Transforming the Oil and Gas Industry:

Strategies for Achieving Sustainability

Preface

The oil and gas industry has long been a cornerstone of India's economic development, providing essential energy resources to fuel growth and industrialization. However, the environmental impact of traditional fossil fuel extraction and consumption has become increasingly evident, necessitating a shift towards more sustainable practices. As the world grapples with the urgent need to address climate change, India stands at a pivotal juncture, with the opportunity to transform its oil and gas sector into a model of sustainability and innovation. This white paper, "Transforming the Oil and Gas Industry: Strategies for Achieving Sustainability in India," explores the critical strategies and technological advancements required to achieve this transformation. By focusing on key areas such as advanced Environment, Health, and Safety (EHS) technologies, Carbon Capture and Storage (CCS), and the integration of renewable energy, this paper outlines a comprehensive approach to reducing emissions, enhancing operational efficiency, and meeting international climate commitments. The following sections provide a detailed analysis of the current status of the industry, the challenges and opportunities that lie ahead, and the collaborative efforts needed to drive sustainable development. It is our hope that this white paper will serve as a valuable resource for policymakers, industry leaders, and stakeholders, inspiring action and fostering a collective commitment to a greener and more resilient future for India's oil and gas sector.

Content

Introduction

The foundation of the world's energy supply is the oil and gas sectors. It complies with the sustainable development principle. India is the most energy-consuming country in the world, has a vast population, and depends heavily on imports. By 2050, India's proportion of the world's energy consumption is expected to double. An accessible use of hydrocarbon reserves, or fossil fuels, is associated with rising energy demand. Emissions from these sources can result in health problems as well as negative external cash flow.

The primary root cause of global warming, according to the Intergovernmental Panel on Climate Change (IPCC), is human activity, specifically the release of greenhouse gases including carbon dioxide, methane, and nitrous oxide. By 2020, the average global surface temperature will have increased by 1.1 °C over pre-industrial levels. Rising sea levels as a consequence of melting ice caps and glaciers and increased frequency and intensity of extreme weather events such as heat waves, severe rainfall, droughts, and tropical cyclones are two effects of global warming.

In addition, the report emphasizes the need for adaptation measures to deal with the inevitable effects of climate change. It calls for urgent action from governments and policymakers, adherence to international agreements like the Paris Agreement, and global cooperation to share technology, knowledge, and resources. Public awareness and engagement are also critical, as widespread understanding and participation in climate action are essential for achieving sustainable and resilient futures.

The IPCC emphasizes the need for immediate and sustained efforts to reduce emissions, including transitioning to renewable energy sources, improving energy efficiency, reforestation, and implementing carbon capture technologies (Calvin et al., 2023).

