13 Future-Proofing India's Coal PSUs

An Analysis of CIL and NTPC

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Context

State-owned enterprises (SOEs), known in India as Public Sector Undertakings (PSUs), hold a strategically important position in India's energy sector. They account for over 90% of coal mined, 50% of power generated, 90% of the electricity distributed, 57% of crude oil refined, and nearly all of petroleum products sold (Viswanathan et al., 2021). They make up 7 of the 11 "Maharatnas" and deliver significant financial returns to the Government of India, their major shareholder (MoF, 2022). Further, they employ millions of citizens, engage in community building, and take on activities of strategic importance.

With the growing pressure from cost-competitive clean energy sources and India's global decarbonisation commitments, the businesses of Indian energy PSUs are expected to face challenges due to their carbon-intensive nature. This can translate into a loss for the Indian state at large. Hence, this creates a need for mitigatory strategies. This chapter focuses on two central-level PSUs facing the most imminent challenges: Coal India Limited (CIL), the largest national coal miner, and NTPC, the largest thermal power producer. These two PSUs have been selected given the thematic focus of this volume.

Profile: Coal India Limited (CIL)

CIL is under the administrative control of the Ministry of Coal (MoC) and operates in 84 mining regions across eight states (CIL, 2022a). As of 1 April 2022, CIL has 318 mines and produced 662 million metric tonnes in FY22, making it the single largest coal producer in the world (CIL, 2022b). It has ten fully owned subsidiaries with seven functioning as regional mining businesses (CIL, 2022a). CIL aims to significantly reduce national coal imports by increasing production to 1 billion tonnes by 2024 and explore new coal-based technologies like coal gasification and coal to chemical projects (MoC, 2022). Its estimated cumulative Scope 1 and 2 greenhouse gas emissions are 4.96 $MtCO_2e$ in FY22 (CPI, n.d.).

In FY22, CIL registered a net profit of Rs. 17,378 crore with gross coal sales reaching Rs. 1,52,667 crore, both record highs. CIL's capital expenditure stood at Rs. 15,401 crore in FY22 having doubled since FY17 and net worth going up 75% in the same period (CIL, 2022b). Currently, CIL is a profitable business with significant contributions to the economy. The Government of India remains CIL's largest shareholder with 66.13%. Other major shareholders include the state-owned Life Insurance Corporation (9.75%) and the State Bank of India (0.51%). The cumulative dividends paid by CIL in FY22 were Rs. 10,476 crore (CIL, 2022b).

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In May 2022, CIL released an Action Plan 2022–2023 which indicates its long-term plans and an acknowledgement to "diversifying into non-coal, secure new businesses, productively utilise sizeable reserves/funds in their Balance Sheet" (MoC, 2022). CIL has set a target of installing 3 GW of renewable capacity through Special Purpose Vehicle (SPV) additions to achieve operational net zero by FY24, signed agreements with NTPC and Solar Electrification Corporation of India Ltd (SECI) towards developing SPV projects, and submitted a bid under Production-Linked Incentive (PLI) scheme for setting up an integrated 4 GW SPV module manufacturing facility (Aggarwal et al., 2022; Viswanathan et al., 2021). CIL has also set up two subsidiaries towards these diversification efforts – CIL Navi Karniya Urja Limited and CIL Solar PV Limited (CIL, 2022a).

CIL has a large social footprint with nearly 250,000 formal employees and several times more through contractors and informal jobs (CIL, 2022b). Through its subsidiaries, CIL is a key developer in several remote mining communities. In FY22, the total corporate social responsibility (CSR) expenditure of CIL was Rs. 586 crore. Any diversification efforts by CIL must account for the impact it has on workers and local communities.

Profile of NTPC Ltd

NTPC is under the administrative control of the Ministry of Power (MoP) and India's largest power utility (NTPC, 21 Nov 22). It operates 69 GW or 17% of India's power generation capacity generating 24% of national electricity produced in FY22 (NTPC, 2022). Thermal power plants (TPP) using coal account for 57 GW including the 2.87 GW added in FY22 (NTPC, 2022). NTPC has announced plans to diversify its mix with a goal of reaching 130 GW of installed capacity by 2032 which includes 85 GW in coal capacity (NTPC, 21 Nov 22). Following the energy price crisis of 2022, NTPC announced its intent to award 4.8 GW of coal projects in the next three years (Goswami, 2022). Its estimated cumulative Scope 1 and 2 greenhouse gas emissions are 304 $MtCO_2e$ in FY22 (CPI, n.d.).

In FY22, NTPC registered a net profit of Rs. 16,111 crore with gross power generation of 300 billion units, both record highs. NTPC's capital expenditure stood at Rs. 21,036 crore in FY22 and has averaged over Rs. 25,000 crore in the last 8 years making it one of the largest developers of infrastructure projects (Raizada et al., 2022). The Government of India remains NTPC's majority shareholder with 51.1%. Other major shareholders include the state-owned Life Insurance Corporation (10.36%) and the State Bank of India (1.39%). The cumulative dividends paid by NTPC in FY22 were Rs. 6,933 crore (NTPC, 2022).

NTPC has emerged as a leader among major energy PSUs in expanding business to clean energy. In June 2021, under the Energy Compact submitted to the United Nations, NTPC has set a target of 60 GW on renewable capacity by 2032 (NTPC, 21 Nov 22; UN, 2021). This requires a rapid expansion from the 1.8 GW operational and 3.4 GW under construction renewable capacity as of April 1, 2022 (NTPC, 2022). To achieve these goals, NTPC has created a subsidiary, NTPC Renewable Energy Ltd, with an intention of making it a standalone publicly listed company. NTPC has identified a need for Rs. 2.5 lakh crore investment to meet RE goals; signed MoUs with several PSUs and started exploring emerging clean technology including battery storage, green hydrogen, and offshore wind (Aggarwal et al., 2022; Viswanathan et al., 2021, 2022). NTPC has also signed a collaboration with NITI Aayog to develop a net zero roadmap (NTPC, 2022).

Lighting one in four households in India, NTPC is a pillar of energy access and crucial for energy security. They operate at higher efficiency levels than competitors and can raise capital, both domestically and internationally, at favourable rates thereby lowering electricity prices. In FY22, the total CSR expenditure of NTPC was Rs. 357 crore. The role of NTPC in a changing energy landscape is critical for energy access, security, and affordability.

Need for Future-Proofing

As discussed in the "Context" section of this chapter, India's energy future has multiple pathways. However, a common element for net zero by 2070 and 1.5-degree aligned pathways is the dramatic reduction of coal in the energy mix. This poses a significant business risk to CIL and NTPC. Building on the foundational work by Köberle et al. (2020), Viswanathan et al. (2022) studied this through the impact on future finances. The methodology developed by the study has been used in this chapter to illustrate the need for future-proofing India's fossil-dependent PSUs.

