7.65	69.86
Bio Energy	10.85	---	---	10.85
Small Hydro	4.99	0.52	---	5.51
Hybrid/ Round the Clock (RTC)/ Peaking Power/ Thermal + RE Bundling	---	---	31.65	31.65
Sub-Total	135.12	86.00	76.97	298.09
Large Hydro	46.92	16.74	---	63.66
Total	182.04	102.74	76.97	361.75
Nuclear Power	7.48	15.00	---	22.48
Total Non-Fossil Fuel	189.52	117.74	76.97	384.23

Highest ever capacity additions of 15.27 GW of total Renewable Energy and 12.78 GW of solar energy capacity were achieved during the year 2022-23.

5.3. Major Steps taken by MNRE to promote Renewable Energy

The Government has taken several measures to promote renewable energy in the country, including, inter-alia, the following:

- Permitting Foreign Direct Investment (FDI) up to 100 percent under the automatic route,
- Waiver of Inter State Transmission System (ISTS) charges for inter-state sale of solar and wind power for projects to be commissioned by 30th June 2025,
- Declaration of trajectory for Renewable Purchase Obligation (RPO) up to the year 2029-30,
- Setting up of Ultra Mega Renewable Energy Parks to provide land and transmission to RE developers for installation of RE projects at large scale,
- Schemes such as Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM), Solar Rooftop Phase II, 12000 MW CPSU Scheme Phase II,
- Laying of new transmission lines and creating new sub-station capacity under the Green Energy Corridor Scheme for evacuation of renewable power,

- Notification of standards for deployment of solar photovoltaic system/devices,
- Setting up of Project Development Cell for attracting and facilitating investments,
- Standard Bidding Guidelines for tariff based competitive bidding process for procurement of Power from Grid Connected Solar PV and Wind Projects.
- Government has issued orders that power shall be dispatched against Letter of Credit (LC) or advance payment to ensure timely payment by distribution licensees to RE generators.
- Notification of Promoting Renewable Energy through Green Energy Open Access Rules 2022.
- Notification of “The Electricity (Late Payment Surcharge and related matters) Rules (LPS rules).
- Launch of Green Term Ahead Market (GTAM) to facilitate sale of Renewable Energy Power through exchanges.
- National Green Hydrogen Mission launched with an aim to make India a global hub for production, utilization and export of Green Hydrogen and its derivatives.
- Notification of prescribed trajectory for RE power bids to be issued by Renewable Energy Implementation Agencies from FY 2023-24 to FY 2027-28. Under the trajectory, 50 GW/annum of RE bids to be issued.

5.4. Major Ongoing Schemes

- a) **Solar Parks Scheme:** To facilitate installation of large-scale grid connected solar power projects, a scheme for “Development of Solar Parks and Ultra Mega Solar Power Projects” is under implementation with a target capacity of 40 GW by March 2026. Solar Parks provide solar power developers with a plug and play model, by facilitating infrastructure like land, power evacuation facilities, road connectivity, water facility, etc. along with all statutory clearances. As on 14-02-2023, 58 Solar Parks with aggregate capacity 40,000 MW have been sanctioned. 12 Solar Parks of aggregate capacity 8,621 MW have been completed and 8 Solar Parks of aggregate capacity 4910 MW have been partially completed. In these parks, solar projects of aggregate capacity 10,576 MW have been developed, so far.
- b) **Roof Top Solar Programme Phase-II:** Roof Top Solar Programme Phase-II for accelerated deployment of solar rooftop systems with a target of 40 GW installed capacity by the year 2025-26, is also under implementation. The scheme provides for financial assistance for achieving a cumulative capacity of 4 GW in the residential sector and also has the provision to incentivize distribution companies for incremental achievement in cumulative rooftop solar capacity over the previous year. For

residential sector, use of domestically manufactured solar cells and modules has been mandated. As of 31.01.2024, a cumulative 10.94 GW solar rooftop projects have been set up in the country. Against the target of 4GW for the Residential sector under the Rooftop Solar Programme Phase-II, an allocation of 3.56 GW has already been made to various states/ UTs and 2.87 GW has already been installed.

- c) **PM Surya Ghar-Muft Bijli Yojana:** The Hon'ble Prime Minister has launched the "PM Surya Ghar: Muft Bijli Yojana" on 13.02.2024 with a financial outlay of over INR 75,000 Crore, aimed at solarizing 1 Crore households through rooftop solar. The Hon'ble Finance Minister had announced the proposed scheme in the budget speech presented in the Parliament on 1st Feb, 2024.
- d) **PM-KUSUM:** For de-dieselisation of farm sector and enhancing farmers income by providing energy and water security, the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) Scheme was launched. The Scheme provides for installation of 14 lakh standalone Solar Pumps to replace diesel pumps; solarisation of 35 lakh grid connected pumps; and Solar power plants of total 10000 MW capacity. There is 30% subsidy each from central & State Government for installation of stand-alone pumps and solarisation of grid connected pumps and an incentive to DISCOMs which would buy power from ground mounted power plants.

The Scheme has an outlay of more than Rs. 146000 crore with CFA of about Rs. 34,422 crore and will result in saving of about 32 million tons of CO₂ emission per annum. Further, standalone solar pumps may result in saving of 1.38 billion litres of diesel per annum and associated savings in foreign exchange. The scheme is likely to generate employment opportunity equivalent to 7.55 lakh job years for skilled and unskilled workers. It will also help states in reducing their subsidy burden. The Ministry has included solarisation of agricultural feeders under the scheme and issued comprehensive revised guidelines to ease the implementation of the scheme. As on 31.01.2024, a total of about 165 MW capacity has been installed under Component 'A' and around 3.03 lakh pumps have been reported installed/ solarized under Component-B and Component-C combined.

- e) **Central Public Sector Undertaking (CPSU) Scheme:** A scheme for setting up 12 GW Grid- Connected Solar PV Power Projects by Central Public Sector Undertakings with domestic cells and modules is under implementation. Viability Gap Funding support is provided under this scheme. Apart from adding solar capacity, the scheme will also create demand for domestically manufactured solar cells/modules, and thus help domestic manufacturing. Under this scheme, Government has sanctioned around 8.2 GW of projects, as on 31.03.2022.
- f) **Production Linked Incentive (PLI) Scheme for High Efficiency Solar PV Modules:** The Government of India is implementing the Production Linked Incentive (PLI) Scheme

for National Programme on High Efficiency Solar PV Modules, for achieving manufacturing capacity of Giga Watt (GW) scale in High Efficiency Solar PV modules. The Scheme is being implemented in two tranches. Under Tranche-I with an outlay of Rs. 4,500 crore, Letters of Award have been issued for setting up 8,737 MW capacity of fully integrated solar PV module manufacturing units (involving manufacturing of polysilicon + ingot-wafer + cell + module). Under Tranche-II with an outlay of Rs 19,500 crore, Letters of Award have been issued for setting up 39,600 MW of fully / partially integrated solar PV module manufacturing units. The scheme will strengthen the domestic manufacturing capabilities and reduce dependence on imports.

- g) Wind Power:** India's wind power potential at hub height of 120 meters and 150 meters have been estimated at 695 GW and 1164 GW respectively. The wind power installed capacity has grown 2.1 times during past 10 years (approx..) to about 44.97 GW and 17.24 GW of projects are at various stages of commissioning (as on 31.01.2024). India has the 4th largest wind power capacity in the world. As part of our ongoing efforts for new areas of wind energy sector, Ministry has issued a Strategy Paper for 'Offshore Wind Development in India' indicating a bidding trajectory of 37 GW by 2030 and various business models for project development. Hon'ble Finance Minister, during the Budget Speech for FY 2024-25, has announced Viability Gap Funding (VGF) for initial 1 GW of offshore Wind Power Project. Further, a bid for leasing out sea bed for 4 GW capacity of offshore Wind Power Projects has been issued.
- h) National Bioenergy Programme :** The Ministry of New and Renewable Energy has notified National Bioenergy Energy Programme on 02.11.2022 for a period 01.04.2021 to 31.03.2026 with an outlay of Rs.858 crore under Phase-I. This National Bioenergy Energy Programme has a provision of Central Financial Assistance for setting up of Bioenergy projects in the country under the following components: (i) Waste to Energy Programme, (ii) Biomass Programme, (iii) Biogas programme. As on 31.01.2024, cumulative installed capacity of
- Biomass power and cogeneration projects stood at about 9.43 GW (Bagasse & IPP) and 0.83 GW (Non-Bagasse),
 - Waste to Energy projects capacity was 249.74 MW (grid connected) and 334.31 MWeq (off-grid). Cumulative installed capacity of Waste to Energy projects stood at about 0.58 GW.
 - As on 31.01.2024, **5100** Number of small biogas plants have been installed during the current FY upto 31.01.2024 under the biogas programme and with this the cumulative achievement of 50.95 Lakhs number of small biogas plants (1-25 cubic meter) and 349 medium sized biogas plants (above 25 m³ -2500 m³) with cumulative off grid power generation capacity of about 10.70 MW have been installed in the country.

- i) **Green Energy Corridor:** In order to facilitate renewable power evacuation and reshaping the grid for future requirements, the Green Energy Corridor (GEC) projects have been initiated.

(a) Intra State Transmission System (InSTS) Green Energy Corridor

Phase-I:

The InSTS GEC scheme is being implemented by 8 renewable rich States of Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu in order to facilitate integration of approx. 24 GW RE power. The project cost is Rs. 10141.68 crore with funding mechanism consisting of 20% State Equity, 40% Government of India Grant (total Rs. 4056.67 crores) and 40% KfW loan (500 million EUR). Out of the 8 States, 4 have completed all the projects, viz. Rajasthan, Madhya Pradesh, Tamil Nadu and Karnataka. On request of the remaining 4 States, the commissioning timeline was extended up to December 2023. However, the projects are delayed, mainly due to right of way issues, and the states have requested for further extension up to June 2024. The scheme includes setting up of 9767 ckm (circuit kilometre) of transmission lines, and Substations of total capacity of 22689 Mega Volt-Amperes (MVA). As on 31.12.2023, 9060 ckm of transmission lines have been constructed and 21303 MVA capacity substations have been charged, and Central Grant of Rs.2804.50 crore has been disbursed to the States.

(b) Intra-State Transmission System Green Energy Corridor Phase-II:

The InSTS GEC Phase-II scheme was approved on 06.01.2022, for addition of 10,753 circuit kilometres (ckm) of transmission lines and 27,546 Mega Volt-Amperes (MVA) transformation capacity of substations in seven States, namely Gujarat, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu and Uttar Pradesh. The scheme will facilitate grid integration and power evacuation of approx. 20 GW RE power. The scheme is to be completed by FY 2025-26, at total estimated project cost of Rs.12,031.33 crore with Central Financial Assistance (CFA) @ 33 percent of the project cost, i.e. Rs. 3970.34 crore. Currently, the projects are under various stages of tendering. Out of 86 packages, a total of 62 packages have been tendered, of which 30 have been awarded as on 31.12.2023.

(c) Green Energy Corridor Phase-II Inter-State Transmission System for 13 GW RE Projects in Ladakh:

MNRE plans to set up 13000 MW RE (9000 MW Solar + 4000 MW Wind) along with 12000 MWh Battery Energy Storage System (BESS). An Inter-State Transmission System would be set up for power evacuation and grid integration of the 13 GW RE projects in Ladakh and dispatch of power from the U.T. of Ladakh to other parts of the

country. The project will also ensure reliable power supply to the Ladakh region as well as Jammu & Kashmir.

POWERGRID is the implementing agency for this project. The project cost for this transmission project works out to Rs. 20,773.70 crore (excluding IDC of Rs. 2168.69 crore) and the central grant will be 40% of project cost is Rs. 8,309.48 crore. The project is anticipated to be completed by FY 2029-30. Under this project, 1268 ckm transmission lines and two nos. of HVDC terminals of 5000 MW capacity each would be setup.

The proposal has been approved by the Cabinet Committee on Economic Affairs (CCEA) on 18.10.2023. Sanction order along with project implementation guidelines issued on 15.02.2024. Currently, POWERGRID is conducting Front End Engineering and Design (FEED) study.

j) National Green Hydrogen Mission: On 4th January 2023, National Green Hydrogen Mission with an initial outlay of Rs.19,744 crore up to the year 2029-30 was launched. The Mission aims to make India the Global Hub for production, usage and export of Green Hydrogen and its derivatives. Major components of the Mission include incentives for electrolyser manufacturing and Green Hydrogen production; pilot projects; Research & Development, framework of regulations, codes and standards; Green Hydrogen hubs; and Skill development programme. By the year 2030, the Mission targets to achieve at least 5 MMT (Million Metric Tonne) of annual green hydrogen production capacity with an associated renewable energy capacity of about 125 GW, 60-100 GW Electrolyser capacity and about 1 lakh crore of Import saving and 50 MMT CO₂ annual emission averted with this target. This scale of requirement is expected to bring over ₹8 lakh crore in total investments and generate employment for over 6 lakh people.

The Green Hydrogen standard has been notified on 18th August, 2023, which sets a limit of 2kg CO₂ equivalent per kg of Hydrogen.

Almost 94 recommendations for adoption of various standards have been sent to the agencies such as BIS, PESO and OISD for adoption. Out of these, 65 standards have been published.

The Research and Development roadmap was released on 7th October, 2023 after incorporating comments of various stakeholders.

The National Single Window Portal for Green Hydrogen and Electrolyser Manufacturing has been made live on 7th October 2023.

SIGHT Programme: -

The total outlay of SIGHT Programme 17490 Cr Rs. The Scheme guidelines for Electrolyser manufacturing and for Green Hydrogen production Mode-I have been notified on 28th June 2023.

Under these two specific interventions proposed to kickstart Green Hydrogen ecosystem:

- Incentives for Electrolyser Manufacturing:
 - Proposed for initial 5 years, starting at Rs. 4440/ KW, tapering down annually.
 - Proposed outlay - Rs. 4440 crore.
 - Request for Selection (RfS) for the Selection of Electrolyser Manufacturers (EM) for Setting up 1.5 GW annual Electrolyser Manufacturing Capacities under SIGHT Scheme (Tranche-I) was issued on 7th July 2023.
 - Capacity has been allocated to 8 companies for 1.5 GW per annum of electrolyser manufacturing capacity on 11th January 2024.

Incentives for Green Hydrogen Production:

- Proposed for 3 years, starting at cap of Rs 50/ Kg and tapering down annually.
- Proposed outlay - Rs 13050 crore.
- Request for Selection (RfS) for Selection of Green Hydrogen Producers for Setting up Production Facilities of 450,000 tons for Green Hydrogen in India under the Strategic Interventions for Green Hydrogen Transition (SIGHT) Scheme (Mode-1-Tranche-I) was issued on 10th July 2023.
- Capacities have been allocated to 10 companies for a total Green Hydrogen production capacity of 412000 MT per annum.
 - Capacity of 410000 MT per annum under Bucket – 1 has been allocated to 9 companies on 8th January 2024
 - Capacity of 2000 MT per annum under Bucket – 2 has been allocated to one company on 8th January 2024.

The scheme guidelines for implementation of SIGHT Programme – Component II i.e. incentive for procurement of Green Ammonia Production under Mode-2A & Green Hydrogen Production Mode-2B has been published on 16th January 2024.

Scheme Guidelines for implementation of Pilot projects for use of Green Hydrogen in the Shipping Sector under the National Green Hydrogen Mission (NGHM), have been issued on 1st February 2024.

Scheme Guidelines for implementation of Pilot projects for use of Green Hydrogen in the Steel Sector under the National Green Hydrogen Mission (NGHM), have been issued on 2nd February 2024.

Scheme Guidelines for implementation of Pilot Projects for use of Green Hydrogen in the Transport Sector under the National Green Hydrogen Sector (NGHM), have been issued on 14th February 2024.

k) Research and Technology Development (RE-RTD) Programme: The Ministry of New and Renewable Energy (MNRE) supports a scheme “Renewable Energy Research and Technology Development Programme (RE-RTD)” through various research institutions and industries to enable indigenous technology development and manufacture for widespread applications of new and renewable energy in efficient and cost-effective manner. The Ministry encourages research and technology development proposals in collaboration with the industry. It provides up to 100% financial support to Government/non-profit research organizations and up to 70% to Industry, startups, Private Institutes, Entrepreneurs, and Manufacturing units.

5.5. Public Sector Undertakings and Autonomous Bodies under MNRE:

To support this Ministry, there are five institutions i.e. two Public Sector Undertakings – Indian Renewable Energy Development Agency (IREDA) and Solar Energy Corporation of India (SECI) and three autonomous bodies- National Institute of Solar Energy (NISE), National Institute of Wind Energy (NIWE), and National Institute of Bio Energy (NIBE). NISE is located at Gwal Pahari in district Gurugram, Haryana and serves as the technical focal point for solar energy research & development. NIWE has been established in Chennai, Tamil Nadu and serves as the technical focal point for wind power research & development. NIBE is located in district Kapurthala, Punjab and is focusing on research & development in Bio energy. IREDA, a Non-Banking Financial Institution located in New Delhi, under the administrative control of this Ministry, provides term-loans for renewable energy and energy efficiency projects. SECI is a section 3 company under the Companies Act situated in New Delhi. It assists the Ministry and functions as the implementing and executing arm for the National Solar Mission.

C. Role of Ministry of Petroleum & Natural Gas in Energy Transition:

6. Background:

Energy transition is a continuous change in the source of energy. The demand for energy is met mostly by fossil fuels as fossil fuels make up 88% of India’s primary energy

requirement. Coal accounts for 55% of the energy mix, oil and gas account for 28% and 6% respectively. Energy transition is the shift from fossil fuels to non-fossil energy sources.