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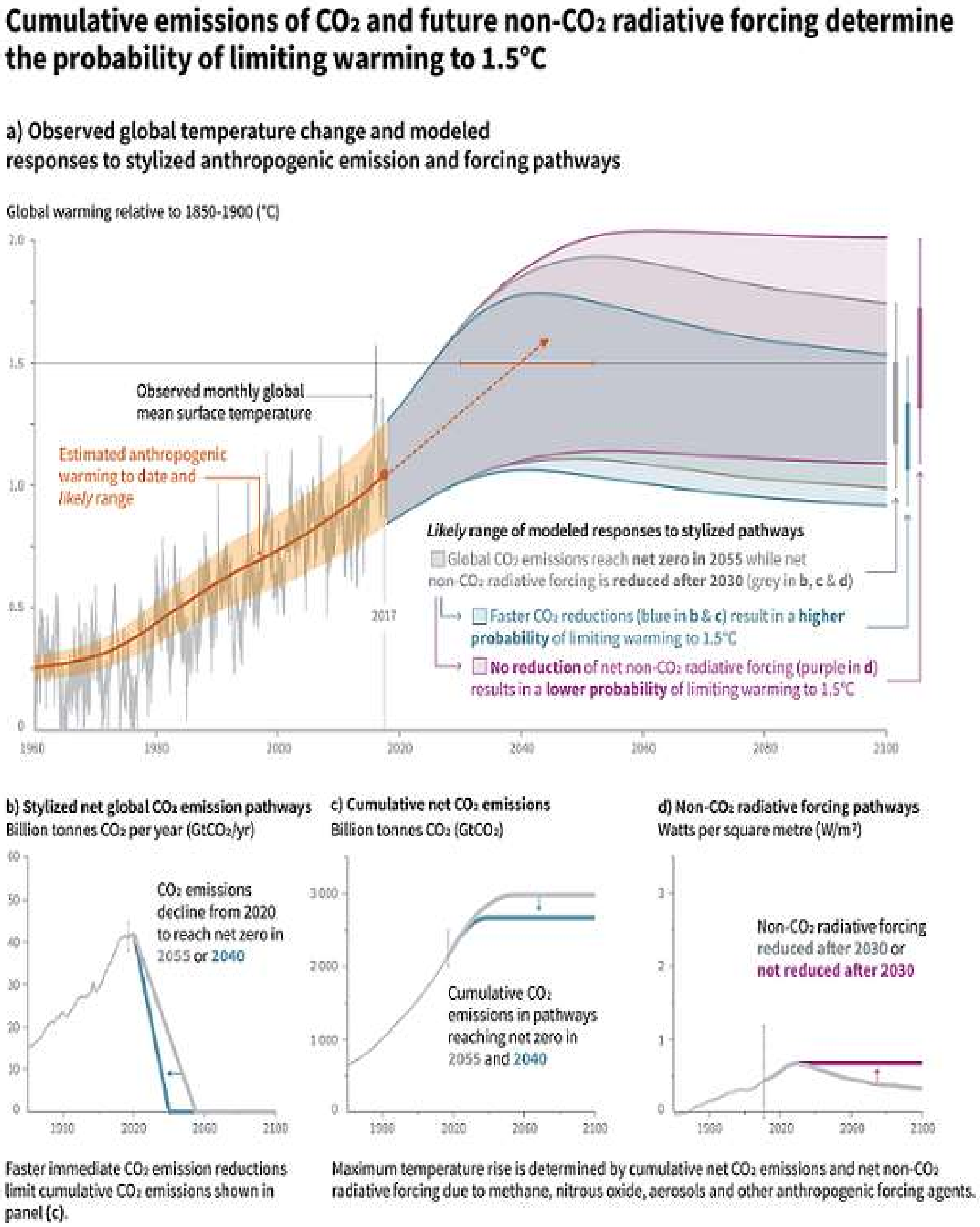
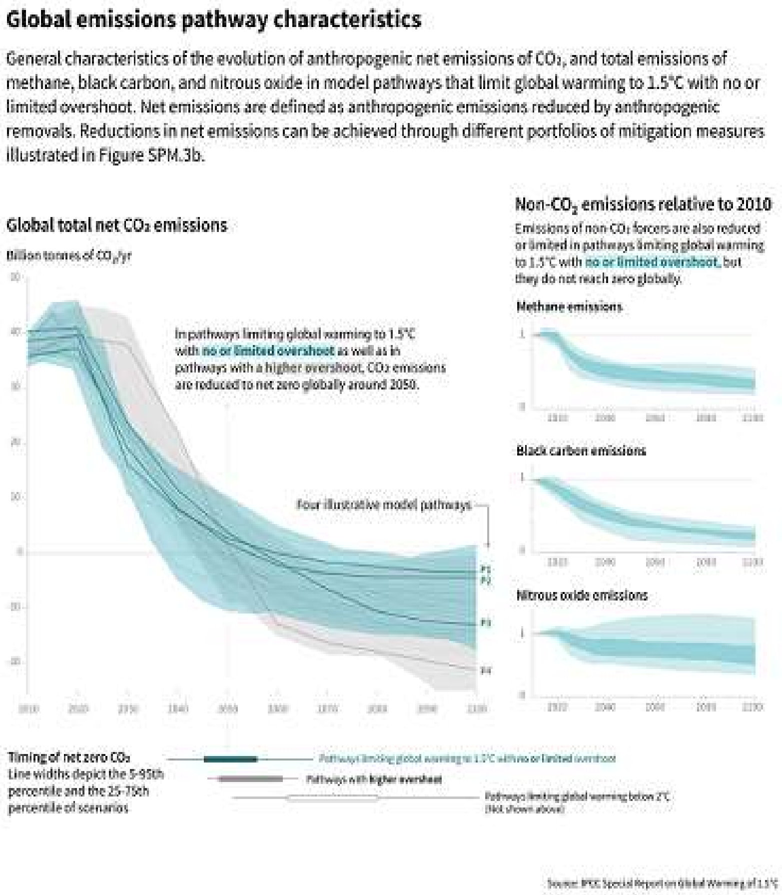