Approaches for Identifying Financial Risk

Forward-looking studies like the International Energy Agency's (IEA) India Energy Outlook 2021 typically identify energy pathways linked to key conditions. A business as usual (BAU) scenario considers no further interventions. Additional scenarios consider a deviation from BAU based on conditions like announced pledges, net zero, or aligning with IPCC's 1.5-degree pathways. If India were to follow these climate aspirational pathways, there is a significant reduction in coal as a part of the energy mix when compared to BAU. It must be observed that there are multiple studies identifying climate aspirational pathways with varying estimates of coal usage. The methodology proposes two scenarios linked to available research and the difference between the two scenarios represents a "risk spectrum" faced by the PSUs operating in this sector.

Viswanathan et al. (2022) used the green economy model (GEM) to model India's energy sector over 2020–2050. GEM follows a systems dynamic approach where various actors are interlinked through explicit cause–effect relationships and feedback loops. For further details on GEM, its design and assumption, readers are recommended to refer to Golechha et al. (2022). Two pathways were developed in GEM using IEA's energy scenarios as a reference (IEA, 2021; Viswanathan et al., 2022).

- BAU: Aligned with the IEA's Stated Policies Scenario (STEPS) and captures trends based on existing plans, including reaching 450 GW of renewable energy capacity by 2030.
- Aspirational: Aligned with the IEA's Sustainable Development Scenario (SDS), which corresponds with reaching net-zero emissions in the 2060s.

These pathways generated from the economy-wide GEM are used as an input for the firm-level financial analysis. This is done by considering existing market shares of firms and stated targets between 2020 and 2050. The inputs from GEM are supplemented with annual reports and financial statements published by the firms (see Figure 13.1).

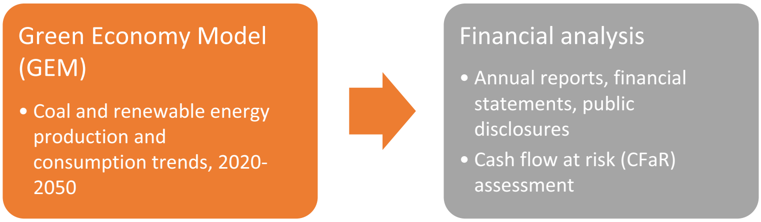

Figure 13.1 Framework for identifying financial risk to energy PSUs.

Source: Recreated from: Viswanathan et al. (2022).

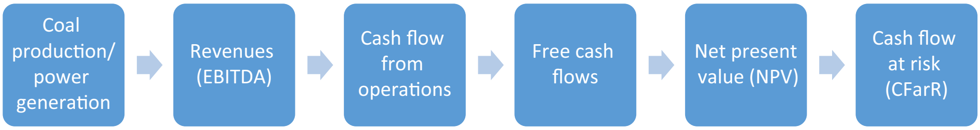

Figure 13.2 Framework for estimating cash flow at risk for energy PSUs.

Source: Recreated from: Viswanathan et al. (2022).

The financial analysis follows a sequence as shown in Figure 13.2. First, the inputs from GEM are used to identify future revenues and expenses under both scenarios. Using this, the annual cash flow is estimated for 2020–2050. Using the cost of finance as a reference, the future cash flows are adjusted to present values. The difference in cash flows at present values across both scenarios (BAU and Aspirational) gives the cash flow at risk (CFaR).

In the next two sections, the methodology has been applied to CIL and NTPC. The results are indicative and based on publicly available information. A more rigorous assessment can be done by the PSU themselves using internally available data.

Estimated Cash Flow at Risk: CIL

CIL's financial flows are integrally tied to the amount of coal produced domestically, which in turn is linked to the domestic coal demand. Under a BAU case, the total coal produced nationally crosses 1 billion tonnes in line with current production targets and peaks by 2035. However, under the aspirational scenario, the peaking takes place by 2025 and reduces dramatically after 2030 (Viswanathan et al., 2022). IEA analysis released in November 2022 supports this trend where under the Announced Pledges Scenario (APS), India's coal production falls by 80% between 2030 and 2050 (IEA, 2022). Consequently, the biggest reduction in CIL annual free cash flows can be seen from 2030 (see Figure 13.3).

When discounting at 12%, the estimated cumulative CFaR is Rs. 24,438 crore in 2030 and Rs. 2.1 lakh crore in 2050, a nine-fold increase (see Figure 13.4).

Estimated Cash Flow at Risk: NTPC

NTPC finances are fundamentally tied to the amount (units) of electricity sold, regardless of the source of power generation. While NTPC operates nearly 70 GW of

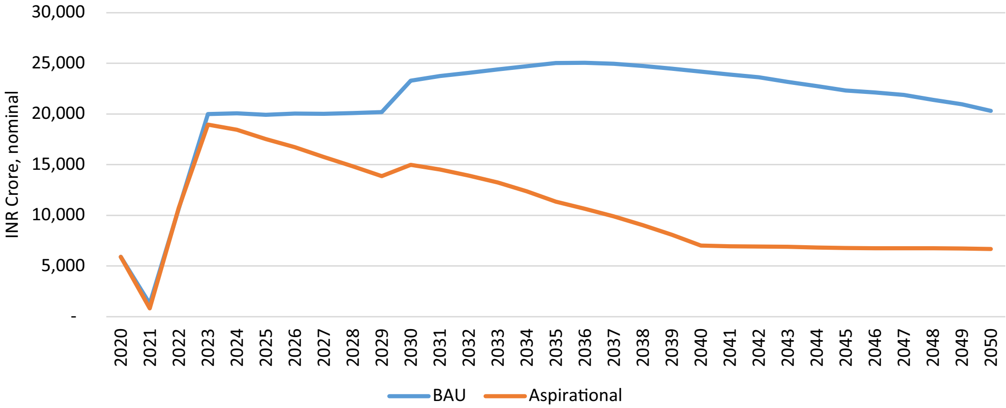

Figure 13.3 Annual free cash flow, CIL, 2020–2030 (Rs. crore, nominal).

Source: Recreated from: Viswanathan et al. (2022).