Energy transition also includes transformation of the global energy sector from fossil-based to zero-carbon by the second half of this century, known as “Net Zero Mission”. Hon’ble Prime Minister has outlined his vision on Energy Transition in COP-26 at Glasgow in 2021, known as “Panchamrut”, which stated:

- To raise the non-fossil fuel based energy capacity of the country to 500 GW by 2030.
- To meet 50% of the country’s energy requirements using renewable energy sources by 2030.
- To reduce the total projected carbon emission by one billion tonnes between now and the year 2030.
- To reduce the carbon intensity of the economy to less than 45% by 2030
- To become carbon neutral and achieve net zero emissions by the year 2070.

In order to achieve India's Net Zero target of 2070, an Energy Transition Pathway is being developed for the Oil & Gas Public Sector Undertakings (O&G PSUs) in the country. This plan aims to enhance energy efficiency, promote the use of alternative fuels, and prioritize research and development for new indigenous feedstocks and processing technologies.

6.1. Measures underway for Energy Transition pertaining to the PNG Sector

1. **Gas-Based Economy:** Natural Gas is being considered as transition fuel by Govt of India in its journey towards Net Zero due to its characteristic of significantly less emission as compared to other fossil fuels, providing easy solution to manage climate change. Natural gas is expected to expand strongly in the medium- and long-term. Increasing the share of gas in the mix will help to reduce coal usage, curb CO₂ emissions and support the deployment of intermittent renewables such as wind and solar. Furthermore, the government supports the gasification of the country (City Gas Distribution project), which aims to reduce the usage of traditional cooking fuels in the residential sector, such as wood charcoal, but will also partly reduce the use of LPG and kerosene. The government has set a target of 15% for gas in the energy mix by 2030. Various steps have been taken by the Government in this direction. For increasing domestic gas production, Government has notified policy reforms for early monetization of fields along with Marketing and Pricing freedom for natural gas. With a mission of “**One Nation, One Grid and One tariff**”, PNGRB has notified necessary regulations pertaining to **Unified Tariff** to develop gas market and facilitate gas availability and affordability including parts of India which are located at the farthest

corner from source of gas like north east. India's first nationwide online delivery-based gas trading platform **India Gas Exchange (IGX)** was launched in June 2020 in order to enable market participants to trade in standardized gas contracts.

2. **Biofuels:** Government is working to reduce import dependence and has taken multiple steps towards green and clean sources of energy like promotion of renewables and alternate fuels like ethanol, second generation ethanol, compressed bio gas and biodiesel, which are being given high priority in the energy mix and will help in reducing country's import dependence. The National Biofuel policy of 2018 also focuses on giving impetus to advanced biofuels. National Policy on Biofuel 2018 laid down indicative target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030 in the country. To strengthen global cooperation for rapid deployment and adoption of biofuels, the Global Biofuels Alliance (GBA) was launched on 9th September 2023, on the sidelines of the G20 Summit in New Delhi with the support of 19 countries and 12 international organizations. GBA intends to expedite the global uptake of biofuels through facilitating capacity-building exercises, technical support for national programs and promoting policy lessons-sharing, technology advancements, intensifying utilization of sustainable biofuels, with participation of a wide spectrum of stakeholders.

Ethanol Blended Petrol (EBP) Programme: Bioethanol is blended with existing gasoline, thereby reducing the consumption of fossil fuels and mitigating emissions. Ethanol blended gasoline has reduced emissions as compared to neat gasoline.

To increase indigenous production of Ethanol, the Government has taken multiple interventions including, re-introduction of administered price mechanism, opening of alternate route for Ethanol production, amendment to Industries (Development & Regulation) Act, 1951 which legislates exclusive control of denatured Ethanol by the Central Government, reduction in Goods & Service Tax (GST) on Ethanol meant for EBP Programme from 18% to 5%, notification of National Policy on Biofuels-2018, scheme for financial assistance to sugar mills for enhancement and augmentation of the Ethanol production capacity, allowed multiple feed-stocks viz. B heavy molasses, sugarcane juice, sugar, sugar syrup, damaged food grains, maize and surplus rice available with Food Corporation of India (FCI) to be used for Ethanol production, differential Ethanol price based on feed stock utilized for Ethanol production, enhanced and remunerative Ethanol pricing, long term Ethanol procurement policy, framework for setting up Ethanol distillation capacities in Ethanol deficit states to name the few.

About 12% (about 500 crores litres) of Ethanol blending has achieved during the ESY 2022-23 (December 2022 to October 2023). Government has set up the target Oil a 20% ethanol blending (E20) by the Ethanol Supply Year (ESY) 2025-26 for which an approximate 1,016 crore litres of ethanol are anticipated to be required during the Ethanol Supply Year 2025-26. E20 is now being retailed from more than 10,700 retail

outlets and is slowly being expanded throughout the country to meet the target by 2025-26.

To further augment ethanol supplies, the Government allowed Ethanol procurement from cellulosic and lignocellulosic materials like rice/ wheat straw, corn cobs, cotton stalk, etc. and petrochemical route. To encourage setting up of Second Generation (2G) Ethanol Bio-refineries, Government launched a scheme "Pradhan Mantri JI-VAN (Jaiv Indhan- Vatavaran Anukool fasal awashesh Nivaran) Yojana" for providing financial assistance to integrated bio-Ethanol projects with a total financial outlay of ₹ 1969.50 crore for the period 2018-19 to 2023-24.

Biodiesel is the second matured biofuel currently running around the world. It is produced from non-edible vegetable oils, acid oil, Used Cooking Oil (UCO) or animal fat and bio-oil. An indicative target of 5% blending of biodiesel in diesel/direct sale of biodiesel is proposed by 2030. As on August 2023 in the current FY, 192532 KL (B-100) Bio-diesel has been procured by the PSU OMCs and 2438815 B-7 sales have been made by these Oil Companies.

Sustainable Aviation Fuel (SAF) is a biofuel that can be easily blended with the existing aviation fuel. It is derived from various renewable resources, including non-edible vegetable oil, UCO, ethanol, Hydrogen, wastes, etc. Currently, India also has mandated 5% SAF blending in ATF initially for international flights by 2030.

Compressed Bio Gas (CBG) is produced through a process of anaerobic decomposition from waste / bio-mass sources. After purification, it is compressed and called Compressed Bio-Gas (CBG) which has more than 90 % methane content. CBG can be utilized as an environment-friendly fuel in usage of transport & industrial/commercial sector. Production of CBG would have multiple benefits viz. reduction of natural gas import, reduction of Green House Gas (GHG) emission, reduction in burning of agriculture residues, remunerative income to farmers, employment generation, effective waste management etc. Further, bio manure is a by-product of the CBG production process which can be utilized in the agriculture sector to promote organic farming and reduce the use of chemical fertilizers.

Government has launched "Sustainable Alternative Towards Affordable Transportation (SATAT)" initiative on 1st October 2018, with the aim of establishing an ecosystem for production of Compressed Bio Gas (CBG) from various waste/ biomass sources and for promoting its use along with Natural Gas. Further, Government has also issued guidelines for co-mingling of domestic gas for supply for Compressed Natural Gas (Transport) & Piped Natural Gas (Domestic) segments of City Gas Distribution (CGD) Networks for synchronization of CBG with CNG in CGD Network

3. **Green Hydrogen** can enable utilization of domestically abundant renewable energy resources across regions, seasons, and sectors, feeding multiple usage streams, either as a fuel or as an industrial feedstock. It can directly replace fossil fuel derived feedstocks in petroleum refining, fertilizer production, steel manufacturing etc. Hydrogen fuelled long-haul automobiles and marine vessels can enable decarbonisation of the mobility sector. The Central Public Sector Enterprises under MoPNG have proposed Green Hydrogen pilot projects of capacity of 2.5 KTPA. At present, Green Hydrogen demonstration plants being set-up in India are based on imported electrolyser technology. Govt. has announced National green Hydrogen Mission with target to produce 5 MMTPA of green Hydrogen by 2030. Oil and Gas sector has already planned to produce 0.8 MMTPA of Green Hydrogen by 2030.

In addition the government is also focussing on Renewable energy which will in turn reduce dependence on imported Oil. Various schemes like Solar parks, National Wind-Solar Hybrid Policy, Offshore wind energy potential, National Hydrogen Energy Mission and schemes like PM KUSUM scheme for Solar powered agriculture pumps and PLI (Performance Linked Incentives) scheme for domestic battery manufacturing are giving push for green energy.

Energy conservation and efficiency improvement can be accomplished by using less energy to perform a given amount of work or by not using energy at all. Energy conservation has enormous potential to improve profitability while reducing greenhouse gas emissions (GHG). Perform, Achieve and Trade (PAT) is the flagship programme under the mission implemented by Bureau of Energy Efficiency (BEE). By the year 2021-22, it is estimated that by embracing current and planned measures for conservation and energy efficiency, conservative targets on net incremental oil and gas savings of 2 MTOE through Petroleum Conservation Research Association's (PCRA) efforts and 3.8 MTOE through Bureau of Energy Efficiency (BEE) could be achieved.

To achieve national target of Net Zero, Oil and Gas (O&G) PSUs have declared their individual Net Zero target by 2040 to 2050. In order to meet their targets, O&G PSUs are planning investments in phased manner. The key projects being undertaken by PSUs include process efficiency improvements, switching from Natural Gas to Green Hydrogen/CBG, increasing grid imports, Renewable energy projects, tree plantations and Carbon Capture, Utilisation and Storage (CCUS). In this context, Government of India has undertaken landmark reforms in the upstream, midstream, and downstream sectors of Hydrocarbon industry in India. In line with our Clean and Green energy vision under the Green Hydrogen Policy of Government of India, the target of production of same is 5 Million Tonne by 2030. CPSE-wise net zero target is as below:

SI. No	CPSE	Net Zero target
1	ONGC	2038

2	OIL	2040
3	GAIL	2040
4	IOCL	2046
5	BPCL	2040
6	HPCL	2040
7	EIL	2035

6.2. Details of measures taken by some Oil & Gas companies are as under:

Indian Oil has committed to achieve net zero operational emissions by the year 2046. The ambitious targets include establishing a portfolio of 5.5 GW Renewable Energy and producing 0.7 MMT Biofuels by 2025; achieving 31 GW Renewable Energy, producing 4 MMT Biofuels, including Biogas by 2030, and 200 GW Renewable Energy, 7 MMT Biofuels, and 9 MMT Biogas by 2050. IndianOil is also striving towards providing 20% ethanol blended petrol (E-20) across India. Indian Oil was a part of the MoP&NG's Energy Transition Advisory Committee (ETAC), which was set up to suggest the transition pathways for oil & gas public sector companies in the country. The company is implementing projects on energy efficiency, renewable energy, process fuel improvements, and technology upgradation to mitigate operational emissions.

HPCL has recently completed its Environmental Strategy with the help of world-renowned consultant. It has drawn a roadmap for de-carbonization of its operations in line with its Net-Zero target of 2040 for Scope-1 Et Scope-2 emissions. This roadmap has a strong focus on transitioning towards a multi-energy green and low carbon Corporation. HPCL has identified key levers for achieving net zero, such as enhancing energy efficiencies in its own operations, using renewable power in refineries, replacing hydrogen requirements with green hydrogen, reducing flare gas emissions, etc. Towards emission intensity reduction, the Corporation is exploring various business areas such as renewable energy and storage, biogas, biofuels, petrochemicals and green hydrogen. To accelerate its energy transformation journey, HPCL has established a new 'Energy Transition Cell', which is dedicated to achieving the Corporation's Net-Zero goals. The incorporation of a wholly owned subsidiary for consolidation of all green and emerging business opportunities under one umbrella is also being planned and is under consideration for approval of the Competent Authority.

BPCL has taken a target to become net zero by 2040 for scope 1 and 2 emissions and has already created a road map with various levers which shall be implemented by 2040, which includes improvement in energy efficiency, Implementation of Green Hydrogen in refineries and other possible opportunities i.e., addition of Hydrogen in CNG, Bio CNG, Renewable energy

including solar and Wind energy plants, Carbon Capture Storage and Utilization (CCUS) etc. BPCL has further drawn a road map to become net zero for scope 3 emissions by 2070 in-line with India's commitment. BPCL 's energy mix will transform to cater to India's demand in 2070 which is expected to be 90 % of renewables /Bio-CNG/Green hydrogen and 10 % of fossil fuel. BPCL is taking various initiatives in this direction by implementing EV charging stations at its outlets, Battery swapping, exploring fuel cell technology, blending of green hydrogen in Natural Gas Stations / addition in PNG and increase in blending of Bio-Fuels (Ethanol/ UCO) in MS/ HSD.

D. Role of Ministry of Coal in Energy Transition

7. Background:

Coal India Limited and NLC India Ltd have taken several measures for transition in the Energy Sector, development and adoption of Renewable Energy, Energy Conservation in its business which has resulted in substantial reduction in CO₂ emission. Measures taken by them are given below:

7.1. Measures taken by Coal India Ltd

7.1.1. Solar Energy:

Coal India and its subsidiaries have cumulative electricity contract demand of 1100 MVA with an annual energy consumption of approximately 4600 million units. This requires installation of 3GW of Solar Power by CIL to become a Net-Zero energy company by 2025-26. The total solar energy generated during 2022-23 was 6.83 million units through installed RE capacity resulting in a reduction of 5,606 Te of CO₂. In FY 2023-24, total 12.48 Million units of electricity are generated through installed Solar Power capacity of 41.3 MW till Jan, 24.

7.1.2. Steps taken by CIL to shift towards Cleaner Resources:

CIL has taken several measures to diversify its portfolio towards green energy resources as well as to become a net-zero energy company. A three-pronged strategy has been adopted by CIL to promote and develop renewable power as given below,

7.1.3. Development of Solar Projects in available land parcels and rooftop spaces at subsidiaries:

CIL has identified suitable mined out land, OB dumps, water filled voids, rooftops at its subsidiaries for installation of Solar Power Projects. CIL is implementing overall 259 MW of

ground mounted solar projects and 10 MW of rooftop solar projects in FY 23-24. Work has been awarded for execution of 259 MW Solar Projects, details are given in table below:

SL. No	Subsidiary	Capacity under Installation
1.	MCL	50 MW
2.	ECL	35 MW
3.	NCL	50 MW (10 MW installed)
4.	SECL	40 MW (20 MW installed)
5.	WCL	15 MW
6.	BCCL	45 MW
7.	CCL	24 MW
TOTAL		259 MW

In addition to above 108.5 MW Ground mounted solar projects are approved and under stages of award (CCL-13.5 MW & 35 MW-WCL tendered and under evaluation, DPRs for 20 MW-MCL and 40 MW –SECL approved and tenders will be floated shortly).

7.1.4. Development of Solar Projects in states with high potential like Rajasthan, Gujarat,UP:

CIL is exploring to set up Solar Power Projects at locations with high insolation like Rajasthan, Gujarat etc. CIL has signed an MOU with Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL) to develop 1190 MW Solar Project at Bikaner, Rajasthan. Land banks at Bundelkhand Region, identified by UP Govt. are being explored for setting up of Solar Projects.

7.1.5. Developing solar projects by participating in Solar tenders of DISCOMs / Solar Parks etc.:

CIL has been participating in Pan-India tenders of Discom(s) /Solar Parks to develop RE Projects and supply power by entering in Power Purchase Agreement/s.

- a) CIL has secured 300 MW Solar Power Project capacity in GUVNL's tender on 25.01.24 and project will be set up in Solar Park at Khavda, Gujarat.
- b) 100 MW Solar Power Project at Patan, Gujarat is under commissioning for which Power Purchase agreement was signed with GUVNL on 22.04.2021.

7.2. Financial Resources and Investing in Green Energy:

CIL has planned to invest approximately Rs. 18000 Cr to develop 3000 MW Solar Projects by 2025-26. In addition, CIL is also exploring to invest in other projects like,

Floating Solar Plants The investment in solar projects identified / under execution over CIL land are presently being financed through CAPEX mode of company. Other Pan India projects are being planned to be financed through debt to be sourced from commercial banks and Financial Institutions.

7.3. Developing skills for Clean Energy:

Solar cells at subsidiary level have been developed to implement RE projects efficiently and time bound manner. Training and development of executives of solar cells are being conducted to enhance the technical and managerial skills at reputed institutes like National Power Training Institute (NPTI) etc.

7.4. Other initiative to reduce carbon emission:

7.4.1. Clean coal initiatives through Surface Coal Gasification (SCG) route:

CIL has taken up several clean coal initiatives through Surface Coal Gasification (SCG) route for production of Syngas which can be subsequently converted into fertilizers, liquid fuels, industrial chemicals, etc. The details of projects in pipeline are as follows:

Sl.No	SCG Initiatives	Status
(i)	Integrated Coal to Ammonia-Urea Project at Talcher (Odisha) through Talcher Fertilizers Limited, a JV company of CIL, GAIL India Limited, RCF and FCIL	Work orders for Coal Gasification plant and Ammonia Urea plant awarded to M/S Wuhuan Engineering Co. Ltd, People's Republic of China on 11.09.2019 and 19.09.2019 respectively. Both LSTK and Non-LSTK scope of works under progress. As of 31 st January 2024, the cumulative progress achieved for Coal Gasification is 55.97%, Ammonia/Urea is 51.44%, and overall project is 55.55%.