Source: Fig.1 of the Summary for the Policymakers of the IPCC''s Special Report on Global Warming 1.5° C

According to the new policy pathway, the earth is expected to be 2.7-3.5°C warmer than pre-industrial temperature. Many countries are aspiring to become climate neutral by 2050 to 2060 (Kapoor & Kumar, n.d.). In order to cap the global warming companies started to focus on decarbonisation in transport and industrial by investing more on renewable energy.

Gas and oil will always be necessary components of what the average person needs. The advancement of technology has led to a rise in the need for vehicles and home appliances. This forces India to take a step toward future decarbonization of factories, appliances, and automobiles.



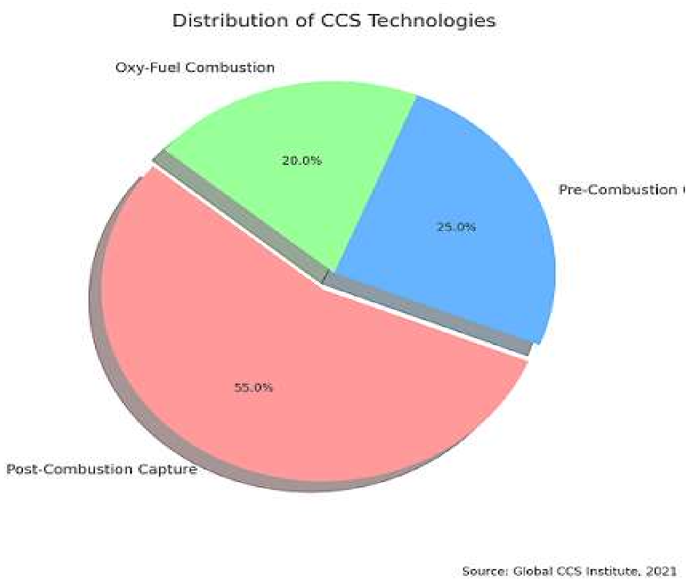
Source: IPCC special report on Global Warming of 1.5°C

Carbon Capturing Process

An essential technique for reducing carbon dioxide (CO_2) emissions from power plants and industrial processes—which are major contributors to climate change—is carbon capture and storage, or CCS. In order to keep CO_2 from entering the atmosphere, carbon capture and storage (CCS) entails capturing CO_2 at its source, such as industrial facilities or power stations, transporting it, and storing it underground in geological formations. There are several ways to carry out the capture process: pre-combustion capture, which entails converting fossil fuels into a mixture of hydrogen and CO_2 prior to combustion; post-combustion capture, which uses chemical solvents to absorb CO_2 from flue gases; and oxy-fuel combustion, which burns fossil fuels in oxygen to produce a flue gas that primarily consists of water vapour and CO_2, which simplifies the capture process. Transporting the captured CO_2 is typically done via pipelines, although ships and trucks can also be used, especially for offshore storage sites. Storage usually involves injecting CO_2 into underground rock formations, such as depleted oil and gas fields, deep saline aquifers, and unmineable coal seams, with continuous monitoring and verification to ensure the CO_2 remains securely stored and does not leak into the atmosphere (Global CCS Institute, 2021).