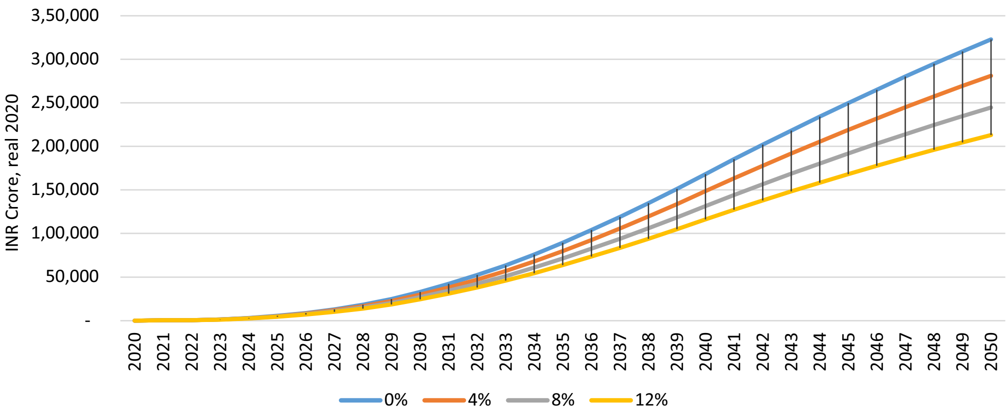

Figure 13.4 Cumulative cash flow at risk adjusted for varying cost of finance, CIL (Rs. crore, real 2020).

Source: Author compilation.

thermal power plants, it also has plans to dramatically scale up its renewable assets. For NTPC under a BAU scenario, the power generated from coal peaks by 2035, and by 2045, renewables start generating more than coal. Meanwhile, in an aspirational scenario, power generation from coal is matched by renewables in 2035 and falls to zero by 2050 (Viswanathan et al., 2022). Due to these changing trends, the annual free cash flows fall between 2030 and 2045 before the renewables start taking over (see Figure 13.5).

Despite an overall increase in free cash flows over the period, NTPC faces a considerable cumulative CFaR. When discounting at 12%, the estimated cumulative CFaR is Rs. 13,072 crore in 2030, Rs. 1.5 lakh crore in 2040, and Rs. 1.8 lakh crore in 2050 (see Figure 13.6).

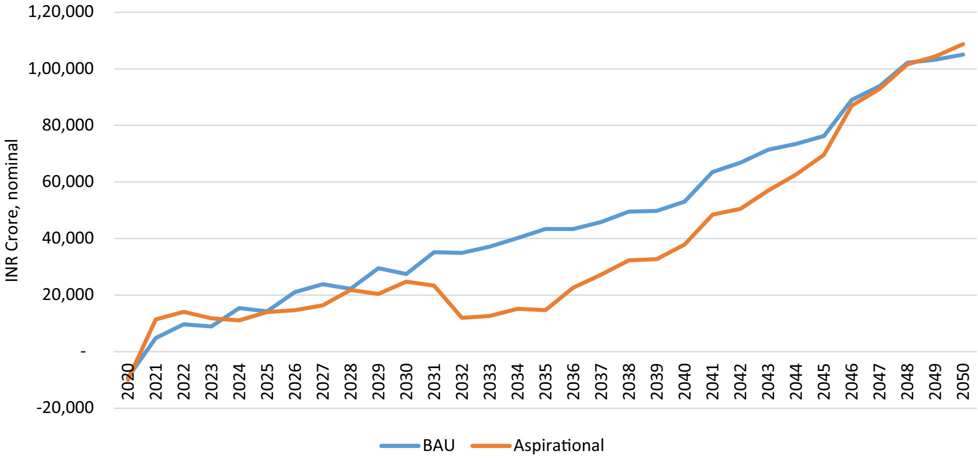

Figure 13.5 Annual free cash flow, NTPC, 2020–2030 (Rs. crore, nominal).

Source: Recreated from: Viswanathan et al. (2022).

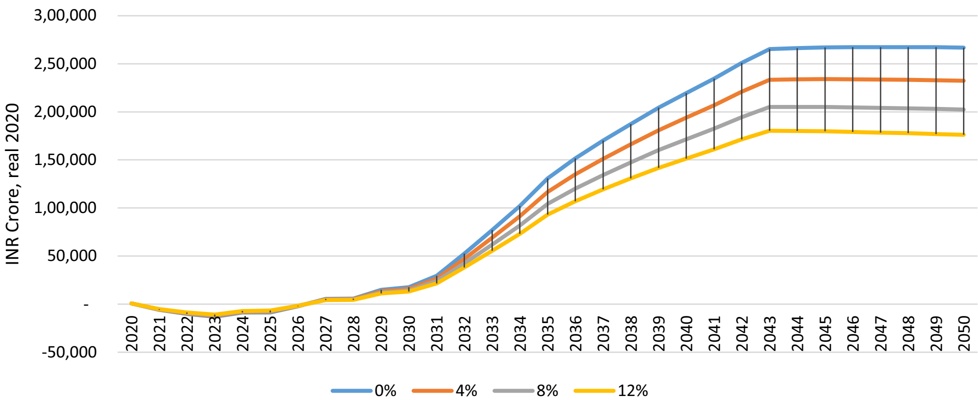

Figure 13.6 Cumulative cash flow at risk adjusted for varying cost of finance, NTPC (Rs. crore, real 2020).

Source: Author compilation and analysis.

These findings indicate that both NTPC and CIL face significant financial uncertainty if India were to follow a more aspirational pathway. To be prepared for a changing energy system, these PSUs must develop a diversification strategy. In the next section, a framework has been described which can be used to future-proof the PSUs.

Building Diversification Strategies

Approach and Methodology

For the evaluation of suitable businesses for diversification and to develop strategies to decarbonise a PSU's business operations, a two-step approach is proposed. The first step towards a diversification strategy could identify suitable business segments through a SWOT analysis coupled with Porter's diamond analysis to prioritise these identified business segments for investment. The second step could identify suitable businesses within the identified business segments which would be facilitated through a multi-criteria decision analysis (MCDA). These identified businesses could be synthesised into a portfolio by factoring in business life cycles using a growth–share matrix.

Step 1 – Approach for identifying diversification segments.

A SWOT analysis assists in the identification of business segments aligned with the firm's present business profile and market conditions, incorporating a systematic evaluation of internal factors (strengths and weaknesses) that are within the PSU's control and external factors (opportunities and threats) that emanate from the environment and impact a business's sustenance and growth. Porter's diamond analysis (Porter, 1998) guides investment prioritisation in the identified business segments. Additionally, it also lays the foundation for detailed business-level analysis within each diversification segment. This approach is highlighted in Figure 13.7.

Step 2 – Approach for analysing business opportunity within diversification segments.

MCDA is a tool that can help in the comparative suitability assessment of businesses by weighing various criteria to reflect their relative importance. Consolidated scoring under MCDA for each business can help in the rating of businesses in the order of suitability. While there may be multiple suitable businesses identified through MCDA, the time sensitivity of investments in these businesses requires an additional augmentation tool. The growth–share matrix is a tool that can be used to develop suitable investment profiles for each PSU, based on related market share and growth over a considerable period.