(ii)	Coal-to-Chemical Projects at subsidiaries of CIL, namely ECL, MCL and WCL.	<p>Pre-Feasibility Reports of ECL (Coal-to-Synthetic Natural Gas), MCL (Coal-to-Ammonium Nitrate) & WCL (Coal-to-Ammonium Nitrate) have been approved by their respective boards/CIL.</p> <p><u>Coal-to-Ammonium Nitrate Project in MCL:</u></p> <p>Both CIL and BHEL Board have accorded 'in-principle' approval to the JV Agreement between CIL and BHEL for Coal to Ammonium Nitrate project in MCL. Work Order issued to M/s Projects and Development Limited (PDIL) for the Job of "Preparation of Detailed Feasibility Report (DFR) for setting up of Coal-to-Ammonium Nitrate Plant in MCL. Cabinet Committee on Economic Affairs (CCEA) has approved proposal for equity investment by CIL for setting up of Coal-to-Ammonium Nitrate Project at MCL command area through a JV of CIL & BHEL on 24.01.2024.</p>
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7.4.2. **Development of CBM projects in CIL Leasehold Areas:**

- Government of India (MoP&NG) had issued partial modification of CBM Policy, 1997 vide notification dated 8th May' 2018 outlined consolidated terms and conditions for grant of exploration and exploitation rights for CBM to Coal India Limited (CIL) and its Subsidiaries from its coal bearing areas for which they possess mining lease for coal mining as it will also be deemed lease for CBM extraction.
- In pursuance of above, CIL/CMPDI has delineated CBM blocks for commercial exploitation, initially in Damodar Valley Coalfields (under leasehold of BCCL and ECL) and Sohagpur Coalfield (under SECL leasehold).
- Jharia CBM Block-I under leasehold areas of BCCL has been awarded to M/s Prabha Energy Private Limited through global bidding for extraction of CBM from the block on revenue sharing basis. The Block is under Exploration Phase.
- CIL and its subsidiaries are eagerly looking for extraction of their untapped methane resources from Coal seams under their leasehold areas with the objective of methane abatement and to reduce GHG emissions as well as achieve the SDG-7 Goal (Affordable and Clean Energy).

7.4.3. **First Mile Connectivity (FMC) Projects:**

Coal India Limited (CIL) is currently advancing its efforts to facilitate the smooth and efficient movement of coal, characterized by automated loading onto railway wagons with minimal human intervention through its First Mile Connectivity (FMC) Projects.

FMC projects offer a focussed and systematic approach for reducing carbon emissions in coal transportation. These initiatives optimize the efficiency of the coal transportation process, streamlining movement from mines to destinations thereby minimizing the carbon footprint per unit of coal transported. By curbing traffic congestion and minimizing the road transport, FMC projects reduce emissions from vehicle exhausts and contribute to enhanced safety. Automation and optimization of coal loading significantly reduce carbon emissions.

75 FMC Projects being executed in four sequential phases at an estimated cost of INR 27,750 crores, are primarily designed to revolutionize mechanized coal transportation and loading systems.

In Phase-I, CIL has undertaken 35 FMC Projects, with a cumulative capacity of 414.50 MTPA. 10 of these projects, with a combined capacity of 142 MTPA, have already been successfully commissioned. Moreover, an additional 8 projects of 83.50 MTPA capacity, are poised for commissioning during the fiscal year of 2023-24.

In Phase-II, CIL has identified 9 more FMC Projects, collectively contributing 57 MTPA to the overall capacity. Construction works in 5 of these projects are in progress and the rest are in tendering stage. These projects are planned to be commissioned by 2025-26.

In Phase-III, 17 projects with an aggregate capacity of 292 MTPA have been planned and anticipated to be commissioned by FY 2028-29.

In Phase-IV, 14 projects of a total capacity of 74 MTPA have been planned for implementation and targeted to be commissioned by FY 2029-30. Post materialization of FMC projects in all the four phases along with previously operational CHP Silos of 151 MTPA capacity, the grand total of mechanized coal loading capacity will be about 988.50 MTPA by FY 2029-30.

Looking ahead, CIL plans to introduce the FMC concept into all its future mining projects wherever techno-economically feasible. This forward-thinking approach underscores CIL's commitment towards sustainable growth by reducing carbon footprint.

7.4.4. Inland Waterways

Following the recommendations of the National Transport Policy Committee (NTPC), the Inland Waterways Authority of India (IWAI) was set up on October 27, 1986 by an Act of Parliament in 1985 for development, maintenance and regulation of National Waterways for shipping and navigation in the country. In the following years (1986 – 2014), 5 waterways were notified as National Waterways in India (named as NW-1 to NW-5). The National Waterways Act, 2016 declared an additional 106 waterways as National Waterways thus totalling 111 National Waterways (NWs) in India. These NWs which cover a total length of 20,162.5 Kms spread across 24 States in the country offer a potentially viable solution to transportation by traditional modes such as roads and railways.

Coal traffic on NW-1 is expected to increase up to 13 Million Tonnes by 2035 and cross 20 Million Tonnes by 2045. In addition to Thermal Power Plants (TPPs), cement manufacturing plants are the major industries located in the hinterland of NW-1. As per IWAI, a major component of such coal traffic is expected to comprise of coal imported from Indonesia, and Australia for TPPs operating on imported coal and such coal reaches Sandheads (Haldia) or Paradeep ports and is then transported via rail or road to TPPs located in the region. At present, the NTPC Thermal Power Plant at Farakka also transports coal via barges after transshipment.

IWT can potentially supplement the congested Railways and Roadways and provide suitable transport alternatives for bulk cargo movement and for carriage of vehicles (in Roll-on-Roll-off mode of cross-ferry). IWAI projects the following sectors to witness maximum freight traffic up to 2045:

- a. Haldia – Patna - Haldia
- b. Sahibganj – Patna – Sahibganj
- c. Haldia – Varanasi – Haldia
- d. Sahibganj – Varanasi – Sahibganj
- e. Patna – Varanasi – Patna

With the objective of reducing TLC for imported coal movement to the hinterland, the IWT route over NW-1 can be a more suitable transportation mode for specific plants for imported coal transhipped at Sagar Island / Sandheads (near Haldia Port) on to barges for further movement to thermal power stations located in proximity to NW-1, provided suitable infrastructure are present along NW-1. Infrastructure development (terminals, LAD, 24/7 operations etc.) needs to be prioritized for utilization of IWT for freight transportation.

Coal is sold on “Free on Rail/Road” basis by the coal companies. Hence decision in respect of modes of despatch is the prerogative of the consumers. Development of alternative modes of transportation, including Inland waterways, is largely dependent on consumers, who put huge importance on the economics of such transportation. It is pertinent to mention that most of the consumers have raised the issue that coal mines of CIL are located far away from waterways and it may involve multi modal movements including bulk road transport and re-handling facilities which will enhance the landed cost of coal for the coal consumers.

Coal movement through National Waterways was also attempted by power plants in the past and failed due to various techno-economic issues including non-maintenance of adequate draft, environmental clearance issues, irregularity in sourcing imported coal non-development of handling infrastructure at Inland ports etc.

Keeping in view that Waterways can be tapped for reducing the transportation cost of coal in select cases, Inland Waterways Authority of India (IWAI) have to take initiative to attract more consumers with regular interactions and continuous follow ups.

7.4.5. E-Vehicles in CIL and its’ Subsidiaries:

Presently Subsidiaries are mostly hiring the services of light vehicles instead of purchasing the same. Light and medium light vehicles like Jeep, Car, and Ambulances etc. are being hired by the Subsidiaries at Area level and Subsidiary HQ level. A few vehicles which are normally used by higher ups are purchased, maintained & operated departmentally.

Since 2021-22 CIL is giving special emphasis on purchasing / hiring of electrical vehicles at different Mines, Areas and Subsidiary HQs.

Since 2021-22 achievement of CIL and its Subsidiaries in respect of purchase/ hiring of electrical vehicle is as follows:

Financial Year	No. of electrical vehicles purchased/ hired
2021-22	05 Nos.
2022-23	71 Nos.
2023-24 (Till January, 2024)	114 Nos.

During the interaction with the Subsidiaries it was pointed out that:

- i. During tendering for hiring of electrical vehicle for Areas and Mines it has been observed that the electrical vehicle manufacturers, dealers and other transport agencies are not responding due to poor road conditions at mine areas and lack of infrastructures like charging facilities & maintenance/ service centres at remote areas.
- ii. Further, the distances of the mines and areas are very long from the headquarters and it is very difficult to cater the total distances in a single charge of the e-vehicles.

CIL HQ and its Subsidiaries has been given a target of purchasing/ hiring 380 electrical vehicles during FY 2023-24. Till January'24 114 nos. electrical vehicles have been purchased / hired so far. Further, 17 nos. of electrical vehicles have been ordered for hiring and tendering is under process for purchasing / hiring another 91 nos. electric vehicles.

7.4.6. **Use of LED Light and Energy efficient appliances:**

More than 3.5 lakhs conventional light fittings have been replaced by energy efficient LED lights at quarries, underground mines, roads & streets, offices, townships and other establishments. This transition to LEDs has resulted in significant energy savings.

Existing Motors, Water Heaters, Fans & Air Conditioners are being replaced by Energy Efficient appliances & equipment. Auto timers are being fitted in Street Lights and Capacitor Banks are being installed to increase the power factors.

7.5. **Measures taken by NLC India Ltd –**

NLCIL has been a forerunner among the PSEs in the country in energy sector, contributing in Lion's share in lignite production. NLCIL had been operating with present Mining Capacity of 50.10 MTPA which includes Lignite 30.10 MTPA & Coal 20.0 MTPA. Also NLCIL has a Present Power Generation Capacity (including JVs) - 6071 MW with Lignite and coal run Thermal Power station, Solar & Wind energy accounting for 3640 MW, 1380 MW & 51 MW respectively. Already NLCIL had adopted the CFBC technology boilers in two thermal power plants to reduce emissions for per unit power generation.

As part of future with Capacity Addition, Mining is increased to 100.35 MTPA & Power Generation increasing to (17,171 MW) (including JVs) with RE energy 6031 MW by FY 2030. In the case of capacity addition of thermal plants, ultra-super critical technology is used in all the future thermal power plants for increased efficiency and less emissions.

With the name of '**First PSU**' to cross 1 GW renewable power capacity, NLCIL is expanding its Green Portfolio by installing Renewable Energy (Solar & Wind) and now the Company has become a member of International Solar Alliance (ISA). At present NLCIL renewable energy capacity is 1431 MW and In-line with the India's commitment during COP 28 for Climate Change,

NLCIL has planned to expand its Renewable Energy Capacity 6 GW by 2030, towards transitioning away from fossil fuels. At present, NLCIL is pursuing with a massive RE expansion programme within the next two years, by taking up projects of 300 MW in Rajasthan, 200 MW in PAN-India basis, 600 MW in Gujarat and another 810 MW as Solar Park in Rajasthan. As part of sustainable development, 50 MW Solar is planned in mined-out area also. The above clearly shows that NLCIL is moving towards more RE which is going to take the center stage in future.

7.5.1. Use of Bio-mass pellets in Thermal power stations as part of Waste to Energy

Use of the Bio-mass pellets upto 5 % blending with coal is being implemented in two thermal power plants of Barsingsar in Rajasthan and Tuticorin in Tamil Nadu. In Barsingsar plant, the OEM BHEL is studying the modifications required in the Boiler. Tender for procuring the bio-mass pellets is in the advance stage. In Tuticorin plant, 500 Tonnes of pellets procurement is carried out to conduct the trial study. Based on the results, regular implementation will be carried out.

7.5.2. Clean Coal Technologies

India is gifted with huge coal resource of 361.41 Billion Tonnes and 46.2 Billion Tonnes of lignite as on 01-04-2022, making it a dependable source of energy for quite some period. Using Coal without adding SO_x, NO_x and CO₂ levels to atmosphere, is a major technological challenge. Development of new 'Clean Coal' technologies is gaining momentum to address this problem so that the India's enormous resources of coal can be utilised for future generations without contributing to global warming.

Owing to the above, quick shift of energy dependence to cleaner source, leaving coal based energy generation may not be a reality in near future. Taking into account of dependence on coal in the Indian energy sector, gasification of coal and other clean coal technologies can pave way for a comparatively clean source of electricity as well as for production of various value added chemicals and liquid fuels. Considering the importance of this clean coal technology, the Indian Government is also rolling out a big subsidy scheme for Rs. 6000 Cr. which will reduce the reliance on imports of ammonia, natural gas, methanol, etc.

7.5.3. Role of NLCIL in Clean Coal Technology

As part of diversification, NLCIL has proposed to establish a lignite-based Surface Gasification and Methanol plant of 0.4 MTPA capacities at Neyveli at a project cost of around Rs. 4394 Cr. The first tender for the conversion of lignite to Syn-gas on LSTK basis was opened and three prospective bidders had participated. Bidders evaluation is under progress. M/s EIL has been engaged as the Project Management Consultant (PMC). This project is expected to go on stream by 2028. NLCIL had also applied for the Rs. 1000 Cr subsidy for this project. Apart from methanol, the production of DME is also being explored. Also Lignite to Diesel is also being taken up.

7.5.4. **Net-Zero Concept**

India had committed Net-Zero by 2070. Supporting India's commitment to increased reliance on renewable energy and as part of its own energy transition program and moving towards Net-Zero, NLCIL rolled out several initiatives including projects such as Lignite to Methanol, Green Hydrogen, expansion of renewable energy with storage technologies, CCUS, Pollution control measures and Green Belt Development.

7.5.5. **NLCIL moving towards Net-Zero**

NLCIL undertakes massive expansion programme in RE power generation which reduces the dependence on fossil fuel power as already stated. Currently around 2 GW of Solar projects is in various stages of implementation. Also, towards the mandatory requirement of bundling of solar power with the coal fired thermal power, NLCIL has planned for installing 223 MW of Solar for Tuticorin Thermal Power Station and 792 MW for Ghatampur Thermal Power station. Land identification for the same is in progress in both the plants. Also another 50 MW of Solar plant in the de-coaled area of Neyveli mines for which the tender is floated. NLCIL is in the process of publishing a Roadmap Net-zero way forward document with approval from competent authority.

7.5.6. **Carbon Capture Usage and Storage (CCUS):**

NLCIL is pioneer in sequestering CO₂ and put up a pilot plant in 2013 to sequester CO₂ from flue gas by **Biological mode of sequestration**. This project is first of its kind & the CO₂ sequestration was carried out in an operating Thermal Power Station to address climate change issue. Moreover, other Carbon sequestration methodologies are under discussion with various reputed institutions/Universities to achieve PM's mission on net zero carbon.

7.5.7. **Pollution Control Measures**

Electrostatic Precipitators (ESPs) of more than 99% efficiency has been installed & continuously operated in all the thermal power stations of NLCIL to remove the ash particles from the outgoing flue gas. In addition, the implementation of FGD is also under progress in three thermal power plants of Neyveli New Thermal Power station, Tuticorin Thermal Power station in Tamil Nadu and Ghatampur Thermal Power Station in Uttar Pradesh at a total Capital Expenditure of around Rs. 2500 Cr., to comply with the MoEF & CC's revised emission norms.

7.5.8. **Greenbelt Development**

Even before the advent of Environmental laws & regulations implemented in our country, NLCIL had given prime importance to Environmental protection through various eco-friendly activities including green belt development. So far, NLCIL has raised more than 35 lakh trees in the region over a period of 6 decades in and around Neyveli Township and its industrial Units. The greenbelt developed acts as a natural carbon sink in the region. NLCIL has also developed a 'SAL VAN' and other plantation activities near Talabira coal fields in Odisha.

In addition, NLCIL has also invested in transcending to e-vehicles in public places like GH, adopting energy efficient measures to reduce energy consumption, adopting green sustainable mining practices, pollution control & monitoring and also creating awareness among employees for the replacement of e-vehicles.

E. SPECIFIC ACTION INITIATED BY MAJOR PUBLIC SECTOR UNDERTAKINGS ASSOCIATED WITH ENERGY SECTOR

8. Background:

8.1. GAS AUTHORITY OF INDIA LIMITED

As per Statistical review of World Energy report published by Energy Institute in 2023 (previously BP energy statistics), share of natural gas in India's primary energy consumption for year 2022 is ~5.8% whereas majority contribution in energy sector came from Coal (~55%) followed by Oil (~28%), Hydro Electric (~ 4.5%), Nuclear (~ 1.15%) and Renewables (~6%). India was the 4th largest importer of Liquefied Natural Gas (LNG) having the share 5% of world LNG import (~28.4 BCM or ~21.6 MMT).

The Hon'ble Prime Minister has stated that India's energy map will be driven by seven key drivers amongst which the foremost pillar is accelerating efforts to move towards a gas-based economy. The other six pillars are (1) cleaner use of fossil fuels particularly petroleum and coal, (2) greater reliance on domestic sources to drive bio-fuels (3) achieving the renewables target of 500 GW by 2030 (4) increasing the contribution of electricity to de-carbonize mobility (5) moving into the emerging fuels including hydrogen and (6) digital innovation across all the energy systems.

Also, in accordance with provisions of Paris Agreement, Govt of India has advanced its Nationally Determined Contributions (INDC) in 2022. India's five new climate targets are:

- To increase its non-fossil energy capacity to 500 GW by 2030 including 450 GW Renewable Energy (RE) capacity addition and 43% RE purchase obligation by 2030
- To meet 50 % of India's power demand via renewable energy sources
- To reduce the carbon intensity of the Indian economy by 45 %.
- To reduce India's total projected carbon emissions by one billion tonnes from 2021 to 2030
- To achieve a target net zero (for carbon emissions) by 2070.