The benefits of CCS are significant, offering substantial climate change mitigation by reducing CO2 emissions from industrial sources and power plants. Additionally, the technology can be used for enhanced oil recovery (EOR), where injected CO2 helps extract more oil from depleted fields, providing an economic incentive for CCS deployment. CCS also supports sustainable industrial development, allowing the continued use of fossil fuels while reducing their environmental impact and aiding the transition to cleaner energy sources.

A notable case study is Shell's Quest CCS Project in Alberta, Canada, which captures over 1 million tonnes of CO2 annually from the Athabasca Oil Sands Project's Scotford Upgrader using amine solvents for post-combustion capture. The CO2 is then transported via pipeline and injected into deep saline aquifers. Quest demonstrates the economic viability of CCS with government support and serves as a model for similar projects in India. By adopting advanced CCS technologies and learning from international examples, India can reduce emissions, meet climate commitments, and support sustainable industrial growth through public-private partnerships and international cooperation (Intergovernmental Panel on Climate Change, 2021) (Shell, 2021).



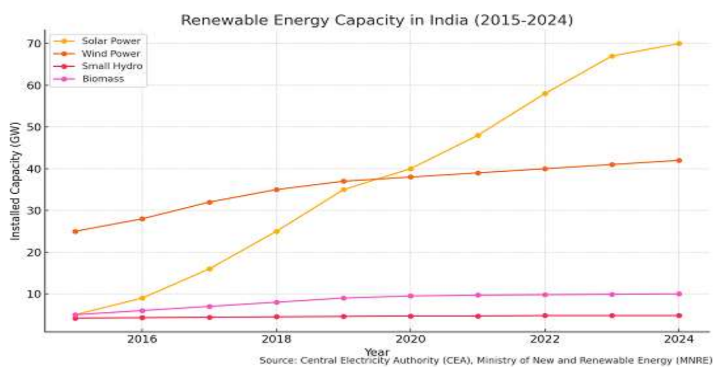
Source: Global CCS institute, 2023

Renewable Energy Integration in India

India has made significant progress in integrating renewable energy into its power grid, driven by ambitious targets and supportive policies. As of 2024, India's installed renewable energy capacity exceeds 150 GW, with plans to reach 450 GW by 2030. This includes major contributions from solar (70 GW), wind (40 GW), small hydro (4.8 GW), and biomass (10 GW). Key initiatives include the National Solar Mission, National Wind Energy Mission, and the Green Energy Corridor project, which aims to enhance transmission infrastructure for renewable energy (MNRE, 2024).

To modernize the grid, India is implementing smart grid technologies and developing large-scale energy storage solutions. Hybrid energy systems, such as solar-wind hybrids and renewable-storage hybrids, are also being promoted. Distributed generation is being encouraged through rooftop solar installations and micro grids, particularly in rural and off-grid areas. The policy framework supports this transition through Renewable Purchase Obligations (RPOs), financial incentives, and streamlined approval processes (MNRE, 2021).

Looking ahead, India aims to achieve 450 GW of renewable energy capacity by 2030 and net-zero emissions by 2070. International collaborations and participation in initiatives like the International Solar Alliance (ISA) will play a key role in this effort (ISA, 2021). The economic and social impacts of this transition are significant, with potential job creation in the renewable energy sector, enhanced energy security, and environmental benefits from reduced greenhouse gas emissions (IEA, 2021).



Source: Central Electricity Authority (CEA) and the Ministry of New and Renewable Energy (MNRE).

Conclusion

In conclusion, India's journey towards a sustainable oil and gas industry involves key strategies such as implementing advanced Environment, Health, and Safety (EHS) technologies, integrating Carbon Capture and Storage (CCS), and adopting renewable energy solutions. These strategies are essential for reducing emissions, improving operational efficiency, and meeting international climate commitments. The future vision for India's oil and gas sector is one of significant carbon emission reductions, increased use of renewable energy, and improved environmental practices, supporting economic growth while preserving the environment for future generations. It is crucial for stakeholders, including government bodies, industry leaders, and the public, to collaborate and take proactive steps towards sustainability. By investing in innovative technologies and fostering partnerships, India can lead the way in creating a greener and more sustainable oil and gas sector.

References

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