This analysis can help in the development of suitable business diversification strategies for PSU to achieve the goal of decarbonisation while ensuring long-term

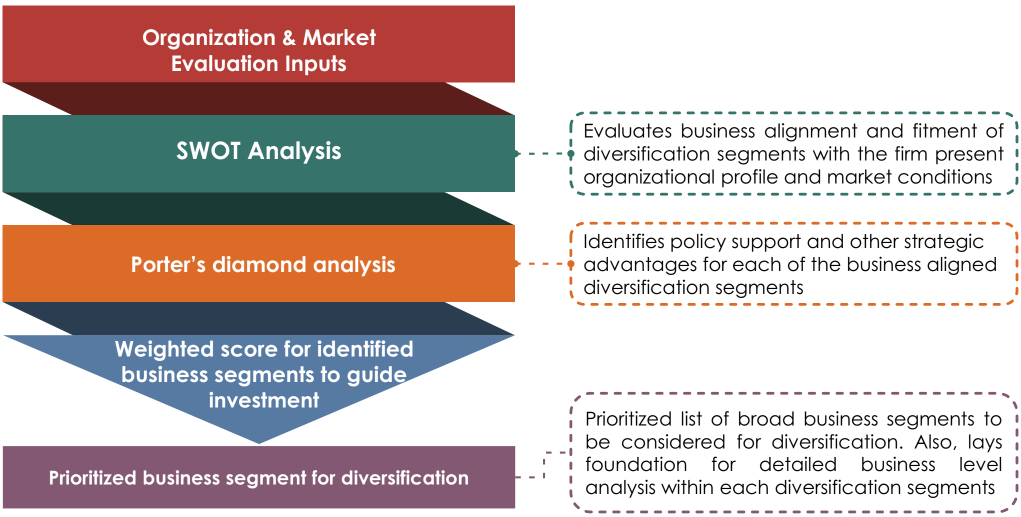

Figure 13.7 Approach for identifying diversification segments.

Source: Climate Policy Initiative.

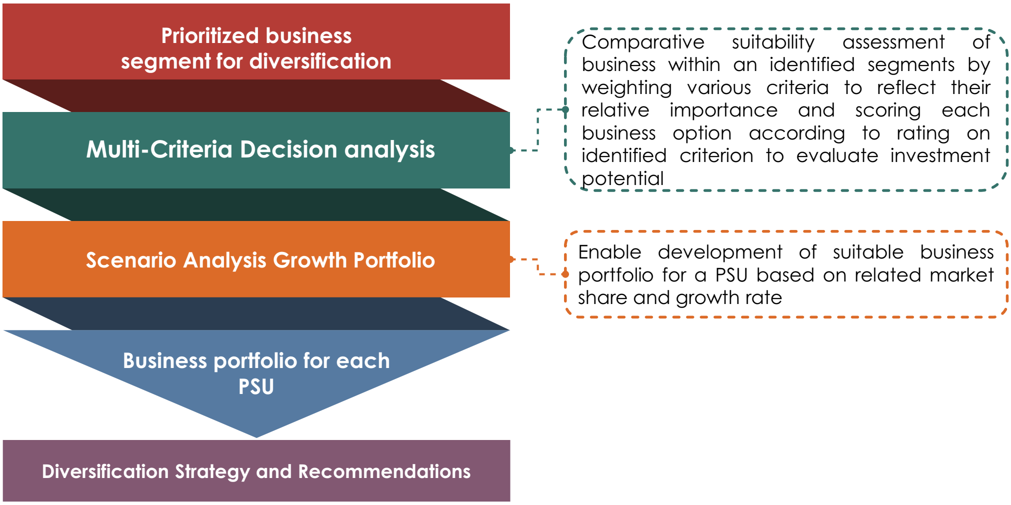

Figure 13.8 Approach for analysing business opportunity within diversification segments.

Source: Climate Policy Initiative.

financial viability of PSU business operations in related areas. This approach is highlighted hereunder in Figure 13.8.

Mechanism for Identification of Suitable Diversification Segments

SWOT Analysis to Analyse the Business's Alignment and Fitment with the Firm Present Business Profile, Plans, and Market Conditions

Strengths and Weaknesses

Strengths and weaknesses are intrinsic attributes of a business that determine its alignment with the organisation's existing business profile and plans. Strengths and weaknesses are responsible for endowing an organisation with or depriving it of a position in the market related to the business and stature within its environment. To assess these dimensions, various factors can be considered such as financial health, existing investments, expertise, experience in businesses/operations, market share, organisational inertia, and availability of skilled workforce.

Opportunities and Threats

This evaluates the external market conditions which impact the business. Market competition, technology maturity, growth potential, and access to financing are the several factors that can be considered. By assessing these factors, the business segment(s) suitable for diversification can be identified based on the combination of strengths and opportunities such that the organisation could capitalise on its strengths to exploit the opportunities available in the market by minimising its internal weakness and counteracting market threats.

SWOT – PSU Perspective

The inherent strengths of Indian PSUs like NTPC and CIL include their strong financial positions with cash balance, dominant market positions, Government of India support, and large skilled workforces. Amongst the key weaknesses that they face towards diversifying their business are organisational inertia towards existing core businesses and lack of experience with inorganic growth. Considering opportunities and threats in the market such as rapid growth in RE, international commitments to reducing emissions, and growing cost competitiveness of storage, PSUs could consider businesses up and down the value chain of their core business for diversification.

Porter's Diamond Framework-Based Assessment of Policy and Government Support for Business Enablement

Porter's Diamond framework helps identify the competitive advantages amongst businesses for industries which operate in a regulated environment and do not enjoy open/free market conditions. The framework does so by factoring in government support through various regulations and policies by considering four major factors to determine the competitiveness of a specific industry in a country: factor conditions; demand conditions; related and supporting industries; and firm strategy, structure, and rivalry along with the government influence on these factors. The analysis can be applied to each investment segment identified under SWOT for the respective PSUs to develop business segment-level priorities.

Factor Conditions

Factor conditions represent the factors (inputs) available in the country to enhance the competitive advantage of the industry. Availability of natural resources domestically on which industry has a major dependency, adequate infrastructure development by the government to assist the industry, and ease of financing the projects through preferential capital are the factors that may be considered in the approach.

Demand Conditions

Demand conditions define the nature of domestic demand for the product or the services provided by a particular industry. There are broadly three significant factors that may be considered in the approach: domestic market size, policy and regulatory support by the government to develop the demand for the product, and the number of business-to-business customers to estimate market demand.

Related and Supporting Industry

This aspect defines the presence of various supporting industries that can contribute to the value chain of a specific industry by sharing intersectoral activities. Factors that may be considered are adequate availability of suppliers which drives market competition and innovation, incentives to suppliers by the government to drive the growth in production, and international competitiveness of the supplier to access its global market acceptance in terms of product performance and pricing.

Firm Strategy, Structure, and Rivalry

This dimension determines the firm's strategic alignment with specific industry and market competitiveness. Factors that may be considered are: organisational targets to determine its alignment with the business, initiatives, and actions undertaken by the firm for market penetration (formation of subsidiaries) and understanding (pilot projects and MoUs) and the number of players in the market to evaluate market competitiveness.