These targets are supported through complementary policy and legislative mandates (Energy Conservation (Amendment) Act), missions (National Green Hydrogen Mission), fiscal incentives (production-linked incentives) and market mechanisms (upcoming national carbon market).

In August 2022, the Lok Sabha passed the Energy Conservation Amendment Bill, 2022 which aims to mandate the use of non-fossil fuel sources including green hydrogen, green ammonia,

biomass and ethanol for energy and feedstock in industries. This bill also gives the power to the Central Government to establish carbon markets.

Natural Gas is being considered as transition fuel by Govt of India in its journey towards Net Zero due to its characteristic of significantly less emission as compared to other fossil fuels, providing easy solution to manage climate change. The government has taken several steps for accelerating India's transition toward a gas-based economy in the entire gas value chain and increase the share of Natural Gas up to 15% of primary energy mix by 2030.

Noteworthy initiatives taken by government for the development of **gas-based economy** are following:

- Significant investment to boost Domestic Gas exploration & production activities
- Building up facilities to import natural gas in the form of LNG. India's current LNG import installed capacity is 47.5 MMTPA and another 15 MMTPA capacity is under construction.
- **Development of National Gas Grid:** Government of India has identified the requirement of development of additional ~10,800 Km of Gas Pipeline in addition to existing ~24,600 km of natural gas pipeline to complete the National Gas Grid.
- **Development of CGD coverage:** After the successful completion of 11th and 11thA CGD bidding round, 98% of India's population and 88% of its geographic area now covered under CGD network. Further, PNGRB has launched 12th CGD bidding round in order to cover almost entire country except Andaman Nicobar and Lakshadweep.
- Implementation of **Natural Gas Marketing Reforms, 2020** for the purpose of discovering market price of gas to be sold in the market by gas producers, through a transparent and competitive process
- **Natural Gas Pricing Reforms** through implementation of recommendations of Kirit Parikh committee report.
- Introduction of **PNGRB (Gas Exchange) regulation, 2020** followed by India's first nationwide online delivery-based gas trading platform **India Gas Exchange (IGX)** launched in June 2020 in order to enable market participants to trade in standardized gas contracts.
- MoP&NG vide guidelines dated 14.11.2013, 03.02.2014, 20.08.2014, 06.05.2022 & 10.08.2022 ensured **no cut in gas allocation/supply to city gas distribution (CGD) entities for PNG (Domestic) and CNG (Transport) purpose.**
- With a mission of "**One Nation, One Grid and One tariff**", PNGRB has notified necessary regulations pertaining to **Unified Tariff** to develop gas market and facilitate gas availability and affordability including parts of India which are located at the farthest corner from source of gas like north east. Accordingly, w.e.f. 01.04.2023, Unified Tariff has been implemented.

In addition, Govt. of India has also taken following key initiatives to accelerate **energy transition**:

- The outlay of Rs. 19,700 cr. for the **National Green Hydrogen Mission** to facilitate transition of the economy to low carbon intensity, reduce dependence on fossil fuel imports. The target is to reach an annual production of 5 MMT by 2030.
- The allocation of Rs. 35,000 cr. for priority capital investments towards energy transition and net zero objectives, and energy security.

- Viability gap funding for 4,000 MWh battery energy storage systems and formulation of a detailed framework for pump storage projects.
- Investment of Rs. 20,700 crore including central support of Rs. 8,300 cr. for strengthening of interstate transmission system for evacuation and Grid Integration of 13 GW renewable energy from Ladakh.
- During G20 summit in Delhi on 9th September, 2023, **Global BioFuel Alliance** has been declared as a catalytic platform to foster global collaboration for the advancement and widespread adoption of biofuels.
- Ministry of Environment and Forest (MoEF) has issued draft rules for the **Green Credit Programme** to incentivize individuals and other entities for their voluntary pro-environment and conservation works.
- Collaboration of **International solar alliance (ISA) and MNRE** for the massive deployment of solar energy by 2030
- Cabinet has approved a viability gap funding (VGF) scheme of Rs. 8,500 cr. for coal gasification projects for public and private sector companies.
- GAIL has been actively supporting the Government's priorities for transition towards lower carbon energy options. Deep dive efforts are being carried out for penetration of renewable energy in the supply mix, with a focus towards electrification, new energy forms like CBG, hydrogen etc. as key drivers of GAIL's own energy transition journey. GAIL has developed its Net Zero strategy target for GHG Emissions of 100% reduction in Scope 1 and Scope 2 emissions and a 35% reduction in Scope 3 emissions by 2040. towards decarbonization and the transition towards net zero goals. GAIL is implementing following measures towards transition in energy sector which are as follows:
- Ministry of Petroleum & Natural Gas (MoP&NG) launched **Sustainable Alternative towards Affordable Transportation (SATAT) programme in October, 2018** for promoting **Compressed Bio Gas (CBG)** by enabling entrepreneurs in setting up of 5,000 CBG plants to target production of 15 MMTPA of CBG in India. GAIL is implementing following projects:
 - ❖ GAIL has been mandated to issue 400 LOIs by FY2024. GAIL has already issued 370 LOIs till December, 2023.
 - ❖ GAIL is in the process of setting of one CBG plant at Ranchi and another in Bangalore using municipal solid waste as feedstock.
 - ❖ Parallely, GAIL has been mandated by MoP&NG to operationalize the CBG-CGD Synchronization Scheme and supply Biogas/CBG co-mingled with domestic gas at Uniform Base Price (UBP) across all CGD entities for CNG (T) and PNG (D) segments of CGD network.
 - ❖ GAIL has put a target to set up 26 CBG plants across India in the next 3-4 years.
- MoP&NG has mandated **Compressed Bio Gas Blending Obligation (CBO)** in CNG and Domestic PNG in November 2023. As per this policy, CBO will be kept voluntary till FY 2024-25 and mandatory blending obligation shall start from FY 2025-26 onwards.
- In line with **National Green Hydrogen Mission (NGHM)** approved by Cabinet on 04.01.2023, GAIL is implementing the following projects:
 - ❖ GAIL has started India's maiden pilot project of blending Hydrogen in City Gas Distribution grid. GAIL started pilot project after due statutory permission by blending 2% in CGD network of Avantika Gas Limited (AGL). Later, 5% blending in PNG network has commenced.

- ❖ GAIL is setting up an electrolyzer plant at its Vijaipur unit having capacity of 10 MW. 4.3 Ton per Day /1.4 Kilo Tons per Annum green Hydrogen will be produced from this facility.
- **Ethanol blending:** In line with Government of India's aim to decrease oil imports and achieve 20% blending of Ethanol Blended Petrol (EBP) by 2025, GAIL is considering the establishment of a 500 KLPD 1G grain-based ethanol plant in Rajasthan to support this goal.
- GAIL has a total installed capacity of 132 MW of alternative energy out of which 118 MW is wind energy projects and 14 MW are solar energy projects including small solar units.

8.2. INDIAN OIL LIMITED

Climate change is a global crisis that has far-reaching implications for various sectors of the economy, including the oil and gas industry. As the world grapples with the consequences of rising temperatures and shifting weather patterns, the oil and gas sector finds itself at a critical crossroads. To remain competitive and sustainable in a rapidly changing world, oil and gas companies are adapting, innovating, and embracing cleaner and more sustainable practices to meet global energy needs while also actively contributing to global efforts to combat climate change.

While climate change poses a significant threat to IndianOil's operations, its supply chain, and the markets it operates in, it also presents a unique opportunity to gain a competitive advantage in the 'Green Energy' domain by leveraging its world-class R&D, large supply chain network and huge customer outreach on one hand, while capitalizing on the growth opportunities in conventional business, on the other.

To maintain Indian Oil's leadership in the downstream segment, the Company has made a robust energy transition strategy based around adoption of clean fuels, decarbonization of operations and building a clean energy portfolio. Realizing the necessity for a smooth and just energy transition, while acknowledging the role of hydrocarbons in the energy security of the country; IndianOil has laid out following strategic plans:

a) Alternative Fuels/Biofuels:

❖ 1G Ethanol:

Within the framework of the government's flagship Ethanol Blended Petrol (EBP) Program, IndianOil has been engaged in the process of blending Ethanol with Petrol (Motor Spirit). This initiative is aimed at strengthening energy security, diminishing reliance on fuel imports, conserving foreign exchange reserves, and addressing environmental concerns.

Oil Marketing Companies (OMCs) have been tasked with achieving a 20% ethanol blending target by the Ethanol Supply Year (ESY) 2025-26. To meet this goal, an approximate 1,016 crore litres of ethanol are anticipated to be required during the Ethanol Supply Year 2025-26.

In line with these efforts, OMCs have entered into Long Term Offtake Agreements (LTOAs) with 131 successful bidders, who have plans to set up 738 crore litres per annum of dedicated ethanol capacity in ethanol deficit states in the next few years.

About 12.14 % of Ethanol blending was achieved by IOCL during the ESY 2022-23 (December 2022 to October 2023). During current ESY 2023-24 (November 2023 to January 2024), IOCL has achieved about 12.08% ethanol blending.

❖ 2G Ethanol:

To enhance energy security and facilitate the transition to more sustainable energy sources, IndianOil has set up Asia's first 2G Ethanol Plant based on Paddy straw feedstock at Panipat (Haryana) having 3 Crore litres per annum capacity. It would use 220 TMT/annum of feedstock and lead to reduction of about 3 Lakh tonnes of GHG emission (equivalent to replacing over 63,000 cars annually from roads of country). The Plant was dedicated to nation by Hon'ble Prime Minister on 10.8.2022. At present, the Plant is under stabilization.

❖ 3G Ethanol:

IndianOil has set up World's first Refinery off gas to ethanol (3G ethanol) producing plant of 4.2 Crore litres per annum capacity at Panipat. Remarkably, IndianOil stands as the very first oil refining company worldwide to adopt this cutting-edge technology. The implementation of this innovation is expected to mitigate around 1.8 lakh tonnes of greenhouse gas emissions annually.

❖ Biodiesel Blending:

As per the National Policy on Biofuels, an indicative target of 5% blending of biodiesel in diesel /direct sale of biodiesel is proposed by 2030. During FY 2023-24 (till Jan '24), 0.47% blending was achieved.

❖ Compressed Bio Gas (CBG):

As part of the Sustainable Alternative Towards Affordable Transportation (SATAT) program, IndianOil currently possesses 1,574 active Letters of Intent (LOIs) dedicated to the production and supply of 4.7 MMTPA of Compressed Biogas (CBG). Under this initiative, IndianOil is marketing CBG through 69 Retail Outlets and to 2 Industrial Consumers. CBG also will play a major role in achieving energy security & transition of country.

❖ Sustainable Aviation Fuel (SAF):

IndianOil is engaged in strategic partnerships with esteemed global technology pioneers such as M/s LanzaJet Inc, USA and M/s Praj Industries Limited, India, aiming to establish Sustainable Aviation Fuel (SAF) facilities. IndianOil's vision encompasses the establishment of an 86.8 TMTA capacity SAF Plant in Panipat, leveraging LanzaJet's Alcohol to Jet (ATJ) Technology.

This plant will derive its feedstock from 1G/3G Ethanol, which offers supplementary carbon advantages, contributing to its sustainability.

In addition, IndianOil has formalized a Memorandum of Understanding (MoU) with M/s Praj Industries Limited to initiate the construction of a SAF demonstration plant with a capacity of 10 Tons Per Day (TPD) in Pune. This initiative is designed for gradual expansion, eventually scaling up to a full-fledged commercial plant with a capacity of 500 TPD by the year 2035.

b) Renewable Energy Portfolio:

As on 31st Jan'24, IndianOil has a portfolio of 243.18 MW of Renewable Energy which includes 167.60 MW of wind capacity and 75.58 MW of solar PV capacity. The total generation through its renewable portfolio during FY 2023-24 (till Jan'24) was 340.13 GWh, which resulted in emission mitigation of 312.41 thousand metric tonnes of carbon-dioxide equivalent.

IndianOil plans to build a renewable portfolio of 31 GW by 2030 and 200 GW by 2050. To expand this energy portfolio, IndianOil is collaborating with other public and private energy companies working in the space of clean energy technologies.

c) E-mobility:

IndianOil has the largest network of Retail Outlets (ROs) in the country to meet the energy needs. Earlier, the primary focus was on the sale of conventional and branded fuels through these ROs. But, now as India moves towards a greener future, bio-fuels and EVs shall be playing a vital role in the energy transition process. For providing sustainable and clean energy solutions, IndianOil has made rapid progress in e-mobility. As on 01.02.2024, there are 8,035 number of IOCL Retail Outlets offering EV Charging Stations & 87 number of IOCL Retail Outlets offering battery swapping facility. Apart from IndianOil ROs, IndianOil is exploring in 3rd party EV Charging stations (beyond ROs) in public places, depots and fleet hubs. IndianOil has already installed EV Charging Stations at some of the prime locations near Taj Mahal Agra, Delhi MCD sites, Gurgaon, Chennai Airport, IndianOil Terminal/Bottling Plants, etc. An expression of Interest has been invited for shortlisting prospective partners for setting up of EVCS at 3rd party sites.

IOCL is engaged with Sun Mobility Pvt. Ltd, Singapore in setting up Battery swapping stations at IndianOil ROs. Approval obtained for formation of 50:50 JV with Sun Mobility and agreements finalization is under progress.

IndianOil has formed 50:50 JV with M/s Phinergy, Israel, a Technology Co. working on aluminum and zinc air batteries. IndianOil's JV with Phinergy Israel, IOC Phinergy Pvt Ltd (IOP), is working on Al-air battery integration in Electric Vehicles both 3-Wheeler and 4-wheeler with leading Auto OEMs in India. Al-battery has a wider application in Stationary and Mobility space, IOP is also working with leading Telcom Tower Company to provide reliable and cost-effective energy solution. A MOU is signed with Indus Towers Limited by IOP on 17.02.2023 for the supply of 300 Al air energy systems and works are in progress.

d) Retail Outlets Solarization:

IndianOil is solarizing its ROs to reduce their energy demand, reduce carbon footprints and improve dealer profitability as well as focusing on generation of non-fuel revenue through strategic tie-ups with business partners under both 'Store' and 'Non-Store' categories, so as to remain profitable even when the growth in sale of traditional fuels slows down during the energy transition. As on 01.02.2024, 23,652 IOCL Retail Outlets across India has Solarized with combined installed capacity of 141.44 MW.

e) Green Hydrogen:

IndianOil is already taking strides towards green hydrogen production to align itself with the Government's National Green Hydrogen mission, which aims to increase green hydrogen production in the country. A 10 KTPA Green Hydrogen plant at Panipat Refinery and Petrochemical complex, Haryana is being setup.

f) Hydrogen Blending:

In pursuit of strengthening the energy transition pathway, IndianOil inked an agreement on 08.02.2023 with Italy's Snam SpA (one of the leading Natural Gas Transmission Network companies globally) for assessment of one of IndianOil's existing natural gas pipelines for transportation of hydrogen blended natural gas. At present, desktop study of identified Dadri-Panipat Pipeline System (DPPL) has been completed in January 2024. Roadmap for phased blending of Hydrogen in Natural Gas has also been prepared.

g) Indoor Solar Cookstoves:

IndianOil R&D developed an in-house design for an indoor solar cooker to provide energy for cooking as per need. Commercial roll out of Surya Nutan solar cookstoves is being done through 10 number of empaneled vendor's, empaneled for manufacturing, marketing, and providing after-sales service of Surya Nutan. Field trials in about 36 Indian households are progressing satisfactorily in Leh, Lakshwadeep, Udaipur, Gwalior, etc. Several state renewable agencies, forest department, rural development departments, etc. are being sensitized to popularize the product. Efforts are being made to obtain carbon financing from various relevant agencies and subsidy from government to reduce the price of the product. IndianOil R&D has also developed a double cooktop variant of the Indoor Solar Cooking Solution, which was unveiled by the Hon'ble Prime Minister as part of India Energy Week 2023 in Bengaluru.

The commercialization of the solar cooker commenced from 31st May 2023 and is being sold to renewable agencies, forest departments and individuals etc. For the wider adoption, IOCL organized first of its kind workshop on carbon finance for solar cooker on 25th Aug 2023. After the workshop, MoU Signed with M/s EKI Energy services Limited on 30th Nov 2023 to manufacture and promote ISCS leveraging Carbon credit at reduced cost to end customer. Later, M/s EKI successfully launched 'Suryotsava: a pilot project of ISCS' in Kandipura Village of Dhar

District (MP) on 16th Jan 2024. Additionally, M/s EKI has also submitted proposal to M/s Bill & Melinda Gates Foundation on 24th Jan 2024 for assistance in roll out of ISCS. In other developments, BEE has advised all Nodal agencies under them to deploy ISCS (~400 units) and Lanka IOC is planning to deploy 200 units.

h) Natural Gas as a Transition Fuel:

As the nation seeks cleaner and more sustainable energy sources, natural gas plays a vital role due to its lower emissions profile and versatility. Natural gas serves as a transition fuel during the shift towards renewable energy sources, helping to bridge the gap while maintaining a reliable power supply. IndianOil is expanding its Natural Gas business and promoting the gas usage in India in-line with Government of India's plans to increase Natural Gas share in India's primary energy from 6.5% to 15%. IndianOil is enhancing its gas infrastructure by putting up LNG terminal and gas pipelines. The participation of IndianOil in this infrastructure is through multiple ways viz. booking of capacities in upcoming LNG Terminals, setting up of LNG Terminals and laying of gas pipelines by IndianOil itself or through JVC route. Further, IndianOil has been actively participating in the CGD bidding being conducted by PNGRB from time to time and pursuing business opportunities to promote LNG as transportation fuel.