Government

Government policies and regulations have a direct and indirect influence on the three determinants to determine competitiveness: factor condition, demand condition, and related and supporting industry. Through various policies and regulations, government may influence factor condition by developing supporting infrastructure, demand condition by developing demand for the product, and related and supporting industry by providing incentives to attract businesses in the segment and increase market competitiveness.

Framework

To identify the attractiveness of the industry for each PSU, a weight of 5 may be assigned to each of the four conditions adding up to 20. A rating scale with values 0–2 and 0–1 may be considered for each of the sub-conditions, depending on the range of responses; a higher rating indicates that there is a higher degree of compliance with that factor. On a rating scale with values of 0–2, a score of 1 signifies limited agreement with the particular factor. An illustrative example is provided in Table 13.1.

Government support to the industry may also have an indirect weightage of 5. Adequate supporting infrastructure from factor condition, incentivising policy for demand creation in demand factor, and production-linked incentives to the supplier in the related and supporting industry can have a weightage of 1, 2, 2, respectively, which portrays the government support to the industry to determine national competitiveness of a particular industry (see Figure 13.9).

Porter's Diamond PSU Perspective

Most of the business segments in which the PSUs operate are regulated and are significantly influenced by government priorities. Business segments like renewable energy, e-mobility solutions, and energy storage are also some of the business segments to have government support, and therefore PSU strategies may be aligned to investing in the same. Therefore, Porter's diamond analysis emerges as a useful framework for identifying business segments' attractiveness as it factors in the influence of government policies, targets, and decisions.

Table 13.1 Determinants of Porter's diamond analysis

Determinants	*Response*	*Weight*
Factor condition		5
Domestic natural resource adequacy	Yes, no, limited	2
Adequate supporting infrastructure	Yes, no	1
Access to preferential capital	Yes, no, limited	2
Demand condition		5
Domestic market size	USD billion	2
Incentivising policy for demand creation	Yes, no, limited	2
No. of B2B customers	Less than three or more	1
Related and supporting industry		5
Adequate domestic suppliers	Yes, no, limited	2
Production-linked incentives to suppliers	Yes, no, limited	2
International competitiveness of suppliers	Yes, no	1
Strategy, structure, and rivalry		5
Company target	Yes, no	1
Initiative/action taken (pilots, MoU, etc.)	Yes, no	2
Number of market competitors	<2, 2, >2	2

Source: Climate Policy Initiative.

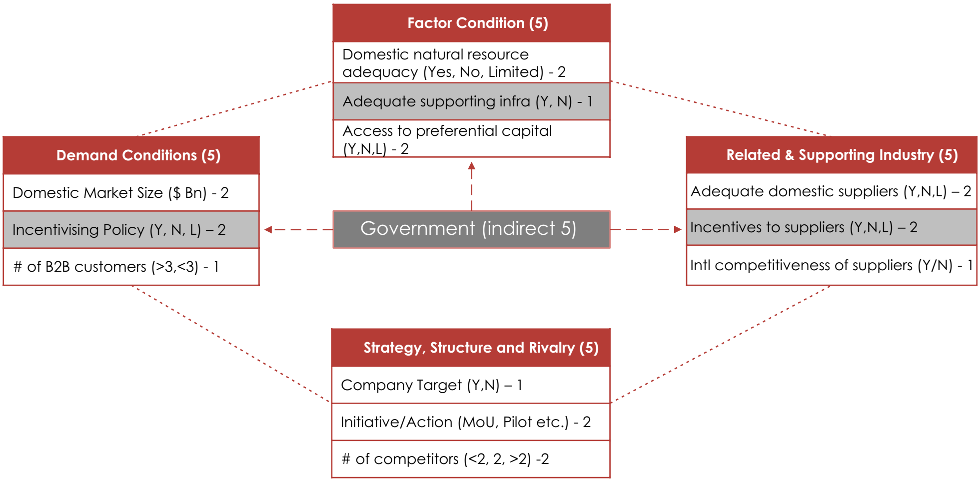

Figure 13.9 Structure of Porter's diamond analysis.

Source: Climate Policy Initiative.

Mechanism for Identification of Suitable Businesses within the Identified Business Segments

Multi-criteria Decision Analysis to Identify Suitable Business Diversification within the Business Segment

To determine the suitable business for diversification for each PSU within the business segment, multi-criteria decision analysis (MCDA) approach may be applied considering various environmental, economic, and technical factors. MCDA provides a comparative suitability assessment of businesses within an identified segment by weighting various criteria to reflect their relative importance and scoring each business option according to rating on identified criteria to evaluate investment potential. Factors that may be considered in MCDA can be classified into two criteria categories: qualifying criteria and scoring criteria. Considering these factors, suitable businesses can be identified for diversification to mitigate energy transition risks and decarbonise their business operations.

Qualifying Criteria

The qualifying criteria aim to serve as a checklist that can inspire the development of business diversification and decarbonisation strategy based on technical maturity, government support in the form of policy, and carbon mitigation potential. Businesses that meet threshold requirements may further be considered in the scoring criteria for diversification.

Scoring Criteria

The scoring criteria give guidance on how the identified businesses may be ranked based on the suitability for diversification, considering factors like investment potential, return on equity, and business-related risk to evaluate investment potential.

Framework

A business, to be considered suitable under this proposed framework for diversification, with an aim to decarbonise business operations, should satisfy all the following factors:

a. *Technology maturity* – Commercial viability of the specific technology related to the business demonstrated successfully either domestically or globally.
b. *Presence of policy support* – Direct and indirect support to the business from the government be present in the form of policies, regulations, and incentives.
c. *Carbon mitigation potential* – Business operations be carbon neutral or have carbon mitigation potential or assist carbon-mitigating business by providing supporting infrastructure and sharing intersectoral activities.

Table 13.2 Qualification criteria

Factors	*Yes*	*Partial yes*	*No*
Technology maturity	Advanced domestically	Internationally advanced	Technology demonstration stage
Presence of policy support	Policies and incentives present in support of the business	Indirect presence of policy support and incentives	Absence of supporting policies and incentives
Carbon mitigation potential	Business with carbon-mitigating potential	Carbon neutral business and carbon mitigation assisting business	Carbon emitting business

Source: Climate Policy Initiative.

A business to be considered for further evaluation under the proposed framework should satisfy all the above-mentioned factors. To gain an overall impression of the business and to rank the businesses in order of suitability for diversification, the following scoring criteria may be considered:

a. *Domestic investment potential* – This is determined using various national targets and projected domestic demand. Sizeable market/investment potential propels business growth and provides opportunities for market penetration and growth to the market players.
b. *Return on equity* – This can be determined from industry averages, regulated returns, and expert inputs (in new businesses). The higher the return, the more lucrative the business for shareholders.
c. *Business risk*
    i. *Capital work-in-progress (CWIP) period* – CWIP refers to the time required for the construction of the project. As the beginning of the recovery of the cost happens after the CWIP period, a lower CWIP period would be encouraging.
    ii. *Market competition* – Competitive market results in a fall in price and reduces profit margins. Competition in business can also shrink a company's market share. Therefore, lower market competition would be desirable.
    iii. *Organisational experience* – Initiatives undertaken by the organisation through business investments, MoUs, pilot projects, and joint ventures demonstrate organisation's willingness and experience.
    iv. *Import dependency* – A business becomes more vulnerable to geopolitical risks and foreign exchange volatility risks with high import dependency. This builds upon the government's Atmanirbhar Bharat initiative and therefore low import dependency would be desirable.

To rank the businesses by suitability for diversification, each criterion can be assigned desired weightage and a rating scale of 0–5 can be considered. Considering the range of responses, a higher rating would indicate that there is a higher degree of compliance with those factors in support of the business.

MCDA – PSU Perspective

This MCDA goes deeper into business-level analysis and considers critical factors for these PSUs such as policy support, carbon mitigation and technology maturity. These are critical for PSUs as they are owned by the government and need to remain aligned to the direction of public policy, including on initiatives like Atmanirbhar Bharat and commitments on carbon mitigation. Also, PSUs need to be more mindful than private sector peers when venturing into new businesses on account of their lower risk appetites, thereby a preference for lower risk mature technologies.

Growth–Share Matrix Analysis to Determine Suitable Business Portfolio

The growth–share matrix (BCG, 1970) may be applied to determine a strategic business portfolio for diversification. The growth–share matrix classifies businesses into four diverse groups based on the attractiveness of the industry and its competitive position, classified as "Pet, Question mark, Cash cow, and Star." This proposed framework characterises businesses on the basis of expected growth rates and likely market share over a 2 × 2 matrix capturing potential to classify them in the four groups mentioned.

"Pet" businesses are likely to have both low growth rates and low market share. These businesses may therefore generate limited revenues which would be required to maintain their operations. There would be limited chances for these businesses to grow bigger or more profitable in near future.

"Question mark" businesses are likely to have high growth rates but low market shares. These businesses can explore untapped opportunities and may be attractive because of the high market growth they enjoy. However, these businesses would need to capture significant shares of their respective market for them to be valuable.

"Cash cow" businesses are likely to have low growth rates but a high market share. These businesses can offer stable sources of revenue for the organisation. As these businesses have low growth, they may not be able to power the organisation's growth ambitions, but because of their high market share, they can generate significant revenue, which can be utilised for developing other businesses within the firm.

"Star" businesses are likely to have both high growth rates and a high market share. These would be highly attractive businesses that generate a large amount of revenue by leveraging their successful market dominance status. But to achieve this state, these businesses may also require significant capital investment to sustain the growing market.

The growth–share matrix can offer a powerful and compact picture of the strengths of businesses in the firm's portfolio by identifying the capacity of each business to generate revenues and also revealing the requirement of investment for each business, thereby assisting in balancing the firm's financial flow by assessing the distinct characteristics of each business and suggesting strategic directions for each business.

While developing the firm's business portfolio for more than one period, movement of businesses within the growth–share matrix can also be considered. The ideal sequence may be one where a "question mark" business captures the market to become a "star" at the first stage, and in the second stage there may be saturation leading to a decline in growth rate but retaining of competitive strengths required to become a "cash cow." In the final stage, a business may lose its market relevance and become a "pet," and the firm could consider divesting from such businesses.

An effective strategy for expediting the process of business diversification and developing a suitable business portfolio may emphasise businesses where there is a strong growth rate accompanied by potential to achieve high market share ("star" businesses and "question mark" businesses which may become "star") (see Figure 13.10).

Growth–Share Matrix – PSU Perspective

NTPC (with its subsidiaries) has a 27% share of India's thermal installed capacity and generated 24% of the total country's electricity generation during 2021–2022. CIL carters 80% of its total supply to the power sector and produces over 83% of the country's total coal output. PSUs enjoy a dominant market share and are likely to invest strategically in the businesses to establish their presence as a relevant market player and maintain their economic relevance. The growth–share matrix can factor the time sensitivity of a business considering related market share and growth over a considerable period to help develop a business portfolio for PSUs by guiding investment into businesses that may offer high growth and large market share.

Recommendations and Way Forward

Business Recommendations

Considering this global shift, along with India's climate commitments, PSUs like CIL and NTPC will need to factor in the transition-linked impacts on their businesses and growth plans. Such diversification would not only de-risk the long-term financial position, particularly cash flows, but also provide the opportunity to become a lead change maker and thereby uphold their dominant position in the energy and economic sphere of India. Keeping this in consideration, key recommendations for strategic realignment are:

- ***Addressing climate-related physical and transition risks by*** evaluating existing and planned investment in assets judiciously, factoring in their long-term potential and necessary costs on transition technologies or future market compliance.
- ***Remaining relevant and maintaining competitiveness by*** prioritising low-carbon investments at an early stage to gain market dominance to deliver sustained growth and avoid competitive pressures.
- ***Incorporating national targets in business strategy and leading the change by imbibing*** the government's initiatives, targets, and climate commitments alongside their objectives of fuelling the country's growth and ensuring its energy security.

Way Forward

Any strategic action and investment decisions taken by the country and in turn by these public sector enterprises to decarbonise their operations will have a significant impact on the pace of India's transition to a low-carbon economy. Indian PSUs can leverage their current position to invest and gain dominance in businesses likely to benefit from transition. Riding on the growing policy support and a strong financial base, reformulation of existing and future business models could lead to significant strategic advantages. Such

Figure 13.10 Growth share matrix to determine suitable business portfolio.

Source: Recreated from: BCG (1970).

diversification would not only de-risk their long-term financial position of the PSUs, particularly cash flows, but also provide them the opportunity to become a lead change maker and thereby uphold their dominant position in the energy and economic sphere of India.

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Appendix 13A

Economics of Coal-Fired Power Plants

Abhishek Raj

The capacity utilisation of India's coal-fired power plants (called coal plants henceforth) has declined over the last decade due to excess capacity, lower-than-expected growth in demand, and rapidly increasing share of renewables. The Central Electricity Regulatory Commission prescribes a Plant Load Factor (PLF) of 85% for recovery of capacity charge, whereas the average PLF of coal stations in India was 58% in FY22 and has been below 80% since 2010, and continuously declining (Ministry of Power, 2023). Apart from excess generation capacity in the system, renewables also have must-run status. As a result, high renewable energy generation periods necessitate coal plants backing down generation. As India embarks towards its 2030 target of 500 GW of non-fossil capacity, the PLF of new coal plants is likely to remain low. The draft National Electricity Plan 2022–2027 estimates a PLF of 55% in 2026–2027 marginally increasing to 62% in FY 2031–2032, under optimistic demand growth conditions (CEA, 2023).