- ❖ LNG Terminals: IndianOil through its JVC - IndianOil LNG Pvt. Ltd. has developed a 5 MMTPA capacity LNG Regasification Terminal at Kamarajar Port, Ennore in Tamil Nadu. IndianOil is looking at expanding its Ennore terminal from 5 to 10 MMTPA. The present regasification capacity of IndianOil in operational LNG terminals is 12.18 MMTPA.
- ❖ Pipeline:
 - IndianOil is operating 3 Natural Gas Pipelines viz. Dadri-Panipat Pipeline (132 Km), Ennore-Thiruvallur- Bengaluru- Puducherry- Nagapattinam- Madurai- Tuticorin Pipeline (operational for 1084 km long section out of 1440 Km), and Dahej-Koyali pipeline (106 Km) to cater to the demand of natural gas in the states of Haryana, Tamil Nadu, Andhra Pradesh, Karnataka, Gujarat and UT of Puducherry. The balance spurlines of Ennore-Thiruvallur-Bengaluru-Puducherry-Nagapattinam-Madurai-Tuticorin Pipeline (356 km) are under construction.
 - IndianOil is implementing a project to lay a 65 km long Natural Gas Pipeline from Hazaribagh to Ranchi which will connect to Urja Ganga Pipeline of GAIL.
 - IndianOil is developing the three Natural Gas pipelines through Joint Venture Company (JVC) route along with GSPL, BPCL& HPCL with a total length of 3490 KM which is under phases of commissioning.
 - Additionally, Indradhanush Gas Grid Limited, a joint venture company of IndianOil, Oil and Natural Gas Corporation Limited, GAIL (India) Limited, Oil India Limited and Numaligarh

Refinery Limited, is implementing 1,656 km long North East Gas Grid (NEGG) Pipeline project to cater to the demand of natural gas in North-Eastern Region of India.

- ❖ City Gas Distribution (CGD): IndianOil along with its two JVCs i.e., IndianOil Adani Gas Pvt. Ltd. (IOAGPL) and Green Gas Ltd. (GGL) are developing CGD networks in 49 authorized Geographical Areas. Cumulatively, both JVCs have provided 4.82 lakhs Domestic-PNG connections and commissioned 637 CNG stations till Jan'24 and IndianOil's standalone basis have provided 1.03 lakhs Domestic-PNG connections and commissioned 220 CNG stations till Jan'24.
- ❖ LNG imports: LNG imports play a pivotal role in diversifying India's energy sources and enhancing energy security. IndianOil ensures procurement of LNG, Domestic Gas and RLNG procurements to ensure demands of customers are met. In line with same, IndianOil has recently signed two HOA's with suppliers for supply of long-term LNG for 10 and 14 years starting from 2026.
- ❖ LNG Stations: Government of India is Promoting LNG as Transport Fuel for long haul Trucks / Buses to lower the big potential of emissions in Automobile sector. IndianOil is developing 16 nos. LNG stations in Phase-1.

I) Indigenous Technology Development for Energy Transition:

By fostering innovation, IndianOil has set itself apart from its rivals. It has instituted distinctive value propositions by crafting cost-efficient, ecologically, and socially conscientious technological solutions that strike a chord with its customers.

In its unwavering commitment to innovation, IndianOil's Research and Development (R&D) Centre plays a pivotal role in supporting the Government of India's vision of "Atmanirbhar Bharat" (self-reliant India) by spearheading the development of indigenous technologies and fortifying the nation's energy security.

IndianOil's R&D has filed 1,717 patents till 31.01.2024, out of which 1,616 are effective patents.

The R&D Centre is at the forefront of futuristic research, addressing critical energy security concerns and aligning its efforts with the evolving energy landscape. Its primary focus extends across key domains such as fuels and lubricants, refining technologies encompassing catalysts, petrochemicals including polymers, and sunrise areas like Nano technology, Solar, Bioenergy, Hydrogen, Fuel Cell, and Energy storage.

These R&D initiatives provide the much-needed support to various government initiatives towards sustainable and equitable availability of energy to all stake holders.

8.3. OIL & NATURAL GAS CORPORATION

With a focus on transitioning from fossil fuels to clean and green energy, Exploration Directorate in ONGC has embarked upon collaborative efforts with concerned agencies to ensure a seamless and coordinated transition across the energy sector. Some of the domains where ONGC has made notable progress are summarized below:

8.3.1. Geothermal Energy

The efforts of assessing India's geothermal potential were taken up way back towards the end of nineteenth century mostly by GSI. Other agencies like NGRI, ONGC and NTPC joined the campaign at a later date.

A Joint working Committee has been created in ONGC with the objective of exploring business opportunities in GTE. In order to assess the potential of known geothermal areas of the peninsular India, review of the available literature and interactions with GSI were carried out. This has resulted into short listing of two areas for immediate focus, Manuguru Geothermal Field (GTF) in Godavari graben of Telangana and Tatapani GTF in Son-Narbada-Tapti (Sonata) lineament zone in Chhattishgarh. Based on preliminary studies, these two areas which appear to have good geothermal potential have been taken up for further in-depth G&G studies for evaluation of their true potential. Geophysical data acquisition in Manuguru area has already been taken up this field season recently.

8.3.2. CCS/CCUS

In order to mitigate the soaring CO₂ emissions and bring it down to a tolerable limit, carbon capture and storage (CCS) / carbon capture utilization and storage (CCUS) has emerged as a crucial component in global carbon management efforts.

ONGC has started screening of potential candidate reservoirs for CCS/ CCUS. Simultaneously, ONGC is scouting for CO₂ sources, as source-sink matching is one of the key challenges in this process, culminating in identification of IOCL's Koyali refinery as a potential source of CO₂ for ONGC's mature oil field of Gandhar in Gujarat. In order to undertake India's first CCS/CCUS project, ONGC and IOCL have signed a MOU. The MOU envisages capturing of CO₂ from IOCL's Koyali Refinery and its utilization in Gandhar oilfield of ONGC. Feasibility studies of their respective part, related to sequestration potential, carbon capture plant, trunk pipeline, surface facilities etc. were carried out by ONGC and IOCL. The novelty of this project includes sequestration of CO₂ and low carbon footprint oil production from mature oil fields. This project shall be a demonstration project, aiding to the understanding of the feasibility of CCUS from Indian perspective and shall contribute immensely in deciding the fate of CCUS in India.

Considering the evolving nature of CCUS and as part of knowledge and capacity building, ONGC is collaborating with best-in-class partners from academia and industry. ONGC has signed MOUs with Equinor and Shell India Markets Private Limited (SHELL) to this effect. These collaborations

are aimed at bringing International best practices in India and shall lead to feasibility studies of sequestration potential of Indian basins. Joint Working Group of ONGC along with SHELL have identified potential in saline aquifers in Western Onshore Basin (Cambay Basin) and Western Offshore Basin as primary focus area as per screening methodology and criteria adopted.

Over the years, laboratories critical to R&D activities related to CCS/CCUS have been developed in ONGC R&D Institutes viz., Institute of Reservoir Studies, Ahmedabad and Keshva Deva Malaviya Institute of Petroleum Exploration, Dehradun. ONGC has initiated R&D projects for ascertaining carbon sequestration potential in depleted reservoirs, saline aquifers and basalt.

Presently OEC is working on RD&D projects in the area of geothermal, hydrogen, CO₂ valorization, biotechnology, Helium, Waste Water Treatment, etc. Many projects (6-7) are entering in to scale up and lab continuous integration and pilot plant and demonstration stage.

A summary of major projects in various alternative energy areas is mentioned below:

8.3.3. Geothermal Project for Carbon Neutral Ladakh - First step to put India on Geothermal Map of the World

Geothermal energy is an energy source that is stored in the form of heat beneath the earth's surface, which is clean, renewable, sustainable, carbon free, continuous, uninterrupted and environment-friendly. It is the only renewable energy available 24x7 to the mankind not requiring storage and unaffected by day-night or seasonality variance. India has seven geothermal provinces and a number of geothermal springs. Geothermal resources in India have been mapped by Geological Survey of India (GSI) and broad estimate suggests that there could be 10 GW geothermal power potential as per Ministry of New and Renewable Energy (MNRE).

Objective: To harness Geothermal Energy at Puga, Ladakh for power generation and direct use of thermal energy.

A maiden Indian venture having potential to put India on world Geothermal Map.

8.3.4. Drilling Operations by ONGC Energy Centre

Project Outcomes 2022-'23:

- OEC started its first campaign for geothermal drilling in August 2022 but due to shallow reservoir complications, well was abandoned at 39.5 m depth.
- A very significant finding in this whole operation was ejection of silica gel from formation with discharged geothermal fluid. Literature survey revealed this silica gel indicates reservoir temperature of at least 180 °C. This was further corroborated by presence of Epidote, Pyrite & Stibnite crystals within the cuttings. Particularly Epidote indicates reservoir temperature beyond 200 °C.

➤ Electrical Resistivity Tomography (ERT) surveys at Puga to delineate low resistivity zones at shallow levels to understand shallow hydrological aspects of the geothermal fluid was carried out jointly with CSIR- NGRI, Hyderabad.

Project Status 2023-'24

- Considering the challenges and lessons learnt from the past drilling operation, the drilling plan was revised.
- Various attempts were made for commencing the drilling operations at Puga Ladakh but due to rig availability and logistic constraints, it could not materialize.
- A recce survey for assessment of the entire route, address logistic challenges and get a holistic picture of the entire route from Delhi-Jammu-Puga via Ramban-Zoji La Pass-Kargil-Leh was conducted.
- Presently, the tender process is under progress and NoA is expected to be given to the successful bidder in the month of February 2024, giving mobilization timeframe of the rig and other auxiliary equipment to Puga site till the end of May 2024.

8.3.5. Hydrogen as the ultimate carbonless fuel

ONGC Energy Centre has developed 3 Cycles for Hydrogen Programme, namely:

Copper Chlorine thermochemical cycle

- This thermochemical cycle has been developed in collaboration with Institute of Chemical Technology (ICT) Mumbai operating at 550°C. Hydrogen generation @25LPH in Closed-loop metallic facility is operational at IPSHEM Goa.
- Scale up @100LPH is under process. The advantages of hydrogen production via thermochemical cycles over electrolysis route are low energy intensive, no carbon footprint when integrated with renewable energy source, the reactants are recycled within the REDOX reaction cycle, the only product being hydrogen and by-product being oxygen due to which the operational cost is low.
- The pilot facility would be operated in continuous mode for minimum six (06) months for data generation which would be a design basis for setting up scale up plant of 12 MTPA at ONGC premises.

Iodine-Sulfur closed loop thermochemical cycle

- The I-S closed loop thermochemical cycle has been developed in collaboration with IIT Delhi operating at 900°C.
- H₂ generation @5LPH by Closed-loop operation in quartz/glass set is operational at IIT Delhi campus.
- Planning for scale up in metallic facility is in progress.

Iodine-Sulfur open loop thermochemical cycle

- The open loop I-S cycle has been developed in collaboration with **IIP Dehradun** operating at 550°C.
- Proof of concept in quartz/glass set up is completed.
- Planning for scale up in metallic facility to produce 100 LPH by integration of components is in progress before setting up the commercial plant at MRPL.
- The benefit of this cycle is that it utilizes waste corrosive H₂S gas from refinery which processes sour crude. Sulphuric acid having commercial value is the main product in the above partially open loop cycle and Hydrogen is the by-product.

8.3.6. Vanadium Redox Flow Battery (VRFB) for Energy storage

OEC has demonstrated 5 k W/ 10 kWh Vanadium Redox Flow Battery (VRFB) energy storage system in collaboration with IIT Madras & M/s. High Energy Batteries (HEB), Trichy. The battery system was funded by OEC, powered by IIT Madras and demonstrated by M/s. HEB, Trichy. The battery was installed and capable of charging all types of EV (electric vehicles) and particularly suitable for remote areas where no grid power is available because it works on solar panel charging. The battery was demonstrated by charging of two wheeler electric vehicle near Hydrogen shed facility at IPSHEM Goa.

Vanadium redox flow battery (VRFB) is a type of rechargeable flow battery which stores energy by using a vanadium electrolyte solution. The energy storage capabilities of VRFBs are already proven in the market in view of their wider adoption of renewable power generation such as wind and solar. VRFB technology offers a long-term solution for off-grid power systems and micro-grids due to its unlimited storage capacity, long battery life, low maintenance requirements, adaptability and almost non-existent environmental footprint. It could be a good alternative for imported lithium ion batteries for stationary applications.

9. The Committee desired to know from the Ministry of Power, the roadmap to fulfil the increasing demand of energy and growth of renewable energy resources aligning the need of the country. The Ministry of Power has furnished the following in response:

"India aims to reach 500 GW non-fossil energy capacity and meet 50 percent of its energy requirements from renewable energy by 2030. The steps taken by MoP to fulfil the increasing demand of energy and growth of renewable energy resources aligning the need of the country are:

- *Establishing Green energy corridors to strengthen transmission networks in RE rich states by laying of new transmission lines and creating new sub-station capacity for evacuation of renewable power.*
- *Transmission System plan for Integration of over 500 GW RE Capacity by 2030 has been prepared by Central Electricity Authority.*

- *Renewable Energy Management Centres (REMCs) –*
 - *For large scale integration of growing RE capacity into the Grid sources, 12 (nos.) of REMCs and one Energy Management Centre (EMC) have been commissioned.*
 - *The system operators have started using these REMCs for forecasting and scheduling of RE generation to the best possible extent.*
- *Amended EC Act 2001 in Dec-2022 to enable development of carbon market and promoting RE (Notification of CCTS and RPO)*
- *Promoting Renewable Energy through Green Energy Open Access Rules 2022, reducing the Open Access limit from 1 MW to 100 kW and no limit for captive consumers.*
- *Waiver of Inter State Transmission System (ISTS) charges for RE projects commissioned up-to June 2025 including PSP and BESS projects.*
- *Guideline for development of Pumped Storage Projects (PSP) has been issued in April 2023. National Framework for promoting Energy Storage System has been issued in August 2023*
- *Transmission System for Integration of over 500 GW RE Capacity by 2030 has been published.*
- *Must-run priority dispatch status for renewables- MoP's Electricity (Promotion of Generation of Electricity from Must-Run Power Plant) Rules, 2021 promote RE power in the merit order dispatch, despite costs.*
- *Launch of Green Term Ahead Market (GTAM) and Green Day-Ahead Market (GDAM) to facilitate sale of Renewable Energy Power through exchanges, to facilitate the trading of RE power- competitive market for Green Energy & green targets by DISCOMs and other consumers.*
- *Real-Time Market (RTM) to manage RE intermittency and demand variation.*
- *Biomass co-firing- use of 5-10% blend of biomass pellets made, primarily of agro-residue along with coal for carbon neutral generation*
- *Rules for Introduction of Time-of-Day Tariff: To incentivize demand increase during the period of excessive RE generation and better utilization and management of RE.*
- *Renewable Energy Certificates (REC): The utilities which cannot meet the RPO obligation can purchase the Renewable Energy Certificates (REC) through the market.*
- *Reserve and Market Based Ancillary Services: To balance the grid requirement of power considering the intermittency and variable nature of renewable energy.*
- *Promotion of use of supercritical/ ultra-supercritical technology in order to improve efficiency, thereby reducing coal consumption and emissions. A total capacity of Supercritical/ Ultra-supercritical units of 63830 MW (92 Units) and 1320 MW (2 units) has been commissioned respectively till 31.08.2023.*

For enabling growth of Renewable Energy (RE) generation capacity, areas which have high solar and wind energy potential are planned to be connected to Inter-State Transmission System (ISTS), so that the power generated could be evacuated to the load centres. As a major step towards it, a detailed transmission plan i.e. "Transmission System for Integration of over 500 GW RE Capacity by 2030" has been prepared. The Plan provides a broad transmission system requirement for having about 537 GW of Renewable Energy capacity by the year 2030. The objective is "Transmission ahead of Generation but in an optimal phased manner"

The transmission plan covers the ISTS system for major RE potential zones like Leh RE park in Ladakh; Fatehgarh, Bhadla, Bikaner in Rajasthan; Khavda RE park in Gujarat; Anantapur, Kurnool RE Zones in Andhra Pradesh; and offshore wind farms in Tamil Nadu and Gujarat etc.

These planned ISTS Schemes are being implemented in a phased manner commensurate with the generation capacity addition. For seamless flow of power from one region to another, adequate inter-regional transmission capacity has been planned, which is likely to increase to about 150 GW by the year 2030 from the present level of about 116 GW.

10. The Committee enquired from the Ministry of Power regarding the rate of energy generation from all renewable sources and its carbon footprint expected to grow by 2030, to which the following response was provided:

" India has been making significant strides in renewable energy generation to meet its growing energy demands and reduce carbon emissions. The rate of energy generation from renewable sources such as solar, wind, hydro, and biomass has been increasing steadily over the years.

India has set a target to reduce the carbon intensity of the Nation's economy by less than 45% by 2030, achieve 50 percent cumulative electric power installed by 2030 from renewables, and achieve net-zero carbon emissions by 2070. India aims for 500 GW of renewable energy installed capacity by 2030. These targets are part of the country's commitment to the Paris Agreement on climate change.

The rate of energy generation from all renewable sources in India is expected to continue growing rapidly as the government implements policies and incentives to encourage renewable energy development. In terms of carbon footprint, the growth of renewable energy is expected to significantly reduce India's reliance on fossil fuels, thereby lowering its carbon footprint. The expected grid emission factor by the end of year 2030-31 is around 0.43 from 0.77 during the year 2013-14."

11. The Committee desired to know various international commitments of India in terms of energy transition to cleaner/ greener sources of energy. The Ministry of Power provided the following response in this respect:

" India at the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom, expressed to intensify its climate action by presenting to the world five nectar elements (Panchamrit) of India's climate action. This update to India's existing NDC translates the 'Panchamrit' announced at COP 26 into enhanced climate targets. The update is also a step towards achieving India's long term goal of reaching net-zero by 2070.

Earlier, India submitted its Intended Nationally Determined Contribution (NDC) to UNFCCC on October 2, 2015. The 2015 NDC comprised eight goals; three of these have quantitative targets upto 2030 namely, cumulative electric power installed capacity from non-fossil sources to reach 40%; reduce the emissions intensity of GDP by 33 to 35 percent compared to 2005 levels and creation of additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent through additional forest and tree cover.

As per the updated NDC submitted in August, 2022, India now stands committed:

- (i) To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for 'LIFE' – 'Lifestyle for Environment' as a key to combating climate change
- (ii) To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.
- (iii) To reduce Emissions Intensity of its GDP by 45 percent by 2030, from 2005 level
- (iv) To achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030, with the help of transfer of technology and low-cost international finance including from Green Climate Fund (GCF)
- (v) To create an additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent through additional forest and tree cover by 2030.
- (vi) To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management.
- (vii) To mobilize domestic and new & additional funds from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.
- (viii) To build capacities, create domestic framework and international architecture for quick diffusion of cutting edge climate technology in India and for joint collaborative R&D for such future technologies.
- (ix) In their 35th Report (Recommendation No. 18, Page 56) on 'Demands for Grants' for the year 2023-24, the Standing Committee on Energy have stated that the national Electricity Policy which was adopted way back in 2005, no longer reflects inter-alia the

dynamics of the fast changing electricity sector. The Committee on Energy have desired that New National Electricity Policy may be finalized and notified at the earliest. "

12. The Committee enquired from the Ministry of Power regarding the status of new Electricity policy in view of Thirty-fifth Report of Standing Committee of Energy. The Ministry of Power furnished in their written replies as follows:

" A draft Cabinet Note on NEP, 2023 was circulated for Inter-Ministerial consultation on 26.04.2023. Comments received from various stakeholders were examined in the Ministry of Power. Subsequently, Ministry of Power has constituted a Committee vide Order dated 21.11.2023 under the chairmanship of Chairperson, Central Electricity Authority to prepare the draft NEP with a vision of Power sector in 2047 and a road map for 2031-32. The draft New Electricity Policy from the Committee is awaited. "

13. The Committee also desired to know the measures being taken to provide electricity to the villages still bereft of such as basic need to which the Ministry has provided the following response:

" Government of India has always supplemented the efforts of the States through its various schemes, like Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), Integrated Power Development Scheme (IPDS), Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA) etc., to help them achieve the objective of providing uninterrupted power supply to all households. Overall Rs. 1.85 lakh crore was spent under the above schemes for strengthening the distribution system of the country.

Recently, Government of India has launched Revamped Distribution Sector Scheme (RDSS) with the objective of improving the quality and reliability of power supply to consumers through a financially sustainable and operationally efficient Distribution Sector. The Scheme has an outlay of Rs. 3,03,758 crore and a Gross Budgetary Support of Rs. 97,631 crore from Government of India over a period of five years from 2021-22 to FY 2025-26. RDSS has a universal coverage and is mainly focused on strengthening of sub-transmission and distribution network of project areas for the benefit of consumers including tribal, remote and hilly areas. The Central Government in line with its commitment, is further supporting States for electrification of these households which were left out under SAUBHAGYA, under the ongoing scheme of Revamped Distribution Sector Scheme (RDSS). Till date, 5.47 lakh households have been sanctioned under the scheme with a project outlay of Rs. 1,243 cr.

In addition, all identified beneficiary Households under PM-JANMAN (Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan) for PVTG Development Mission for on-grid electricity connection shall be eligible for funding under RDSS as per the scheme guidelines. Till date 89,682 PVTG households have been sanctioned under the scheme with a project outlay of Rs. 372 cr."

14. The Committee enquired from the Ministry of Power regarding the measures taken to ensure that the Green Energy Corridor is synchronized with the conventional national grid in India, and its impact in improving the generation, supply, and distribution of electricity. The Ministry of Power in their written replies has provided the following response:

" There is one synchronous National Grid in the country. Green Energy Corridor is a part of the National Grid. Some Inter-state and intra State transmission works are being implemented under Green Energy Corridor (GEC-I) and GEC-II scheme in order to facilitate integration of large scale renewable generation capacity.

The National Grid facilitates seamless transfer of power from Generating Stations (Renewable & Conventional) to the Load Centres. The capacity of National Grid is being expanded on a continuous basis commensurate with the increasing demand of electricity, evacuation of power from RE sources and conventional generation projects."

15. The "Technology and Innovation Report 2023" brought out by the United Nations Conference on Trade and Development, has ranked India at 46th position in its "Frontier Technologies Readiness Index" which is needed for a low carbon footprint. The Committee desired to know the reasons behind the change in India's ranking in frontier technologies readiness from 43 in 2021 to 46 in Technology and Innovation Report 2023. The Ministry of Power furnished the following reply:

" The ranking is determined by considering five factors, including "Information and Communication Technology (ICT) deployment", "Skill development", "Research and Development (R&D) activity", "Industry Activity", and "Access to Finance". India consistently secures the 4th position in Research and Development (R&D) rankings in both years.

Although the rank of India has changed from 43rd in 2021 to 46th in 2022, the Industry activity rank has improved from 28th to 22nd and Access to Finance Rank has improved from 76th to 75th. In page 34 of the "Technology and Innovation Report 2023", it is stated that developing countries like India, China, South Africa, Brazil etc. have lower rankings due to the ICT connectivity and skills parameters.

Also, there has been a decrease in India's rank on ICT deployment frontier, where from 93rd India has slipped to 95th and the Skill rank has also changed from 108th in 2021 to 109th in 2022. However it may be noted that the Total score of India has increased from 0.62 in 2021 to 0.66 in 2022."

16. Since huge investments are required in the Renewable energy sector to achieve net zero goal in carbon emissions, the Committee desired to know regarding the steps being taken to mobilize finances for new and eco-friendly projects in the renewable energy sector. The Ministry of Power furnished the following reply in their written submission:

" REC and PFC are providing finance for power sector projects. The efforts of each towards financing clean energy transition are as below:

Efforts of REC:

- Major player in India's Clean Energy Transition; actively contributing to the nation's sustainable future
- REC, as a leading NBFC, has been a catalyst in realising RE capacities
- Till Q3 FY 2024, provided financial assistance for RE sector projects of ~30,000 MW; cumulative sanctions of ~Rs. 1.7 lakh Crore translating into a 45 million tons annual reduction in carbon emissions.
- REC has earmarked financial assistance of Rs. 1.2 lakh crore in favour of 8 Roof Top Solar (RTS- Gol Scheme) implementing CPSEs
- Sanction of 600 MTPD Green Ammonia project in Orissa ~Rs. 3,692 Cr. sanctioned
- REC has sanctioned projects consisting of deployment of 9,842 e- buses. This would strengthen the green public transportation infrastructure of the country and further reduce the carbon emissions
- Hosted Green Finance Summit in July 2023 (under Clean Energy Ministerial), on the side lines of India's G20 presidency
 - i. Top management had one-on-one discussions with various RE developers – solar, wind, PSPs, E-mobility, RE manufacturing, Green ammonia/ hydrogen, Battery storage, etc.
 - ii. Successfully signed Rs. 2.85 lakh crore MoUs spanning over the next 3-5 years
 - iii. Projects of over Rs. 60,000 Crore already identified, being taken up for sanctions & subsequent disbursements
- Green Ammonia project in Oman: 300 MTPD (Metric Tons Per Day); 350 MW Solar; 320 MW Electrolyser; ~Rs. 4,300 Crore sanctioned
- Target green loan book of Rs. 3 lakh crore by 2030 i.e. over ten times expansion in next 07 years
- REC is well-prepared with various Project appraisal and Entity appraisal policies as well as guidelines put in place for facilitation of Clean energy project financing.
- REC is also extending multiple products for developers in this sector such as:
 - Non-fund based Letter of Comfort (LoC)
 - Letter of Undertaking (LoU)
 - Project Specific Funding (PSF)

It has emphasized three key pillars, including grid decarbonization, industrial decarbonization, and transport transition, which together serve as the foundation for India's energy transition goals and are anticipated to reduce current emissions by 90%.

Efforts of PFC:-

PFC has taken following key policies initiatives for development of eco-friendly projects in the renewable energy sector:

- Faster appraisal through web-based loan application system.
- Sole lending for debt up to Rs. 2000 Cr to expedite financial closure.

- Loan tenor up to 80% of economic life; Principal Moratorium of up to 1 year.
- Debt: Equity Ratio of up to 80:20.
- Introduced Letter of Undertaking to RE project developers, which can be used in lieu of Performance Bank Guarantee, for participating in tariff based bidding.
- Introduced Project Specific Funding to RE Equipment Manufacturers/ EPC Contractors to ensure timely execution of projects.
- Introduced financial products for meeting capital expenditure for setting up manufacturing of equipment for RE projects.
- PFC has amended its MoA to support clean energy projects like e-mobility, energy efficiency, energy conservation etc.
- Standard Loan Documents introduced for solar projects to reduce documentation time.
- Made financial products attractive to RE players by lowering their prepayment premium.
- Under GoI Liquidity Package, PFC has introduced Special Long Term Transitional loans to Discoms for clearance of dues including RE dues.
- Under Late Payment Surcharge (LPS) Policy, PFC has introduced Financial Assistance to DISCOMs for clearance of Outstanding Dues of Gencos (including RE).
- *Interest Rates for Renewable Projects*
 - For solar & wind projects, interest rates (on monthly rest) are ~170 bps lower than conventional generation projects.
 - Special rebate of 10 bps on card rate for solar projects if the domestic content is 75% or more.
 - Post CoD rebate of 25 bps after 6 months of satisfactory commercial operations.

Other Steps being taken to mobilize finances for new and eco-friendly projects in the renewable energy sector are as follows:

- a. PFC on the sidelines of the G20 meeting in Goa during July 21 & 22, 2023 executed various MoUs of more than Rs. 2.40 lakh crore with 20 companies both in public & private sector in Clean Energy Space.
- b. These MoUs were signed with Solar Power, Wind Power, Green Hydrogen, Battery storage, Electric Vehicle companies as well as manufacturers of green energy equipment among others in Clean energy space.
- c. PFC Ltd have signed an MoU with SJVN for providing financial support to various projects, including Renewable Energy ventures (Solar, Hydro, and Pumped Storage) totalling 12,178 MW capacity, along with a 660 MW thermal generation project for an estimated project cost of approximately Rs 1,18,826 crore.

Further PFC suggested following during the meeting of PAC, held on 21.2.2024

There is a huge fund requirement of approx. USD 10 trillion for achieving India's net zero target. To meet this huge requirement, Govt. support is required to encourage blended financing or provide concessionality with the help of MDBs, sovereign funds to crowd in

Private capital for large scale funding with multiplier effect. Out of the US\$ 10 trillion requirement approximately 80% is required for power sector alone. In this context, there is also a requirement of nodal/focal agency to channelize such funds for the purpose of energy transition and to meet net zero target by 2070."

17. The Committee desired to know how the Ministry is collaborating with international and development financing institutions to catalyze investment in the renewable energy sector, to which the Ministry of Power has furnished the following reply:

REC:

- *REC is in discussions with Multilateral Agencies like, ADB & KEXIM to avail low cost financing to fund Renewable Energy Sector.*
- *The proposed facility aims to provide concessional and blended financing facility for making government's green growth oriented initiatives viable.*
- *The facility will drive investor confidence and will attract large scale private investments to meet Govt of India's objective.*
- *The facility will focus on contributing to India's updated NDC's and COP26/ COP27 commitments through interventions in renewable energy, e-mobility and green manufacturing sectors.*
- *In the past, REC has successfully tapped the international Green Bond market and effectively utilized the proceeds to finance RE projects contributing to positive environmental impact:*
 - *Raised USD 450 million Green Bond in July 2017 for a tenure of 10 years - First green bond listed on London Stock Exchange's new International Securities Market (ISM)*
 - *Raised USD 750 million 5-year 144A/ RegS Green Bonds in 2023:*
 - i. *Bonds listed exclusively in IFSC International Stock Exchanges at India INX and NSE IFSC in GIFT City*
 - ii. *First Green Bond issuance by an Indian Company post India's G20 Presidency*
 - iii. *Largest ever Senior USD tranche by an Indian NBFC*
 - iv. *Largest ever Senior Green Bond Tranche by a South & South-East Asian issuer*
 - v. *Investors across the Globe participated in the issue: Asia Pacific (APAC) - 42%; Europe, Middle East & Africa (EMEA) - 26%; US - 32%*

PFC:

- *Issued its first USD Green bond in December, 2017 and raised US \$400 million.*
- *In September, 2021 PFC issued its first ever Euro Green Bonds amounting to EUR 300 million.*

Following steps have been taken by Ministry in regard to collaborating with international and development financing institutions to catalyze investment in the renewable energy sector :

- Ministry of Power through PFC is in discussions with Multilateral Agencies like, ADB, KfW, JBIC & KEXIM to avail low cost financing to fund Renewable Energy Sector.
- The proposed facility aims to provide concessional and blended financing facility for making government's green growth oriented initiatives viable.
- The facility will drive investor confidence and will attract large scale private investments to meet Govt of India's objective.
- The facility will focus on contributing to India's updated NDC's and COP26/ COP27 commitments through interventions in renewable energy, e-mobility and green manufacturing sectors.
- In the past, PFC has successfully tapped the international Green Bond market and effectively utilized the proceeds to finance RE projects contributing to positive environmental impact."

18. The Committee asked the Ministry regarding the action taken by it to promote R&D for energy efficiency along with the major steps taken as a result of R&D. The Ministry of Power has furnished the following response:

" The Ministry of Power through Central Power Research Institute (CPRI) has taken several measures to promote R&D for energy efficiency. Through the National Electricity Plan released by CEA, the Ministry has highlighted the priority areas of research for energy efficiency in the Power Sector.

The Research and Development on the priority areas identified in the National Electricity Plan for the Indian Power Sector is promoted through CPRI, which encourages applied research leading to technology development in the Power Sector through the "R&D schemes of Ministry of Power being implemented through CPRI".

The Ministry of Power (MoP) and the Ministry of New and Renewable Energy (MNRE) have jointly initiated a National "Mission on Advanced and High Impact Research (MAHIR)". The mission envisages identification of emerging technologies and develop them indigenously for deployment and demonstration. The funding for these projects is envisaged to be sourced from pooled funds from the MNRE, the Ministry of Power, and their respective Central Public Sector Enterprises (CPSEs). Through the promotion of research and the facilitation of potential technology transfers, the Ministry aspires to stimulate high-tech R&D in the Indian Power Sector, positioning India as a global leader in power sector technology innovation. The Mission is overlooked by a Technical Scoping Committee chaired by Chairperson, CEA and having subject matter experts on different domains. The Technical Scoping Committee reports to the Apex Committee of MAHIR which is chaired by Hon'ble Minister of Power and has representation from Academia, Industry, CPSEs, Policy Makers and other Ministries. The CPRI provides secretarial assistance for the Mission.

The Ministry has established a robust evaluation and monitoring mechanism for the R&D projects supported under the schemes involving the key stakeholders of the Power Sector. The projects pertaining to grid, distribution and energy conservation are reviewed and monitored by the Technical Committee on Grid, Distribution and Energy Conservation Research which is Chaired by Professor of IIT Delhi and has representation from CEA, CPRI, BEE, MNRE, TANGEDCO and IEEMA. The Chairman of the Technical Committees are also members of the Standing Committee on Research and Development (SCRD) which is the apex body for administering Research and Development activities in the Power Sector.

The SCRD has been constituted by the Ministry of Power with Chairperson, CEA as the Chairman and having representation from MoP, DSIR, DST, DPIIT, MNRE, BHEL, POWERGRID, NTPC, NHPC, and CEA. The SCRD further supervises project progress and is kept informed about the outcomes of research initiatives. This integrated approach ensures that key stakeholders in the Power Sector remain well-informed about supported research projects, facilitating the formulation of future policy decisions and the effective utilization of successful research outcomes to benefit the sector. Several R&D Projects pertaining to areas such as advanced materials for solar cell and grid integration of REs have been funded by the MoP under the R&D Schemes of MoP leading to capacity building and skill development.

In line with the objective to reduce Energy Intensity, Bureau has initiated few R&D projects with IITs and other research institutes. Details of the project is as follows:

Iron & Steel Sector:R&D on Optimization of the performance of rotary kiln to maximize %metallization including use of natural gas/syngas as reductant. the benefits expected from this study include reduced Coal consumption, improved metallization in klin etc.

Pulp & Paper Sector: Demonstration project on Lime free conversion of Green liquor (soda pulping) to NaOH without solid waste generation, reduced water consumption, minimized carbon foot print and particulate emissions approaching ZLD. The key benefits are reduction in Fossil Fuel Consumption and subsequent GHG Emissions will be reduced and Improvement in Process efficiency, Optimization of energy in the process.