To determine the future electricity mix that minimises the cost of generation, it is important to replace the practice of assuming an 85% PLF while estimating the cost of electricity from new coal plants with more realistic assumptions on utilisation and conditions of operation. Low-capacity utilisation significantly increases the per-unit cost of coal generation. Per-unit fixed cost of electricity increases as capacity charges are paid for plant availability and not actual dispatch. Variable costs also increase due to lower efficiency on account of increased station heat rate.

With a future electricity mix dominated by renewables, especially solar, coal plants will often be forced to operate at a technical minimum during the daytime, with significant flexibility in operation. Operating in low-loading conditions will add to Operation and Maintenance (O&M) cost and will require investments for retrofitting to meet flexibility requirements.

It usually takes 5–7 years for a coal plant to complete construction. Any new coal plant construction starting in 2023 is unlikely to commence operation before 2028–2030.

Table 13.3 depicts levelised cost of electricity (LCOE) of hypothetical new coal plants at different load factors, based on capital expenditure requirements specified in the National Electricity Plan.

Table 13.3 Levelised cost of electricity of coal plants

Pithead coal plant	*Year of commencement*		
(Rs./kwh)	2028	2029	2030
LCOE at 85% PLF	5.31	5.43	5.56
LCOE at 60% PLF	6.41	6.56	6.72
LCOE at 55% PLF	6.75	6.91	7.07

Scalable Renewable Energy (RE) Alternatives to Coal Power Plants

Solar and wind energy have a lower per-unit cost of electricity when compared to coal but are infirm sources, subject to variability. Energy storage technologies solve these limitations and can serve as an effective replacement for new coal plants being built to meet demand peaks that cannot be met by RE. The price of lithium-ion batteries has declined significantly over the last decade and is expected to decline further. However, in 2022, battery prices went up due to the rise in the price of raw materials. This price rise is expected to be temporary, but it has led to an increased focus on developing alternative chemistries for grid-scale storage, such as sodium-sulphur, sodium-ion, and liquid metal amongst others.

In 2020, ReNew Power won a bid put out by Solar Energy Corporation of India to supply Round-the-Clock (RTC) power at Rs 3.6/kWh levelised tariff. The project will supply power at an 80% PLF with a minimum 70% monthly utilisation, comparable to coal plants. The 400 MW RTC project is likely to be supplied by 900 MW of wind and 400 MW of solar, supplemented by 100 MWh of battery storage (Mercom, 2022). The project oversizes the RE project to supply the contracted amount of RTC. Oversizing RE projects without storage is also possible but the size of RTC supply will be smaller. Oversizing RE projects for RTC supply have limitations, as reliable alternatives for selling excess generation are required for project feasibility. In addition, there have also been auctions that blend renewables with conventional sources such as hydro and thermal power, with a minimum guaranteed supply from renewables.

Renewable power paired with significant storage capacity will soon be cost-competitive with new coal, with steep learning curves being observed in renewable and storage costs. According to the draft NEP, capital expenditure for 5 hours of storage (adjusted upwards for depth of discharge) is expected to drop from 9.3 Cr/MW in 2022 to 5.24 Cr/MW in 2030. Table 13.4 depicts the Levelised Cost of Storage (standalone, not paired with RE) estimates as per NEP assumptions.

Table 13.4 Levelised cost of storage

Storage (5 hours)	*Year of commencement*		
(Rs./kwh)	2028	2029	2030
LCOS	5.66	5.35	5.05

The choice between coal and renewables for meeting the peak load while minimising the cost of generation requires multiple considerations. The year of capacity addition, size of additional capacity required, and demand in non-solar hours have implications on the choice of alternatives. RTC auctions with oversized RE have proved to be more economical than coal power and can be used to meet some of the incremental demand before large-scale energy storage becomes viable. However, in a scenario with strong electricity demand growth from 2022 onwards, limits to scaling with oversized RE will likely emerge.

Coal plants have a long gestation period of 5+ years once permits are granted, with cost overruns (as compared to initial estimates) being the norm. Additionally, the cost of coal power is inflationary in nature due to the increase in coal price and logistics. On the other hand, renewables and storage have a much shorter deployment period of 1.5 and 0.5 years, respectively, and have a deflationary cost trend. However, there is still some uncertainty around the cost estimates of lithium-ion batteries due to factors such as the availability of raw materials, increased deployment, and technological breakthroughs. The reversal of lithium-ion cost declines observed in the last year and uncertainty about its trajectory in the short term has led to recent calls for further coal capacity expansion in India. However, it is increasingly probable that by the time any new coal capacity commences operation, it will be economically unviable compared to the same generation from a combination of RE + battery storage.

New coal plants are not compatible with the target of limiting temperature increase to 1.5°C (Ganti and Brecha, 2019). Development finance institutions such as the Asian Development Bank and Climate Investment Fund are developing pilots for retiring coal plants. New research by LUT University suggests that by transitioning to renewables by 2050, India can reduce its electricity costs by 40%. The study estimates the cost of renewables to fall further by 50–60% by 2050 and the cost of coal power to increase by 70% (Gulagi et al., 2022). The rapidly evolving economics of electricity generation has tipped in favour of renewables already, and will soon favour battery storage as well. This, in combination with the imperative to bring down global fossil fuel emissions by 2050, will make it likely that any new coal power plant will not be permitted to complete its useful economic life of 25 years or more.

Benefits of Retiring/Repurposing Older Coal Plants

Excess coal-fired power generation capacity is the main reason why fleet capacity utilisation factors are low. This has also meant that younger, more efficient units are, in some cases, being sub-optimally utilised. At the same time, distribution utilities are saddled with fixed cost payments with contracted plants, even if they are not always utilised due to merit order placement. The surplus capacity in the system means that in the short-to-medium term, there is, in most cases, no shortage of peaking power availability.

This combination of factors allows for an opportunity for states to selectively retire a few of their oldest/least efficient/most expensive power plants, replacing their generation with cheaper new renewable capacity or even renewables with storage capacity, lowering the average cost of generation. This will also allow for rationalisation of coal linkages to replace supplies from distant mines with mines closer to the operating fleet, generating additional savings. Retiring older plants will reduce the investment needed for pollution control technologies to meet air pollution standards.

Climate risk horizons analysis for Maharashtra shows that there is up to 4.02 GW of potential retirements in the state that can be made at a significant financial benefit, as demonstrated in the table 13.5.