Solar thermal energy application (for medium temperature application(150oC-400oC): In this project solar thermal energy will be utilized for raw material drying & calcination of phospho gypsum. The expected annual energy saving from the project is 70,000 toe (10% TSR) with Annual Co2 emission reduction of 2,55,000 tonnes.

Process design and integration of RDF/biomass gasification to cement plant calciner to enhance alternative fuel utilization in Indian cement industry: In this project, refused derived fuel is used to generate syngas which acts as alternate fuel in the kiln. The expected annual energy saving from the project is 1905000 toe.

Design of alternative fuel dryer for cement plant by utilizing cooler ESP vent air : In this project, waste gases from Cooler Electrostatic Precipitator will be used for drying of alternate fuel & raw materials to improve the thermal substitution rate. The expected annual energy saving from the project is 70,000 toe with Annual Co2 emission reduction of 800,000 tonnes "

19. The Committee desired to know from the Ministry of the measures towards developing skills/ businesses for development and utilization of renewable energy sources, to which the following reply was furnished:

" *National Power Training Institute (Eastern Region) has signed MoU with Paschim Banga Society for Skill Development (PBSSD), Govt. of West Bengal to implement DDUGKY worth Rs 4.99 crores, a flagship program of Ministry of Rural Development (MoRD), Govt of India.*

National Power Training Institute, Neyveli is also conducting DDU-GKY Training Program – Solar PV Installer for Diploma Holders and the duration of the program is 12 weeks. The Institute has installed "Solar PV Port" funded by GIZ (Germany) in collaboration with MNRE under Indo-German Solar Energy Partnership (IGSP). The "Solar PV Port" is a standardized plug-n-play + grid interactive photovoltaic system with battery storage, designed for 100% self consumption. The objective of this project is to support the installation of the solar rooftop PV systems and aims at up-skilling the Solar Installers (Suryamitras) through capacity building, vocational education, and employment (iRISE) of youth in the solar sector.

National Power Training Institute has also signed agreement with some of the PSUs to organize "Skill Development Programs" under their Corporate Social Responsibility (CSR) funds. Under this Scheme more than 10 programs each of 1-Month duration organized for NTPC-SAIL Power Co. Ltd (NSPCL) & Bokaro Power Supply Co. Ltd. (A Joint Venture of DVC & SAIL) during current and recent past.

Other efforts of NPTI are as under:

- *NPTI is also conducting training programs on "Solar Power Project" for middle-level officers from Coal India Limited, MES, ONGC.*
- *Winter Internship program on power and Energy Technologies NPTI Badarpur 4 Weeks UG (Engineering & Polytechnic Colleges)*
- *NPTI Guwahati successfully conducted 2 Day's National Workshop on Energy Conservation Act and Energy Transition from 26th - 27th October, 2023 at Ratnamauli Palace, Guwahati.*
- *Residential Training Program on "Solar Photovoltaic System Design and Installation " for MES Engineers was conducted in September 2023*
- *Capacity Building Program on Solar PV Power Plant & Grid Integration (Design, DPR Preparation, Grid Integration, Tariff & AI in Solar) have been conducted by NPTI – Guwahati in September 2023 for MSPCL, AEGCL*
- *3 Pilot Programs under PM Suryodaya Yojna conducted at Rajkot, Varanasi and Vadodara.*

- *NPTI is also planning to start One Year Post Graduate Diploma Course in Renewable Energy.*

20. The Committee enquired from the Ministry of Power regarding the steps being taken for promoting research & development to improve current clean energy technologies and boost new technologies for energy transition in a cost effective manner. The Ministry furnished the following reply:

" The Ministry of Power is promoting research and development in the Power Sector through Central Power Research Institute (CPRI), which encourages applied research leading to technology development through the "R&D schemes of Ministry of Power being implemented through CPRI.

CPRI under the "R&D schemes of MoP being implemented through CPRI" has been supporting research projects aiding in clean energy transition and overcoming the challenges of the renewable energy like (a) non-dispatchability (b) fluctuations over time which results in intermittent feed-in of electricity into the grid, (c) stability, protection control and power quality issues of renewable energy micro-grids etc. Also, CPRI has identified some of the priority areas for research required for clean energy transition like recycling of end-of-life solar panels, wind turbine blades and li-ion batteries, Energy Storage alternative to Li-ion batteries, Indigenous Development of EV chargers etc. where CPRI plans to support research projects.

Some of the thrust areas of research investigated through research projects managed by CPRI is furnished below:

- *Power Conversion, Control and Protection Technologies for Micro-Grid*
- *Development of Different MPPT Algorithms for a Stand-Alone Photo Voltaic System using Artificial Intelligence*
- *Development of Control Strategies for Grid Connected PV System utilizing the MPPT and Reactive Power Capability*
- *Development of solid state transformer as a wind power interfacing device*
- *Development of efficient system for simultaneous active power sharing and reactive power compensation in a grid-connected photovoltaic system*
- *Development and Demonstration of an Adaptive Protection Scheme for Distribution Systems under High Penetration of Distributed Energy Resources*
- *Impact of harmonics on Power Distribution Network due to Electric Vehicle Charging*

In order to realize the renewable energy target, research in the area of Hydro-electric power generation is also given prime focus. Large hydro-power can play a key role in balancing variable electricity due to its ability to store water and generate electricity on demand, setting it apart from other renewable energy sources. CPRI has a focused research approach for research in the area of Hydro-electric power generation where the issues such as widening of operating ranges for turbines, development of suitable coatings to avoid erosion, transient operation of turbines etc. have been studied. Some of the thrust areas of research investigated through research projects supported by CPRI is furnished below:

- *Erosion-Corrosion Studies on Thermal Sprayed Conventional and Nanostructured Coatings*
- *Development of a selection methodology for road header and tunnel boring machine in different geological conditions for rapid tunneling*
- *Establishing Novel Erosive Wear Test Facility for Testing of Materials Used in Hydro-turbine Components*
- *Investigation on flow instabilities in draft tube at off-design operation of hydraulic turbines*
- *Reduction of Switching Transients in Doubly Fed Induction Machines Used in Large Pumped Storage Plant*
- *Run-of-the-River low head micro hydroelectric system for off-grid micro-grid operation.*
- *Development of High-Entropy Alloy Coatings for Improved Cavitation and Silt Erosion Resistance of Hydro turbine Components*

Further, the Ministry of Power and the Ministry of New and Renewable Energy have jointly launched a National Mission titled “Mission on Advanced and High-Impact Research (MAHIR)”. This mission is designed to facilitate extensive indigenous research, development, and demonstration of cutting-edge technologies within the power sector. By identifying emerging technologies on a global scale and then advancing them indigenously to a stage of large-scale implementation, MAHIR aims to harness these technologies as the primary drivers of clean energy transition and future economic growth. Some of the priority areas of focus under MAHIR are Alternatives to Li-ion batteries, Geothermal Energy, Hydrogen Technologies etc.

R&D in POWERGRID focuses on development, demonstration and evaluation of power transmission technologies and condition monitoring techniques including use of Artificial Intelligence / Machine Learning ensuring efficiency, reliability and high availability of the inter-state transmission network. Some of the technological advancements to enhance operational efficiency adopted by POWERGRID in recent years are:

- **Voltage Source Convertor (VSC)** based High Voltage Direct Current (HVDC) technology together with underground power cables for long distance power transmission.
- **Static Synchronous Compensators (STATCOMs)** to improve grid reliability and voltage stability limit for effective renewable energy integration.
- **Fault Current Limiter (Series Reactor)** for enhancing operational life of equipment in power transmission system.
- **Environmentally friendly oil (natural ester)** filled new reactor as well as retro-filling of in-service reactor for a sustainable future.
- **Process bus based Digital Substation** for control and protection system for enhancing reliability, efficiency, and availability of power transmission system in an environmentally friendly manner.
- **Monopole towers** to address **Right-of-Way** in densely populated urban areas.
- Development and use of **advanced software tools** for effective asset management like POWERGRID Asset Life Management System (**PALMS**),

POWERGRID Digital Application for Routine Patrolling & Assessment of Network (PGDARPAN), Unique Digital Analysis of Assets and Network (UDAAN) etc.

- **Drones** for transmission line patrolling to improve efficiency in anomaly detection.
- **Resin Impregnated Paper bushings at 765kV** level for enhancing operational performance of equipment and safety of personnel and nearby equipment.
- **Augmented / Virtual Reality** based digital headgears for maintenance activities facilitating remote expert assistance in field, leading to reduced downtime, knowledge sharing, higher safety & reliability in equipment performance.

Further, POWERGRID is committed towards developing state-of-the-art technologies in power transmission sector and several new initiatives have been undertaken as listed below:

- **Battery Energy Storage Systems** for enhancing utilization of transmission capacity and transmission congestion management.
- **Substation Inspection Robot** for automation of routine inspection and facilitate data-driven decision-making.
- **Cyber security in Operational Technology of Transmission and Grid Operation in collaboration** with IISC Bengaluru.
- **Insulated cross arm** on towers for reducing the Right-of-Way requirement for construction of transmission lines.
- **Programmable drones** for substation aerial inspection with AI/ML based analytics to enhance efficiency, accuracy, and safety of substation aerial inspections.
- **Heavy lift drones** for carrying constructions materials to enhance speed of construction of transmission system in challenging terrains.
- **Replacement of conventional SF6** filled equipment with environmentally sustainable gas/clean air-based switchgear and substation.
- **Nano-coating for insulators** for improving its hydrophobicity thereby reducing failure and improving system availability.
- **Dynamic Line Loading** to facilitate optimum utilization of transmission line capacity under varying climatic conditions.

Together, these R&D initiatives are ensuring healthy grid operations facilitating seamless integration of Renewable Energy into the National Grid and thereby contributing to energy transition."

21. The Committee desired to know the roadmap to decrease dependence on petroleum and coal and how it is being aligned with the needs of the country and substituting with renewable energy sources. The Ministry of Coal furnished the written reply in this regard, as follows:

" Consuming energy from non-renewable resources should be offset by an equal amount of energy from renewable resources. To achieve a sustainable future, we must transit to renewable energy sources like solar, wind, and hydroelectric power. We must also offset the environmental impact of past non-renewable energy usage through initiatives like carbon capture and reforestation. By neutralizing non-renewable energy consumption, we can mitigate climate change and create a more environmentally friendly energy landscape. Coal companies have been directed to install rooftop solar on all government buildings and setting up of solar projects in de-coaled areas. Net Zero target set by Coal PSUs and achievement till dated are as under-

Coal/Lignite PSUs	Net Zero Achievement Target	Planned to achieve Net Zero by Enhancing Capacity	Commissioned Renewable so far	
			Solar	Wind
CIL	2025-26	3 GW	41 MW	
NLCIL	2030	+ 6 GW	1421 MW	51MW
SCCL	2024	550 MW	224 MW	
<i>Total</i>			1686 MW	51 MW

22. The Committee desired to know the commitments India has made over various international fora for reducing carbon emissions and transitioning to cleaner/ greener energy resources. The Committee further enquired regarding the measures being taken to preserve established carbon-intensive sectors, such as steel, chemical, airlines and manufacturing, which are strategically important and account for a significant share of jobs and GDP. The Ministry of Coal has furnished the following response in this respect:

" Despite absolute growth in India's demand for coal as per the IEA, the Government is committed to support India's journey to achieve its Intended Nationally Determined Contributions (INDCs) by 2030. Coal PSUs are taking following steps for reducing carbon emissions in line with the commitments made by Gol:

- (a) Creation of Carbon Sink through Plantation:** CIL & its Subsidiaries have planned to carry out plantation over about 6,800 hectare in 5 years (i.e. 2021-2026) which will offset about 2.72 lakh Tonne of CO₂ per year. Other coal PSUs are also taking similar exercise.
- (b) Eco-Parks:** CIL envisaged to develop about 39 new eco-parks/tourism sites during FY 21-22 to FY 2025-26, in which planting of saplings is also an activities. CIL has already developed 32 Eco-Parks/ Eco-restoration site.
- (c) Renewable Energy initiatives:** CIL has programmed to install 3,000 MW of solar power projects by 2025-26 which will create a CO₂ offset potential of 3.936 million Tonne per year. NLCIL has planned to establish RE projects having more than 6 GW capacity.
- (d) First Mile Connectivity (FMC):** CIL plans to operationalize all 75 FMC projects of Phase-I, Phase-II, Phase-III and Phase-IV by FY 29-30, thereby having a cumulative mechanized Rapid Loading capacity of 988.5 MTPA.
- (e) Energy Efficiency Measures:** Coal PSUs have planned for other energy efficient measures in 5 years (i.e. 2021-2026) which includes replacing conventional light by LED lights, installing energy efficient ACs, Super fan, Efficient water heaters, Energy efficient motors for pumps, Auto-timer in street lights and to add E-Vehicles.
- (f) Mine Water Utilisation:** The objective of coal PSUs is to attempt for maximum utilization of treated mine water discharge for community use. This indirectly saves corresponding electric power usage by community members.
- (g) Clean Coal Technology:** Committed to reduce environment footprint in addressing Climate Change and promoting cleaner use of coal in longer run, the company is promoting initiatives for cleaner and alternative uses of coal through Surface Coal Gasification (SCG) route, that is, conversion from coal to syngas and subsequently into chemicals.
- (h) UG Vision Plan:** CIL has also planned to augment coal production from underground mines from 25.487 MT in FY 2022-23 to 100 MT by 2027-28 as underground mining has minimal environmental impact as compared to opencast mining."

23. The Committee asked the Ministry regarding their plan to ensure the livelihood of the workers involved in the petroleum and coal sectors is maintained and the transition to cleaner/greener sources of energy doesn't impact them adversely. The Ministry of Coal furnished the replies as follows:

" The Mine Closure Guidelines, 2009, which was subsequently revised in 2013 and later in 2020 takes care of the social aspects of mine closure. The direct manpower of mines, affected due to closure, is deployed in another mines for gainful utilization. However, for informal/induced workers impacted due to energy transition (mine closure), a separate just transition framework and funding mechanism with involvement of relevant stakeholders is required.

Coal PSUs are adding renewable portfolio along with its mining activities in a phased manner. Their investment on renewable energy will generate direct and indirect employment to the workers."

24. The Committee enquired regarding the measures planned to ensure the livelihood of those involved in coal mining etc. is maintained through the transition to cleaner energy resources to which the Ministry of Coal provided the following reply:

" In India, transition away from coal is not happening in foreseeable future. Although there will be push for renewable/non-fossil based energy, but share of coal in the energy basket is going to remain significant in years ahead. Coal demand in the country is yet to peak.

Mines are worked & closed as per the Mine Plan & Mine closure Plan. Mine closure guidelines were first introduced by the Ministry of Coal in 2009 and again in 2013 and 2020. Mine closure guidelines for mines closed before 2009 has been recently issued. These guidelines are still evolving covering the technical and environment aspects. Social aspects of mine closure has not been adequately addressed in these guidelines.

World Bank has approached the Ministry of Coal to develop a country-wide uniform framework for mine closure on principles of just transition which includes grant based technical assistance and concessional funding to cover the expenses on execution of pilot mine closure projects on JT principles.

Mine closure framework on just transition principles:

- *There is need for developing a uniform country-wide comprehensive coal mine closure framework on Just Transition principles along with development of an appropriate institutional arrangement and funding mechanism covering every aspect of mine closure matching with global standards.*

Additional provisions relating to social aspects of mine closure aligned with just transition model:

- *Re-skilling/re-training of affected people in phased manner during the operational life of the mine*
- *Financial support in setting up small scale business – individually or in partnerships*
- *Support in finding alternative employment and also in relocation*
- *Repurposing of land & mine assets by engaging private firms to create avenues for employment in the region – solar parks, eco-parks, fish-farming, ware-house, resorts, museum, picnic spot, golf course, pumped hydro using mine voids/UG voids etc.*
- *Creation of a trust with provisioning of dedicated fund – to ensure sustenance of social infrastructures*

To support repurposing of land and mine assets, Government has approved a policy for use of land acquired under CBA Act. The policy will unlock the non-minable and mined out land for development and setting up of infrastructure relating to coal and energy and allow private investment also. This will definitely help coal companies in creating new avenues of revenue and employment generation.

According to website of Ministry of Coal, there are 117 ongoing Mining projects having an annual capacity of 928.7 MT which have contributed 501 MT in the year 2022-23.

25. The Committee desired to know the targets under the SDG-7 for Coal India and its subsidiaries. The Ministry of Coal furnished the following response:

" As per the information available on UN's website (<https://sdgs.un.org/goals/goal7>) , SDG-7 goal related to RE development is as under:

"By 2030, increase substantially the share of renewable energy in the global energy mix"

CIL has planned to set up solar projects of 3000 MW cumulative capacity by FY 2025-26 which will reduce its dependence on fossil fuel-based power and make it a net zero company and contribute towards SDG-7 goals of country.

Year-wise Program for addition of Solar Power Generation capacity:

<i>Year</i>	<i>2023-24</i>	<i>2024-25</i>	<i>2025-26</i>	<i>Total</i>
<i>Capacity in (MW)</i>	<i>180</i>	<i>1562</i>	<i>1258</i>	<i>3000</i>

26. The Committee asked the Ministry of Coal regarding the reasons for import of coal expected to increase if the coal companies are planning to shift to greener sources of energy. The Ministry of Coal gave reply as follows:

" Import of coal by the country may increase with the expected increase in demand of Coking coal and High grade non-coking coal.

Regarding, import of coking coal it is observed that the requirement of steel sector is mainly concentrated towards low-ash coking coal which is not available at India & there is very little production of Prime coking coal in the country hence it is imported by Steel sector. Though, the entire production of washed coking coal/ metallurgical coking coal by the coal companies, are being supplied to the steel sector for blending purpose, the

quantity is less compared to the demand. Therefore, complete substitution of import of coking coal is not feasible.

Regarding non-coking coal import, thermal coal imported by import based power plants cannot be substituted due to the specific coal requirement of their boiler designed on imported coal. Apart from the above, many industries import high GCV (more than 6000 GCV) & low ash coal for their plants, which is not substitutable due to non-availability of such high GCV/low ash coal."

27. The Committee enquired regarding the steps if any taken by the Ministry towards Clean hydrogen and carbon capture utilization and storage (CCUS). The Committee desired to know the Ministry's view regarding the leading technologies for decarbonizing hard-to-abate sectors, such as steel and chemicals, which appear to have been gaining momentum around the world. The Ministry of Coal has furnished the following response:

" Ministry of Coal has prepared a document on "Roadmap for Coal to Hydrogen production" wherein it has been emphasized that for production of hydrogen, coal gasification with CCUS (Blue hydrogen) could be the interim step before switching to green hydrogen from renewable resources.

Ministry also supports the research proposal on CCUS through its S&T funding."

28. The Committee enquired from the Ministry of New & Renewable Energy regarding its specific strategies for securing critical minerals required for renewable energy sector in India and the critical minerals being imported along with their percentage of total requirement.

29. The Committee also desired to know the critical minerals being imported and the strategy being planned to reduce the dependency on import. The Ministry of New & Renewable Energy furnished the following reply:

" In June 2023, Ministry of Mines came up with list of critical minerals dependency list. Of these, following minerals used for Renewable Energy products/ technology are classified based on their import dependency that are relevant in the context of RE technology:

<i>Sl. No.</i>	<i>Name of Mineral</i>	<i>Imp ort Dep end enc y</i>	<i>Import Source</i>

1	Lithium	100 %	Chile, Russia, China, Ireland, Belgium
2	Cobalt	100 %	China, Belgium, Netherlands, US, Japan
3	Nickel	100 %	Sweden, China, Indonesia, Japan, Philippines
4	Vanadium	100 %	Kuwait, Germany, South Africa, Brazil, Thailand
5	Zirconium (zircon)	80 %	Australia, Indonesia, South Africa, Malaysia, US
6	Graphite(natural)	60 %	China, Madagascar, Mozambique, Vietnam, Tanzania
7	Manganese	50 %	South Africa, Gabon, Australia, Brazil, China
8	Chromium	2.5 %	South Africa, Mozambique, Oman, Switzerland, Turkey
9	Silicon	<1 %	China, Malaysia, Norway, Bhutan, Netherlands

Source: Report of the Committee on Identification of Critical Minerals, Ministry of Mines (June 2023)

Reduce Dependency:

The country is following a multi-pronged strategy. First, it has been involved in various partnerships to secure minerals from the ores, through the MSP, bilateral agreements with countries like Chile, Argentina, Bolivia, Brazil and others. Second, for the processing and technology sharing, it has undertaken technology related agreements with France, Japan and other countries especially Australia to become self-reliant in the medium term. Finally, for the upstream and end-product generation, it is also undertaking PPP modes to access leading technologies available in the commercial domain.

Apart from these, the country have opened up the mining sector for private players to undertake exploration and extraction the list of the blocks where private agencies can undertake such activities has been published during January 2024 by the Hon'ble Minister of Mines. "

30. The Committee desired to know how the Government of India is ensuring that power from solar energy is made accessible and affordable to all citizens, especially those in rural/remote areas. The Ministry of New & Renewable Energy has furnished the following replies in their written submission:

" Government of India is promoting Renewable Energy including Solar Energy through various schemes and Policies, which helped in increasing the acceptability of RE in the country. It is worth mentioning that these policies have also helped in reducing the RE tariff especially Solar Energy from a high tariff of ₹18-19/unit to the record lowest of ₹1.99/unit.

The energy produced from these projects are being fed into the national grid and is distributed to all including remote/rural areas of the county. Further, policies like Green Open Access allows small consumers to purchase renewable power as low as 100 kW through open access. In addition to this, off-grid applications also provide energy solutions to rural/remote areas.

Further, to facilitate large scale adoption of rooftop solar, the Union Cabinet has approved PM-Surya Ghar: Muft Bijli Yojana with a total outlay of Rs.75,021 crore for installing rooftop solar and providing free electricity up to 300 units every month for One Crore households."

31. The Committee also enquired from the Ministry of New & Renewable Energy whether any environmental impact assessment of use of renewable energy sources has been/ being undertaken, to which the ministry replied as follows:

" So far, no such study has been initiated by the Government. It is pertinent to mention that Solar Projects are not covered under the ambit of Environmental Impact Assessment (EIA) notification 2006 and hence, no environment clearance is required. Further, as per Central Pollution Control Board, Solar PV power plants of all capacities, Wind power plants of all capacities and Hydel Power plants up to 25 MW capacity are categorized as White category of industries. These white category industries are considered non-polluting and do not require Consent to Operate."

32. The Committee asked the Ministry regarding the role the private sector plays in financing clean energy transition in the country and the steps undertaken by the Ministry to facilitate the private sector to deploy clean-energy technologies. The Ministry of New & Renewable Energy furnished the following response:

"The private sector plays a critical role in driving the clean energy transition by providing investment, innovation, and expertise to help accelerate the adoption of renewable energy technologies.

Most of the Renewable Energy projects in the country are being set-up by private sector developers selected through a transparent bidding process. Private sector developers identify locations for setting up the renewable energy projects and also arrange financing of these projects.

The sources available for Equity Funding include Private Equity Capital, Own Funds of the developers, Venture Capital etc. The sources available for debt financing include commercial banks, FIs like IREDA, PFC, REC, external commercial borrowings and foreign currency loans from multilateral and bilateral agencies like World Bank, ADB, KfW, Exim Bank, AfD, etc

In order to encourage investment in renewable energy sector, some of the steps taken by Government are as under:

- *Waiver of Inter State Transmission System (ISTS) charges for inter-state sale of solar and wind power for projects to be commissioned by 30th June 2025.*
- *Declared plan to add 50 GW of renewable energy capacity annually for next 5 years*
- *Declaration of trajectory for Renewable Purchase Obligation (RPO) up to the year 2029-30.*
- *Standardization Bidding Guidelines for tariff based competitive bidding process.*
- *Implementation of Production Linked Incentive (PLI) scheme for solar PV manufacturers*
 - *Reducing PPA counterparty risk by sourcing energy purchases through highly rated Central Public Sector Enterprises;*
 - *Increasing overall health of the sector through various schemes as Liquidity Infusion Scheme to help Distribution Companies settle their debt and Electricity (Late Payment Surcharge & related matters) Rules, 2022 to encourage timely payment of dues, apart from the Revamped Distribution Sector Scheme;*
 - *Facilitating support through its dedicated agencies such as National Institute of Wind Energy (NIWE) and National Institute of Solar Energy."*

33. In view of the huge investments required in the Renewable energy sector to achieve net zero goal in carbon emissions, the Committee desired to know the steps being taken to

mobilize finances for new and eco-friendly projects in the renewable energy sector. The Ministry of New and Renewable Energy gave the following response:

" In order to provide clean energy to the consumers, an ambitious target of 500 GW from non-fossil fuel-based capacity by 2031 has been targeted by the Government of India. National Electricity Plan (May 31, 2023) prepared by Central Electricity Authority (CEA) has estimated the fund requirement for Renewable Energy generation projects from FY 2022 – 2032 as Rs. 27.93 lakh crore.

In order to encourage green investments in the country, some of the steps taken by Government are as under:

- *Government of India raised Sovereign Green Bonds of Rs.16,000 crore (approximately) during FY 22-23. Out of the proceeds of Sovereign Green Bonds, Rs. 6,186 crore were dedicated for renewable energy.*
- *Permitting Foreign Direct Investment (FDI) up to 100 percent under the automatic route for renewable energy projects.*
- *IREDA had raised Green Masala Bonds of USD 300 Million in October, 2017 for financing green energy projects in India. These bonds had a tenor of 5 years and were listed on the International Securities Market segment of the London Stock Exchange, Singapore Stock Exchange and also NSE IFSC. These bonds matured in October, 2022.*
- *Infused ₹ 1,500 Crore as equity in IREDA in 2022, which has helped in enhanced lending to RE Sector. Further, recently IREDA has also successfully raised ₹2,150.21 crores through its IPO. The IPO proceeds towards fresh issue of ₹1290.13 Crores shall be utilized by the company for capital augmentation and on-lending.*

The Government, through its various policy initiatives and programmes, would continue to promote renewable energy the country."

34. During the course of evidence, the Committee desired to know the amount of funds needed to be mobilised for energy transition and plans to mobilise the required funds. The CMD of Power Finance Corporation gave the following reply in this respect:

" It is expected that for net zero, there is a shortage of approximately over and above what is available in the country, 10 trillion dollars for meeting the net zero target. It is expected that the major investment is going to happen up to 2047 or 2050. So, for that, whatever is available as per the domestic sources, companies are already raising. Over and above, we are exploring the international market also for raising the funds. Besides,

we are proposing to have some blended facility. We will be inviting the multilateral agencies as well as the FIs for investment in the sector to fund the equity portion majorly. Right now, if we see the renewable energy, a lot of investment is being done in the equity also by the international sovereign funds and the investors who are very active in the space. "

35. The Committee desired to know from the Ministry of New and Renewable Energy how it is collaborating with international and development financing institutions to catalyze investment in the renewable energy sector. The Ministry of New and Renewable Energy furnished the following response:

" The Ministry of New and Renewable Energy (MNRE) collaborates with international and development financing institutions to catalyze investment in the renewable energy sector through various initiatives:

Bilateral and Multilateral Partnerships: *MNRE collaborates with countries and international organizations to promote renewable energy investments. This includes partnerships with organizations and bilateral agreements with countries like the United States, Japan, and Germany.*

Financial Support: *MNRE works with institutions like the World Bank, Asian Development Bank (ADB), and Green Climate Fund (GCF) to secure financial support for renewable energy projects in India. This can include loans, grants, and other forms of financial assistance.*

Technical Assistance: *MNRE partners with international institutions to receive technical assistance for renewable energy projects. This can include expertise in project planning, implementation, and monitoring.*

Capacity Building: *MNRE collaborates with international organizations to build capacity in the renewable energy sector. This includes training programs, workshops, and knowledge sharing initiatives.*

Policy Support: *MNRE works with international institutions to develop policies that support renewable energy investments. This can include regulatory frameworks, incentives, and market mechanisms to promote renewable energy development."*

36. The Committee enquired from the Ministry of New & Renewable Energy regarding the actions taken by it to develop skills / businesses for development and utilization of renewable energy sources. The Ministry gave the following reply:

" Ministry of New and Renewable Energy (MNRE) is developing qualified and skilled manpower under short term training component and fellowship component of Human Resource Development Programme, to train skilled manpower for installation, operation and maintenance of Renewable Energy.

- i. *Suryamitra Skill Development Programme (Solar PV technician training) launched by MNRE in 2015 trained Over 56000 suryamitras up to January 2023. Jal-Urjmitra, Vayumitra and Varunmitra Skill Development Programmes provides trainings in Small Hydro Power, Wind power and solar water pumping areas. MNRE had also supported six months training programme specifically for semi-literate women of rural areas on assembly, installation, operation and maintenance of solar lanterns, lamps, etc.*
- ii. *National Renewable Energy Fellowships at M.Tech, M.Sc., and Ph.D levels are provided to students for pursuing higher education in the courses on renewable energy technologies.*
- iii. *1,00,000 Solar installers will be trained under PM-Surya Ghar: Muft Bijli yojna .*

37. The Committee desired to know the steps taken by Ministry of New and Renewable Energy in promoting research & development to improve current clean energy technologies and boost new technologies for energy transition in a cost effective manner. The Ministry furnished the following response in their written replies:

" The Ministry is implementing Renewable Energy Research and Technology Development Programme through various research institutions and industry to develop indigenous technologies and manufacturing for widespread applications of new and renewable energy in efficient and cost-effective manner. It provides up to 100% financial support to government/non-profit research organizations and up to 70% to industry, start-ups, private institutes, entrepreneurs, and manufacturing units."

38. Whether derived from conventional or nonconventional sources, adequate land, labour, capital and technology are essential for energy production. Technological advancements and production costs significantly influence energy production. Competition in labor, capital, and technology markets impacts energy market functionality and ultimately affects energy prices for consumers, thereby influencing economic growth and development. Direct energy sources like electricity and petrol are vital drivers of economic growth. While the macro-level relationship between energy and economic growth is well-established, the micro-level impacts, such as access to reliable electricity, are often overlooked. At the macro level, energy plays a

critical role in the economic growth of a nation. Access to affordable energy is particularly crucial for developing economies, as it enhances quality of life, supports industrial expansion, facilitates small business growth, enables modern agricultural practices, and promotes education accessibility. These factors act as foundational blocks to the development and continuous growth of a nation.

39. The Committee understand that with respect to the rate of energy generation from all non-renewable sources and its carbon footprint expected to grow by 2030, the Government has set a target to reduce carbon emissions to less than 45% by 2030 and achieve 50 percent cumulative electric power installed by 2030 from renewables, and achieve net-zero carbon emissions by 2070. The Committee observe that India aims for 500 GW of renewable energy installed capacity by 2030 and that these targets are part of the country's commitment to the Paris Agreement on climate change. Further, India submitted its Intended Nationally Determined Contribution (NDC) to UNFCCC on October 2, 2015. The 2015 NDC comprised eight goals; three of these have quantitative targets up to 2030 namely, cumulative electric power installed capacity from non-fossil sources to reach 40%; reduce the emissions intensity of GDP by 33 to 35 percent compared to 2005 levels and creation of additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent through additional forest and tree cover. The Committee are of the view that in order to achieve this, it is essential to put forward and propagate a healthy and sustainable way of living wherein a climate friendly and a cleaner path of economic development is adopted.

40. The Committee note that although there is and will be a push for renewable/non-fossil based energy, the share of coal in the energy basket is going to remain significant in years ahead and that demand for coal in the country is yet to peak. Phasing out coal, while beneficial for the environment, impacts various economic sectors and societal groups differently. Hence, there's a need to develop sustainable, non-polluting energy technologies to replace reliance on coal, ensuring continued economic growth and job opportunities. Guidelines primarily focused on safeguarding

the livelihoods of those dependent on the coal industry, directly or indirectly should be formulated before phasing out. These guidelines should emphasize on energy security for the poor and vulnerable, economic, and environmental considerations, emphasizing the importance of providing green jobs, training and retraining affected individuals, thereby fostering job creation. The framework should encourage a holistic approach involving Government bodies, trade unions, businesses, and enterprises, fostering dialogue among stakeholders to facilitate a smooth transition.

Focus areas should include economic growth, industrial, and investment policies, skill development and social protection, aimed at addressing social, economic, and environmental concerns during the transition.

41. The Committee also note that Mining operations often have significant environmental impact and proper closure and rehabilitation of mines are essential as we aim for more sustainable energy solutions. In respect of the Mine Closure Guidelines for mines that are closed, the Committee note that the Mine Closure Guidelines are continuing to evolve, covering the technical and environment aspects. The Committee believe that Communities and regions that rely on mining for their livelihood need extensive and long term support to transition to alternative economic activities. The Committee, therefore, in the interim, recommend that a uniform country wide mine closure framework be urgently finalized in tandem with the ambitious energy transition target of the country.

The framework may ensure consistency, transparency and accountability in the process of closing mines, including environmental remediation, community engagement and economic transition planning. The Committee also recommend that while framing these guidelines the Ministry of Coal should appropriately consider the social aspects of mine closure and align it with a 'just' transition model.

42. The Committee observe that to achieve the ambitious target committed at Paris Convention to achieve net zero carbon emission

by 2070 will require huge investments in the Renewable energy sector to achieve net zero goal in carbon emissions. The Committee further note from the statement of the Power Finance Corporation while tendering evidence that there is a huge fund requirement of approx. USD 10 trillion for achieving India's net zero target. Recognizing the huge gap in financing of the energy sector, the Committee recommend that the Government should formulate a detailed plan to extend necessary support to the Financial Institutions in the Energy and Power Sector and endeavour to find innovative solutions for low cost financing and encourage similar solutions as suggested by PFC such as blended financing or providing concessions with the help of Multilateral Development Banks, etc. The Committee further recommend for creation of a nodal/focal agency to channelize such funds for the purpose of energy transition and to meet net zero target by 2070.

43. Owing to multiple stakeholders involved in the contribution and growth of the energy sector such as non-official witnesses / experts who are yet to be examined by the Committee, in addition to the examination of the concerned Ministries and Undertakings, this report might be considered as a Preliminary Report. Consequently, if deemed imperative, the Committee would take further evidence of the representatives of the Ministry and concerned organizations of the subject. The Committee would, thereafter, formulate their detailed recommendations on the subject. In the meanwhile, the Committee would expect that the concerned Ministries/Undertakings who have not yet submitted their views/responses to the queries of the Committee to submit their replies/observations within three months. In the interim, the Ministries of Power and Coal may furnish Action Taken Replies to the Observations of Committee.

NEW DELHI:
20 April, 2024
18 Chaitra, 1946 (Saka)

ADHIR RANJAN CHOWDHURY
Chairperson,
Public Accounts Committee