Table 13.5 Maharashtra: potential savings from retiring 4,020 MW coal plants over 20 years of age

Savings summary	
Avoided retrofits by phasing out plants older than 20 years	Rs. 2,063 Cr
Coal supply rationalisation to reduce freight charges	Rs. 627–967 Cr per annum
Replace lost generation from plants 20 years and older with renewable energy	Rs. 1,656 Cr per annum

Data inputs

Pit head coal plant levelised cost of electricity (LCOE)		
Particulars	Value	Source
Capex	Rs. 10.28 Cr/ MW (2027)	NEP
O&M	Rs. 20.93 lakhs/MW (2024)	CERC, inflation adjusted
Coal GCV	3,250 kcal/kg	Jindal and Shrimali
Coal price (Rs./MT)	Rs. 3000	Jindal and Shrimali, inflation adjusted
SHR	2390 kcal/kwh	CERC, adjusted for flexible operation as per CEA study on flexible operation
Auxiliary consumption	8.5%	NEP
Plant life	25 years	
Cost of debt	12%	
Cost of equity	15.5%	
Debt:equity ratio	70:30	

Levelised cost of storage (LCOS) 5 hours		
Particulars	Value	Source
Capex (adjusted for depth of discharge)	Rs. 5.24 Cr/ MW (2030)	NEP
Opex	1% of Capex	NEP
Project life	15 years	NEP
Cost of debt	9%	
Cost of equity	15.5%	
Debt:equity ratio	75:25	

Source: Fernandes, Ashish, and Harshit Sharma. "Maharashtra's Energy Transition: A 75,000 Cr. Savings Opportunity." Accessed January 7, 2023. https://climateriskhorizons.com/research/Maharashtra-Enery-Transmission.pdf.

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Appendix 13B

Collaborations Among Indian Firms as a Business Strategy to Foray into Green Hydrogen

Vibhuti Garg

India has laid out ambitious plans for renewable energy. Further, the Central Government announced the Energy Conservation Bill 2022 (*The Energy Conservation (Amendment) Bill, 2022*, n.d.), which empowers the government to lay down different consumption thresholds for various non-fossil sources and consumer categories. In addition, the government approved the green hydrogen mission with the target of development of green hydrogen production capacity of at least 5 MMT (million metric tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country (PIB, 2023).

PSUs Taking the Lead in Building Partnerships

It becomes imperative that Public Sector Undertakings start joining hands with renewable energy companies to decarbonise their operations, particularly for the production of green hydrogen in India. The development of a green hydrogen ecosystem is highly capital-intensive. Conventional debt will not be available to fund these forays. A large part of the capital will need to come from the promoter's balance sheet. Thus, for one particular company to diversify, across the green hydrogen value chain carries many risks and requires huge capital. Hence, collaborations are necessary to successfully develop green hydrogen/green ammonia in India.

Collaborations can help companies to continue with their primary business but at the same time decarbonise and shift towards clean energy. The partnerships can happen in the form of joint ventures (JVs), the creation of Special Purpose Vehicles (SPVs), etc., to provide firm power.

Build Strength Across the Value Chain

One such example is Indian Oil Corporation (IOC) and NTPC signing an agreement in July 2022 to form a JV company to meet the power requirement of upcoming projects of IOC refineries with round-the-clock renewable energy to the tune of 650 MW by December 2024 (*Indian Oil, L&T, ReNew Power in JV For Green Hydrogen*, n.d.).

IOC is further showing its commitment towards a cleaner goal by signing a Memorandum of Understanding (MoU) in October 2020 through its Research and Development Centre (R&D) with the Indian Institute of Science (IISc) (*Indian Institute of Science*, n.d.). The partnership aims to develop biomass gasification-based hydrogen generation technology for producing fuel cell-grade hydrogen at an affordable price. Under this MoU, IISc and IOC will work jointly to optimise biomass gasification and hydrogen purification processes.

IOC is going big on green hydrogen. The company signed a pact in February 2021 with Greenstat Norway to set up a Centre of Excellence on Hydrogen (COE-H) (www.ETEnergyworld.com, n.d.). The COE-H will facilitate the transfer and sharing of technology, know-how, and experience through the green hydrogen value chain and other relevant technologies, including hydrogen storage and fuel cells.

Larsen & Toubro (L&T) and ReNew Power have also signed a tripartite agreement with IOC to supply green hydrogen at an industrial scale (*Indian Oil, L&T, ReNew Power in JV For Green Hydrogen*, n.d.). The tripartite venture brings together the strong credentials of L&T in designing, executing, and delivering EPC projects, IOC's expertise in petroleum refining along with its presence across the energy spectrum, and ReNew Power's prowess in offering and developing utility-scale renewable energy solutions.

Leveraging Individual Strengths

In June 2022, Oil and Natural Gas Corporation Limited (ONGC) signed an MoU with Greenko ZeroC Private Limited to jointly pursue opportunities in renewables, green hydrogen, green ammonia, and other derivatives of green hydrogen ("ONGC Inks MoU with Greenko to Manufacture Green Hydrogen," 2022).

State-owned GAIL (India) Ltd is also building India's largest green hydrogen-making plant to supplement its natural gas business with carbon-free fuel. GAIL can also collaborate with other renewable energy companies to produce green power (*India's Largest Green Hydrogen Plant to Be Built by GAIL*, 2021). Such synergies will drive more efficiency and cost optimisation in achieving climate goals. Given there is a demand from such PSUs, more investments will go into renewable energy deployment as off-taker risks get minimised.

If such collaborations and partnerships are successful, many more PSUs will likely follow, given that the government is setting out their individual net-zero targets or consumption targets for certain sectors.

Private Companies Too Have Joined the Bandwagon

Further, such partnerships are not only restricted to PSUs, and even private companies are playing to their strengths and joining hands with each other. For example, Larsen & Toubro, India's leading engineering conglomerate, and ReNew Power, India's leading renewable energy company, announced a partnership agreement in December 2021 to tap the emerging green hydrogen business in India. Under this agreement, L&T and ReNew will jointly develop, own, execute, and operate green hydrogen projects in India (*L&T and ReNew Announce Partnership to Focus on the Green Hydrogen Business in India*, n.d.).

Adani has signed an MoU with Ballard Power Systems for fuel cell manufacturing in India ("Adani Group, Ballard Power Systems Sign MoU for Hydrogen Fuel Cell JV," 2022).

Greenko Group also joined hands with John Cockerill, a Belgian manufacturer of alkaline electrolysers. Greenko and John Cockerill aim to jointly develop market initiatives for green hydrogen electrolysers in India and innovate technologies to manufacture carbon-negative fuels.

If we look at the global trends, green hydrogen development is a part of industrial clusters. In industrial clusters, several different entities will be operating, each with diverse expertise, including green hydrogen producers, logistics providers, and end-users. Thus, collaboration is important among all these entities within a cluster. In India, too, this template is being followed. Mangalore is becoming the hotspot for green hydrogen projects in the country.

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